Characteristic Lower Cretaceous Megafossils From Northern Alaska

GEOLOGICAL SURVEY PROFESSIONAL PAPER 335

Prepared in cooperation with the U.S. Department of the Navy, Office of Naval Petroleum and Oil Shale Reserves

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By RALPH W. IMLAY

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CHARACTERISTIC LOWER CRETACEOUS MEGAFOSSILS FROM NORTHERN ALASKA

By Ralph W. Imlay

ABSTRACT

The megafossils from the Lower Cretaceous rocks of northern Alaska prove that only the Berriasian, Valanginian, and Albian stages are represented by strata. They prove that the lower Berriasian coincides with an erosional unconformity that locally truncates rocks of Jurassic, Triassic, and late Paleozoic age and that the Hauterivian, Barremian, and Aptian stages coincide with an angular unconformity involving mountain building, overthrusting, and considerable erosion. They date the Okpikruak formation as being of Berriasian and Valanginian ages and show that the earliest Cretaceous sea advanced over a hilly terrane, of which some high spots were not covered until the middle Valanginian. They date the Fortress Mountain formation, the Torok formation, and the overlying formations to the base of the Cenomanian Ninuluk formation as of Albian age only. This is rather astonishing considering that the sedimentary rocks involved, excluding the Fortress Mountain formation, range in thickness from about 9,000 to 11,000 feet. The abrupt termination of the megafossil species at the top of the Albian strata indicates that some major geologic event occurred at the end of Albian time, either in Alaska or in the Boreal region.

The Okpikruak formation of Berriasian to Valanginian age in many places contains an abundance of the pelecypod *Aucella*, but otherwise contains very few fossils. The Aucellas belong to species that are common in the Boreal region and along the west coast of North America. They permit dividing the Okpikruak formation into three faunal zones based on the stratigraphic distribution of the species. The thick shells of the Aucellas and their common occurrence in coarse detrital sedimentary beds suggest that they lived in the shallowest part of the neritic zone or even partly in the littoral zone.

The beds of Albian age in northern Alaska include more genera and species of marine megafossils than have ever been described previously from Albian beds in lands bordering the Arctic Ocean. Most of the fossils are from beds that are dated as middle Albian. A scarcity of megafossils in the lower Albian beds coincides with a scarcity of microfossils and is ascribed to exceedingly rapid sedimentation. A scarcity of marine megafossils in the latest Albian beds is explained by the fact that part of those beds are continental and much of the remainder are littoral in origin. The Albian sedimentary rocks are divided on the basis of megafossils into 5 faunal zones, of which 3 are of early Albian age, 1 is of middle Albian age, and 1 is probably of late Albian age. The general composition of the megafossil assemblage living in, or on the bottom of the Albian sea in northern Alaska greatly resembles assemblages living today in shallow sea bottoms of temperate latitudes.

INTRODUCTION

This study of the Lower Cretaceous megafossils from northern Alaska, exclusive of echinoderms and brachiopods, is based on collections made by E. de K. Leffingwell in 1911 and by field parties of the U.S. Geological Survey since 1901. Most of the collections have been made since 1945. The writer visited some of the field parties in northern Alaska during the summer of 1950 to obtain background information on the stratigraphic succession and has kept in close touch with the field geologists since 1948. They were consulted frequently during the preparation of the chapters dealing with stratigraphic relationships, faunal zones and correlations, and ecology in order to obtain pertinent data and opinions, or to make sure that all available stratigraphic and paleontologic information was being evaluated. These geologists, including R. S. Bickel, R. M. Chapman, R. L. Detterman, J. T. Dutro, George Gryc, A. S. Keller, B. H. Kent, M. D. Mangus, R. H. Morris, W. W. Patton, Jr., H. N. Reiser, E. G. Sable, I. L. Tailleur, and C. L. Whittington, have also checked or rewritten all locality descriptions and have plotted the positions of the localities on figure 1.

Great credit goes to the U.S. Navy for the financial and logistic support given these geologists. Without that support most of the fossils described herein and the supporting field data would not have been obtained.

The echinoderms and brachiopods are being studied by other paleontologists and will be described elsewhere. These classes are mentioned herein and are listed on distribution charts only in order to show their stratigraphic distribution and faunal associations. Such information may be useful to the field geologist, may give the biologist an impression of the entire megafauna, and should not detract from the value of later detailed publications.

Description of the Lower Cretaceous megafossils of northern Alaska, analyses of their stratigraphic and ecological significance, and the establishment of a succession of faunal zones should have immediate applications in geologic studies elsewhere in Alaska.

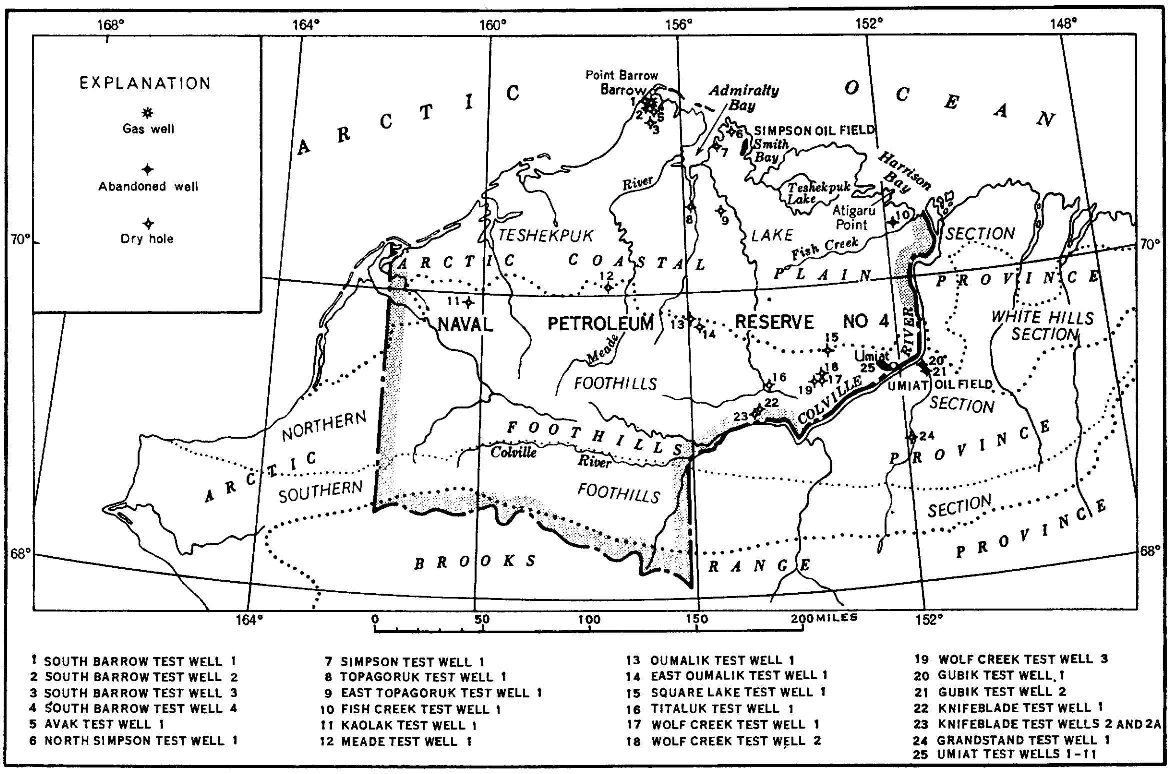

FIGURE 1.—Index map of northern Alaska showing location of test wells.

The name *Aucella* is used throughout this paper instead of *Buchia* which has priority. The ruling by the International Commission on Biological Nomenclature regarding *Buchia* was received too late for changes to be made herein. Also, the name *Inoceramus anglicus* Woods should be replaced by *Inoceramus comancheanus* Cragin as demonstrated by the studies of Tatsuro Matsumoto at the U.S. National Museum during 1958.

BIOLOGIC ANALYSIS

The Lower Cretaceous megafossils from northern Alaska (table 1) include 2 specimens that are similar to jelly fish, about 120 of echinoderms, 20 of brachiopods, at least 555 of tube-bearing worms, about 2,200 pelecypods, 56 gastropods, 82 ammonites, 5 belemnites, and 20 spiral borings. No attempt was made to count the chaetopod worm *Ditrupa* because it occurs in enormous numbers locally. Likewise among pelecypods the numbers of *Aucella* and *Aucellina* now in the collection are a mere sampling of the numbers present in the outcrops. The genus *Aucella* of Berriasian to Valanginian age accounts for about half of the pelecypods collected. Among the pelecypods of Albian age, the most abundant are *Arctica?*, *Panope?*, *Entolium*, *Aucellina*, and *Tancredia*. Fairly common genera include *Astarte*, *Inoceramus*, and *Thracia*, but *Astarte* is common only in the Ignek formation. Much less common genera include *Yoldia*, *Dicranodonta*, *Flaventia?*, *Veniella*, *Solecurtus?*, *Pleuromya*, *Camptonectes*, *Placunopsis*, *Oxytoma*, and *Modiolus*. Rarely occurring genera include *Nucula*, *Nuculana*, *Lucina*, *Cultellus?*, *Homomya*, *Goniomya*, *Myopholas*, *Pinna*, *Lima*, *Plicatula*, and *Anomia*. Gastropods and cephalopods are much less common than the pelecypods. Only a few belemnites have been found and some of these are possibly derived from Jurassic beds.

The Albian megafaunule is characterized by having many specimens and few genera of tubed worms, a fair number of specimens and few genera of echinoderms, many specimens and genera of pelecypods, and numerically few but rather varied gastropods and cephalopods. Brachiopods are rare, but their very presence may be of some interest. Of these organisms only the coelenterates, worms, and mollusks are considered herein (tables 4–6).

Among the Albian mollusks the ammonites belong mostly to genera that have not been recorded elsewhere than in North America. Ammonite genera in common with northwest Europe include only *Cleoniceras* and *Beudanticeras*, which has certain peculiarities that justify the assignment of a subgeneric name. The pelecypods all belong to genera that are common in the Albian beds of northwest Europe, but do not include any representatives of the Ostreidae or of the genera *Trigonia*, *Glycymeris*, *Cardita*, *Protocardia*, and *Mytilus* that are fairly common in Europe. The gastropods are too poorly preserved to merit description. They have been examined briefly by Norman Sohl, of the U. S. Geological Survey, who assigns 24 specimens to the Trochidae, 18 to the Naticidae, 5 to the Acteonidae, 4 to the Cerithiacea, 1 questionably to the Epitonacea, and several are not assignable.

TABLE 1.—*Relative abundance of Lower Cretaceous megafossils in northern Alaska*

Megafossils	Number of specimens	Megafossils	Number of specimens
Jellyfish?	2	*Myopholas*	1
Crinoid remains	50	*Oxytoma*	12
Starfish	10	*Aucella*	1,100
Brittle Stars	10	*Aucellina*	100
Echinoid spines	50	*Pinna*	1
Brachiopods	20	*Isognomon?*	9
Chaetopod worms:		*Inoceramus*	70
Serpula	5	*Lima*	2
Spirorbis	50	*Camptonectes*	10
Ditrupa	500	*Entolium*	100
Pelecypods	2,191	*Eopecten?*	1
Nucula	5	*Plicatula*	3
Nuculana	4	*Anomia*	2
Yoldia	26	*Placunopsis*	24
Dicranodonta	25	*Modiolus*	32
Unio	12	Gastropods	56
Astarte	70	Ammonites	82
Corbula?	20	*Lytoceras*	3
Tancredia	95	*Phylloceras*	1
Lucina	2	*Pusozia?*	11
Arctica?	240	*Beudanticeras*	2
Veniella	9	*Colvillia*	11
Flaventia?	11	*Subarcthoplites*	16
Solecurtus?	13	*Gastroplites*	6
Cultellus?	1	*Paragastroplites*	8
Pleuromya	19	*Cleoniceras*	6
Panope?	105	*C.* (*Neosaynella*)?	4
Homomya	4	*C.* (*Grycia*)	10
Goniomya	3	*Pseudopulchellia*	4
Thracia	50	Belemnites	5
Psilomya?	10	*Xenohelix*? borings	20

STRATIGRAPHIC RELATIONSHIPS

BEDS OF BERRIASIAN TO VALANGINIAN AGE

The Okpikruak formation (Gryc, and others, 1951, p. 159) comprises the basal Cretaceous beds in northern Alaska (pl. 22). It is exposed in the southern part of the Arctic foothills from the Kukpowruk River eastward to near the Canning River, a distance of nearly 400 miles. It ranges in thickness from 0 to about 3,000 feet. It consists mostly of dark claystone, siltstone, and fine-grained greenish-gray graywacke. Minor amounts of conglomerate and coarse sandstone generally occur in the basal part of the formation and rarely at higher levels. It differs from the underlying Tiglukpuk formation of Jurassic age by having more distinct stratification and generally rhythmic alternation of sandstone, siltstone, and claystone (Patton, 1956a, p. 218). It differs from the overlying Fortress Mountain formation by its rhythmic alternation of beds and by generally containing conglomerate and sandstone only near its base (Patton, 1956b, p. 220). The contact with the adjoining formations is unconformable and locally angular.

The physical evidence for an unconformity between the outcropping Jurassic beds and the Okpikruak formation consists mostly of the highly variable thickness of the Jurassic and its local absence. The faunal evidence for an unconformity consists of the absence locally of certain aucellan species that are present elsewhere. The succession of aucellan species that occurs in northern Alaska is shown by formation and age in the following table.

TABLE 2.—*Succession of aucellan species in northern Alaska*

Characteristic species	Formation	Probable age
Aucella crassicollis Keyserling.	Okpikruak (lower to upper parts).	Middle to late Valanginian.
Aucella sublaevis Keyserling.	Okpikruak (lower part).	Early Valanginian.
Aucella okensis Pavlow and *A. subokensis* Pavlow.	Okpikruak (basal).	Berriasian.
Aucella piochii Gabb	Tiglukpuk	Middle to late Portlandian.
Aucella rugosa (Fischer) and *A. mosquensis* (von Buch).	Tiglukpuk (lower to middle parts).	Middle Kimmeridgian to early Portlandian.
Aucella concentrica (Sowerby) and *A. spitiensis* Holdhaus.	Tiglukpuk (lower to middle parts) and Kingak (upper part).	Late Oxfordian to early Kimmeridgian.

Aucella spitiensis Holdhaus has been found in northern Alaska only in a small area between the most easterly branch of the Shaviovik River and the Canning River. The range of *A. concentrica* overlaps a little with the range of *A. rugosa* (Fischer) and *A. mosquensis* (Von Buch). *A. piochii* (Gabb) contrary to recent published statements (Imlay, 1955, p. 75) is now known from one locality on the middle Fork of the Okpikruak River. (See pl. 7, fig. 11.) The stratigraphic position of *A. piochii* within the Tiglukpuk formation is unknown, but its occurrence at one place suggests that the upper part of the formation in other places above the beds containing *A. rugosa* may also be of middle to late Portlandian age. The species of *Aucella* in the Lower Cretaceous beds occur in the succession shown in the table, although locally any of the three species may occur at the base of the Cretaceous. There is no evidence that the ranges of the species overlap, although such would not be surprising considering the ranges reported for these species in northern Eurasia.

Stratigraphic collecting of these aucellan species by field geologists has demonstrated that any one of the Cretaceous species may occur at the base of the Cretaceous and any one of the Jurassic species may occur at the top of the Jurassic. For example, along the west bank of the Canning River, beds containing *Aucella subokensis* Pavlow (Mes. loc. 24031) rest directly on beds containing *Aucella spitiensis* Holdhaus and *Aucella concentrica* (Sowerby). About 400 miles to the west on the Kukpowruk River, beds containing *Aucella sublaevis* Keyserling (Mes. loc. 23698) are separated from beds containing *Aucella rugosa* (Fischer) by a narrow covered interval. In the intervening area any one of the species in the Cretaceous may rest on the Jurassic Tiglukpuk formation whose upper part generally does not contain megafossils but whose lower to middle parts have furnished *Aucella concentrica* and *Aucella rugosa*. The upper part above the occurrences of *A. rugosa* may be locally of middle to late Portlandian age as indicated by the discovery of one specimen of *Aucella piochii* (Gabb) from a locality on the middle fork of the Okpikruak River. Failure to find *A. piochii* elsewhere in the upper part of the Tiglukpuk might be explained by unfavorable facies for Aucellas, by collecting failure, or by absence of beds of middle to late Portlandian age. The problem cannot be solved without additional fieldwork.

The duration of the unconformity between the Jurassic and Cretaceous must be limited on the basis of the known ranges of the aucellan species to late Portlandian and Berriasian times. The fact that *Aucella piochii* has been found at only one locality suggests that nondeposition or erosion began in late Portlandian time. The thinness of the beds, containing *A. okensis* and *A. subokensis*, and the absence of those beds locally indicates that the unconformity was developed in part during early Berriasian time and that some areas were not submerged by the Cretaceous sea until Valanginian time.

BEDS OF ALBIAN AGE

Beds of Albian age in northern Alaska aggregate more than 10,000 feet in thickness, include varied lithologic types, and exhibit marked facies changes from south to north and from east to west (pl. 22). Many names have been applied to show the known complex intertonguing and intergrading relations and to avoid extending names across areas where soil cover or faulting make stratigraphic relations uncertain. The resulting terminology for the area extending from the Colville River and its tributaries northward to the Arctic Coastal Plain has been described recently (George Gryc and others, 1956). The terminology used in areas to the east and west of the Colville River has been described by Sable (1956). As these papers may be consulted readily, a summary description of the formations will not be presented herein.

Regional correlations of the formations of Albian age are based on the faunal data presented in two range plates (pls. 23, 24). Local correlations are based on this faunal data and on the stratigraphic relations observed by field geologists. The correlations shown on plate 22 are based on both lines of evidence.

Faunally the lower part of the Torok formation is correlated with the lower part of the Fortress Mountain formation by means of the ammonites *Colvillia* and *Beudanticeras*. The middle third of the Torok formation contains the ammonite *Subarcthoplites*, which occurs in Alberta in the Clearwater formation and in the upper part of the Loon River formation. The lower two-thirds of the Torok formation contain a microfauna that occurs elsewhere in the Fortress Mountain formation of the southern foothills and in the subsurface Oumalik formation. The ammonite *Cleoniceras* was found associated with this microfauna in the Torok about 700 feet above *Subarcthoplites*. It occurs in Europe near the boundary of the lower and middle Albian.

A distinct assemblage of megafossils and microfossils appearing in the upper third of the Torok formation is abundant in the Tuktu formation, persists in reduced numbers through the Grandstand formation, and then terminates abruptly. This assemblage can be divided into a lower zone characterized by the ammonite *Gastroplites* and an upper zone above the range of that ammonite. The genus *Cleoniceras* ranges up to the middle of the Tuktu formation. The presence of these genera show that the upper third of the Torok and all the Tuktu may be correlated with the middle Albian of Europe.

The Tuktu formation contains species which in Canada are known partly from older beds, partly from younger beds, and partly from beds of the same age as determined by ammonites. The Tuktu formation is distinguished, therefore, by an association of species that in Canada occur at different positions. It also contains species, such as *Dicranodonta dowlingi* McLearn, that are not known at higher or lower positions. On the basis of such associations, or restricted species, the Tuktu is correlated with the lower part of the lower member of the Ignek formation in the Canning River area; with the highest part of the Torok and the lower and middle parts of the Kukpowruk formation of the Meade-Kigalik-Awuna River area; with part of the Kukpowruk formation of the Corwin-Utukok River area; and with the upper part of the subsurface Topagoruk formation.

The Grandstand formation where it overlies the Tuktu formation is correlated with the Shaftesbury and the Sikanni formations in British Columbia because it contains some of the same species of pelecypods and because the underlying Tuktu formation contains ammonites that are identical with those in the Peace River formation.

The Albian sequence in northern Alaska rests unconformably on the Okpikruak formation or on Jurassic beds. At its type locality the Fortress Mountain formation (Patton 1956b, p. 220) rests on the Tiglukpuk formation of Late Jurassic age. In the Utukok-Corwin area, west of the upper part of the Colville River, the Fortress Mountain formation overlies beds as young as the Okpikruak formation and as old as Triassic. Elsewhere it rests on the Okpikruak formation with locally angular discordance. The Torok formation in the area between the Sagavanirktok River and the Shaviovik Valley lies on the *Aucella sublaevis* beds of the Okpikruak formation. The lower member of the Ignek formation on the west bank of the Canning River rests on Jurassic beds of late Oxfordian age. About 12 miles to the northeast in Ignek Valley the lower member of the Ignek formation overlies on beds of Toarcian age (Imlay, 1955, p. 71). In the subsurface of the Arctic Coastal Plain the Oumalik formation in the Oumalik test well 1 rests on the *Aucella sublaevis* beds of the Okpikruak formation. In the Topagoruk test well 1 the Oumalik formation rests on beds containing *Aucella* cf. *A. rugosa* (Fischer) of Late Jurassic age. In test wells in the vicinity of Point Barrow, beds of Albian age rest on beds of Early to Middle Jurassic age. Evidently, the pre-Albian unconformity is as well developed in the subsurface as in outcrop areas. Its duration apparently corresponds to the Hauterivian, Barremian, and Aptian stages as discussed previously (Imlay and Reeside, 1954, p. 241).

An angular unconformity may be present locally in the lower part of the Albian sequence between the subsurface Oumalik formation and the overlying Topagoruk formation (Robinson, Rucker, and Bergquist 1956, p. 226, 230). The evidence consists of greater induration and compaction of the Oumalik formation than of the Topagoruk as shown in well cores, and of a conspicuous, widespread seismic change at the boundary. An unconformity in the outcrop at a corresponding position has not been found by field geologists except possibly in the Utukok River area (E. G. Sable, oral communication, 1956). If present, it should be about 2,000 feet below the top of the Torok formation. Failure to determine the presence of such an unconformity does not prove that it is absent because the Torok formation consists mostly of soft shale and siltstone that is poorly exposed and where exposed is generally much crumpled. It is conceivable, however, that the unconformity noted in the subsurface disappears southward and becomes greater northward. Such is suggested by northward thinning of the Oumalik formation to a few hundred feet in the Barrow test wells and the probability that this thickness represents only the lower part of the formation (Robinson, Rucker, and Bergquist, 1956, p. 226).

The Albian sequence passes upward conformably and locally gradationally into the Ninuluk formation of Cenomanian age according to the field geologists (Detterman, 1956, p. 241). The presence of a conglomerate at many places at the base of the Ninuluk formation is discounted as indicating a disconformity because similar conglomerates are common at higher and lower levels in the Cretaceous. The megafossils in the Grandstand formation and in equivalent beds underlying the Ninuluk formation differ specifically from those in the Ninuluk formation and include more genera. Such differences by themselves, however, are not evidence for an unconformity between the Grandstand and Ninuluk formations. The exact nature of the boundary between these formations can only be settled by additional fieldwork.

FAUNAL ZONES AND CORRELATIONS

AUCELLA OKENSIS ZONE

Aucella okensis Pavlow and *A. subokensis* Pavlow in northern Alaska are commonly associated and have been found only within the lower 200 to 300 feet of the Okpikruak formation. Wherever the stratigraphic position of these species has been determined, they underlie beds containing *Aucella sublaevis* Keyserling and overlie Late Jurassic beds ranging in age at their top from late Oxfordian to Portlandian.

Most of the collections of *A. okensis* and *A. subokensis* have been made in two widely separated areas. One of these areas extends from the Sagavanirktok to the Canning River, and the other is more than 150 miles farther west at the headwaters of the Nuka, Colville, and Utukok Rivers. Between these areas there are 2 occurrences on the Ipnavik River—1 on the Etivluk River and 1 on Tiglukpuk Creek, which is a tributary of the Siksikpuk River. This scarcity of occurrences may be in part due to collecting failure or to unfavorable facies for Aucellas, but is probably due mainly to nondeposition of sediment during the time that *A. okensis* and *A. subokensis* lived. Such can be proved locally where the younger species *A. sublaevis* Keyserling and *A. crassicollis* Keyserling occur in the basal beds of the Okpikruak formation, as at Mesozoic localities 22484, 22487, 22493, 22518, and 23565. Evidently the invading Cretaceous sea spread over an irregular, hilly terrain, and some spots were not covered by marine waters for a considerable length of time.

The beds containing *Aucella okensis* and *A. subokensis* are correlated with the Berriasian (Infravalanginian) stage of Europe on the basis of the occurrences of those species in Russia (Pavlow, 1907, p. 40, 42, 76, chart opposite p. 84). *A. subokensis* is reported to range from the very highest Jurassic into the Russian zone of *Subcraspedites spasskensis* at the very base of the Cretaceous. *A. okensis* is reported to range into the next higher zone of *Subcraspedites stemomphalus*. In northern Alaska neither species appears to range higher than the other. Of course, there is no evidence that the entire Berriasian stage is represented in northern Alaska. Only partial representation is suggested by the local absence of *A. okensis* and *A. subokensis*, by the slight thickness of the beds containing them as compared with the overlying beds of Valanginian age, and by their association with conglomerate and coarse sandstone at the base of Okpikruak formation.

AUCELLA SUBLAEVIS ZONE

Aucella sublaevis Keyserling in northern Alaska occurs in the lower few hundred feet of the Okpikruak formation directly above beds containing *A. okensis* Pavlow and *A. subokensis* Pavlow and directly below beds containing *A. crassicollis* Keyserling. In a few places in the western part of the De Long Mountains it occurs within a few feet of beds mapped as Late Jurassic. At a few localities *A. sublaevis* occurs with some of the other aucellan species mentioned, but the locality descriptions show that the collections are aggregates made from several beds, or units, or were made from float. These localities are discussed under the descriptions of the species.

Most of the collections of *A. sublaevis* have been made in the western part of the De Long Mountains and in the foothills to the northwest. East of this area it has been found at 1 locality on the Kiligwa River, 1 locality on the Oolamnagavik River, 2 localities at the headwaters of the Sagavanirktok River, and 1 locality on Kemik Creek at the head of the Shaviovik River. Its absence east of Kemik Creek is due to post-Okpikruak erosion (Imlay, 1955, p. 71), but its scarcity in the 150 miles west of the Sagavanirktok River cannot be so explained because the younger *Aucella crassicollis* Keyserling has been found at many localities throughout that area. This scarcity is comparable to that of *A. okensis* and *A. subokensis* in the same area and likewise may be explained by nondeposition of sediment locally during the time that *A. sublaevis* lived. At least at one place between the Kuna and Ipnavik Rivers (Mes. loc. 22518), the beds with *A. crassicollis* rest directly on Upper Jurassic beds, which is evidence that land existed at that place early in the Cretaceous.

The beds containing *Aucella sublaevis* Keyserling are considered to be of Valanginian rather than of Berriasian age because of the range of the species recorded in northern Russia and Spitzbergen (Pavlow, 1907, p. 64, chart opposite p. 84; Lahusen, 1888, p. 42; Sokolow, 1908b, p. 2, 7; Sokolow and Bodylevsky, 1931, p. 117, 118). In those areas *A. sublaevis* begins higher stratigraphically than *A. okensis* Pavlow and is associated in the upper part of its range with *A. crassicollis* Keyserling. The position of the *A. sublaevis* beds in northern Alaska directly below the *A. crassicollis* beds indicates that they are of early Valanginian age because *A. crassicollis* attained its greatest abundance in the middle Valanginian in the Boreal region. The slight thickness of the *A. sublaevis* beds as compared with the overlying *A. crassicollis* beds suggests that the former represents a shorter length of time. Of course, in the absence of ammonites the exact age of the *A. sublaevis* beds in northern Alaska cannot be definitely established, but their assignment to the early Valanginian seems more reasonable than to the late Berriasian or the middle Valanginian.

Such an age assignment implies, however, that a stratigraphic break exists between the *A. sublaevis* beds and the underlying beds containing *A. okensis* and *A. subokensis*, if those species have the same range as in Eurasia. A stratigraphic break would explain the absence of aucellan specimens that are definitely identifiable with *A. volgensis* Lahusen (1888, p. 26, 38, 39, pl. 3). Its absence could, also, be explained by collecting failure, or by misidentifications. Only additional fieldwork can solve the problem.

AUCELLA CRASSICOLLIS ZONE

Aucella crassicollis Keyserling in northern Alaska attains its greatest abundance near the middle of the Okpikruak formation but occurs also throughout the lower and upper parts of the formation. It even occurs near the base of the formation at Mesozoic localities 22490 and 22779 and at the base at Mesozoic localities 22493, 22518, and 23565. Wherever its stratigraphic position relative to the other aucellan species can be determined, it is definitely higher. Therefore, wherever *A. crassicollis* occurs at the base of the Okpikruak the time during which *A. okensis* and *A. sublaevis* lived is not represented by sediments.

Aucella crassicollis has been obtained at many localities from the western part of the De Long Mountains eastward 140 miles to Kanayut River, a tributary of the Anaktuvuk River. Farther east it has been found only at one locality on the Ribdon River. Its absence still farther east is due to post-Okpikruak erosion. Its absence between the Kanayut River and the Ribdon River is explained by scarcity of outcrops, extensive coverage by glacial debris, and lack of fieldwork. Its apparent absence in an area between the Etivluk and Killik Rivers is probably due to collection failure and insufficient fieldwork. The much greater distribution of *A. crassicollis* than of *A. okensis* or *A. sublaevis* in northern Alaska can be matched in other parts of Alaska.

The presence of *Aucella crassicollis* Keyserling in considerable abundance, by comparisons with its occurrences elsewhere in the Boreal region, is excellent evidence that the enclosing beds are of Valanginian age and are probably not older than middle Valanginian (Pavlow, 1907, p. 62, 76, 77, table opposite p. 84). Similarly an age not older than middle Valanginian is indicated for the *Aucella crassicollis* beds in California and Oregon by such ammonites as *Sarasinella*, *Thurmanniceras*, *Polyptychites*, and *Neocraspedites*. Therefore, a middle to late Valanginian age for the *A. crassicollis* beds in northern Alaska seems reasonable.

COLVILLIA CRASSICOSTATA ZONE

This zone is represented in the Fortress Mountain formation and in the lower part of the Torok formation by a meager faunule (table 4) that includes the ammonites *Colvillia crassicostata* Imlay, *C. kenti* Imlay, *Beudanticeras* (*Grantziceras*) *affine* (Whiteaves), *Puzosia?* sp. juv. and pelecypods *Aucellina dowlingi* McLearn, *Thracia kissoumi* McLearn, *Pleuromya kelleri* Imlay n. sp., *Placunopsis nuka* Imlay, n. sp., *Panope?* sp., and *Inoceramus* cf. *I altifluminis* McLearn. Most of these species are represented by only a few specimens, except for *Aucellina*, which occurs locally in enormous numbers.

The fossil collections from the Fortress Mountain formation that can be located stratigraphically are mostly from the lower half of the formation. *Aucellina* occurs within several hundred feet of the base of the formation at Mesozoic locality 22511 and elsewhere is probably at least 2,000 feet above the base. *Colvillia* was found in the lower 600 feet near the Okpikruak River (Mes. loc. 21558) and probably within 2,000 feet of the base near the Kiligwa River (Mes. loc. 24040). It was also found near the headwaters of the Colville River (Mes. loc. 23558) in beds that are probably in the upper part of the Fortress Mountain formation. Fragmentary ammonites probably belonging to *Colvillia* were found in the lower part of the formation at one place (Mes. loc. 22523) between the Etivluk and Ipnavik Rivers. *Puzosia?* sp. juv. was found in the same area at an unknown level, but probably in the lower 2,000 feet of the formation. Several specimens of *Inoceramus* similar to *I. altifluminis* McLearn were found 1,800 feet above the base of the Fortress Mountain formation at the type locality.

The *Colvillia crassicostata* zone is represented definitely in the lower part of the Torok formation, at Mesozoic locality 21554 near the Chandler River, by *Colvillia crassicostata* Imlay, *Beudanticeras* (*Grantziceras*) *affine* (Whiteaves), *Puzosia?* sp. juv., and *Inoceramus* sp. juv. These fossils were obtained between 4,000 and 4,600 feet below the top of the Torok formation, and probably represent the lowest known occurrence of megafossils in the formation.

The subsurface equivalent of the *Colvillia crassicostata* zone is considered to be in the lower part of the Oumalik formation. The same microfauna occurs in the Oumalik formation as in the lower and middle parts of the Torok formation (Robinson, Rucker, and Bergquist, 1956, p. 226) and in the lower part of the Fortress Mountain formation. (Oral communication from Harlan Bergquist, 1956). The megafossils include undetermined species of *Flaventia?*, *Pleuromya*, *Inoceramus*, *Lima?*, and *Entolium* that are not of much age significance. The presence of *Astarte ignekensis* Imlay, n. sp., and *Thracia* cf. *T. kissoumi* McLearn shows that the Oumalik is part of the Albian sequence.

Correlation may also be made with the Clearwater and Loon River formations of Alberta and the Moosebar, Gates, and lower part of the Buckinghorse formations of northeastern British Columbia (see pl. 22) by means of such megafossils as *Aucellina dowlingi* McLearn, *Thracia* cf. *T. kissoumi* McLearn, and *Beudanticeras* (*Grantziceras*) *affine* (Whiteaves). Of these, *B. affine* has been recorded from the Clearwater, Loon River, Moosebar and Gates formations (McLearn, 1931, p. 3; 1933a, p. 139; 1945a, p. 10; Wickenden, 1951, p. 4) and also from the basal member of the Peace River formation (Henderson, 1954, p. 2285). *Aucellina dowlingi* McLearn has been recorded from the basal part of the Buckinghorse formation (McLearn and Kindle, 1950, p. 86). *Thracia kissoumi* McLearn has been recorded from the lower part of the lower sandstone member of the Peace River formation (McLearn, 1933a, p. 148). The ranges of these two pelecypod species are not known although McLearn (1945a, p. 10) intimates that they are associates of *Beudanticeras affine* (Whiteaves).

The described mollusks from the Canadian formations just mentioned include many more genera and species (Stelck, Wall, Bahan, and Martin, 1956, p. 12–14) than have been found in the Fortress Mountain formation or in the lower part of the Torok formation. In particular they include the ammonite *Subarcthoplites* (equals *Lemuroceras* of Spath, 1942, p. 688, and McLearn, 1945a), which in northern Alaska occurs in the middle third of the Torok formation. This ammonite in Canada occurs in the upper part of the Loon River formation and in equivalent beds (McLearn, 1933a, p. 139, 140; McLearn and Kindle 1950, p. 76, 84, 86), but apparently has a shorter range than

Beudanticeras affine (Whiteaves), with which it is associated.

Considering the ranges of the various ammonites and pelecypods just discussed, the beds in northern Alaska that contain *Colvillia* and *Aucellina* may reasonably be correlated with only the basal parts of the Canadian Buckinghorse, Moosebar, Loon River and Clearwater formations. The presence of *Aucellina dowlingi* McLearn in the lower few hundred feet of the Fortress Mountain formation compares with its occurrence in the basal part of the Buckinghorse formation on the Sikanni Chief River. The nonassociation of *Subarcthoplites* with *Colvillia* in the Fortress Mountain formation and the presence of *Subarcthoplites* at a much higher level in the Torok formation indicates that *Colvillia* is the older genus and that the beds in which it occurs should be correlated with parts of Canadian formations below the range of *Subarcthoplites*.

The age of the *Colvillia crassicostata* zone, within the Fortress Mountain formation and the lower part of the Torok formation, is probably early Albian. Stratigraphic position alone, some thousands of feet below beds containing *Gastroplites* and *Cleoniceras*, indicate that it is early Albian or older. An Aptian age seems unlikely because it lacks such ammonites as *Deshayesites*, *Sanmartinoceras*, *Tropaeum*, and *Crioceras* that occur in late Aptian beds in Greenland (Frebold, 1935, Maync, 1949 p. 227, 258–270; Spath, 1946, p. 6, 7; Donovan, 1953, p. 50, 117, 136) and in Spitzbergen (Stolley, 1912, p. 16–20; Frebold and Stoll, 1937, p. 54, 55, 75, 76). An early Albian rather than Aptian age is favored also by the characteristics of some of the mollusks in the *Colvillia crassicostata* zone. The resemblance of *Aucellina dowlingi* McLearn to *A. gryphaeoides* (Sowerby) indicates an age not older than Albian if the stratigraphic distribution of species of *Aucellina* is the same in North America as in Eurasia (Sokolow, 1918, p. 310, 311). The small ammonites referred to *Puzosia?* sp. juv. are similar to the Greenland "*Puzosia*" *sigmoidalis* Donovan (1953, p. 115, pl. 24, figs. 3–6), which is associated with *Leymeriella* of early Albian age. *Beudanticeras* (*Grantziceras*) *affine* (Whiteaves) shows some resemblances to certain species of *Beudanticeras* from the Albian of Europe (Spath, 1923, pl. 3, figs. 3a–d) and also to the early Albian *Anadesmoceras* (Casey, 1954, p. 107). The genus *Colvillia* shows considerable resemblance to *Callizoniceras* of late Barremian to early Albian age (Wright, 1955, p. 573). Its presence alone is fairly good evidence that the enclosing beds are not younger than early Albian.

SUBARCTHOPLITES BELLI ZONE

This zone in the middle third of the Torok formation is probably several thousand feet thick. The lowest occurrence (Mes. loc. 21557) is reported to be in the lower part of the Torok formation at a place that is nearly along the strike from beds containing the ammonite *Colvillia* (Mes. loc. 21554). All the other occurrences (Mes. loc. 13311, 21822, 24639, and 25814) are distinctly above the middle of the Torok formation, but at least 2,000 feet below the top (oral communication of R. L. Detterman, 1956).

The megafauna collected from these localities is meager. It consists of the ammonites *Subarcthoplites belli* (McLearn), *S. colvillensis* Imlay, *S. bickeli* Imlay, *Puzosia?* sp. juv., *Inoceramus* cf. *I. anglicus* Woods, and *I.* sp. juv. Of these fossils the small puzosioid ammonite is nondescript and of little stratigraphic value. *Subarcthoplites belli* occurs in Alberta in the upper part of the Loon River formation (McLearn, 1945a, pl. 3, figs. 17, 18). Similar species of *Subarcthoplites* are reported from Canada from the lower part of the Buckinghorse formation and from the Clearwater formation (McLearn and Kindle, 1950, p. 86, 93), but are not recorded from the lower member of the Peace River formation (McLearn, 1933a, p. 139; Wickenden, 1951, p. 6). The small specimens of *Inoceramus* associated with *Subarcthoplites* in northern Alaska may belong to *Inoceramus dowlingi* McLearn, which species occurs in Alberta in the Clearwater formation, but they probably represent immature stages of *I. anglicus* Woods, or *I. cadottensis* McLearn.

The age of the *Subarcthoplites* beds in northern Alaska is considered to be early Albian because they occur some hundreds of feet below the lowest appearance of the ammonite *Cleoniceras*, which in western Europe ranges from the upper part of the zone of *Leymeriella tardefurcata* through the zone of *Douvilleiceras mammillatum* (Spath, 1943, p. 687, 699; Breistroffer, 1947, p. 25) to about the middle part of the middle Albian. The age of beds in Canada that contain *Subarcthoplites* (equals *Lemuroceras* in part of McLearn) is considered by Canadian paleontologists (Stelck, and others, 1956, p. 6, 9) to be early middle Albian. Such an age assignment is based in part on the identification of certain species with *Lemuroceras*, which genus occurs in Madagascar in the zone of *Douvilleiceras mammillatum*, and in part on stratigraphic position of the *Lemuroceras* beds above beds containing *Cleoniceras* and *Sonneratia*. Validation of a middle Albian age must await descriptions of the specimens assigned to *Cleoniceras* and *Sonneratia*, presentation of evidence that *Lemuroceras* is correctly identified, and determination of the total range of *Lemuroceras*.

UNNAMED ZONES CONTAINING CLEONICERAS TAILLEURI

The probability that the beds containing *Subarcthoplites* are separated from the beds containing *Gastroplites* by an appreciable stratigraphic interval in both Alaska and the western interior of Canada is supported by several lines of evidence.

In Canada such an interval is indicated by McLearn (1945a, figs. 1, 2) at the position of the lower sandstone member (Notikewin) of the Peace River formation and equivalent beds which have furnished *Beudanticeras affine* (Whiteaves) (Henderson, 1954, p. 2285), but not *Gastroplites* or *Subarcthoplites*. It is suggested by the absence of macrofossils in the overlying Harmon shale member of the Peace River formation (Stelck, Wall, Bahan and Martin, 1956, p. 16). It is indicated, also in a statement by C. R. Stelck (*in* Mellon and Wall, 1956, p. 11) that the *Gastroplites* beds are underlain successively by beds containing *Lemuroceras mcconnelli* (Whiteaves), *L. irenense* McLearn, *L.* cf. *L. indicum* (Spath), and *Cleoniceras* cf. *C. subbayleyi* Spath. Emphasis is placed on the abundance of *L. mcconnelli* in the Clearwater shale and on its stratigraphic position relative to the other ammonites listed. Such a succession, if sustantiated, would be significant stratigraphically and chronologically because only the species referred to *L. indicum* could belong in the genus *Subarcthoplites* as defined by Casey (1954, p. 111) and the other species listed under *Lemuroceras* belong in other genera. *L. mcconnelli* in particular has many characteristics of the genus *Leymeriella*, such as figured by Jacob (1908, pl. 7), and probably belongs in the family Leymeriellidae of early Albian age. The occurrence of that family below beds containing *Gastroplites* and above beds containing *Subarcthoplites* would agree very well with the age evidence for those beds based on the Alaskan megafossils as discussed herein.

In northern Alaska the presence of a stratigraphic interval between the *Subarcthoplites* and the *Gastroplites* beds is indicated by a partial sequence of the Torok formation exposed on the Etivluk River about 8½ miles above its mouth near its junction with the East Fork. This sequence is reported by R. L. Detterman (oral communication, 1956) to be above the middle of the Torok formation, but probably several thousand feet below the top. The units, measured by R. S. Bickel, from top to bottom are as follows:

	Feet
1. Clay shale; top not exposed. Contains *Cleoniceras tailleuri* Imlay, n. sp., *Puzosia?* sp. juv. and *Inoceramus* sp. (Mes. loc. 24640)	200
2. Clay shale, silty shale, some thin interbeds of sandstone, possibly faulted	200
3. Clay shale rubble	430
4. Sandstone, medium-grained, some shale	75
5. Siltstone, rhythmically bedded (4 to 6 in. thick), and clay shale (10 in. thick); base not exposed . . . *Subarcthoplites bickeli* Imlay, n. sp., and *Inoceramus* cf. *I. anglicus* Woods (Mes. loc. 24639) were obtained either from this unit or the overlying unit	185
Total exposed thickness	1,090

Judging from the above data, *Cleoniceras tailleuri* was collected at least 630 feet above *Subarcthoplites* and probably more than 700 feet above. The presence of *Cleoniceras tailleuri* by itself might be taken as indicating a high position in the Torok formation because the other records of the species are from the lower and middle parts of the overlying Tuktu formation. However, the sequence in question is claimed by field geologists to be well below the highest part of the Torok formation, which part has furnished the ammonite *Gastroplites* and a distinctive microfauna that ranges upward to the top of the Lower Cretaceous (Robinson, Rucker and Bergquist, 1956, p. 230). The microfossils obtained from the sequence, and from outcrops above and below, are not particularly helpful stratigraphically because they consist only of long-ranging species that range throughout the Albian beds in northern Alaska (written communication from Harlan R. Bergquist, Jan. 7, 1957).

The stratigraphic relations exhibited along the Etivluk River show at least the relative stratigraphic positions of *Subarcthoplites* and *Cleoniceras* and indicate that *Subarcthoplites* occurs many hundreds of feet below the lowest position at which *Gastroplites* has been found. It seems probable that the interval between *Subarcthoplites* and *Gastroplites* corresponds with the part of the Canadian Gates formation and Clearwater formation that contains "*Lemuroceras*" *mcconnelli* (Whiteaves) (Stelck, Wall, Bahan, and Martin, 1956, p. 10, 15).

The age of the beds containing *Cleoniceras tailleuri*, at Mesozoic locality 24640, is probably early Albian corresponding with the earliest appearance of *Cleoniceras* in Europe at the top of the *Leymeriella tardefurcata* zone. Such an age assignment is favored by the distribution of *Cleoniceras* in northern Alaska through at least 2,000 feet of beds in the upper part of the Torok formation and through more than half of the Tuktu formation, which ranges from 1,000 to 1,300 feet in thickness.

GASTROPLITES KINGI ZONE

This zone is characterized by the ammonites *Gastroplites* and *Paragastroplites* in association with a large assemblage of other mollusks, echinoderms, and chaetopod worms (table 5). It is represented by all the Tuktu formation, the upper third of the Torok formation, and equivalent formations in northern Alaska. Its thickness ranges from 1,000 to nearly 4,000 feet and averages about 3,000 feet. It is represented in the subsurface by most of the Topagoruk formation.

The most common ammonites in the zone are identical, or closely comparable with *Gastroplites kingi* McLearn. *Paragastroplites spiekeri* (McLearn) and fragments comparable with that species are nearly as common. *P. flexicostatus* Imlay, n. sp., has been found only in the upper two-thirds of the Tuktu formation. The genus *Cleoniceras* ranges throughout most of the zone but is absent in the upper third of the Tuktu formation. The highest recorded occurrence (Mes. loc. 21827) of typical *Cleoniceras*, such as *C. tailleuri* Imlay, n. sp., is from 360 to 400 feet below the top of the Tuktu formation in an area where the formation is about 1,000 feet thick. An ammonite referred questionably to the subgenus *Neosaynella* occurs still higher, about 600 feet above the base of the Grandstand formation at Mesozoic locality 24638.

Most of the megafossils other than ammonites in the *Gastroplites kingi* zone range beyond that zone (see pl. 24). Many range upward into the Grandstand formation, and a few are recorded below the upper part of the Torok formation. Of the 14 species of pelecypods definitely identified with Canadian species, 6 were originally found in Canada in beds a little below the *Gastroplites kingi* zone, 7 were found in beds higher than that zone, and only *Dicranodonta dowlingi* McLearn occurs within that zone. Besides these species, *Inoceramus cadottensis* McLearn and *I. altifluminis* McLearn from the *Gastroplites*-bearing beds in Canada are probably represented in northern Alaska in beds containing *Gastroplites*. The association of species in northern Alaska that in Canada apparently occur separately is probably related to the fact that in Canada only a few species of pelecypods and starfish have been recorded from the beds containing *Gastroplites*.

It appears, therefore, that the *Gastroplites kingi* zone in northern Alaska contains a commingling of species having different ranges. Those ranging into it from older beds include *Yoldia kissoumi* McLearn, *Astarte portana* McLearn, *A. ignekensis* Imlay, n. sp., *Oxytoma camselli* McLearn, *Thracia kissoumi* McLearn, *Panope? elongatissima* McLearn, *Goniomya matonabbei* McLearn, and probably *Inoceramus anglicus* Woods and *I. altifluminis* McLearn. Those species first appearing in the zone but ranging above it include *Ditrupa cornu* Imlay, *Tancredia stelcki* McLearn, *T. kurupana* Imlay, n. sp., *Solecurtus? chapmani* Imlay, n. sp., *Pleuromya sikanni* McLearn, *Panope? kissoumi* McLearn, *Thracia stelcki* McLearn, *Entolium utukokense* Imlay, n. sp., and *Modiolus archisikanni* McLearn. The species other than ammonites recorded only from the *Gastroplites kingi* zone include *Dicranodonta dowlingi* McLearn, *Flaventia? kukpowrukensis* Imlay, n. sp., *Cultellus? kokolikensis* Imlay, n. sp., *Camptonectes dettermani* Imlay, n. sp., and the borings referred to *Xenohelix*. The range of many of these species probably is greater than the records show, considering that very few collections have been made from the beds, overlying or underlying the Tuktu formation (see pls. 22–24).

The base of the *Gastroplites kingi* zone coincides with the earliest appearance of a microfauna (Robinson, Rucker, and Berquist, 1956, p. 230) which continues upward to the top of the Grandstand and Chandler formations. Such an extended range coincides with that of many species of megafossils herein described.

The *Gastroplites kingi* zone is correlated with the middle Albian of Europe as defined by Spath (1942, p. 668). The main evidence consists of the presence of typical *Cleoniceras* throughout most of the zone as well as in beds below the zone, as at Mesozoic locality 24640 previously discussed. This occurrence below the zone may reasonably be correlated with the first appearance of *Cleoniceras* in Europe at the top of the *Leymeriella tardefurcata* zone. The presence of *Cleoniceras* throughout 2,000 to 3,000 feet of the *Gastroplites kingi* zone seems ample to account for the occurrences of *Cleoniceras* in the lower part of the middle Albian. The absence of *Cleoniceras* in the upper few hundred feet of the Tuktu formation suggests that part of the *Gastroplites kingi* zone corresponds to part of the middle Albian above the range of *Cleoniceras*. Such is supported by the presence of *Gastroplites* in England at the very top of the middle Albian (Spath, 1937, p. 257–260). Of course, this does not prove that the top of the *Gastroplites kingi* zone corresponds exactly with the top of the middle Albian of England, but there cannot be much difference in age.

Additional evidence for considering that the *Gastroplites kingi* zone is not older than middle Albian is the abundance of *Inoceramus anglicus* Woods. This species in England is common in the middle and upper Albian (Woods, 1911, p. 265). In Greenland it occurs in beds that are probably mainly middle Albian (Donovan, 1953, p. 94), but may be partly upper Albian. If *I. dowlingi* McLearn (1919, p. 11, pl. 3, figs. 7, 8), which occurs rarely in the Clearwater formation of Alberta, should be an immature *I. anglicus* Woods, the range of the species would include some of the lower Albian. Similarly the occurrence in the *Subarctho-*

plites belli zone in northern Alaska (Mes. loc. 24639) of a small *Inoceramus*, comparable to the immature stages of *I. anglicus* Woods, may extend the range of that species. It may be significant, however, that typical large specimens of *Inoceramus anglicus* have not been found below the *Gastroplites kingi* zone. Whether the abrupt appearance of *I. anglicus* in abundance in this zone is of time significance, or is ecological, will have to be determined by future fieldwork.

UNNAMED ZONE OF POSSIBLE LATE ALBIAN AGE

Between the Etivluk and Itkillik Rivers in the northern foothills, the Tuktu formation of middle Albian age is separated from the Ninuluk formation of Cenomanian age by 1,700 to 4,300 feet of marine and nonmarine rocks referred respectively to the Grandstand formation and to the Killik tongue of the Chandler formation. The thinnest sequence is in the type area of the Grandstand formation on the Anaktuvuk River and is mostly marine. The thickest sequence is about 120 miles to the west near the mouth of the Etivluk River and is mostly nonmarine. These sequences, regardless of notable differences in thickness, probably represent the same time interval, because the top of the Tuktu formation and the base of the Ninuluk formation appear to be essentially time planes (oral communication from R. L. Detterman, 1956). The duration of the time interval must include all of the late Albian, as the field geologists insist that both the Tuktu and Ninuluk formation are conformable with the intervening lithologic units.

