Annotated Bibliography of High-Calcium Limestone Deposits in the United States Including Alaska, to April 1956

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By G. C. GAZDIK *and* KATHLEEN M. TAGG

CONTRIBUTIONS TO BIBLIOGRAPHY OF MINERAL RESOURCES

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References on geology, areal distribution, results of chemical and physical tests, mining, utilization, reserves, and potential resources

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by G. C. GAZDIK and KATHLEEN M. TAGG

ABSTRACT

This bibliography of 226 annotated references lists publications that appeared before May 1956. Annotations emphasize geology, areal distribution, results of chemical and physical tests on samples, mining, utilization, reserves, and potential resources of high-calcium limestone. The index forms a cross-reference system to the literature cited.

INTRODUCTION

Preparation of this bibliography was begun by the United States Geological Survey early in 1954 as the result of numerous requests for information concerning high-grade limestone. Most of the bibliography was compiled by the junior author between March 1954 and September 1955. The annotation was done by the senior author during the period September 1955–June 1956. New publications were added until May 1, 1956. Many of the references contain further bibliographic information. All references in this report are published and can be obtained either from or through any major library. Stratigraphic nomenclature used in the annotations is that of the original authors and is not necessarily that of the Geological Survey.

At present there is no universally accepted definition of high-calcium limestone. A calcium carbonate content greater than 95 percent seems to be the most generally used figure for high-calcium limestone, although many authors use a figure as high as 98 percent. In this bibliography, references to any limestone having a calcium carbonate content greater than 90 percent are included. It was thought that by so doing the bibliography would find a broader use because many large consumers of high-calcium limestone do not require an extremely high degree of purity. A few references included describe limestones that just approach 90 percent calcium carbonate; these references are only for areas deficient in high-grade limestone.

The chemical composition of a limestone may change from one locality to another; consequently it would be presumptuous to assume that a formation known to be a high-calcium limestone in one locality is consistently a high-calcium limestone throughout its extent. For this reason, selection of references in this bibliography was restricted to those that in some way indicate that the formation discussed is of high calcium content in the locality studied.

The index provides a geographic cross reference system wherein separate lists of authors are given for each State and Alaska. A list at the beginning of the index under the heading, "General," refers to publications on limestone deposits throughout the States in general.

BIBLIOGRAPHY

Abbott, C. E., 1935, A limestone mine in the Birmingham district: Am. Inst. Min. Metall. Eng. Tech. Pub. 666, 15 p.

Describes mining of the Warsaw formation (Lower Mississippian) in the Muscoda mine of the Tennessee Coal, Iron and Railroad Company, near Bessemer, Jefferson County, Ala. Limestone is 40 to 50 feet thick and averages more than 98 percent calcium carbonate. Mining, crushing and washing, and safety procedures are noted. Summarizes geology and includes a mine map.

Adair, R. B., Doody, T. C., and Schoenborn, E. M., 1947, Evaluation of North Carolina raw materials for the production of portland cement, part 1, Preliminary laboratory investigation: N. C. State Coll., Dept. Eng. Research, Bull. 35, 31 p.

Describes physical and chemical tests of limestones and marls sampled chiefly along Trent and Deep Rivers. Rocks tested offer good possibilities as raw material for manufacture of portland cement. Tables and analyses are included.

Adams, G. I., Haworth, Erasmus, and Crane, W. R., 1904, Economic geology of the Iola quadrangle, Kansas: U. S. Geol. Survey Bull. 238, p. 11–20, 63–69.

The Fort Scott and Iola limestones (Pennsylvanian) are utilized for cement. Discusses cement manufacturing processes. Two geologic maps, Iola quadrangle, scale 1:125,000, and a strip to the east of Iola quadrangle, scale 1:125,000, are included.

Allen, H. W., 1953, Progress report of limestone survey, Knox County [Maine], *in* Report of the State Geologist for 1951–1952: Maine Devel. Comm., p. 11–30.

Describes geography of the Rockland, Rockport, and Union limestone belts. Discusses these areas, giving reserves and possible uses of deposits in each. Most important uses of Knox County limestones are in agriculture, in the chemical and cement industries, in manufacturing rock wool, and as a flux stone. The Union limestone belt, although small, is chiefly high-calcium limestone. Tables give limestone analyses of 40 samples from the Rockland belt, 27 from the Rockport belt, and a representative sample from the Union belt. A geologic map of each belt, at various scales, is included.

Allen, J. E., 1946, Reconnaissance geology of limestone deposits in the Williamette Valley, Oreg.: Oreg. Dept. Geology and Mineral Industries Short Paper 15, 15 p.

Summarizes geology and describes limestone deposits. Of 25 localities studied, 3 in Polk County and 1 in Clackamas County have commercial significance. Listed for these deposits are owner, location, development, topography, geology, grade and reserves. Includes a summary of characteristics and importance of formations arranged by counties, a bibliography, analyses, index map, and three geologic maps, at various scales.

Ames, J. A., 1949, High-calcium limestones in the area served by the Baltimore and Ohio Railroad: Baltimore, Baltimore and Ohio Railroad Co., 105 p.

Lists stratigraphic occurrences, areal distribution, and chemical composition of high-calcium limestones in New York, Ohio, Pennsylvania, Virginia, and West

Virginia. Appendices include a discussion of the origin of limestone, uses of high-calcium limestone, summary of the stratigraphy of the areas covered, and glossary of terms. A comprehensive bibliography, some analyses, and many geologic maps, at various scales, are included.

Anderson, A. L., 1928, Portland cement materials near Pocatello, Idaho: Idaho Bur. Mines and Geology Pamph. 28, 15 p.

Reviews topography, stratigraphy, and structure. Mentions the Black Rock and Langston limestones (Cambrian) as most economically feasible for cement material. Discusses three suitable quarry sites and summarizes factors controlling location of cement plants.

——— 1931, Geology and mineral resources of eastern Cassia County, Idaho: Idaho Bur. Mines and Geology Bull. 14, 164 p.

Presents an extensive discussion of stratigraphy and structure. Summarizes topography, geologic history, mineralization, individual mines, and all types of building stones quarried in Cassia County. The section on limestone and marble includes 3 analyses of the Carboniferous limestones (Brazer and Wells formations) and 4 analyses of Precambrian marbles. All average more than 93 percent calcium carbonate. The Carboniferous limestones have not been utilized, but the Precambrian marble has been quarried for building stone and burned for lime. There is sufficient quality of these rocks to form a valuable potential resource. Analyses, structure sections, and a geologic map, scale 1:250,000, are included.

Argall, G. O., Jr., 1949, Industrial minerals of Colorado: Colo. School Mines Quart., v. 44. no. 2, p. 254–274.

Catalogues industrial nonmetallic minerals. Summarizes uses, occurrences, and production of each. Describes limestone operations in 23 counties. Discusses treatment and marketing of the limestone. Map, scale 1:500,000, shows construction materials and nonmetallic mineral resources of Colorado.

Bain, H. F. *See* Eckel, 1905.

Baldwin, E. M., 1947, Geology of the Dallas and Valsetz quadrangles: Oreg. Dept. Geology and Mineral Industries Bull. 35, 61 p.

Dallas and Valsetz quadrangles are chiefly within Polk County with western edges in Lincoln County. Discusses geography, topography, stratigraphy, structure, physical geology, geologic history, and economics. Describes the Dallas limestone (basal member of the Umpqua formation, Middle Eocene), its characteristics and uses. Also lists other limestones, their locations and calcium carbonate content. A bibliography, index map, and geologic maps of Dallas and Valsetz quadrangles, scale 1:62,500, are included.

Ball, E. M., and Beck, A. W., 1937, Limestone mining in Muscoda No. 5—A unique underground operation in the Birmingham district: Eng. Min. Jour., v. 138, no. 12, p. 32–36.

Describes history and development of mine in the Warsaw formation (Mississippian), including mining methods and hauling. The limestone is 130 feet thick and is 330 feet above the Clinton iron ore. Cross section of mine and diagrams of methods used are included.

Ball, J. R., 1952, Geology and mineral resources of the Carlinville quadrangle: Ill. Geol. Survey Bull. 77, 110 p.

Résumé of physiography, stratigraphy, structure, geologic history, and economic geology. Describes cores and field sections. At most places limestones in the

Carlinville quadrangle are less than 10 feet thick and not suitable for large-scale commercial operation. Analyses and geologic map, scale 1:62,500, are included.

Banks, D. M. *See* Bowles, 1933, 1941.

Barnes, V. E., 1952, High purity Marble Falls limestone, Burnet County, Tex.: Tex. Univ., Bur. Econ. Geology Rept. Inv. 17, 27 p.

Describes stratigraphy and areal distribution of the Marble Falls limestone (Pennsylvania), which has a calcium carbonate content greater than 99 percent in this area, and the Honeycut formation (Ordovician), which may be of economic value. Includes detailed description of the type section of the Marble Falls limestone, table of analyses, and two geologic maps, scale 4 inches = 1 mile.

Bascom, Florence, and Stose, G. W., 1938, Geology and mineral resources of the Honeybrook and Phoenixville quadrangles, Pennsylvania: U. S. Geol. Survey Bull. 891, p. 106–110.

Summarizes geography, topography, stratigraphy, structural and historical geology, and mineral resources. Gives location of limestone quarries in Chester County. Colored geologic map and structure sections of Honeybrook and Phoenixville quadrangles, scale 1:62,500, are included. [Many other geologic maps, at various scales, and structure sections are included.]

Bassler, R. S., 1905, Cement materials of the Valley of Virginia: U. S. Geol. Survey Bull. 260, p. 531–544.

Presents information on general geology and suitability of various limestone beds in the Valley of Virginia for commercial use. Locations of favorable sites for cement plants are given. Analyses of samples from Augusta, Rockbridge, Rockingham, and Shenandoah Counties and geologic maps, scale 1 inch = about 10 miles, are included.

——— 1908, Cement materials of western Virginia: Econ. Geology, v. 3, p. 503–524.

Almost all cement materials of western Virginia are confined to outcrops in the Valley of Virginia and surrounding foothills. Most important source rocks for cement materials are of Cambrian and Ordovician age. Cross sections, analyses, and small-scale map showing outcrop of Ordovician limestones and shales are included.

——— 1909, The cement resources of Virginia west of the Blue Ridge: Va. Geol. Survey Bull. 2–A, 309 p.

Discusses general geology, stratigraphy, and cement materials by individual county in western Virginia. E. C. Eckel contributed the chapter on materials and processes used in production of hydraulic cements. Fossil illustrations, analyses, and many geologic maps and cross sections, at various scales, are included.

Bastin, E. S., 1906, The lime industry of Knox County, Maine: U. S. Geol. Survey Bull. 285–J, p. 393–400.

Knox County has the only limestone in Maine that is suitable for the production of lime. Describes physical features and occurrence of the limestone. Locates adjacent dolomite deposits. The limestone from a quarry at Rockland has a calcium carbonate content of 98.17 percent. Seven analyses and two small-scale geologic maps are included.

Bates, R. L., 1939, Geology of Powell Valley in northeastern Lee County, Va.: Va. Geol. Survey Bull. 51–B, p. 31–94.

Gives detailed information on stratigraphy and structure. Geography, physiography, and mineral resources are noted. The limestone of the area is used chiefly as agricultural lime or road metal. Some is of sufficiently high quality for use as a

flux material or for calcining, but it is not so accessible as similar deposits elsewhere. The Mosheim and Lenoir limestones have the highest calcium carbonate content, 93.12 percent. Three analyses, structural cross section across Powell Valley, and structural and geologic maps, at various scales, are included.

Beach, J. O. *See* English, 1940.

Beatty, K. O., and Adair, R. B., 1948, Evaluation of North Carolina raw materials for the production of portland cement, part 2, Small-scale production of portland cement: N. C. State Coll. Eng. School Bull. 42, 51 p.

Briefly reviews laboratory investigations reported in part 1 of this paper. Both high- and low-grade limestone of the Trent formation was used to produce cement, thus proving that, with proper treatment, cement can be made from low-grade limestone. Discusses purification methods. Gives location of other cement raw materials. Describes preparation and physical properties of cement. Report concludes that North Carolina has suitable raw materials for cement. The most promising area is southern Jones and Craven Counties in the vicinity of the Trent River. Analyses and small-scale map showing outcrop of Trent limestone and Triassic shale are included.

Beck, A. W. *See* Ball, 1937.

Bengston, R. J., and others, 1950, Survey report on mineral resources of southeastern Ohio to the southeastern Ohio Regional Council: Ohio Dept. Nat. Res., Div. Geol. Survey, p. 44–57.

