Middle Jurassic (Bathonian) Ammonites From Southern Alaska

GEOLOGICAL SURVEY PROFESSIONAL PAPER 1091

Middle Jurassic (Bathonian) Ammonites From Southern Alaska

By RALPH W. IMLAY

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Studies of Bathonian ammonites from southern Alaska provide correlations with the arctic region in general, with the Pacific coast and western interior regions of North America, and with the early Bathonian of some other parts of the world

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ILLUSTRATIONS

[Plates 1–12 follow index]

TABLES

CONVERSION FACTORS

Metric unit		Inch-Pound equivalent
Length		
millimeter (mm)	= 0.03937	inch (in)
meter (m)	= 3.28	feet (ft)
kilometer (km)	= .62	mile (mi)
Area		
square meter (m^2)	= 10.76	square feet (ft^2)
square kilometer (km^2)	= .386	square mile (mi^2)
hectare (ha)	= 2.47	acres
Volume		
cubic centimeter (cm^3)	= 0.061	cubic inch (in^3)
liter (L)	= 61.03	cubic inches
cubic meter (m^3)	= 35.31	cubic feet (ft^3)
cubic meter	= .00081	acre-foot (acre-ft)
cubic hectometer (hm^3)	= 810.7	acre-feet
liter	= 2.113	pints (pt)
liter	= 1.06	quarts (qt)
liter	= .26	gallon (gal)
cubic meter	= .00026	million gallons (Mgal or 10^6 gal)
cubic meter	= 6.290	barrels (bbl) (1 bbl = 42 gal)
Weight		
gram (g)	= 0.035	ounce, avoirdupois (oz avdp)
gram	= .0022	pound, avoirdupois (lb avdp)
metric tons (t)	= 1.102	tons, short (2,000 lb)
metric tons	= 0.9842	ton, long (2,240 lb)
Specific combinations		
kilogram per square centimeter (kg/cm^2)	= 0.96	atmosphere (atm)
kilogram per square centimeter	= .98	bar (0.9869 atm)
cubic meter per second (m^3/s)	= 35.3	cubic feet per second (ft^3/s)
Specific combinations—Continued		
liter per second (L/s)	= .0353	cubic foot per second
cubic meter per second per square kilometer [$(m^3/s)/km^2$]	= 91.47	cubic feet per second per square mile [$(ft^3/s)/mi^2$]
meter per day (m/d)	= 3.28	feet per day (hydraulic conductivity) (ft/d)
meter per kilometer (m/km)	= 5.28	feet per mile (ft/mi)
kilometer per hour (km/h)	= .9113	foot per second (ft/s)
meter per second (m/s)	= 3.28	feet per second
meter squared per day (m^2/d)	= 10.764	feet squared per day (ft^2/d) (transmissivity)
cubic meter per second (m^3/s)	= 22.826	million gallons per day (Mgal/d)
cubic meter per minute (m^3/min)	= 264.2	gallons per minute (gal/min)
liter per second (L/s)	= 15.85	gallons per minute
liter per second per meter [(L/s)/m]	= 4.83	gallons per minute per foot [(gal/min)/ft]
kilometer per hour (km/h)	= .62	mile per hour (mi/h)
meter per second (m/s)	= 2.237	miles per hour
gram per cubic centimeter (g/cm^3)	= 62.43	pounds per cubic foot (lb/ft^3)
gram per square centimeter (g/cm^2)	= 2.048	pounds per square foot (lb/ft^2)
gram per square centimeter	= .0142	pound per square inch (lb/in^2)
Temperature		
degree Celsius (°C)	= 1.8	degrees Fahrenheit (°F)
degrees Celsius (temperature)	= [(1.8 × °C) + 32]	degrees Fahrenheit

MIDDLE JURASSIC (BATHONIAN) AMMONITES FROM SOUTHERN ALASKA

By Ralph W. Imlay

ABSTRACT

The Bathonian ammonites of southern Alaska include (1) some genera characteristic of the Boreal realm, such as *Kepplerites*, *Arctocephalites*, and *Cranocephalites;* (2) some genera that occur nearly worldwide except in the Boreal realm, such as *Cadomites* and *Siemeradzkia;* and (3) many genera that are known only in the Pacific coast region of Alaska or in areas farther south. Those taxa found to date only in southern Alaska include *Tuxednites* n. gen., *Talkeetnites* n. gen., and *Chinitnites*. Those taxa found in the Pacific coast region from Alaska to Oregon include *Parareineckeia*, *Cobbanites*, and *Iniskinites*. Of these, *Cobbanites* occurs also in the western interior region. In addition, *Xenocephalites* occurs along the Pacific coast of both North and South America as well as in the western interior region of North America.