The age of the Grandstand formation and of the Killik tongue of the Chandler formation in areas where they overlie the Tuktu formation is based on the fossils shown in the following table:

TABLE 3.—*Stratigraphic positions of fossils from the Grandstand formation and equivalent beds between the Tuktu and Ninuluk formation*

Name of fossils	USGS Mesozoic locality	Relative position in Grandstand formation or equivalent beds	Position, in feet, above top of Tuktu formation	Position, in feet, below base of Ninuluk formation
Echinoid spine	24638	Lower	600	3, 700
Starfish	20473	Upper		≦200
Brittle star	24638	Lower	600	3, 700
Ditrupa cornu Imlay, n. sp	20477	do	100–200	1, 000–1, 050
Do	20435	do	100–200	1, 000–1, 050
Tancredia kurupana Imlay, n. sp	20478	do	200–300	900–950
Do	24638	do	600	3, 700
Arctica? sp	Various	Lower or upper		100–3, 700
Panope? *kissoumi* (McLearn)	24301	Upper		240
Do	20474	do		≦200
Do	20435	Lower	100–200	1, 000–1, 050
elongatissima (McLearn)	20399	do	750	3, 200
Thracia stelcki McLearn	12413	Upper		45– 50
Do	20477	Lower	100–200	900– 950
Inoceramus anglicus Woods	20399	do	750	3, 200
Do	20457	Upper		100–150
Entolium utukokense Imlay, n. sp	20478	Lower	200–300	900–950
Do	24298	Upper		540
Do	24638	Lower	600	3, 700
Do	25137	do	100–200	1, 000–1, 050
Do	20435	do	100–200	1, 000–1, 050
Cleoniceras? *whittingtoni* Imlay, n. sp	24638	do	600	3, 700
Xenohelix? borings	24638	do	600	3, 700

Judging from the data presented above, the formations in question are entirely of Albian age. The species they contain are identical with those in the Tuktu formation, are entirely distinct from those in the Ninuluk formation, and range through the greater part of the Grandstand formation; and some occur within 100 feet of the base of the overlying Ninuluk formation. One species in particular, *Inoceramus anglicus* Woods, found near the top of the Grandstand formation is characteristic of the middle and late Albian in England and has not been found in the Cenomanian. The fact that these species have persisted through 4,000 to 7,000 feet of strata and then are replaced abruptly by different species at the very base of the Ninuluk formation shows that some major event occurred at the end of the deposition of the Grandstand formation and that that formation belongs with the underlying Albian sequence. This conclusion is supported by a similar abrupt change in microfossil species (oral communications from Helen Tappan Loeblich and Harlan Bergquist, 1956) at the boundary of the Grandstand and Ninuluk formations.

There is no faunal evidence that any part of the Grandstand formation, or the equivalent nonmarine Killik tongue of the Chandler formation is younger than middle Albian, as the species are identical with those in the underlying Tuktu formation of definite middle Albian age. However, a late Albian age is not excluded because most of the megafossils are identical with species in the late Albian Shaftesbury and Sikanni formations in the western interior of Canada. A middle Albian age for the basal part of the Grandstand is suggested by the presence of the ammonite *Cleoniceras* (*Neosaynella*)? *whittingtoni* Imlay, n. sp. at Mesozoic locality 24638. A late Albian age for most of the Grandstand would be certain if the boundary with the Ninuluk formation is conformable, as maintained by field geologists. Their views receive support by comparisons with the sequences in British Columbia where the Dunvegan formation, which is lithologically and faunally nearly identical with the Ninuluk formation, grades downward through transitional beds into the Sikanni formation (Henderson, 1954, p. 2279; Webb, 1951, p. 2311). Their views are presented herein on plate 22 but the problem is by no means settled.

COMPARISONS WITH OTHER FAUNAS

The four species of *Aucella* present in northern Alaska in beds of Berriasian and Valanginian ages are found widely distributed throughout the Boreal region and along the west coast of North America as far south as British Columbia. One of the species, *A. crassicollis* Keyserling, is abundant farther south in Oregon and California. The absence of *Aucella okensis* Pavlow, *A. subokensis* Pavlow, and *A. sublaevis* Keyserling in those States is ascribed to erosion or nondeposition during the times those species lived, namely during the Berriasian and the early Valanginian.

The Albian fauna in northern Alaska includes many species that were described originally from northeastern British Columbia and northern Alberta. The same fauna is widespread in the Yukon basin of central Alaska, but includes some genera, such as *Trigonia*, not found in northern Alaska. Probably some of the pelecypod species will be found in Albian beds in Montana and Wyoming when the fossils of the Mowry and Aspen shales are described. The fauna in northern Alaska has almost nothing in common with the described Albian fauna of California and Oregon (Anderson, 1938), which extends northward through the Queen Charlotte Islands into the Chitina Valley of Alaska.

The Albian fauna from northern Alaska and the western interior of Canada is much richer in genera and species than any yet reported from other areas bordering the Arctic Ocean. Similar species of the ammonite *Puzosia?* and the pelecypods *Entolium* and *Aucellina* are known from Albian beds in Greenland (Donovan, 1953, p. 36). *Aucellina* occurs in Albian beds in northern Russia (Pavlow, 1907, p. 85–90). A few comparable species of *Nucula* (*Pectinucula*), *Astarte*, *Dicranodonta*, and *Arctica* have been recorded from the lower part of the Yenisei River in northern Siberia (Schmidt, 1872, p. 22, 23, 148–152). *Inoceramus anglicus* Woods from East Greenland (Bøgvad and Rosenkrantz, 1934, p. 18) is the only species known to occur both in northern Alaska and in any of the other areas mentioned.

Albian faunas of richness comparable to those in northern Alaska exist considerably south of the Boreal region in England (Woods, 1899–1913), Holland, and Germany (Wollemann, 1907, 1912), but only the pelecypods are similar specifically. At least one species, *Inoceramus anglicus* Woods from England, is identical with the common *Inoceramus* in northern Alaska. Marked generic differences exist between the Albian ammonites of Alaska and those of England or Germany. The dominance of *Gastroplites* in Alaska contrasts with a single occurrence in England and none in Germany. *Cleoniceras* is an element common to both Alaska and northwest Europe, but most of the specimens from Alaska cannot be placed in the same subgenera of *Cleoniceras*. Only *C. tailleuri* Imlay, n. sp., is similar to the typical species of *Cleoniceras* from northwest Europe. Another faunal contrast consists of the scarcity of gastropods in northern Alaska. This may reflect local ecological conditions, because gastropods are common in the Albian beds on the Yenisei River in northern Siberia.

It seems probable that the dearth of descriptions of Albian faunas for most of the lands bordering the Arctic Ocean is due in part to the scarcity of well-preserved fossils and in part to difficult accessibility. The Albian fossils herein described could not have been obtained in fairly large quantities without ample logistic support from the U.S. Navy.

ECOLOGICAL CONSIDERATIONS

The Lower Cretaceous sedimentary rocks of northern Alaska were deposited in an eastward-trending trough inherited from earlier times and were derived from a rising landmass to the south in an area now occupied by the central and southern parts of the Brooks Range. Along the southern part of the trough was deposited about 3,000 feet of sediment of Berriasian to Valanginian age and at least 10,000 feet of sediment of Albian age. In the central part of the trough, the Oumalik test well penetrated nearly 11,000 feet of sedimentary rocks of Albian age that rest on an unknown thickness of sedimentary rocks of Valanginian age. Farther north on the Barrow Platform an incomplete sequence of Albian age from 1,600 to 3,000 feet thick overlies Jurassic beds. It seems unlikely that this sequence was ever nearly as thick as that farther south. These thicknesses, considering the time involved, show that sedimentation was very rapid.

In the beds of Berriasian to Valanginian age, the dominant fossils are Aucellas (table 7). Of the other fossils listed from these beds (see table 8), some were obtained from a sandstone at the base of the Okpikruak formation (Mes. locs. 24008, 24009) and may actually be of Jurassic age; some were obtained at the boundary between the Ignek formation and the Okpikruak formation (Mes. loc. 24031) and may be in part from the Ignek formation; one lytoceratid ammonite (Mes. loc. 22496) could be from the Torok formation; the fragmentary belemnites (Mes. locs. 22738, 22757, 24031) resemble Jurrassic rather than Cretaceous genera, and may have been derived from the Jurassic. One large *Phylloceras* (Mes. loc. 22594) contains many specimens of *Aucella okensis* Pavlow in the sandstone matrix of its whorls and evidently was dead when the Aucellas lived. It seems unlikely, however, that such a large thin-shelled ammonite could have been derived from Jurassic beds. More probably it lived during Berriasian time and drifted after death from the open sea into shallow water near shore.

The Aucellas in the Okpikruak formation probably lived in the shallower parts of the sea, or even partly in the littoral zone. The large species referred to *A. okensis* Pavlow and *A. subokensis* Pavlow are associated with fine to coarse-grained sandstones that are locally pebbly. *A. sublaevis* Keyserling occurs mostly in thin calcareous shell beds associated with clay shale and siltstone, but occurs also in fine-grained sandstone. *A. crassicollis* Keyserling occurs both in sandstone and in nodular calcareous lenses in a clay shale or siltstone matrix. Some specimens of *A. okensis* and *A. crassicollis* occurring in pebbly beds appear to be worn or fragmented as though they had been subjected to wave action.

Most sequences of the Okpikruak formation contain Aucellas at irregular intervals throughout. Other sequences that lithologically and stratigraphically belong in the Okpikrauk formation have not yielded any Aucellas. If it is assumed that the sequences are correctly identified, the absence of Aucellas implies that deposits of sediment locally were accumulating too rapidly, or that waters were too deep, or that other conditions were unfavorable for the existence of Aucellas.

Such conditions might exist if the sea of Okpikruak time invaded an area of moderate to strong relief, because the valleys would become the sites of bays having appreciably deeper waters and probably receiving more sediment than the nearby parts of the sea bordering the headlands. That the sea did invade an area of low to moderate relief is shown by the overlap of the Okpikruak formation within short distances onto beds ranging in age from latest Jurassic to Mississippian and perhaps Devonian; by the fact that locally different parts of the formation, as determined by fossils, rest on the pre-Cretaceous rocks; and by the fairly common occurrence of conglomerate and coarse-grained sandstone at the base of the formation regardless of which fossil zone is present at the base. Evidently the bordering land was sufficiently high to supply coarse sediment during the entire Okpikruak time.

The Albian sequence in northern Alaska, for purposes of discussing ecological conditions, may be divided stratigraphically into three parts. The lower part is of early Albian age and consists of the Oumalik formation, the lower two-thirds of the Torok formation, and at least the lower half of the Fortress Mountain formation. The middle part is of middle Albian age and comprises the upper third of the Torok formation, all of the Tuktu formation, and the various lithologic units that are correlated with these formations (pl. 22). The upper part is probably mostly of late Albian age, but its basal beds may be of middle Albian age. This part includes the Grandstand formation in the area between the Killik and Itkillik Rivers and the equivalent beds of the Chandler and Corwin formations.

The lower part, of early Albian age, comprises more than half the total thickness of the Albian beds. Its southernmost exposures, included in the Fortress Mountain formation, consist of thousands of feet of conglomerate, graywacke, siltstone, silty shale, and clay shale that formed very rapidly in a sea whose bottom was sinking at an equally rapid rate, considering that all the beds appear to be shallow marine. Its northernmost exposures, included in the lower two-thirds of the Torok formation, consist of from 4,000 to 6,000 feet of soft silt shale and clay shale. Still farther north in the subsurface, the lower Albian, represented by the Oumalik formation, consists mostly of 6,000 feet of clay shale but includes some siltstone and sandstone in its lower 1,610 feet.

Few megafossils have been found in the lower Albian beds (table 4). In the Fortress Mountain and Torok formations, the megafossils consist mostly of free-swimming organisms, such as ammonites, fish, and perhaps *Inoceramus*. The rarity of bottom-dwelling organisms, such as *Pleuromya*, *Panope*, and *Thracia*, shows that bottom conditions were generally unfavorable for their existence. The pelecypod *Aucellina* occurs in a few places in enormous numbers, forming thin shell units in a matrix of silty shale. Its larvae probably settled on hard bottoms that temporarily were not receiving sediment. In the Oumalik formation, megafossils appear to be slightly more common than in the Torok or Fortress Mountain formations. The free-swimming organisms found in well cores include fish and the pelecypods *Entolium* and *Lima*, and perhaps *Inoceramus*. Organisms that lived in clay or silt muds include the brachiopod *Lingula* and the pelecypods *Astarte*, *Flaventia*, *Pleuromya*, and *Thracia*.

TABLE 4.—*Number of fossil occurrences in the Lower Cretaceous (Albian) beds characterized by* Colvillia *and* Subarcthoplites

Fossils	Fortress Mountain formation	Torok formation, lower two-thirds	Oumalik formation (subsurface cores)
Brachiopods	----------	----------	2
Astarte	----------	----------	2
Flaventia?	----------	----------	1
Pleuromya	1	----------	2
Panope?	1	----------	----------
Thracia	1	----------	5
Aucellina	3	----------	----------
Isognomon?	----------	1	----------
Inoceramus	4	6	2
Lima?	----------	----------	1
Entolium	----------	----------	4
Placunopsis	1	----------	----------
Gastropods	----------	----------	2
Puzosia?	4	2	----------
Beudanticeras (Grantziceras)	1	1	----------
Colvillia	4	1	----------
Subarcthoplites	----------	5	----------
Cleoniceras	----------	1	----------
Fish remains	1	2	3

TABLE 5.—*Number of fossil occurrences in the Lower Cretaceous (middle Albian) zone of* Gastroplites kingi

Fossils	Kukpowruk formation of the Corwin-Utukok area	Kukpowruk formation of Meade-Kigalik-Awuna valleys	Tuktu formation	Topagoruk formation (subsurface cores)	Ignek formation, lower member	Torok formation, upper third
Jellyfish?	1	----------	----------	----------	----------	1
Crinoid remains	----------	1	2	3	----------	1
Starfish	3	----------	1	----------	----------	----------
Brittle stars	2	----------	3	----------	----------	----------
Chaetopod worms	3	3	23	6	4	2
Brachiopods	----------	----------	----------	1	3	----------
Nucula	----------	----------	1	1	----------	----------
Nuculana	----------	----------	----------	----------	1	----------
Yoldia	----------	----------	2	4	4	----------
Dicranodonta	----------	----------	10	----------	1	----------
"Unio"	1	----------	----------	----------	----------	----------
Astarte	----------	----------	6	1	8	----------
Tancredia	19	13	6	----------	----------	3
Lucina	----------	----------	2	----------	----------	----------
Arctica?	22	4	19	1	6	1
Veniella	----------	----------	1	----------	----------	----------
Flaventia?	2	1	1	----------	1	1
Solecurtus?	1	----------	5	1	----------	1
Cultellus?	1	----------	----------	----------	----------	----------
Pleuromya	----------	----------	5	2	----------	----------
Panope?	12	3	19	1	7	2
Homomya	----------	----------	3	----------	----------	----------
Goniomya	----------	----------	1	----------	2	----------
Thracia	2	1	11	5	3	----------
Psilomya sp.?	----------	----------	1	----------	----------	----------
Myopholas	----------	----------	----------	----------	1	----------
Oxytoma	5	1	1	----------	----------	2
Pinna	----------	----------	1	----------	----------	----------
Isognomon ?	2	----------	3	----------	1	----------
Inoceramus	----------	7	24	5	----------	2
Lima sp	----------	----------	----------	----------	----------	1
Camptonectes	5	----------	----------	----------	----------	----------
Entolium	14	5	17	4	5	----------
Eopecten sp	----------	----------	----------	----------	1	----------
Anomia	----------	----------	----------	1	1	----------
Placunopsis	----------	----------	2	----------	1	----------
Modiolus	----------	1	9	2	----------	----------
Gastropods	1	----------	5	1	5	1
Beudanticeras ?	----------	----------	----------	1	----------	----------
Gastroplites	1?	----------	7	2	----------	2
Paragastroplites	----------	1	5	----------	----------	1

TABLE 5.—*Number of fossil occurrences in the Lower Cretaceous (middle Albian) zone of* Gastroplites kingi—Continued

Fossils	Kokpowruk formation of the Corwin-Utukok area	Kukpowruk formation of Meade-Kigalik-Awuna valleys	Tuktu formation	Topagoruk formation (subsurface cores)	Ignek formation, lower member	Torok formation, upper third
Cleoniceras			2			
(*Neosaynella*)?		1	1?			1
(*Grycia*)			1	1		2
Pseudopulchellia			1			
Belemnites					2	
Xenohelix? borings			7			
Fish remains			1			
Reptile tooth						1

TABLE 6.—*Number of fossil occurrences in the Lower Cretaceous (Albian) beds above the* Gastroplites kingi *zone*

Fossils	Chandler and Corwin formations	Grandstand formation east of Etivluk River	Chandler formation (subsurface cores)	Grandstand formation (subsurface cores)
Crinoid remains				2
Starfish	1			
Brittle star		1		
Brachiopods			1	2
Chaetopod worms		2		4
Nucula (*Pectinucula*)				1
Yoldia				3
"*Unio*"	3			
Corbula?				6
Tancredia	2	4		
Arctica?	1	7	1	5
Veniella				1
Flaventia?		1		
Solecurtus?				1
Panope?	2	6		
Thracia		2		2
Psilomya?	1			2
Oxytoma	1			
Inoceramus		3		
Entolium	1	6		6
Anomia?				1
Placunopsis				1
Gastropods				4
Beudanticeras?				1
Cleoniceras (*Neosaynella*)?		1		
Xenohelix? borings		1		
Fish remains			1	1

The scarcity of megafossils in the lower Albian formations under consideration is probably related mainly to exceedingly rapid accumulation of sediments. Perhaps some of the scarcity may be ascribed to poor exposures and to difficult accessibility of the outcrops of formations. All the formations, however, have furnished a meager microfauna (Robinson, Rucker, and Bergquist, 1956, p. 226), which indicates that the scarcity of megafossils is not due primarily to lack of diligent searching.

The middle Albian beds, characterized by the ammonite *Gastroplites*, are about 3,000 feet or less in thickness and grade upward from slightly sandy clay shale and silt shale to fine-grained sandstone that contains interbeds of siltstone and silt shale and are locally pebbly. These beds contain a large megafauna (table 5) and an abundant microfauna (Robinson, Rucker, and Bergquist, 1956, p. 230). Both faunas are least abundant near the base of the division and become more abundant and varied toward the top as sandiness increases. The megafauna includes a host of pelecypods that lived in muddy to sandy bottoms along with numerous chaetopod worms, brittle stars, and some unknown organism that made corkscrewlike borings. Pelecypods that were attached to the bottom include *Oxytoma*, *Isognomon*, *Anomia*, *Placunopsis*, and *Modiolus*. Free-swimming organisms include reptiles, fish, ammonites, belemnites, pectens, jellyfish?, crinoids, and perhaps *Inoceramus*. Starfish were present. Gastropods were small and uncommon.

This megafauna of middle Albian age varies considerably in composition from place to place in northern Alaska, as shown in table 5, which records the relative frequency of genera and larger organic units by formations. The greater number of fossil occurrences in the Tuktu formation than in the other formations reflects better exposures, easier accessibility, and highly fossiliferous beds. The Tuktu is probably more fossiliferous than the other formations, but not as much as the number of occurrences would suggest. For convenience in judging faunal differences the formations are arranged from west to east with the exception of the Torok, which underlies the first three formations listed, and the Topagoruk formation, which is the subsurface equivalent of the others and lies north of them.

The formations of middle Albian age in northern Alaska were all deposited in shallow water, as indicated by the frequent occurrence of chaetopod worms, of myas, of razor clams, and of the genera *Thracia* and *Entolium*. Otherwise there are differences that can be explained most easily if the sea deepened slightly eastward and northward from the site of deposition of the Kukpowruk formation.

The Kukpowruk formation west of the Utukok River, is distinguished faunally from the other formations by the presence of "*Unio*" and *Camptonectes*, an abundance of *Tancredia*, a rarity of ammonites, and the absence of the pelecypods *Nucula*, *Nuculana*, *Yol-*

dia, *Astarte*, *Inoceramus*, and *Modiolus*. The presence of "*Unio*" shows that part of the formation is of fresh water origin. The absence of such pelecypod genera as *Inoceramus* and *Modiolus* indicates that the waters must have been either very shallow or perhaps brackish toward the west during middle Albian time.

The Kukpowruk formation of the Meade-Kigalik-Awuna valleys has a faunule similar to that of the Kukpowruk formation farther west, but lacks "*Unio*" and *Camptonectes; Tancredia* is a little less common; *Inoceramus* is very common; and *Modiolus* is present. The presence of the last two genera suggests deposition in deeper water than the Kukpowruk formation of the Corwin-Utukok area.

The Tuktu formation, lying east of the Kukpowruk formation just discussed, differs from it by the presence of *Nucula*, *Yoldia*, and *Astarte*, by *Tancredia* being less common, and by having many occurrences of *Inoceramus*, *Modiolus*, and ammonities. Its upper few hundred feet are characterized locally by peculiar corkscrewlike borings. The faunule as a whole appears to be typical of the shallow part of the neritic zone.

The Ignek formation, lying east of the Tuktu formation, contains a faunule in its lower 400 feet very similar to that in the Tuktu. It differs by containing brachiopods, the pelecypod *Nuculana*, and belemnites. It has not furnished such genera as *Nucula*, *Tancredia*, *Solecurtus*, *Oxytoma*, *Modiolus*, or any ammonites, but their apparent absence may be explained by the fact that the Ignek formation is relatively inaccessible as compared with the Tuktu formation and has not been searched nearly as intensively for fossils.

The megafaunule in the Topagoruk formation, as obtained from well cores, is likewise similar to that in the Tuktu formation except for a lack of the genera *Astarte*, *Tancredia*, and *Oxytoma*. However, both *Tancredia* and *Oxytoma* occur typically in thin sandstones, and are more common in the Kukpowruk formation than in any other Lower Cretaceous formation in northern Alaska. The absence of these genera from the Topagoruk formation may be related, therefore, to lack of hard substrata on the sea bottom during deposition of that formation, or to too great a depth of water. One indication that the Topagoruk formation may have been deposited in deeper water than the equivalent outcropping formations is the frequent occurrence of crinoid remains in well cuttings and cores from the Topagoruk formation.

The highest Albian beds in northern Alaska, above the range of *Gastroplites*, comprise on the outcrop the nonmarine Killik tongue of the Chandler formation and the marine Grandstand formation in areas where it overlies the Tuktu formation. The Grandstand formation in the Chandler River area is replaced gradually southward and westward by the nonmarine Killik tongue. In the area between the Killik and Itkillik rivers the Grandstand formation is replaced southeastward by the Killik tongue. Combined thicknesses range from 1,700 feet in a sequence that is dominantly marine to 4,360 in a sequence that is dominantly nonmarine, such as near the Etivluk River. In the subsurface the Grandstand formation ranges from 130 to more than 2,800 feet, and the overlying Chandler formation ranges from 280 to nearly 2,000 feet. The outcrops of the Grandstand formation differ from the underlying Tuktu formation mainly by having beds of white quartz sandstone and some coal. In the subsurface the sandy character of the Grandstand formation contrasts with the shaly character of the underlying Topagoruk formation.

The megafaunule obtained from the outcrops of the highest Albian beds is meager (tables 6, 12). Field men report that exposures are rather poor and fossils are uncommon. The fossils that are present belong to the same species as in the Tuktu formation, but the rarity of ammonites and the intercalation of marine and nonmarine beds indicate deposition in shallower waters than those in which the Tuktu formation was deposited.

In contrast, a much more varied faunule has been obtained from the subsurface Grandstand formation. Its composition is similar to that in the Tuktu formation except for the absence of *Tancredia*, *Panope?*, and *Inoceramus*. Most probably the subsurface Grandstand formation was deposited in deeper water than the surface Grandstand formation but in shallower water than the underlying Topagoruk formation.

The Albian megafossils from northern Alaska probably all lived in the neritic zone, and many of them lived in its shallowest part. The cephalopods, in part, belong to genera that lived in the northwest Europe and, in part, appear to be boreal. Some of them are identical with species that lived in the shallow seas that covered the western interior of Canada and the Yukon area of Alaska. The gastropods are an insignificant part of the fauna; their scarcity and small size, coupled with the complete absence of oysters, indicates that the sea waters were not warm. The pelecypods belong to genera that were common in the shallow seas of northwest Europe during Albian time. In general, the composition of the fauna living in, or on, the bottom of the Albian sea in northern Alaska is not greatly different than that living today in the shallow sea bottoms of temperate latitudes. Some of the generic names are different, but many of the families are represented. That the sea water was temperate rather than cold is indicated by an abundance of burrowing pelecypods and of pectens (Nicol, 1955, p. 122).

GEOGRAPHIC DISTRIBUTION

The occurrence by area and locality of the species described in this report is indicated in tables 7 to 14. The general position of each locality is shown in figure 1. Detailed descriptions of the individual localities are given in the following table.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
1	13716	26AS19	W. R. Smith, 1926. Kivalina River; exact location unknown. Okpikruak formation. Valanginian.
2	24485	49ASa138	E. G. Sable, 1949. Kukpowruk River. Lat 69°24′30″ N., long 162°37′30″ W. Shale, siltstone and sandstone. Kukpowruk formation, about 2,500 feet above base. Albian.
3	24469	49ACh115	R. M. Chapman, 1949. Kukpowruk River. Lat 69°17′40″ N., long 162°37′ W. Siltstone. Kukpowruk formation, about 800 feet above base. Albian.
3	24470	49ACh117	R. M. Chapman, 1949. Kukpowruk River. Lat 69°17′40″ N., long 162° 36′30″ W. Siltstone and shale. Kukpowruk formation, about 1,800 feet above base. Albian.
3	24471	49ACh120	R. M. Chapman, 1949. Kukpowruk River. Lat 69°17′40″ N., long 162° 36′45″ W. Siltstone. Kukpowruk formation, about 2,100 feet above base. Albian.
3	24484	49ASa121	E. G. Sable, 1949. Kukpowruk River. Lat 69°17′45″ N., long 162°37′20″ W. Shale, siltstone and sandstone. Kukpowruk formation, about 2,300 feet above base. Albian.
4	12178	23AF100, 23AF101	Wm. T. Foran, 1923. Kukpowruk River, cut banks 43 miles above mouth. Approximate lat 69°15′ N., long 162°42′ W. Kukpowruk formation. Albian.
4	24483	49ASa110	E. G. Sable, 1949. Kukpowruk River. Lat 69°15′05″ N., long 162°44′ W. Shale, siltstone, and sandstone. Kukpowruk formation, about 2,500 feet above base. Albian.
5	24466	49ACh99	R. M. Chapman, 1949. Kukpowruk River. Lat 69°14′ N., long 162°39′ W. Siltstone. Kukpowruk formation, about 3,340 feet above base. Albian.
5	24467	49ACh102	R. M. Chapman, 1949. Kukpowruk River. Lat 69°14′20″ N., long 162°39′30″ W. Sandstone and siltstone. Kukpowruk formation, about 2,800 feet above base. Albian.
5	24468	49ACh108	R. M. Chapman, 1949. Kukpowruk River. Lat 69°15′15″ N., long 162°43′ W. Siltstone and shale. Kukpowruk formation, about 1,100 feet above base. Albian.
6	24465	49ACh87	R. M. Chapman, 1949. Kukpowruk River. Lat 69°09′45″ N., long 162°41′30″ W. Siltstone. Kukpowruk formation, 3,350 feet above base. Albian.
6	24481	49ASa88	E. G. Sable, 1949. Kukpowruk River. Lat 69°09′ N., long 162°41′30″ W. Shale, siltstone and sandstone. Kukpowruk formation, about 3,900 feet above base. Albian.
6	24482	49ASa96	E. G. Sable, 1949. Kukpowruk River. Lat 69°11′ N., long 162°42′ W. Shale, siltstone and sandstone. Kukpowruk formation, about 3,400 feet above base. Albian.
7	24464	49ACh71	R. M. Chapman, 1949. Kukpowruk River. Lat 69°01′ N., long 162°54′ W. Siltstone. Kukpowruk formation, 1,050 feet above base. Albian.
7	24480	49ASa73	E. G. Sable, 1949. Kukpowruk River. Lat 68°59′30″ N., long 162°55′ W. Shale, siltstone, and sandstone. Kukpowruk formation, about 2,900 feet above base. Albian.
8	24478	49ASa71	E. G. Sable, 1949. Kukpowruk River. Lat 68°59′30″ N., long 162°56′20″ W. Shale, siltstone, and sandstone. Kukpowruk formation, about 2,740 feet above base. Albian.
8	24479	49ASa72	E. G. Sable, 1949. Kukpowruk River. Lat 68°59′20″ N., long 163°00′30″ W. Kukpowruk formation, about 2,600 feet above base. Albian.
9	24476	49ASa60	E. G. Sable, 1949. Kukpowruk River. Lat 68°54′20″ N., long 163°06′ W. Shale, siltstone, and sandstone. Kukpowruk formation, about 3,180 feet above base. Albian.
9	24477	49ASa65	E. G. Sable, 1949. Kukpowruk River. Lat 68°55′ N., long 163°04′ W. Torok formation, upper 300 feet.
10	24461	49ACh54	R. M. Chapman, 1949. Kukpowruk River. Lat 68°54′15″ N., long 163°03′ W. Very fine grained sandstone. Kukpowruk formation, 1,770 feet above base. Albian.
10	24462	49ACh61	R. M. Chapman, 1949. Kukpowruk River. Lat 68°55′40″ N., long 163°00′30″ W. Siltstone. Kukpowruk formation, about 700 feet above base. Albian.
10	24463	49ACh62	R. M. Chapman, 1949. Kukpowruk River. Lat 68°54′30″ N., long 163°01′ W. Siltstone. Torok formation, probably in upper 1,000 feet. Albian.
11	13717	26AS37	W. R. Smith, 1926. Igloo Mountain near Kukpowruk River. Approximate lat 68°46′00″ N., long 162°50′ W. Upper part of Torok formation or Kukpowruk formation. Albian.
11	23698	49ACh36	R. M. Chapman, 1949. Six miles southwest of Igloo Mountain near Kukpowruk River. Lat 68°43′40″ N., long 163°07′30″ W. Shale and sandstone. Okpikruak formation.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
12	22128	49ASa46	E. G. Sable, 1949. Westernmost bend of Kukpowruk River southwest of Igloo Mountain. Lat 68°44′ N., long 163°02′ W. Sandstone, shale, and coquinoid siltstone. Okpikruak formation. Valanginian.
13	13730	26AS66	P. S. Smith, 1926. Kokolik River. Approximate lat 69°15′ N., long 161°45′ W. Kukpowruk formation. Albian.
14	13729	26AS61	P. S. Smith, 1926. Kokolik River. Approximate lat 69°10′ N., long 162°00′ W. Probably in Kukpowruk formation, rather than upper part of Torok formation. Albian.
15	13728	26AS60	P. S. Smith, 1926. Kokolik River. Approximate lat 69°09′ N., long 162°08′ W. Probably in Kukpowruk formation. Albian.
16	24473	49ACh176	R. M. Chapman, 1949. Kokolik River. Lat 69°00′20″ N., long 161°53′ W. Siltstone and shale. Kukpowruk formation, 1,080 feet above base. Albian.
16	24474	49ACh177	R. M. Chapman, 1949. Kokolik River, Lat 69°00′30″ N., long 161°50′30″ W. Siltstone and shale. Kukpowruk formation, 1,000 feet above base. Albian.
16	24475	49ACh182	R. M. Chapman, 1949. Kokolik River. Lat 69°00′31″ N., long 161°56′ W. Siltstone. Torok formation, about 400 feet below top. Albian.
16	24488	49ASa187	E. G. Sable, 1949. Kokolik River. Lat 68°59′45″ N., long 161°53′45″ W. Shale, siltstone, and sandstone. Kukpowruk formation, 1,930 feet above base. Albian.
17	24472	49ACh153	R. M. Chapman, 1949. Kokolik River, near top of Poko Mountain. Lat 68° 50′10″ N., long 162°20′ W. Siltstone and claystone. Kukpowruk formation, about 1,500 feet above base. Albian.
18	13720	26AS45	P. S. Smith, 1926. Kokolik River. Approximate lat 68°53′ N., long 161°58′ W. Kukpowruk formation, possibly middle or upper part. Albian.
18	13721	26AS48	P. S. Smith, 1926. Kokolik River, south limb of Tupikchak Basin. Approximate lat 68°53′00″ N., long 161°59′ W. Kukpowruk formation, possibly lower part. Albian.
18	13722	26AS49	P. S. Smith, 1926. Kokolik River. Approximate lat 68°56′N., long 161°55′ W. Kukpowruk formation, possibly in upper part. Albian.
18	24486	49ASa165	E. G. Sable, 1949. Kokolik River. Lat 68°52′30″ N., long 161°59″ W. Shale siltstone, and sandstone. Kukpowruk formation, 80 feet above base. Albian.
18	24487	49ASa165a	E. G. Sable, 1949. Kokolik River. Lat 68°52′30″ N., long 161°59″ W. Float from Kukpowruk formation, at or within 80 feet of base. Albian.
19	22481	50ASa52A	E. G. Sable, 1950. High ridge north of main Iligluruk Creek. Lat 68°41′22″ N., long 161°31′15″ W. Coquinoid limestone interbedded with siltstone and sandstone. Okpikruak formation. Valanginian.
19	22497	50AMg79	M. D. Mangus, 1950. Lat 68°41′10″ N., long 161°31′15″ W. Quartzitic shale. Okpikruak formation. Valanginian.
20	22485	50ASa117	E. G. Sable, 1950. High ridge north of Iligluruk Creek. Lat 68°41′07″ N., long 161°29′46″ W. Coquinoid limestone and interbedded quartzitic siltstone and shale. Okpikruak formation. Valanginian.
21	22496	50AMg69	M. D. Mangus, 1950. Lat 68°40′30″ N., long 161°14′25″ W. Probably upper part of Okpikruak formation, but possibly from Torok formation.
22	22500	50AMg224	M. D. Mangus, 1950. Lat 68°30′15″ N., long 161°40′ W. Graywacke. Okpikruak formation, lower part. Valanginian.
23	13309	25ASmF5	W. R. Smith, 1925. Four miles downstream from head of Utukok River Pass. Exact location unknown. Okpikruak formation. Probably Berriasian.
23	22490	50ASa251	E. G. Sable, 1950. North side of east flowing tributary at headwaters of Utukok River. Lat 68°34′10″ N., long 161°04′30″ W. Okpikruak formation, about 75 to 100 feet above base. Valanginian.
23	22491	50ASa249	E. G. Sable, 1950. Two miles west of Utukok River. Lat 68°34′21″ N., long 161°07′15″ W. Sandstone, conglomerate, and shale. Okpikruak formation. Valanginian.
23	22492	50ASa262	E. G. Sable, 1950. West side of Utukok River. Lat 68°34′20″ N., long 161°-03′40″ W. Sandstone, conglomerate, and siltstone. Okpikruak formation. Berriasian.
24	22482	50ASa92	E. G. Sable. Headwaters of west fork of Iligluruk Creek. Lat 68°31′30″ N., long 161°38′ W. Sandstone and siltstone. Okpikruak formation, lower 500 feet. Valanginian.
24	22483	50ASa97	E. G. Sable, 1950. West fork of Iligluruk Creek, south of drainage divide. Lat 68°32′29″ N., long 161°36′30″ W. Sandstone, siltstone, and shale. Okpikruak formation, probably middle or upper part. Valanginian.
24	22484	50ASa103	E. G. Sable, 1950. Near head of Iligluruk Creek on the south drainage. Lat 68°30′52″ N., long 161°36′25″ W. Dark-grayish-green siltstone and shale. Okpikruak formation, basal part. Valanginian.
25	22486	50ASa135	E. G. Sable, 1950. Headwaters of the west fork of Iligluruk Creek. Lat 68°-33′50″ N., long 161°19′ W. Fine-grained sandstone. Okpikruak formation, basal part (possibly a fault contact with Jurassic). Probably Valanginian.
25	22488	50ASa247	E. G. Sable, 1950. Ridge at head of east fork of Iligluruk Creek. Lat 68°33′07″ N., long 161°13′45″ W. Conglomerate and conglomeratic sandstone. Okpikruak formation, middle or upper part. Valanginian.
25	22489	50ASa251	E. G. Sable, 1950. Upper Utukok River drainage. Lat. 68°34′07″ N., long. 161°17′ W. Okpikruak formation. Valanginian.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
26	22487	50ASa135A	E. G. Sable, 1950. Headwaters of west fork of Iligluruk Creek. Lat. 68°33′50″ N., long 161°19′ W. Sandstone. Okpikruak formation, lower 50 feet. Probably Valanginian.
26	22493	50ASa267	E. G. Sable, 1950. South side of the west fork of the Utukok River. Lat 68°32′03″ N., long 161°07′45″ W. Dark-gray silty shale, siltstone, and conglomerate. Okpikruak formation, basal part. Valanginian.
27	22498	50AMg187	M. D. Mangus, 1950. Lat 68°37′40″ N., long 160°59′10″ W. Okpikruak formation, upper part. Valanginian.
27	22499	50AMg193	M. D. Mangus, 1950. Lat 68°32′15″ N., long 161°05′ W. Graywacke. Okpikruak formation, lower part. Berriasian.
28	22474	50ADu191	J. T. Dutro, Jr., 1950. Kugururok Valley, De Long Mountains. Lat 68°25′45″ N., long 161°14′25″ W. Okpikruak formation, lower part. Valanginian.
28	22475	50ADu199	J. T. Dutro, Jr. and A. H. Lachenbruch, 1950. Kugururok Valley, De Long Mountains. Lat 68°26′ N., long 161°15′ W. Okpikruak formation Valanginian.
28	22476	50ADu206	J. T. Dutro, Jr., 1950. Kugururok Valley, north of the main fork on Rock Creek. Lat 68°27′05″ N., long 161°15′45″ W. Okpikruak formation, probably upper part. Valanginian.
28	22478	50ALa179	A. H. Lachenbruch, 1950. Kugururok Valley. Lat 68°26′ N., long 161°18′ W. Okpikruak formation, lower part. Berriasian.
29	22477	50ALz145	M. C. Lachenbruch, 1950. Kugururok Valley. Lat 68°25′55″ N., long 161°08′ W. Okpikruak formation, probably upper part. Valanginian.
30	22479	50ADu265	J. T. Dutro, Jr., 1950. Kugururok Valley. Lat 68°18′50″ N., long 161°32′30″ W. Conglomerate. Okpikruak formation. Probably Berriasian.
31	22781	51ASa106	E. G. Sable, 1951. Hill three-fourths of a mile southeast of west-central fork of Driftwood Creek. Lat 68°36′45″ N., long 160°43′ W. Shale containing limestone lenses. Okpikruak formation, probably upper part. Valanginian.
31	22783	51ASa131	E. G. Sable, 1951. Hills 2,000 feet northeast of west-central fork of Driftwood Creek. Lat 68°34′50″ N., long 160°31′30″ W. Shale containing limestone lenses. Okpikruak formation. Valanginian.
31	22784	51ASa137	E. G. Sable, 1951. Large cutbank near the head of westernmost fork of Driftwood Creek. Lat 68°34′25″ N., long 160°30′ W. Okpikruak formation. Valanginian.
32	22734	51AMo105	R. H. Morris, 1951. Crest of ridge three-fourths of a mile west of west-central fork of Driftwood Creek. Lat 68°36′ N., long 160°38′ W. Okpikruak formation, middle part. Valanginian.
33	23565	51ADu85	J. T. Dutro, Jr., 1951, Driftwood Creek, one-fourth of a mile east of west-central fork. Lat 68°36′30″ N., long 160°35′45″ W. Okpikruak formation, probably basal part. Berriasian. L
33	22778	51ASa65	E. G. Sable, 1951. Two miles east of east-central fork of Driftwood Creek. Lat 68°36′20″ N., long 160°28′10″ W. Shale containing limestone lenses. Okpikruak formation, probably middle part. Valanginian.
33	22779	51ASa74	E. G. Sable, 1951. Hills one-half of a mile east of east-central fork of Driftwood Creek. Lat 68°37′40″ N., long 160°32′20″ W. Shale containing limestone lenses. Okpikruak formation, probably near base. Valanginian.
33	22780	51ASa75	E. G. Sable, 1951. Hills three-fourths of a mile east of east-central fork of Driftwood Creek. Lat 68°37′15″ N., long 160°31′25″ W. Okpikruak formation, probably lower part. Valanginian.
33	22782	51ASa120	E. G. Sable, 1951. One-half of a mile east of east-central fork of Driftwood Creek. Lat 68°37′10″ N., long 160°32′ W. Sandstone and shale containing limestone lenses. Okpikruak formation, lower 150 feet. Valanginian.
34	22501	50AMg242	M. D. Mangus, 1950. Lat 68°46′30″ N., long 160°41′ W. Shale. Okpikruak formation, probably upper part. Valanginian.
34	22772	51ASa7	E. G. Sable, 1951. East side of Driftwood Creek. Lat 68°46′30″ N., long 160°41′ W. Same as loc. 22501. Okpikruak formation, upper part. Valanginian.
34	22773	51ASa9	E. G. Sable, 1951. East side of Driftwood Creek. Lat 68°46′30″ N., long 160°41′ W. Coquinoid limestone Okpikruak formation, nearly same position as loc. 22772. Valanginian.
34	22774	51ASa10	E. G. Sable, 1951. East side of Driftwood Creek. Lat 68°46′30″ N., long 160°41′ W. Coquinoid limestone. Okpikruak formation, about same position as loc. 22772. Valanginian.
34	22775	51ASa12	E. G. Sable, 1951. East side of Driftwood Creek. Lat 68°46′30″ N., long 160°41′ W. Coquinoid limestone. Okpikruak formation, about same position as loc. 22772. Valanginian.
35	22494	50ASa300	E. G. Sable, 1950. Hills east of Driftwood Creek. Lat 68°47′10″ N., long. 160°36′30″ W. Coquinoid limestone lenses interbedded with sandstone, siltstone, and shale. Probably Okpikruak formation.
36	23558	51ASa299	E. G. Sable, 1951. West side of Colville River. Lat 68°52′ N., long, 160°20′ W. Siltstone, sandstone, and shale interbedded. Fortress Mountain formation. Albian.
37	23566	51ADu127	J. T. Dutro, Jr., 1951. Two miles west of Storm Creek. Lat 68°44′30″ N., long 160°13′30″ W. Okpikruak formation. Valanginian.
38	22785	51ASa218	E. G. Sable, 1951. Low hills 2½ miles east of Storm Creek. Lat 68°44′ N., long 160°02′ W. Shale containing limestone lenses and coquinoid sandstone. Okpikruak formation, probably upper part. Valanginian.

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39	22777	51ASa64	E. G. Sable, 1951. One-half of a mile west of easternmost fork of Driftwood Creek. Lat 68°38′ N., long 160°25′15″ W. Shale containing limestone lenses. Okpikruak formation. Valanginian.
40	22724	51AMo24	R. H. Morris, 1951. Ridge one quarter of a mile west of lakes at the base of Thunder Mountain. Lat 68°40′ N., long 160°20′ W. Sandstone lenses in shale. Okpikruak formation, middle part. Berriasian.
40	22725	51AMo41	R. H. Morris, 1951. Two miles southwest of Thunder Mountain. Lat 68°38′ N., long 160°22′ W. Limestone and sandstone lenses in shale. Okpikruak formation, middle part. Valanginian.
40	22726	51AMo42	R. H. Morris, 1951. Crest of mountain, 3 miles southwest of Thunder Mountain. Lat 68°38′ N., long 160°20′ W. Fossils from talus of coarse sandstone. Okpikruak formation, upper part. Berriasian.
40	22727	51AMo47	R. H. Morris, 1951. Small ridge one quarter of a mile west of Storm Creek. Lat 68°39′ N., long 160°17′ W. Okpikruak formation. Probably Berriasian.
40	22728	51AMo67	R. H. Morris, 1951. Ridge above Creek 1½ miles southwest of Thunder Mountain. Lat 68°39′30″ N., long 160°21′ W. Okpikruak formation, upper part. Berriasian.
40	22729	51AMo68	R. H. Morris, 1951. Ridge 1 mile south of Thunder Mountain. Lat 68°39′30″ N., long 160°20′ W. Okpikruak formation. Berriasian.
40	22730	51AMo69	R. H. Morris, 1951. Ridge 1 mile south of Thunder Mountain. Lat 68°39′30″ N., long 160°19′ W. Sandstone. Okpikruak formation, upper part. Berriasian.
40	22731	51AMo70	R. H. Morris, 1951. Creek cut in Valley. One-half of a mile south of Thunder Mountain. Lat 68°39′30″ N., long 160°19′ W. Shale containing limestone nodules. Okpikruak formation, near middle. Valanginian.
40	22732	51AMo72	R. H. Morris, 1951. Float in creek cut in valley one-half of a mile south of Thunder Mountain. Lat 68°39′30″ N., long 160°19′ W. Okpikruak formation, middle part. Berriasian.
40	23564	51ADu50	J. T. Dutro, Jr., 1951. South side of Thunder Mountain. Lat 68°40′00″ N., long 160°20′ W. Sandstone and shale containing limestone lenses. Okpikruak formation, lower part. Berriasian.
41	22786	51ASa227	E. G. Sable, 1951. Hill, 300 feet north of Nuka River. Lat 68°42′10″ N., long 160°00′30″ W. Shale and silty limestone. Okpikruak formation, probably near base. Berriasian.
41	22789	51ASa252	E. G. Sable, 1951. South bank of the Nuka River. Lat 68°42′45″ N., long 159°59′ W. Interbedded sandstone, siltstone, and silty claystone. Okpikruak formation, 25 feet above base. Berriasian.
41	22790	51ASa255	E. G. Sable, 1951. North bank of the Nuka River. Lat 68°42′ N., long 160°00′45″ W. Interbedded sandstone, siltstone, and silty claystone. Okpikruak formation, 25 feet above base. Berriasian.
41	22791	51ASa256	E. G. Sable, 1951. Creek junction 500 feet west of Mes. loc. 22790. Coquinoid limestone interbedded with shale. Okpikruak formation about 100 feet above base. Berriasian.
41	22792	51ASa 261	E. G. Sable, 1951. North bank of Nuka River. Lat 68°41′30″ N., long 160°02′10″ W. Siltstone, claystone, and limestone lenses. Okpikruak formation, 35 feet above base. Berriasian.
41	22793	51ASa262	E. G. Sable, 1951. North bank of Nuka River, in large cutbank 500 feet west of Mes. loc. 23558. Lat 68°52′ N., long 160°20′ W. Shale containing limestone concretions. Aggregate fossil collection from several hundred feet of section. Okpikruak formation. Valanginian.
41	22794	51ASa267	E. G. Sable, 1951. Tributary Creek south of Nuka River. Lat 68°42′ 30″ N., long 159°58′30″ W. Sandstone and shale containing limestone lenses. Okpikruak formation, within 15 feet of base. Probably Berriasian.
41	22795	51ASa270	E. G. Sable, 1951. Same location as Mes. loc. 22794. Okpikruak formation. Berriasian.
41	23559	51ASa1043	E. G. Sable, 1951. South bank of Nuka River. Lat 68°42′10″ N., long 160°00′30″ W. Coarse-grained sandstone. Okpikruak formation, probably near base. Berriasian.
41	23560	51ASa1045	E. G. Sable, 1951. North bank of Nuka River. Lat 68°41′30″ N., long 160°02′15″ W. Sandstone and shale containing limestone lenses. Okpikruak formation. Valanginian.
42	22736	51AMo156	R. H. Morris, 1951. East bank of Nuka River. Lat 68°41′ N., long 160°08′ W. Limestone and sandstone lenses in shale. Okpikruak formation, lower part. Valanginian.
42	22737	51AMo157	R. H. Morris, 1951. East bank of Nuka River. Lat 68°41′ N., long 160°08′ W. Shale containing limestone and sandstone lenses. Okpikrauk formation, lower part. Valanginian.
42	22787	51ASa232	E. G. Sable, 1951. Creek, one-quarter of a mile north of Nuka River. lat 68°40′ N., long 160°07′30″ W. Shale and silty limestone. Okpikrauk formation, lower 200 feet. Valanginian.
42	22788	51ASa233	E. G. Sable, 1951. Hill, 1,000 feet north of Mes. loc. 22787. Shale and silty limestone. Okpikrauk formation, several hundred feet above base. Valanginian.

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42	23553	51ASa285	E. G. Sable, 1951. North bank of Nuka River. Lat 68°40′15″ N., long 160°06′20″ W. Shale containing limestone lenses. Okpikruak formation, lower 200 feet. Valanginian.
42	23554	51ASa287	E. G. Sable, 1951. North bank of Nuka River. Lat 68°40′30″ N., long 160°05′20″ W. Shale containing limestone lenses. Okpikruak formation, about 300 feet above base. Valanginian.
42	23555	51ASa289	E. G. Sable, 1951. North bank of Nuka River. Lat 68°40′45″N., long 160°05′ W. Sandstone and shale containing limestone lenses. Okpikruak formation, about 300 feet higher stratigraphically than Mes. loc. 23556. Berriasian.
42	23556	51ASa290	E. G. Sable, 1951. Cutbank on the north side of Nuka River about 1,000 feet north of Mes. loc. 23555. Coquinoid limestone and shale. Okpikruak formation. Berriasian.
42	23557	51ASa291	E. G. Sable, 1951. Same location as Mes. loc. 23556, but 3 feet lower in section. Okpikruak formation. Berriasian.
42	23567	51ADu131	J. T. Dutro, Jr., 1951. One and one-half miles west of Storm Creek. Lat 68°42′40″ N., long 160°13′ W. Clay shale containing limestone lenses. Okpikruak formation. Valanginian.
43	23551	51ASa279	E. G. Sable, 1951. Mountainside west of main divide between Nuka River and Nimiuktuk River. Lat 68°35′30″ N., long 160°15′ W. Sandstone and shale containing limestone lenses. Okpikruak formation. Valanginian.
44	22471	50ADu5	J. T. Dutro, Jr., 1950. West side of Nimiuktuk River. Lat 68°20′30″ N., long 159°57′ W. Okpikruak formation. Berriasian or Valanginian.
44	22472	50ALz6	M. C. Lachenbruch and A. H. Lachenbruch, 1950. North bank of Seagull Creek, Nimiuktuk Valley, DeLong Mountains. Lat 68°19′50″ N., long 159°59′ W. Okpikruak formation, lower part. Berriasian.
44	22473	50ALz13	M. C. Lachenbruch, 1950. Nimiuktuk Valley. Lat 68°21′ N., long 160°00′ W. Okpikruak formation, lower part. Berriasian or Valanginian.
45	22480	50ASa32	E. G. Sable, 1950. Tributary of Utukok River. Lat 68°53′24″ N., long 161°21′ W. Dark-gray calcareous siltstone interbedded with shale. Torok formation, upper part. Albian.
46	24451	47ATm5	R. M. Thompson, 1947. Northwest of Utukok River 1.2 miles. Lat 68°57′ N., long 161°14′ W. Sandstone. Kukpowruk formation, about 700 feet above base. Albian.
47	24452	47ATm9	R. M. Thompson, 1947. West of Utukok River about 4.9 miles. Lat 69°07′30″ N., long 161°03′45″ W. Sandstone. Kukpowruk formation, about 500 feet above base. Albian.
48	24455	47ATm10, Bed 29	R. M. Thompson, 1947. Utukok River, about 2 miles north of a south bend. Lat 69°08′15″ N., long 160°49′00″ W. Sandstone and claystone. Kukpowruk formation, 2,080 feet above base. Albian.
49	24453	47ATm10, Bed 10	R. M. Thompson, 1947. Southeast of Utukok River about 0.4 mile. Lat 69°07′ N., long 160°50′02″ W. Sandstone and siltstone. Kukpowruk formation, 380 feet above base. Albian.
49	24454	47ATm10, Bed 16	R. M. Thompson, 1947. Utukok River. Lat 69°07′10″ N., long 160°49′20″ W. Sandstone and claystone. Kukpowruk formation, 840 feet above base. Albian.
49	24460	47ABa52	W. L. Barksdale, 1947. Utukok River lat 69°07′ N., long 160°39′33″ W. Sandstone and claystone. Kukpowruk formation, 600 feet above base. Albian.
50	24459	47ABa34	W. L. Barksdale, 1947. About 7½ miles due east of Utukok River. Lat 69°02′05″ N., long 160°35′ W. Kukpowruk formation, about 400 feet above base. Albian.
51	24456	47ATm11	R. M. Thompson, 1947. East bank of the Utukok River. Lat 69°09′45″ N., long 160°33′30″ W. Sandstone and claystone. Kukpowruk formation, about 500 feet above base. Albian.
51	24457	47ATm12	R. M. Thompson, 1947. About four-tenths of a mile north of Mes. loc. 24456 from river gravels. Probably Kukpowruk formation. Albian.
52	24458	47ATm13, Bed 13	R. M. Thompson, 1947, near Utukok River. Lat 69°14′20″ N., long 160°35′45″ W. Sandstone. Kukpowruk formation, about 870 feet above base. Albian.
53	13310	25ASmF6	W. R. Smith, 1925. Two miles north of Colville River. Approximate lat 69°01′ N., long 160°00′ W. Probably in Kukpowruk formation, but possibly in upper part of Torok formation. Albian.
54	25809	50AWh10	C. L. Whittington, 1950. West bank of Utukok River, about 6¼ miles northwest of mouth of Carbon Creek. Lat 69°23′ N., long 159°59′ W. Rubble from 23 feet of sandstone. Kukpowruk formation, about 1,025 feet above base. Albian.
54	25810	50AWh9	C. L. Whittington, 1950. Same location as Mes. loc. 25809, but about 165 feet lower. Kukpowruk formation. Albian.
54	25918	53AB164	R. S. Bickel, 1953. Utukok River, west bank, about 6¼ miles northwest of mouth of Carbon Creek. Lat 69°23′20″ N., long 159°59′ W. Same location as Mes. locs. 25809 and 25810. Kukpowruk formation, 925 to 1,060 feet above base. Albian.