Limestones of southeast Ohio are used chiefly as road metal and for portland cement. The Vanport (Pennsylvanian) and the Maxville (Mississippian) limestones have been utilized in the Ohillco area for portland cement. The Maxville is a high-calcium limestone, its composition and thickness vary, and its occurrance is spotty. The Vanport limestone is more persistent and of more uniform composition although only about 10 to 12 feet thick. Reserves and future uses of available limestone are discussed. Includes two sketch maps of southeast Ohio, one showing the known occurrances of the Maxville, the other showing the occurrances of the Vanport, Brush Creek, and Cambridge limestones and some dolomites; production figures, costs and prices, uses and markets; and analyses of Vanport and Maxville limestones.

Berry, E. W. *See also* Loughlin, 1921.

——— 1947, Marls and limestones of eastern North Carolina: N. C. Dept. Conserv. Devel., Div. Min. Res. Bull. 54, 16 p.

Discusses physiography, location of outcrops, and commercial development of marls and limestones for each of the 35 counties in eastern North Carolina. Marls of the New Bern and Wilmington area are described separately because of their persistence and higher grade. Includes analyses of limestones of many counties, 20 partial analyses from New Bern area, and geologic map, scale 1 inch = 10 miles.

Beyer, S. W., 1906, Supplementary report on portland cement materials in Iowa: Iowa Geol. Survey Bull. 3, 36 p.

Discusses limestones of Iowa. Includes analyses of major formations and sketch map of Iowa showing chief localities investigated for portland cement materials.

Blatchley, R. S., 1908, The Indiana oolitic limestone industry in 1907: Ind. Dept. Geology and Nat. Res., Ann. Rept. 32, p. 301–459.

Concerns limestone in Owen, Monroe, and Lawrence Counties. Includes topography, stratigraphy, physical characteristics, and properties of the limestone. Quarrying and handling methods are discussed and individual quarries are described. Also included are a list of quarries, active and inactive, and their locations;

19 chemical analyses; and geologic maps of Bedford and Bloomington districts, scale 1 inch = 2 miles.

Bleininger, A. V., 1904, The manufacture of hydraulic cements: Ohio Geol. Survey, 4th ser., Bull. 3, 391 p.

The report is concerned chiefly with the manufacture of hydraulic cements. However, one chapter reviews the available limestones of Ohio and another chapter describes methods of determining the value of a depost. Four pages of chemical analyses are included.

Bleininger, A. V., Lines, E. F., and Layman, F. E., 1912, Portland cement resources of Illinois: Ill. Geol. Survey Bull. 17, 121 p.

Discusses portland cement materials including impurities and their effects. Roughly half of the report deals with mechanics of the manufacture of portland cement. Describes the stratigraphy of Illinois with special reference to portland cement materials. More than 100 analyses and locations of limestones and many clays are given.

Boucher, L. J., 1930, Limestone quarrying at Northampton plant of the Atlas Portland Cement Co.: Am. Inst. Min. Metall. Eng. Tech. Pub. 272, 19 p.

The cement rock of the Lehigh district of Pennsylvania and New Jersey is from the Jackson series of the Trenton limestone. Its composition is variable and its thickness is from 150 to 300 feet. The Atlas cement plant at Northampton, Pa., is the largest in the world (1930). The article is chiefly concerned with describing the mining procedures at the cement plant's quarry.

Bowen, O. E., Jr., 1950, Lime and limestone, *in* Mineral commodities of California: Calif. Dept. Nat. Res., Div. Mines Bull. 156, p. 171–176.

The portland cement industry is the most important consumer of limestone in California. Bulletin discusses local limestones used in portland cement, their formation, and distribution and lists the important limestones from each district. Summarizes mining and manufacturing methods, utilization, and markets.

Bowles, Oliver, and Banks, D. M., 1933, Limestone, part 1, General information: U. S. Bur. Mines Inf. Circ. 6723, 21 p.

Reports in general on the uses of limestone, considers many of the uses of high-calcium limestone, and gives production and consumption statistics.

——— 1941, Lime: U. S. Bur. Mines Inf. Circ. 6884R, 48 p.

Presents a history of the use of limestone, its origin, composition, and varieties. Gives location of major limestone areas in the United States and describes many uses for high-calcium limestone. Includes statistics, economics of plant location, and grades of lime produced in selected counties of each producing State. Outlines manufacturing processes.

Boynton, R. S., and Jander, F. K., 1952, Lime and limestone, *in* Encyclopedia of chemical technology: New York, The Interscience Encyclopedia, Inc., v. 8, p. 346–382.

Describes physical characteristics and chemical behavior of limestone. Includes distribution, origin, mining, quarrying, manufacturing methods, and economics of the limestone industry. Analyses from 16 typical areas of high calcium rocks and small-scale map of the United States showing the occurrence of high-calcium limestone and dolomite are included.

Branner, G. C., 1940, Mineral resources of Benton, Carroll, Madison, and Washington Counties [Ark.]: Ark. Geol. Survey, County Mineral Rept. 2, p. 33–36.

Limestones in Benton, Carroll, Madison, and Washington Counties are used as building stones, road metal, limestone for burning, and agricultural lime. Of 30

analyses, including samples from the Boone, Brentwood, and Pitkin formations, 21 samples contain more than 95 percent calcium carbonate. Map showing location of samples is included.

Branner, G. C., 1941, Limestones of northern Arkansas: Ark. Geol. Survey Pub., 24 p.

Limestones are restricted to northern Arkansas in the Interior Highlands physiographic province. They range in age from Ordovician to Pennsylvanian. Discusses reserves and value from 1889 to 1939. Lists limestone companies and quarries. Includes analyses and locations of 114 limestone samples and small-scale maps.

Brantly, J. E., 1916, Limestones and marls of the Coastal Plain of Georgia: Ga. Geol. Survey Bull. 21, 300 p.

Presents a comprehensive report on physiography, structure, and stratigraphy of the Coastal Plain deposits. About half of the text is devoted to discussions of calcareous deposits considered by county. Included are history of workings, analyses, and future possibilities. Also includes information on quarrying, preparation, and use of limestone. Many analyses and geologic map of the Coastal Plain of Georgia with locations of limestone properties, scale 1:1,000,000, are included.

Bryson, R. P., Fox, E. L., Larrabee, D. M., and others, 1947, Construction materials and nonmetallic mineral resources of South Dakota: U. S. Geol. Survey Missouri Basin Studies Map 12, scale 1:500,000.

Includes information on an outcrop of Niobrara formation (Cretaceous) that has been used for cement manufacture at Yankton.

Buddington, A. F., 1926, Mineral investigations in southeastern Alaska: U. S. Geol. Survey Bull. 783–B, p. 58–62.

Contains a short discussion on the readily accessible high-calcium limestone occurring in thick and extensive deposits on the islands off the west coast of Alaska and at the north end of Prince of Wales Island. In these areas, the Silurian limestones have the highest calcium carbonate content, ranging from 95 to 99 percent. Many deposits are discussed and 20 analyses are included.

Buddington, A. F., and Chapin, Theodore, 1929, Geology and mineral deposits of southeastern Alaska: U. S. Geol. Survey Bull. 800, p. 44, 83–88, 390–393.

Describes outcrops of important limestone beds and their physical characteristics. In 1928 the Pacific Coast Cement Co.'s newly installed plant at Seattle initiated the use of a limestone quarried at Dall Island, Alaska. The calcium carbonate content averaged between 95–99 percent.

Buehler, H. A., 1907, The lime and cement resources of Missouri: Mo. Bur. Geology and Mines, 2d ser., v. 6, 255 p.

Presents a general discussion about limestone and clay. Methods given for manufacturing lime and portland, natural, and pozzolean cements, also specifications for various uses of cement and concrete. County-by-county discussions of the lime and cement materials of Missouri including chemical analyses and the amount and type of development in each county. Seven pages of analyses are included.

Burchard, E. F., 1912, Lime, *in* Mineral Resources of the United States for 1911, part 2, Nonmetals: U. S. Geol. Survey, p. 645–718.

Includes 50 pages of analyses from nearly every State.

——— 1940, The cement industry in Alabama: Ala. Geol. Survey Circ. 14, 32 p.

Mentions use of Chickamauga, Bangor, Conasauga, and St. Stevens limestones and the Selma chalk as cement materials. Discusses cement plants, their raw materials,

processes, and production. A few analyses and a map showing areas of high-calcium limestone in Alabama, with portland and puzzolan cement plants located, are included.

Burchard, E. F. and Chapin, Theodore, 1920, Marble resources of southeastern Alaska: U. S. Geol. Survey Bull. 682, 118 p.

This bulletin is primarily concerned with marble suitable for cutting and polishing but many analyses are included which show calcium carbonate as high as 99 percent. Quarries and prospects are located and described. Sketch maps show the location of these deposits.

Burchard, E. F., and Emley, W. E., 1914, The source, manufacture, and use of lime, *in* Mineral Resources of the United States for 1913, part 2, Nonmetals: U. S. Geol. Survey, p. 1509–1593.

Includes small-scale map of Eastern United States showing distribution of high-calcium limestone.

Burr, A. C., Fallgatter, W. S., and MacMillan, W. W., 1950, Raw materials for the manufacture of portland cement in North Dakota: N. Dak. Acad. Sci. Proc. 1949, v. 3, p. 15–18.

Reports on feasibility of a cement plant in North Dakota. Discusses Niobrara formation and marl deposits. Concludes that the Colgrove Butte deposits are most favorable. Gives cost statistics.

Butts, Charles, 1907, Limestone and dolomite in the Birmingham district, Alabama: U. S. Geol. Survey. Bull. 315–G, p. 247–255.

The Bangor, Chickamauga, and Conasauga limestones and the Knox dolomite are used for flux stone, and in the manufacture of lime and cement. The Chickamauga (Ordovician) is the limestone used locally in the cement industry. Notes occurrences and includes lithologic sections and a few analyses.

——— 1940, Description of the Montevallo-Columbiana quadrangles, Alabama: U. S. Geol. Survey Geol. Atlas, folio 226, 20 p.

Includes 7 analyses of Newala limestone, which is used for cement manufacture at Leeds, Ala. Geologic and topographic quadrangle maps, scale 1:62,500, are included.

Butts, Charles, and Gildersleeve, Benjamin, 1948, Geology and mineral resources of the Paleozoic area in northwest Georgia: Ga. Geol. Survey Bull. 54, p. 127–137.

Report briefly describes the Paleozoic limestones and dolomites that occur throughout northwest Georgia. Analyses of 21 limestones with descriptions of sample locations are given.

Butts, Charles, and Moore, E. S., 1936, Geology and mineral resources of the Bellefonte quadrangle, Pennsylvania: U. S. Geol. Survey Bull. 855, 111 p.

Much high-calcium limestone occurs in this quadrangle. No cement plants have been built, probably because of the lack of adjacent shale beds. Includes a few analyses and a geologic map of the quadrangle, scale 1:62,500.

Butts, Charles, Swartz, F. M., and Willard, Bradford, 1939, Geology and mineral resources, Tyrone quadrangle [Pennsylvania]: Pa. Geol. Survey, 4th ser., Topog. and Geol. Atlas 96, 110 p.

Limestone is the most important mineral resource. The Lowville (Ordovician) is the highest quality limestone in the area. Publication includes analyses for many Ordovician limestones in the quadrangle; geologic and topographic maps, scale 1:62,500; and geologic structure sections.

Cady, G. H., 1907, Cement making materials in the vicinity of La Salle, *in* Year-Book for 1907: Ill. Geol. Survey Bull. 8, p. 127–134.

Both natural and portland cement are manufactured in the vicinity of La Salle, Ill. Natural cement is made from the Lower Magnesian limestone and portland cement from the La Salle limestone and the carbonaceous shale underlying it. The article describes thickness and outcrops of these formations. Includes analyses of 7 natural cement rock samples, 21 portland cement rock samples, and 3 clays; also small-scale map showing outcrop of cement formations and location of plants.

Calhoun, F. H. H., 1915, Limestone and marl deposits of South Carolina: S. C. Expt. Sta., Clemson Agr. Coll. Bull. 183, 27 p.

Discusses briefly limestone and its use in agriculture. Possible quarry sites are listed. Forty-four analyses of limestones and marls, a few showing high calcium content, and a small-scale map showing location of limestone and marl are included.

Calhoun, W. A. *See* Hinchley, 1947.

Catlett, Charles, 1904, Cement resources of the Valley of Virginia: U. S. Geol. Survey Bull. 225, p. 457–462.

The Trenton limestone, famous as the cement rock of the Lehigh Valley of Pennsylvania, is well developed throughout the Valley of Virginia. Two other raw materials also necessary in the manufacture of portland cement are readily available; namely, shale (Hudson) and coal which is used as a fuel. Includes discussion of the limestones and economic factors of the most promising undeveloped locations and analyses of samples from many of these places.

Chapin, Theodore. *See* Buddington, 1929.

Clabaugh, S. E., Larrabee, D. M., Griffitts, W. R., and others, 1946, Construction materials and nonmetallic mineral resources of Wyoming: U. S. Geol. Survey Missouri Basin Studies Map 9, scale 1:500,000.