Ammonites of Bathonian Age in southern Alaska occur in the Bowser Formation west of Cook Inlet, in unnamed beds in the Talkeetna Mountains, and in the Nizina Mountain Formation in the Wrangell Mountains. These lithologic units are dated as Bathonian mainly by the presence of (1) a sequence of ammonites similar to those in northern Canada, northern Alaska, and East Greenland; (2) *Cadomites* in the lower part of the unnamed beds in the Talkeetna Mountains and in the Nizina Mountain Formation in the Wrangell Mountains; (3) *Siemeradzkia* in the lower part of the Bowser Formation west of Cook Inlet; (4) *Kepplerites* not associated with *Cadoceras* in the uppermost part of the Bowser Formation; (5) *Cobbanites* of the Leptosphinctinae throughout most of the Bowser Formation but mostly in the lower part; and (6) the lithologic units in question in the Talkeetna Mountains and west of Cook Inlet lying unconformably below beds of early Callovian Age.

More detailed dating of the Bowser Formation and equivalent units in southern Alaska is made possible by the ammonites that are not known solely from the Pacific coast region. The succession of such ammonites from the base upward is characterized (1) by many specimens of *Cranocephalites costidensus* (Imlay) in association with rare occurrences of *Siemeradzkia* and *Cadomites;* (2) next higher, by species of *Cranocephalites* similar to *C. ignekensis* Imlay from northern Alaska and to *C. vulgaris* Spath from the Arctic region; (3) next higher, by *Arctocephalites* similar to *A. elegans* Spath from the Arctic region; and (4) at the top, by weakly to nontuberculate species of *Kepplerites* that are not associated with *Cadoceras*.

Concerning this succession, the lowermost part is probably of early Bathonian rather than latest Bajocian Age as shown by the presence of *Siemeradzkia* and a species of *Cadomites* similar to *C. rectelobatus* (von Hauer). It cannot be younger than early Bathonian as indicated by the presence of *C.* cf. *C. deslongchampsi* (d'Orbigny). The fact that the associated *Cobbanites* belongs to the Bajocian subfamily Leptosphinctinae favors a late Bajocian Age but does not prove such an age because the genus also occurs much higher near the top of the Bowser Formation.

The next higher part of the succession characterized by the highest occurrences of *Cranocephalites* is dated as late early Bathonian on the basis that similar species occur in East Greenland at a similar stratigraphic position. Likewise, the overlying part characterized by *Arctocephalites* is dated as probably middle Bathonian by comparisons with East Greenland. The highest part characterized by *Kepplerites* that is not associated with *Cadoceras* may be equivalent in East Greenland to the lowermost occurrence of *Kepplerites* in the upper part of the range of *Arctioceras* just below the lowermost occurrence of *Cadoceras*. Apparently the uppermost Bathonian in East Greenland that contains both *Kepplerites* and *Cadoceras* is represented in southern Alaska either by an unconformity at the base of the Chinitna Formation or by the basal part of the Chinitna Formation that contains the uppermost occurrences of *Iniskinites intermedius* (Imlay).

INTRODUCTION

The Bathonian ammonites of southern Alaska, partially described by the writer (Imlay, 1962a), have been restudied to reevaluate the stratigraphic distribution of genera and species, to establish regional and intercontinental correlations, and to date the lithologic units more precisely in terms of the standard Bathonian zones of western Europe. This study is based on biostratigraphic data compiled by Detterman and Hartsock (1966, p. 36–40) for the Bowser Formation west of Cook Inlet; by Arthur Grantz (1965; written commun., 1972) for equivalent unnamed beds in the Nelchina area of the Talkeetna Mountains; by R. L. Detterman and the writer, 1972 and 1974 (unpub. data), for equivalent beds in the Boulder Creek area of the Talkeetna Mountains; and by E. M. MacKevett, Jr., (1963, unpub. data; 1969, p. A42–A45; 1971, p. 16, 17) for the Nizina Mountain Formation in the Wrangell Mountains. The writer took part in field studies west of Cook Inlet with D. J. Miller in 1948 and with R. L. Detterman in 1974; in the Talkeetna Mountains with Arthur Grantz in 1952 and with R. L. Detterman in 1972 and 1974; and in the Wrangell Mountains with E. M. MacKevett, Jr., in 1962. Many thanks are due all these geologists for collecting the fossils and for furnishing accurate fossil locality and stratigraphic data.