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55	25806	50ASv11	J. M. Stevens, 1950. West bank of creek, 300 feet north of Utukok River and 3¼ miles northwest of mouth of Carbon Creek. Lat 69°22′ N., long 159°52′ W. Sandstone and shale. Kukpowruk formation, about 1,000 feet above base. Albian.
56	25808	50AWh4	C. L. Whittington, 1950. West bank of east fork of Ketik River, about 16½ miles northeast of mouth of Carbon Creek. Lat 69°30′ N., long 159°14′ W. Conglomeratic sandstone underlain by coal. Corwin formation. Albian.
57	25798	49AWh69	C. L. Whittington, 1949. About one-half of a mile southeast of Falcon Creek. Lat 69°25′ N., long 158°05′ W. Most prominent sandstone on south flank of Kigalik anticline. Kukpowruk formation at contact with Chandler formation. Albian.
58	20491	46AWb8	E. J. Webber, 1946. Meade River, about one mile east of Falcon Creek. Same as Mes. loc. 25801. Lat 69°33′ N., long 157°59′ W. Kukpowruk formation, near base. Albian.
58	25801	49AWh76	C. L. Whittington, 1949. Cutbank on east side of meander of Meade River, about 1 mile east of Falcon Creek. Lat 69°33′ N., long 157°59′ W. Same location as Mes. loc. 20491. Lowest sandstone in south third of cutbank. Kukpowruk formation, near base. About 600 feet lower than Mes. loc. 25785. Albian.
59	25799	49AWh70	C. L. Whittington, 1949. North bank of Meade River, about 4 miles west of mouth of Pahron Creek. Lat 69°32′ N., long 157°39′ W. Lowest sandstone in poorly exposed 100-foot section. Kukpowruk formation, upper part unless faulted. Albian.
59	25800	49AWh71	C. L. Whittington, 1949. Same location as Mes. loc. 25799, but from conglomeratic sandstone 50 feet higher in section.
60	25802	49AWh87	C. L. Whittington, 1949. North bank of Meade River about 3 miles west of mouth of Pahron Creek. Lat 69°32′ N., long 157°35′ W. From sandstone in 35-foot section of sandstone, shale, coal and ironstone. Corwin formation, probably near base. Albian.
61	25785	49AWh86	C. L. Whittington, 1949. Meade River, east bank, about one-half of a mile southeast of mouth of Pahron Creek. Lat 69°32′ N., long 157°28′ W. About 10 feet of sandstone exposed. Kukpowruk formation, near top. Albian.
62	25793	49AWh1	C. L. Whittington, 1949. About 2 miles south of upper part of Carbon Creek. Lat 69°10′ N., long 158°42′ W. Sandstone. Kukpowruk formation, about 150 feet above base. Albian.
63	25807	49AKe89	A. S. Keller, 1949. North bank of Awuna River, 2½ miles west of mouth of west flowing tributary. Lat 69°10′ N., long 158°17′ W. Sandstone and siltstone 20 feet thick. Torok formation, about 50 feet below top. Albian.
64	25797	49AWh65	C. L. Whittington, 1949. North side of west-flowing tributary of Awuna River about 3 miles east-southeast of junction. Lat 69°10′ N., long 158°05′ W. Slumped sandstone. Torok formation, about 100 feet below top. Albian.
65	25794	49AWh62	C. L. Whittington, 1949. South slope of Lookout Ridge about 1 mile north of Grayling Creek. Lat 69°05′ N., long 158°20′ W. Sandstone in lowest exposures. Kukpowruk formation, about 100 feet above base. Albian.
66	23573	51AKt22	B. H. Kent, 1951. Brady anticline on Kiligwa River. Lat 68°57′ N., long 158°25′ W. Shell beds in dark siltstone and shale. Okpikrauk formation, a few hundred feet below top. Valanginian.
67	24693	53ATr105	I. L. Tailleur, 1953. Brady anticline on Kiligwa River. Lat 68°57′ N., long 158°25′ W. Same as Mes. loc. 23573. Shell beds in dark siltstone and shale. Okpikruak formation, a few hundred feet below base of Fortress Mountain formation. Albian.
67	24694	53ATr120	I. L. Tailleur, 1953. Brady anticline on Kiligwa River. Lat 68°57′ N., long 158°25′ W. Interbedded siltstone and shale. Fortress Mountain formation, a few hundred feet above base. Albian.
68	24040	51AKt18	B. H. Kent, 1951. Kiligwa River. Lat 68°56′ N., long 158°31′ W. Sandstone. Fortress Mountain formation. Albian.
69	24695	53ASa64	E. G. Sable, 1953. Nuka River, east bank, 1½ miles above junction with Colville River. Lat 69°00′ N., long 158°57′ W. Interbedded sandstone, siltstone, and shale. Fortress Mountain formation. Albian.
70	24041	51AKt72	B. H. Kent, 1951. Kiligwa River. Lat 68° 37′ N., long 158°28′ W. Okpikruak formation. Valanginian.
71	24692	53ATr18	I. L. Tailleur, 1953. Lat 68°45′ N., long 159°26′ W. Interbedded shale and fine-grained sandstone. Okpikruak formation. Valanginian.
72	24691	53ATr9	I. L. Tailleur, 1953. West of Sorepaw Creek between Nuka and Kiligwa Rivers. Lat 68°44′ N., long 159°17′ W. Sandstone. Okpikruak formation. Berriasian or Valanginian.
73	22512	50ATr280	I. L. Tailleur, 1950. Kiligwa River. Lat 68°44′ N., long 158°49′ W. Sandstone containing shale interbeds. Okpikruak formation. Berriasian or Valanginian.
73	23574	51ATr177	I. L. Tailleur, 1951. West fork of Kiligwa River. Lat 68°44′ N., long 158°49′ W. Sandstone and claystone. Okpikruak formation. Valanginian.
74	23575	51ATr209	I. L. Tailleur, 1951. East fork of Kiligwa River. Lat 68°41′ N., long 158°28′ W. Shale and siltstone. Okpikruak formation, 1,061to 1,178 feet above base. Valanginian.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
74	23576	51ATr231	I. L. Tailleur, 1951. East fork of Kiligwa River. Lat. 68°42′ N., Long. 158°26′ W. Shale, siltstone, and sandstone. Okpikruak formation. Valanginian.
75	22511	50ATr264	I. L. Tailleur, 1950. Swayback Creek. Lat 68°44′ N., long 158°07′ W. Silty to clayey shale. Fortress Mountain formation, a few hundred feet above base. Albian.
76	13313	25ASmF9	W. R. Smith, 1925. Forty miles upstream from mouth of Etivluk River. Okpikruak formation. Berriasian or Valanginian.
77	24657	49AMg46	M. D. Mangus, 1949. Kuna River. Lat 68°38′ N., long 157°55′ W. Okpikruak formation. Valanginian.
78	21821	49ALå74	A. H. Lachenbruch, 1949. Bluff on west side of west fork of Kuna River. Fossils in part from sandstone rubble. Lat 68°32′ N., long 157°56′ W. Okpikruak formation. Berriasian.
79	22522	50AKt285	B. H. Kent, 1950. Two miles east of Kuna River. Lat 68°33′ N., long 157°48′ W. Dark-greenish-gray, fine-grained graywacke. Okpikruak formation, middle part. Valanginian.
80	22521	50AKt257	B. H. Kent, 1950. Between Ipnavik and Kuna Rivers. Lat 68°38′ N., long 157°30′ W. Greenish-gray, fine-grained, thin-bedded graywacke. Okpikruak formation. Berriasian or Valanginian.
81	22519	50AKt219	B. H. Kent, 1950. Eight miles east of Kuna River. Lat 68°37′ N., long 157° 36′ W. Grayish-green, fine-grained graywacke. Okpikruak formation, lower part. Probably Valanginian.
82	22518	50AKt185	B. H. Kent, 1950. Between Ipnavik and Kuna Rivers. Lat 68°36′ N., long 157°31′ W. Dark-green, very fine grained graywacke. Okpikruak formation, basal part. Valanginian.
83	25791	47ATr132	M. L. Troyer, 1947. Discovery Creek, 6½ miles north of junction with Awuna River. Lat 69°17′ N., long 157°25′ W. Conglomeratic sandstone. Kukpowruk formation, about 1,000 feet above base, Albian.
84	25792	47AWh223	C. L. Whittington, 1947. East bank of Quartzite Creek, 7¼ miles north of junction with Awuna River. Lat 69°16′ N., long. 157° 01′ W. From 10 feet of sandstone. Kukpowruk formation, about 100 feet below top and 1,600 feet above base. Albian.
85	25803	52AWh16	C. L. Whittington, 1952. East bank of Quartzite Creek, about 2¾ miles north of Awuna River. Lat 69°13′ N., long 157°04′ W. 100 feet above base of exposure. Torok formation, 1,000 to 2,000 feet below top. Albian.
85	25812	47AWh174	C. L. Whittington, 1947. East bank of Quartzite Creek, about 2¾ miles north of Awuna River. Lat 69°13′ N., long 157°04′ W. About 90 feet above base of exposures. Torok formation, 1,000 to 2,000 feet below top. Albian.
85	25815	52AWh15	C. L. Whittington, 1952. Same location as Mes. loc. 25812. Float within 25 feet of base of exposures. Torok formation, 1,000 to 2,000 feet below top. Albian.
86	25813	52AWh40	C. L. Whittington, 1952. Birthday Creek, west fork, 3¾ miles northwest of mouth of main creek. Lat 69°12′ N., long 156°47′ W. From 15 feet of shale and siltstone. Torok formation, about 1,200 feet below top. Albian.
87	25804	52AWh17	C. L. Whittington, 1952. East side of Birthday Creek, 2½ miles north of mouth. Lat 69°12′ N., long 156°38′ W. Talus at base of cliffs that consist of 20 feet of shale capped by 8 feet of sandstone. Torok formation, 200 feet below top. Albian.
88	25805	52AWh71	C. L. Whittington, 1952. East bank of Birthday Creek, 1¼ miles north of mouth. Lat 69°11′ N., long 156°40′ W. From 180 feet above base of 300-foot exposure. Torok formation, about 1,200 to 1,500 feet below top. Albian.
89	12478	24AS64, 24AS65	P. S. Smith, 1924. Kigalik River, cut bank on west side about 3 miles north of Birthday Pass. Lat 69°19′ N., long 156°34′ W. Corwin formation, near middle, about 1,500 feet above base. Albian.
90	12479	24AS67, 24AS68	P. S. Smith, 1924. Kigalik River, about 1½ miles west of east end of the upper canyon. Same as Mes. loc. 25787. Lat 69°22′ N., long 156° 27′ W. Kukpowruk formation, inferred to be 1,100 feet above base. Albian.
90	12480	24AS69	P. S. Smith, 1924. Kigalik River, north side, one-quarter of a mile west of east end of upper canyon. Same as Mes. loc. 25786. Lat 69°22′ N., long 156°24′ W. Kukpowruk formation, about 100 feet above lowest beds exposed, and inferred to be 1,000 feet above base of formation. Albian.
90	25786	47AWh103	C. L. Whittington, 1947. Kigalik River, about one-quarter of a mile west of east end of upper canyon. Lat 69°22′ N., long 156°24′ W. Same location as Mes. loc. 12480. Rubble from sandstone about 100 feet above base of outcrops. Kukpowruk formation, about 1,000 feet above base. Albian.
90	25787	47AWh104	C. L. Whittington, 1947. Kigalik River, about 1½ miles west of east end of upper canyon. Lat 69°22′ N., long 156°27′ W. Same as Mes. loc. 12479. Small sandstone rubble heap. Kukpowruk formation, about 200 feet above lowest outcrop and 1,100 feet above base of formation. Albian.
90	25788	47AWh106	C. L. Whittington, 1947. Kigalik River, on north side about 2¼ miles west of east end of upper canyon, Lat 69°22′ N., long 156°29′ W. Sandstone rubble about 100 feet above lowest outcrops. Kukpowruk formation, about 1,000 feet above base of formation. Albian.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
91	25789	47AWh111	C. L. Whittington, 1947. Kigalik River, west side of meander at west end of lower canyon. Lat 69°22′ N., long 156°21′ W. Sandstone rubble in lowest exposures. Kukpowruk formation, about 900 feet above base. Albian.
92	12481	24AS72, 24AS73	P. S. Smith, 1924. Near Kigalik River. Lat 69°21′ N., long 156°15′ W. to long 156°19′ W. Kukpowruk formation, from 200 to 400 feet above lowest beds exposed, and inferred to be 1,100 to 1,300 feet above base of formation. Albian.
92	25790	47AWh119	C. L. Whittington, 1947. Kigalik River, south side at east end of lower canyon. Lat 69°21′ N., long 156°13′ W. Sandstone rubble from 90-foot exposure. Kukpowruk formation, about 1,100 feet above base of formation. Albian.
93	21822	49ALa141	A. H. Lachenbruch, 1949. Bluff on north side of Colville River, 2 miles west of Ipnavik River. Lat. 68°54′30″ N., long 156°35′ W. Dark shaly sandstone. Torok formation, upper part. Albian.
93	25814	47ATh324	R. F. Thurrell, Jr., 1947. Colville River, north bank. Lat 68°55′10″ N., long 156°31′ W. Shale and siltstone. Torok formation, upper part. Probably lower Albian.
94	12476	24AS46	P. S. Smith, 1924. Etivluk River. Approximate lat 68°51′30″ N., long 156°04′ W. Torok formation. Albian.
94	12477	24AS50	P. S. Smith, 1924. Etivluk River, about 8 miles above mouth. Lat. 68°51′30″ N., long 156°04′ W. Torok formation. Albian.
94	13311	25ASmF7	W. R. Smith, 1925. Etivluk River, 8½ miles above mouth. Approximate lat 68°51′ N., long 156°04′ W. Torok formation, upper part. Albian.
94	24639	53AB194	R. S. Bickel, 1953. West side of Etivluk River, near junction with east fork. Lat 68°53′ N., long 156°08′ W. Torok formation, upper part, but at least 2,000 feet below top. Albian.
94	24640	53AB1100	R. S. Bickel, 1953. West side of Etivluk River near junction of east fork. Lat 68°53′30″ N., long 156°08′ W. Torok formation, upper part, from 630 to 1,000 feet higher than Mes. loc. 24639. Albian.
94	25811	53AB180	R. S. Bickel, 1953. West side Etivluk River, 1 mile above junction with east fork. Lat 68°51′ N., long 156°11′ W. Torok formation. Albian.
95	24638	53AB1108	R. S. Bickel, 1953. South side of Colville River, 5 miles downstream from mouth of Etivluk River. Lat 68°58′ N., long 156°46′ W. Tuktu formation, 80 feet above base, overlying 520 feet of Killik tongue of Chandler formation, and 3,700 feet below base of Ninuluk formation. Albian.
96	23599	51ATr125	I. L. Tailleur, 1951. Ipnavik River. Lat 68°46′ N., long 156°55′ W. Siltstone and sandstone. Fortress Mountain formation. Albian.
97	23600	51ATr129	I. L. Tailleur, 1951. Ipnavik River. Lat 68°67′ N., long 156°46′ W. Siltstone and sandstone. Fortress Mountain formation. Albian.
98	23601	51ATr135	I. L. Tailleur, 1951. Ipnavik River. Lat 68°48′ N., long 156°39′ W. Siltstone. Fortress Mountain formation. Albian.
99	23602	51ATr144	I. L. Tailleur, 1951. Ipnavik River. Lat 68°49′ N., long 156°32′ W. Siltstone. Fortress Mountain formation. Albian.
99	23603	51ATr139	I. L. Tailleur, 1951. Ipnavik River. Lat 68°48′ N., long 156°35′ W. Sandstone and siltstone. Fortress Mountain formation. Albian.
100	22508	50ATr217	I. L. Tailleur, 1950. Ipnavik River. Lat 68°40′ N., long 157°12′ W. Okpikruak formation. Berriasian.
100	22510	50ATr229	I. L. Tailleur, 1950. Ipnavik River. Lat 68°41′ N., long 157°09′ W. Okpikruak formation. Valanginian.
101	22503	50ATr93	I. L. Tailleur, 1950. Between Etivluk and Ipnavik Rivers. Lat 68°39′ N., long 157°00′ W. Calcareous, fine-grained sandstone. Okpikruak formation. Valanginian.
102	22502	50ATr70	I. L. Tailleur, 1950. Between Etivluk and Ipnavik Rivers. Lat 68°40′ N., long 156°45′ W. Sandstone and siltstone. Fortress Mountain formation. Albian.
103	22523	50AKt2000	B. H. Kent, 1950. Mount Araga. Lat 68°43′ N., long 156°32′ W. Dark-grayish-green graywacke and shale. Fortress Mountain formation, near base. Albian.
104	22515	50AKt167	B. H. Kent, 1950. One mile west of Ipnavik River. Lat 68°36′ N., long 157°16′ W. Grayish-green graywacke. Okpikruak formation, middle part. Probably Berriasian.
104	22517	50AKt174	B. H. Kent, 1950. One mile west of Ipnavik River. Lat 68°37′ N., long 157°16′ W. Dark-greenish-gray graywacke. Okpikruak formation, lower part. Valanginian.
105	22506	50ATr139	I. L. Tailleur, 1950. Ipnavik River. Lat 68°34′ N., long 157°11′ W. Sandstone containing shale interbeds. Okpikruak formation. Valanginian.
105	22516	50AKt173	B. H. Kent, 1950. East bank of Ipnavik River southwest of Ekakevik Mountain. Lat 68°36′ N., long 157°13′ W. Gray to green graywacke. Okpikruak formation. Probably Berriasian.
106	22514	50AKt113	B. H. Kent, 1950. Northeast of Ekakevik Mountain. Lat 68°36′ N., long 156°57′ W. Gray to green graywacke. Okpikruak formation. Valanginian.
107	22505	50ATr128	I. L. Tailleur, 1950. Ipnavik River. Lat 68° 33′ N., long 157°13′ W. Sandstone and shale. Okpikruak formation, near middle. Valanginian.
108	22504	50ATr122	I. L. Tailleur, 1950. Five miles south of Ekakevik Mountain on Ipnavik River. Lat 68°30′ N., long 157°15′ W. Sandstone containing shale interbeds. Okpikruak formation. Berriasian or Valanginian.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
109	24656	49ADt39	R. L. Detterman, 1949. East side. Nigu River, 6 miles upstream from junction with Etivluk River. Lat 68°24′ N., long 156°25′ W. Okpikruak formation. Probably Berriasian.
110	26141	47AZ555a	J. H. Zomberge, 1947. Colville River, south bank. Lat 69°00′15″ N., long 155°31′ W. Sandstone, siltstone, and shale. Chandler formation, lower part of Killik tongue or possibly Grandstand formation. Albian.
111	20396	46ACh115	R. M. Chapman, 1946. Kurupa River. Lat 68°54′ N., long 155°13′ W. Sandstone. Middle of Tuktu formation. Albian.
111	20397	46ACh120	R. M. Chapman, 1946. Kurupa River. Lat 68°54′ N., long 155°13′ W. Sandstone. Tuktu formation, about 400 above base. Albian.
111	20398	46ACh137	R. M. Chapman, 1946. Kurupa River. Lat 68°59′ N., long 155°10′ W. Shaly sandstone. Grandstand formation, 300 feet above base. Albian.
111	20399	46ACh139	R. M. Chapman, 1946. Kurupa River. Lat 68°59′ N., long 155°10′ W. Sandstone and conglomerate. Grandstand formation, 700 feet above Tuktu formation. Albian.
111	20412	46ACh124	R. M. Chapman, 1946. Kurupa River. Lat 68°57′30″ N., long 155°10′ W. Tuktu formation, basal 150 feet. Albian.
112	20405	46ATh106	R. F. Thurrell, Jr., 1946. Kurupa River. Lat 68°50′ N., long 155°17′ W. Sandstone and shale. Tuktu formation, upper part. Albian.
113	23172	50ARe87	C. D. Reynolds, 1950. Oolamnagavik River. Lat 68°29′15″ N., long 154°23′ W. Shaly limestone. Okpikruak formation. Valanginian.
114	20392	46ACh57	R. M. Chapman, 1946. Oolamnagavik River. Lat 68°48′ N., long 154°25′ W. Sandstone and shale. Tuktu formation, about 150 ft. above base. Albian.
114	20394	46ACh67	R. M. Chapman, 1946. Oolamnagavik River. Lat 68°48′30″ N., long 154°24′ W. Conglomerate and sandstone. Tuktu formation, upper part. Albian.
114	20395	46ACh68	R. M. Chapman, 1946. Oolamnagavik River. Lat 68°48′ N., long 154°22′ W. Sandstone and conglomerate. Tuktu formation, upper part. Albian.
115	20401	46ATh55	R. F. Thurrell, Jr., 1946. Oolamnagavik River. Lat 68°48′ N., long 154°18′ W. Sandstone and conglomerate. Tuktu formation, upper part. Albian.
116	20402	46ATh60	R. F. Thurrell, Jr., 1946. Oolamnagavik River. Lat 68°51′ N., long 154°10′ W. Sandstone. Tuktu formation, upper part. Albian.
116	20403	46ATh67	R. F. Thurrell, Jr., 1946. Oolamnagavik River. Lat 68°52′ N., long 154°11′ W. Siltstone and sandstone. Tuktu formation, upper part. Albian.
117	24617	53ADt65	R. L. Detterman, 1953. Colville River. Lat 69°03′30″ N., long 154°14′ W. Chandler formation, Killik tongue, lower part, 2,000 feet below top. Albian.
118	20404	46ATh80	R. F. Thurrell, Jr., 1946. Colville River. Lat 69°00′ N., long 154°05′ W. Sandstone. Tuktu formation, upper 200 feet. Albian.
118	20406	46ATh209	R. F. Thurrell, Jr., 1946. Colville River. Lat 68°59′ N., long 154°02′ W. Sandstone and silty shale. Tuktu formation, upper 150 feet. Albian.
118	20407	46ATh211	R. F. Thurrell, Jr., 1946. Junction of Oolamnagavik and Colville Rivers. Lat 68°59′ N., long 154°09′ W. Sandstone. Tuktu formation, probably upper part. Albian.
119	20408	46ATh219	R. F. Thurrell, Jr., 1946. Colville River. Lat. 69°00′ N., long 159°03′ W. Sandstone and shale. Tuktu formation. Albian.
119	20409	46ATh222	R. F. Thurrell, Jr., 1946. Colville River. Lat 69°00′ N., long 154°03′ W. Sandstone and shale. Tuktu formation. Albian.
119	20411	46ATh230	R. F. Thurrell, Jr., 1946. Colville River. Lat 69°00′ N., long 154°03′ W. Sandstone and shale. Tuktu formation, upper part. Albian.
119	24636	53AB121	R. S. Bickel, 1953. North side of Colville River at Killik Bend. Lat 69°01′ N., long 154°02′ W. Tuktu formation, upper part. Albian.
120	20479	45AWa85B	L. A. Warner, 1945. Killik River near the Colville River. Lat 68°59′ N., long 153°51′ W. Calcareous siltstone. Killik tongue of Chandler formation, about 500 feet below base of Ninuluk formation. Albian.
121	20473	45AKr128	C. E. Kirschner, 1945. Colville River. Lat 69°04′ N., long 153°42′ W. Sandstone, siltstone, and shale. Killik tongue of Chandler formation, about 200 feet below base of Ninuluk formation. Albian.
121	20474	45AKr129	C. E. Kirschner, 1945. Colville River. Same data as Mes. loc. 20473. Chandler formation, within upper 200 feet. Albian.
122	20464	45AWa72	L. A. Warner, 1945. Killik River. Lat 68°51′15″ N., long 153°24′30″ W. Shaly sandstone. Tuktu formation, near middle. Albian.
122	20472	45AKr82A	C. E. Kirschner, 1945. Killik River. Lat 68°51′15″ N., long 153°24′30″ W. Shaly sandstone. Tuktu formation, a little below middle. Albian.
122	24619	53ADt48	R. L. Detterman, 1953. Killik Bluffs, 4 miles downstream from junction of Killik River with Okpikruak River. Lat 68°52′ N., long 153°25′ W. Tuktu formation, 700 feet below top. Albian.
122	24633	53AB19	R. S. Bickel, 1953. Killik Bluffs on Killik River. Lat 68°51′ N., long 153°24′ W. Tuktu formation, upper part. Albian.
122	24634	53AB113	R. S. Bickel, 1953. Killik Bluffs on Killik River. Lat 68°52′ N., long 153°24′ W. Tuktu formation, lower part of middle. Albian.
122	24635	53AB114	R. S. Bickel, 1953. Killik Bluffs on Killik River. Lat 68°52′30″ N., long 153°24′ W. Tuktu formation, lower part of middle. Albian.
123	21558	49APa345	W. W. Patton, Jr., 1949. Cutbank on east side of Okpikruak River. Lat 68°38′ N., long 153°30′ W. Calcareous sandstone. Fortress Mountain formation, lower third. Albian.

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123	21559	49APa347	W. W. Patton, Jr., 1949. Cutbank on west side of Okpikruak River. Lat 68°38′ N., long 153°30′ W. Calcareous sandstone. Fortress Mountain formation, lower third. Albian.
124	20470	45AWa36	L. A. Warner, 1945. East bank of Okpikruak River. Lat 68°35′ N., long 153°29′15″ W. Green sandstone, siltstone, and silt shale sequence 200 feet thick. Okpikruak formation. Valanginian.
124	20471	45AKr52	C. E. Kirschner, 1945. East bank of Okpikruak River. Lat 68°35′10″ N., long 153°29′45″ W. Okpikruak formation. Valanginian.
124	21553	49ATr374	I. L. Tailleur, 1949. Ridge 3,500 feet east of Okpikruak River. Lat 68°35′ N., long 153°28′ W. Shale and sandstone. Okpikruak formation. Valanginian.
124	21824	49ATr388	I. L. Tailleur, 1949. Cutbank on east side of East Fork of Okpikruak River. Lat 68°35′ N., long 153°29′ W. Sandstone. Okpikruak formation. Valanginian.
125	21557	49ATr754	I. L. Tailleur, 1949. Cutbank on east side of Pediment Creek. Lat 68°43′ N., long 153°15′ W. Siltstone. Torok formation. Albian.
126	21826	49ATr288	I. L. Tailleur, 1949. Cutbank on east side of Fortress Creek. Lat 68°35′ N., long 153°01′ W. Dark clay and silt shale containing concretions. Fortress Mountain formation. Albian.
127	21823	49APa192	W. W. Patton, Jr., 1949. Ridge 2,500 feet east of Ayiyak River. Lat 68°35′ N., long 152°48′ W. Sandstone and silty shale. Okpikruak formation. Valanginian.
127	21825	49ATr167	I. L. Tailleur, 1949. Cutbank on north side of Fortress Creek. Lat 68°36′ N., long 152°54′ W. Silt and clay shale. Fortress Mountain formation. Albian.
127	21837	49APa203	W. W. Patton, Jr., 1949. Ridge 4,000 feet east of Ayiyak River. Lat 68°36′ N., long 152°47′ W. Sandstone and silty shale. Okpikruak formation. Valanginian.
128	21556	49ATr722	I. L. Tailleur, 1949. Cutbank on east side of Kiruktagiak River. Lat 68°37′ N., long 152°43′ W. Shale. Fortress Mountain formation. Albian.
128	21562	49APa584	W. W. Patton, Jr., 1949. Cutbank on west side of Kiruktagiak River. Lat 68°37′ N., long 152°43′ W. Shale and calcareous concretions. Fortress Mountain formation. Albian.
128	26142	49APa613	W. W. Patton, Jr., 1949. East side of Kiruktagiak River. Lat 68°35′ N., long 152°45′ W. Fortress Mountain formation, 1,800 feet above base. Albian.
129	21560	49APa400	W. W. Patton, Jr., 1949. Cutbank on tributary of Kiruktagiak River, 7½ miles south of confluence of Castle Creek with the river. Lat 68°27′ N., long 152°44′ W. Fine-grained sandstone. Okpikruak formation. Berriasian.
130	21555	49ATr615	I. L. Tailleur, 1949. Cutbank on east side of Torok Creek. Lat 68°34′ N., long. 152°29′ W. Fortress Mountain formation. Albian.
131	21561	49APa512	W. W. Patton, Jr., 1949. Ridge 1,500 feet east of Chandler River. Lat 68°35′ N., long 152°22′ W. Silt, clay shale, and fine-grained sandstone. Okpikruak formation. Valanginian.
132	21827	49ATr741	I. L. Tailleur, 1949. Cutbank on west side of Chandler River at junction with Kiruktagiak River. Lat 68°44′ N., long 152°19′ W. Same locality as 25124. Green to gray sandstone. Tuktu formation, from 360 to 400 feet below top. Albian.
132	25124	48ADt153	R. L. Detterman, 1948. West side of Kiruktagiak River near junction with Chandler River. Lat 68°44′ N., long 152°22′ W. Medium-green fine-grained friable shaly sandstone. Tuktu formation, about 360 feet below top.
132	25125	48ADt158	R. L. Detterman, 1948. Junction of Kiruktagiak and Chandler Rivers. Lat 68°44′ N., long 152°20′30″ W. Silty shale, siltstone, and fine-grained sandstone. Tuktu formation, about 260 feet below top. Albian.
133	20454	45AGr31, 45AGr37	George Gryc, 1945. Tuktu Bluff. Lat 68°43′30″ N., long 152°17′ W. Fine-grained thick-bedded sandstone. Tuktu formation, basal 250 feet. Albian.
133	25120	48ADt86	R. L. Detterman, 1948. South side of Tuktu Bluff on Chandler River. Lat 68°42′30″ N., long 152°15′ W. Interbedded silt, clay shale, and siltstone. Torok formation, 1,400 feet below top. Albian.
133	21554	49ATr641	I. L. Tailleur, 1949. Cutbanks on east side of Chandler River and north side of Torok Creek. Lat 68°41′ N., long 152°14′ W., to 152°17′ W. Torok formation, lower part, 3,800 to 4,500 feet below top of formation. Albian.
133	25121	48ADt129	R. L. Detterman, 1948. Tuktu Bluff. Lat 68°43′30″ N., long 152°17′ W. Fine-grained thick-bedded sandstone. Tuktu formation, 260 feet above base. Albian.
133	25122	48ADt134	R. L. Detterman, 1948. Tuktu Bluff. Lat 68°43′30″ N., long 152°17′ W. Fine-grained greenish-gray shaly sandstone and siltstone. Tuktu formation, 360 feet below top. Albian.
133	25123	48ADt147	R. L. Detterman, 1948. Tuktu Bluff. Lat 68°43′15″ N., long 152°15′ W. Thin bed of conglomeratic sandstone. Tuktu formation, 110 feet above base. Albian.
134	24431	50AKe291	A. S. Keller, 1950. Cutbank on east side of tributary of Siksikpuk River. Lat 68°33′ N., long 152°06′ W. Fortress Mountain formation. Albian.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
135	22590	50AKe273	A. S. Keller, 1950. Cutbank on east side of Tiglukpuk Creek. Lat 68°18′ N., long 151°50′ W. Sandstone. Okpikruak formation. Berriasian or Valanginian.
135	22592	50AKe272	A. S. Keller, 1950. Cutbank on east side of Tiglukpuk Creek. Lat 68°18′ N., long 151°50′ W. Calcareous siltstone. Okpikruak formation. Valanginian.
135	22594	50APa285	W. W. Patton, Jr., 1950. Cutbank on west side of Tiglukpuk Creek. Lat 68°18′ N., long 151°50′ W. Calcareous siltstone. Okpikruak formation. Berriasian.
136	20435	46AGr211	George Gryc, 1946. Colville River, north side. Lat 69°15′15″ W., long 152°52′ W. Same as Mes. loc. 25137. Grandstand formation, 100 to 200 feet above Tuktu formation. Albian.
136	20477	45AKr169A	C. E. Kirschner, 1945. Colville River. Lat. 69°15′ N., long 152°51′ W. Sandstone. Grandstand formation, 100 to 200 feet above Tuktu formation. Albian.
136	20478	45AKr171	C. E. Kirschner, 1945. Colville River. Lat. 69°16′ N., long 152°40′ W. Sandstone. Grandstand formation, 200 to 300 feet above Tuktu formation. Albian.
136	25137	47ADt187	R. L. Detterman, 1947. Colville River, north side. Lat. 69°15′15″ N., long 152°52′ W. Fine-grained silty dark-gray sandstone. Grandstand formation, 100 to 200 feet above Tuktu formation. Albian.
137	12413	24AMt69	J. B. Mertie, Jr., 1924. Colville River, northwest bank, 4.3 miles southwest of confluence with Prince Creek. Lat 69°16′30″ N., long 152°34′ W. Grandstand formation, 45 to 50 feet below base of Ninuluk formation. Albian.
138	20432	46AGr187	George Gryc, 1946. Fossil Creek. Lat 69°13′45″ N., long 152°28′15″ W. Medium-grained sandstone. Tuktu formation, 320 feet below top. Albian.
138	20433	46AGr188	George Gryc, 1946. Fossil Creek. Lat 69°13′45″ N., long 152°28′ W. Medium- to fine-grained thick-bedded sandstone. Tuktu formation, 200 feet below top. Albian.
138	20492	46AGr182	George Gryc, 1946. Fossil Creek. Lat 69°14′30″ N., long 152°28′ W. Siltstone and shale. Tuktu formation, 800 feet below top. Albian.
138	24620	53ADt89	R. L. Detterman, 1953. Fossil Creek. Lat 68°14′ N., long 152°28′ W. Thin-bedded sandstone and claystone. Tuktu formation, 760 feet below top. Albian.
138	24621	53ADt90	R. L. Detterman, 1953. Fossil Creek. Lat 68°13′30″ N., long 152°28′ W. Thin-bedded sandstone interbedded with silty shale and siltstone. Tuktu formation, 75 feet below top. Albian.
138	25128	47ADt238	R. L. Detterman, 1947. Fossil Creek. Lat 69°14′15″ N., long 152°28′30″ W. Fine-grained thin-bedded sandstone. Tuktu formation, 670 feet below top. Albian.
138	25129	47ADt248	R. L. Detterman, 1947. Fossil Creek. Lat 69°14′ N., long 152°28′ W. Interbedded sandstone, siltstone, and silty shale. Tuktu formation, 300 feet below top. Albian.
138	25917	47ADt243	R. L. Detterman, 1947. South side of Fossil Creek. Lat 69°14′ N., long 152°28′30″ W. Tuktu formation, 540 feet below top. Albian.
139	24622	53ADt91	R. L. Detterman, 1953. Fossil Creek. Lat 68°13′ N., long 152°28′30″ W. Tuktu formation, 320 feet below top. Albian.
139	25138	47ADt265	R. L. Detterman, 1947. Fossil Creek. Lat 69°12′30″ N., long 152°29′30″ W. Interbedded siltstone, clay shale, and coal. Grandstand formation, 320 feet below top. Albian.
139	25139	47ADt267	R. L. Detterman, 1947. Fossil Creek. Lat 69°12′13″ N., long 152°29′30″ W. Fine-grained dark-gray sandstone. Grandstand formation, 80 feet below top. Albian.
140	24273	52AB1229	R. S. Bickel, 1952. Chandler River. Lat 69°12′ N., long 151°52′ W. Fine-grained light-yellow sandstone. Grandstand formation. Albian.
141	24274	52AB1261	R. S. Bickel, 1952. Chandler River. Lat 69°06′ N., long 152°05′ W. Siltstone and shale. Tuktu formation, upper part. Albian.
141	24293	52ADt202	R. L. Detterman, 1952. Chandler River. Lat 69°06′ N., long 151°58′ W. Sandstone, siltstone, and limestone. Tuktu formation, upper part. Albian.
141	24294	52ADt204	R. L. Detterman, 1952. Chandler River. Lat 69°06′ N., long 152°00′30″ W. Thin- to medium-bedded sandstone. Tuktu formation, upper part. Albian.
141	24295	52ADt206	R. L. Detterman, 1952. Chandler River, west side. Lat 69°05′30″ N., long 152°00′30″ W. Sandstone and thin-bedded limestone. Tuktu formation, upper part. Albian.
142	20457	45AGr56	George Gryc, 1945. Chandler River. Lat 69°03′50″ N., long 151°51′30″ W. Grandstand formation, 100 to 150 feet below Ninuluk formation. Albian.
142	24296	52ADt207	R. L. Detterman, 1952. Chandler River, east side. Lat 69°05′ N., long 151°56′ W. Thin- to medium-bedded sandstone. Tuktu formation, 75 to 100 feet below top. Albian.
142	24297	52ADt210	R. L. Detterman, 1952. Chandler River. Lat 69°04′45″ N., long 151°55′30″ W, Interbedded standstone, siltstone and shale. Tuktu formation, 100 to 125 feet below top. Albian.
142	24298	52ADt213	R. L. Detterman, 1952. Chandler River. Lat 69°04′ N., long 151°52′ W. Sandstone, siltstone, silty shale, and coal seams. Grandstand formation, about 540 feet below top. Albian.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
142	25126	48ADt287	R. L. Detterman, 1948. Chandler River on south side of the Big Bend anticline. Lat 69°05′ N., long 151°55′30″ W. Silty, thin-bedded sandstone interbedded with siltstone and shale. Tuktu formation, from 50 to 100 feet below top. Albian.
142	25136	48ADt280	R. L. Detterman, 1948. Chandler River on south side of Big Bend anticline. Lat 69°04′N., long 151°52′W. Coarse-grained massive sandstone. Grandstand formation, 500 feet below top. Albian.
143	25127	48ADt341	R. L. Detterman, 1948. Trouble Creek. Lat 69°06′30″N., long 151°38′W. Interbedded silty shale, clayey shale, and fine-grained thin-bedded sandstone. Tuktu formation, upper 100 feet. Albian.
144	24299	52ADt216	R. L. Detterman, 1952. Chandler River. Lat 68°52′30″N., long 151°55′30″ W. Interbedded clay, silt shale, and sandstone. Tuktu formation, upper part. Albian.
145	24292	52ADt88	R. L. Detterman, 1952. Ayiyak River. Lat 68°52′N., long 152°17′30″W. Grandstand formation. Albian.
146	24301	52ADt157	R. L. Detterman, 1952. Anaktuvuk River. Lat 68°52′N., long 151°11′W. Medium-bedded sandstone. Grandstand formation, 240 feet below top. Albian.
147	24624	53ADt103	R. L. Detterman, 1953. West side Nanushuk River, at east end of Roof Top Ridge. Lat 68°51′30″N., long 150°30′30″W. Sandstone, siltstone, and silty shale. Tuktu formation, 710 feet below top. Albian.
147	24625	53ADt104	R. L. Detterman, 1953. Nanushuk River. Lat 68°51′30″ N., long 150°30′-45″ W. Siltstone. Tuktu formation, 570 feet below top. Albian.
147	24626	53ADt106	R. L. Detterman, 1953. Nanushuk River. Lat 68°51′30″ N., long 150°31′ W. Medium-bedded sandstone. Tuktu formation, 100 feet below top. Albian.
147	24627	53ADt108	R. L. Detterman, 1953. Nanushuk River. Lat 68°51′30″ N., long 150°31′30″ W. Massive sandstone. Tuktu formation, 420 feet below top. Albian.
147	25131	47AWb101	E. J. Webber, 1947. Nanushuk River at east end of Roof Top Ridge. Lat 68°51′30″ N., long 150°30′30″ W. Siltstone and silty shale containing a few sandstone interbeds. Tuktu formation, about 400 feet below top. Albian.
147	25132	47AWb103	E. J. Webber, 1947. Nanushuk River at same location as Mes. loc. 25131. Thin silty fine-grained, greenish sandstone. Tuktu formation, about 350 feet below top. Albian.
147	25133	47AWb106	E. J. Webber, 1947. Nanushuk River at same location as Mes. loc. 25131. Fine-grained silty greenish-gray sandstone and siltstone. Tuktu formation, about 500 feet below top. Albian.
147	25135	47AWb110	E. J. Webber, 1947. Nanushuk River, at same location as Mes. loc. 25131. Siltstone and thin-bedded sandstone. Tuktu formation, about 720 feet below top.
148	20480	45AFs55	R. E. Fellows, 1945. Anaktuvuk River, opposite mouth of Kanayut Creek. Lat 68°44′ N., long 151°07′ W. Sandstone and shale. Same location as Mes. loc. 24637. Tuktu formation, upper part. Albian.
148	24637	53AB130	R. S. Bickel, 1953. Anuktuvuk River, opposite mouth of Kanayut Creek. Lat 68°44′ N., long 151°07′ W. Same location as Mes. loc. 20480. Sandstone and shale. Tuktu formation, upper part. Albian.
149	3204	551–556	F. C. Schrader, 1901. Anaktuvuk River, east bank, at mouth of Kanayut Creek. Same as Mes. locs. 20484 and 24623. Lat 68°44′ N., long 151°03′ W. Tuktu formation, upper 100 to 150 feet. Albian.
149	20484	45AFs217	R. E. Fellows, 1945. Anaktuvuk River at junction of Kanayut Creek. Same as Mes. loc. 3204. Lat 68°44′ N., long 151°03′ W. Sandstone and shale. Tuktu formation, upper part. Albian.
149	24623	53ADt93	R. L. Detterman, 1953. Kanayut Creek. Lat 68°44′ N., long 151°03′ W. Same location as Mes. loc. 20484. Tuktu formation, upper 150 feet. Albian.
150	3202	538–540	F. C. Schrader, 1901. Anaktuvuk River. Okpikruak formation. Valanginian.
150	3203	546–548	F. C. Schrader, 1901. Anaktuvuk River, east bank. Same as Mes. loc. 20494. Lat 68°38′15″ N., long 151°09′ W. Green sandstone. Tuktu formation, upper 100 to 150 feet. Albian.
150	20494	45AFs28	R. E. Fellows, 1945. Anaktuvuk River. Lat 68°38′15″ N., long 151°09′ W. Same as Mes. loc. 3203. Sandstone. Tuktu formation, near middle. Albian.
151	24432	50AKe213	A. S. Keller, 1950. Cutbank on east side of Kanayut Creek. Lat. 68°39′ N., long 150°51′ W. Chandler formation. Albian.
152	24427	50APa180	W. W. Patton, Jr., 1950. Cutbank on east side of Nanushuk River. Lat 68°39′ N., long 150°32′ W. Tuktu formation, basal 40 feet. Albian.
152	25130	47AWb21	E. J. Webber, 1947. Nanushuk River. Lat 68°35′05″ N., long 150°32′ W. Siltstone and fine-grained shaly sandstone. Tuktu formation, basal 100 feet. Albian.
152	26140	50APa192	W. W. Patton, Jr., 1950. Cutbank on east side of Nanushuk River. Lat 68°39′ N., long 150°32′ W. Tuktu formation, upper 76 feet. Albian.
153	24426	50APa156	W. W. Patton, Jr., 1950. Cutbank on north side of east fork of Nanushuk River. Lat 68°35′ N., long 150°24′ W. Calcareous sandstone. Tuktu formation. Albian.
154	24428	50AKe19	A. S. Keller, 1950. Ridge east of May Creek. Lat 68°42′ N., long 150°08′ W. Sandstone. Tuktu formation. Albian.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
154	24429	50AKe25	A. S. Keller, 1950. Cutbank on west side of May Creek. Lat 68°41′ N., long 150°13′ W. Tuktu formation. Albian.
154	24430	50AKe35	A. S. Keller, 1950. Cutbank on west side of May Creek. Lat 68°40′ N., long 150°10′ W. Sandstone. Tuktu formation. Albian.
155	24425	50APa29	W. W. Patton, Jr., 1950. Cutbank on east side of May Creek. Lat 68°35′ N., long 150°11′ W. Sandstone. Tuktu formation. Albian.
156	22589	50AKe224	A. S. Keller, 1950. Cutbank on east side of tributary of Welcome Creek. Lat 68°25′ N., long 150°49′ W. Sandstone. Okpikruak formation. Valanginian.
157	22593	50APa201	W. W. Patton, Jr., 1950. Cutbank on east side of tributary of Kanayut Creek. Lat 68°34′ N., long 150°45′ W. Calcareous siltstone. Torok formation. Albian.
158	20437	46AGr31	George Gryc, 1946. Sagavanirktok River. Lat 68°32′ N., long 149°03′ W. Tuktu formation. Albian.
159	22756	51ADt184	R. L. Detterman, 1951. Sagavanirktok River. Lat 68°39′ N., long 149°02′ W. Float from sandstone and conglomerate exposures. Torok formation. Albian.
160	20436	46AGr11	George Gryc, 1946. Sagavanirktok River. Lat 68°46′ N., long 149°02′ W. Tuktu formation. Albian.
160	22755	51ADt178	R. L. Detterman, 1951. Sagavanirktok River. Lat 68°46′ N., long 148°57′ W. Sandstone and siltstone. Tuktu formation, about 600 to 700 feet below top. Albian.
161	20438	46AGr34	George Gryc, 1946. Sagavanirktok River. Lat 68°56′ N., long 148°47′ W. Tuktu formation. Albian.
162	22765	51AKe128	A. S. Keller, 1951. Nosebleed Creek. Lat 68°52′ N., long 148°12′ W. Siltstone. Okpikruak formation. Berriasian.
162	22767	51AKe139	A. S. Keller, 1951. Lupine River. Lat 68°54′ N., long 148°18′ W. Siltstone. Okpikruak formation. Valanginian.
163	20439	46AGr62	George Gryc, 1946. Sagavanirktok River. Lat 69°03′ N., long 148°05′ W. Tuktu formation. Albian.
163	22753	51ADt112	R. L. Detterman, 1951. West fork of Ivishak River, near junction with main river. Lat 69°04′45″ N., long 148°03′ W. Sandstone, siltstone, and silty shale. Tuktu formation, probably upper part. Albian.
163	22754	51ADt113	R. L. Detterman, 1951. West fork of Ivishak River near junction with main river. Lat 69°04′45″ N., long 148°03′ W. Silty sandstone containing interbeds of siltstone and silty shale. Tuktu formation, probably upper part. Albian.
164	22744	51ADt94	R. L. Detterman, 1951. Gilead Creek. Lat 69°15′ N., long 147°49′ W. Clay shale. Okpikruak formation. Valanginian.
165	22761	51AKe761	A. S. Keller, 1951. Kashivi Creek. Lat 69°12′ N., long 147°44′ W. Siltstone. Okpikruak formation. Valanginian.
165	22762	51AKe77	A. S. Keller, 1951. Kashivi Creek. Lat 69°12′ N., long. 147°44′ W. Siltstone. Okpikruak formation. Berriasian.
166	22758	51AKe33	A. S. Keller, 1951. Echooka River. Lat 69°24′ N., long 147°42′ W. Ignek (?) formation.
167	22738	51ADt18	R. L. Detterman, 1951. East side of west fork of Shaviovik River. Lat 69°24′30″ N., long 147°15′ W. Silty clay shale. Okpikruak formation. Berriasian.
167	24010	52AMo3	R. H. Morris, 1952. Cutbank on Shaviovik River. Lat 69°25′ N., long 147°14′ W. Limestone lenses in shale. Okpikruak formation, lower part. Berriasian.
168	22742	51ADt50	R. L. Detterman, 1951. Kemik Creek. Lat 69°26′30″ N., long 147°10′ W. Siltstone lenses in shale. Okpikruak formation, below middle. Valanginian.
169	22757	51AKe23	A. S. Keller, 1951. Kemik Creek. Lat 69°26′ N., long 147°10′ W. Siltstone lenses. Okpikruak formation, lower 700 feet. Berriasian.
169	24008	52AMo1	R. H. Morris, 1952. East cutbank of Kemik Creek. Lat. 69°25′ N., long 147°10′ W. Siltstone and shale. Okpikruak(?) formation, basal sandstone member. Probably Berriasian.
170	24009	52AMo2	R. H. Morris, 1952. Ridge east of Kemik Creek. Lat 69°25′ N., long 147°05′ W. Ironstone concretions in shale. Okpikruak(?) formation, basal sandstone member. Probably Berriasian.
171	24027	52AKe6	A. S. Keller, 1952. Fin Creek. Lat 69°29′ N., long 147°08′ W. Siltstone. Ignek formation, lower member. Albian.
172	24025	52AKe4	A. S. Keller, 1952. Fin Creek. Lat 69°29′ N., long 146°58′ W. Siltstone. Ignek formation, lower member. Albian.
173	10306	100	E. de K. Leffingwell, 1911. Canning River, bluff on west side opposite Shublik Island. Lat 69°32′40″ N., long 146°22′40″ W. Sandstone. Ignek formation, lower member. Albian.
173	24015	52AMo44	R. H. Morris, 1952. Cutbank on west side of Canning River. Lat 69°32′ N., long 146°21′ W. Ignek formation, lower member, 10 feet above base. Albian.
173	24016	52AMo44A	R. H. Morris, 1952. Same location as Mes. loc. 24015, but 80 feet above base of Ignek formation.
173	24017	52AMo45	R. H. Morris, 1952. Same location as Mes. loc. 24015, but 100 feet above base of Ignek formation.