High-calcium limestones suitable for cement manufacture occur in the Niobrara, Forelle, Greenhorn, and Sundance formations and in some calcareous Tertiary sediments.

Clapp, F. G., 1905, Limestones of southwestern Pennsylvania: U. S. Geol. Survey Bull. 249, 52 p.

Describes each of the important limestones of southwestern Pennsylvania from the Pocono formation (Mississippian) through the Dunkard series (Permian). The Vanport and Upper Freeport limestones are of sufficiently high quality for cement. Includes a geologic map of southwestern Pennsylvania, scale 1 inch = 20 miles; two maps of the outcrop pattern of the Vanport limestone, scale 1 inch = 10 miles; and many analyses.

Clark, W. B., 1954, The Cool-Cave Valley limestone deposits, El Dorado and Placer Counties, Calif.: Calif. Jour. Mines and Geology, v. 50, p. 439–465.

The Cool-Cave Valley limestone, discussed in this report, consists of two lenses in the Calaveras group (Paleozoic). The limestone was used in the manufacture of portland cement from 1910 to 1942 and was the chief source of limestone in northern California from 1910 to 1930. It is uniformly high in calcium, much averaging about 98 percent calcium carbonate. Geology of the limestone and also quarrying and milling methods are discussed. Gives ownerships for other limestone deposits together with literature references, analyses of 45 samples from the Cool-Cave Valley limestone, and many analyses from other nearby limestones. Includes

geologic maps showing the Cool-Cave Valley limestone: scale approximately 1 inch = 3,000 feet.

Cobb, E. H. *See* Moxham, 1953.

Cook, C. W., 1912, Michigan cement, *in* Mineral resources of Michigan * * *: Mich. Geol. Biol. Survey, Pub. 8, Geol. Ser. 6, p. 337–354.

Gives classification of cements and location of raw materials. Only the Traverse and the Michigan limestones are used for cement. Includes list of plants, analyses of 4 limestones and 5 marls, one map showing location of cement plants.

Cooke, C. W., 1945, Geology of Florida: Fla. Geol. Survey Bull. 29, p. 111–136.

Mention is made of high calcium content of the Ocala limestone (Eocene) and the Mariana and Suwannee limestones (Oligocene). These formations are shown on the accompanying map of Florida, scale 1:1,000,000.

Cooper, B. N., 1944, Industrial limestones and dolomites in Virginia, New River–Roanoke River district: Va. Geol. Survey Bull. 62, 98 p.

Presents a general discussion of physiography and stratigraphy followed by detailed descriptions of areas with respect to structure, operating quarries, and possible sites for new quarries. Also included are lithologic sections and maps showing occurrances of limestone and dolomite, active quarries and possible quarry locations, and analyses of 89 samples.

——— 1945, Industrial limestones and dolomites in Virginia, Clinch Valley district: Va. Geol. Survey Bull. 66, 259 p.

Considering the quality of the available rock, quarrying conditions, and cost of fuel, the cost of producing lime in Clinch Valley is less than in any other section of the Appalachian Valley of Virginia. General geology of Clinch Valley district precedes detailed discussion of geology and stratigraphy by county. Includes many analyses, lithologic sections, and maps, including geologic maps of the three counties in the district. The scales of the county maps range from 1 inch = 1½ miles to 1 inch = 2 miles.

Cooper, B. N., and Dietrich, R. V., 1953, Virginia mineral resources [map]: Va. Eng. Expt. Sta., Va. Poly. Inst., scale 1:500,000.

Shows areas in State that are directly underlain by limestone and dolomite; limestones and dolomites of chemical grade are designated.

Crider, A. F., 1905, Cement resources of northeast Mississippi: U. S. Geol. Survey Bull. 260, p. 510–521.

Selma Chalk is a high-quality cement material. Some well logs and analyses are given.

——— 1907, Cement and portland cement materials of Mississippi: Miss. Geol. Survey Bull. 1, 73 p.

Gives a general history of cement and lists cement materials and manufacturing methods. Formations ranging from Devonian to Tertiary in age are discussed. The Selma Chalk (Cretaceous), Jackson marl (Eocene), and Vicksburg formation (Oligocene) are discussed in detail. Analyses are given.

Crump, M. H., 1913, The oolitic limestones of Warren County [Ky.]: Ky. Geol. Survey, 4th ser., v. 1, pt. 2, p. 1037–1051.

Oolitic limestones occur in the Mississippian, immediately below the Chester formation. They are used chiefly as a building stone, but would make a good stainless portland cement. Lists quarrying companies, their holdings and production, and describes their products. Two analyses are given.

Cullen, John, 1917, Lime resources and industry in Oklahoma: Okla. Geol. Survey Bull. 26, 70 p.

Discusses the composition and uses of lime and also the types and uses of cements. Methods of quarrying and milling limestone are described. The limestones of Oklahoma range in age from Cambrian to Cretaceous. Each limestone formation is discussed with respect to distribution, thickness, location of quarries, and, where available, chemical analyses. A history of the Oklahoma lime industry and small-scale map showing limestone areas in the State are included.

Cushman, J. A. *See* Loughlin, 1921.

Dale, T. N., 1914, The commercial marbles of western Vermont: Vt. State Geologist Rept. 9, for 1913–1914, p. 1–160.

Section summarizes physical properties, origin, and areal distribution. Structure is described and accompanied by cross sections. Both mineralogic and commercial types of marbles are noted. Important quarries are discussed. Includes five analyses and geologic maps of the marble belts of western Vermont, south of Salisbury, scale 1:125,000, and of the Rutland marble belt, scale 1:31,250.

——— 1923, The lime belt of Massachusetts and parts of eastern New York and western Connecticut: U. S. Geol. Survey Bull. 744, 71 p.

Describes, by quadrangle, the limestone and dolomite formations and notes their outcrops. Discusses those suitable for a good grade of finishing lime, those that yield a poorer quality, and those rejected by the lime industry. Four geologic maps distinguishing limestone from dolomite, scale 1:62,500, are included.

Darton, N. H., 1909, Structural materials in parts of Oregon and Washington: U. S. Geol. Survey Bull. 387, p. 21–33.

Report discusses, by county, limestones and marbles suitable for cement. The majority of these are very high in calcium. Some of these deposits occur adjacent to natural harbors which make ocean transportation readily available. Includes analyses and map showing distribution of limestone in Washington and Oregon, scale 1 inch = about 75 miles.

——— 1910, Cement materials in Republican Valley, Nebr.: U. S. Geol. Survey Bull. 430–F, p. 381–387.

The only limestones suitable for cement in the Republican Valley are those of the Niobrara formation. They occur at or near the surface in Webster, Franklin, Harlan, and Furnace Counties. Includes four analyses and map showing outcrop of Niobrara formation, scale 1 inch = about 30 miles.

Decker, C. E., and Merritt, C. A., 1928, Physical characteristics of the Arbuckle limestone: Okla. Geol. Survey Circ. 15, 56 p.

Describes geology of the Arbuckle formation and gives detailed lithologic section 12 miles north of Ardmore, Carter County. One bed, more than 43 feet thick, averages 98 percent calcium carbonate, and another, about 143 feet thick, averages 96 percent. The remainder of this 7,442-foot section is low in calcium.

DeWolf, F. W., 1929, New Castle quadrangle, Topographic and geologic atlas of Pennsylvania, no. 5: Pa. Geol. Survey, 4th ser., p. 169–188.

Describes the Vanport limestone as a valuable resource used for road material, flux stone, sinter stone, cement, and lime. Uniform in both thickness and purity, it commonly occurs in several distinct benches: the bottom two, a total of from 5 to 10 feet, are the high-calcium limestones, averaging about 96 percent calcium carbonate. Individual exposures are described. Includes analyses and map of the

New Castle quadrangle showing outcrop pattern of the Vanport limestone, scale 1:62,500.

Dietrich, R. V. *See* Cooper, 1953.

Diller, J. S., 1904, Mining and mineral resources in the Redding quadrangle, California, in 1903: U. S. Geol. Survey Bull. 225, p. 176–177.

States that the McCloud and Hosselkus limestones are high in calcium. Parts of the Hosselkus limestone could be used for portland cement.

——— 1914, Mineral resources of southwestern Oregon: U. S. Geol. Survey Bull. 546, p. 15–17.

Gives the distribution and age of local limestones. Includes 10 analyses from Josephine and Jackson Counties, Oreg., many showing very high calcium content, and map showing limestone outcrops, scale 1 inch = 5 miles.

D'Invilliers, E. V., 1883, The geology of the South Mountain belt of Berks County [Pa.]: Pa. 2d Geol. Survey Progress Rept., D–3, v. 2, pt. 1, p. 136–197.

Notes the distribution and uses of those limestones of the Great Valley that occur in Berks County. Includes short descriptions of the limestone exposures giving physical characteristics, thickness, and dip; analyses; and maps, at various scales, supplementing this report in Pennsylvania Geological Survey Atlas D–3.

Doody, T. C. *See* Adair, 1947.

Dott, R. H. *See* English, 1940; 1943.

Dubins, I. M. *See* Runnels, 1949.

Eardley, A. J., 1932, A limestone chiefly of algal origin in the Wasatch conglomerate, southern Wasatch Mountains, Utah: Mich. Acad. Sci. Papers, v. 16, p. 399–414.

Describes a very small fresh-water lake deposit. The limestone is almost 100 percent calcium carbonate, and has been used as an interior decoration. Small-scale map of Utah showing the location of this deposit is included.

Eckart, R. A. *See* Moxham, 1953.

Eckel, E. C., 1904, Cement-rock deposits of the Lehigh district of Pennsylvania and New Jersey: U. S. Geol. Survey Bull. 225, p. 448–456.

Lists the Hudson shale and Trenton and Kittatinny limestones of the Lehigh district as cement resources. Notes the distribution of each of these formations. Discusses manufacturing processes and composition of portland cement. Gives analyses.

——— 1905a, Cement materials and industry of the United States: U. S. Geol. Survey Bull. 243, 395 p.

The bulletin is divided into two parts. Part 1, "Materials and manufacture of portland cement," is concerned with composition of portland cement, composition and characteristics of cement raw materials, mining methods, and manufacturing processes. Part 2, "Portland cement resources of the United States" includes sections by E. C. Eckel, E. A. Smith, J. A. Taff, H. F. Bain, W. H. Weed, E. O. Ulrich, and R. S. Bassler. The States are taken up in alphabetical order and cement resources, both developed and undeveloped, are located and described. The cement industry of each State is noted. Analyses and maps are included.

——— 1905b, Portland-cement resources of New York: U. S. Geol. Survey Bull. 260, p. 522–530.

Notes the Chazy, Trenton, Helderberg, Onondaga, and Tully limestones and marls of Quaternary age as being of such quantity and chemical composition to be

important as portland cement materials. Includes chemical analyses of each of the above formations, their distribution, and relative usefulness as regards composition and location.

Eckel, E. C., 1906, Cement resources of the Cumberland Gap district, Tennessee-Virginia: U. S. Geol. Survey Bull. 285-I, p. 374-376.

Mentions the Newman limestone (Mississippian) as being high in calcium and suitable for portland cement. Notes the proximity of rail transportation and the Middlesboro coal district for manufacture of the cement. Includes some analyses.

——— 1913, Portland cement materials and industry in the United States: U. S. Geol. Survey Bull. 522, 401 p.

Bulletin divided into three parts. Parts one and two are written entirely by Eckel. Part one, "The portland cement industry," reviews types of cements, discusses their history, and gives cement industry statistics. Part two, "Raw materials of the portland cement industry," covers cement materials, elaborating on limestone, its composition and impurities. It lists the types of limestone and the types of fuels used. A section is devoted to factors to be considered when building a cement plant. The third part of this bulletin, entitled, "Portland cement resources of the United States," has chapters contributed by E. C. Eckel, E. F. Burchard, A. F. Crider, G. B. Richardson, E. A. Smith, J. A. Taff, E. O. Ulrich, and W. H. Weed. This part of the bulletin discusses, for each State, general geology, known and possible cement raw materials, and their distribution. Many analyses and maps are included.

——— 1933, Limestone deposits of the San Francisco region: Calif. Jour. Mines and Geology, v. 29, p. 348-361.

The Gavilan limestone of the Santa Lucia series (Paleozoic?) and the Calera limestone of the Franciscan series (Jurassic) are two limestones of this area of major interest as industrial stones. There are several others of less importance. Distribution is discussed and some outcrops and quarries described. Analyses of 31 samples are given.

——— 1935, Large high-calcium deposit found in northwestern Alabama: Pit and Quarry, v. 27, no. 9, p. 26.

Deposit in area near Muscle Shoals discovered and bought by Tennessee Valley Authority. Article states that the deposit may be the largest and purest limestone in the country. Includes 11 analyses; all show more than 98 percent calcium carbonate.

Eckel, E. C., and Bain, H. F., 1905, Cement and cement materials of Iowa, *in* Ann. Rept. for 1904: Iowa Geol. Survey, v. 15, p. 102-124.