BIOLOGIC ANALYSIS

Southern Alaska ammonites of Bathonian, or probably Bathonian, Age that are discussed or described herein, number 343 specimens. Some of these were described in

1962 (Imlay, 1962a), but most were obtained subsequently from the Wrangell and Talkeetna Mountains and from the north side of Cook Inlet between Iniskin Bay and Tuxedni Bay. Their distribution by genus, subfamily, and family is shown herein table 1. Among the families, the Cardioceratidae constitutes 60 percent of the total number of specimens; the Reineckeiidae?, 18 percent; the Perisphinctidae, nearly 8 percent; and the Phylloceratidae, 6 percent. The Cardioceratidae is dominated by *Cranocephalites* and comprises six genera, of which *Tuxednites* and *Talkeetnites* are recognized as new.

The characteristics of most of the genera and subgenera present have been described adequately in fairly recent publications. *Liroxyites* has been described by Imlay (1962b, p. A–8); *Cadomites*, by Arkell (1952, p. 79, 80), Arkell and others (1957, p. L290), and Kopik (1974, p. 12, 13); *Cranocephalites* and *Arkelloceras*, by Arkell and others (1957, p. L301) and Imlay (1962a, p. C2; 1976, p. 2); *Chinitnites* and *Iniskinites*, by Imlay (1975, p. 17, 18, 23); and *Parareineckeia*, by Imlay (1962a, p. C–25) and Bourquin (1968, p. 160).

Cobbanites is now assigned to the subfamily Leptosphinctinae, instead of the Zigzagiceratinae, at the suggestion of John Callomon (1971, written commun.). This assignment is based on the presence of deep forwardly inclined constrictions, of slightly to strongly forwardly inclined ribs that arch adorally and weaken on the venter, and of lateral tubercles on the inner whorls of some species. Within the Leptosphinctinae, *Cobbanites* may be distinguished from *Leptosphinctes* proper by its much coarser ribbing and larger size (Buckman, 1920, pls. 160, 161; 1921, pls. 201, 202); from *Prorsisphinctes* by the presence of tubercles on its inner whorls, much more compressed whorls, and considerably weaker ribbing on its outermost septate whorl (Buckman, 1921, pls. 200, 247; 1922, pl. 326; 1923, pl. 366; 1927, pl. 446a, b; Sturani, 1964, pl. 4, fig. 1); and from *Vermisphinctes* by its considerably larger size (Buckman, 1920, pls. 162, 190), by more distinct tubercles on the inner whorls of some species, by more definite weakening of ribs along the midline of the venter, and perhaps by the presence of lateral lappets (Arkell, 1958, p. 168).

TABLE 1.—*Bathonian ammonite genera in southern Alaska showing biological relationships and relative numbers available for study*

Family	Subfamily	Genus or subgenus	Number of specimens
Phylloceratidae---	Phylloceratinae-------	Phylloceras----------	2
		Macrophylloceras-----	18
	Calliphylloceratinae--	Calliphylloceras-----	12
Lytoceratidae-----	Lytoceratinae---------	Lytoceras------------	2
Oppeliidae--------	Oppeliinae------------	Oppelia (Oxycerites)-	2
		(Liroxyites)-------	1
		Oecotraustes?--------	1
Stephanoceratidae	Cadomitinae-----------	Cadomites------------	4
Macrocephalitidae------------------------		Xenocephalites-------	4
		Xenocephalites?------	4
Kosmoceratidae---------------------------		Kepplerites----------	4
		Kepplerites?---------	2
Cardioceratidae---	Cadoceratinae---------	Cranocephalites------	154
		Arctocephalites------	1
		Tuxednites n. gen.---	19
		Tuxednites?----------	5
		Chinitnites----------	16
		Iniskinites----------	8
		Talkeetnites n. gen.-	2
Reineckeiidae?---------------------------		Parareineckeia-------	60
Perisphinctidae---	Leptosphinctinae------	Cobbanites-----------	23
	Pseudoperisphinctinae-	Siemiradzkia---------	2