Locality on figure 1	Geological Survey Mesozoic locality	Collection field No.	Collector and year of collection, description of locality, stratigraphic assignment, and age
173	24018	52AMo46	R. H. Morris, 1952. Same location as Mes. loc. 24015, but 160 feet above base of Ignek formation.
173	24019	52AMo47	R. H. Morris, 1952. Same location as Mes. loc. 24015, but 160 feet above base of Ignek formation.
173	24020	52AMo53	R. H. Morris, 1952. Same location as Mes. loc. 24015, but 100 feet above base of Ignek formation.
173	24031	52AKe33	A. S. Keller, 1952. Canning River. Lat 69°32′ N., long 146°25′ W. Okpikruak formation, highest bed. Berriasian.
174	24034	52AKe44	A. S. Keller, 1952. Canning River. Lat 69°34′ N., long 146°22′ W. Sandstone. Ignek formation, lower member, lower 500 feet. Albian.
175	10293	3	E. de K. Leffingwell, 1911. Ignek Valley, south side of Red Hill. Lat 69°33′35″ N., long 146°13′ W. Probably same as loc. 23773. Dark shale. Ignek formation, upper shale unit of lower member, probably within 200 feet of base. Albian.
175	23773	50AGr59	George Gryc, 1950. Ignek Creek, near Red Hill. Lat 69°38′35″ N., long 146°13′ W. Dark shale. Probably same as loc. 10293. Ignek formation, upper shale unit of lower member. Albian.
175	23774	50AGr58	George Gryc, 1950. Ignek Creek, near Red Hill. Lat. 69°33′ N., long. 146°13′ W. Concretions derived from black shale. Ignek formation, upper shale unit of lower member. Albian.
175	23775	50AGr57	George Gryc, 1950. Ignek Creek, near Red Hill. Lat 69°33′ N., long 146°13′ W. Concretions in dark shale. Ignek formation, upper shale unit of lower member.
176	10311	117A	E. de K. Leffingwell, 1911. Marsh Creek, east side. About 1 mile downstream from loc. 10312. Ignek formation, lower member. Albian.
176	10312	118A	E. de K. Leffingwell, 1911. Marsh Creek, bluff on northeast side. First large exposure of sandstone. Ignek formation, lower member. Albian.

TABLE 7.—*Geographic distribution by Mesozoic locality numbers, of aucellan species in the outcrops of the Okpikruak formation in northern Alaska*

[A question mark indicates that the *Aucella* present is merely compared with the species under which it is listed]

<table>
<tr><th>Aucella okensis Pavlow</th><th>Aucella subokensis Pavlow</th><th>Aucella sublaevis Keyserling</th><th>Aucella crassicollis Keyserling</th><th>Aucella sp.</th></tr>
<tr><td>22478
22492
22499
22594
22724
22726
22729
22730
22732
22789
22790
22792
22795
23557
23559</td><td>13309(?)
22479(?)
22508
22515(?)
22516(?)
22727(?)
22728
22762
22786
22794(?)
23555
23556
24010
24656(?)</td><td rowspan="2">13716
22128
22474
22475
22476
22477
22481
22482
22483
22484
22485
22489
22490
22491
22492
22494(?)
22497
22498
22500
22501
22724
22734
22736
22742
22744
22761
22772
22773
22774
22775
22782
22783
22785
22787
22793
23172
23553
23554
23566
23567
23573
23574
23698
24693</td><td rowspan="2">3202
20470
20471
21553
21561
21823
21824(?)
21837
22473(?)
22486(?)
22487(?)
22488
22490
22493
22503
22505
22506
22510
22514
22517
22518
22519(?)
22522
22589
22592
22724
22725
22731
22737
22767
22777
22778
22779
22780
22781
22784
22788
23551
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23565
23575
23576
24041
24657
24692</td><td rowspan="2">13313
22471
22504
22512
22521
22590
24691</td></tr>
<tr><td colspan="2">21560
21821
22472
22738
22757
22765
22791
23564
24031</td></tr>
</table>

Geographic distribution of megafossils other than Aucella *in the Okpikruak formation in northern Alaska*

Fossil	*Mesozoic loc.*
Brachiopods undet	24008
Parallelodon? spp	24009
Plicatula sp	24008
Plicatula? sp	24009
Tancredia? sp	24031
Camptonectes sp	24031
Gastropod fragments	22757
Lytoceras sp	24008
Lytoceras sp	22496
Phylloceras tiglukpukense Imlay, n. sp	22594
Belemnites undet	22738, 22775, 24031

SUMMARY OF RESULTS

The Lower Cretaceous strata in northern Alaska represent only the Berriasian, Valanginian, and Albian stages. They have not furnished fossils of the Hauterivian, Barremian, and Aptian stages either on the outcrop or in the subsurface. Locally the basal beds of the Cretaceous are not older than middle Valanginian. The base of the Lower Cretaceous coincides with an erosional unconformity that truncates Upper Jurassic to Mississippian beds. This unconformity probably involves part of the Portlandian stage at the very top of the Jurassic considering that the Portlandian has been identified faunally only at one spot. The position of the Hauterivian to Aptian stages coincides with an angular unconformity involving mountainous uplift along the site of the Brooks Range, overthrusting toward the north, and considerable erosion.

The megafossils found in the Lower Cretaceous rocks of northern Alaska permit a close dating of the strata

TABLE 8. *Geographic distribution of megafossils in the Fortress Mountain and Torok formations in northern Alaska*

[Two- and three-digit numbers in boxheads refer to localities on plate 21; other numbers are Mesozoic locality numbers]

	Fortress Mountain formation																	Torok formation																									
	36	68	69	75	96	97	98	99		102	103	123	127	128			134	9	10	11	16	45	63	64	85			86	87	88	93		94						125	133		157	159
	23558	24040	24695	22511	23599	23600	23601	23602	23603	22502	22523	21558	21825	21556	21562	26142	24431	24477	24463	13717	24475	22480	25807	25797	25803	25812	25815	25813	25804	25805	21822	25814	12476	12477	13311	24639	24640	25811	21557	21554	25120	22593	22756
Kirklandia? sp																									X																		
Crinoid cirri																										X																	
Ditrupa cornu Imlay, n. sp.																					X							X															
Tancredia sp.																					X	X						X															
Arctica? sp.																			X									X															
Flaventia? kukpowrukensis Imlay, n. sp.																				X																							
Solecurtus? chapmani Imlay, n. sp.																							X																				
Pleuromya kelleri Imlay, n. sp.																X																											
Panope? kissoumi (McLearn)																	X	X	X																								
sp.																X																											
Thracia cf. *T. kissoumi* McLearn																X																											
Oxytoma camselli McLearn																												X															
sp.																						X																					
Aucellina dowlingi McLearn			X										X	X																													
Isognomon? sp.																																					X						
Inoceramus cf. *I. altifluminis* McLearn															X																												
sp. juv. cf. *I. anglicus* Woods																									X							X		X	X				X		
sp. juv.				X					X			X																	X									X			X
Placunopsis nuka Imlay, n. sp.			X																																								
Lima sp.																													X														
Naticoid gastropods																						X																					
Puzosia? sp. juv.						X	X	X	X																											X			X			
Beudanticeras (*Grantziceras*) *affine* (Whiteaves)																																							X			
(*Grantziceras*) cf. *B. affine* (Whiteaves)		X																																									
Colvillia crassicostata Imlay, n. sp.	X											X																											X			
cf. *C. crassicostata* Imlay, n. sp.																																							X			
kenti Imlay, n. sp.		X										X																															
C. cf. C. kenti Imlay, n. sp.											X																																
Subarcthoplites bickeli Imlay, n. sp.																																			X	X							
colvillensis Imlay, n. sp.																															X												
cf. *S. colvillensis* Imlay, n. sp.																																							X				
belli (McLearn)																																X											
Gastroplites cf. *G. kingi* McLearn																																										X	
sp.																									X																		
Paragastroplites aff. *P. spiekeri* (McLearn)																										X																	
Cleoniceras taileuri Imlay, n. sp.																																				X							
(*Neosaynella?*) *whittingtoni* Imlay, n. sp.																												X															
(*Grycia*) *sablei* Imlay, n. sp.																									X		X																
Ammonite fragment																																	X										

TABLE 9.—*Geographic distribution of megafossils in the Ignek formation in northern Alaska*

[Three-digit numbers in boxheads refer to localities on plate 21; other numbers are Mesozoic locality numbers]

	166	171	172	173							174	175				176	
	22758	24027	24025	10306	24015	24016	24017	24018	24019	24020	24034	10293	23773	23774	23775	10311	10312
Worm? tubes											X						
Spirorbis? leffingwelli Inlay, n. sp.												X	X				
Ditrupa cornu Imlay, n. sp.				X			X										
Brachiopods undetermined		X	X											X			
Nuculana sp.												X					
Yoldia cf. *Y. kissoumi* McLearn			X			X						X	X				
Dicranodonta dowlingi McLearn				X													
Astarte ignekensis Imlay, n. sp.				X			X		X		X	X	X			X	X
Arctica? sp.				X		X	X	X			X						X
Flaventia? sp.												X					
Panope? kissoumi (McLearn)						X											
elongatissima (McLearn)				X		X			X	X						X	
sp.		X															
Goniomya matonabbei McLearn												X			X		
Thracia stelcki McLearn												X					
cf. *T. kissoumi* McLearn												X	X				
Myopholas sp.												X					
Isognomon? sp.				X													
Entolium? sp.		X	X								X	X	X				
Eopecten? sp.			X														
Anomia? sp.												X					
Placunopsis sp.												X					
Trochid gastropods				X								X					
Acteon sp.												X					
? sp.											X						
Natica? sp.				X													
Belemnite fragments	X			X													

TABLE 10.—*Geographic distribution of megafossils in the Tuktu formation in northern Alaska*

[Three-digit numbers in boxheads refer to localities on plate 21; other numbers are Mesozoic locality numbers]

	Kurupa-Oolamnagavik Rivers																	Killik-Chandler Rivers																					
	111			112	114			115	116		118			119				122						132			133				138								139
	20396	20397	20412	20405	20392	20394	20395	20401	20402	20403	20404	20406	20407	20408	20409	20411	24636	20464	20472	24619	24633	24634	24635	21827	25124	25125	20454	25121	25122	25123	20432	20433	20492	24620	24621	25128	25129	25917	24622
Crinoid stems and cirri											X																												
Brittle star													X														X												
Star fish																																							
Worm? burrows					X											X																							
Ditrupa cornu Imlay, n. sp		X	X	X		X				X			X														X		X					X	X	X			X
Nucula (*Pectinucula*) cf. *N. dowlingi* McLearn																																							
Yoldia cf. *Y. kissoumi* McLearn																											X												
Dicranodonta dowlingi McLearn				X		X	X			X																					X								
Astarte ignekensis Imlay, n. sp																											X												
Astarte portana McLearn																																							
sp		X																																					
Tancredia kurupana Imlay, n. sp				X																																			
sp			X					X						X																									
Lucina sp						X	X																																
Arctica? sp	X	X		X	X		X							X						X							X			X									
Veniella sp	X																																						
Flaventia? sp																																X							
Solecurtus? chapmani Imlay, n. sp							X																																
Pleuromya sikanni McLearn							X																														X		
sp								X																								X							
Panope? kissoumi (McLearn)																																							
elongatissima (McLearn)				X																								X											
sp		X					X																						X	X									
Homomya sp																											X		X										
Goniomya matonabbei McLearn				X																																			
Thracia stelcki McLearn			X																									X											
cf. *T. stelcki* McLearn																																							
Psilomya sp																																							
Oxytoma camselli McLearn										X																													
sp		X																																					
Pinna cf. *P. hagi* McLearn							X																																
Isognomon? sp																																							
Inoceramus anglicus Woods					X	X			X		X	X			X		X	X	X	X	X	X	X																
cf. *I. cadottensis* McLearn																					X						X												
cf. *I. altifluminis* McLearn																																							
sp				X						X															X	X													
Entolium utokokense Imlay, n. sp				X						X			X															X			X				X				X
sp		X			X	X																																	
Placunopsis spp																																			X				
Modiolus archisikanni McLearn	X	X		X			X																										X						
sp																																							
Trochid? gastropods																																							
Cerithiid? gastropods																																							
Naticoid gastropods		X					X																																
Beudanticeras? sp																																							
Gastroplites kingi McLearn																																							
cf. *G. kingi* McLearn																					X																	X	
Paragastroplites spiekeri (McLearn)		X																																					
flexicostatus Imlay, n. sp										X												X																	
Cleoniceras tailleuri Imlay, n. sp																								X															
cf. *C.* (*Neosaynella?*) *whittingtoni* Imlay, n. sp							X																																
(*Grycia*) *sablei* Imlay, n. sp				X																																			
Pseudopulchellia pattoni Imlay, n. sp																																							
Xenohelix? sp																																							

TABLE 10.—*Geographic distribution of megafossils in the Tuktu formation in northern Alaska*—Continued

	Killik-Chandler Rivers									Anaktuvuk-Nanushuk Rivers																							Sagavanirktok River						
	141				142			143	144	147								148		149			150		152			153	154			155	158	160		161	163		
	24274	24293	24294	24295	24296	24297	25126	25127	24299	24624	24625	24626	24627	25131	25132	25133	25135	20480	24637	3204	20484	24623	3203	20494	24427	25130	26140	24426	24428	24429	24430	24425	20437	20436	22755	20438	20439	22753	22754
Crinoid stems and cirri																		X																					
Brittle star																					X																		
Star fish																			X																				
Worm? burrows																			X				X																
Ditrupa cornu Imlay, n. sp	X		X	X					X	X	X						X	X			X	X	X									X							
Nucula (Pectinucula) cf. *N. dowlingi* McLearn											X																												
Yoldia cf. *Y. kissoumi* McLearn								X																															
Dicranodonta dowlingi McLearn					X															X	X	X									X								
Astarte ignekensis Imlay, n. sp																X				X																			
Astarte portana McLearn											X					X																							
sp																																							
Tancredia kurupana Imlay, n. sp																																							
sp							X									X																							
Lucina sp																																							
Arctica? sp								X	X	X		X	X		X	X						X								X	X								
Veniella sp																																							
Flaventia? sp																																							
Solecurtus? chapmani Imlay, n. sp											X								X						X					X									
Pleuromya sikanni McLearn																														X									
sp																																							
Panope? kissoumi (McLearn)						X	X			X																													
elongatissima (McLearn)	X										X					X	X				X	X			X	X					X								
sp		X										X				X		X																					
Homomya sp												X																											
Goniomya matonabbei McLearn																																							
Thracia stelcki McLearn	X												X	X							X			X							X			X					
cf. *T. stelcki* McLearn					X																											X							
Psilomya sp																											X												
Oxytoma camselli McLearn																																							
sp																																							
Pinna cf. *P. hagi* McLearn																																							
Isognomon? sp																X													X					X					
Inoceramus anglicus Woods																																				X	X		X
cf. *I. cadottensis* McLearn																												X										X	
cf. *I. altifluminis* McLearn																																						X	
sp					X											X		X		X						X									X				
Entolium utukokense Imlay, n. sp												X				X			X		X	X																	
sp			X	X														X																					
Placunopsis spp																					X																		
Modiolus archisikanni McLearn												X										X																	
sp							X																										X						
Trochid? gastropods													X																										
Cerithiid? gastropods											X																												
Naticoid gastropods																		X																					
Beudanticeras? sp																						X																	
Gastroplites kingi McLearn																					X																X		
cf. *G. kingi* McLearn																X	X		X																				X
Paragastroplites spiekeri (McLearn)																																							
flexicostatus Imlay, n. sp																					X																		X
Cleoniceras tailleuri Imlay, n. sp																																				X			
cf. *C. (Neosaynella?) whittingtoni* Imlay, n. sp																																							
(Grycia) sablei Imlay, n. sp																																							
Pseudopulchellia pattoni Imlay, n. sp																									X														
Xenohelix? sp																			X	X	X	X	X								X						X		

TABLE 11.—*Geographic distribution of megafossils in the Kukpowruk formation in northern Alaska*

[? following locality number indicates that locality may be in Torok or Corwin formation. Two-digit numbers in boxheads refer to localities on plate 21; other numbers are Mesozoic locality numbers]

	Corwin, Kukpowruk, and Utukok Rivers																															
	2	3				4		5			6			7		8		9	10		13	14	15	16			17	18				
	24485	24469	24470	24471	24484	12178	24483	24466	24467	24468	24465	24481	24482	24464	24480	24478	24479	24476	24461	24462	13730	13729?	13728?	24473	24474	24488	24472	13720	13721	13722	24486	24487
Kirklandia? sp																																
Crinoid cirri																																
Echinoid spine		X																														
Brittle star		X																														
Star fish														X						X	X							X				
Ditrupa cornu Imlay, n. sp															X																	
Hamulus? sp																					X											
"*Unio*" sp																											X					
Tancredia stelcki McLearn	X				X											X		X														
kurupana Imlay, n. sp						X				X																						
cf. *T. stelcki* McLearn															X									X								
sp		X					X															X								X	X	
Arctica? sp	X	X				X		X		X	X	X			X		X		X			X			X	X			X	X	X	
Flaventia? kukpowrukensis Imlay, n. sp		X																						X								
Solecurtus? chapmani Imlay, n. sp										X																						
Cultellus? kokolikensis Imlay, n. sp																										X						
Pleuromya sp																																
Panope? kissoumi (McLearn)		X	X																												X	X
elongatissima (McLearn)																																
cf. *P. elongatissima* (McLearn)				X																												
sp										X																			X	X		
Thracia stelcki McLearn			X						X																							
Oxytoma camselli McLearn																																
cf. *O. pinania* McLearn																																
sp		X																														
Isognomon? sp																																
Inoceramus anglicus Woods																		X														
Camptonectes dettermani Imlay, n. sp							X											X														
Entolium utukokense Imlay, n. sp		X					X	X					X															X				X
sp	X																															
Modiolus sp																																
Naticoid gastropods																										X						
Gastroplites? sp																						X										
Paragastroplites cf. *P. spiekeri* (McLearn)																																
Cleoniceras (*Neosaynella?*) *whittingtoni* Imlay, n. sp																																

	Corwin, Kukpowruk, and Utukok Rivers														Meade, Kigalik, and Awuna valleys																	
	46	47	48	49			50	51	52	53	54			55	57	58		59		61	62	65	83	84	90					91	92	
	24451	24452	24455	24453	24454	24460	24459	24456	24458?	13310?	25809	25810	25918	25806	25798	20491	25801	25799	25800	25785	25793	25794	25791	25792	12479	12480	25786	25787	25788	25789	12481	25790
Kirklandia? sp													X																			
Crinoid cirri																											X					
Echinoid spine																											X					
Brittle star											X																					
Star fish																																
Ditrupa cornu Imlay, n. sp													X								X				X		X					
Hamulus? sp																																
"*Unio*" sp																																
Tancredia stelcki McLearn				X					X														X	X			X		X	X		X
kurupana Imlay, n. sp		X	X	X	X	X			X							X			X			X	X				X					
cf. *T. stelcki* McLearn																																
sp															X		X	X														
Arctica? sp		X			X		X		X	X							X										X			X		X
Flaventia? kukpowrukensis Imlay, n. sp																														X		
Solecurtus? chapmani Imlay, n. sp																																
Cultellus? kokolikensis Imlay, n. sp																																
Pleuromya sp																											X					
Panope? kissoumi (McLearn)																																
elongatissima (McLearn)								X								X																
cf. *P. elongatissima* (McLearn)																																
sp	X						X										X														X	
Thracia stelcki McLearn																								X								
Oxytoma camselli McLearn		X																														
cf. *O. pinania* McLearn					X																											
sp			X			X																					X					
Isognomon? sp									X																							
Inoceramus anglicus Woods																				X				X	X	X	X	X				X
Camptonectes dettermani Imlay, n. sp				X	X	X																										
Entolium utukokense Imlay, n. sp					X	X			X			X		X			X						X			X	X					X
sp	X						X																									
Modiolus sp																	X															
Naticoid gastropods																																
Gastroplites? sp																																
Paragastroplites cf. *P. spiekeri* (McLearn)																X																
Cleoniceras (*Neosaynella?*) *whittingtoni* Imlay, n. sp																																X

TABLE 12.—*Geographic distribution of megafossils in the Grandstand, Chandler, and Corwin formations in northern Alaska*

[Two- and three-digit numbers in boxheads refer to localities on plate 21; other numbers are Mesozoic locality numbers]

	Grandstand formation															Chandler formation						Corwin formation		
	95	111		136				137	139		140	142			146	110	117	120	121		151	56	60	89
	24638	20398	20399	20435	20477	20478	25137	12413	25138	25139	24273	20457	24298	25136	24301	26141	24617	20479	20473	20474	24432	25808	25802	12478
Echinoid spine	×																							
Brittle star	×																							
Starfish																			×					
Ditrupa cornu Imlay, n. sp				×	×																			
"*Unio*" sp																×	×	×						
Tancredia kurupana Imlay, n. sp	×					×																		
stelcki McLearn																							×	
sp				×									×									×		
Arctica? sp	×	×		×						×			×	×	×									×
Panope? kissoumi (McLearn)				×											×					×	×			
elongatissima (McLearn)			×																					
sp						×	×		×		×			×										
Psilomya sp																					×			
Oxytoma sp																						×		
Thracia stelcki McLearn					×			×																
Inoceramus anglicus Woods			×									×												
sp													×											
Entolium utukokense Imlay, n. sp	×			×		×	×						×								×			
sp											×													
Cleoniceras (Neosaynella?) whittingtoni Imlay, n. sp	×																							
Xenohelix? sp						×																		

TABLE 13.—*Test wells from which Lower Cretaceous fossils have been obtained*

[Elevations and stratigraphic data given in feet from kelly bushings (derrick floor)]

Test well or core test	Location	Elevation (feet)	Top of formation or system: Chandler (feet)	Grandstand (feet)	Topagoruk (feet)	Oumalik (feet)	Opkikruak (feet)	Jurassic (feet)
South Barrow 1	Lat 71°19′12″ N., long 156°42′16″ W	18		[1] 70	700	2,790(?)		3,330
South Barrow 2	Lat 71°15′49″ N., long 156°38′03″ W	34.5			[1] 80?	1,910(?)		2,328
South Barrow 3	Lat 71°09′47″ N., long 156°34′44″ W	44			[1] 100??	1,115(?)		1,645
Avak 1	Lat 71°15′02″ N., long 156°28′06″ W	17.3				(?)		1,360
Simpson core test 13	Lat 70°58′58″ N., long 154°38′43″ W	33		661				
Simpson core test 25	Lat 70°56′10″ N., long 154°42′12″ W	17		832±				
Simpson core test 29	Lat 70°55′47″ N., long 154°41′31″ W	15		450±				
Simpson core test 30	Lat 70°55′49″ N., long 154°40′41″ W	15±		445				
Simpson core test 30A	Lat 70°55′51″ N., long 154°40′35″ W	15±		445±				
North Simpson 1	Lat 71°03′12″ N., long 154°58′06″ W	30.5		([2])	2,700	3,590		
Simpson 1	Lat 70°57′12″ N., long 155°21′52″ W	29		[1] 25	990	3,580	5,290(?)	5,630(?)
Topagoruk 1	Lat 70°37′30″ N., long 155°53′36″ W	42		[1] 50	1,350	3,900		6,600
East Topagoruk 1	Lat 70°34′37″ N., long 155°22′39″ W	67		[1] 90	1,750			
Kaolak 1	Lat 69°56′00″ N., long 160°14′51″ W	178	1,175	3,140	3,270			
Oumalik 1	Lat 69°50′18″ N., long 155°59′24″ W	194		[1] 30	2,825	4,860	10,880(?)	
East Oumalik	Lat 69°47′29″ N., long 155°32′39″ W	293	[1] 50	730	3,050	5,200		
Square Lake 1	Lat 69°34′00″ N., long 153°18″ W	340	1,960(?)	2,475				
Titaluk 1	Lat 69°25′21″ N., long 154°34′04″ W	840	590	1,850	3,500			
Wolf Creek 3	Lat 69°23′11″ N., long 153°31′25″ W	750	500	1,400	2,760			
Umiat 1	Lat 69°23′52″ N., long 152°19′45″ W	810	1,010	1,309	2,850	5,650		
Umiat 2	Lat 69°23′04″ N., long 152°05′01″ W	342	[1] 80	365	1,060	4,700		
Umiat 8	Lat 69°23′59″ N., long 152°06′56″ W	740	[3] 170, 555	840				
Umiat 9	Lat 69°23′14″ N., long 152°10′11″ W	424	155	425	1,090			
Umiat 11	Lat 69°24′29″ N., long 152°05′58″ W	481	2,160	2,420	3,075			
Gubik 1	Lat 69°26′46″ N., long 151°28′06″ W	156	(?)	3,735	4,315			
Gubik 2	Lat 69°25′10″ N., long 151°27′26″ W	163	(?)	4,025	4,395			
Grandstand 1	Lat 68°57′58″ N., long 151°55′02″ W	660		[1] 110	1,070			1,191

[1] Eroded.
[2] Absent.
[3] Faulted.

TABLE 14.—*Lower Cretaceous megafossils from well cores in northern Alaska*

[C=Chandler formation. G=Grandstand formation. T=Topagoruk formation. O=Oumalik formation. K=Okpikruak formation]

Fossils	Test wells and core tests from which fossils were obtained (depths in feet)													
	South Barrow 1	South Barrow 2	South Barrow 3	Avak 1	Simpson core test 13	Simpson core test 25	Simpson core test 29	Simpson core test 30	Simpson core test 30A	North Simpson 1	Simpson 1	Topagoruk 1	East Topagoruk 1	Kaolak 1
Crinoid remains										G 301 T 1,187				
Starfish												T 1,492		
Brittle star											T 1,340			
Echinoid spines											T 1,087 T 1,187 T 1,277			
Worm? tubes	O 3,126	O 1,973												
Ditrupa cornu Imlay, n. sp.					G 852 1,050						G 510	T 2,087 2,097		
Lingula sp.														
Brachiopods undetermined	O 3,126	O 2,212												
Nucula cf. *N. dowlingi* McLearn														
sp.													T 2,087	
Yoldia kissoumi McLearn						G 889								
sp.		T 1,353 T 1,354												
Nemodon? sp.														
Astarte ignekensis Imlay, n. sp.	O 3,120													
sp.		O 2,046												
Corbula? sp.								G 603				G 911–919		
Arctica? sp.						G 938						G 911–919		
Veniella sp.														
Flaventia? sp.		O 2,277												
Cymbophora? sp.														
Leptosolen? sp.														
Solecurtus? chapmani Imlay, n. sp.														
Pleuromya sp.		O 2,276	O 1,628									T 1,490 T 1,501		
? sp.														
Panope? sp.														
Thracia stelcki McLearn												G 911–919		
cf. *T. kissoumi* McLearn	O 3,118 O 3,138													
sp.	O 3,108			O 1,041										
Psilomya? sp.				O 1,057										
Aucella sublaevis Keyserling														
Aucella or *Aucellina* sp.														6,560 6,570
Inoceramus cf. *I. anglicus* Woods														
sp.										O 3,760 3,774		T 1,490 1,501		
Lima? sp.		O 1,977												
Entolium sp.	O 3,121 O 3,221	O 2,212 O 2,275					G 683		G 690 G 698					T 3,996
Anomia? sp.														
Placunopsis sp.														
Modiolus? sp.														
Gastropods undeterminable	O 3,125 O 3,221													
Cerithiopsis? sp.								G 603						
Ammonites undeterminable						G 895								
Beudanticeras? sp. juv.						G 884								
Gastroplites sp.														
Cleoniceras (Grycia) sablei Imlay, n. sp.												T 3,249		
? sp.														
Fish teeth and scales	O 3,334			O 1,262 O 1,275										

TABLE 14—*Lower Cretaceous megafossils from well cores in northern Alaska*—Continued

Fossils	Test wells and core tests from which fossils were obtained (depths in feet)												
	Oumalik 1	East Oumalik 1	Square Lake 1	Titaluk 1	Wolf Creek 3	Umiat 1	Umiat 2	Umiat 8	Umiat 9	Umiat 11	Gubik 1	Gubik 2	Grand-stand 1
Crinoid remains				T 3,676			T 5,800						
Starfish													
Brittle star													
Echinoid spines							T 2,404						T 1,751
Worm? tubes													
Ditrupa cornu Imlay, n. sp				T 3,551 T 4,018	T 3,092 T 3,112				T 1,170		G 4,302		G 979 T 1,552
Lingula sp			344						G 844 G 562				G 979
Brachiopods undetermined					G 1,487				G 838				
Nucula cf. *N. dowlingi* McLearn									T 1,122		G 4,302		
sp													
Yoldia kissoumi McLearn						G 1,635 G 1,645			T 1,171				T 2,413
sp									O 1,099				
Nemodon? sp											T 4,559		
Astarte ignekensis Imlay, n. sp													
sp													
Corbula? sp	G 1,417					G 1,635 G 1,693			G 844				
Arctica? sp		G 1,356 G 1,360			G 1,520	G 1,713					C 3,360		T 1,275
Veniella sp										C 2,175			
Flaventia? sp													
Cymbophora sp									G 562				
Leptosolen? sp										C 2,175			
Solecurtus chapmani Imlay, n. sp												G 4,255	T 1,926
Pleuromya sp											T 4,360		
? sp									G 691 T 1,197				
Panope? sp													T 1,288
Thracia stelcki McLearn													
cf. *T. kissoumi* McLearn													T 1,606
sp			G 2,494		T 3,755				T 1,099				T 2,017 T 2,420 T 1,279
Psilomya? sp		G 1,355	G 3,597										T 1,606
Aucella sublaevis Keyserling	K 10,992 K 11,007												
Aucella or *Aucellina* sp													
Inoceramus cf. *I. anglicus* Woods					T 3,755		T 2,784						
sp													T 1,607 T 2,210
Lima? sp													
Entolium sp			G 3,743		G 1,520	T 3,415		G 1,183	T 1,195		G 4,277 G 4,294		T 1,417
Anomia? sp		G 1,354							T 1,099				
Placunopsis sp		G 2,442											
Modiolus? sp											T 4,546		T 1,276
Gastropods undeterminable						G 1,693 G 1,703			G 838				
Cerithiopsis? sp													
Ammonites undeterminable					T 3,095								
Beudanticeras? sp. juv									T 1,171				
Gastroplites sp							T 2,148 T 2,634						
Cleoniceras (*Grycia*) *sablei* Imlay, n. sp													
? sp													T 1,600
Fish teeth and scales										C 2,330			

and consequently of major events. They show that uplift and erosion occurred late in the Jurassic, that the Cretaceous sea advanced over a hilly terrane during the Berriasian and early Valanginian and that submergence reached its maximum in middle to late Valanginian. The fossils show that the beds of Valanginian age are separated from overlying beds of Albian age by an angular unconformity involving half of the Early Cretaceous. During this interval all northern Alaska was above the sea and was shedding sediments north of the present coastline.

The sea advanced again early in the Albian to the base of high mountains along the present site of the Brooks Range and stayed there apparently during all the Albian. Outpouring of detrital sediment into the sea was enormous, totaling at least 6,000 feet during the early Albian and from 4,000 to 7,000 feet during the remainder of the Albian. An abrupt faunal change at the end of the Albian indicates the occurrence of some major geologic event. As field geologists cannot detect an unconformity between the Albian and Cenomanian strata, the event must have been ecological as far as northern Alaska is concerned, although possibly reflecting diasrophism elsewhere.

The Lower Cretaceous megafossils from northern Alaska include 2 specimens that may be jellyfish, about 120 echinoderms, 20 brachiopods, many hundreds of tube-bearing worms, about 2,200 pelecypods, 56 gastropods, 87 cephalopods, and 20 spiral borings made by some unknown organism. About half of the pelecypods represent the genus *Aucella*. About one-fourth represent the genera *Arctica?*, *Panope?*, *Entolium*, *Aucellina*, and *Tancredia*. The megafossils of Albian age include more genera and species than have ever been reported previously from Albian beds in lands bordering the Arctic Ocean.

The sediments of Berriasian to Valanginian ages contain four species of *Aucella* that are identical with species that are widely distributed in the Boreal region and along the west coast of North America. The Berriasian is represented by *Aucella okensis* Pavlow and *A. subokensis* Pavlow, the early Valanginian by *A. sublaevis* Keyserling, and the middle to late Valanginian by *A. crassicollis* Keyerserling. These Aucellas are thick shelled and associated with detrital sediment and probably lived in the shallowest part of the neritic zone. Other fossils are rare in the Berriasian to Valanginian beds, but includes one large ammonite, *Phylloceras*. The presence of such a thin-shelled creature in association with rather thick-shelled Aucellas could be explained most easily if the ammonite drifted in from the open sea after death.

The rocks of early Albian age have not furnished many fossils of any kind. The megafossils obtained from the outcrops consist mostly of free-swimming organisms, such as ammonites, fish, and perhaps specimens of *Inoceramus*, but include several bottom burrowing organisms, such as *Pleuromya*, *Panope*, and *Thracia*. Megafossils are slightly more common in the equivalent subsurface rocks where they include more genera that lived in clay or silt muds, such as *Astarte*, *Flaventia*, *Pleuromya*, and *Thracia*. The general scarcity of fossils of early Albian age is ascribed mainly to exceedingly rapid sedimentation, although many of the exposures are poor or are accessible with difficulty. Faunally the early Albian rocks may be divided into three zones. The lower zone is characterized by the ammonite *Colvillia* and the pelecypod *Aucellina*, the middle zone by the ammonite *Subarcthoplites*, and the upper zone by the lowest appearance of the ammonite *Cleoniceras*. These fossils permit approximate correlations with formations of early Albian age in the western interior of Canada.

The middle Albian rocks in northern Alaska contain an abundant and varied fauna. They are characterized by the ammonites *Gastroplites*, *Paragastroplites*, and *Cleoniceras*. They include a host of pelecypods that lived on or in muddy to sandy bottoms along with numerous tube-bearing worms and brittle stars. Free-swimming organisms include reptiles, fish, ammonites, belemnites, pectins, jellyfish(?), crinoids, and perhaps *Inoceramus*. Such free-moving organisms as starfish and gastropods are present also. Many of the cephalopods and pelecypods are identical with species that lived in the shallow Albian seas that covered the western interior of Canada and the Yukon area of Alaska. The cephalopods in part belong to genera that lived in northwest Europe and in part are known only from northern North America. The pelecypods belong to genera that lived in the shallow seas of northwest Europe during Albian times, but do not include any of the Ostreidae or of the genera *Trigonia*, *Glycymeris*, *Cardita*, *Protocardia*, and *Mytilus* that were common in Europe. The general composition of the megafauna living in, or on the bottom of the middle Albanian sea in northern Alaska is not greatly different than that living today in the shallow sea bottoms of temperate latitudes.

The latest Albian rocks that crop out in northern Alaska above the range of the ammonite *Gastroplites* contain a meager megafauna, but the fossils present are identical specifically with those in the underlying beds of definite middle Albian age. The rarity of ammonites and the presence of some nonmarine beds containing "*Unio*" and coal indicate that the sea was shallower than during the middle Albian. In contrast, the subsurface rocks of latest Albian age contain a more varied marine assemblage than the outcropping rocks, which suggest deposition in slightly deeper water.

Correlation of these latest Albian rocks in Alaska with the late Albian of Europe is a little uncertain because of the absence of ammonites except near the base. Their assignment to the late Albian is made because field geologists consider them to lie conformably between beds of middle Albian and Cenomanian ages, they are faunally related to the middle Albian and faunally distinct from the Cenomanian, they contain *Inoceramus anglicus* Woods, throughout, and they occupy the same stratigraphic position above beds containing *Gastroplites* as the late Albian Shaftesbury and Sikanni formations in the western interior of Canada. The presence of *Inoceramus anglicus* Woods is excellent evidence for excluding any of the beds in question from the Cenomanian.

SYSTEMATIC DESCRIPTIONS

Phyllum COELENTERATA
?Class HYDROZOA
?Genus KIRKLANDIA Castor, 1945

Kirklandia? sp.

Plate 1, figures 1, 2, 9, 10

Two crown-shaped molds have a subcircular outline and radially disposed lobes that are suggestive of a jellyfish. Only one surface is preserved, and that, by comparison with the jellyfish, should be the aboral surface.

The largest mold is flattened and has a slightly concave central part. It bears 12 lobes separated by narrow furrows that are indented considerably on the periphery of the corona and that fade out toward its center. Some furrows extend nearer to the center than others, but there does not appear to be any regular arrangement of long and short furrows. This mold greatly resembles the aboral surface of *Kirklandia texana* Castor (1945, pl. 5, figs. 1, 4), from beds of upper Albian age in Texas. It differs mainly by being ½ to ⅓ as large and by having more deeply indented lobes.

The smallest mold from northern Alaska is partly broken and shows only 8 lobes, but probably had 12 lobes originally. It differs from the largest mold by having a conical instead of a flattened aboral surface and by the lobes not extending as far toward the center. The preservation is not sufficient to show whether these differences are real or are related to compaction and to weathering.

The systematic assignment of these specimens from Alaska to the Coelenterata seems reasonable, but any lower order of assignment must await discovery of specimens that show the oral surface.

Figured specimens USNM 128591, 128592.

Occurrences.—Torok formation at USGS Mes. loc. 25803; Kukpowruk formation at Mes. loc. 25918.

Phyllum ANNELIDA
Class CHAETOPODA
Genus SPIRORBIS Daudin, 1800

Spirorbis? leffingwelli Imlay, n. sp.

Plate 1, figures 3–8, 11–22

This species occurs in abundance locally in the lower member of the Ignek formation. Most of the specimens are coiled left handed and have a low spire in which the coils touch each other. Some of the specimens have almost no spire, and a few are coiled loosely. Some of the coiled specimens become uncoiled in the adult. Some fragments of tubes are only slightly curved and evidently were never part of a coil. In cross section the tubes are nearly circular, but this shape is modified by longitudinal furrows where the coils touch and by other furrows and flattened areas that apparently are not related to coiling.

The outer surfaces of the tubes are strongly ornamented by prominent transverse swellings and constrictions and by sharp wavy dense transverse ribs. These ribs divide and unite rather intricately. Rib branching and waviness are greatest where the ribs cross the furrows, but may occur anywhere on the tubes.

This species is characterized by its fine sharp wavy transverse ribbing, which is similar to that on the tube of another worm, *Ditrupa decorata* Stolley (1911, p. 23–26, pl. 21, figs. 5, 6, pl. 3), from the lower Aptian of Spitzbergen. Some of the uncoiled fragments of *Spirorbis? leffingwelli* might easily be mistaken for the gently curved tubes of *Ditrupa decorata*, but the association of these fragments with spiral coils shows that an assignment to *Ditrupa* is not possible.

The species is named in honor of E. de K. Leffingwell who collected most of the specimens.

Types.—Holotype, USNM 128593; paratype, USNM 128594.

Occurrences.—Ignek formation, lower member, at USGS Mes. locs. 10293, 23773.

Genus DITRUPA Berkeley, 1832

Ditrupa cornu Imlay, n. sp.

Plate 2, figures 1–18

This species occurs in enormous numbers in sandstone and pebbly sandstone beds of the Tuktu and Grandstand formations. It is uncommon in the sandstones of the Torok and Ignek formations. It has been obtained from many drill cores of sandstone and siltstone in the subsurface Topagoruk formation. The best preserved tubes occur in siltstone and very fine-grained sandstone.

The tubes are calcareous, round, slender, gently bowed to nearly straight, gradually tapered, and range in length from about ½ to 2 inches. Most of the tubes are evenly bowed, but in some the amount of bowing varies in an irregular manner. Slight differences in the degree of taper are evident when large numbers of tubes are viewed close together. The small ends of the tubes are bluntly rounded and apparently bear tiny openings. The large ends are generally swollen in a collarlike manner and then constricted abruptly. The aperture is only about half as wide as the outside diameter of the tube and has a fairly sharp edge.

The shelly material of the tubes in cross section (pl. 2, fig. 13) shows color changes that are generally abrupt. A thick outer part of the tube is yellowish brown and somewhat horny in appearance; an equally thick middle part is nearly white; and a very thin inner part is light yellow. The inner and outer parts appear to be textureless, but the thick, whitish inner part bears fine layers arranged in a series of cones as in *Serpula* (see Stephenson, 1923, v. 5, pl. 9, fig. 7). The cone-shaped layering is much finer and less distinct than in *Serpula* (pl. 1, fig. 26) or *Hamulus* (pl. 1, fig. 27) and was noted in only a few specimens under reflected light. It does not show on any photographs of *Ditrupa* published herein.

The inner surfaces of the tubes are nearly smooth or are marked by faint transverse striae. The outer surfaces are also fairly smooth, but when examined under the microscope show weak, broad transverse swellings and constrictions on which are superimposed very fine transverse striae. Evidently the shelly material of the tubes is brittle because many tubes have been cracked longitudinally on their upper and lower surfaces. The external molds of such tubes are marked by ridges corresponding to the cracks on the tubes.

Ditrupa cornu Imlay has been assigned to the scaphopod *Laevidentalium* in recent publications dealing with northern Alaska (1951, Gryc and others, p. 163; 1956, Gryc and others, p. 230, 234). Similarly species of *Ditrupa* from the lower part of the Aptian stage of Spitzbergen and northern Russia were once assigned to *Dentalium* until Stolley (1912, p. 22–26) pointed out that their slightly irregular shape and the presence of transverse swellings and striae were features of *Ditrupa* and not of *Dentalium*. Other features that differentiate the Alaskan specimens of *Ditrupa* from *Dentalium* or *Laevidentalium* are variability in degree of tapering and of bowing from one specimen to another when viewed in mass, and the arrangement of growth layers tangentially instead of at right angles to the surface of the tube. (See pl. 1, fig. 28.)

Stolley (1911, p. 26) also pointed out that *Ditrupa* occurs commonly in conglomerate and sandstone of shallow-water origin, whereas *Dentalium* is characteristic of finer sediment of deeper water origin. The illustrations by Frebold (1930, pl. 17, fig. 2) of *Ditrupa* in conglomeratic beds in Spitzbergen can be matched by similar occurrences in northern Alaska. However, some of the occurrences of *Ditrupa* in northern Alaska are in siltstone, and the living *Ditrupa* is reported to occur in both muds and sands throughout a considerable range in depth.

Ditrupa cornu differs from *D. notabilis* (Eichwald) (1868, p. 800, pl. 28, figs. la, b; Sinzow, 1872, p. 30, pl. 4, fig. 22) from the lower Aptian of Russia by having a more regular shape and less pronounced transverse swellings. *D. nodulosa* (Lundgren) (1883, p. 10, pl. 2, figs. 7–9) from the lower Aptian of Spitzbergen tapers more rapidly. *D.? lindstroemi* (Lundgren) (1883, p. 10, pl. 2, figs. 1, 2, 6; Sokolow and Bodylevsky, 1931, p. 29, 30, 122) from Spitzbergen appears to be similar to *D. cornu*, but the original description and illustrations are inadequate for close comparisons or even for generic determinations.

Types.—Holotype, USNM 128595; paratypes USNM 128596–602.

Occurrences: Torok formation at Mes. loc. 22480, 25804; Tuktu formation at USGS Mes. locs. 3203, 20394, 20397, 20403, 20405, 20407, 20412, 20454, 20480, 20484, 24274, 24294, 24295, 24299, 24425, 24620–24625, 25122, 25128, 25135; Kukpowruk formation at Mes. locs. 12479, 24480, 25786, 25793, 25918; Grandstand formation at Mes. locs. 20435, 20477; Grandstand formation (subsurface) in Simpson test well 1 at 510 feet, Simpson core test 13 at 863 feet, Simpson core test 30A at 696 feet, Gubik test well 1 at 4,302 feet, Grandstand test well 1 at 979 feet; Topagoruk formation in the Titaluk test well 1 at 4,018, 3,551, and 3,672 feet, Umiat test well 9 at 1,170 feet, Wolf Creek test well 3 at 3,092–3,112 feet, Topagoruk test well 1 at 2,087–2,097 feet, Grandstand test well 1 at 1,552 feet; Ignek formation at Mes. locs. 10306, 24017.

Phyllum MOLLUSCA
Class PELECYPODA
Genus NUCULA Lamarck, 1700
Subgenus PECTINUCULA Quenstedt, 1930

Nucula (Pectinucula) cf. N. dowlingi McLearn

Plate 3, figure 24

Three specimens resemble *Nucula dowlingi* McLearn (1919, p. 9, pl. 3, figs. 1, 2) from Alberta in shape, position of beaks, and presence of rounded, radiating ribs, but the preservation is not sufficient to show whether the beaks curve backward as in *N. dowlingi.*

Figured specimen USNM 128603.

Occurrences.—Tuktu formation at USGS Mes. loc. 24625; Grandstand formation in Gubik test well 1 at 4,302 feet; Topagoruk formation in the Umiat test well 9 at depth of 1,122 feet.

Genus YOLDIA Möller, 1842

Yoldia kissoumi McLearn

Plate 3, figures 1–3, 8

Yoldia kissoumi McLearn, 1933, Royal Soc. Canada Trans., 3d ser., v. 27, sec. 4, p. 142, pl. 1, figs. 1–3.

The genus *Yoldia* is represented by 26 specimens from Northern Alaska. These probably all belong to *Y. kissoumi* McLearn, but only five specimens are preserved sufficiently well to show the characteristic ornamentation, which consists of horizontal striae trending nearly straight across fine concentric growth lines.

Plesiotypes.—USNM 128606, 128607; figured specimens USNM 128604, 128605.

Occurrences.—Grandstand formation in Simpson test well 25 at depth of 889 feet and in Umiat test well 1 at depths of 1,635–1,645 feet; Topagoruk formation in Umiat test well 9 at depth of 1,171 feet and in Grandstand test well 1 at depth of 2,413 feet. Specimens probably belonging to *Y. kissoumi* occur in the Tuktu formation at USGS Mes. locs. 20454 and 25127, in the Grandstand formation in the Umiat test well 9 at depths of 1,099–1,101 feet, and in the lower 400 feet of the Ignek formation at Mes. locs. 10293, 23773, 24016, 24025.

Genus DICRANODONTA Woods, 1899

Dicranodonta dowlingi McLearn

Plate 4, figures 1–7

Dicranodonta dowlingi McLearn, 1919, Canada Geol. Survey, Museum Bull. no. 29, Geol. Ser. no. 36, p. 9, 10, pl. 3, figs. 3–5.

Dicranodonta dowlingi McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 8, figs. 1, 2.

The original description is as follows:

> The nearest species is *Dicranodonta obliqua* (Keeping) from the lower Greensand (Aptian) of Upware; compared with it the Peace River species is larger, more obtuse, not flattened centrally, has a slightly longer hingeline, more numerous central teeth, and lacks the fine radiating striae of the English species. The short hingeline, the curving down of the laterals, and the rounded outline place it in the genus *Dicranodonta.* Height 42 mm, length 52 mm. This species is named after D. B. Dowling.

Dicranodonta in northern Alaska is represented by 25 specimens, of which 21 are from the Tuktu formation. Most of the specimens are molds and are poorly preserved, but 3 specimens retain considerable shell, and 1 specimen shows both the interior and the exterior of the shell. It is assumed that the shell-bearing specimens belong to the same species as the molds, of which some are closely comparable to the type specimens of *Dicranodonta dowlingi* McLearn.

The shell is stout, oblong, rounded, nearly equilateral. On immature specimens the anterior and posterior margins are regularly rounded, and the ventral margin is slightly curved. On adult specimens the posterior margin becomes straighter, steeply inclined, and rounds rather abruptly into the ventral margin. The umbones are prominent, without a ridge; the beaks are incurved and blunt. The surface of the shell is marked by many fine concentric growth lines, by much coarser concentric growth lines at wide intervals, and by very fine radial striae.

The hinge area is narrow, extends about one-third of the length of the shell and bears many ligamental grooves. The hinge is long; the median teeth small, transverse on middle of hinge but becoming oblique laterally; the lateral teeth, numbering 3 to 4 on each side of hinge, are curved strongly ventrally and some bifurcate. The adductor scars are subovate, and the pallial line simple. There is no posterior adductor plate. The margins of the shell are smooth.

The small specimen shown on plate 4, figures 4, and 5, has a length of 14 mm, a height of 10.5 mm, and a convexity of 5 mm. Comparable measurements of the specimen shown on plate 4, figure 3, are 37 mm, 25 mm, and 8 mm.

The holotype of *Dicranodonta dowlingi* McLearn is from the Cadotte member of the Peace River formation and is part of the fauna characterized by the ammonite *Gastroplites.* In northern Alaska *Dicranodonta* has likewise been found only in the *Gastroplites*-bearing beds in the upper part of the Tuktu formation and in the lower 400 feet of the Ignek formation.

Dicranodonta dowlingi McLearn greatly resembles *D. petschorae* (Keyserling) (Schmidt, 1872, p. 151, 152, pl. 1, figs. 14a–d, pl. 3a, figs. 17a–c) from the lower part of the Yenisei River in northern Siberia. It appears to be more compressed near its ventral margin and to have coarser concentric ribbing. *D. obliqua* (Keeping) (Woods, 1899, p. 55, 56, pl. 11, figs. 3a–c, 4) is more ovate, less convex, and has less prominent umbones.

Plesiotypes.—USNM 128608–128611.

Occurrences.—Tuktu formation at USGS Mes. locs. 3204, 20394, 20395, 20403, 20405, 20432, 20484, 24296, 24430, 24623; Ignek formation at Mes. loc. 10306.

Genus ASTARTE Sowerby, 1816

Astarte ignekensis Imlay, n. sp.

Plate 3, figures 4–6, 9–12

This species is very abundant in both the black shale and the underlying sandstone that constitute the lower member of the Ignek formation. Elsewhere in northern Alaska the species is represented only by two specimens from the Tuktu formation.

The shell is moderately convex, most inflated above the midheight, and subquadrate in outline in young, becoming subtriangular in adult. The beaks are fairly prominent, situated a little anterior to the middle. The ornamentation on the young and on the umbones of the adults consists of sharp high widely spaced concentric ribs. On these and on the interspaces are superimposed fine concentric striae. During growth the sharp ribs are replaced ventrally rather abruptly by broad indistinct undulations on which are superimposed fine, dense concentric ribs.

The following are dimensions of the holotype: Length 20 mm, height 21 mm, estimated convexity 13 mm.

A. ignekensis is characterized by the abrupt change in the character of its ribbing from very coarse to fine. *A. senecta* Woods (1906, p. 106, pl. 14, figs. 13–20), from the Lower Cretaceous of England, is similar in appearance but has a more subquadrate outline and more anteriorly situated beaks and does not show an abrupt change in ribbing during growth.

Types.—Holotype, USNM 128612; paratypes, USNM 128613, 128614.

Occurrences.—Tuktu formation at Mes. locs. 3204, 20454, 25133; Topagoruk formation in the South Barrow test well 1 at 3,120 feet; Ignek formation at USGS Mes. locs. 10293, 10306, 10311, 10312, 23773, 24017, 24019, 24034.

Astarte portana McLearn

Plate 3, figure 20

Astarte portana McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 5, figs. 1, 2. Appendix validating species published in 1948.

The original description is as follows:

> Small, ovate below, triangular outline above. Beaks anterior to middle. Concentric, broad, flat ribs on bands separated by evenly spaced furrows. Concentric ornament broader and flatter than in *Astarte senecta* Woods.