High-calcium limestone occurs throughout Iowa in the following formations: Trenton limestone (Ordovician), Kinderhook limestone, Augusta formation, and St. Louis limestone (Mississippian). Analyses are given.

Edmundson, R. S., 1945, Industrial limestones and dolomites in Virginia—northern and central parts of Shenandoah Valley: Va. Geol. Survey Bull. 65, 195, p.

Emphasis is on the occurrence of high-calcium limestone and high-magnesian dolomite in the northern and central sections of the Valley of Virginia. Geology of the Valley of Virginia is discussed, but most of the report deals with industrial limestones; starting with the northernmost county of the Valley and working southward. Includes, for each of the nine counties, geology and stratigraphy of the local limestones with special attention to high calcium and high magnesium content. Uses

of high-calcium limestones are listed. Also includes many lithologic sections, some structure sections, a geologic map of each county and analyses.

Emley, W. E. *See* Burchard, 1914.

English, S. G., Dott, R. H., and Beach, J. O., 1940, Limestone analyses: Okla. Geol. Survey Mineral Rept. 5, 28 p.

Includes brief description of chief limestone areas in the State, general information on the importance of limestone in the chemical industry, and list of chemical specifications for limestone in various products. Table 1 lists, by county, limestone analyses with calcium carbonate content greater than 95 percent. Table 2 lists analyses of limestones with combined calcium and magnesium content greater than 90 percent, but magnesium content less than 10 percent. Map, scale 1 inch = about 50 miles, shows principal limestone outcrops and indicates those of commercial thickness and quality.

Fisher, R. B. *See* Hinchey, 1947.

Galloway, J. J., 1919, Geology and natural resources of Rutherford County [Tenn.]: Tenn. Div. Geology Bull. 22, p. 75, 81.

Formerly the Hermitage limestone was used for making a natural hydraulic cement, but its distance from fuel and transportation now makes it of little economic importance. Six analyses (p. 81) of the Lebanon, Ridley, and Murfreesboro limestones show high calcium content. Geologic map of Rutherford County, scale 1 inch = 1 mile, is included.

Gay, T. E., Jr. *See* Wright, 1953.

Gildersleeve, Benjamin. *See also* Butts, 1948.

——— 1946a, Minerals and structural materials of the Kentucky Reservoir area: TVA, Commerce Dept., Regional Products Research Div., Rept. 1, p. 13–16.

Principal limestones occur east of the Tennessee River. Notes the Warsaw-St. Louis formations (Mississippian) and some Silurian formations as having a high calcium content. Includes 10 analyses, geologic map, and a map indicating the locations of minerals and structural materials in the Kentucky Reservoir area (scales 1 in. = about 16 mi.).

——— 1946b, Minerals and structural materials of the Pickwick, Wilson, and Wheeler reservoir areas: TVA, Commerce Dept., Regional Products Research Div., Rept. 2, p. 27–28.

Most of the limestones in the area have a high calcium content. Gives three analyses of limestones, two exceed 98 percent calcium carbonate. Geologic map, scale 1 inch = 7½ miles is included.

——— 1946c, Minerals and structural materials of the Guntersville Reservoir area: TVA, Commerce Dept., Regional Products Research Div., Rept. 3, p. 14–16.

High-calcium limestones (Mississippian) underlie the sandstone and shale formations of Sand Mountain and other erosional remnants of the Cumberland Plateau. Includes limestone analyses from Marshall and Jackson Counties, Ala., and Marion County, Tenn., and a map, scale 1 inch = 4 miles.

——— 1946d, Minerals and structural materials of the Hales Bar and Chickamauga reservoir areas: TVA, Commerce Dept., Regional Products Research Div., Rept. 4, p. 43.

High-calcium Mississippian limestones occur in outliers of the Cumberland Plateau. Limestones in this area are quarried for the lime, chemical, and cement industries and for other uses. Map, scale 1 inch = about 9½ miles, is included.

Gildersleeve, Benjamin, 1946e, Minerals and structural materials of southwest Virginia: TVA, Commerce Dept., Regional Products Research Div., Rept. A, p. 29–31.

Notes the Mosheim, Lenoir, and Holston limestones as being high grade. The Mosheim, in places, is nearly 100 percent calcium carbonate.

——— 1946f, Minerals and structural materials of east Tennessee: TVA, Commerce Dept., Regional Products Research Div., Rept. B, p. 19–20.

High-calcium limestones are found in the Mississippian rocks of the Cumberland Plateau and in the Ordovician rocks of the Great Valley. Seven analyses are included.

——— 1946g, Minerals and structural materials of the Watts Bar and Fort Loudoun Reservoir areas: TVA, Commerce Dept., Regional Products Research Div., Rept. 5, p. 8, 21.

Mentions that many of the limestones of the area are high calcium. Limestone analyses are included in the chapter on cement.

Glover, S. L., 1936, Nonmetallic mineral resources of Washington, with statistics for 1933: Wash. Div. Geology Bull. 33, p. 53–61.

Gives important limestone deposits of Washington by county. Notes those that are high in calcium content.

Gordon, C. H., 1911, Cement resources and possibilities, *in* The resources of Tennessee: Tenn. Geol. Survey, v. 1, p. 58–69.

Describes outcrops of the three important cement lime rocks in Tennessee which are the Holston marble, Lenoir (Chickamauga) limestone, and the Bangor or Newman limestone. Locates several favorable sites for cement plants. Analyses are included.

Gould, C. N., 1911, Limestone, *in* Preliminary report on the structural materials of Oklahoma: Okla. Geol. Survey Bull. 5, p. 66–84.

Indicates that high-calcium limestone can be found in most areas of Oklahoma. Maps show limestone areas: one in northern Oklahoma and one in the Arbuckle Mountains, scale 1 inch = 20 miles.

Graf, D. L., 1951, Petrology of the basal high-purity bed of the Burlington limestone: Ill. Geol. Survey Circ. 170, p. 160–164.

A petrographic study of the high-purity, chert-free limestone occurring near the base of the Burlington formation in western Illinois. Discusses the major and minor components of the rock and the history of its formation.

Grasty, J. S. *See* Mathews, 1910.

Gray, Carlyle, 1951, Preliminary report on certain limestones and dolomites of Berks County, Pa.: Pa. Geol. Survey, 4th ser., Progress Rept. 136, 85 p.

Includes a short summary of local structure and stratigraphy; analyses of 366 samples of Ordovician limestones from the Beekmantown, Annville, and Jacksonburg formations; a short description of locations from which these samples were taken; contour diagrams of the chemical composition of some of the limestones analysed; and a map showing principal limestone areas of Berks County, scale 1 inch = 2 miles.

——— 1952, The high calcium limestones of the Annville belt in Lebanon and Berks Counties, Pa.: Pa. Geol. Survey, 4th ser., Progress Rept. 140, 17 p.

The Annville limestone, upper Cambro-Ordovician, occurs on the north limb of a regional anticlinorium and is exposed in a narrow east-west belt in Lebanon and

Berks Counties, Pa. It ranges in purity from 88 percent to more than 98 percent calcium carbonate; most of the higher purity stone is in the western part of the belt. Used now in cement, steel, and chemical industries. Geologic mapping indicates large reserves. Includes maps: one showing the Annville outcrop, scale 1 inch = 1 mile, and others showing certain important areas, scale 1 inch = about 600 feet; also cross sections.

Griffitts, W. R. *See* Larrabee, 1947.

Grimsley, G. P., 1906, Clays, limestones, and cements: W. Va. Geol. Survey, v. 3, p. 330–357.

Describes the limestones of West Virginia from the Kanawha series (Pennsylvanian) through the Dunkard series (Permian). Only the Shenandoah limestone (Silurian) is noted as having a high calcium content. However, in places, this formation is a dolomite of nearly theoretical composition. Gives location of outcrops and discusses development. Includes analyses.

——— 1916, Jefferson, Berkeley, and Morgan Counties [W. Va.]: W. Va. Geol. Survey County Rept., p. 361–511.

Briefly describes limestones of the eastern panhandle counties. These limestones are used for furnace flux, fertilizer, glass industry, in asphalt paving and in cement. Includes description and analyses of marl deposits and location of plants and quarries.

A chapter concerns the chemical characteristics of the low-silica fluxing limestones in Berkeley and Jefferson Counties. Many of these flux stones are high in calcium. Includes location of outcrops and analyses.

The chapter on lime and cement resources includes a general discussion of lime, its properties, uses, and manufacture. Notes existing cement plants and their limestone sources. Advises on locations for new plants.

Analyses are given throughout the report. Includes maps, at various scales, under separate cover: one topographic and one geologic of Jefferson, Berkeley, and Morgan Counties, and a map of low-silica limestones in the Martinsburg area.

Grogan, R. M., and Lamar, J. E., 1940, Agricultural limestone resources of Cumberland, Effingham, Clay, Richland, and Jasper Counties [Ill.]: Ill. Geol. Survey Rept. Inv. 65, 44 p.

In Illinois the following limestones are sufficiently thick to quarry: Bogata, Newton, Omega, and Shumway. Describes thickness variations, outcrops, quantity and substance of overburden, general quarrying considerations, and prospecting suggestions for each of these limestones. The calcium carbonate equivalent of various localities and formations is given throughout the text. Many sketch maps show outcrops.

Grout, F. F., Stauffer, C. R., Allison, I. S., and others, 1932, Geologic map of the State of Minnesota: Minn. Geol. Survey, scale 1:500,000.

According to the explanation, Cedar Valley limestone (Devonian) has beds of nearly pure calcium carbonate; the Galena formation (Ordovician) is also high grade.

Hale, D. J., and others, 1903, Marl (bog lime) and its application to the manufacture of portland cement: Mich. Geol. Survey, v. 8, pt. 3, 399 p.

Includes theories of origin of marls and discussion of the manufacturing of portland cement from marl. Lists plants using marls and locates and describes their source areas. Includes a great many analyses and a map, scale 1 inch = 45 miles, showing marl deposits in lower Michigan, location of portland cement plants, and suggested sites for future developments.

Ham, W. E., Dott, R. H., Burwell, A. L., and Oakes, M. C., 1943, Geology and chemical composition of the St. Clair limestone near Marble City, Okla.: Okla. Geol. Survey Mineral Rept. 16, 24 p.

Gives structure, stratigraphy, and lithologic description of the high calcium and dolomitic St. Clair formation (Silurian). A conservative estimate of 50 million tons of high calcium stone is available for quarrying. Includes analyses of 18 samples and a map showing sample locations, quarries, and distribution of the St. Clair formation in Sequoyah County.

Haworth, Erasmus. *See also* Schrader, 1906.

Haworth, Erasmus, and Schrader, F. C., 1905, Portland-cement resources of the Independence quadrangle, Kansas: U. S. Geol. Survey Bull. 260, p. 506–509.

Independence quadrangle embraces all of Montgomery County and parts of adjacent counties. The Drum and Piqua limestones are used here to manufacture cement. Analyses of nine samples of Piqua limestone are included.

Hazenbush, G. C. *See* Wright, 1953.

Heyl, G. R., and Walker, G. W., 1949, Geology of limestone near Gazelle, Siskiyou County, Calif.: Calif. Jour. Mines and Geology, v. 45, p. 514–520.

Structure and stratigraphy of limestone occurring 2 to 5 miles west southwest of Gazelle along the North Branch of Willow Creek. Large reserves of high-grade stone with very little overburden are available. Only small quarries have been opened. Includes five analyses, a location map, and a geologic map with cross sections showing the Gazelle deposits, scale 3 inches = 4,000 feet.

Heyl, G. R., and Wiese, J. H., 1949, Geology of limestone near Sonora, Tuolumne County, Calif.: Calif. Jour. Mines and Geology, v. 45, p. 509–513.

Describes accessibility, general topography, and geology. The high-calcium limestone is found in two zones in the limestone belt; one in the east along Black Leg Creek, the other on the west near Sullivan Creek. Because of the crystallinity of the formation the limestone can be easily distinguished from the dolomite by a difference in the grain size: the limestone having a grain size of from 0.5 to 5 mm and the dolomite from 0.05 to 0.3 mm. The limestone has been quarried for the glass and chemical industries. Only a minor amount of the available resources has been mined. Includes five analyses and a geologic map and cross sections of limestone at Black Leg Creek, scale 3 inches = 4,000 feet.

Hinchey, N. S., Fischer, R. B., and Calhoun, W. A., 1947, Limestones and dolomites in the St. Louis area: Mo. Geol. Survey and Water Res. Div. Rept. Inv. 5, 80 p.

Gives analyses of 270 samples of Ordovician and Mississippian formations from 17 localities. Description of sample locations includes a stratigraphic section and available transportation. High-calcium limestone is available.

Hodge, E. T., 1935, Available raw material for a Pacific Coast iron industry: U. S. Army Corps of Engineers, Office of the Div. Engineer, North Pacific Div., Portland, Oreg., v. 4, App. L, p. 19–84.