These resemblances show that *Cobbanites* is closely related to *Leptosphinctes* and its subgenera and is possibly a descendant of *Vermisphinctes*. Nonetheless, *Cobbanites* is herein retained as a distinct genus because it does not fit precisely morphologically with either *Vermisphinctes* or *Prorsisphinctes* and occurs in beds that are mainly or entirely of Bathonian Age, whereas those subgenera are not known above beds of late Bajocian Age (Arkell, 1957, p. L314; Sturani, 1966, p. 9; Pavia and Sturani, 1968, p. 310).

STRATIGRAPHIC SUMMARY

Bathonian ammonites have been found in southern Alaska west of Cook Inlet, in the southern part of the Talkeetna Mountains, and in the southern part of the Wrangell Mountains (fig. 1 and tables 2–4). On the west side of Cook Inlet between Iniskin Bay and Tuxedni Bay, the Bathonian is represented by the Bowser Formation, which has been described and illustrated in detail by Detterman and Hartsock (1966, p. 35–40, 42, pl. 5) and is illustrated herein in figure 2. That formation ranges in thickness from 1,250 to 1,850 feet. It consists of units of siltstone, sandstone, and conglomerate that vary from thick to thin bedded, are commonly massive, change markedly laterally, and became less conglomeratic and finer grained northward. Coquinoid beds containing mostly *Inoceramus* and *Trigonia* are common in the sandstone. Ammonite-bearing concretions occur in the siltstone and are fairly common north of Chinitna Bay. The pebbles, cobbles, and boulders in the conglomerates consist mostly of felsite and basalt but include some granitic rocks. The Bowser Formation rests unconformably on the Twist Creek Siltstone or on older Bajocian beds. It is overlain sharply, but apparently conformably, by the Chinitna Formation on the Iniskin Penisula, and unconformably by that formation between Chinitna Bay and Tuxedni Bay.

In the Talkeetna Mountains, the Bathonian is represented in the Boulder Creek and Nelchina areas (fig. 3) by unnamed beds that are overlain unconformably by the Chinitna Formation of early to early middle Callovian Age (Imlay, 1975, p. 7, 14) and are underlain unconformably by beds ranging in age from Early Jurassic (Tal-