The broad, flat, evenly spaced ribs and the trigonal outline are the distinguishing features of *A. portana*. They are well shown on two specimens from northern Alaska.

Astarte portana McLearn is recorded from the Gates formation in the East Peace River foothills, British Columbia (McLearn and Kindle, 1950, p. 76).

Plesiotype.—USNM 128615.

Occurrences.—Tuktu formation at USGS Mes. locs. 24625, 25133.

Genus TANCREDIA Lycett, 1850

Tancredia stelcki McLearn

Plate 4, figures 8–12

Tancredia stelcki McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 10, fig. 5, pl. 12, fig. 10. Appendix validating species published in 1948.

The original descriptions is as follows:

> Holotype is moderately convex with angular, anterior outline. Shallow radial furrow ventral to post-umbonal slope. Not so flattened as *Tancredia? dowlingi* McLearn, has the radial furrow and antero-dorsal margin not so straight.

The type specimens have a short high outline, a steep posterior margin, subcentral beaks, and a distinct furrow extending from the posterior part of the umbones to the posteroventral margin. The paratype differs from the holotype by being twice as large, by having a less angular anterior margin, and by its posterior margins meetings the ventral margin at nearly a right angle instead of rounding evenly with the ventral margin. The differences in shape are probably related to the greater size and maturity of the paratype.

The species is represented in northern Alaska by 44 specimens, of which 43 are from the Kukpowruk formation, and 1 is from the Corwin formation. These agree very well with the type specimens, except that the postumbonal furrow is not present on all specimens, is more common on small specimens than on large specimens, and its position is indicated on the largest specimens by a flattened area lying in front of a postumbonal swelling. The ornamentation consists of fine to moderately coarse concentric ribs that are coarsest near the posterior margins.

T. stelcki McLearn belongs to the corbuliform group of *Tancredia* (Cox, 1929, p. 573) and greatly resembles *T. americana* Meek (1876, p. 142, pl. 38, figs. 1 a–h), from the Montana group of Late Cretaceous age of the western interior region of the United States. That species likewise may, or may not have a postumbonal furrow. *T. americana* differs from *T. stelcki* mainly by being more inflated and by having a more steeply inclined posterior margin.

Plesiotypes.—USNM 128616–128619.

Occurrences.—Kukpowruk formation at Mes. locs. 24453, 24458, 24476, 24478, 24484, 24485, 25786, 25788–25792; Corwin formation at Mes. loc. 25802.

Tancredia kurupana Imlay, n. sp.

Plate 3, figures 19, 21–23, 25, 26

The species is represented by 50 specimens, of which most are from the Kukpowruk formation. The shell is elongate subtrigonal in outline, stout in young, becoming moderately compressed in adult. The posterodorsal margin is slightly convex and moderately inclined. The posterior end rounds regularly into the ventral margin in the young, but makes an acute angle in the adult. The anterodorsal margin is slightly concave and moderately inclined. The anterior end is very narrowly rounded and rostrate. The ventral margin is broadly convex. The beaks are moderately prominent and are located a little in front of the middle of the shell. The surface is marked by fine concentric ribs and by irregularly spaced concentric undulations that are strongest on the umbonal region and near the posterior margin. The pallial line (pl. 3, fig. 25) is simple, remote from margin, and bends up sharply at an acute angle to the posterior adductor scar.

The dimensions of the type specimens are as follows:

Specimen	Length (mm)	Height (mm)	Convexity of one valve (mm)
Paratype (pl.3, fig. 26)	98	61	12
Holotype (pl. 3, fig. 23)	78	50	12
Paratype (pl. 3, fig. 19)	67	43	13
Paratype (pl. 3, fig. 22)	49	29	9.5
Paratype (pl. 3, fig. 21)	49	28	7

Tancredia kurupana differs from *T. stelcki* McLearn by its more elongate, stouter shell, more anteriorly situated beaks, more vigorous ribbing, and by lacking a postumbonal furrow. Immature specimens are considerably more elongate than *T. pacia* McLearn (1919, pl. 5, fig. 5; 1948, Appendix to Canada Geol. Survey Paper 44–17), from the Clearwater shale of Alberta.

T. kurupana occurs with *T. stelcki* at only four localities but has a similar range.

Types.—Holotype, USNM 128620; paratypes, USNM 128621–128624.

Occurrences.—Kukpowruk formation at USGS Mes. locs. 12178, 24452–24455, 24458, 24460, 24468, 25786, 25791, 25794, 25800; Tuktu formation at Mes. loc. 20405; Grandstand formation at Mes. locs. 20478, 24638.

Genus ARCTICA Shumacker, 1817

Arctica? sp.

Plate 6, figures 11–14, 16

Pelecypods closely related to, or possibly belonging to, the genus *Arctica* are common in beds of Albian age in northern Alaska. The Geological Survey collections contain 85 specimens from the Tuktu formation, 93 from the Kukpowruk formation, 28 from the Grandstand formation, 15 each from the Corwin and Ignek formations, 12 from the Torok formation, and 2 from the Topagoruk formation. Most of the specimens are internal molds, are deformed, and are very poorly preserved. Probably only one species is present, but that cannot be proved. Specimens of medium size resemble in size and outline *Arctica* sp. figured by McLearn (1945, pl. 5, fig. 7). Some are as much as twice as large, but many are smaller. The height and the forward inclination of the beaks are highly variable features and seem to be related in part to deformation. The surface is covered with fine, but irregular concentric riblets. A weak ridge extends from the posterior side of the umbo to the posteroventral margin.

Figured specimens USNM 128625–128628.

Occurrences.—Torok formation at USGS Mes. locs. 13717, 25804; Kukpowruk formation at Mes. locs. 12178, 13310, 13721, 13722, 13729, 24452, 24454, 24458, 24459, 24461, 24465, 24466, 24468, 24469, 24474, 24479, 24480, 24481, 24485, 24486, 24488, 25786, 25789, 25790, 25801; Tuktu formation at Mes. locs. 20392, 20395, 20396, 20397, 20405, 20408, 20454, 24299, 24429, 24430, 24619, 24623, 24624, 24626, 24627, 25123, 25127, 25132, 25133; Grandstand formation (surface) at Mes. locs. 20398, 20435, 24298, 24301, 24638, 25136, 25139; Grandstand formation (subsurface) in East Oumalik test well 1 at depth of 1,356 feet, Topagoruk test well 1 at 911–919 feet, Titaluk test well 1 at 528–530 feet, Wolf Creek test well 3 at 1520–1522 feet; Topagoruk formation in Grandstand test well 1 at 1,275 feet; Ignek formation at Mes. locs. 10306, 10312, 24016, 24017, 24018, 24034; Corwin formation at Mes. loc. 12478.

Genus VENIELLA Stoliczka, 1870

Veniella sp.

Plate 6, figures 5–7

The genus is represented by 9 fragments from the subsurface Grandstand formation and 4 from the Tuktu formation. These all retain some shelly material and the fragments from the Grandstand formation show traces of the hinge and adductor scars. The specimens from the Tuktu formation (pl. 6 figs. 6, 7) are all small, ovate, tumid, and have a distinct postumbonal ridge. Their beaks curve strongly inward and forward. Their surfaces bear fine concentric ribs and widely-spaced, prominent concentric undulations. The specimens from the Grandstand formation are much larger than those from the Tuktu formation, are not nearly as stout, and the postumbonal ridge is weaker.

Their beaks curve inward and forward, and are situated near the anterior end of the shell. Their surfaces bear very fine concentric ribs and distant, coarser concentric ridges. The interior of a right valve exhibits a deeply impressed, ovate anterior adductor scar and a weak pallial line.

The Alaskan specimens of *Veniella* are similar in shape and ornamentation to *V. goniophora* Meek (1876, p. 152, 153, pl. 4, fig. 4, fig. 12 on p. 152), from the Colorado group of Early and Late Cretaceous Age of the western interior of the United States, but differ by their weaker postumbonal ridge and less anteriorly situated beaks.

Figured specimens USNM 128629, 128630.

Occurrences.—Tuktu formation at USGS Mes. loc. 20396; Grandstand formation in the Umiat test well 11 at a depth of 2,175 feet.

Genus FLAVENTIA Jukes-Browne, 1909

Flaventia? kukpowrukensis Imlay, n. sp.

Plate 6, figure 17

Nine external molds from northern Alaska belong to a species that is subovate in outline, longer than high, and fairly convex. The umbones are broad. The beaks are prominent, curved inward and forward, and situated about two-fifths of the length of the shell from the anterior end. The lunule and escutcheon are long and narrow. The anterodorsal margin is broadly concave and descends gently; the anterior margin is regularly rounded; the ventral margin is broadly rounded, curves gradually into anterior margin and rather sharply into posterior margin; the posterodorsal margin is long, slightly convex, and descends steeply; the posterior margin is short and nearly vertical. The surface is marked by fine, irregular concentric lines and by more widely spaced grooves. A weak but fairly distinct ridge extends from the umbo to the posteroventral margin. The hinge is not preserved.

Dimensions of holotype, a right valve: length 38 mm, height 28 mm, convexity 6 mm.

This species has the shape and ornamentation that characterize the Cretaceous genera *Flaventia* and *Aphrodina*, but the available molds do not show the hinge features that permit positive differentiation of these genera. Such features as the distinct umbonal ridge, the regularly rounded anterior margin, and the slightly rounded posterodorsal margin favor an assignment to *Flaventia* rather than to *Aphrodina* which characteristically has a narrowly rounded anterior margin and a humped posterodorsal margin. Also the occurrence of the Alaskan species in beds of Albian age favors such an assignment, because *Flaventia* has been recorded from various stages of the Lower Cretaceous, whereas the records of *Aphrodina* known to the writer are entirely from the Upper Cretaceous. Both genera are known from the lower part of the Upper Cretaceous, but *Aphrodina* ranges higher.

Flaventia? kukpowrukensis Imlay is distinguished readily from the described North American species of *Flaventia* (Stewart, 1930, p. 247, pl. 4, fig. 6; Popenoe, 1937, p. 392–394, pl. 48, figs. 4, 9–11; Stephenson, 1952, p. 112, pl. 28, figs. 14–18) by having a well defined umbonal ridge, a less convex posterodorsal margin, and more prominent beaks. Among European species it is very similar in shape to *F. ricordeana* (d'Orbigny) in Woods (1908, p. 189, pl. 29, figs. 16–18), from the Lower Greensand of England, but has a less convex posterodorsal margin and a more distinct umbonal ridge.

Holotype.—USNM 128631.

Occurrences.—Torok formation at Mes. loc. 24475; Kukpowruk formation at USGS Mes. locs. 24469, 24473, 25789.

Genus SOLECURTUS Blainville, 1824

Solecurtus? chapmani Imlay, n. sp.

Plate 3, figures 14–18

Solecurtus? (Azor)? sp. McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 11, fig. 2.

Pharus sp. McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 12, fig. 7.

This species is represented by 11 molds, of which 4 include both valves. The shell is elongate, oblong, moderately convex but bears a slight concavity near the middle of flanks. The posterior margin is more broadly rounded than the anterior. The ventral and dorsal margins are nearly parallel. The posterior dorsal area is slightly concave and bounded ventrally on the umbo by a weak carina. Umbones broad, inconspicuous, situated a little anterior to the middle of the shell. Ornamentation on immature specimens and on umbonal region of adults consists of strong concentric folds. During growth these are replaced by fine concentric ribs that appear first on the median part of the shell, then on the anterior end, and finally on the posterior end.

This species is similar in shape to *Solecurtus pelagi* (d'Orbigny) in Woods (1909, p. 218, pl. 35, figs. 5, 6), from the Cenomanian beds of England, and to *Solecurtus* cf. *S. pelagi* (d'Orbigny) in Frebold and Stoll (1937, p. 22, pl. 1, fig. 8), from the Aptian of Spitzbergen. It differs from both by having strong concentric folds.

The species is named for R. M. Chapman, of the Alaskan Branch of the U.S. Geological Survey.

Types.—Holotype, USNM 128632; paratypes, USNM 128633–128636.

Occurrences.—Torok formation at USGS Mes. loc. 25797; Kukpowruk formation at Mes. loc. 24468; Tuktu formation at Mes. locs. 20395, 24427, 24429, 24625, 24637; Grandstand formation in Gubik test well 2 at depth of 4,255 feet; Topagoruk formation in Grandstand test well 1 at depth of 1,926 feet.

Genus CULTELLUS Schumacher, 1817

Cultellus? kokolikensis Imlay, n. sp.

Plate 3, figures 7, 13

This species is represented by one internal mold that bears fragments of shell on the right valve and has been crushed slightly laterally. The shell is elongate, compressed, apparently gaping posteriorly, a little concave near middle of flanks, and bears a pronounced umbonal ridge that weakens toward the lower posterior margin. The umbones are broad and low. The beaks are inclined forward, barely rise above the hingeline and are situated about one-sixth the length of the shell from the anterior end. A shallow internal rib extends from the beak downward and slightly backward, fading out near the middle of the shell. Hinge characters are unknown. The anterior margin is steeply inclined and rounds rather sharply into the broadly rounded ventral margin; the posterior margin is steeply inclined and subangular at junction with ventral margin; the dorsal margin posterior to the beaks is long and straight. The surface of the mold is marked with rather prominent, irregularly spaced growth undulations that bend back sharply on the umbonal ridge.

Dimensions of holotype: length 80+ mm, height 36 mm, convexity 16+ mm (not allowing for crushing).

The generic position of this species is very uncertain. Its shape, the position of its beaks, and the prominent umbonal ridge suggest a position within the Cultellidae rather than the Solenidae. It shows a general resemblance to "*Solen*" *guerangeri* d'Orbigny from the Late Cretaceous of France but is stouter and its beaks are more anterior. Its shape is similar to that of *Ceroniola australis* (Gabb), in Wilckens (1904, p. 249, pl. 20, figs. 11–13), from the Late Cretaceous of Chile, but it is distinguished readily by its pronounced umbonal ridge.

Holotype.—USNM 128637.

Occurrence.—Kukpowruk formation at USGS Mes. loc. 24488.

Genus PLEUROMYA Agassiz, 1845

Pleuromya sikanni McLearn

Plate 5, figures 1, 2, 5, 6

Pleuromya sikanni McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pd. 12, fig. 1. Appendix validating species [published in 1948].

The original description is as follows:

Inflated, ovate, nearly anterior beaks. Concentric irregular striations and varices of growth. Lacks regular, concentric ornament of *Pholadomya* (*Pleuromya?*) *ligeriensis* d'Orbigny.

Eleven specimens from the Tuktu formation are identified with *P. sikanni* McLearn, from the *Neogastroplites*-bearing beds in British Columbia. All are more or less distorted, as is common in the genus, resulting in considerable variation in the outline of the shell and the position of the beak. Compared with *P. borealis* Warren (1947, p. 119, pl. 29, figs. 1–4), from the *Subarcthoplites*-bearing beds of the Mackenzie River valley, *P. sikanni* appears to have much finer and less regular concentric ribbing and less prominent umbones.

Plesiotypes.—USNM 128638, 128639.

Occurrences.—Tuktu formation at USGS Mes. locs. 20395, 24429, 25129. The species is probably represented by much distorted specimens from the Oumalik formation in the South Barrow test well 2 at the depth of 2,276 feet and in the South Barrow test well 3 at the depth of 1,628 feet.

Pleuromya kelleri Imlay, n. sp.

Plate 5, figures 3, 4, 7

Four specimens from the Fortress Mountain formation belong to a species that is quite distinct in shape and ribbing from the described species of Albian age in Western Canada. Its shape is oblong, subtrigonal, compressed. The valves gape slightly posteriorly. The anterior margin is slightly convex, slopes steeply forward, and rounds rather abruptly into the ventral margin. The posterodorsal margin inclines gently backward and passes rather abruptly into a moderately narrow posterior margin. The ventral margin is slightly convex and rounds evenly into the posterior margin. The umbones are moderately prominent. The beaks curve inward and forward and are situated about one-fourth of the length of the shell from the anterior end. The surface is marked with fine concentric growth lines and weak concentric folds. A faint depression extends from the umbones to the ventral margin in the anterior part of the shell. The holotype has a length of 44 mm, a height of 29 mm, and a convexity of 16.5 mm. It has been compressed slightly and its posterior margin is imperfect.

P. kelleri is characterized by its fine ribbing and compressed subtrigonal shape. Both *P. sikanni* McLearn and *P. borealis* Warren have much coarser ribbing, a more evenly rounded anterior margin, more prominent umbones, and are much more robust.

This species is named for A. S. Keller of the Geological Survey, who collected the type specimens.

Types.—Holotype.—USNM 128640; paratype, USNM 128641.

Occurrence.—Fortress Mountain formation at USGS Mes. loc. 24431.

Genus PANOPE Ménard, 1807

Panope? kissoumi (McLearn)

Plate 5, figures 8, 9, 11, 12

Pleuromya kissoumi McLearn, 1945, Canada Geol. Survey Paper 44-17 (2d ed.), pl. 10, fig. 8. Appendix validating species [published in 1948].

The original description of *Pleuromya kissoumi* McLearn is as follows:

Fairly convex, elongate, narrowing posteriorly. Beaks a little anterior to middle. Irregular concentric striae and varices of growth. More elongate, more narrow posteriorly and beak nearer center than in *Pleuromya orbigniana* (Rouillier).

The collections from northern Alaska contain 45 specimens of a species, of which the larger match very well with *Pleuromya kissoumi* McLearn. These show that during growth the posterior margin becomes more narrowly rounded and a weak postumbonal ridge develops.

The species *Pleuromya kissoumi* McLearn probably belongs to the same genus as *Psilomya elongatissima* McLearn (1933a, p. 149, pl. 3, fig. 2). It differs by being more convex, more elongate posteriorly, and by having slightly stronger ribbing. The posterior margin is truncated more obliquely as a consequence of the greater elongation. Assignment to *Panope* rather than *Pleuromya* is favored by the position of the beaks, the roundness of the anterior margin, and the absence of a sulcus on the anteroventral margin. The narrowed posterior margin contrasts with the quadrate margin of most species of *Panope*, but is matched very closely by *Panope recta* d'Orbigny (1845, p. 334, pl. 336, figs. 1, 2), from the Neocomian of France. The correct generic status of *Panope? kissoumi* (McLearn) and *P.? elongatissima* McLearn can only be determined by the discovery of specimens that show the hinge.

In Canada *Pleuromya kissoumi* McLearn has been recorded from beds characterized by the ammonite *Neogastroplites* (McLearn, 1945a, p. 11). In northern Alaska the records of *Panope? kissoumi* (McLearn), from the Tuktu formation and the upper part of the Torok formation, show that the species occurs as low as the *Gastroplites* zone.

Plesiotypes.—USNM 128642–128644.

Occurrences.—Torok formation at USGS Mes. locs. 13717, 24463, 24477; Kukpowruk formation at Mes. locs. 24469, 24470, 24486, 24487; Tuktu formation at Mes. locs. 24297, 24624, 25126; Grandstand formation at Mes. locs. 20435, 24301; Chandler formation at Mes. locs. 20474, 24432; Ignek formation at Mes. loc. 24016.

Panope? elongatissima (McLearn)

Plate 5, figures 10, 13–17

Psilomya elongatissima McLearn, 1933, Royal Soc. Canada Trans., 3d ser., v. 25, sec. 4, p. 149, pl. 3, fig. 2.

The original description is as follows:

This is a moderately convex elongate thin-shelled species. The beaks are situated a little in front of the middle to one-quarter the length from the anterior end. The shell is evenly convex, and somewhat compressed posteriorly. The anterior margin is well rounded, the ventral margin rounded and the posterior margin obliquely truncate above. Very little of the surface is preserved and it shows low varices of growth. Low concentric undulations show in the mold of the interior. The pallial line and dentition are not known. The species is referred provisionally to *Psilomya*, on basis of general form, but with less certainty than *P. peterpondi* n. sp.

Measurements of holotype are: height 29 mm, length 45.5 mm.

This species is more elongate than *P. peterpondi* n. sp., is more evenly convex and more compressed posteroventrally. It is very close to *Liopistha* (*Psilomya*) *elongata* Stanton from which it differs mainly in being more elongate and a little larger. larger.

Comparison of a plaster replica of the holotype of *Psilomya elongatissima* McLearn with the type specimens of *Psilomya elongata* (Stanton) (1893, p. 119, pl. 26, figs. 11, 12) shows that McLearn's species has much lower umbones, less anteriorly situated beaks, a much less convex shell, and finer, irregular concentric ribbing. The low umbones, irregular ribbing, and the lack of radial rows of tiny tubercles show that it does not belong in *Psilomya*.

Examination of about 35 molds of the species from northern Alaska suggests that its generic position is near *Panope*. Such an assignment is favored by the shape and positions of the umbones, the irregularity of the concentric folds and riblets, a posterior gape, and the presence of a weak ridge extending posteriorly a short distance from the umbones. The features not favoring an assignment to *Panope* are the roundness of the ventral margin and the oblique truncation of the posterior margin of the shell. Most described species of *Panope* have a subquadrate outline. However, one *Panope* from Russia (Eichwald, 1868, p. 778, pl. 27, figs. 10a, b) has an outline nearly identical with that of *Panope? elongatissima*. Also, *Panope cottaldina* (d'Orbigny) (1845, p. 330, pl. 354, figs. 1, 2) from France has a similar outline.

Plesiotypes.—USNM 128650–128652.

Occurrences.—Kukpowruk formation at USGS Mes. locs. 20491, 24456; Grandstand formation at Mes. locs. 20399; Tuktu formation at Mes. locs. 20405, 20484, 24274, 24427, 24430, 24623, 24625, 25121, 25130, 25133, 25135; Ignek formation at Mes. locs. 10306, 10311, 24016, 24019, 24020.

Genus HOMOMYA Agassiz, 1842

Homomya sp.

Plate 6, figures 20, 22

Homomya is represented in northern Alaska by 2 large and 2 small internal molds that are too poorly preserved to describe as a new species. The shell is oblong, robust, and gapes posteriorly. The umbones are broad and low. The beaks are nearly terminal and strongly incurved. The surface is ornamented with rather weak concentric undulations and riblets.

Figured specimen USNM 128653.

Occurrences.—Tuktu formation at USGS Mes. locs. 20454, 24626, 25122.

Genus GONIOMYA Agassiz, 1842

Goniomya matonabbei McLearn

Plate 6, figure 18

Goniomya matonabbei McLearn 1933, Royal Soc. Canada Trans., 3d ser., v. 27, sec. 4, p. 147, pl. 1, fig. 8.

The original description is as follows:

A broadly ovate, moderately convex species, rounded anteriorly and obliquely truncated posteriorly. The surface has rather irregular concentric ridges. The V-shaped ornament does not descend to the ventral part of the shell, at least on the left valve. Dentition and interior are not known. Measurements of the holotype are: height 33 mm, length 66 mm.

Three specimens from northern Alaska show the essential features of the holotype, although less well preserved.

Plesiotype.—USNM 128654.

Occurrences.—Tuktu formation at USGS Mes. loc. 20405, Ignek formation at Mes. locs. 10293, 23775.

Genus THRACIA Leach, 1823

Thracia stelcki McLearn

Plate 6, figures 1–3

Thracia stelcki McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 11, fig. 9. Appendix validating species published in 1948.

The original description is as follows:

Somewhat quadrate outline, longer than high. Somewhat flattened sides of shell with distinct 'carina'. Irregular, concentric folds or bands. Straighter carina, less convex than *Thracia sanctae-crucis* Pictet and Campiche.

This species is distinguished from *Thracia kissoumi* McLearn (1933a, p. 147, pl. 1, figs. 6, 7) by its more elongate, quadrate outline and less convex shell. Of these features the quadrate outline is the most useful in distinguishing the species, as the other features appear to be more variable and may have been modified by crushing.

In Canada, *Thracia stelcki* McLearn has been found in beds characterized by the ammonite *Neogastroplites* (McLearn, 1945a, p. 11), and *Thracia kissoumi* McLearn in beds characterized by the ammonite *Subarcthoplites*, but the genus *Thracia* has not been reported from the intervening beds characterized by the ammonite *Gastroplites.*

In collections from northern Alaska, *Thracia stelcki* is represented by 41 specimens, of which most are from the Tuktu and Grandstand formations. As these formations have furnished the ammonite *Gastroplites*, the species *T. stelcki* has a longer range than is indicated by its reported range in Canada.

Plesiotypes.—USNM 128655a, b.

Occurrences.—Kukpowruk formation at USGS Mes. locs. 24467, 24470; Tuktu formation at Mes. locs. 20412, 20436, 20484, 20494, 24274, 24430, 24627, 25121, 25131, 25792; Grandstand formation at Mes. locs. 12413, 20477; Ignek formation at Mes. loc. 10293.

Thracia cf. T. kissoumi McLearn

Plate 6, figure 4

A few specimens have a shorter, rounder outline than *T. stelcki* McLearn and may belong to *T. kissoumi* McLearn (1933a, p. 147, 148, pl. 1, figs. 6, 7). Definite identification cannot be made because all the specimens in question are crushed or distorted.

Figured specimen USNM 128656.

Occurrences.—Fortress Mountain formation at USGS Mes. loc. 24431; Ignek formation at Mes. locs. 10293, 23773; Oumalik(?) formation in the South Barrow test well 1 at 3,118 and 3,138 feet; Topagoruk formation in the Grandstand test well 1 at 1,606 and 2,017 feet. Tuktu formation at Mes. loc. 24296.

Genus MYOPHOLAS Douville, 1908

Myopholas sp. juv.

Plate 6, figure 8

One small specimen of *Myopholas* about 7 mm long shows considerable resemblance to a specimen from the Lower Greensand of England figured by Woods (1909, p. 253, pl. 42, figs. 3a, b). It has only six sharp radial ribs on the anterior part of the shell, whereas the specimen from England has thirteen, but this difference may be related to its much smaller size.

Figured specimen USNM 128657.

Occurrences.—Ignek formation at USGS Mes. loc. 10293.

Genus OXYTOMA Meek 1864

Oxytoma camselli McLearn

Plate 6, figures 9, 10

Oxytoma camselli McLearn, 1931, Royal Soc. Canada Trans., 3d ser., v. 25, sec. 4, p. 5, pl. 1, figs. 7, 8.
Oxytoma camselli McLearn, 1933, Royal Soc. Canada Trans., 3d ser., v. 27, sec. 4, p. 143, pl. 1, figs. 4, 5.
Oxytoma camselli McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 3, fig. 13.

Four specimens are assigned to *O. camselli* McLearn on the basis of having fine, dense, radiating riblets of which the primaries are not much stronger than the secondaries.

Plesiotypes.—USNM 128658, 128659.

Occurrences.—Torok formation at USGS Mes. loc. 25804; Kukpowruk formation at Mes. loc. 24452; Tuktu formation at Mes. loc. 20403.

Genus AUCELLA Keyserling 1846

Aucella okensis Pavlow

Plate 7, figures 5–20

Aucella okensis Pavlow, 1907, Soc. Imp. Naturalistes Moscou, Nouv. Mém., v. 17, livr. 1, p. 40, pl. 1, figs. 10a–c, 11a–c.
Aucella okensis Sokolov, 1908, Acad. Imp. Sci. St. Pétersbourg, Mus. Géol. Pierre le Grand Travaux, vol. 2, p. 67, pl. 4, fig. 6a, b.
Aucella canadiana Crickmay, 1930, Natl. Mus. Canada Bull. 63 (Geol. Ser. 51, Contr. to Canadian Paleontology), p. 47, pl. 10, figs. 3–5.
Aucella cascadensis Crickmay, 1930, idem, p. 47, pl. 10, figs. 1, 2.
Aucella okensis Sokolov and Bodylevsky, 1931, Skrifter om Svalbard og Ishavet no. 35, p. 40, pl. 1, figs. 7, 8.

This species is represented from northern Alaska by about 100 specimens. It is characterized by being much larger than most species of *Aucella* and by having sharp, high, distantly spaced concentric ribs. Its general appearance is similar to that of *Inoceramus* and isolated valves might easily be so mistaken.

The shell is moderately elongated and inequivalved. The left valve is strongly convex and the right valve moderately convex. The umbo of the left valve is stout and curved over the umbo of the right valve. The surface is marked by sharp concentric ribs that are unusually widely spaced and that increase in coarseness and spacing until the shell attains a fairly large size. On the largest shells the concentric ribs are replaced near the ventral and posterior margins by weak, irregularly spaced ribs.

Pavlow (1907, p. 40, 42) notes that *A. okensis* is easily distinguished by its large size from most other species, but that it greatly resembles *A. subokensis* with which it is associated in the lower part of its range. He says that *A. subokensis* has less convex valves, a smaller beak, a more trigonal outline, and a smaller posterior ear.

One of the specimens of *A. okensis* illustrated by Pavlow (1907, pl. 1, figs. 10a–c) is reported to be from the Knoxville formation of Late Jurassic age of California, which formation as then defined included beds of Portlandian to Valanginian ages. This report is interesting because the west coast collections of the U.S. Geological Survey do not contain a single representative of *A. okensis*, nor did Anderson describe the species in his papers dealing with the Late Jurassic and Early Cretaceous of the west coast. The mere listing of *A. okensis* by Anderson (1945, p. 940, 942) is of little value.

In Russia *A. okensis* is recorded by Pavlow (1907, p. 40) from beds that are correlated with the Berriasian, or Infravalanginian. In northern Alaska the species occurs in the lower part of the Okpikruak formation and generally within the lower 200 to 300 feet. It underlies beds containing *Aucella sublaevis* (Keyserling (equals *A. piriformis* Lahusen) which in turn underlies beds containing *A. crassicollis* Keyserling. This is the same sequence as in Russia. *A. okensis* has been recorded elsewhere in Alaska in the Eagle district in the Upper Yukon region, but its stratigraphic relationship to *A. sublaevis* found in the same district is not known (Imlay and Reeside, 1954, p. 236). The occurrences of *Aucella* from the Harrison Lake area, recorded by Crickmay (1930, p. 40–42) show that *A. okensis* underlies *A. crassicollis* but do not prove that *A. okensis* is older than Valanginian. The Berriasian age for *A. okensis* in British Columbia and Alaska is based on the similarity of the faunal sequence with that in Russia where the ages of the beds are based on ammonites.

Plesiotypes.—USNM 128670–128676.

Occurrences.—Okpikruak formation USGS Mes. locs. 21560, 21821, 22472, 22478, 22492, 22499, 22594, 22724, 22726, 22729, 22730, 22732, 22738, 22757, 22765, 22789–22792, 22795, 23557, 23559, 23564, 24031.

Aucella subokensis Pavlow

Plate 7, figures 1–4

Aucella subokensis Pavlow, 1907, Soc. Imp. Naturalistes Moscou, Nouv. Mém. v. 17, livr. 1, p. 41, 42, pl. 1, figs. 17a–c.

Aucella subokensis Sokolov and Bodylevsky, 1931, Skrifter om Svalbard og Ishavet, no. 35, p. 41.

?*Buchia volgensis* Spath, Meddelelser om Grønland, 1947, v. 132, no. 3, p. 34, pl. 1, fig. 9, pl. 3, fig. 5, pl. 4, figs. 8, 9, pl. 5, figs. 1, 2.

Nearly 100 specimens from northern Alaska are assigned to *Aucella subokensis* Pavlow. They are similar to *A. okensis*, with which they are associated at five localities, but are distinguished by their smaller size, more elongate shape, and finer, more closely spaced ribbing. Some of the coarser ribbed specimens of *A. subokensis* are rather similar to some of the immature finer ribbed specimens of *A. okensis*. The two species are considered distinct, however, because most specimens are easily placed in one species, or the other, and because each species occurs without the other at a number of localities in Alaska.

The Alaskan specimens of *A. subokensis* likewise show resemblances to *A. volgensis* Lahusen (1888, p. 16, 38, pl. 3, figs. 1–16; Woods, 1905, p. 69, pl. 10, figs. 1a–c, 2a–c; Pavlow, 1907, p. 27, pl. 2, figs. 10a–c, 12a–c; Sokolow, 1908b, p. 19, pl. 2, figs. 14, 15), but have sharper, more widely spaced, more regularly spaced ribs and are much less elongated posteriorly. Some specimens from the basal Cretaceous of East Greenland assigned by Spath (1947, pl. 4, figs. 8, 9, pl. 5, figs. 1, 2) to *A. volgensis* have the same kind of ribbing as the Alaskan specimens herein referred to *A. subokensis*. Perhaps the variation in *A. volgensis* is sufficient to include *A. subokensis*, but the latter appears to be more similar to *A. okensis* than to most specimens of *A. volgensis* that have been illustrated.

In Russia, *A. subokensis* Pavlow is reported to range from the zone of *Riasanites rjasanensis*, of probable latest Jurassic age, into the zone of *Subcraspedites spasskensis* at the very base of the Cretaceous (Pavlow, 1907, p. 42, 76, chart opposite p. 84). In northern Alaska it occurs in the lower few hundred feet of the Okpikruak formation beneath the beds containing *Aucella sublaevis* (Keyserling) and is associated with *A. okensis* at a number of localities. In southeastern Alaska *A. subokensis* is recorded from Chichagof Island (Imlay and Reeside, 1954, p. 227).

Plesiotypes.—USNM 128677–128679.

Occurrences.—Okpikruak formation, USGS Mes. locs. 21560, 21821, 22472, 22508, 22728, 22738, 22757, 22762, 22765, 22786, 22791, 23555, 23556, 23564, 24010, 24031. Fragmentary specimens probably belonging to *A. subokensis* Pavlow occur at Mes. locs. 13309, 22479, 22515, 22516, 22727, 22794, and 24656.

Aucella sublaevis Keyserling

Plate 8, figures 1–15

Aucella concentrica var. *sublaevis* Keyserling, 1846, Wissenschaftliche Beobachtungen a. e. Reise in das Petschora-Land. St. Petersburg, p. 300, pl. 16, figs. 3–16.

Aucella piriformis Lahusen, 1888, Mém. Com. Géol. St. Petersbourg. v. 8, no. 1, p. 22, 42, pl. 5, figs. 1–7.

Aucella sublaevis Nikitin, 1888, Mém. Com. Géol. St. Petersbourg, v. 5, no. 2, p. 74, pl. 2, figs. 13, 14.

Aucella piriformis Pavlow, 1907, Soc. Imp. Naturalistes Moscou, Nouv. sér, Mém., v. 17, livr. 1, p. 63, 64, pl. 5, figs. 20a–c, 21a–c, 22a–c.

Aucella sublaevis Sokolov, 1908b, Mém. Com. Géol. St. Petersbourg, Nouv. sér., livr. 36, p. 22, pl. 3, figs. 3–5.

?*Aucella keroiskensis* Crickmay, 1930, Natl. Mus. Canada Bull. 63 (Geol. Ser. 51, Contr. to Canadian Paleontology), p. 48, pl. 10, figs. 6, 7.

Aucella sublaevis Sokolov and Bodylevsky, 1931, Skrifter om Svalbard og Ishavet, no. 35, p. 45, pl. 2, figs. 6, 7.

This species is represented by more than 600 specimens from northern Alaska. It is characterized by a small, plump, pear-shaped shell with numerous faint radial striae. The left valve is very convex and bears a small, pointed, projecting beak. The right valve is generally a little smaller and less convex than the left valve. The ventral margins of the two valves bend sharply toward each other and may meet at an obtuse angle. The surfaces are covered with concentric ribs that are commonly weak to fairly weak, but are moderately strong on a few specimens. Generally the concentric ribs become very faint near the ventral margins. A few of the largest specimens bear a pronounced constriction (pl. 8, fig. 14) similar to that commonly present on *Aucella crassicollis* Keyserling, but they may be distinguished by the presence of fine, radial striae provided some shell material or the external mold is preserved.

In northern Russia and Spitzbergen *Aucella sublaevis* Keyserling is recorded from beds of early to late Valanginian age (Pavlow, 1907, p. 64; Lahusen, 1888, p. 42; Sokolow, 1908b, p. 2, 7; Sokolow and Bodylevsky, 1931, p. 117, 118). It occurs higher than *A. okensis* and is associated at the top of its range with *A. crassicollis*.

In northern Alaska *A. sublaevis* occupies a similar stratigraphic position directly above *A. okensis* and *A. subokensis* and directly below *A. crassicollis*. In only two collections (Mes. locs. 22492 and 22724) is it definitely associated with *A. okensis*. In both of these the specimens of *A. sublaevis* have a slightly different matrix than that of the associated *A. okensis*, which suggests that the two species were collected from different beds. According to E. G. Sable, collection 22492 was an aggregate made along a cutbank several hundred feet long, and collection 22724 was obtained from float. Collection 22724 also contains *A. crassicollis* preserved in a different matrix than either *A. sublaevis* or *A. okensis*. In another collection (Mes. loc. 22490) *A. sublaevis* is associated with an *Aucella* that has the broad undulating ribbing characteristic of *A. crassicollis*. According to E. G. Sable, the specimens were not obtained from a single bed and the stratigraphic position of the beds is uncertain because of faulting. Except for these three collections, *Aucella sublaevis* was not obtained in association with either *A. okensis*, *A. subokensis*, or *A. crassicollis*.

Records of the position of *A. sublaevis* above the base of the Okpikruak formation show that the species occurs only in the lower few hundred feet of the formation. Collection 22484 was made from the very base, collection 22487 and 22793 about 100 feet above the base, collection 22485 and 22785 within 200 feet of the base, and collection 23554 within 400 feet of the base. Evidently in places where *A. sublaevis* occurs at the base of the formation, the zone of *A. okensis* is not represented by sediments.

Aucella sublaevis Keyserling has been identified elsewhere in Alaska: in the Nutzotin Mountains; in east-central Alaska; in various parts of the Yukon region; and in the Kuskokwim region; but its stratigraphic position relative to other species of *Aucella* has not been determined.

A. sublaevis is not present in the Geological Survey collections from the west coast States and was not described by Anderson (1938) in his monographic discussion of Lower Cretaceous faunas from California and Oregon. The absence of *A. sublaevis* and *A. okensis* from California and Oregon is in accord with the writer's observations that the oldest Cretaceous ammonites found in those states are not older than middle Valanginian.

Plesiotypes.—USNM 128680–128682.

Occurrences.—Okpikruak formation, USGS Mes. locs. 13716, 22128, 22474–22477, 22481–22485, 22489–22492, 22497, 22498, 22500, 22501, 22724, 22734, 22736, 22742, 22744, 22761, 22772, 22773, 22774, 22775, 22782, 22783, 22785, 22787, 22793, 23172, 23553, 23554, 23566, 23567, 23573, 23574, 23698, 24693, Oumalik test well 1 at 10,992–11,007 feet. *A.* cf. *sublaevis* Keyserling occurs at Mes. loc. 22494.

Aucella crassicollis Keyserling

Plate 8, figures 21–23, 26–32

(For most of the synonymy see Stanton, 1896, U.S. Geol. Survey Bull. 133, p. 45; Pavlow, 1907, Soc. Imp. Naturalistes Moscou, Nouv. Mém., v. 17, livr. 1, p. 62; Sokolow, 1908b, Com. Geol. (Petrograd) Mém., Nouv. ser., livr. 36, p. 24; Stewart, 1930, Acad. Nat. Sci. Philadelphia Special Pub. 3, p. 112–113; Anderson, 1938, Geol. Soc. America Special Paper 16, p. 103.

Several hundred specimens from northern Alaska are assigned to *A. crassicollis* Keyserling. Some of these at one time were placed by the writer under such names as *A. crassa* Pavlow, *A. solida* Pavlow, *A. uncitoides* Pavlow, and *A. terebratuloides* Lahusen. It was fairly easy to select specimens that resembled closely the illustrations of those species, but further studies of additional collection of *Aucella* from northern Alaska and from the west coast States led to the conviction that Stanton's concept of *A. crassicollis* is valid and that the extensive splitting of species by Pavlow, Anderson, and others is fictitious. After examining vast numbers of the *Aucella* in question in the field and laboratory the writer is convinced that only a single population is involved and that the differences that have been used to distinguish many so-called species can easily be explained by conditions of crowding on the sea bottom, by minor individual variations, by changes during growth, and by compression after burial. This conclusion regarding *A. crassicollis* is supported by Donovan (1953, p. 90), based on his recent studies in East Greenland. Evidently the concept of species in *Aucella* must have sufficient latitude to allow for the variable factors just mentioned. When such is done the various species can readily be recognized and used stratigraphically by field geologists, as has been demonstrated successfully in northern Alaska and in Oregon.

Aucella crassicollis Keyserling, as used herein, is a large, stout species having an ovate to trigonal outline. Both valves are strongly convex. The left valve is the larger and its beak is more elongate and strongly incurved. The right valve is more triangular than the left and its beak is smaller, more pointed, and inclined anteriorly. The surface ornamentation is highly variable. Some specimens are nearly smooth; a majority have low, rounded, irregularly spaced, concentric ribs; some have fairly sharp, more regularly spaced concentric ribs; and many specimens have ribs of intermediate characteristics. Weak to moderately strong concentric constrictions at irregular intervals are common, but may not be present on small and presumably immature specimens. Some adults have a pronounced concentric constriction that separates a swollen umbonal portion from a much less convex ventral portion. Such specimens fit the usual concept of *A. crassicollis*, but they are associated with others that differ only by not having such a constriction. Therefore, the feature is not of specific value. It is, however, of stratigraphic value, because it occurs most commonly among Aucellas of Valanginian age, as indicated by Pavlow (1907, table opposite p. 84) long ago.

In northern Eurasia, the range of *Aucella crassicollis* Keyserling, as the species was defined by Pavlow (1907, p. 62, p. 76, 77, table opposite p. 84), is middle Valanginian. Its range as the species is defined herein is Valaginian and possibly also upper Berriasian.

In northern Alaska, *A. crassicollis* is most common in the middle part of the Okpikruak formation, but occurs also in both the lower and upper parts. It even occurs in the basal beds of the formation at Mesozoic localities 22493, 22518, and 23565. Wherever its stratigraphic position relative to other aucellan species can be determined, it is higher than *Aucella subokensis* or *A. okensis*, and with the possible exception of Mesozoic locality 22490 it is higher than *A. sublaevis*. At this locality the specimens, according to the collector E. G. Sable, were not obtained from a single bed, and it is not known whether *A. crassicollis* and *A. sublaevis* were associated or occurred in different beds. The occurrence of *A. crassicollis* with *A. okensis* and *A. sublaevis* at Mesozoic locality 22724 has no significance, because all the fossils were obtained from float.

The presence of *Aucella crassicollis* in great abundance, by comparison with its occurrences in Eurasia, is strong evidence that the enclosing beds are of Valanginian age. Such an age assignment is supported by the occurrence of *A. crassicollis* in California and Oregon within beds containing the ammonites *Sarasinella*, *Thurmanniceras*, *Polyptychites*, and *Neocraspedites* and below beds containing lower to middle Hauterivian ammonites.

Aucella crassicollis Keyserling has been found at many places in Alaska and appears to be much more widespread than *Aucella sublaevis* Keyserling or *A. okensis* Pavlow.

Plesiotypes.—USNM 128683–128688.

Occurrences.—Okpikruak formation, USGS Mes. locs. 3202, 20470, 20471, 21553, 21561, 21823, 21837, 22488, 22490, 22493, 22503, 22505, 22506, 22510, 22514, 22517, 22518, 22522, 22589, 22592, 22724, 22725, 22731, 22737, 22767, 22777–22781, 22784, 22788, 23551, 23560, 23565, 23575, 23576, 24041, 24657, 24692. Specimens probably belonging to *A. crassicollis* occur at Mes. locs. 21824, 22473, 22486, 22487, and 22519.

Genus AUCELLINA Pompeckj 1901

Aucellina dowlingi McLearn

Plate 8, figures 16–20, 24, 25

Aucellina? dowlingi McLearn, 1945, Geol. Survey Canada Paper 44–17, pl. 5, fig. 3 [unpaged descriptive leaflet published in February 1948, to validate the new species illustrated].

Aucella dowlingi McLearn is represented by nearly 100 specimens in three collections from northern Alaska. These have been compared with plaster casts of the type specimen and agree very well in shape and ornamentation. A few specimens that are larger and flatter than the type specimen probably represent a more adult growth stage.

The shell is elongated posteriorly and becomes more elongated, during growth. The left valve is strongly convex, its umbo stout, and its beak strongly incurved. The right valve is gently convex to nearly flat and its beak is low and pointed. The surface is covered with very fine radial striae that are crossed by faint concentric ribs and by irregularly spaced concentric undulations. The latter become more prominent during growth.

Aucellina dowlingi is similar in shape to *A. gryphaeoides* (Sowerby) (Woods, 1905, p. 72, pl. 10, figs. 6–13; Pavlow, 1907, pl. 6, figs. 33–37; Sokolow, 1908a, pl. 5, figs. 7, 8; Sokolow, 1909, p. 57, pl. 5, figs. 7, 8), but has finer radial ribbing that covers more of the surface of the shell and has much weaker concentric ribbing. Donovan (1953, p. 92) confirms that radial ribbing is faint or absent on typical examples of *A. gryphaeoides* from England. Compared with *A. pompeckj* Pavlow (1907, p. 88, pl. 6, figs. 25–27), *A dowlingi* appears to be more convex and more elongated posteriorly, but the specimens figured by Sokolow (1908a, p. 74, pl. 4, fig. 7; Sokolow and Bodylevsky, 1931, p. 46, pl. 11, fig. 5) differ mainly in their much larger size. *A. maxima* Wollemann (1912, p. 156, pl. 9, figs. 2, 3, 3a, b), from Northern Germany appears to differ from *A. dowlingi* by its more elongate shape, larger size, and less pronounced concentric undulations.

The presence of *Aucellina* closely resembling *A. gryphaeoides* (Sowerby) indicates that the beds in which it occurs are not older than Albian, if the stratigraphic distribution of species of *Aucellina* discussed by Sokolow (1918, p. 310, 311) is the same in North America as in Eurasia.

Aucellina dowlingi McLearn has been found in northern Alaska only in the lower part of the Fortress Mountain formation. A similar species has been found southwest of the Brooks Range near the town of Bettles in the Koyukuk Valley. The common *Aucellina* in the

Kennicott formation of Early Cretaceous age of the Chitina Valley in southern Alaska is much larger, more rugose, and greatly resembles the Late Jurassic *Aucella mosquensis* (von Buch). The type specimens of *Aucellina dowlingi* are from the basal part of the Buckinghorse formation on the Sikanni Chief River in northeastern British Columbia (McLearn and Kindle, 1950, p. 86).

Plesiotypes.—USNM 128689–128691.

Occurrences.—Fortress Mountain formation, USGS Mes. locs. 21556, 21562, 22511.

Genus ISOGNOMON Solander, 1786

Isognomon? sp.

Plate 6. figures 15, 21

Nine specimens from northern Alaska have a compressed subquadrate shape, weak concentric growth lines, and a beak situated at the upper anterior extremity of the shell. The hinge area is imperfectly preserved, but appears to have many ligamental grooves arranged transverse to the hinge line. The general appearance is similar to that of "*Pedalion*" *williardi* Stephenson (1923, p. 125, pl. 23, figs. 1–3), from the Upper Cretaceous of North Carolina.

Figured specimens USNM 128693, 128694.

Occurrences.—Torok formation at USGS Mes. loc. 25811; Kokpowruk formation at Mes. locs. 24458, 24476; Tuktu formation at Mes. locs. 20436, 24428, 25133; Ignek formation at Mes. loc. 10306.

Genus INOCERAMUS J. Sowerby, 1819

Inoceramus anglicus Woods

Plate 9, figures 3, 4, 6; plate 10, figures 1, 4, 9

Inoceramus anglicus Woods, 1911, Palaeontographical Soc. for 1910, v. 2, pt. 7, p. 264, 165, pl. 45, figs. 8–10, text fig. 29.
Inoceramus cf. *anglicus* Frebold, 1932, Medd. om Grønland, v. 84, no. 6, p. 33, text figs. 14, 15.
Inoceramus anglicus Rosenkrantz, 1934, (in Bogvad and Rosenkrantz, Medd. om Grønland) v. 93, no. 1, p. 18, pl. 1, figs. 1, 2, pl. 2, fig. 1.
Inoceramus anglicus Donovan, 1953, Medd. om Grønland, v. 111, no. 4, p. 93, 94.

The Geological Survey collections from northern Alaska contain about 50 specimens of *Inoceramus anglicus* that compare very closely in shape and ribbing to the illustrations of the species from England and Greenland. Its subrounded shape and distinctive ribbing makes it one of the most easily recognized species of *Inoceramus*.

The species attains a maximum height of more than a foot. It is subovate in outline, higher than long, but becomes rounder during growth. The beaks are near the anterior margin. The hinge line is fairly short. The anterior part of the shell is moderately convex, the posterior part flattened. The ornamentation consists of strong, rounded symmetrical, regularly spaced concentric ribs that are separated by broader, rounded interspaces. The ribs become much less distinct on the flattened posterior part of the shell and this change may occur gradually or abruptly. Rib bifurcation, intercalation, and discontinuity is characteristic of the species. During growth the ribs increase gradually in strength ventrally on most specimens, but on a few specimens the ribs become irregular in strength near the ventral margin. Most of the Alaskan specimens show ribbing comparable to those specimens figured by Woods in his text figure 29, and his plate 45, figure 10, but some Alaskan specimens have somewhat finer ribbing, such as Woods shows on his plate 45, figures 8a, b, and 9.

The known distribution of *I. anglicus* indicates that it is a boreal species of middle to late Albian age. It has not been found in Alaska south of the Brooks Range or anywhere on the west coast of North America. In northern Alaska it occurs throughout the Tuktu formation, which is considered to be of middle Albian age. It is probably represented in the upper part of the underlying Torok formation by some small immature Inocerami. These possible occurrences in the Torok formation are in areas where the lower part of the Tuktu formation passes laterally into the upper part of the Torok. *I. anglicus* has not been reported from Canada, but *I. dowlingi* McLearn (1919, p. 11, pl. 3, figs. 7, 8; 1933a, p. 142, 143) from the Clearwater formation of Alberta may be based on immature specimens of *I. anglicus*. In the western interior region of the United States typical specimens of *I. anglicus* occur with the ammonite *Neogastroplites* in the Mowry shale, which is not older than late Albian (Reeside, 1923, p. 200; Cobban and Reeside, 1951, p. 1892, 1893; Cobban, 1951, p. 2197). In east Greenland *I. anglicus* has been recorded from a number of localities (Mayne, 1949, p. 34, 46, 145, 258; Donovan, 1953, p. 35, 36, 93, 94) in beds of middle Albian age. In England it is recorded from beds of middle and late Albian age (Woods, 1911, p. 265).

Plesiotypes.—USNM 128695–128699.

Occurrences.—Tuktu formation, USGS Mes. locs. 20392, 20394, 20402, 20404, 20406, 20409, 20438, 20439, 20464, 20472, 22754, 24619, 24633, 24634, 24635, 24636; Grandstand formation at Mes. locs. 20399, 20457; Kukpowruk formation at Mes. locs. 12479, 12480, 25785, 25786, 25787, 25790, 25792. Small Inocerami probably belonging to *I. anglicus* occur in the Torok formation at Mes. locs. 12477, 24639, 24640, 25120, 25812 and in the Tuktu formation at Mes. loc. 20403.