Describes and gives analyses for many deposits in Alaska, Washington, Oregon, and California. Some other deposits outside economic transportation range are mentioned.

——— 1938, Northwest limestones, Section 3, *in* Market for Columbia River hydroelectric power using northwest minerals: Portland, Oreg., War Dept., Corps of Engineers, Office Div. Engineer, North Pacific Div., 621 p.

Discusses general geology, occurrence of limestone, quarrying, tonnage, and costs. Part 1, volume 1, "Limestones of the Northwestern States," is concerned with

Washington, Oregon, and Idaho. Part 2, volume 2, "Other limestone occurrences available to (or) competitive with the lower Columbia area," includes chapters on deposits in California, Nevada, southeastern Alaska, and British Columbia. Part 3, volume 2, discusses uses, technology, and available markets for limestone and lime.

——— 1944, Limestones of the Pacific Northwest; available limestones suitable for calcium carbide and/or for flint glass industries: [Portland, Oreg.], Bonneville Power Administration, 104 p.

A comprehensive report on the availability and marketability of high-calcium and high-purity limestones. The introduction discusses transportation costs, rail, ship and barge, and mining costs. Gives potential markets and their consumption. The areas included are the southeastern coastal Alaska, coastal British Columbia, all of Washington, Oregon, and Idaho, western and southwestern Montana, northwestern Nevada, and northern and coastal California. The discussion for each of these areas includes mileage to various markets, estimated transportation costs, composition of the limestone, short description of the deposit, and a map showing the location of the deposit.

Hodges, P. C., 1936, Production and preparation of blast furnace flux: Am. Inst. Min. Metall. Eng. Tech. Pub. 668, 11 p.

The Columbus and Delaware limestones (Devonian) are quarried at Marble Cliff quarry, Franklin County, Ohio. The Columbus limestone is noted as a high-calcium flux and chemical stone; the Delaware is used as an aggregate and as railroad ballast.

Hopkins, T. C., 1893, Marbles and other limestones: Ark. Geol. Survey Ann. Rept. for 1890, v. 4, p. 96–115, 212–356.

The marble belt of Arkansas is in the north and northwestern part of the State. The high-calcium limestones of this part of the Ozark Plateau are the St. Joe marble and the Boone limestones, members of the Boone formation (Mississippian), and the Izard and St. Clair formations (Silurian). Analyses and the location and description of outcrops are included.

Huner, John, Jr., 1939, Geology of Caldwell and Winn Parishes [La.]: La. Geol. Survey Bull. 15, p. 210–214, 284–288.

One of the two limestone quarries in the State is in the cap rock limestone of the Winnfield salt dome. The limestone is used chiefly as chemical lime. Three analyses are given.

Iowa Geological Survey, 1907, Analyses of limestones and chalks, *in* Ann. Rept. for 1906: Iowa Geol. Survey, v. 17, p. 531–537.

Contains more than 100 analyses of Iowa chalks and limestones arranged alphabetically by county.

Jander, F. K. *See* Boynton, 1952.

Jewett, J. M. *See* O'Connor, 1951.

Jicha, H. L., Jr., 1956, A deposit of high-calcium lime rock in Valencia County, N. Mex.: N. Mex. Inst. Mining and Technology, State Bur. Mines and Min. Res., 5 p.

An analysis of two samples of limestone from an area in Valencia County, 34 miles west of Belen, shows an aggregate calcium carbonate content of 97.5 percent. The formation is a travertine deposited on the Chinle formation (Triassic). The deposit is 5½ miles long and 1 mile wide. Its maximum thickness of 150 feet is in the northeast with a thinning to the south and west. There are estimated re-

serves of 100 million tons. Two small-scale maps, one location and one geologic, are included.

Jones, W. B., 1926, Index to the mineral resources of Alabama: Ala. Geol. Survey Bull. 28, p. 60–74.

Divides source areas for cement raw materials in Alabama into four groups. The first district, the Coosa and neighboring valleys, has available the Ordovician limestones and the Bangor limestone. Analyses are given of the Trenton limestone. The second district, the Tennessee Valley region, has available the Bangor and Tuscumbia limestones. Analyses of the Bangor are given. The third district is the Selma chalk belt of central Alabama. The analyses show that the formation is not high in calcium. The fourth district is the St. Stevens limestone belt of south Alabama. Analyses of this formation are included

Kay, G. M., 1943, Chemical lime in central Pennsylvania: Econ. Geology, v. 38, p. 188–203.

Of the many limestones of central Pennsylvania, only the Valentine member of the Curtin formation is suitable for large-scale production of chemical-grade stone. The Valentine limestone is exposed in parts of Centre, Clinton, and Lycoming Counties. Includes a map showing distribution and thickness of the Curtin formation and some chemical analyses of the Valentine member.

Kerns, W. H. *See* Rutledge, 1953.

Knight, Nicholas, 1929, The chemical composition of the Burlington limestone near Oakville, Iowa: Iowa Acad. Sci. Proc., v. 35, p. 217–218.

Four analyses of limestone from near Oakville, Louisa County, Iowa, are given.

Krey, Frank, and Lamar, J. E., 1925, Limestone resources of Illinois: Ill. Geol. Survey Bull. 46, p. 311–334.

The publication is concerned chiefly with limestone as a road material but includes 23 pages of chemical analyses and location of samples. Many of the limestones tested show high calcium content.

Lamar, J. E. *See also* Krey, 1925; Grogan, 1940.

Lamar, J. E., 1927, Economic geology of the limestones of Illinois: Rock Products, v. 30, no. 8, p. 56–59.

Discusses Illinois limestones in chronological order. Gives uses and chemical and physical analyses. The formations high in calcium include the Kimmswick, Wapsipinicon, Burlington, Salem, St. Louis, Ste. Genevieve, and Shoal Creek limestones.

——— 1929, The limestone resources of the Pontiac-Fairbury region: Ill. Geol. Survey Rept. Inv. 17, 27 p.

Results of a survey of possible uses for the Pontiac limestone (Pennsylvanian). Notes that this stone is of uniform quality, has only from 1 to 5 feet overburden, and estimated reserves of 7.5 million tons. Discusses active quarries. Includes analyses, location map, and a map showing areas sampled.

——— 1936, The economic utilization of the Burlington limestone in the Quincy region: Ill. Acad. Sci. Trans., v. 29, no. 2, p. 170–171.

In the Quincy region the normally cherty Burlington limestone has a 20- to 30-foot chert-free stratum averaging 98 percent carbonate. Because of its white color and high calcium content, this limestone has a variety of uses.

Lamar, J. E., and Willman, H. B., 1931, High-calcium limestone near Morris, Ill.: Ill. Geol. Survey Rept. Inv. 23, 26 p.

Two high-calcium limestone deposits occur only 60 miles from Chicago and are adjacent to both rail and water transportation. They are in the Divine limestone (Ordovician). Includes one analysis and maps showing outcrops and area underlain by the Divine limestone and areas with less than 3½ feet overburden.

——— 1933, Results of test drilling of limestone near Morris, Ill.: Ill. Geol. Survey Inf. Circ. 4, 6 p.

Four test borings were made to supplement the information given in the Illinois Geological Survey Report of Investigation 23 (Lamar and Willman, 1931). These borings show that the high calcium part of the limestone is buff to brown in color and only the upper 4 to 5 feet contain more than 95 percent calcium carbonate. The purity decreases with depth. The fact that so little of the stone is rich in calcium and that this is discolored would probably limit the use of this stone. Logs and analyses of cores are included.

——— 1938, A summary of the uses of limestone and dolomite: Ill. Geol. Survey Rept. Inv. 49, 50 p.

Discusses the chemical and physical properties required by many of the limestone industries. Many uses of high-calcium limestone are included.

Lamborn, R. E., 1945, Recent information on the Maxville limestone: Ohio Geol. Survey Inf. Circ. 3, 18 p.

The Maxville limestone is thick enough in a few places in Muskingum and Perry Counties to be commercial. Burned for lime to make mortar and also used as flux stone. Article includes lithologic sections and chemical analyses from a few important quarries. These analyses show that the calcium carbonate content varies considerably.

——— 1951, Limestones of eastern Ohio: Ohio Geol. Survey, 4th ser., Bull. 49, 377 p.

Detailed description of limestone formations, by counties, includes distribution, economic significance, and lithologic sections. Chemical analyses given for Mississippian, Pennsylvanian, and Permian limestones that are of unusual commercial importance or that represent some stratigraphic horizon. Map shows sample locations. Table at end of report summarizes the more than 150 analyses given in the text.

Landes, Henry, 1906, Cement resources of Washington: U. S. Geol. Survey Bull. 285–I, p. 377–383.

Limestone is found in Washington from Puget Sound to Idaho County. Report describes the limestone deposits of the northern counties and includes analyses.

Landes, K. K., 1949, Metallurgical limestone reserves in the United States: Washington, D. C., National Lime Assoc., 25 p.

Discusses extent of metallurgical limestone reserves. State-by-State discussion gives important metallurgical limestones, their grade, and possibilities for production expansion.

Larrabee, D. M., Clabaugh, S. E., Griffitts, W. R., and others, 1947, Construction materials and nonmetallic mineral resources of Colorado: U. S. Geol. Survey Missouri Basin Studies Map 10, scale 1:500,000.

The map text notes that the Leadville, Madison, Timpas, and Greenhorn limestones are high in calcium but that the Timpas and Greenhorn have a tendency toward being clayey.

Lincoln, F. C., 1929, Quarrying limestone in the Black Hills of South Dakota: Rock Products, v. 32, no. 11, p. 42–47.

There are three sources of high-calcium limestone in the Black Hills. The Minnekahta, which is the highest purity limestone in the State, and the Niobrara are laterally uniform in quality. The Pahasapa is normally a dolomite but in places is quarried as a high calcium stone. Reviews the history of the uses of South Dakota limestones which include road stone, concrete, aggregate, lime, cement, etc.

Lindgren, Waldemar, 1905, Description of the Clifton quadrangle, Arizona: U. S. Geol. Survey Atlas, folio 129, p. 13.

The upper 100 feet of the Modoc formation (Mississippian) has a calcium carbonate content as high as 96 percent. Includes a geologic map, scale 1:62,500.

Ljungstedt, O. A. *See* Stose, 1932.

Logan, C. A., 1947, Limestone in California: Calif. Jour. Mines and Geology, v. 43, p. 175–357.

Reviews the origin and uses of limestone. Discusses, by county, the geology of the State and the history of production of limestone; gives location of existing quarries; and gives a few chemical analyses. Map shows limestone deposits.

Logan, W. N., 1911, The structural materials of Mississippi: Miss. Geol. Survey Bull. 9, 78 p.

Report not chiefly concerned with high-calcium limestones but analyses from Tishomingo, Warren, and Wayne Counties are given. Some of these are high calcium.

——— 1916, Preliminary report on the marls and limestones of Mississippi: Miss. Geol. Survey Bull. 13, p. 29–82.

Report is primarily concerned with agricultural limestone. Includes chemical analyses for nearly every county in the State, some of which are high in calcium content.

Loughlin, G. F., Berry, E. W., and Cushman, J. S., 1921, Limestones and marls of North Carolina: N. C. Geol. and Econ. Survey Bull. 28, 211 p.

Discusses in general limestone and its physical characteristics. First, the limestone areas in western North Carolina are discussed, then those in the east. Describes in detail the distribution and availability of the limestones and gives useful quarrying information. Includes a section on North Carolina's position in the limestone and marble industry, three pages of analyses, and many county maps showing the distribution of limestone.

Luttrell, E. M. *See* Stokley, 1952.

McCue, J. B., Lucke, J. B., and Woodward, H. P., 1939, Limestones of West Virginia: W. Va. Geol. Survey, v. 12, 560 p.

Marine limestones crop out mainly in the eastern panhandle and along the eastern boundary from Mercer County to Preston County. Fresh-water limestones crop out in the north-central part of the State and, in general, are less uniform and of lower grade than the marine deposits. The few outcrops in the central and southwestern parts of the State generally are too thin and low grade to be of economic importance. The most valuable deposits are Ordovician, Silurian, and Devonian.

A brief introduction to the history of limestone is followed by a discussion of the limestones of West Virginia arranged according to their geologic age. The Cambrian to Devonian formations are discussed by H. P. Woodward and the Mississippian to Permian by J. B. Lucke. These sections include distribution of the formation,

structure, stratigraphy, lithologic sections, and some analyses. The final chapters were contributed by J. B. McCue. They discuss mining methods, preparation, and utilization of the limestone. Analyses are found on pages 379–428. Map shows location of samples and important limestone outcrops.

McFarlan, A. C. *See* Stokley, 1952.

Martens, J. H. C., 1948, Possibility of shaft mining of Greenbrier limestone: W. Va. Geol. Survey Rept. Inv. 6, 18 p.