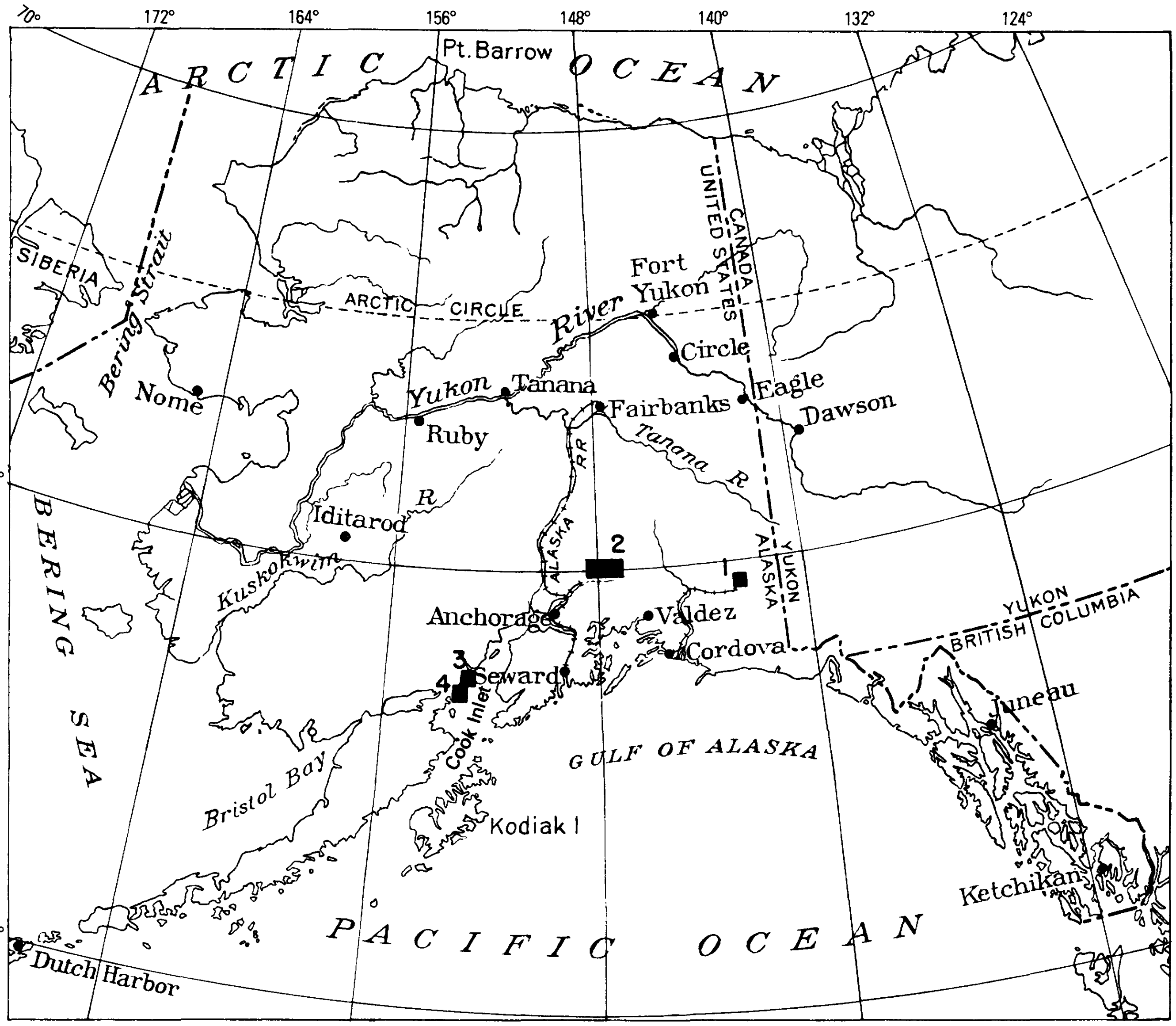

FIGURE 1.—Index map showing principal areas of outcrop of Bathonian marine rocks in southern Alaska. 1, Wrangell Mountains; 2, Talkeetna Mountains; 3, Chisik Island and peninsula between Tuxedni Bay and Chinitna Bay; 4, Iniskin Peninsula.

keetna Formation) to early late Bajocian (uppermost part of Tuxedni Group).

In the Boulder Creek area, the Bathonian unnamed beds are best exposed on a northwest-trending divide (figs. 3 and 4) about 6 miles N. 20° E. of the junction of East Boulder Creek with the main Boulder Creek. On that divide those beds are about 475 feet thick and consist from top to bottom of 150 feet of volcanic graywacke that includes some beds of coquina, 255 feet of gray to brown concretionary siltstone, and 70 feet of graywacke that includes a few beds of siltstone. Pelecypods and belemnites are fairly common in the coquina beds in the upper volcanic graywacke. Ammonites are abundant in limestone concretions in the siltstone unit and occur rarely in siltstone beds within the lower unit of graywacke.

This lowermost graywacke forms a steep slope above a covered interval about 70 feet thick. Next lower is 30 feet of soft brownish-gray to orange-gray, ash-bearing siltstone that closely resembles the Twist Creek Siltstone west of Cook Inlet (Detterman and Hartsock, 1966, p. 35) and contains the same early late Bajocian ammonites in limy concretions (Imlay, 1962b). Most probably the overlying covered interval is underlain by similar soft siltstone, because identical siltstone attains a thickness of at least 100 feet on a ridge about 1 mile to the

TABLE 2.—*Geographic distribution of Bathonian ammonites*

[Numbers 1-20 are keyed to locality numbers in figures 8 and 9.