Inoceramus cf. I. cadottensis McLearn

Plate 9, figure 1

Several specimens from northern Alaska are compared with *I. cadottensis* McLearn (1931, p. 5, pl. 2, fig. 3; 1945a, pl. 7, fig. 3) rather than *I. anglicus* Woods mainly because their concentric ribs weaken and become indistinct toward the anterior, ventral, and posterior margins. They do not have the nearly terminal beak that occurs on the holotype of *I. cadottensis* and may be, therefore, only a variant of *I. anglicus*. It is possible, however, that *I. cadottensis* itself is only a variant of *I. anglicus* in which the ribs weaken marginally in the adult.

In Canada, *I. cadottensis* has been recorded at many places in northwestern Alberta and northeastern British Columbia, and in a few places north of these provinces associated with the ammonite *Gastroplites*, with starfish, or with certain pelecypods (McLearn, 1945a, p. 10, 11). The beds in which it occurs are considered middle Albian because of the presence of *Gastroplites* and because of their stratigraphic position with respect to other ammonite-bearing beds. The total range of *I. cadottensis* in Canada is not known, although published records (Henderson, 1954, p. 2275, 2284) show that it occurs at least in the lower part of the beds containing *Gastroplites*.

The specimens from northern Alaska that are compared with *I. cadottensis* occur with *I. anglicus* Woods in the Tuktu formation and apparently are not indicative of any particular part of the formation.

Figured specimen USNM 128700.

Occurrences.—Tuktu formation, USGS Mes. locs. 20454, 22753, 24426, 24633.

Inoceramus cf. I. altifluminis McLearn

Plate 9, figures 2, 5

Two specimens from the Tuktu formation and four specimens from the Fortress Mountain formation are possibly immature individuals of *I. altifluminis* McLearn (1943, p. 43; 1945a, pl. 6, fig. 4). Their shells are much higher than long and are obliquely modiolid in outline. The beaks are situated near the anterior extremity. The surface bears highly variable, unevenly spaced ribs, folds, and some irregular depressions. The ribs unite and divide in an irregular manner and tend to fade toward the margins of the shell.

These specimens are much smaller than the holotype of *I. altifluminis* McLearn and bear irregular ribbing at an earlier stage in their development. Their specific identification must await the finding of better material, or descriptions of the variations of *I. altifluminis*.

The occurrence of *I. altifluminis* in the Tuktu formation should not be surprising as the species in British Columbia is associated with *Gastroplites kingi* McLearn and *Inoceramus cadottensis* McLearn (McLearn and Kindle, 1950, p. 78, 80, 91), but an occurrence within the lower part of the Fortress Mountain formation would extend the range of the species much lower than any record from British Columbia.

Figured specimens USNM 128701, 128702.

Occurrences.—Fortress Mountain formation at USGS Mes. loc. 26142; Tuktu formation at Mes. loc. 22753.

Genus CAMPTONECTES Meek, 1865

Camptonectes dettermani Imlay, n. sp.

Plate 10, figures 2, 3, 7, 8

Ten specimens from northern Alaska belong to a species that attains an unusually large size for *Camptonectes*. The shell is suborbicular, its height and length are about equal, its posterodorsal margin is gently convex, and its anterodorsal margin is concave. The right valve is moderately convex in immature stages but becomes less convex during growth. The left valve is slightly more convex than the right valve. The anterior ears are much larger than the posterior. The surface of the shell is much corroded, but shows narrow, shallow, widely separated, fan-wise radiating striae. These are crossed on the larger shells by narrow, widely spaced, irregular concentric growth lines. The ears are marked by fine, vertical growth lines.

This species compares in size and relative dimensions with *Camptonectes cinctus* Sowerby in Woods (1902, p. 152, pl. 28), from the Lower Cretaceous of England, but is less symmetrical, has different ornamentation, and has a much larger anterior ear on the right valve. It compares more closely in shape to the equally large *C. giganteus* Arkell (1930, p. 100, pl. 7, figs. 2, 3), from the Upper Jurassic of England, but has much more widely spaced radiating striae. *C. matonabbei* McLearn (1933a, p. 146, pl. 2, figs. 11–13), from the Clearwater formation of Alberta, has a relatively higher shell and is much smaller than the species from northern Alaska, but comparisons are difficult to make because McLearn's species is based on two worn left valves that do not show the ribbing of the main body of the shell.

This species is named for R. L. Detterman of the Geological Survey, who collected many of the fossils discussed herein.

Types.—Holotype, USNM 128703; paratypes, USNM 128704, 128705.

Occurrences.—Kukpowruk formation at USGS Mes. locs. 24453, 24454, 24460, 24476, 24483.

Genus ENTOLIUM Meek, 1865

Entolium utukokense Imlay, n. sp.

Plate 11, figures 1–3, 5, 6, 8, 9

More than 100 specimens from northern Alaska are considered to belong to a single variable species. The valves are broadly ovate to nearly circular in outline. Some valves are slightly elongated posteroventrally. The left valves are moderately to strongly convex, have prominent umbones, and their surfaces bear irregular, broad concentric undulations. The right valves are slightly convex. Their surfaces are marked by closely spaced, regular concentric striae and by very widely spaced, narrow concentric furrows. The areas between the furrows are flat, or nearly flat. Some of the internal molds of the right valves bear radial striae, but such are not visible on the few specimens that retain the shell. The ears are nearly equal in size, rise slightly above the beak on the right valves and are slightly lower than the beak on the left valves. The surfaces of the ears bear fine growth lines and widely spaced furrows.

The interior of the right valve shows a resilium, a ligamental groove bounded by two ridges, and prominent crural ridges that are elevated at their ventral ends. On one specimen (pl. 11, fig. 3) the ligamental groove bears curved, transverse ridges.

The dimensions of some left valves are as follows:

Plate 11	Length (mm)	Height (mm)	Convexity
Figure 2	41	43	10
Figure 6	78	?	14
Figure 8	105	103	25

The left valve shown on plate 11, figure 8 is the most convex in the collections, but some left valves from northern Alaska are a little larger.

Entolium utukokense is distinguished from other described species of *Entolium* by its greater size and convexity. It appears to be most similar to *E. alcesianum* (McLearn) (1933a, p. 145, pl. 3, fig. 3), from the Clearwater formation of Alberta, but its left valve is much more convex and its left umbo is narrower and more prominent. The right valve of *E. alcesianum* (McLearn) is unknown and cannot be compared, therefore, unless it is represented by the holotype of *E. irenense* McLearn (1933a, p. 144, pl. 1, figs. 9, 10) of which species the left valve is unknown. The right valve of *E. irenense* appears to be less circular and less distinctly ribbed than any of the right valves of *E. utukokense*. All these species are assigned to *Entolium* rather than *Syncyclonema* because of their much larger size and because the ears on the right valve project dorsally above the hinge márgin.

Types.—Holotype, USNM 128706; paratypes, USNM 128707–128712.

Occurrences.—Kukpowruk formation at USGS Mes. locs. 12480, 13721, 24454, 24458, 24460, 24466, 24469, 24482, 24483, 24487, 25786, 25790, 25791, 25801, 25806, 25810; Grandstand formation at Mes. locs. 20435, 20478, 24298, 24638, 25137; Tuktu formation at Mes. locs. 20403, 20405, 20407, 20432, 20484, 24621, 24622, 24623, 24626, 24637, 25121, 25133; Chandler formation at Mes. loc. 24432.

Genus PLACUNOPSIS Morris and Lycett, 1853

Placunopsis nuka Imlay, n. sp.

Plate 11, figures 4, 7

This species is represented by two specimens and is characterized by strong but highly irregular, concentric folds and furrows. These are crossed by faint, undulating, radial striae of irregular strength and spacing. The shells are flattened, subcircular in outline, and have small pointed beaks near their margins.

Types.—Holotype, USNM 128713; paratype, USNM 128714.

Occurrences.—Fortress Mountain formation at USGS Mes. loc. 24695.

Placunopsis spp.

Plate 10, figures 5, 6

Twenty-two specimens show the undulating radial striae and irregular growth lines of the genus *Placunopsis.* Two species are present, but the preservation of the fossils does not justify assigning new names. One species, represented by eight specimens from the Tuktu formation at Mesozoic locality 24621, is characterized by being small, plumb, and coarsely striate. (Pl. 10, fig. 6.) The other species is larger, more depressed, and bears very fine, dense radial striae that are crossed by weak concentric growth lines. (Pl. 10, fig. 5.) Its general appearance is similar to *P. linensis* Whiteaves (1900, p. 301, pl. 39, fig. 2) from the Queen Charlotte Islands, but its striations are much finer.

Figured specimens USNM 128715, 128716.

Occurrences.—Tuktu formation at USGS Mes. loc. 20484, 24621; Grandstand formation in the East Oumalik test well 1 at depth of 2,442 feet; Ignek formation at Mes. loc. 10293.

Genus MODIOLUS Lamarck, 1799

Modiolus archisikanni McLearn

Plate 6, figure 19

Modiolus archisikanni McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d edition), pl. 12, fig. 4. [Appendix validating species in 1948.]

The original description is as follows:

"Elongate, narrowing anteriorly. Moderately convex, with smoothly rounded postumbonal slope. Fine, even concentric striation. More elongate and has more gently rounded postumbonal slope than *Modiolus semiornata* d'Orbigny."

The species is represented by 30 specimens from northern Alaska. Most of these are larger than the holotype and have a more elongate posteroventral margin.

Plesiotype: USNM 128717.

Occurrences.—Tuktu formation at USGS Mes locs. 20395, 20396, 20397, 20405, 20492, 24623, 24626.

Class CEPHALOPODA
Genus PHYLLOCERAS Suess, 1865

Phylloceras (Phylloceras) tiglukpukense Imlay, n. sp.

Plate 12, figures 1–3

This species is based on one specimen that consists only of the left side of two sutured whorls. The maximum measurable diameter of the largest whorl is a little more than 14 inches (360 mm), but it may be greater, as the venters are not completely preserved. There are indications that another half whorl was present. Evidently the body whorl was at least 2 feet in diameter. The preserved whorls do not appear to be crushed. They show that the shell had a compressed, discoidal shape, slightly convex flanks, a narrow umbilicus, and ribbing characteristics of the subgenus *Phylloceras*.

The ribs are slightly flexuous, incline forward gently on the middle parts of the flanks, and are radial on the upper parts of the flanks. They are fine, threadlike, and densely spaced near the umbilicus and gradually become a little coarser and wider spaced ventrally. The surface is also marked by faint broad folds. There are no indications of constrictions.

The suture line is not well preserved enough to be drawn, nor can measurements be made of the thickness of the shell.

The species is characterized by its large size and by its fine, uniform ribbing. The ribbing on the smaller whorl is similar to that of the Late Jurassic *P. knoxvillensis* Stanton (1896, p. 72, pl. 14, figs. 1–4), but the latter has pronounced constrictions.

It is interesting that the matrix between the two whorls contains specimens of *Aucella okensis* Pavlow. These were not injested by the living animal because the shell is entirely sutured. They must have lived on or near the ammonite shell after the right side of the shell had been removed in some manner and before complete burial of the left side. This implies that the preserved left side of the shell was deposited face down, which position is indicated by the weathered appearance of the matrix containing the Aucellas.

The presence of *Phylloceras* is interesting, as the only other record of *Phylloceras* from Valanginian beds in the Boreal region is from East Greenland (Donovan, 1953, p. 100, pl. 20, figs. 6a, b). The specimen from Greenland is much stouter, does not show ribbing, and probably belongs to a different subgenus than the Alaskan species. The Early Cretaceous species of *Phylloceras* described by Anderson (1938, p. 139–144) from California and Oregon are all of Hauterivian to Albian age, although the collections of the Geological Survey from California contain fragments of *Phylloceras* from beds of Valanginian age.

Holotype.—USNM 128718.

Occurrences.—Okpikruak formation, USGS Mes. loc. 22594.

Genus LYTOCERAS Suess, 1865

Lytoceras sp.

Plate 13, figure 20

Three fragments of *Lytoceras* from northern Alaska were obtained from a sandstone at the boundary between the Jurassic and Cretaceous. The exact age of the sandstone is unknown, but its stratigraphic position above shales containing *Aucella rugosa* Fischer and below shales containing *Aucella okensis* Pavlow shows that it is either of latest Jurassic or earliest Cretaceous age. It was mapped for convenience as the basal sandstone of the Okpikruak formation. The occurrence of *Lytoceras* at such a position is uncommon in the Boreal region north of the Arctic Circle (Spath, 1932, p. 151) and is worth adding to the record.

The figured specimen of *Lytoceras* is entirely septate, is crushed laterally, but shows the coiling and ribbing characteristic of the genus. The ribs are gently flexuous, curve forward on the lower part of the flanks, recurve slightly on the upper part of the flanks, and then curve forward again on the venter. Several weak, flexuous constrictions are present. The specimen was obtained from the same concretion as a fragment of a larger, nonseptate whorl having a height of 80 mm. This dimension indicates that the species represented by the specimens attained a diameter of more than one foot.

Figured specimen USNM 128719.

Occurrences.—Okpikruak(?) formation, USGS Mes. loc. 24008.

Genus PUZOSIA Bayle, 1878

Puzosia? sp. juv.

Plate 13, figures 21–23

Eleven small specimens have ribbing and constrictions similar to that on *Puzosia.* The whorls are moderately compressed and moderately involute; the venter is rounded; the umbilical wall is steep below and rounds evenly above into the flanks. The surface of the whorl is marked by 7 or 8 weak, gently flexuous constrictions that are projected forward on the venter. Between successive constrictions occur from 7 to 9 fine, sharp ribs that are reduced in strength on the venter. The suture line, partially preserved on one specimen (pl. 13, figs. 22, 23) has bifid saddles, a very broad external saddle, narrow lobes, and its auxiliary lobes descend evenly toward the umbilicus.

The assignment to *Puzosia* is questioned because of the even descent of the auxiliary lobes and the tendency of the ribs to weaken on the venter, but a correct generic assignment must await the discovery of larger and better preserved specimens. *Puzosia?* sp. of Warren (1947, p. 122, pl. 29, figs. 6, 7), from the lower part of the Mackenzie Valley in northwestern Canada, could be an adult of the same species as the specimens from northern Alaska, but its ribbing appear to be coarser and more flexuous. "*Puzosia*" *sigmoidalis* Donovan (1953, p. 115, pl. 24, figs. 3–6), from East Greenland, is more evolute, has a sharp instead of an evenly rounded umbilical edge, and has considerably coarser ribbing.

It seems unlikely that these small puzosid specimens from northern Alaska are the young of *Beudanticeras? affine* (Whiteaves) because their ribs and constrictions are not falciform, their ribs show no tendency toward bundling, their umbilicus is much wider, and the first lateral lobe is much narrower.

Figured specimens USNM 128720.

Occurrences.—Fortress Mountain formation, USGS Mes. locs. 23600–23603. Basal part of Torok formation at Mes. loc. 21554. Upper part of Torok formation at Mes. loc. 24640.

Genus BEUDANTICERAS Hitzel, 1905

Subgenus Grantziceras Imlay, n. subgenus

This subgenus is distinguished from typical species of *Beudanticeras* by having numerous regularly spaced falciform constrictions that appear at an early age, broadly bundled striae on the flanks, and a scaphitoid body chamber. It is possibly distinguished, also, by a lack of strong periodic ridges on the shell, and by attaining a size considerably larger than any described species of *Beudanticeras.* It shows considerable resemblance to the lower Albian *Anadesmoceras* Casey (1954, p. 107, 109, figs. 2a, b) in amount of involution, whorl shape, presence of bundled striae on the flanks, and presence of sigmoidal constrictions. *Anadesmoceras* differs by having umbilical nodes on the inner whorls, a distinct umbilical rim, and broader constrictions that are confined to the body chamber. *Boliteceras* Whitehouse (1928, p. 203), from the late Albian of Australia, differs from *Grantziceras* by having fainter and fewer constrictions and a much steeper umbilical wall. The type species of *Grantziceras* is *Beudanticeras* (*Grantziceras*) *multiconstrictum* Imlay, n. sp.

The subgenus is named in honor of Arthur Grantz of the Geological Survey, who collected the specimens of the type species.

Beudanticeras (Grantziceras) multiconstrictum Imlay, n. sp.

Plate 14, figure 1; plate 15, figures 1–12

This species is based on five specimens from the head of Billy Creek in the Talkeetna Mountains of south-central Alaska. It is described herein because the excellent preservation of the specimens makes the species an excellent choice as the type of a new subgenus.

The shell is discoidal, compressed. The whorls are higher than wide, subovate to subtrapezoidal in shape, embrace about two-thirds of the preceding whorls, and are thickest along the line of involution. The flanks are slightly convex and converge toward the moderately arched venter. The umbilicus is narrow, its wall is moderately steep and rounds evenly into the flanks. The body chamber occupies about half a whorl. Its anterior end is retracted somewhat from the remainder of the shell.

The internal mold bears many regularly spaced, deeply impressed, strongly falciform constrictions that are strongest on the venter and weakest near the umbilicus. In addition the venter generally has several weak constrictions that do not extend to the flanks. The constrictions are bounded anteriorly by a swollen rim. The number of constrictions varies with the size of the specimen, the holotype having 16 at a diameter of 87 mm and the largest specimen having 23 at a diameter of 143 mm.

On the shell itself the ornamentation consists mostly of dense, fine, strongly falciform striae that are grouped into bundles on the flanks and pass into weak ribs on the venter. Bundling of striae is most conspicuous just below the middle of the flanks and on specimens of small to medium size. The constrictions are weak, in places are scarcely visible, and represent shallow depressions between the bundles of striae. The contrast in ornamentation between the shell and the internal mold is well shown on plate 15, figures 10–12.

The suture line is moderately complex. The first lateral lobe is wide, slightly asymmetrical, and much longer than the external lobe. The second lateral lobe is much smaller than the first lateral lobe. The general pattern of the suture is typical of the genus and is very similar to that of *Beudanticeras ligatum* (Newton & Jukes Browne) as figured by Spath (1923, pl. 3, fig. 3e).

The holotype at a diameter of 87 mm has a whorl height of 40 mm, a whorl thickness of 30 mm, and an umbilical width of 19 mm.

This species is distinguished from *Beudanticeras* (*Grantziceras*) *affine* Whiteaves (1893, p. 113, pl. 8, pl. 11, figs. 1, 1a; Warren, 1947, p. 121, pl. 30, fig. 5) by having about twice as many constrictions per whorl, a little wider umbilicus, and a shorter second lateral lobe. It appears to be a little more compressed than *B. affine* and the largest known specimens are only about half as large. McLearn (1945a, pl. 5, fig. 6) figured a framentary ammonite as *Beudanticeras* cf. *B. affine* (Whiteaves) that probably has as many constrictions per whorl as *B. multiconstrictum* and may belong in that species. The most similar European species is *B. ligatum* (Newton and Jukes-Browne) as figured by Spath (1923, pl. 3, figs. 3a–d), which differs by being much more compressed and by having fewer constrictions.

Types.—Holotype, USNM 128721; paratypes, USNM 128722, 128723.

Occurrences.—From USGS Mes. locs. 24877, 25320 and 25329 in basal part of Matanuska formation overlying Nelchina limestone at head of Billy Creek in southeastern part of Talkeetna Mountains, south-central Alaska. Ammonites occur in worn concretions that were derived from beds older than the Matanuska formation but younger than the Nelchina limestone.

Beudanticeras (Grantziceras) affine (Whiteaves)

Plate 13, figure 24; plate 14, figure 2

Desmoceras affine Whiteaves, 1893, Royal Soc. Canada Trans., 1st. ser., v. 10, p. 113, pl. 8, pl. 11, figs. 1, 1a.
Beudanticeras cf. *B. affine* (Whiteaves). Warren, 1937, Jour. Paleontology, v. 11, no. 1, p. 70, text figs. 1–3.
Beudanticeras affine (Whiteaves). McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 4, fig. 1.
Beudanticeras affine (Whiteaves). Warren, 1947, Jour. Paleontology, v. 21, no. 2, p. 121, pl. 30, fig. 5.

One laterally crushed, septate specimen, retaining fragments of the shell, closely resembles the smaller of the two type specimens figured by Whiteaves (1893, pl. 11, figs. 1, 1a) in his original description. Its whorl sides are gently convex, its umbilicus is very narrow, and its umbilical wall is steeply inclined and rounds evenly into the flanks. The internal mold bears seven wide, regularly spaced, deeply impressed constrictions. These are strongly falciform, not reduced in strength on the venter, and are bounded anteriorly by a swollen rim. The shell is covered by weak falciform striae that become stronger ventrally and on the venter pass into weak ribs.

The small specimen, represented on plate 13, figure 24 by a rubber cast of an external mold, is probably an immature whorl of *B. affine* (Whiteaves). It bears numerous falciform striae grouped in irregular bundles that become stronger ventrally.

The distinguishing features of *B. affine* (Whiteaves) are its deep, falciform, regularly spaced constrictions, its very narrow umbilicus, and its rather stout whorl section. Among European species *B. ligatum* (Newton and Jukes-Browne) in Spath (1923, pl. 3, figs. 3a–d) has similar constrictions but is more tightly coiled and has a much stouter whorl section. Most of the European species of *Beudanticeras* have more compressed whorl sections than *B. affine*, are not as strongly or as regularly constricted, and apparently do not attain nearly as large a size.

Plesiotype.—USNM 128724; figured specimen shown on plate 13, figure 24, USNM 128725.

Occurrences.—Torok formation, lower part, at USGS Mes. loc. 21554. The small specimen compared with *Beudanticeras affine* (Whiteaves) is from the Fortress Mountain formation at Mes. loc. 24040.

Genus COLVILLIA Imlay, n. genus

Colvillia, named after the Colville River in northern Alaska, is characterized by fairly involute coiling; by a compressed, narrowly-arched whorl section; by prominent, thick, long primary ribs that bifurcate and trifurcate at or above the middle of the flanks; by the forward curvature of the secondary ribs on the upper parts of the flanks and on the venter; and by the presence of constrictions that are strongest on the venter. Its suture line has a short external lobe, a broad, slightly asymmetrical first lateral lobe, much reduced second lateral and auxiliary lobes and a very broad external saddle. The type species is *Colvillia kenti* Imlay, n. sp.

Colvillia shows considerable resemblance in shape, ornamentation, and suture line to the desmoceratid genus *Callizoniceras* (Spath, 1923, p. 35), from beds of Barremian to lower Albian age in Europe (Brinkmann, 1937, p. 8–10; Spath, 1942, p. 687–690; Breistroffer, 1947, p. 10–11, 21, 23, 70). It differs by being more involute, by having much stronger primary ribs, by rib branching occurring higher on the flanks and much more commonly, and by the strong or fairly strong ribbing on the venter of adult specimens.

Colvillia kenti Imlay, n. sp.

Plate 13, figures 1–6, 13

Only three specimens of this species are known. The whorls are compressed, the flanks flattened, and the venter narrowly arched. The umbilicus is fairly narrow. The umbilical wall is low, vertical at base, and rounds rather abruptly into the flanks. The body chamber is probably represented by most of the holotype.

The ribs are slightly flexuous on the flanks. The primary ribs incline forward most strongly near the umbilicus and less strongly near the middle of the flanks. They are prominent, wide, triangular in section and closely spaced. They are most prominent on the lower third of the flanks and become a little broader and lower near the middle of the flanks where they divide into 3, or less commonly into 2 weaker secondary ribs. These curve forward strongly on the upper parts of the flanks and arch forward on the venter without reduction in strength along the midventral line. Some short secondary ribs arise freely, high on the flanks. Four forwardly inclined constrictions are present on the holotype and are strongest on the venter. Traces of the suture line are barely visible.

The holotype of this species was once considered by the writer as belonging to the same genus as "*Dichotomites*" *gregerseni paucicostatus* Donovan (1953, p. 110–112, pl. 23, figs. 1a, b), from the Valanginian beds of East Greenland. It differs in appearance by having a wider umbilicus, a flatter venter, more flexuous ribbing, and broader and closer spaced primary ribs that are more depressed at their ventral ends. Its stratigraphic position only about 150 feet stratigraphically above a bed containing *Aucella sublaevis* Keyserling suggested that it might be of Valanginian age. However, according to Irving Tailleur (oral communication 1956), the holotype specimen was obtained from the lower part of the Torok formation in beds that differ markedly lithologically from the underlying *Aucella*-bearing Okpikruak formation and that probably pass laterally into the Fortress Mountain formation. From the latter have been obtained the paratype specimens of *Colvillia kenti* as well as various mollusks of Albian age described herein. From the lower part of the Torok formation at several localities have been obtained fragments of ammonites similar to *Puzosia*, *Beudanticeras*, and *Subarcthoplites*. The presence of such ammonites indicates that the holotype of *Colvillia kenti* Imlay is from beds of Albian rather than of Valanginian age.

The species is named for B. H. Kent, of the U.S. Geological Survey, who collected the holotype specimen.

Types.—Holotype, USNM 128726; paratypes: USNM 128727a, b.

Occurrences.—Fortress Mountain formation, USGS Mes. loc. 21558, 24040.

Colvillia crassicostata Imlay, n. sp.

Plate 13, figures 7–12, 14, 15

This species is represented by seven fragmentary specimens. The whorls are compressed, the flanks flattened, and the venter narrowly arched. The umbilicus is fairly narrow, and the umbilical wall is steeply inclined and rounds evenly into flanks. The body chamber is unknown, but may be represented by the largest fragment.

The ribbing is moderately flexuous in the small specimens and less flexuous in the larger specimens. The primary ribs on the shell begin near the line of involution, are wide, fairly high, and are separated by interspaces of about equal width. The primary ribs on the internal molds are sharper and more widely spaced. On both shell and mold the primary ribs curve forward to the middle, or to slightly above the middle of the flanks, and then divide into 2 or 3 weaker secondary ribs that curve forward rather strongly on the upper parts of the flanks and arch forward gently on the venter. The ribs are weakened slightly along the midventral line on the small specimens, but not on the larger. A few short secondary ribs arise freely, high on the flanks. Most of the specimens have one or more constrictions that are most conspicuous on the venter. The suture line is unknown.

One large external mold, shown on plate 13, figure 14, is considered to be an adult. Its posterior part greatly resembles the fragment of an internal mold shown on plate 13, figure 15. This part has prominent wide primary ribs of variable strength and spacing that pass ventrally into three secondary ribs whose lower parts only are preserved. The anterior part shows only the primary ribs and these are much weaker and more variable in strength and spacing than on the posterior part. Several constrictions are present.

Colvillia crassicostata may be distinguished readily from *C. kenti* by its coarser and sparser ribbing. It also has a less compressed shape and the smaller specimens have slightly reduced ribbing along the midventral line. It shows a general resemblance to the

European species *Callizoniceras hoyeri* (von Koenen) (1902, p. 60–62, pl. 38, figs. 5a, b, 6a, b, 7) and *C. Keilhacki* (Wollemann) (1907, p. 36, pl. 5, figs. 4, 4a, 5, 5a), but is distinguished readily by its longer primary ribs and its multiple rib branching.

Types.—Holotype, USNM 128728; paratypes USNM 128730a–c; paratype USNM 128729.

Occurrences.—Fortress Mountain formation, USGS Mes. loc. 21558, 23558; lower part of Torok formation at Mes. loc. 21554.

Colvillia cf. C. crassicostata Imlay

Plate 13, figures 16–19

One specimen associated with *Colvillia crassicostata* Imlay is possibly a variant of that species in which strong primary ribs develop at a later growth stage than typically. It includes one complete whorl of which nearly half is body chamber. The whorl is subquadrate in section, the flanks are flattened, the venter is narrowly arched, the umbilicus is fairly narrow, the umbilical wall is low and vertical, and the umbilical shoulder is abruptly rounded.

The sutured part of the specimen lacks shell material. It bears faint, widely spaced, nearly radially trending ribs on the lower part of the flanks and somewhat stronger, more numerous ribs on the upper part of the flanks. Some of the stronger ribs are indistinctly united with the weaker ribs near the middle of the flanks. The stronger ribs arch forward gently on the venter and are reduced in strength along the midline.

The body chamber is covered with shell material. It bears low rounded ribs of variable strength on the flanks. The stronger ribs begin on the umbilical wall or low on the flanks. The weaker ribs begin near or above the middle of the flanks and most of them are not connected with the stronger ribs. Only in two places is rib furcation evident. All ribs are nearly equal in strength on the edge of the venter and all nearly disappear along the midline. The ribs are nearly radial near the beginning of the body chamber, but anteriorly become inclined forward and gently flexuous. All ribs arch forward on the venter. Near the anterior end of the preserved part of the body chamber the lower parts of the flanks bear swollen ribs similar in strength and spacing to the primary ribs on *C. crassicostata*. The complete specimen has at least nine weak constrictions that trend in the same manner as the ribs.

The suture line is well preserved. It has a short external lobe, a broad and slightly asymmetrical first lateral lobe, and a very short second lateral lobe. There are five auxiliary lobes that decline regularly toward the umbilicus. The external saddle is broad and bifid, the first lateral saddle is narrow, but nearly as high, and the auxiliary saddles all are much shorter and smaller.

The general pattern of the suture resembles that of *Callizoniceras hoyeri* (von Koenen) (1902, pl. 38, figs. 6a–c, 7) but is distinguished by having more auxiliary lobes and a more abrupt change in height between the first lateral saddle and the auxiliary saddles. The pattern is even more similar to that on certain species of *Beudanticeras* (Spath, 1923, pl. 3, fig. 3e, pl. 4, fig. 2c). The resemblance is excellent evidence that *Colvillia* belongs in the family Desmoceratidae.

Figured specimen USNM 128731.

Occurrence.—Torok formation, USGS Mes. loc. 21554.

Genus SUBARCTHOPLITES Casey, 1954

This genus was defined by Casey (1954, p. 111) as follows:

> "Like *Arcthoplites*, but with a more convex venter, the ribs bifurcating from a lower point on the flanks and without the pronounced tendency to cupid's-bow curvature. Umbilical wall subvertical, fairly high, with rounded rim. Suture line as in *Arcthoplites*".

Casey designated *Lemuroceras belli* McLearn (1945, p. 10, pl. 3, figs. 17, 18; 1948, appendix to Paper 44–17) as the genotype species of *Subarcthoplites* and emphasized its greater resemblance to the boreal *Arcthoplites* than to *Lemuroceras* from India and Madagascar. Concerning *Lemuroceras* he says:

> "It is a more planulate form than *Subarcthoplites*, with an oblique, generally rimless umbilical wall. Definite bifurcation of the ribs is much less frequent than in the Canadian genus; moreover, the manner in which the ribs issue almost tangentially from the umbilicus and then abruptly change direction on the flank gives a distinctive appearance to *Lemuroceras*."

The definition of *Subarcthoplites* by Casey was based apparently only on the holotype of *Lemuroceras belli* McLearn which does not include the adult body chamber and which is much distorted and compressed owing to crushing. A more complete description of the genus is now possible on the basis of 15 molds from northern Alaska and by comparison of these with a plaster replica of the holotype.

Subarcthoplites has a compressed shell, an ovate whorl section that is a little higher than wide, a narrowly arched venter, and a fairly narrow umbilicus. The umbilical wall is fairly low to moderately high, steep, and rounds evenly into the flanks. The body chamber comprises about half a whorl. The ribs on the septate whorls are high, sharp, and gently flexuous on the flanks, and slightly reduced in strength on the venter. They incline forward on the umbilical wall and on the lower part of the flank, recurve near the middle of the flank, incline forward on the upper part of the flank, and arch forward on the venter. Secondary ribs arise near the middle of the flank, either freely or by furcation of the primary ribs. The ribbing weakens rather abruptly at the beginning of the body chamber and nearly disappears anteriorly. Constrictions occur on several strongly ribbed specimens but are not present on the body chamber except possibly at the anterior end of the specimen shown on plate 16, figure 30. The holotype of *S. belli* appears to have two constrictions when viewed under oblique lighting.

The above description shows that *Subarcthoplites* is quite different from *Arcthoplites*. Some of the immature specimens of *Subarcthoplites belli* (McLearn) from Alaska are similar in appearance to the immature specimens of *Arcthoplites jachromensis* (Nikitin) (1888, pl. 4, fig. 7), but the adults are clearly differentiated by lower points of rib branching, by constrictions, and by a tendency for the ribbing to disappear on the body chamber instead of becoming coarser.

As these features of *Subarcthoplites* are all found on the adult of *Lemuroceras*, evidently *Subarcthoplites* and *Lemuroceras* have much in common. Examination of the excellent illustrations of *Lemuroceras* from India (Spath, 1933, p. 801, pl. 128, figs. 3–6, pl. 129, figs. 4, 5, 10) and Madagascar (Collignon, 1949, pl. 12, figs. 2–9, pls. 13–15) and of a topotype specimen of *Lemuroceras aburense* (Spath) from India, shows that *Lemuroceras* differs from *Subarcthoplites* by having flatter flanks, more flexuous ribbing, and by a more abrupt change in the direction of ribbing on the lower part of the flanks. Also, most of the described species of *Lemuroceras* are more evolute than *Subarcthoplites*. The other distinctions between the genera discussed by Casey (1954, p. 111) probably cannot be maintained. In particular, the apparent fairly high umbilical wall and rounded umbilical rim on the holotype of *S. belli* (McLearn) are probably a result of distortion, as they are present only on one side of the holotype and are not present on the specimens of *Subarcthoplites* from northern Alaska. Considering the slight differences between *Subarcthoplites* and *Lemuroceras* enumerated above, the writer questions maintaining *Subarcthoplites* as a distinct genus. Perhaps a subgeneric rank might be as useful.

Subarcthoplites belli (McLearn)[1]

Plate 16, figures 13–18, 30

Lemuroceras belli McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d edition), pl. 3, figs. 17, 18.

Lemuroceras belli Casey, 1954, Jour. Wash. Acad. Sci., v. 44, no. 4, p. 111.

Two external molds from northern Alaska belong to this species. The whorls are ovate in section, higher than wide, gently convex on the flanks, and narrowly arched on the venter. The umbilicus is fairly narrow, its wall steep at the base, but rounding evenly into the flanks.

One of the molds (pl. 16, fig. 17) bears ribbing nearly identical in strength, spacing, and frequency of furcation with the posterior part of the holotype. About half of the primary ribs bifurcate near the middle of the flanks and half of the secondary ribs arise freely along the zone of furcation. Three narrow constrictions are present.

A larger mold (pl. 16, fig. 18) greatly resembles the anterior part of the holotype, but represents a slightly later growth stage and has a little coarser ribbing. This mold represents an adult septate whorl and is part of a specimen that includes an internal cast of the body chamber (pl. 16, fig. 30). This cast bears gently flexuous, sharp, widely spaced ribs that are variable in strength, but become weak anteriorly. The body chamber is half a whorl in length and is probably nearly complete. The septate whorls are ovate in section, higher than wide, and overlap the preceeding whorls about three-fifths. The body chamber has more convex flanks than the septate whorls and appears to be somewhat retracted from the remainder of the shell.

Plesiotypes.—USNM 128738 a, b.

Occurrence.—Torok formation, USGS Mes. loc. 25814.

Subarcthoplites bickeli Imlay, n. sp.

Plate 16, figures 19–25

Ten specimens of this species are in hand. The shell is similar in shape and coiling to *S. belli* (McLearn). It differs mainly by having higher and more widely spaced ribs on the septate whorls and a smoother body chamber. On most of the septate whorls about half of the secondary ribs arise freely at or above the middle of the flank and the remainder arise by bifurcation of the primary ribs. Most forked ribs are Y-shaped. As in *S. belli* the secondary ribs on the venter, are fairly sharp, arch forward gently ,and are only slightly reduced in strength as compared to their strength on the flanks. Near the anterior end of the last septate whorl most of the primary ribs are unbranched and secondary ribs are uncommon. The surface of the body chamber is nearly smooth except for low, broad, transverse undulations whose crests bear weak, gently flexuous ribs. Two or three narrow constrictions are present on some of the septate whorls. The body chamber occupies at

[1] On plate 22, column 6, *Subarcthoplites belli* is erroneously referred to as *Subarctioceras belli.*

least half a whorl. The details of the suture line cannot be traced.

The fragmentary ammonite from Canada illustrated by McLearn (1945a, pl. 5 fig. 4) as *Lemuroceras* cf. *indicum* Spath shows some resemblance to the posterior part of the penultimate whorl of *S. bickeli*, but differs by having swollen primary ribs.

The specific name is in honor of Mr. R. S. Bickel, of the U. S. Geological Survey.

Types.—Holotype, USNM 128732; paratypes: USNM 128733, 128734.

Occurrences.—Torok formation, USGS Mes. locs. 13311 and 24639.

Subarcthoplites colvillensis Imlay, n. sp.

Plate 16, figures 26–29

Three molds of this species are known. The shell is compressed. The whorls are ovate in section and much higher than wide. The flanks are gently convex. The venter is narrowly rounded. The umbilicus is fairly narrow; its wall is low, nearly vertical on inner whorls, gently inclined on outer whorls, and rounds evenly into flanks. The body chamber is represented by at least half a whorl.

On the smallest specimen (pl. 16, fig. 26) the primary ribs are weak, widely spaced, and gently flexuous on the flanks. Between adjoining primary ribs are single, weak secondary ribs that begin freely near the middle of the flanks.

On the penultimate whorl (pl. 16, fig. 27) the ribbing consists of low but rather sharp, gently flexuous primaries that become much stronger anteriorly. Most of the primary ribs are separated by single secondary ribs that arise freely on the middle of the flanks, but some are indistinctly joined with single secondary ribs. All ribs arch forward gently on the venter.

On the body whorl (pl. 16, figs. 28, 29) the ribbing weakens markedly at the beginning of the body chamber and is replaced anteriorly by fine, forwardly inclined striae and widely spaced weak riblets. One constriction is present on the last septate whorl. The suture line cannot be traced.

This species is more compressed, has weaker ribs, and fewer bifurcating ribs than either *S. belli* (McLearn) or *S. bickeli* Imlay. It also has wider spaced ribbing than *S. belli*.

The specific name is derived from the Colville River.

Types.—Holotype, USNM 128735; paratypes: USNM 128736 a, b.

Occurrence.—Torok formation, USGS Mes. loc. 21822.

Subarcthoplites? cf. S. colvillensis Imlay

Plate 16, figures 1, 2

One ammonite fragment is illustrated because it may belong to *Subarcthoplites*, although occurring considerably lower stratigraphically than the species that are herein definitely assigned to that genus. The specimen, reported to be from the lower 600 feet of the Torok formation, bears ribbing similar to that on the penultimate whorl of *S. colvillensis* Imlay. The primary ribs are prominent, widely spaced, and moderately flexuous on the flanks. They remain strong on the venter and curve forward gently. Adjoining primary ribs are separated by 1 or 2 secondary ribs that arise freely above the middle of the flanks, are as strong as the primary ribs on the venter, and may be continuous with primary ribs on the opposite flanks.

Figured specimen USNM 128737.

Occurrence.—Torok formation at Mes. loc. 21557.

Genus GASTROPLITES McLearn, 1930

Gastroplites kingi McLearn

Plate 17, figures 9–17, 19–23

Gastroplites kingi McLearn, 1931, Royal Soc. Can. Trans., 3d ser., v. 25, sec. 4, p. 5, pl. 1, fig. 9.

Gastroplites kingi McLearn, 1933b, Royal Soc. Can. Trans., 3d ser., v. 27, sec. 4, p. 19, 20, pl. 3, figs. 4, 5.

Gastroplites kingi McLearn, 1945, Canada Geol. Survey Paper 44-17 (2d ed.), pl. 6, figs. 2, 3.

This species is represented in northern Alaska by three immature specimens. These bear thick, prominent ribs that are reduced only slightly in strength on the venter. The primary ribs incline forward strongly near the umbilicus and most of them bifurcate low on the flanks. They are swollen, but not tuberculate at the furcation points. Some secondary ribs begin freely near the middle of the flanks. All secondary ribs recurve strongly on the flanks and then bend forward slightly at the margin of the venter. The secondary ribs increase in strength ventrally and are slightly swollen at the edge of the venter. The specimens have a compressed shape, flattened flanks, and nearly flat venter.

These ammonites from northern Alaska cannot be identified directly with *G. kingi* because the inner whorls of that species have not been described, but they are identical with the small immature whorls of *G. kingi* from the Nulato and Rampart areas of central Alaska. From each of these areas have been obtained specimens of various sizes of which some are illustrated herein for comparison with the small fragments from northern Alaska and with the holotype.

The adult whorl of *G. kingi is* compressed, has flattened flanks, a nearly flat venter, and an angular shoulder. Its umbilicus is fairly narrow, the umbilical wall low and gently inclined, and the umbilical edge rounded. The ribs on the flanks are thick, prominent, inclined forward, and gently flexuous. On the venter they are broader, lower, and are slightly arcuate. Some ribs bifurcate near the top of the lower third of the flanks. Many ribs remain single. Most ribs start low on the umbilical wall but some arise near the middle of the flanks. Most ribs are slightly swollen along the zone of furcation. Interspaces are broader than ribs on both flanks and venter.

The adult *G. kingi* differs from *G. canadensis* (Whiteaves) (1893, p. 118, pl. 2, figs. 3, 3a, 4, 5; McLearn, 1933b, p. 19, pl. 1, figs. 4, 5) (see pl. 17, figs. 1, 2) by being more involute, more compressed, and by having broader, more arcuate ribs on the venter. The immature whorls from Alaska that are herein referred to *G. kingi* show some resemblance to *G. allani* McLearn (1931, p. 5, pl. 1, fig. 10; 1933b, p. 18, pl. 1, figs. 6–8), but have thicker ribs on the flanks and much stronger, less arcuate ribs on the venter (see pl. 16, figs. 9–12). These immature whorls also show some resemblance to *G. cantianus* Spath (1937, p. 259; 1937, Paleontographical Soc. Mon., pl. 57, figs. 37a, b), from the middle Albian beds of England, but at a comparable size are more compressed, have a lower, more rounded umbilical wall, and the ribs arch forward on the venter instead of being straight. *G. stantoni* McLearn (see pl. 17, figs. 3–8) has much stouter whorls than *G. kingi. G. anguinus* McLearn (see pl. 16, figs. 7, 8) has a much wider umbilicus.

G. kingi McLearn is recorded from British Columbia, Canada, from the lower part of the Hasler formation exposed along the south side of Peace River Canyon just above the mouth of Deep Creek (McLearn, 1933b, p. 20; 1945a, p. 10). Some recent studies by Henderson (1954, p. 2275) suggest that this occurrence is in the lower part of the range of *Gastroplites.*

Plesiotypes.—USNM 128739–128745. Figured specimens USNM 128746.

Occurrences.—Tuktu formation, USGS Mes. locs. 20439 and 20484; Shaktolik group of the Nulato area in central Alaska at Mes. locs. 2678, 2927, 21418, and 25294; Rampart area in central Alaska at Mes. locs. 4278, 4279, and 8900. Fragmentary specimens probably belonging to *Gastroplites kingi* occur in the Tuktu formation at Mes. locs. 22754, 24633, 24637, 25133, 25135, and 25917 and in the Torok formation at Mes. loc. 22593.

Genus PARAGASTROPLITES Imlay, n. genus

This genus is distinguished from *Gastroplites* by having a narrower umbilicus, a gently to narrowly arched venter instead of a flattened or nearly flattened venter, convergent instead of subparallel flanks, and a smooth or nearly smooth venter on small- and intermediate-sized specimens. On adult specimens the venter bears broad, low ribs that arch slightly forward and are generally somewhat weaker than the ribs on the flanks. The type species of the genus is *Gastroplites spiekeri* McLearn (1931, p. 5, pl. 2, fig. 2; 1933b, p. 21, pl. 3, figs. 2, 3).

Most of the specimens from Alaska now assigned to *Paragastroplites* were once placed by the writer in *Cleoniceras*, but they differ from *Cleoniceras* by lacking umbilical tubercles and by having less flexuous flank ribs that are commonly, instead of rarely, forked and that become slightly swollen and bent forward as they pass over the ventrolateral margins of the shell.

Paragastroplites spiekeri (McLearn)

Plate 19, figures 1, 4–10, 12

Gastroplites spiekeri McLearn, 1931, Royal Soc. Canada Trans., 3d ser., sec. 4, v. 25, p. 5, pl. 2, fig. 2.
Gastroplites spiekeri McLearn, 1933, Royal Soc. Canada Trans., 3d ser., sec. 4, v. 27, p. 21, pl. 3, figs. 2, 3.
Gastroplites spiekeri McLearn, 1945, Canada Geol. Survey Paper 44–17 (2d ed.), pl. 8, fig. 4.

This species is represented in northern Alaska by two immature ammonites that are much smaller than the holotype. They can be identified specifically because similar immature ammonites are associated with adult specimens of *G. spiekeri* in the Rampart area of central Alaska.

The shell is compressed, the venter narrowly arched, the flanks gently convex and slightly convergent, and the umbilicus is narrow. The umbilical wall is nearly vertical at its base and evenly rounded above. It is low on the inner and penultimate whorl and moderately high on the body whorl. The body chamber is represented by at least half a whorl.

On the inner and penultimate whorls (pl. 19, figs. 1, 4–7, 9, 10, 12) the primary ribs are narrow and widely separated. They trend forward gently from the umbilical wall to the lower fourth of the flanks where they recurve backward abruptly and become slightly raised but not tuberculate. Along the zone of abrupt curvature some primary ribs bifurcate, some are indistinctly connected with a secondary rib, and some remain single. A few secondary ribs arise independently below the middle of the flanks. All ribs on the flanks are narrow, widely spaced and nearly equal in strength. All curve forward gently on the upper part of the flanks and terminate in small swellings on the edge of the venter. The venter is nearly smooth, bearing only faint undulations that connect the ribs on the flanks.

On the body chamber (pl. 19, fig. 8) the ribs become broader, lower, and more closely spaced. Most secondary ribs arise freely below the middle of the flanks, but some branch from the primary ribs. They are all gently flexuous and terminate ventrally in broad swellings that incline forward. The venter is smooth except for broad, low, transverse undulations.

The holotype was obtained from the Cadotte member of the Peace River sandstone in Alberta. This occurrence is in the lower part of the range of *Gastroplites.*

P. spiekeri (McLearn) is closely related to "*Placenticeras*" *liardense* Whiteaves (1889, p. 158, pl. 20, figs. 1, 2) from the Lepine formation on the Liard River, British Columbia (McLearn and Kindle, 1950, p. 91). (See pl. 19, figs. 11, 13.) *P. spiekeri* appears to have weaker ribbing on its outer whorls but, whether it is a distinct species or not, cannot be settled until the characteristics of Whiteaves species are much better known.

Plesiotypes: USNM 128747–128749.

Occurrences.—Tuktu formation at USGS Mes. loc. 20397; unnamed beds in Rampart area of central Alaska at Mes. locs. 4278 and 4279. The species is probably represented in the Kukpowruk formation in northern Alaska at Mes. loc. 20491.

Paragastroplites aff. P. spiekeri (McLearn)

Plate 19, figures 2, 3

One immature ammonite shows some resemblance to *P. spiekeri* (McLearn) (1933b, p. 21, pl. 3, figs. 2, 3) in lateral view, but its ribs incline forward more strongly on the margins of the venter. They bifurcate a little higher on the flanks, and they are connected across the venter by somewhat stronger undulations.

Figured specimen USNM 128750.

Occurrence.—Torok formation at USGS Mes. loc. 25815.

Paragastroplites flexicostatus Imlay, n. sp.

Plate 18, figures 10–20

Four specimens from northern Alaska and four from central Alaska belong to a species that resembles *P. spiekeri* (McLearn) in its very small umbilicus, compressed shape, and gently arched venter. It differs by having weaker ribs, which are more closely spaced, more flexuous, less commonly forked, and much less distinct near the umbilicus. The venter on the small specimens is smooth, on the medium-sized specimens it bears weak undulations, and on the largest specimen (pl. 18, fig. 19) it bears broad, low ribs.

Types.—Holotype, USNM 128757; paratypes, USNM 128751–128756.

Occurrences.—Tuktu formation at USGS Mes. locs. 20403, 20484, 22754, 24634; Nulato area in central Alaska at Mes. locs. 21418 and 25294. Rampart area in central Alaska at Mes. loc. 8900.

Genus CLEONICERAS Parona and Bonarelli, 1896

Cleoniceras tailleuri Imlay, n. sp.

Plate 20, figures 1–5

Six specimens from northern Alaska are closely similar to the genotype species *Cleoniceras cleon* (d'Orbigny) (1841, pl. 84, figs. 1, 2, 4; Spath, 1922, p. 91, 92, text fig. 19), a plaster cast of which has kindly been furnished by Raymond Casey of the Geological Survey of Great Britain and is herein illustrated for comparison (pl. 20, fig. 10–12). They have strongly compressed whorls, flattened flanks, and a narrowly arched venter toward which the flanks converge. The umbilicus is narrow, the wall low and vertical, and the edge abruptly rounded.

About 14 sigmoidal ribs begin on the umbilicus at tiny tubercles. These ribs curve forward on the lower part of the flanks, recurve near the middle, and then curve forward on the upper part of the flanks and on the venter. They are fairly sharp on the lower part of the flanks, become broader and stronger on the upper part of the flanks, and are weakened on the venter. The primary ribs are separated commonly by two secondary ribs that begin near or below the middle of the flanks. Some of the secondary ribs are indistinctly connected with the primary ribs but most arise freely on the flanks. Three constrictions are present on the specimen shown on plate 20, figure 5. This specimen, which appears to be nearly undeformed, has a diameter of 50 mm, a whorl height of 24 mm, and an umbilical width of 11 mm. The suture line is not preserved.

Compared with *Cleoniceras cleon* (d'Orbigny) (1841, p. 286, pl. 84, figs. 1, 2, 4), *C. tailleuri* Imlay has smaller umbilical tubercles and sharper, less flexuous ribs that are not projected forward as much on the venter. *C. quercifolium* (d'Orbigny) (1841, p. 284, pl. 83, figs. 4–6; Jacob, 1908, p. 59, pl. 9, figs. 3–5) appears to have coarser ribbing that is projected forward much more ventrally. *C. morgani* Spath (1942, p. 702, text fig. 248; 1927, Paleontographical Soc. Mon., pl. 17, fig. 7, pl. 18, fig. 5) probably has coarser, more widely spaced ribbing, but comparisons are difficult because the illustrated specimens are much larger than the specimens of *C. tailleuri*.

Types.—Holotype, USNM 128761; paratypes, USNM 128762, 128763.

Occurrences.—Torok formation at USGS Mes. loc. 24640; Tuktu formation at Mes. locs. 20438 and 21827.

Subgenus NEOSAYNELLA Casey, 1954

Cleoniceras (Neosaynella)? whittingtoni Imlay, n. sp.

Plate 20. figures 6–9

Three specimens have a shape similar to *Cleoniceras* and the faint ornamentation of the subgenus *Neosaynella* Casey (1954, p. 106). The whorls are compressed, much higher than wide, and attain their greatest thickness at about the top of the lower third of the flanks. The lower part of the flanks is slightly convex. The upper part of the flanks is nearly flat and converges rapidly to a very narrow but bluntly rounded venter. The umbilicus is fairly narrow, its wall low and vertical, and its rim angular. The body chamber is unknown. The surface is smooth except for faint falcoid crescents on the upper part of the flanks and even fainter forwardly inclined striae. A fragment of an internal mold of the largest specimen shows traces of the external saddle and first lateral lobe. These are rather simple. The first lateral lobe appears to be asymmetrical and fairly broad.