Notes localities in the State where underground mining of Mississippian Greenbrier limestone is feasible. It is quarried along the outcrop from Monongalia County to Mercer County and underlies much of the western and central part of the State. Six pages of analyses are included.

Martin, G. C., 1909, The Niobrara limestone of northern Colorado as a possible source of portland cement material: U. S. Geol. Survey Bull. 380–J, p. 314–326.

A survey for cement materials in Boulder and Larimer Counties. Niobrara is the only limestone of sufficiently high calcium content for portland cement. Includes stratigraphy, lithologic sections, and analyses. Map of a part of the foothills area shows distribution of Niobrara formation.

Martin, H. M., 1936, The centennial geological map of Michigan: Mich. Dept. Conserv., Geol. Survey Div. Pub. 39, Geol. Ser. 33, 2 pts., scale 1:500,000.

Lists uses or possible uses of the following high-calcium limestones: the Slonington formation (Ordovician), the Burnt Bluff (Silurian), the Mackinac formation and Traverse group (Devonian), and the Bayport limestone (Mississippian).

Mathews, E. B., and Grasty, J. S., 1910, The limestones of Maryland: Md. Geol. Survey, v. 8, pt. 3, p. 227–477.

Describes the origin, types, and uses of limestone. There is a lengthy section on portland cement and its raw materials. Most of the report is concerned with lime and cement materials of Maryland. The limestones are discussed by physiographic province. Includes a discussion of structure, location of quarries, a description of other cement materials, and a map noting location of samples, scale 1 inch = 8 miles. Many analyses are given throughout text.

Maynard, T. P., 1912, A report on the limestones and cement materials of north Georgia: Ga. Geol. Survey Bull. 27, 293 p.

Presents a short review of the origin and uses of limestones, clays, and shales; discussion of the differences between hydraulic limes, natural cements, and portland cements; and a section on the physiography, stratigraphy, and structure of north Georgia. The remainder of the bulletin describes the limestone and cement materials that occur in the Piedmont Plateau and the Appalachian Mountain areas of Georgia. Describes, by county, individual areas, gives lithologic sections, discusses economic development, and includes analyses throughout the text and a geologic map of the Appalachian Valley and the Cumberland Plateau, scale 1 inch = 4 miles.

Mellen, F. F., 1942, Mississippi agricultural limestone: Miss. Geol. Survey Bull. 46, 20 p.

The report is concerned only with agricultural uses of limestone but analyses appear on pages 10–13. Some of these show high calcium content.

Miller, B. L., 1925, Limestones of Pennsylvania: Pa. Geol. Survey, 4th ser., Bull. M–7, 368 p.

The preliminary discussion includes types of limestone, mineralogy, origin, and uses; also a chart showing the many uses of lime.

The commercial limestones of Pennsylvania are confined to the southern part of the State and high-grade limestones are, in general, confined to the central and southeastern parts. Limestones of the southwest counties are generally too thin or impure to be of great importance. Even the valuable Vanport limestone of southwestern Pennsylvania has small reserves when compared with limestones of the southeastern counties.

The main body of the report discusses Pennsylvania's limestones first by age and then by area. A general section on stratigraphy, structure, and topography is included. A formation-by-formation discussion of physical characteristics, description of quarries, and uses follows. Analyses occur throughout the text. Map, scale 1:500,000, shows limestone outcrops in Pennsylvania.

——— 1934, Limestones of Pennsylvania: Pa. Geol. Survey, 4th ser., Bull. M–20, 729 p.

The first few chapters include such general information as the minerals occurring in metamorphosed and unmetamorphosed limestones, origin, effects of weathering, table of physical properties, topography of limestone areas, and uses of Pennsylvania limestones. Stratigraphy is discussed and a columnar section is included. Describes the limestones by counties, arranged in alphabetical order. Each county is preceded by a small-scale geologic map showing limestone outcrops and quarries. The discussion of the individual formations in places includes physical characteristics, lithologic sections, descriptions of quarries, available sites for new quarries, and analyses. Map shows limestones of Pennsylvania, scale 1:750,000.

Minister, P. F., 1930, Quarrying of limestone at Lime Spur, Mont.: Mining and Metallurgy, v. 11, no. 278, p. 108–110.

Describes history, geology, and quarry methods. Quarry is 4½ miles east of Cardwell, Jefferson County, in limestone of the Madison formation. Most of the production is for the sugar industry and flux stone; it is also used for concrete aggregate and glass manufacture. The average calcium carbonate content is 98 percent.

Moore, B. N., 1937, Nonmetallic mineral resources of eastern Oregon: U. S. Geol. Survey Bull. 875, p. 118–149.

Deposits of commercial importance are limited to crystalline Paleozoic and Mesozoic limestones of the Ochoco and Blue Mountain regions and Baker, Crook, Wallowa, Grant, and Wheeler Counties. Each of these areas is discussed individually and geography, accessibility, structure, stratigraphy, geomorphology, and description of limestone occurrences are included. Most of the limestone of eastern Oregon is high calcium. Analyses are given. Geologic maps of areas are discussed.

Moore, E. S. *See* Butts, 1936.

Moore, F. H., 1935, Marbles and limestones of Connecticut: Conn. Geol. and Nat. History Survey Bull. 56, 56 p.

The marbles of Connecticut are confined to the Western Highlands physiographic division. In general, the calcitic marble occurs south of the village of Brookfield and dolomitic marble to the north. A discussion of topography, weathering, stratigraphy, origin, and physical and chemical properties is included. Describes in detail the marbles of the northern, central, and southern sections of the marble belt, and the Ridgefield and smaller areas. Includes distribution, structure, and description of each marble. Economics, location of quarries, and age relationships are considered. Analyses and a small-scale map showing occurrence of marbles in Connecticut are included.

Moore, W. E., 1955, Geology of Jackson County, Fla.: Fla. Geol. Survey Geol. Bull. 37, p. 84–85.

The Eocene limestones of Jackson County have a high calcium carbonate content and are soft and easily mined. County geologic map, scale 1:137,500, is included.

Moresi, C. K., 1936, Limerock, *in* Twelfth biennial report: La. Dept. Conserv., General Conserv. Bull. for 1934-35, p. 505-511.

Limestone is quarried from the cap rock of two Louisiana salt domes, the Pine Prairie and the Winnfield. The rock is used for lime and road metal. Analyses are given.

Morse, W. C., 1910, The Maxville limestone: Ohio Geol. Survey, 4th ser., Bull. 13, 128 p.

This bulletin is chiefly concerned with stratigraphy, but the included analyses indicate that the Maxville is a high-calcium limestone in Ohio. Location and description of exposures are given.

Mossom, Stuart, 1925, A preliminary report on the limestones and marls of Florida: Fla. Geol. Survey 16th Ann. Rept., 1923-24, p. 33-203.

Reviews types of limestone found in Florida, their origin, uses, physical properties, structure, and weathering. The section on stratigraphy includes the distribution and uses of each limestone and marl discussed. Describes deposits by counties and locates operating quarries. Many analyses are given throughout the text. Map of Florida shows distribution of workable limestone and marl deposits, scale 1 inch = about 53 miles.

Moxham, R. M., Eckhart, R. A., Cobb, E. H., West, W. S., and Nelson, A. E., 1953, Geology and cement raw materials of the Windy Creek area, Alaska: U. S. Geol. Survey open-file rept. 49 p.

Discusses in general topography, climate, accessibility, and stratigraphy. The Windy Creek area is in the northern part of the Alaska Railroad region. Three deposits of commercial size are described. Many analyses and a geologic map of the Windy Creek area, scale 1 inch = about 4,500 feet, are included. Also included are maps of the three limestone areas discussed.

Mulligan, J. J. *See* Rutledge, 1953.

Nelson, A. E. *See* Moxham, 1953.

Oakes, M. C. *See* Ham, 1943.

O'Connor, H. G., Goebel, E. D., and Plummer, Norman, 1953, Mineral resources of Lyon County, *in* Geology, mineral resources, and ground-water resources of Lyon County, Kans.: Kans. Geol. Survey, v. 12, pt. 2, p. 24-27.

Gives a short discussion of uses and possible uses of the local limestones, and analyses and locations of 22 samples.

O'Connor, H. G., Jewett, J. M., and Smith, R. K., 1951, Mineral resources of Chase County [Kans.]: Kans. Geol. Survey, v. 11, pt. 2, p. 16-19.

Describes uses of limestone and gives locations of quarries in Chase County. Map, scale 1 inch = 1⅓ miles, shows, among other things, limestone quarries, limestone plants, location of samples, and a columnar section. Analyses of 17 samples are given.

O'Hara, C. C., 1908, The cement resources of the Black Hills: S. Dak. School Mines Bull. 8, p. 9-27.

Structure and area of outcrop of the high-calcium Minnekahta limestone are discussed. A stratigraphic column and two analyses are included. Report contains maps of individual formations, and a small-scale map shows outcrop of Minnekahta limestone and its relation to cultural features.

Orton, Edward, Jr., and Peppel, S. V., 1906, The limestone resources and the lime industry in Ohio: Ohio Geol. Survey, 4th ser., Bull. 4, p. 20-248.

The beginning chapters include the stratigraphy of Ohio. The limestones of Ohio are discussed first by their occurrence in counties and then each formation is

discussed individually as to areal extent and chemical and physical properties. Thickness, lithologic sections, analyses, location of samples, and the value of each limestone to the cement industry are all considered. Tables of analyses are given for each of the formations discussed. A small-scale geologic map of the State shows location of samples.

Patton, J. B., 1949, Crushed stone in Indiana: Ind. Dept. Conserv., Div. Geology, Progress Rept. 3, 47 p.

Describes briefly the limestones being used for crushed stone in Indiana. Quarry locations are listed and formations being quarried are named. Five pages of analyses and a map showing quarry and location of samples, scale 1 inch = 10 miles, are included.

Peck, F. B., 1908, Geology of the cement belt in Lehigh and Northampton Counties, Pa. * * *: Econ. Geology, v. 3, no. 1, p. 37–55.

Describes physiography, stratigraphy, and structure of the cement belt. Locates and describes the formations used in cement manufacture. Analyses are given throughout. Map, 1 inch = 4 miles, shows the location of plants, quarries, and outcrops.

Peppel, S. V. *See* Orton, 1906.

Pepperberg, L. J., 1909, Cement material near Havre, Mont.: U. S. Geol. Survey Bull. 380–J, p. 327–336.

Approximately 5 miles south of Havre, Hill County, about 80 acres are underlain by a 15-foot-thick limestone giving a reserve estimate of more than 4 million tons of stone. This cement raw material is important because of the scarcity of other building materials in this area.

Perry, E. S., 1949, Gypsum, lime, and limestone in Montana: Mont. Bur. Mines and Geology Mem. 29, p. 27–43.

Limestone outcrops are confined to the western and central parts of the State. The Upper Madison (Mississippian) and the Meagher (Cambrian) are the two limestones of Montana quarried because of their high calcium content. The Meagher has a variable calcium content. The Tertiary marls of northern Montana, although not yet exploited, are nearly pure calcium carbonate. Individual quarries are described. Small-scale maps show distribution of limestones in Montana and quarry locations. A few analyses are given.

Perry, T. G., Smith, N. M., and Wayne, W. J., 1954, Salem limestone and associated formations in south-central Indiana: Ind. Geol. Survey Field Conf. Guidebook 7, 73 p.

Analyses of samples from stops made during the field trip are given on pages 58–71.

Plummer, Norman. *See* O'Connor, 1953.

Popoff, C. C., 1948, Investigation of the Sauk Mountain limestone deposits, Skagit County, Wash.: U. S. Bur. Mines Rept. Inv. 4355, 14 p.

Deposit is located 110 miles northeast of Seattle near the towns of Sauk and Rockport. The limestone is probably Carboniferous. It extends from 600 to 4,500 feet on the west and south slopes of Sauk Mountain. The beds are highly metamorphosed and faulted. A list of property owners is given, and individual deposits are discussed. Calcium oxide usually ranges between 53 and 55 percent and magnesium seldom exceeds 3 percent, but silica may be as high as 10 per cent. Numerous analyses and maps, at various scales, showing location of deposits, are included.

——— 1949a, Investigation of limestone deposits near Arlington, Snohomish County, Wash.: U. S. Bur. Mines Rept. Inv. 4393, 14 p.

These deposits are 45 miles north of Seattle. A list of property owners is given, geology is reviewed, and individual deposits are discussed. The calcium oxide con-

tent is uniformly high and the magnesium oxide is generally less than 1 percent. Analyses and a map showing areal extent of the limestones and sample locations are included.

Popoff, C. C., 1949b, Investigation of Whitehorse limestone deposits, Snohomish County, Wash.: U. S. Bur. Mines Rept. Inv. 4510, 9 p.

Deposit is found in north-central part of Snohomish County. Lists property owners, discusses geology and climate. Of the three limestone deposits described, the Galbraith shows the highest average calcium oxide content, 51.1 percent. Includes analyses and maps showing areal extent of deposits and location of samples.