Genus and species	Wrangell Mountains												
	Nizina Mountain Formation												
	McCarthy C-5 quadrangle												
	1	2	3		4	5	6	7	8		9	10	11
	28524	28525	28527	28699	28526	28692	28698	28696	28682	28701	28681	28683	28691
Phylloceras (Macrophylloceras) grossicostatum Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--
(M.) cf. P. (M.) grossicostatum Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--
Calliphylloceras freibrocki (Imlay)	--	--	--	--	--	--	--	--	--	--	--	--	--
Lytoceras sp	--	--	--	--	--	--	--	--	--	--	--	--	--
Oecotraustes (Paraecotraustes?) sp	--	--	--	--	--	--	--	--	--	--	--	--	--
Cadomites cf. C. deslongchampsi (d'Orbigny)	--	--	--	--	--	--	--	--	--	--	--	--	--
cf. C. rectolobatum (Hauer)	--	--	--	--	--	--	--	--	X	--	--	--	--
Cranocephalites costidensus Imlay	--	--	--	--	--	--	--	--	X	--	X	--	--
cf. C. costidensus Imlay	--	X	--	X	--	--	--	--	--	--	--	--	--
alaskanus Imlay n. sp	--	--	--	--	--	--	--	--	X	--	--	--	--
cf. C. alaskanus Imlay n. sp	--	X	X	--	--	--	X	--	--	--	X	--	--
cf. C. pompeckji (Madsen)	--	--	--	--	--	--	--	--	--	--	--	--	--
globosus Imlay n. sp	--	--	--	--	--	--	--	--	--	--	--	--	--
cf. C. vulgaris Spath	--	--	--	--	--	--	--	--	--	--	--	--	--
Cranocephalites sp	--	--	--	--	--	--	--	X	--	--	--	--	X
Tuxednites alticostatus (Imlay)	--	--	--	--	--	--	--	--	X	--	--	--	--
? sp	--	--	--	--	--	--	--	--	X	--	--	--	--
Chinitnites sp	--	--	--	--	--	--	--	--	--	--	--	--	--
Talkeetnites cadiformis Imlay n. sp	--	--	--	--	--	--	--	--	--	--	--	--	--
Parareineckeia hickersonensis Imlay	X	--	--	X	--	--	X	X	X	X	X	--	--
nelchinensis Imlay n. sp	X	--	X	--	--	--	--	--	X	--	X	X	--
sp	--	X	--	--	X	X	--	--	--	--	--	--	--
Cobbanites talkeetnanus Imlay	--	X	--	X	--	--	--	--	X	--	--	--	--
striatus Imlay n. sp	--	--	--	--	--	--	--	--	X	--	--	--	--
cf. C. striatus Imlay	--	--	--	X	--	--	--	--	--	--	--	--	--

southwest in the SW¼SE¼ sec. 34, T. 22 N., R. 7 E., and the NW¼NE¼ sec. 3, T. 21 N., R. 7 E.

Unnamed bed of Bathonian Age in the Nelchina area of the Talkeetna Mountains were mapped and briefly described by Grantz (1960a, b; 1965). Some descriptions furnished by Grantz (1959, 1972, written communs.) were published by Imlay (1962a, p. C4; 1975, p. 2, 3, fig. 3) and are shown herein (fig. 4). The Bathonian sequence northwest of Limestone Hills in the upper part of the Little Nelchina River Valley contains some highly fossiliferous siltstone similar to that in the Boulder Creek area, as just described, but differs by consisting mostly of gray medium- to thick-bedded sandstone and by containing pebbles and cobbles in its upper part. The sequence exposed from 3 to 4 miles farther north on the south side of the Little Oshetna River differs by consisting mostly of thick-bedded sandstone that is interbedded with lenses of conglomerate in its upper part and with coaly and plant-bearing beds in its lower part; it contains very few marine fossils.

On the southern flank of the Wrangell Mountains the Bathonian is represented within the Nizina Mountain Formation, which crops out in the McCarthy C–5 quadrangle (MacKevett, 1969, p. A42–A45; 1971, p. 16, 17, *in the Wrangell Mountains and Talkeetna Mountains, Alaska*

Higher numbers are USGS Mesozoic locality numbers]

Talkeetna Mountains																													
Unnamed beds equivalent to Bowser Formation																													
Nelchina area												Boulder Creek area																	
12	13	14	15	16								17													18	19	20		
27515	24822	24115	24825	24116	24117	24118	30286	30287	30288	30289	30290	30274	30275	30276	30277	30278	30279	30574	30575	30576	30577	30578	30579	RAL65	30292	8573	30271	30272	30273
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28). That formation attains a maximum thickness of 1,500 feet, at most places is much thinner, and locally pinches out. It is overlain disconformably by the Root Glacier Formation of late Oxfordian to middle Tithonian Age or by younger rocks. It is underlain disconformably by the Lubbe Creek Formation of Pliensbachian Age or by the upper member of the McCarthy Formation of earliest Jurassic Age (MacKevett, 1969, p. A44, A46; 1970; Imlay and Detterman, 1973, fig. 11A). It consists mostly of hard dark-greenish-gray fine to very fine grained medium-bedded graywacke but includes some limy shale and some shaly partings.