This species resembles *Cleoniceras* (*Neosaynella*) *inornatum* Casey (1954, p. 107, figs. 3a, b on p. 109) from England in most particulars. It differs mainly by its whorls being thickest on the lower part of the flanks instead of at the umbilical edge. In this respect it differs likewise from *C.* (*Neosaynella*) *platidorsatum* (Sinzow) (1909, p. 33, pl. 2, figs. 1, 2, 6) from the Mangyshlak Peninsula in Russia. Whether the venter of the inner whorls of *C.? whittingtoni* is tabulate as in *Neosaynella* is not determinable on the type specimens. Until better preserved specimens are found the generic and subgeneric status of this species will be uncertain.

The species is named for C. L. Whittington of the Geological Survey, who collected some of the type specimens.

Types.—Holotype, USNM 128764; paratypes, USNM 128765, 128766.

Occurrences.—Torok formation at USGS Mes. loc. 25804; Grandstand formation at Mes. loc. 24638; Kukpowruk formation at Mes. loc. 25790. A fragment possibly belonging to *C.? whittingtoni* occurs in the Tuktu formation at Mes. loc. 20395.

Subgenus GRYCIA Imlay, n. subgenus

This subgenus is distinguished from typical *Cleoniceras*, such as *Cleoniceras cleon* (d'Orbigny) (1841, p. 286, pl. 84, figs. 1, 2, 4), by its whorl sections becoming more rounded during growth instead of more acute, by its ribbings increasing in strength anteriorly instead of diminishing in strength, by lacking distinct umbilcal tubercles, by developing rather indistinct bifurcation on the outer whorls, and by a tendency for the body chamber to become scaphitoid. It is retained in *Cleoniceras* because of its compressed shape, sharpened to narrow venter, the characteristics of its umbilicus, and its general rib pattern. It shows some resemblance in lateral view to *Paragastroplites*, defined herein, but is distinguished by its higher and abruptly rounded umbilical wall, by its primary ribs weakening toward the middle of the flanks instead of becoming high and swollen, and by its secondary ribs fading gradually ventrally instead of becoming swollen and projected forward. The type species of *Grycia* is *Cleoniceras* (*Grycia*) *sablei* Imlay, n. sp.

The subgenus is named for George Gryc, of the Geological Survey, who has spent many years in northern Alaska as a field geologist and as geologist in direct charge of field operations.

Cleoniceras (Grycia) sablei Imlay, n. sp.

Plate 20, figures 13–20

Eight external molds and two internal molds of this species were obtained in northern Alaska. Five of these occur on a small slab of sandstone (Mes. loc. 25812) that likewise contains two fragments of *Gastroplites*. A fragment of *Paragastroplites* (pl. 19, figs. 2, 3) was found nearby. Rubber casts made from the external molds of *C. sablei* show that all the molds are somewhat crushed laterally. The cast shown on plate 20, figure 14 was made from a mold that retains fragments of shell.

The whorls are compressed, much higher than wide, and thickest a little above the umbilicus. The flanks are slightly convex in their lower part and flattened in their upper part. The venter is very narrow on the smallest specimens but becomes broader during growth and on the longest specimen is narrowly arched. The umbilicus is very narrow on the septate whorls, but appears to become wider at the beginning of the body whorl. The umbilical wall is steeply inclined; its edge is evenly rounded on the smallest specimens and abruptly rounded on the larger specimens. The body chamber is unknown but is probably represented by a small part of the outer whorl of the holotype.

The surface on the smallest specimens is nearly smooth, being marked only by faint flexuous striae. At a diameter of about 20 mm, widely spaced swellings having a backward curvature appear on the lower part of the flanks. Within half a whorl, at a diameter of about 25 to 30 mm, these swellings are replaced by low, broad, ribs that begin weakly near the umbilicus, incline forward in a flexuous manner, and disappear on the upper part of the flanks. Anteriorly another half whorl, at a diameter of about 40 mm, short secondary ribs appear on the upper part of the flanks. Some of these ribs are indistinctly connected with the primary ribs. At the anterior end of the specimen shown on plate 20, figure 14, the primary ribs are swollen at the edge of the umbilicus, but are not distinctly tuberculate. On this specimen, fine, flexuous striae are evident under magnification.

The surface on the largest specimen bears fine flexuous striae, about 18 primary ribs, and about twice as many secondary ribs. The primary ribs are weak, begin in low swellings on the umbilical edge, incline strongly forward to about the middle of the flank, and then become indistinct. The secondary ribs on the upper part of the flanks are broad, low, and much stronger than the primary ribs. Some of them under oblique lighting appear to arise in pairs from the primary ribs. They are radial or have a slight forward inclination, and fade gradually into the margin of the smooth venter without becoming swollen or projected forward.

The suture line is dimly shown on the holotype. It appears to be fairly simple but cannot be traced.

This species is named for E. G. Sable, of the U.S. Geological Survey.

Cleoniceras sablei resembles *C. subbaylei* Spath (1942, p. 700, 701, text fig. 246 on p. 701) from the lower Albian of England and differs from most species of *Cleoniceras* by its whorl sections changing from subacute to arched during growth, by its ribbings increasing in strength anteriorly, by lacking umbilical tubercles, and apparently by a tendency for the body chamber to become scaphitoid. It appears to be a little more compressed than *C. subbaylei*, its secondary ribs are broader and more nearly radial, and some of them appear to arise in pairs from the primary ribs.

Types.—Holotype, USNM 128767; paratypes, USNM 128768–128771.

Occurrences.—Torok formation, USGS Mes. loc. 25813, 25812; Tuktu formation at Mes. loc. 20405. Topagoruk formation in the Topagoruk test well 1 at the depth of 3,249 feet.

Genus PSEUDOPULCHELLIA Imlay, n. genus

Pseudopulchellia is characterized by having a narrow umbilicus, a low, vertical umbilical wall, flattened flanks, a narrowly arched venter, and flat-topped, steep-sided ribs similar to those in the Barremian genus *Pulchellia*. The ribs are projected gently forward on the margins of the venter and continue across the venter as very broad, weak undulations. The absence of rib furcation on the type specimens is probably also of generic significance. The type species is *Pseudopulchellia pattoni* Imlay, n. sp.

Pseudopulchellia is distinguished from *Pulchellia* by a much smaller umbilicus and an arched venter. Its shape is similar to *Paragastroplites*, new genus described herein, but its ribbing is very different.

Pseudopulchellia pattoni Imlay, n. sp.

Plate 18, figures 1–5, 9

Two external and two internal molds from a single locality are the basis for this species. The internal molds have been crushed laterally. The external molds appear to be undeformed. The shell is compressed, the venter narrowly arched, and the flanks flattened. The umbilicus is narrow but enlarges a little on the outer whorl. The umbilical wall is low, vertical, and its edge is abruptly rounded. The body chamber is represented on the two largest specimens by about half a whorl but may have been larger.

The ribbing on the inner whorls as shown in the umbilicus of two specimens is very strong, widely spaced, and inclined forward. On the outer whorl most of the ribs begin on the umbilical wall, incline forward on the lower third of the flanks, recurve slightly on the middle of the flanks, and then curve forward again near the venter. The ribs are projected slightly on the umbilical edge, are high and narrow, low on the flanks, but broaden ventrally and on the upper parts of the flanks are very broad, flat topped, and steep sided. At the very edge of the venter the ribs are most strongly swollen and are projected gently forward. The ribs are faintly continued across the venter of the internal mold by broad, low undulations. On the smallest specimen all the ribs start at the umbilicus; on 2 specimens, there are single intercalated ribs that begin low on the flank; on 1 specimen (pl. 18, fig. 1) there occurs several intercalated ribs. None of the ribs bifurcate. On the two largest specimens the ribbing becomes narrower anteriorly.

Only traces of the suture line can be observed.

This species in lateral view is similar to the Barremian genus *Pulchellia* but has a much smaller umbilicus and a different shaped venter. Its ribbing also resembles certain species of *Leymeriella* from the lower Albian of Europe (Jacob, 1908, pl. 7 (17), figs. 9–13), but its umbilicus is much smaller and its venter is rounded instead of flattened. Its shape suggests a relationship with *Paragastroplites spiekeri* (McLearn), but its flat-topped ribbing is so different that a reference to a different genus seems justified.

The species is named for W. W. Patton, of the Geological Survey, who discovered the type specimens.

Types.—Holotype, USNM 128772; paratypes, USNM 128773 a, b, c.

Occurrences.—Tuktu formation at USGS Mes. loc. 24427.

Genus CYLINDROTEUTHIS Bayle and Zeiller 1878

Cylindroteuthis? sp.

Plate 18, figures 6–8

Only one belemnite guard from the Lower Cretaceous of northern Alaska is sufficiently well preserved to be illustrated. This guard is long and slender, flattened on the sides and venter, and bears a distinct ventral groove throughout most of its length. The alveolar cavity occupies less than one-third of the length of the guard.

This belemnite is associated with many specimens of *Aucella sublaevis* Keyserling, which proves that the enclosing sediments are of very early Cretaceous age. The characteristics of the belemnite, however, are suggestive of a Jurassic age. Also, its guard is bent in a manner indicating reworking after original deposition. Such a possibility is indicated by the fragmentary nature of the other two belemnites found in the Okpikruak formation and by the fact that belemnites are easily reworked. For example, the Ignek formation of Cretaceous age near the Canning River in northern Alaska contains belemnite fragments that appear to be of Jurassic age. Also, the Late Cretaceous deposits on the Alaskan Peninsula and in the Copper River region contain belemnites of both Jurassic and Early Cretaceous ages.

Figured specimen USNM 128774.

Occurrence.—Okpikruak formation at USGS Mes. loc. 22775.

PROBLEMATIC FOSSILS

Xenohelix?

Plate 16, figures 3–6

Spiral coils, referred questionably to "*Xenohelix*" Mansfield (1927, p. 5), have been found at seven localities in the Tuktu formation and at one locality in the Grandstand formation. The coils are of the same composition as the surrounding rock, lie parallel to the bedding in association with the molds of pelecypods and ammonities, and are more or less crushed at right angles to the bedding as are the associated mollusks. The coils are closely spaced, are not uniformly arranged with respect to the axis of coiling, and may or may not taper slightly in one direction. They do not bear any trace of shelly material or of ornamentation. The tubes of the coils are elliptical to nearly round in section.

The spiral coils have some resemblance to the molds of gastropods but differ by their asymmetry and lack of distinct taper. They also resemble certain spiral fossils called *Xenohelix*, from the Miocene of California and the Upper Cretaceous of Mexico (Mansfield, 1930, p. 1–4, pls. 1, 2), but they are much smaller, more tightly and irregularly coiled. They are even more similar to a specimen from the middle Tertiary of Austria (Abel, 1935, fig. 353 on p. 424), and differ mainly by their smaller size and tighter coiling. The origin of none of these spiral coils is known, but the specimen from the Alps is compared by Abel (1935, p. 425–427) to the spiral borings made by a small crab living on the coast of Australia. Such an origin for the specimens from northern Alaska seems most unlikely because they all lie parallel to the bedding planes, whereas a boring should be at a steep angle to the bedding.

Figured specimens USNM 128775–128778.

Occurrences.—Tuktu formation at USGS Mes. locs. 3203, 3204, 20439, 20484, 24430, 24623, 24637; Grandstand formation at Mes. loc. 20478.

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Italic numbers indicate descriptions]

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PLATES 1–20

PLATE 1

[Figures natural size unless otherwise indicated]

FIGURES 1, 2, 9, 10. *Kirklandia*? sp. (p. 39).

1, 2. Aboral and lateral views. USNM 128592, from Kukpowruk formation at USGS Mes. loc. 25918.

9, 10. Same views, USNM 128591, from Torok formation at USGS Mes. loc. 25803.

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26. Longitudinal section, USNM 128647, from Ripley formation at USGS Mes. loc. 25406, Tenn.

24, 27. *Hamulus* sp. (p.40).

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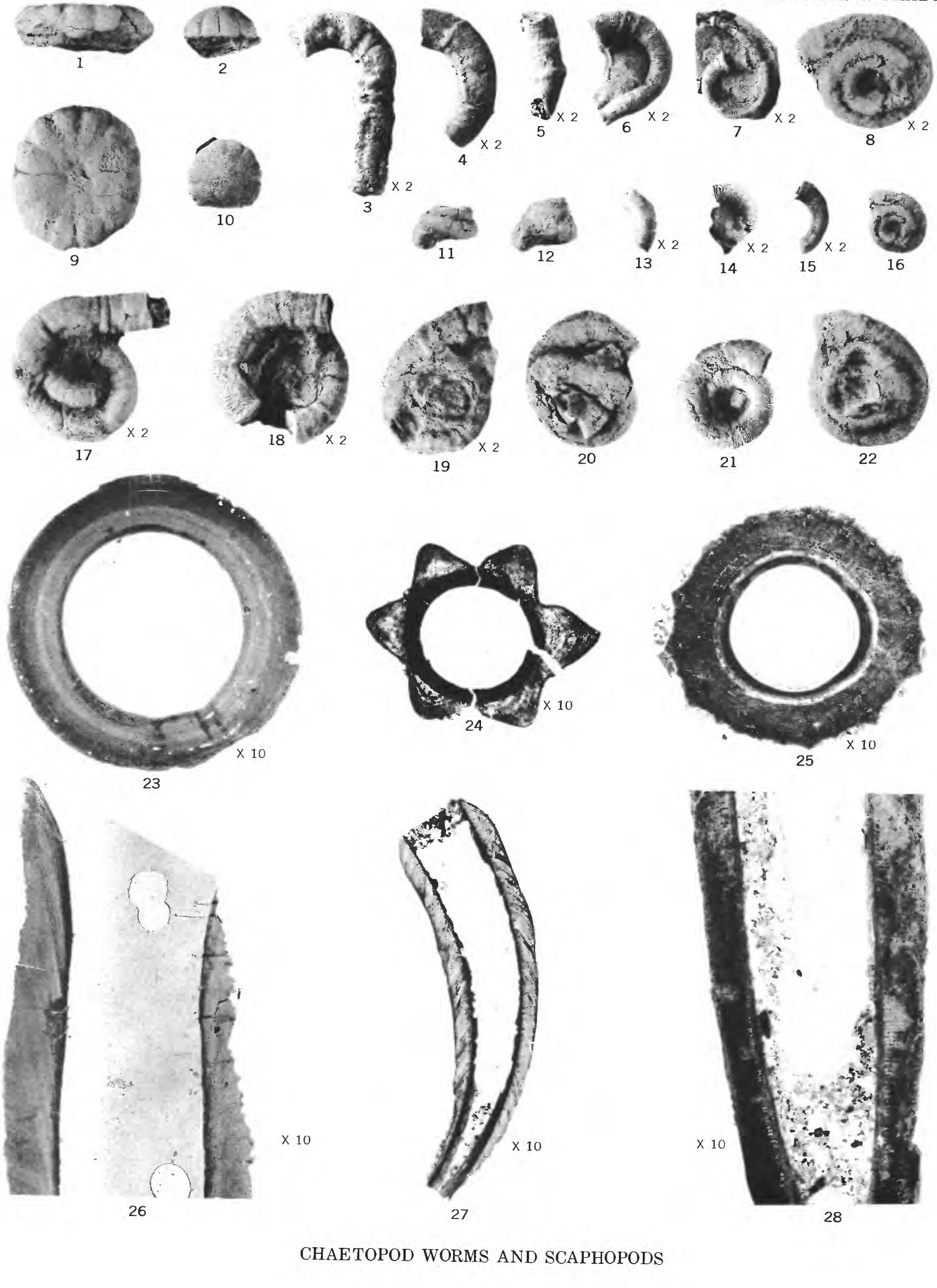
28. Longitudinal section, USNM 128645, from Coon Creek tongue of Ripley formation at USGS Mes. loc. 18616, Miss.



CHAETOPOD WORMS AND SCAPHOPODS

PLATE 2

[Figures 14 and 16 natural size, others as indicated]

FIGURES 1–18. *Ditrupa cornu* Imlay, n. sp. (p. 39).

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14. Small tubes showing varying amounts of bowing; paratypes, USNM 128601, from Kukpowruk formation at USGS Mes. loc. 25786.

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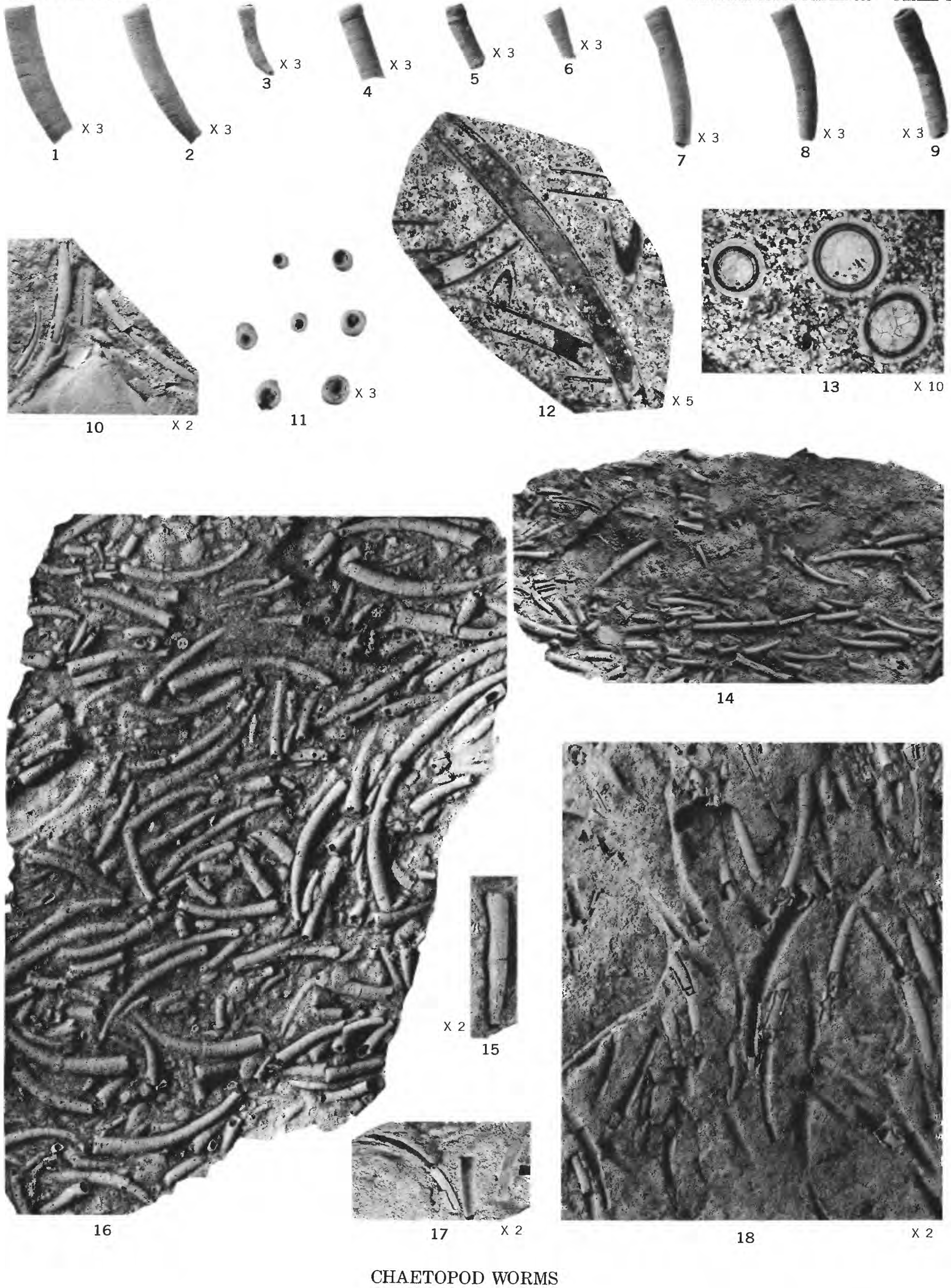
16. Large tubes showing varying amounts of bowing; paratypes, USNM 128602, from Kukpowruk formation at USGS Mes. loc. 25793.

18. External and internal views of tubes showing transverse striae; paratypes, USNM 128600, from Tuktu formation at USGS Mes. loc. 20394.



CHAETOPOD WORMS

PLATE 3

[Figures natural size unless otherwise indicated]

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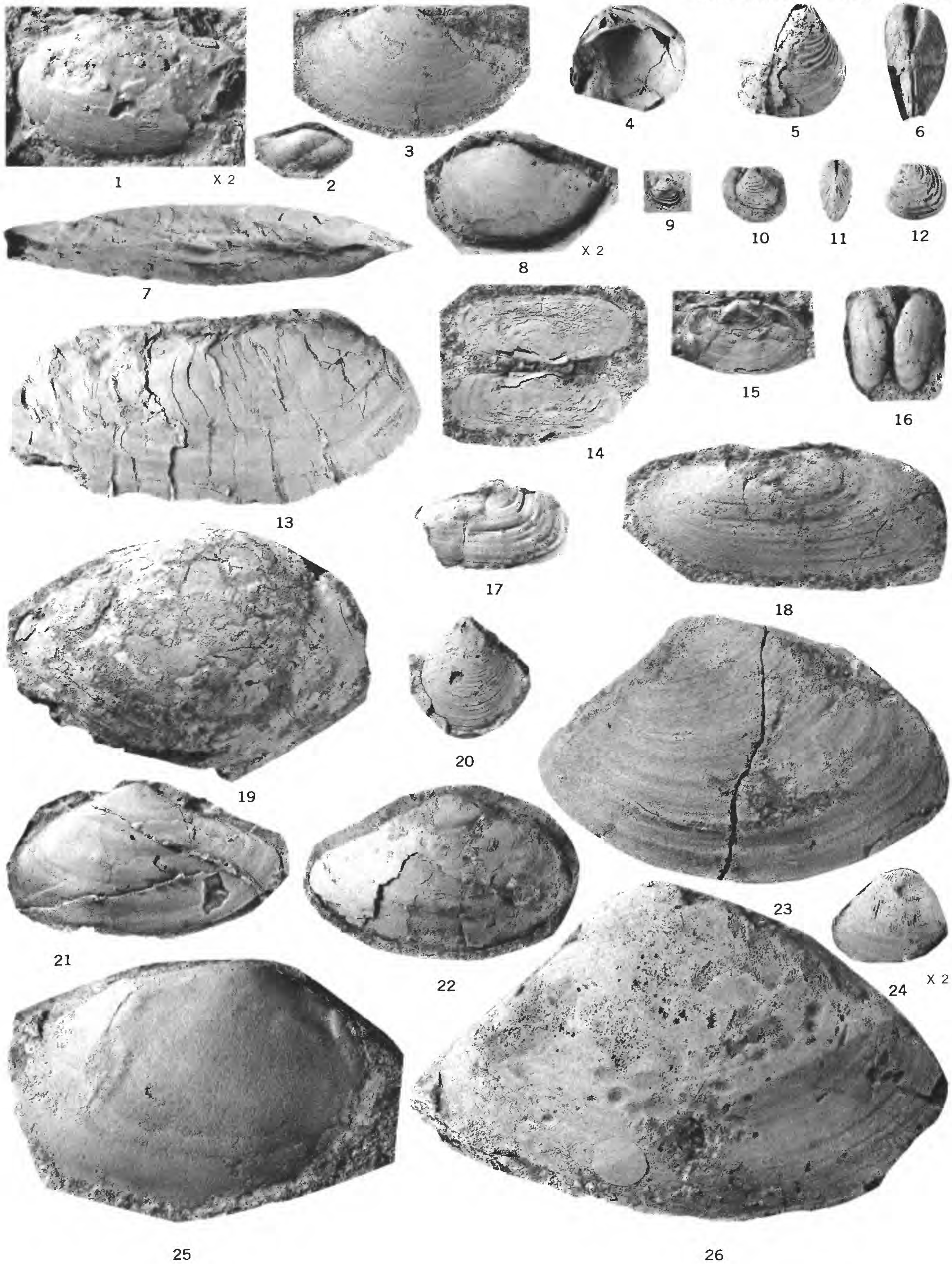
24. *Nucula* (*Pectinucula*) cf. *N. dowlingi* McLearn (p. 40).
USNM 128603, from Tuktu formation at USGS Mes. loc. 24625.



YOLDIA, ASTARTE, SOLECURTUS?, CULTELLUS?, TANCREDIA

PLATE 4

[Figures natural size unless otherwise indicated]

FIGURES 1–7. *Dicranodonta dowlingi* McLearn (p. 41).

1, 2. Exterior and interior of left valve; plesiotype, USNM 128609, from Tuktu formation at USGS Mes. loc. 20403.

3. Internal mold of left valve; plesiotype, USNM 128610, from Tuktu formation at USGS Mes. loc. 24430. Note radial striae.

4, 5. Exterior and interior of left valve; plesiotype, USNM 128608, from Tuktu formation at USGS Mes. loc. 20395.

6, 7. Internal mold of right valve; plesiotype, USNM 128611, from Tuktu formation at USGS Mes. loc. 24623. Note radial striae.

8–12. *Tancredia stelcki* McLearn (p. 42).

8, 9. Rubber cast of external mold of left valve, internal mold of right valve; plesiotypes, USNM 128618, from Kukpowruk formation at USGS Mes. loc. 25786.

10. Internal mold of right valve; plesiotype, USNM 128619, from Corwin formation at USGS Mes. loc. 25802.

11. Internal molds of left and right valves that probably belong to one individual; plesiotype, USNM 128617, from Kukpowruk formation at USGS Mes. loc. 25791.

12. Internal mold of right valve; plesiotype, USNM 128616, from Kukpowruk formation at USGS Mes. loc. 24484

DICRANODONTA AND *TANCREDIA*

PLATE 5

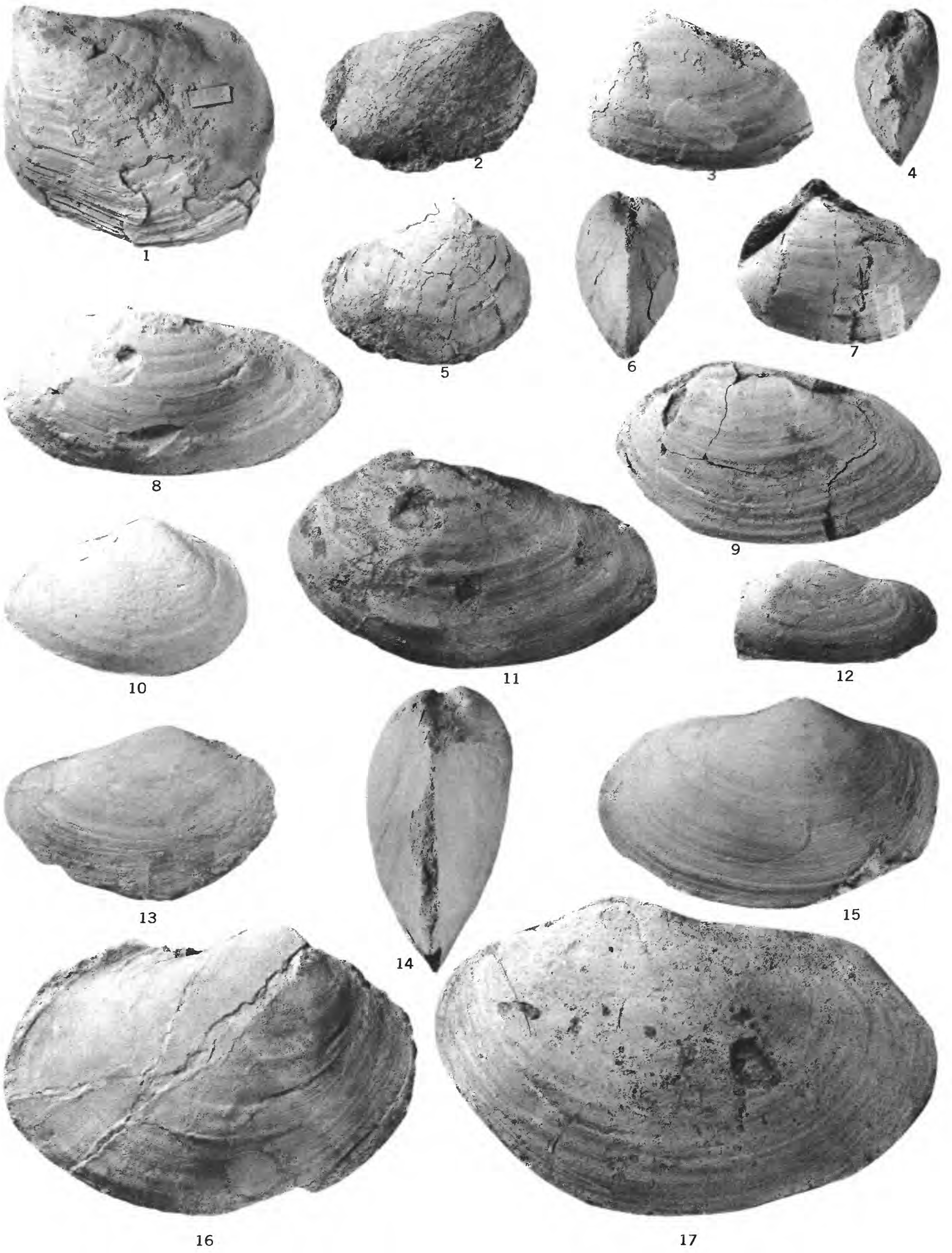
[All figures natural size]

FIGURES 1, 2, 5, 6. *Pleuromya sikanni* McLearn (p. 45).
1. Plesiotype, USNM 128639, from Tuktu formation at USGS Mes. loc. 25129.
2, 5, 6. Right valve, and anterior view; plesiotypes, USNM 128638, from Tuktu formation at USGS Mes. loc. 20395.

3, 4, 7. *Pleuromya kelleri* Imlay, n. sp. (p. 45).
3, 4, 7. Left valve and anterior view of holotype, USNM 128640; left valve, paratype, USNM 128641. Both specimens from Fortress Mountain formation at USGS Mes. loc. 24431.

8, 9, 11, 12. *Panope? kissoumi* (McLearn) (p. 46).
8. Plaster replica of holotype in collections of Geological Survey of Canada.
9. Internal mold, plesiotype, USNM 128642, from Chandler formation at USGS Mes. loc. 24432.
11. Internal mold, plesiotype, USNM 128644, from Tuktu formation at USGS Mes. loc. 25126.
12. Internal mold, plesiotype, USNM 128643, from Torok formation at USGS Mes. loc. 24463.

10, 13–17. *Panope? elongatissima* (McLearn) (p. 46).
10. Plaster replica of holotype in collections of Geological Survey of Canada.
13, 15. Internal molds; plesiotypes, USNM 128650, from Ignek formation at USGS Mes. loc. 10306.
14, 16. Anterior view and right valve of internal mold; plesiotype, USNM 128651, from Tuktu formation at USGS Mes. loc. 20405.
17. Internal mold of left valve; plesiotype, USNM 128652, from Tuktu formation at USGS Mes. loc. 24427.



PLEUROMYA AND *PANOPE*

PLATE 6

[All figures natural size unless otherwise indicated]

FIGURES 1–3. *Thracia stelcki* McLearn (p. 47).
1, 3. Internal molds of right valves; plesiotypes, USNM 128655, from Tuktu formation at USGS Mes. loc. 24430.
2. Plaster replica of holotype in collections of Geological Survey of Canada.

4. *Thracia* cf. *T. kissoumi* McLearn (p. 47).
Right valve; USNM 128656, from Fortress Mountain formation at USGS Mes. loc. 24431.

5–7. *Veniella* sp. (p. 43).
5. Left valve; USNM 128630, from Grandstand formation in Umiat test well 1 at depth of 2,175 feet.
6, 7. Posterior view and right valve; USNM 128629, from Tuktu formation at USGS Mes. loc. 20396.

8. *Myopholas* sp. juv. (p. 48).
USNM 128657, from Ignek formation at USGS Mes. loc. 10293.

9, 10. *Oxytoma camselli* McLearn (p. 48).
9. Rubber cast of external mold of left valve; plesiotype, USNM 128659, from Kukpowruk formation at USGS Mes. loc. 24452.
10. Rubber cast of external mold of left valve; plesiotype, USNM 128658, from Tuktu formation at USGS Mes. loc. 20403.

11–14, 16. *Arctica*? sp. (p. 43).
11. Internal mold of left valve; USNM 128627, from Tuktu formation at USGS Mes. loc. 24623.
12. Rubber cast of hinge area of right valve; USNM 128625, from Kukpowruk formation at USGS Mes. loc. 12178.
13, 14. Right valve and posterior view; USNM 128626, from Kukpowruk formation at USGS Mes. loc. 24481.
16. Internal mold of left valve; USNM 128628, from Kukpowruk formation at USGS Mes. loc. 25790.

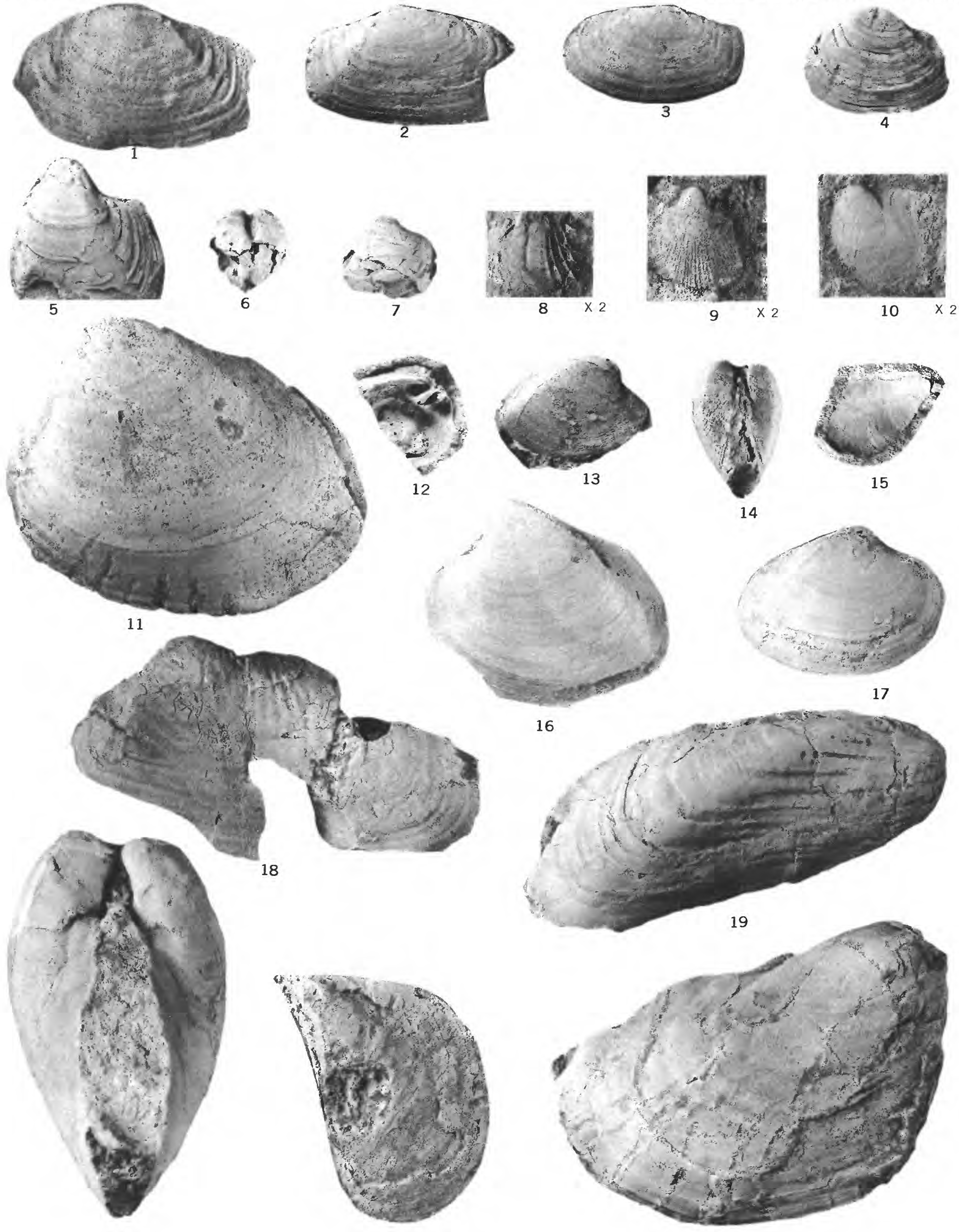
15, 21. Isognomon? sp. (p. 52).
15. Right valve, USNM 128694, from Tuktu formation at USGS Mes. loc. 25133.
21. Internal mold with fragments of shell adhering to left valve; USNM 128693, from Kukpowruk formation at USGS Mes. loc. 24476.

17. *Flaventia kukpowrukensis* Imlay, n. sp. (p. 44).
Rubber cast of external mold; holotype, USNM 128631, from Kukpowruk formation at USGS Mes. loc. 24469.

18. *Goniomya matonabbei* McLearn (p. 47).
Internal mold of left valve; plesiotype, USNM 128654, from Ignek formation at USGS Mes. loc. 23775.

19. *Modiolus archisikanni* McLearn (p. 55).
Internal mold of right valve; USNM 128717, from Tuktu formation at USGS Mes. loc. 20395.

20, 22. *Homomya* sp. (p. 47).
Dorsal view and right valve; USNM 128653, from Tuktu formation at USGS Mes. loc. 25122.



THRACIA, MYOPHOLAS, OXYTOMA, VENIELLA, ARCTICA?, FLAVENTIA?, GONIOMYA, MODIOLUS, HOMOMYA, ISOGNOMON?

PLATE 7

[Figures natural size unless otherwise indicated]

FIGURES 1–4. *Aucella subokensis* Pavlow (p. 49).

1, 2, 4. Anterior and lateral view of left valve, right valve; plesiotypes, USNM 128677, from Okpikruak formation at USGS Mes. loc. 22762.

3. Right valve; plesiotype, USNM 128679, from Okpikruak formation at USGS Mes. loc. 21821.

5–20. *Aucella okensis* Pavlow (p. 48).

5, 17, 18. Dorsal, lateral, and anterior view of a large, coarsely-ribbed adult; plesiotype, USNM 128672, from Okpikruak formation at USGS Mes. loc. 22472.

6–8, 13–16. Left valve, posterior view, and right valve of an immature specimen having typical ribbing of species; left and right valve of a specimen having much weaker ribbing than most specimens of the species; anterior view and left valve of a specimen having slightly weaker ribbing than average in the species; plesiotypes, USNM 128670, from Okpikruak formation at USGS Mes. loc. 21560.

9. Large right valve having coarse ribbing; plesiotype, USNM 128676, from Okpikruak formation at USGS Mes. loc. 22792.

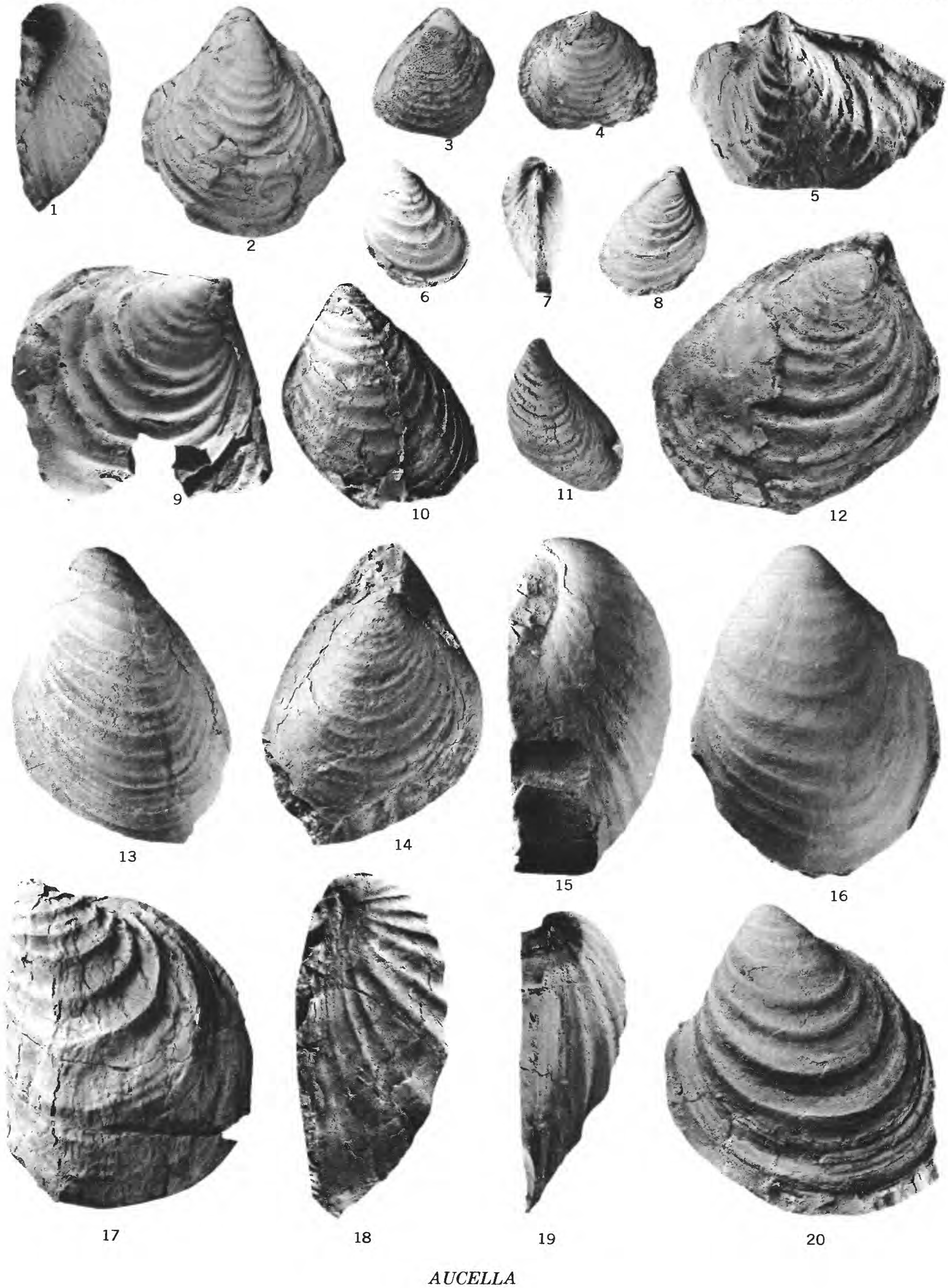
10. Rubber cast of left valve of a medium-sized specimen having typical ribbing; plesiotype, USNM 128673, from Okpikruak formation at USGS Mes. loc. 22724.

12. Right valve; plesiotype, USNM 128675, from Okpikruak formation at USGS Mes. loc. 22790.

19, 20. Large left valve with typical coarse ribbing; plesiotype, USNM 128674, from Okpikruak formation at USGS Mes. loc. 22757.

11. *Aucella piochii* (Gabb) (p. 3).

Left valve; plesiotype, USNM 128692, from Tiglukpuk formation at USGS Mes. loc. 26390.
Lat. 68° 32′ 30″N., long 153° 30′ 30″ W



AUCELLA

PLATE 8

[Figures natural size unless otherwise indicated]

FIGURES 1–15. *Aucella sublaevis* Keyserling (p. 49).

1–3, 9, 15. Plesiotypes, USNM 128681, from Okpikruak formation at USGS Mes. loc. 23554. Figures 1–3 show posterior view and right and left valves of an average specimen. Figures 9 and 15 represent views of one specimen in which radial striation is conspicuous.

4–8, 12–14. Plesiotypes, USNM 128680, from Okpikruak formation at USGS Mes. loc. 22736. Figures 4–6 show anterior view and right and left valves of an average specimen. Figures 7 and 8 show right valve and anterior view of an average specimen. Figures 12 and 13 show anterior view and left valve of a large specimen. Figure 14 shows the left valve of an unusually large specimen that has an umbonal constriction similar to that on some specimens of *Aucella crassicollis* Keyserling.

10, 11. Left valve and posterior view of an unusually coarse-ribbed specimen; plesiotype, USNM 128682, from Okpikruak formation at USGS Mes. loc. 23567.

16–20, 24, 25. *Aucellina dowlingi* McLearn (p. 51).

16. Right valve; plesiotype, USNM 128690, from Fortress Mountain formation at USGS Mes. loc. 21556.

17–19, 24, 25. Plesiotypes, USNM 128689, from Fortress Mountain formation at USGS Mes. loc. 21562. Figures 17 and 19 show posterior and lateral views of a left valve; figures 18, 24, and 25 show variations in shape of three left valves.

20. Anterior view of left valve; plesiotype, USNM 128691, from Fortress Mountain formation at USGS Mes. loc. 22511. Shows details of radial and concentric markings.

21–23, 26–32. *Aucella crassicollis* Keyserling (p. 50).

21–23. Anterior, lateral, and dorsal views of left valve; plesiotype, USNM 128686, from Okpikruak formation at USGS Mes. loc. 22780.

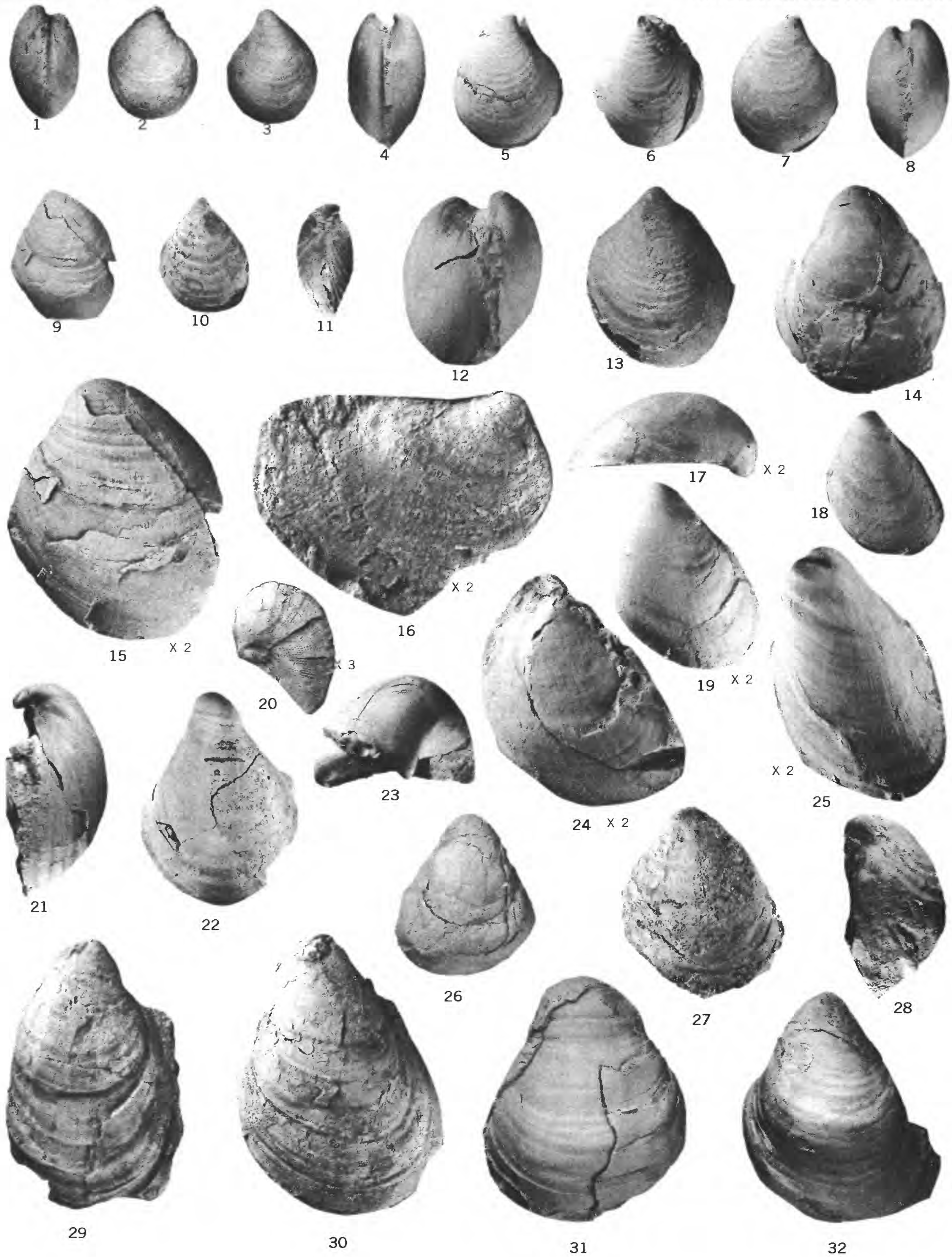
26. Left valve; plesiotype, USNM 128687, from Okpikruak formation at USGS Mes. loc. 23560. This variant resembles *Aucella solida* Pavlow.

27, 28. Lateral and anterior views of left valve; plesiotype, USNM 128683, from Okpikruak formation at USGS Mes. loc. 22514. This variant is commonly called *Aucella crassa* Pavlow.

29. Left valve; plesiotype, USNM 128688, from Okpikruak formation at USGS Mes. loc. 23575. This variant has several prominent constrictions.

30. Stout left valve; plesiotype, USNM 128684, from Okpikruak formation at USGS Mes. loc. 22731. Shows weak, irregular constrictions and ribs.

31, 32. Stout left valves; plesiotypes, USNM 128685, from Okpikruak formation at USGS Mes. loc. 22767. Shows swollen umbonal region marked ventrally by a conspicuous constriction.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AUCELLA

PLATE 9

[All figures natural size]

FIGURE 1. *Inoceramus* cf. *I. cadottensis* McLearn (p. 53).
Right valve; USNM 128700, from Tuktu formation at USGS Mes. loc. 24426.

2, 5. *Inoceramus* cf. *I. altifluminis* McLearn (p. 53).
2. Left valve; USNM 128702, from Fortress Mountain formation at USGS Mes. loc. 26142.
5. Left valve; USNM 128701, from Tuktu formation at USGS Mes. loc. 22753.

3, 4, 6. *Inoceramus anglicus* Woods (p. 52).
3. Immature right valve; plesiotype, USNM 128697, from Tuktu formation at USGS Mes. loc. 20472.
4. Adult right valve showing typical ribbing; plesiotype, USNM 128698, from Tuktu formation at USGS Mes. loc. 24634.
6. Right valve; plesiotype, USNM 128699, from Kukpowruk formation at USGS Mes. loc. 25787.