Richardson, C. H., 1923, The building stones of Kentucky: Ky. Geol. Survey, 6th ser., v. 11, p. 259–329.

A few high-calcium limestones are represented in these 70 pages of analyses.

——— 1927, Cement materials of Kentucky: Ky. Geol. Survey, 6th ser., v. 29, p. 65–154.

Contains chapters on the history of the cement industry, types of cement, its composition, necessary raw materials, and its manufacture. Discusses the cement materials of Kentucky by dividing the State into districts. Gives for each district the available cement raw materials and the best locations for new cement plants. Some analyses are given.

Richardson, G. B., 1908, Portland cement materials near El Paso, Tex.: U. S. Geol. Survey Bull. 340–H, p. 413–414.

Notes that the Carboniferous and Cretaceous limestones of the El Paso region are high calcium. Gives a representative analysis for each.

——— 1909, Description of El Paso quadrangle, Texas: U. S. Geol. Survey Geol. Atlas, folio 166, p. 4–5, 10.

Notes the Hueco and Comanche limestones (Pennsylvanian) as being high calcium. Reserves available for expansion of industries using this grade of stone. Includes a geologic map, scale 1:125,000, and a few analyses.

Ries, Heinrich, 1899, Limestones of New York and their economic value: N. Y. State Geologist 17th Ann. Rept., 1897, p. 355–467.

Report is chiefly concerned with chemical uses of limestone. Describes the important limestones of New York by county. Includes a general section on origin, types, and uses of limestone. Gives analyses throughout text.

——— 1901, Lime and cement industries of New York: N. Y. State Mus. Bull. 44, p. 753–849, 893–955.

Describes the limestones of New York and notes the Trenton and Helderberg as being the most important high-calcium limestones. Includes, by counties arranged in alphabetical order, the areal extent, analyses, and location and description of quarries. Gives many tables of analyses of limestones throughout the United States.

Roehm, J. C., 1946, Some high-calcium limestone deposits in southeastern Alaska: Alaska Dept. Mines Pamph. 6, 85 p.

In southeastern Alaska high-calcium limestones are confined to the Silurian, Devonian, and certain formations of indefinite but pre-Silurian age. The Silurian beds are the most uniform and extensive, have the greatest thickness, and the highest calcium content. Much good-quality limestone suitable for large-scale production is readily accessible to ocean-going vessels. Discusses in detail individual areas, including information about the geology, applicable mining methods, available shipping and housing sites, and recommended uses for the stone. Includes analyses and many index maps showing the areas studied and sampled.

Rothrock, E. P., 1931, A preliminary report on the chalk of eastern South Dakota: S. Dak. Geol. and Nat. History Survey Rept. Inv. 2, 42 p.

Gives descriptions of the Niobrara chalk, lithologic sections, and possible quarry sites for many areas. Includes analyses and a sketch map showing the cultural features and chalk outcrops.

——— 1944, Mineral resources, part 3 *of* A geology of South Dakota: S. Dak. Geol. Survey Bull. 15, 255 p.

Discusses and gives analyses of the Pahasapa, Minnekahta, and Greenhorn limestones and Niobrara chalk; all are high in calcium. Map shows mineral resources of South Dakota.

Runkle, D. M., 1951, Chemical limestone: Ohio Chamber Commerce, Indus. Devel. Dept., Inf. Brochure 9, 7 p.

Discusses uses of chemical limestones. Map (scale 1 in. = 30 mi.) shows the limestones of Ohio that might contain more than 90 percent calcium carbonate and their areal extent.

Runnels, R. T., 1951, Some high-calcium limestones in Kansas: Kans. Geol. Survey Bull. 90, pt. 5, p. 81–104.

Analyses of samples from 14 formations in eastern Kansas. All have greater than 90 percent calcium carbonate and three are over 98 percent. Discusses possible uses of high-calcium limestone and available quarry sites.

Runnels, R. T., and Dubins, I. M., 1949, Chemical and petrographic studies of the Fort Hays chalk in Kansas: Kans. Geol. Survey Bull. 82, pt. 1, p. 8–9, 22–23.

Gives analyses and location of samples of the Fort Hays member of the Niobrara formation.

Russell, I. C., 1901, Geology and water resources of Nez Perce County, Idaho, Pt. 2: U. S. Geol. Survey Water-Supply Paper 54, p. 120–121.

Describes high-calcium limestone deposits along Snake and Columbia Rivers and gives analyses of limestones from Nez Perce County.

Rutledge, F. A., Thorne, R. L., Kerns, W. H., and Mulligan, J. J., 1953, Preliminary report—nonmetallic deposits accessible to the Alaska Railroad as possible sources of raw materials for the construction industry: U. S. Bur. Mines Rept. Inv. 4932, p. 90–124.

West Fork of Windy Creek near Foggy Pass has large tonnages of high-grade limestone. Includes data on accessibility, ownership, general geology, and description of deposits; logs and analyses of drill cores; small-scale maps showing geology and distribution of limestones; also maps of areas discussed.

Sampson, Edward, 1928, Geology and silver ore deposits of the Pend Oreille district, Idaho: Idaho Bur. Mines and Geology, Pamph. 31, p. 9–10.

The Lakeview limestone is of commercial interest because it is the only limestone in this area and is used for portland cement. Gives short description of deposits.

Schoenborn, E. M. *See* Adair, 1947.

Schrader, F. C. *See also* Haworth, 1905.

Search, Herman, and Ranklin, Roy, 1939, The lime content of rocks of the Upper Cretaceous system of Osborne County, Kans. [abs.]: Kans. Acad. Sci. Trans., v. 42, p. 233–236.

Analyses of the Smoky Hill and Fort Hays members of the Niobrara formation show that the Fort Hays has a consistantly high calcium carbonate content.

Schrader, F. C., and Haworth, Erasmus, 1906, Economic geology of the Independence quadrangle, Kansas: U. S., Geol. Survey Bull. 296, p. 55–58.

In discussing the growing cement industry of the Independence quadrangle the Drum, Allen, Piqua, and Iola limestones are mentioned as sources of raw materials. The Piqua and Iola limestones are noted as being persistent over wide areas and of uniformly high calcium content. Includes analyses and a geologic map, scale 1 = 125,000.

Shedd, Solon, 1903, The building and ornamental stones of Washington: Wash. Geol. Survey Ann. Rept., 1902, v. 2, pt. 1, p. 75–133, 141–142.

Many of these stones used for building purposes have a high calcium content. Analyses are scattered throughout the text from pages 75–133; tables of analyses on pages 141–142.

——— 1913, Cement materials and industry in the State of Washington: Wash. Geol. Survey Bull. 4, p. 112–251.

Limestones are found in only a few localities of eastern Washington, and in the western half of the State they are found only in the north. In general, western limestones are higher grade. Discusses each county having high-calcium limestone, and includes a summary of topography, general geology, and individual deposits. Gives analyses for important localities and a location map showing cultural features, streams, and the known extent of the limestone. Tables of analyses are on pages 244–251.

Sloan, Earle, 1908, Catalogue of the mineral localities of South Carolina: S. C. Geol. Survey, ser. 4, Bull. 2, p. 225–240, 256–261.

Gives description and location of limestone and marble outcrops. Limestone analyses are on pages 256–261.

Smith, E. A., 1903, The cement resources of Alabama: U. S. Geol. Survey Bull. 225, p. 424–447.

The limestones suitable for portland cement in northern Alabama are the Carboniferous, especially the Chester, and the Ordovician Trenton limestone. In the central and southern parts of the State the Selma chalk (Cretaceous) and the St. Stephens limestone (Tertiary) are of sufficiently high quality to be used. Tables of analyses are given.

Smith, R. A., 1916, Limestones of Michigan, *in* Mineral resources of Michigan * * *: Mich. Geol. Biol. Survey Pub. 21, Geol. Ser. 17, p. 101–311.

Introductory chapters discuss origin, types, and uses of limestone. The stratigraphy and distribution of Michigan limestones follows. The final section describes, by counties, the distribution, character, and development of deposits. Analyses are given throughout the text. Many small-scale maps show extent of individual formations.

——— 1917, The portland cement industry, *in* Mineral Resources of Michigan * * *: Mich. Geol. Biol. Survey Pub. 21, Geol. Ser. 17, p. 132–141.

The limestones of Michigan sufficiently pure for cement are the Bayport limestone (Upper Mississippian), the Traverse formation and Dundee limestone (Devonian), and the lower part of the Niagara (Silurian). Discusses occurrence, physical characteristics, and past and present uses of each of these formations and includes many tables of analyses.

Smith, R. W., 1937, Limestone mining at Ste. Genevieve, Mo.: Am. Inst. Min. Metall. Eng. Tech. Pub. 902, 23 p.; Am. Inst. Min. Metall. Eng. Trans., v. 129, p. 76–98; 1938, Min. Technology, v. 2, no. 3.

The high-calcium limestone quarried at Ste. Genevieve, Mo., is the upper part of the Spergen formation. The analyses given show the calcium carbonate content

to be nearly 99 percent. A sketch map shows the area where this limestone is at the surface. The report continues with a lengthy discussion of mining procedures.

Smock, J. C., 1890, Building stone in New York: N. Y. State Mus. Bull. 10, p. 358.

The report is concerned with the building stone industry. A table, opposite page 358, giving the results of physical and chemical tests show that many of the samples have a high calcium content.

Stauffer, C. R., 1944, The geological section of the limestone mine, Barberton, Ohio: Am. Jour. Sci., v. 242, p. 251–271.

The Columbus (Onondaga) limestone of Devonian age is mined at a depth of more than 2,300 feet at Barberton, about 40 miles south of Cleveland, Ohio. It yields high-calcium limestone for the Columbia Chemical Division of the Pittsburgh Plate Glass Co. This operation produces 1.3 million tons per year. The report gives a complete stratigraphic section of the shaft and discusses the key horizons. Includes a small-scale sketch map of Ohio showing the relation of Barberton, Ohio, to the cultural features and geology of the State and nine analyses of the Columbus limestone.

Stauffer, C. R., and Thiel, G. A., 1933, The limestones and marls of Minnesota: Minn. Geol. Survey Bull. 23, 193 p.

An introductory chapter discusses uses of limestone, dolomite, and marl. The main part of the bulletin is divided into two parts: the limestones and dolomites of Minnesota, and the marls of Minnesota.

Part 1 reviews the origin of limestone and dolomite. The limestones and dolomites range from Cambrian to Devonian and occur in the eastern and southeastern parts of the State. Discussion by individual county includes lithologic sections. The Prosser limestone (Ordovician) in Fillmore and Olmsted Counties, the limestone members of the Decorah shale (Ordorician), and the Cedar Valley limestone (Devonian) are noted as high-calcium stones. Analyses are given on pages 72–73.

Part 2 discusses origin of marl and the relation of marl deposits to types of glacial drift. Includes prospecting procedures, discussion by counties, sketch maps showing location of marl beds, and analyses for larger deposits.

Steidtmann, Edward, 1924, Limestones and marls of Wisconsin: Wis. Geol. and Nat. History Survey, Econ. ser. 22, Bull. 66, 208 p.

Discusses origin of marl, limestone, and dolomite. Stratigraphy and distribution included in the chapter on general geology. High-calcium limestone occurs in the upper Black River formation and in the lower part of the Galena formation in Grant, Iowa, and Lafayette Counties. Some found also in Pierce and Dane Counties. Index to high-calcium limestone analyses occurring in the text is given in the last paragraph on page 97. Some marls also have a high calcium content. Analyses of these are given on page 191. Discusses uses and possible uses of Wisconsin marls, limestones, and dolomites with emphasis on portland cement.

Stewart, R. M. *See* Wright, 1953.

Stokley, J. A., 1949, Industrial limestones of Kentucky: Ky. Geol. Survey, ser. 9, Rept. Inv. 2, 51 p.

Describes uses of limestone and dolomite with emphasis on chemical uses. Gives table of specifications for important chemical uses and detailed discussion of stratigraphy and distribution of formations. About half the report consists of tables of analyses. Map shows approximate location of high-calcium limestone in Kentucky.

Stokley, J. A., and Luttrell, E. M., 1952, High-calcium limestone in the Kentucky Lake area: Ky. Geol. Survey Inf. Circ. 2, 5 p.

High-calcium limestone occurs in the Warsaw formation (Mississippian) where it crops out on the Tennessee River, a few miles upsteam from Kentucky Dam, Lyon

County. Locates, very generally, the extent of that part of the formation that is high calcium. Includes a sketch map showing cultural features and analyses of 47 samples.

Stokley, J. A., and McFarlan, A. C., 1952, Industrial limestones of Kentucky—No. 2: Ky. Geol. Survey, ser. 9, Rept. Inv. 4, 94 p.