INOCERAMUS

500859 O—61——5

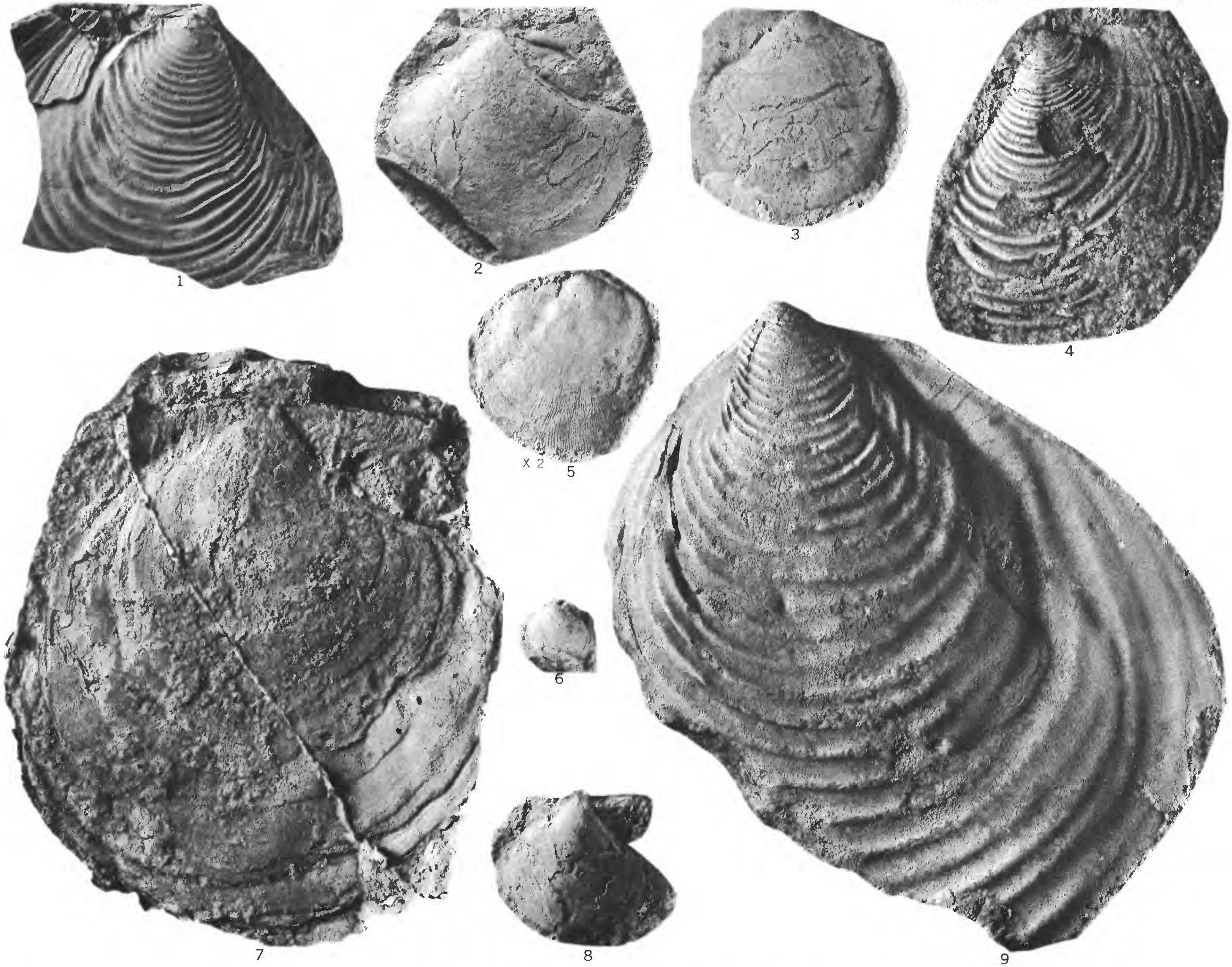
PLATE 10

[Figures natural size unless otherwise indicated]

FIGURES 1, 4, 9. *Inoceramus anglicus* Woods (p. 52).
1. Right valve; plesiotype, USNM 128695, from Grandstand formation at USGS Mes. loc. 20399.
4. Left valve; plesiotype, USNM 128699, from Kukpowruk formation at USGS Mes. loc. 25787.
9. Left valve; plesiotype, USNM 128696, from Tuktu formation at USGS Mes. loc. 20402.

2, 3, 7, 8. *Camptonectes dettermani* Imlay, n. sp. (p. 53).
2, 3. Right valve, left valve; both paratypes, USNM 128705, from Kukpowruk formation at USGS Mes. loc. 24453.
7. Right valve; holotype, USNM 128703, from Kukpowruk formation at USGS Mes. loc. 24483.
8. Right valve; paratype, USNM 128704, from Kukpowruk formation at USGS Mes. loc. 24460.

5, 6 *Placunopsis* spp. (p. 54).
5. USNM 128715, from Tuktu formation at USGS Mes. loc. 20484.
6. USNM 128716, from Tuktu formation at USGS Mes. loc. 24621.



INOCERAMUS, CAMPTONECTES, PLACUNOPSIS

PLATE 11

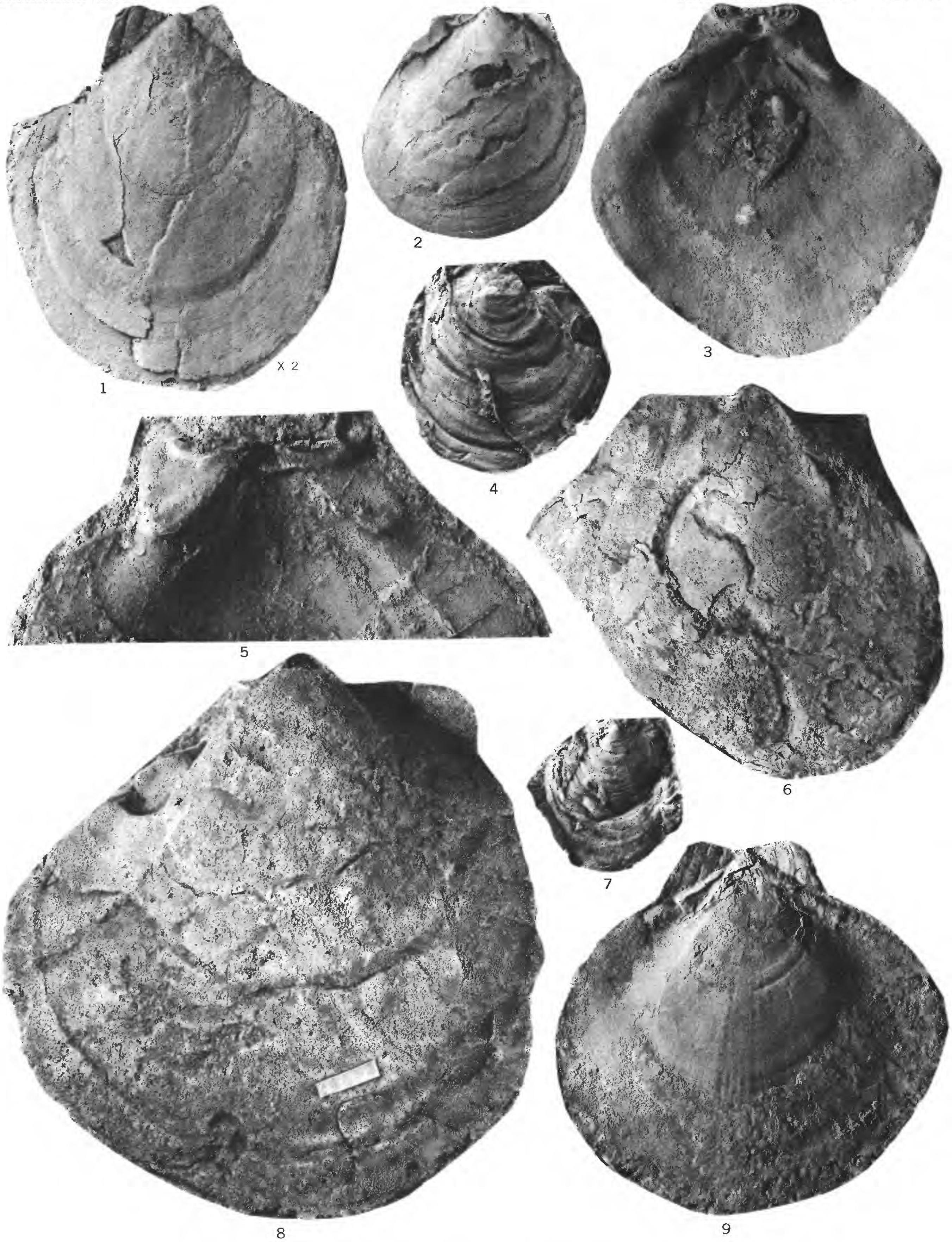
[All figures natural size unless otherwise indicated]

FIGURES 1–3, 5, 6, 8, 9. *Entolium utukokense* Imlay, n. sp. (p. 54).

1. Right valve with shell preserved showing fine concentric ribbing; paratype, USNM 128708, from Kukpowruk formation at USGS Mes. loc. 24458.
2. Left valve with some shell adhering; paratype, USNM 128709, from Kukpowruk formation at USGS Mes. loc. 24466.
3. Rubber cast of interior of right valve; paratype, USNM 128707, from Tuktu formation at USGS Mes. loc. 20492.
5. Rubber cast of interior of upper part of right valve; paratype, USNM 128711, from Tuktu formation at USGS Mes. loc. 24623.
6. Left valve; paratype, USNM 128710, from Kukpowruk formation at USGS Mes. loc. 24483.
8. Left valve; holotype, USNM 128706, from Kukpowruk formation at USGS Mes. loc. 24482.
9. Right valve with some shell adhering; paratype, USNM 128712, from Tuktu formation at USGS Mes loc. 24637.

4, 7. *Placunopsis nuka* Imlay, n. sp. (p. 54).

4, 7. Holotype, USNM 128713; paratype, USNM 128714; both specimens from Fortress Mountain formation at USGS Mes. loc. 24695.



ENTOLIUM AND *PLACUNOPSIS*

PLATE 12

FIGURES 1–3. *Phylloceras (Phylloceras) tiglukpukense* Imlay, n. sp. (p. 55).

Fragments of three successive sutured whorls. Specimen shown on figure 2 occurs half a whorl earlier than lowermost part shown on figure 1. Holotype, USNM 128718, from Okpikruak formation at USGS Mes. loc. 22594. Figs. 1 and 2, ×1; fig. 3, ×⅔.

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X 2/3

3

PHYLLOCERAS

PLATE 13

[Figures natural size unless otherwise indicated]

FIGURES 1–6, 13. *Colvillia kenti* Imlay, n. sp. (p. 58).

1, 2, 13. Ventral and lateral views; paratype, USNM 128727, from Fortress Mountain formation at USGS Mes. loc. 21558.

3. Rubber cast of external mold from same locality as figures 1, 2, and 13.

4–6. Lateral and ventral views; holotype, USNM 128726, from Fortress Mountain formation at USGS Mes. loc. 24040. Figure 4 is from a rubber cast of an external mold. On figure 5 the anterior end is to the right.

7–12, 14, 15. *Colvillia crassicostata* Imlay, n. sp. (p. 58).

7–12. Lateral views, lateral and ventral views, lateral views, paratypes, USNM 128730, from Torok formation at USGS Mes. loc. 21554.

14. Holotype, USNM 128728, from Fortress Mountain formation at USGS Mes. loc. 23558.

15. Paratype, USNM 128729, from Fortress Mountain formation at USGS Mes. loc. 23558.

16–19. *Colvillia* cf. *C. crassicostata* Imlay, n. sp. (p. 59).

Lateral, ventral, apertural views and suture lines of specimen, USNM 128731, from Torok formation at USGS Mes. loc. 21554.

20. *Lytoceras* sp. (p. 55).

USNM 128719, from Okpikruak formation at USGS Mes. loc. 24008.

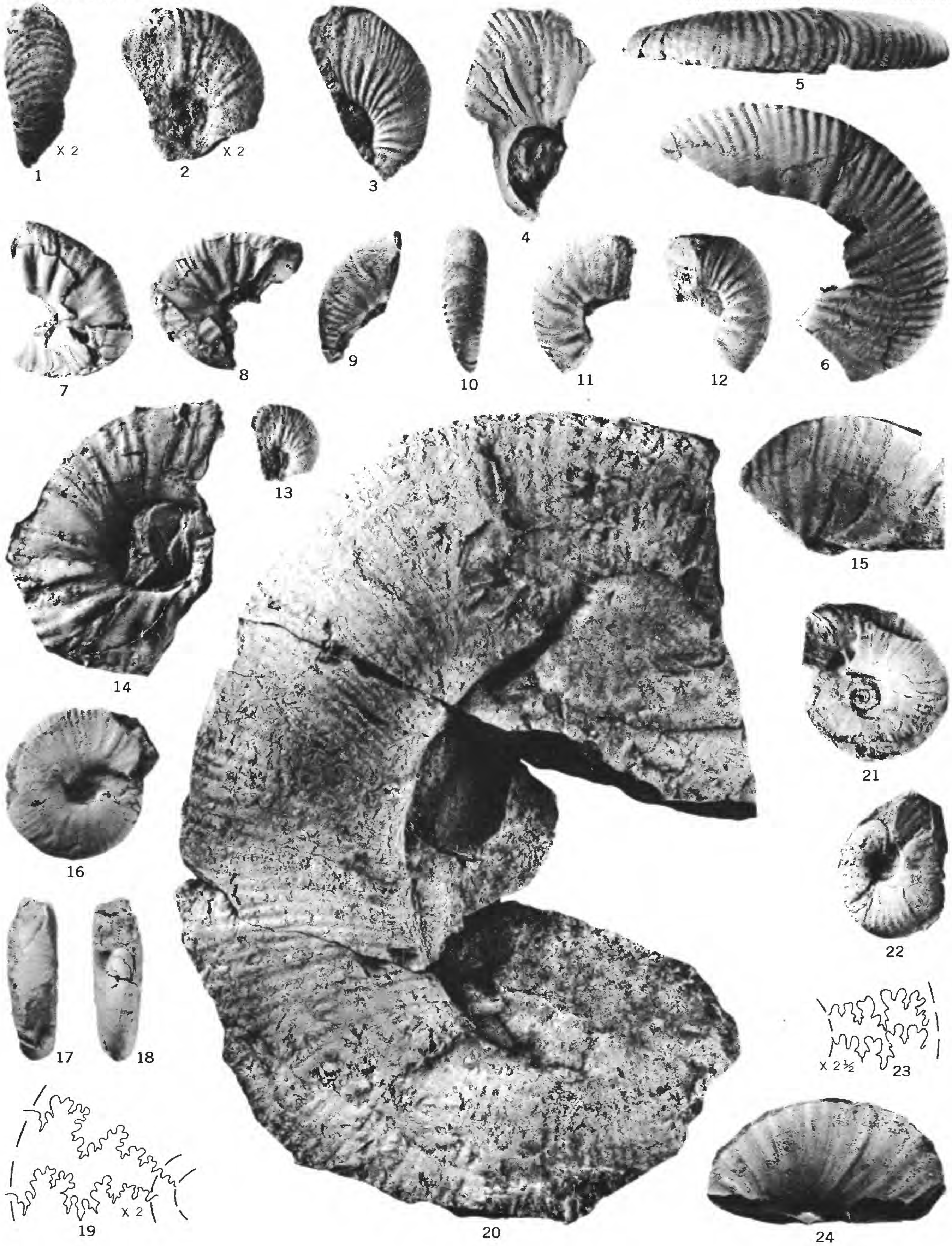
21–23. *Puzosia*? sp. juv. (p. 56).

21, 22. Lateral views.

23. Suture line of specimen shown on figure 22. USNM 128720 from Torok formation at USGS Mes. loc. 21554.

24. *Beudanticeras* cf. *B. affine* (Whiteaves) (p. 57).

Rubber cast of external mold; USNM 128725, from Fortress Mountain formation at USGS Mes. loc. 24040.



LYTOCERAS, PUZOSIA?, COLVILLIA, BEUDANTICERAS

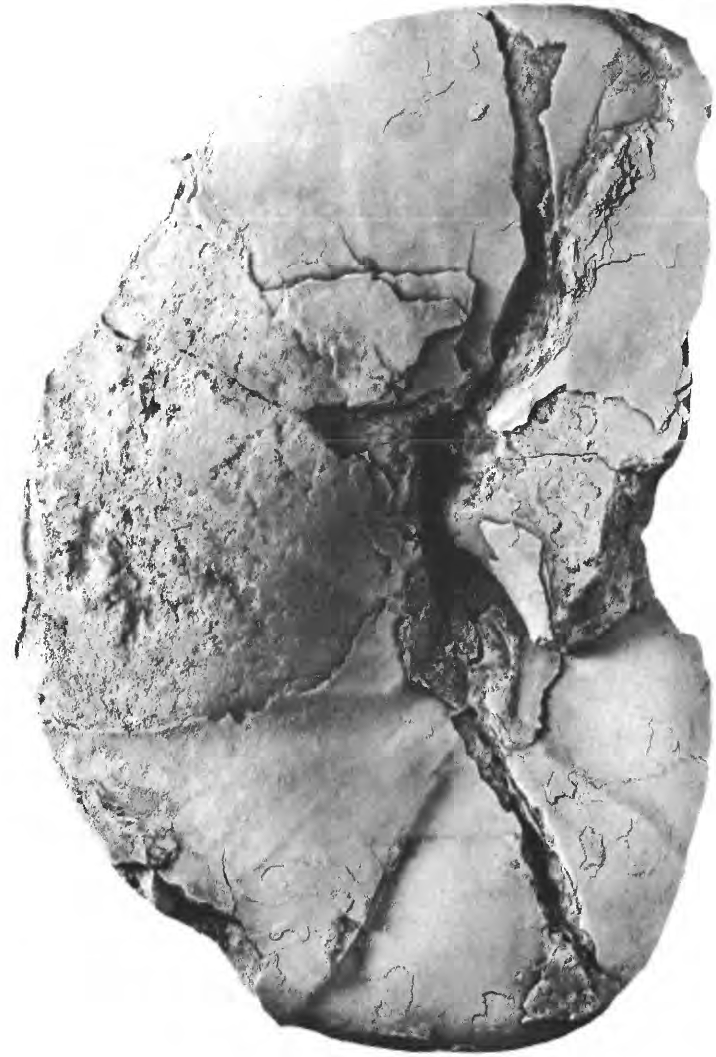
PLATE 14

[All figures natural size]

FIGURE 1. *Beudanticeras* (*Grantziceras*) *multiconstrictum* Imlay, n. sp. (p. 56).
Paratype, USNM 128723, from basal beds of the Matanuska formation at USGS Mes. loc. 25329.

2. *Beudanticeras* (*Grantziceras*) *affine* (Whiteaves) (p. 57).
Plesiotype, USNM 128724, from Torok formation at USGS Mes. loc. 21554.

1



2

BEUDANTICERAS

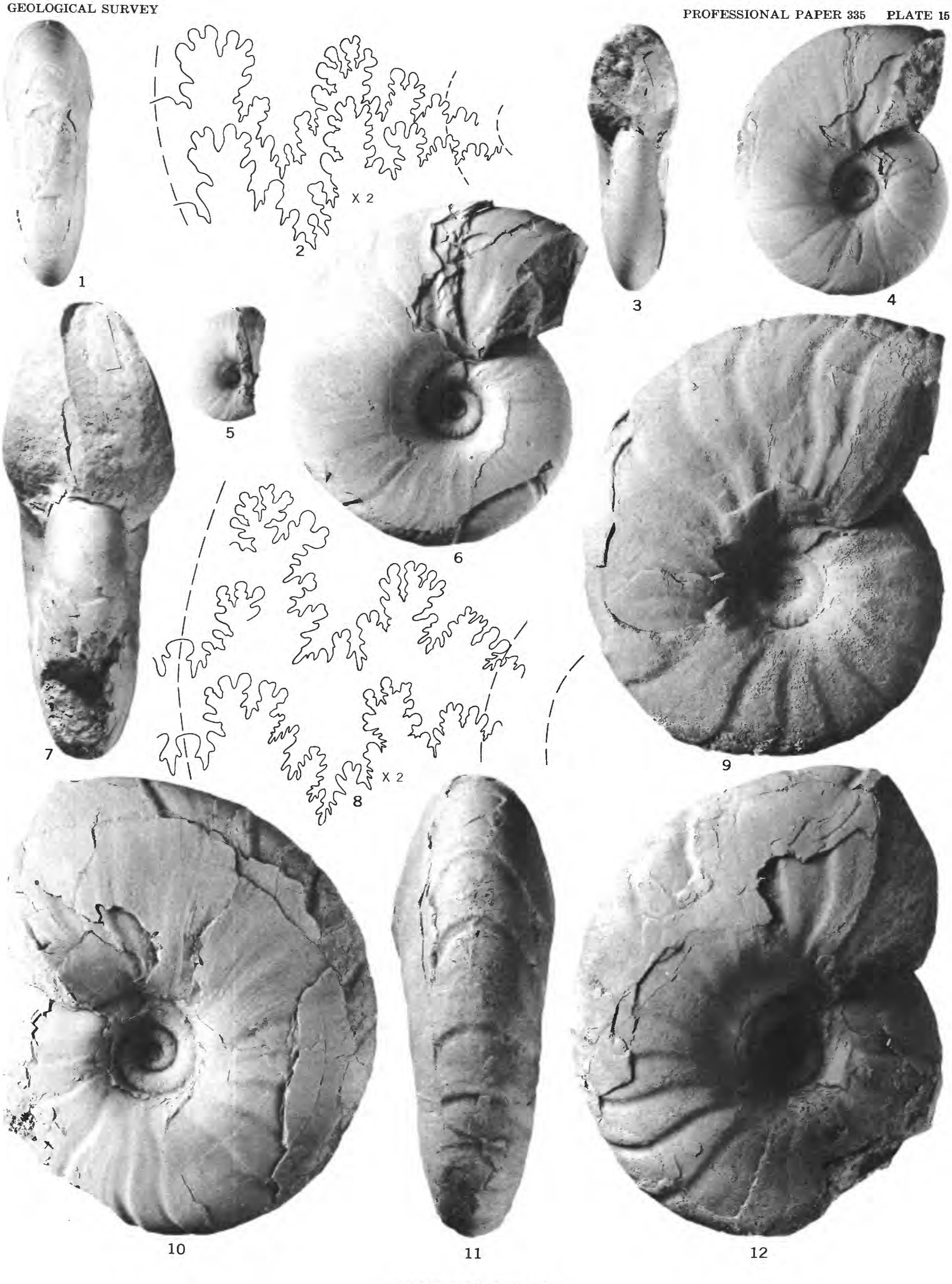
PLATE 15

[Figures natural size unless otherwise indicated]

FIGURES 1–12. *Beudanticeras* (*Grantziceras*) *multiconstrictum* Imlay, n. sp. (p. 56).

1–6, 9. Paratypes, USNM 128722, from basal beds of Matanuska formation at USGS Mes. loc. 24877. Figures 1, 3, 4, ventral, apertural and lateral views of small specimens; 2, 9, suture and lateral view; 5, lateral view of immature specimen; 6, lateral view of medium-sized specimen.

7, 8, 10–12. Holotype, USNM 128721, from basal beds of Matanuska formation at USGS Mes. loc. 24877. All specimens of this species were obtained from concretions that were derived from rocks older than the Matanuska formation.



BEUDANTICERAS

PLATE 16

[All figures natural size]

FIGURES 1, 2. *Subarcthoplites*? cf. *S. colvillensis* Imlay, n. sp. (p. 61).
Lateral views; USNM 128737, Torok formation at USGS Mes. loc. 215597.

3–6. *Xenohelix*? (p. 66).
3. USNM 128775, from Tuktu formation at USGS Mes. loc. 20484.
4. USNM 128776, from Tuktu formation at USGS Mes. loc. 24430.
5. USNM 128778, from Tuktu formation at USGS Mes. loc. 24637.
6. USNM 128777, from Tuktu formation at USGS Mes. loc. 24623.

7, 8. *Gastroplites anguinus* McLearn (p. 62).
Ventral and lateral views of plaster replica of holotype; Natl. Mus. Canada 6338.

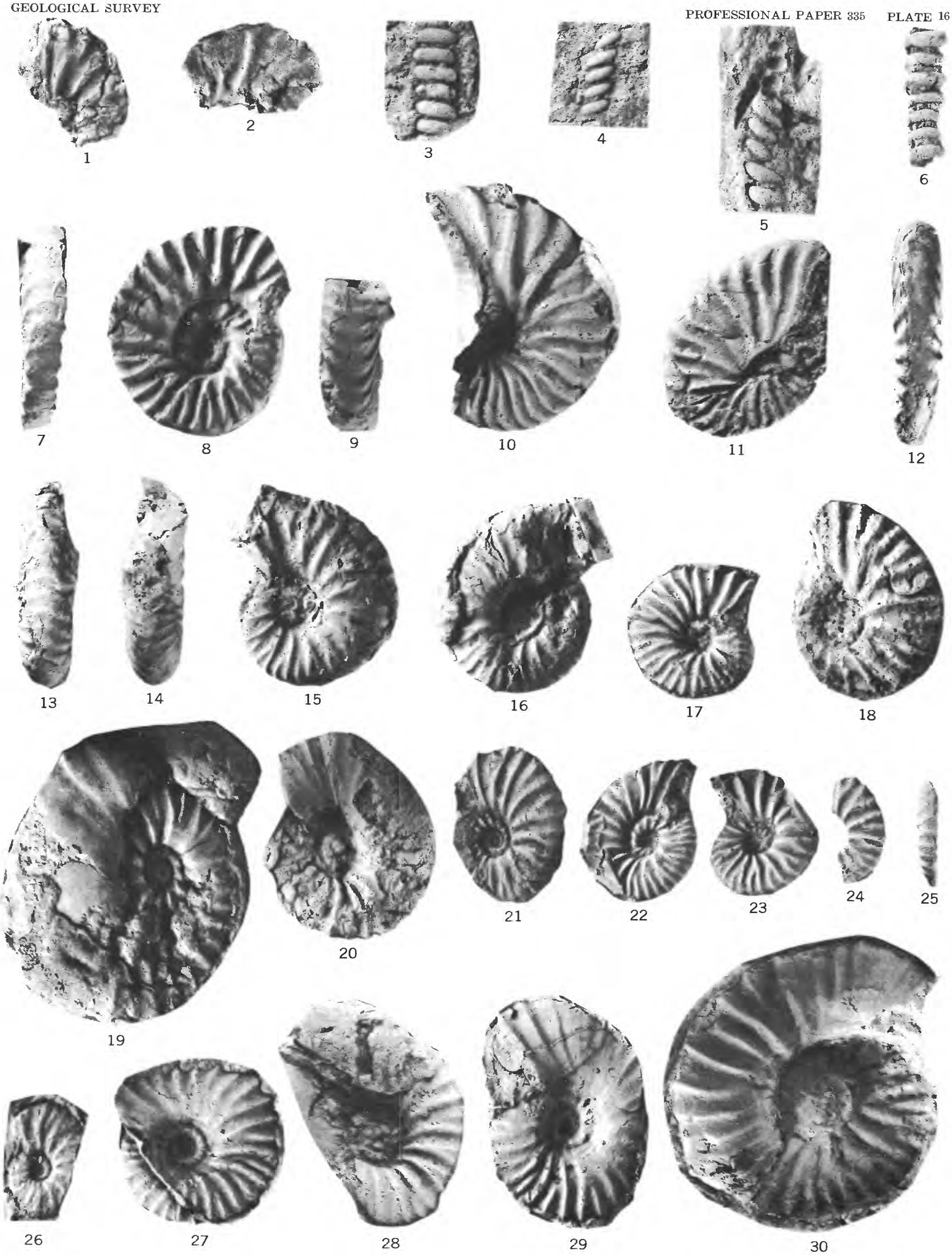
9, 10. *Gastroplites allani* McLearn (p. 62).
Ventral and lateral views of plaster replica of holotype; Natl. Mus. Canada 6337.

11, 12. *Gastroplites* cf. *G. allani* McLearn (p. 62).
Lateral and ventral views; USNM 128760, from Shaktolik group at USGS Mes. loc. 2927 on right bank of Yukon River at Bishop Rock, Nulato area, Alaska.

13–18, 30. *Subarcthoplites belli* McLearn (p. 60).
13–16. Ventral, apertural and lateral views of plaster replica of holotype; Nat. Mus. Canada 9570.
17. Rubber cast of external mold; plesiotype, USNM 128738a, from Torok formation at USGS Mes. loc. 25814.
18, 30. Plesiotype, USNM 128738b, from Torok formation at USGS Mes. loc. 25814. Figure 18 is a rubber cast of the external mold from the posterior part of the specimen shown in figure 30. The anterior part of figure 30 is an internal mold of the body chamber.

19–25. *Subarcthoplites bickeli* Imlay, n. sp. (p. 60).
19. Holotype, USNM 128732, from Torok formation at USGS Mes. loc. 13311. Shows half a whorl of body chamber.
20, 23–25. Paratypes, USNM 128733, from Torok formation at USGS Mes. loc. 13311. On figure 20 note abrupt weakening of ribs on body chamber. Figures 24 and 25 represent a small specimen that has fairly strong ribbing on the venter.
21, 22. Rubber casts of external molds of paratype, USNM 128734, from Torok formation at USGS Mes. loc. 24639.

26–29. *Subarcthoplites colvillensis* Imlay, n. sp. (p. 61)
26, 28. Lateral views of paratype, USNM 128736, from Torok formation at USGS Mes. loc. 21822.
27, 29. Rubber casts of holotype, USNM 128735, from Torok formation at USGS Mes. loc. 21822. Body chamber represents about one-third of the whorl shown in figure 29. Inner whorls revealed by removal of body chamber is shown on figure 27.



SUBARCTHOPLITES, GASTROPLITES AND *XENOHELIX?*

PLATE 17

[All figures natural size]

FIGURES 1, 2. *Gastroplites canadensis* McLearn (p. 62).
Lateral and ventral views of plaster replica of holotype; Natl. Mus. Canada 7430.

3–8. *Gastroplites stantoni* McLearn (p. 62).

3–5. Ventral and lateral views; plesiotype, USNM 128758, from Shaktolik group at USGS Mes. loc. 2678. Right bank of Yukon River at Bishop Mountain, 12 miles above mouth of Koyukuk River, Alaska.

6. Lateral view; plesiotype, USNM 128759, from Shaktolik group at USGS Mes. loc. 2926. Right bank of Yukon at Bishop Rock, Nulato area, Alaska.

7, 8. Ventral and lateral views of plaster replica of holotype; Natl. Mus. Canada 6336. Venter appears wider than in illustration by McLearn (1933b, pl. 1, fig. 9), probably owing to imperfections in the plaster cast.

9–17, 19–23. *Gastroplites kingi* McLearn (p. 61).

9, 16. Lateral views; plesiotype, USNM 128740, from Shaktolik group at USGS Mes. loc. 2927. Bishops Rock on Yukon River, Alaska.

10, 11. Lateral views; plesiotype, USNM 128739, from USGS Mes. loc. 2678. Bishop Mountain on Yukon River, 12 miles above mouth of Koyukok River, Alaska.

12, 19. Lateral views; plesiotypes, USNM 128745, from Tuktu formation at USGS Mes. loc. 20484.

13, 14. Lateral and ventral views; plesiotype, USNM 128744, from Tuktu formation at USGS Mes. loc. 20439.

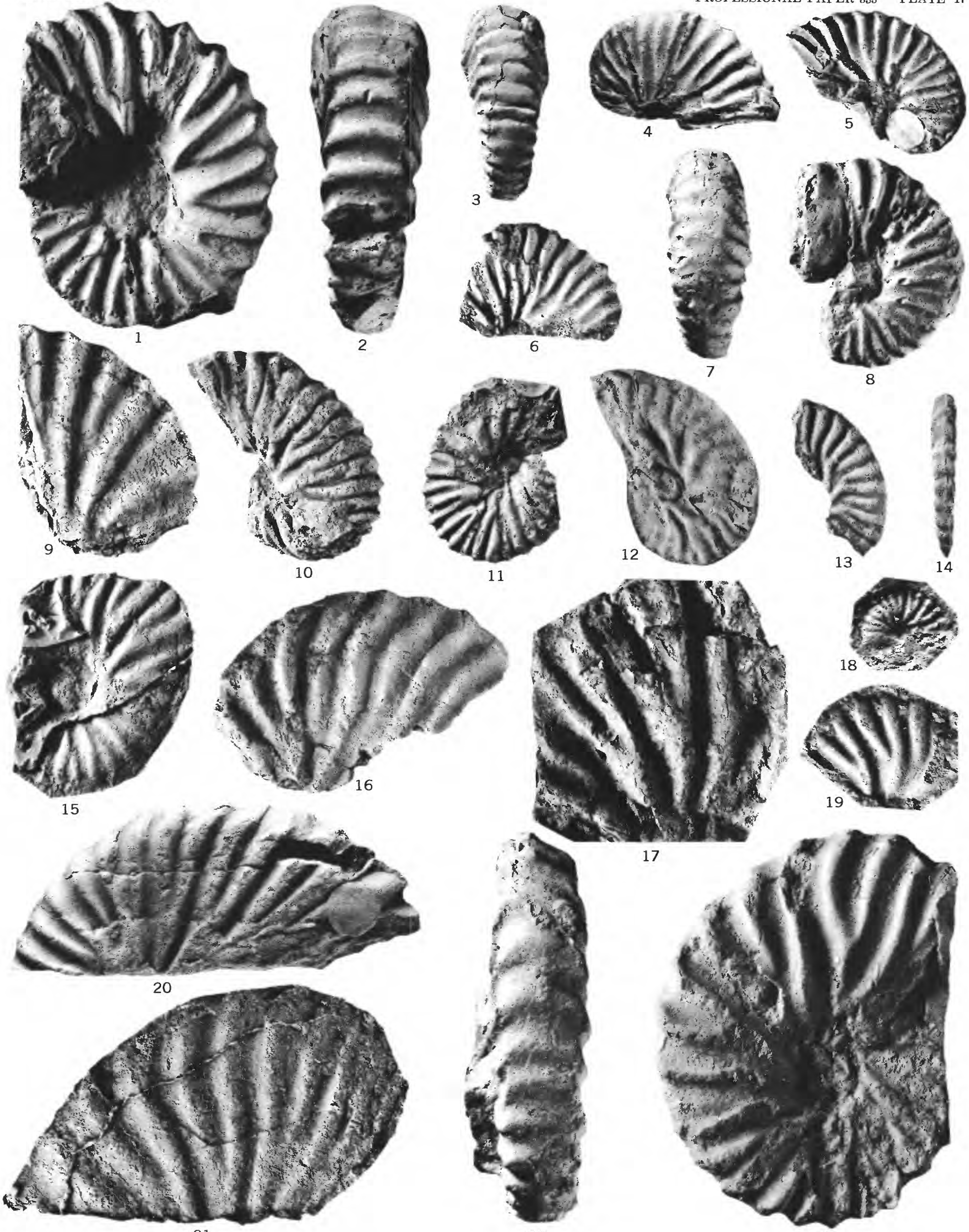
15, 17. Lateral views; plesiotype, USNM 128742, from USGS Mes. loc. 4278 in the Rampart area, central Alaska. Figure 15 is a rubber cast of an external mold.

20. Plesiotype, USNM 128741, from Shaktolik group at USGS Mes. loc. 21418. Bishop Rock on Yukon River, Alaska.

21. Plesiotype, USNM 128743, at USGS Mes. loc. 4279. Rampart area, central Alaska.

22, 23. Ventral and lateral views of plaster replica of holotype; Natl. Mus. Canada 6340.

19. *Gastroplites* sp. juv. cf. *G. kingi* McLearn (p. 62).
USNM 128746, from Torok formation at USGS Mes. loc. 22593.



GASTROPLITES

PLATE 18

[All figures natural size]

FIGURES 1–5, 9. *Pseudopulchellia pattoni* Imlay, n. sp. (p. 65).

1–4, 9. Internal molds of paratypes, USNM 128773, from Tuktu formation at USGS Mes. loc. 24427. Figure 9 shows ventral view of same specimen as figure 2 which is oriented with its anterior end on the right. Figure 3 shows the opposite side of the anterior half of the same specimen shown in figure 4

5. Rubber cast of external mold; holotype, USNM 128772, from Tuktu formation at USGS Mes. loc. 24427.

6–8. *Cylindroteuthis* n. sp. (p. 66).

6–8. Ventral view, section 44 mm anterior to broken apical end, section 70 mm anterior to broken apical end; USNM 128774, from Okpikruak formation at USGS Mes. loc. 22775.

10–20. *Paragastroplites flexicostatus* Imlay, n. sp. (p. 63).

10, 11. Ventral and lateral views of internal molds; holotype, USNM 128757, from Tuktu formation at USGS Mes. loc. 24634.

12, 16, 18. Internal molds; paratypes, USNM 128753, from Shaktolik group at USGS Mes. loc. 25294, Nulato area, central Alaska.

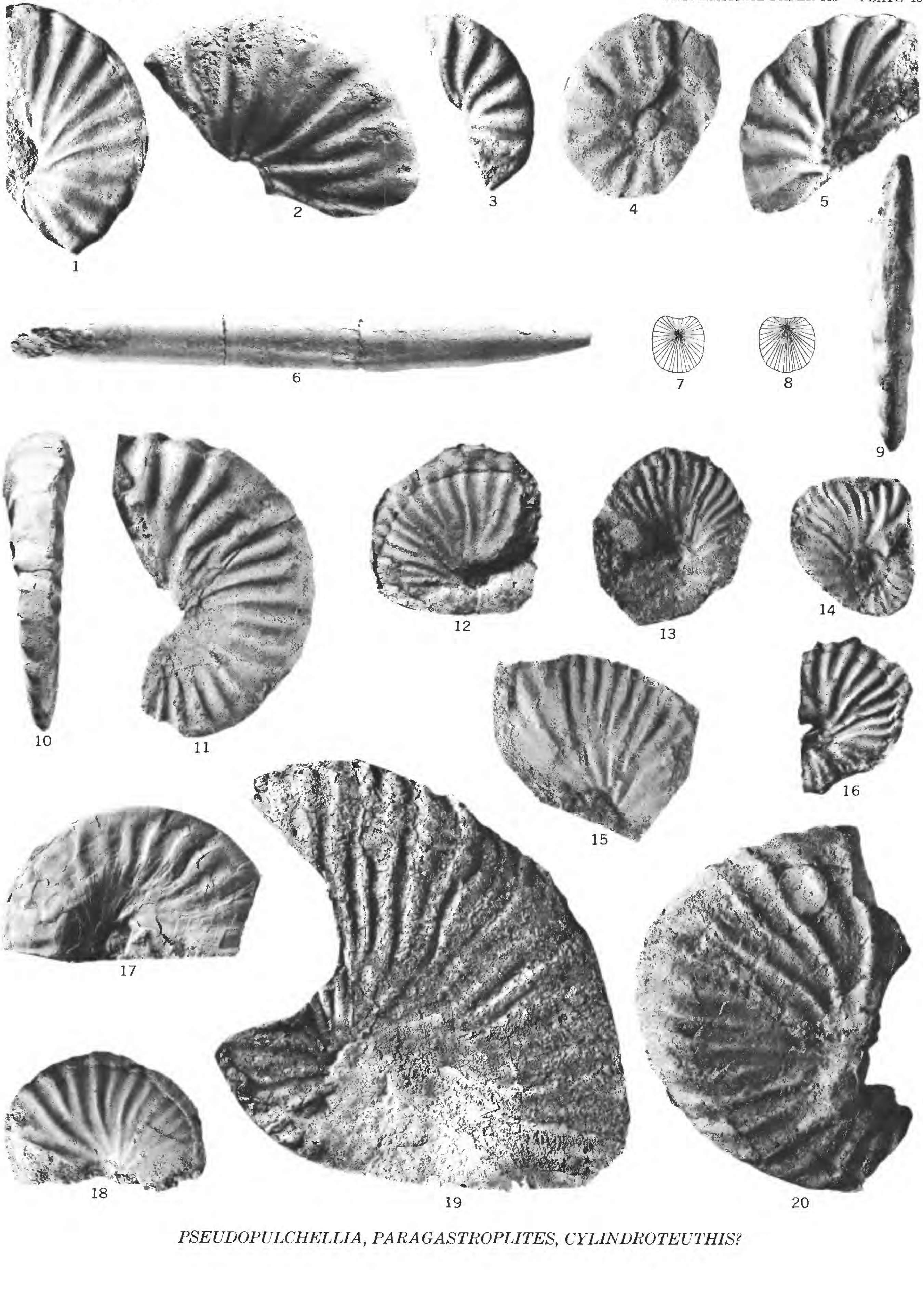
13. Internal mold; paratype, USNM 128752, from Shaktolik group at USGS Mes. loc. 21418. Bishop Rock along Yukon River, central Alaska. Note encrusting bryozoan.

14. Rubber cast of external mold; paratype, USNM 128755, from Tuktu formation at USGS Mes. loc. 20484.

15. Rubber cast of external mold; paratype, USNM 128756, from Tuktu formation at USGS Mes. loc. 22754.

17. Internal mold with some shell adhering; paratype, USNM 128754, from Tuktu formation at USGS Mes. loc. 20403.

19, 20. Rubber cast and internal mold; paratypes, USNM 128751, from USGS Mes. loc. 8900. Rampart area, central Alaska.



PSEUDOPULCHELLIA, PARAGASTROPLITES, CYLINDROTEUTHIS?

PLATE 19

[All figures natural size]

FIGURES 1, 4–10, 12. *Paragastroplites spiekeri* McLearn (p. 62).

1, 6, 12. Rubber casts of external mold; plesiotype, USNM 128748, at USGS Mes. loc. 4279. Rampart area, central Alaska. Figure 1 differs from figure 6 by showing a small part of the body chamber. Figure 12 is identical with the lowermost part of figure 6, but is oriented to show the smoothness of the venter.

4, 5. Lateral and ventral views of plaster replica of holotype; Nat. Mus. Canada 6339.

7, 9, 10. Rubber cast of external mold, internal mold of an immature specimen; plesiotypes, USNM 128749, from Tuktu formation at USGS Mes. loc. 20397.

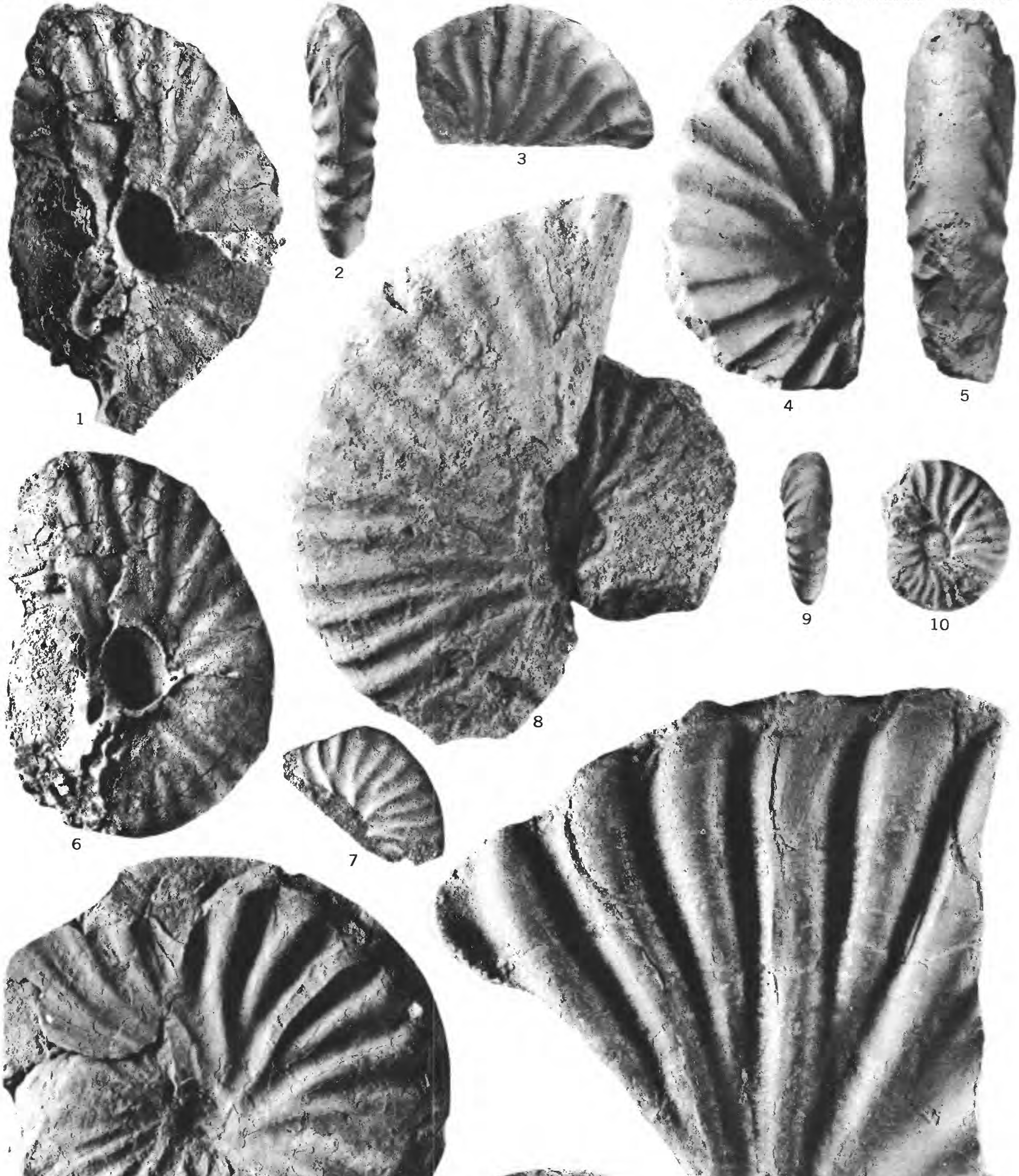
8. Internal mold showing half a whorl of body chamber; plesiotype, USNM 128747, from USGS Mes. loc. 4278. Rampart area, central Alaska.

2, 3. *Paragastroplites* aff. *P. spiekeri* (McLearn) (p. 63).

Ventral and lateral views; USNM 128750, from Torok formation at USGS Mes. loc. 25815.

11, 13. *Paragastroplites liardense* (Whiteaves) (p. 63).

Lateral views of plaster replicas of cotypes; Natl. Mus. Canada 4808.



PARAGASTROPLITES

PLATE 20

[All figures natural size]

FIGURES 1–5. *Cleoniceras tailleuri* Imlay, n. sp. (p. 63).

1, 3. Lateral views; paratypes, USNM 128763, from Tuktu formation at USGS Mes. loc. 21827. Figure 1 is from a rubber cast of an external mold. Figure 3 is from a compressed internal mold.

2. Rubber cast of an external mold; paratype, USNM 128762, from Tuktu formation at USGS Mes. loc. 20438.

4, 5. Cross-section and rubber cast of external mold; holotype, USNM 128761, from Torok formation at USGS Mes. loc. 24640.

6–9. *Cleoniceras (Neosaynella)? whittingtoni* Imlay, n. sp. (p. 64).

6. Rubber cast of external mold; paratype, USNM 128765, from Torok formation at USGS Mes. loc. 25804.

7, 8. Cross-section and rubber cast of external mold; holotype, USNM 128764, from Grandstand formation at USGS Mes. loc. 24638.

9. Internal mold; paratype, USNM 128766, from Kukpowruk formation at USGS Mes. loc. 25790.

10–12. *Cleoniceras cleon* (d'Orbigny) (p. 63).

Lateral, apertural and ventral views of a plaster replica received from Raymond Casey; labeled British Museum no. C–40219. These views are inserted for comparison with *Cleoniceras tailleuri* Imlay, n. sp.

13–20. *Cleoniceras (Grycia) sablei* Imlay, n. sp. (p. 64).

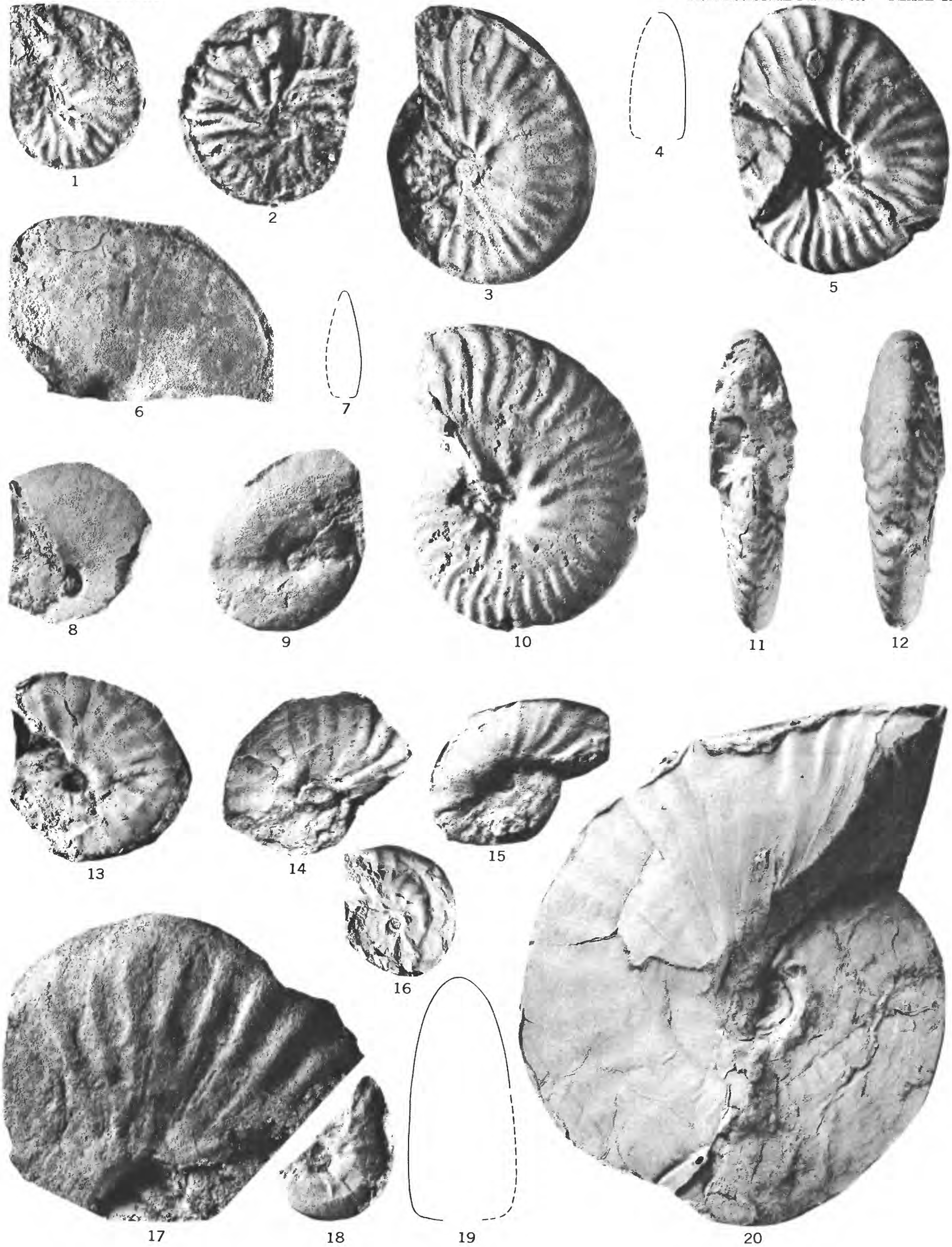
13, 15, 18. Rubber casts of external molds; paratypes, USNM 128771, from the Torok formation at USGS Mes. loc. 25812. These occur on the same slab with *Gastroplites* sp.

14. Rubber cast of external mold; paratype, USNM 128768, from Torok formation at USGS Mes. loc. 25813.

16. Crushed external mold; paratype, USNM 128770, from Topagoruk formation in the Topagoruk test well 1 at depth of 3,249 feet.

17, 19. Lateral view and cross section of internal mold; paratype, USNM 128769, from Tuktu formation at USGS Mes. loc. 20405.

20. Rubber cast of external mold; holotype, USNM 128767, from Torok formation at USGS Mes. loc. 25813.



CLEONICERAS