The important industrial limestone in eastern Kentucky is the Lower Chester and in southern and western Kentucky, the Lower Chester and the Ste. Genevieve. Discusses Middle and Upper Mississippian stratigraphy. Describes favorable area for quarry sites. Most of report consists of analyses of limestones from quarries. Many of these are accompanied by pictures of the quarry faces with formations and members traced on the photos. Maps include one showing location and available information about quarries in Kentucky, and another showing approximate location of high-calcium limestone belts in Kentucky.

Stokely, J. A., and Walker, F. H., 1952, High-calcium limestone in the Somerset, Pulaski County area [Kentucky]: Ky. Geol. Survey Inf. Circ. 3, 8 p.

High-calcium limestone deposit in Paint Creek formation (Mississippian) where it crops out near Somerset, Pulaski County. Includes maps showing cultural features and probable occurrence of high-calcium limestone, and analyses of 91 samples.

——— 1953, Industrial limestones of Kentucky—No. 3: Ky. Geol. Survey Rept. Inv. 8, 62 p.

Includes recently discovered industrial limestone localities. This report adds to the material contained in Stokley and McFarlan, 1952. High-calcium limestone found in the Paint Creek, Warsaw, and Perryville formations. Extent of outcrop discussed and shown on maps. Most of the report consists of analyses from limestone quarries. Many pictures of the quarries are given with formations and members designated. Map shows location and data available for quarries.

Stose, G. W. *See also* Bascom, 1938.

——— 1904, Barite in southern Pennsylvania and pure limestone in Berkeley County, W. Va.: U. S. Geol. Survey Bull. 225, p. 516–517.

Near Martinsburg, W. Va., the limestones at the top of the Cambro-Ordovician are very thick and pure. Quarried for use as a flux stone for Pittsburgh's steel industry. Two analyses show the stone to average about 97 percent calcium carbonate.

Stose, G. W., and Ljungstedt, O. A., 1932, Geologic map of West Virginia: W. Va. Geol. Survey, scale 1:500,000.

The explanation states that the Moccasin, Stones River, and Chambersburg limestones contain beds high in calcium.

Stose, G. W., and Swartz, C. K., 1912, Description of the Pawpaw and Hancock quadrangles [Maryland-West Virginia-Pennsylvania]: U. S. Geol. Survey, Geol. Atlas, folio 179, p. 22.

The Helderberg limestone is sufficiently high in calcium to be used for cement. The Wills Creek formation has some shaly limestone members suitable for natural cement. Includes three analyses and geologic maps of the Hancock and Pawpaw quadrangles, scale 1:62,500.

Stout, W. E., 1941, Dolomites and limestones of western Ohio: Ohio Geol. Survey, 4th ser., Bull. 42, 468 p.

Introductory chapters include a discussion of the origin and early uses of limestone and dolomite in Ohio. Summarizes stratigraphy. Description by individual coun-

ties which gives distribution of each limerock formation in that county. Analyses are given for many. Final chapters review the present uses of limestone and dolomite. Analyses and location of 286 samples are given in tabular form. Map shows location of samples.

Stout, W. E., 1946, Mineral resources of Ohio: Ohio Geol. Surgey, 4th ser., Inf. Circ. 1, p. 17–18.

Notes the Brassfield, Maxville, Vanport, and locally the Columbus limestones as being high in calcium. Gives some information about thickness, extent, and uses.

Swain, F. M., 1946, Geology and economic aspects of the more important high-calcium limestone deposits in Pennsylvania: Pa. State Coll., Mineral Industries Expt. Sta. Bull. 43, 31 p.

The Bellefonte area in the central part of the State is the most important because of the great extent and the uniform quality of the Middle Ordovician, Valentine limestone. The other areas discussed are the Vanport limestone in western Pennsylvania and the Annville and York-Thomasville in eastern Pennsylvania. Map shows the districts consuming limestone produced in each of these areas. Gives stratigraphic sections. Describes each area separately including lithologic sections, sketch map showing limestone outcrop and cultural features, and discussion of composition, reserves, and present operations.

Swartz, C. K. *See* Stose, 1912.

Talmage, S. B., and Wootton, T. P., 1936, The non-metallic mineral resources of New Mexico and their economic features (exclusive of fuels): N. Mex. Bur. Mines and Min. Res. Survey Bull. 12, p. 60–61.

Notes the limestone of the Magdelena formation (Pennsylvanian) in Bernalillo County and some of the Permian limestones in Chaves and Eddy Counties as being suitable for portland cement.

Thiel, G. A. *See also* Stauffer, 1933.

Thiel, G. A., and Stauffer, C. R., 1947, The high calcium limestones of Minnesota: Minn. Geol. Survey Summary Rept. 1, 13 p.

Minnesota has limited reserves of high-calcium limestone. The calcium content of the Prosser formation (Ordovician) varies considerably but in places is high. The Cedar Valley formation (Devonian) has the highest grade limestone in Minnesota, but it is interbedded with dolomite which increases the cost of quarrying a high-grade stone. Report includes lithologic sections and analyses.

Thorn, R. L. *See* Rutledge, 1953.

Toulmin, L. D., 1940, The Salt Mountain limestone of Alabama: Ala. Geol. Survey Bull. 46, 126 p.

The 90-foot-thick Salt Mountain limestone (Lower Eocene) crops out for a distance of about 3 miles in Clark County. Includes nine analyses and a geologic map, scale 1 inch = nearly 1,000 feet.

Trainer, D. W., Jr., 1932, The Tully limestone of central New York: N. Y. State Mus. Bull. 291, 43 p.

Discusses structure, distribution, and mineral composition of the high-calcium Tully limestone. Includes structure contour and isopach maps of the Tully limestone in the Finger Lakes region, New York, scale 1 inch = 6 miles.

Tucker, W. B., 1923, Limestone deposits of McCloud, Shasta County, and their possible value for cement material, *in* Report 19 of the State Mineralogist: Calif. State Min. Bur., p. 69–71.

The McCloud limestone is from 200 feet to 2,000 feet thick. The most accessible and largest exposures of this high-calcium limestone are at Gray Rock's, near Bayha,

and farther north on the McCloud River opposite the United States Fishery. Available raw materials and transportation make this an excellent area for development of a cement industry.

Tucker, W. B., 1929 [Lime and limestone, Kern County, Calif.]: Calif. Dept. Nat. Res., Div. Mines and Mining, Mining in California, v. 25, p. 70–73.

Mentions specifically three important areas in Kern County, stating that the most extensive limestone deposits are in the Tehachapi Range near the town of Tehachapi. Briefly describes some individual limestone deposits.

United States Geological Survey, 1933, Mineral resources of the Tennessee River Basin and adjoining areas [map]: U. S. Geol. Survey, scale 1 = 500,000.

Map shows areas in which high-calcium limestone predominates in parts of Kentucky, Tennessee, Georgia, Alabama, Virginia, and minor parts of Mississippi, North Carolina, and West Virginia.

Valentine, G. M., 1949, Inventory of Washington Minerals, part 1, Nonmetallic minerals: Wash. Dept. Conserv. Devel., Div. Mines and Geology Bull. 37, p. 48–51.

Gives brief description of known limestone, marl, and travertine occurrences with indication that some are high-grade stone. These areas are shown on a map, scale 1 inch = about 25 miles.

Ver Steeg, Karl, and Yunk, George, 1935, Geography and geology of Kelley's Island: Ohio Jour. Sci., v. 35, no. 6, p. 429–431.

Kelley's Island, in Lake Erie, is composed of Columbus limestone (Middle Devonian) underlain by the Monroe limestone (Upper Silurian). This island is the northermost locality of this high-calcium limestone. The formation in this area decreases in calcium content from the top down. Used for lime and as a flux stone.

Virginia Geological Survey, 1928, Geologic map of Virginia, scale 1:500,000.

The Stones River, Lenoir, and Mosheim limestones are suitable for lime, lime products, and cement manufacture.

Walker, F. H. *See* Stokley, 1952, 1953.

Walker, G. W. *See also* Heyl, 1949.

——— 1950a, Sierra Blanca limestone in Santa Barbara County, Calif.: Calif. Div. Mines Special Rept. 1–A, 5 p.

Describes, in detail, the occurrence of the Sierra Blanca limestone in the upper Santa Yney River basin. The limestone occurs in two lenses, one 7 and the other 18 miles north of the city of Santa Barbara. The northernmost lens reaches the maximum thickness, 250 feet, and the maximum purity, 98 percent. This area is accessible only by poor Forest Service roads, so, as yet, remains underdeveloped but possible quarry sites are discussed. Includes analyses of six samples and a reconnaissance geologic map, scale 1 inch = 1 mile.

——— 1950b, The Calera limestone in San Mateo and Santa Clara Counties, Calif.: Calif. Div. Mines Special Rept. 1–B, 8 p.

Describes geology of the Calera limestone and its physical and chemical properties. Calcium carbonate content of one stratigraphic unit approaches 97 percent. Included in report are analyses of eight samples and a sketch map, scale 1 inch = 2 miles, showing approximate distribution of the limestone.

Wallis, B. F., 1915, The geology and economic value of the Wapanucka limestone of Oklahoma: Okla. Geol. Survey Bull. 23, p. 84–88.

Three limestones of this area—the Wapanucka, Viola, and Chimneyhill—are high in calcium and low in magnesium, and free from silica and iron.

Wayne, W. J. *See* Perry, 1954.

West, W. S. *See* Moxham, 1953.

Whitlatch, G. I., 1941, Limestone and lime: Tenn. Dept. Conserv., Div. Geology, Markets Circ. 10, 38 p.

Discusses limestone specifications of various chemical industries and includes 20 analyses of Tennessee limestones.

Wiese, J. H. *See* Heyl, 1949.

Willard, Bradford, 1931, Commercial limestones of Rhode Island: Pan-Am. Geologist, v. 56, no. 2, p. 116–122.

Two large limestone bodies occur in Rhode Island; they are known as the Lime Rock and Dexter beds. The Dexter quarry is in the town of Lincoln, 1 mile southwest of the village of Berkeley. The gray, upper part of this metamorphosed limestone is high in calcium. The structure and age of the limestone are discussed.

Williams, I. A., 1914, Limestone deposits in Oregon, *in* Mineral Resources of Oregon: Oreg. Bur. Mines and Geology, v. 1, no. 7, p. 52–70.

Describes distribution of limestones in Jackson and Josephine Counties. Individual outcrops are described and some analyses are given.

Willman, H. B. *See* Lamar, 1931, 1933, 1938.

Wilson, Hewitt, and Skinner, K. G., 1937, Occurrence, properties, and preparation of limestone and chalk for whiting: U. S. Bur. Mines Bull. 395, p. 98–154.

Limestones, chalks, and marbles of high carbonate content and purity are discussed by States in alphabetical order. Includes some analyses and a sketch map showing location of chalk and limestone in the United States.

Wolfe, P. E., 1948, Agricultural mineral resources of New Jersey: Rutgers Univ., Bur. Min. Research Bull. 2, p. 18–50.

High-calcium limestones are restricted to the northern part of the State. The Franklin limestone (Precambrian), Jacksonburg formation (Ordovician), some Silurian and Devonian formations, and Recent calcareous marl deposits have high-grade stone. Discusses each of these limestones and includes a general description of the formation, its areal distribution, the available transportation, a sketch map showing the distribution of the formation, and a table of analyses.

Woodward, H. P., 1932, Geology and mineral resources of the Roanoke area, Virginia: Va. Geol. Survey Bull. 34, p. 121–125.

The Mosheim limestone (Ordovician) is the only high-calcium limestone in the Roanoke area. It averages about 23 feet thick and is uniform in both color and composition. It crops out in a narrow belt in the Catawba Valley just south of the Catawba Sanitorium. Analyses of two samples are given.

Wright, L. A., Stewart, R. M., Gay, T. E., Jr., and Hazenbush, G. C., 1953, Mines and mineral deposits of San Bernardino County, Calif.: Calif. Jour. Mines and Geology, v. 49, p. 166–181.

The limestone produced in San Bernardino County is consumed largely by the local cement industry. The Victorville-Oro Grande district is the chief producing area. This district and others are described in detail. Includes a few analyses and a map of the county showing location of mines and mineral deposits, scale 1 inch = 6 miles.

Yunck, George. *See* Ver Steeg, 1935.

Anonymous, 1926, Limestone for portland cement in Greene County, N. Y.: Eng. Min. Jour.-Press, v. 121, no. 20, p. 805–806.

The Coeymans and Becraft limestones of the Helderberg group are both high calcium, but because of its higher position in the section, only the Becraft is quarried at present. The problems of mining in this area are discussed and demonstrated by a cross section and a small-scale map showing distribution and fault traces of the limestones. The possibility of underground mining west of the main fault where the rocks are less highly contorted and faulted is discussed.

——— 1931, To sell large limestone deposits in California soon: Rock Products, v. 34, no. 24, p. 83.

Reports on a newly discovered high-calcium limestone deposit in eastern Riverside County, Calif. There are reserves of more than 100 million tons averaging 99.45 percent calcium carbonate.

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