BATHONIAN AMMONITE SUCCESSION

WEST OF COOK INLET

The stratigraphic positions of many fossil collections within the Bowser Formation between Iniskin Bay and Tuxedni Bay are described herein in table 4 and are depicted in part on columnar sections (fig. 2). These data permit fairly accurate determinations of the stratigraphic ranges of many species relative to the top and bottom of the formation and to other species or genera (fig. 5).

TABLE 3.—*Geographic distribution of Bethonian ammonites*

[Numbers 21-58 are keyed to locality numbers in figures

	West side of Cook Inlet between Tuxedni Bay and Iniskin Bay															
	Bowser Formation															
	Chisik Island and Peninusla to the south															
	Tuxedni Bay area													Near Lake Hickerson		
	21		22	23	24	25	26	27	28	29		30	31	32	33	34
	3014	21272	30263	30262	30257	30261	21284	21283	30258	22711	22712	22713	22714	22698	22699	22700
Phylloceras cf. P. bakeri Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
(Macrophylloceras) grossicostatum Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
(Macrophylloceras) sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calliphylloceras freibrocki (Imlay)	--	--	--	--	--	--	--	--	--	--	X	--	--	--	--	--
Lytoceras sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Oppelia (Oxycerites) sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
(Oxycerites) aff. O. (O.) chinitnana Imlay	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
(Liroxyites) cf. O. (L.) kellumi Imlay	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
Xenocephalites cf. X. hebetus Imlay	--	--	--	--	--	--	--	--	--	--	--	X	--	--	--	--
? sp	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--	--
Kepplerites sp. A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
sp. B	--	--	--	--	--	--	--	--	X	--	--	--	--	--	--	--
sp. C	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--	--
? sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cranocephalites costidensus Imlay	--	--	--	--	--	--	--	X	--	--	X	--	--	X	--	--
cf. C. costidensus Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
alaskanus Imlay n. sp	--	--	--	--	--	--	--	X	--	--	--	--	--	X	--	--
cf. C. Imlay n. sp	--	--	--	--	--	--	--	--	--	X	X	--	--	--	--	--
cf. C. pompeckji (Madsen)	--	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--
globosus Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
sp. A	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
sp. B	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--
sp. juv	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
? sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arctocephalites cf. A. elegans Spath	--	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--
Tuxednites alticostatus (Imlay)	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--
cf. T. alticostatus Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--
? sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chinitnites parviformis Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iniskinites intermedius (Imlay)	X	X	--	--	--	--	--	--	--	--	--	--	--	--	--	X
cf. I. intermedius (Imlay)	--	--	--	X	--	--	--	--	--	--	--	--	--	--	--	--
sp. juv. cf. I. magniformis (Imlay)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Parareineckeia hickersonensis Imlay	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--
nelchinensis Imlay n. sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cf. P. nelchinensis Imlay n. sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cobbanites tuxedniensis Imlay n. sp	--	--	--	--	--	X	--	--	--	--	--	--	--	--	--	--
sp	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Siemeradzkia cf. S. aurigera (Oppel)	--	--	--	--	--	--	--	--	--	--	--	--	--	X	--	--

between Tuxedni Bay and Iniskin Bay west of Cook Inlet, Alaska

10 and 11. Higher numbers are USGS Mesozoic locality numbers]

West side of Cook Inlet between Tuxedni and Iniskin Bay--Continued																													
Bowser Bay Formation--Continued																													
Iniskin Peninsula																													
Chinitna Bay area					Tonnie Creek and Brown Creek					Bowser Creek												Iniskin Bay area							
35			36		37	38	39	40		41	42	43	44	45	46	47	48	49		50	51	52		53	54	55	56	57	58
21311	21312	22436	21308	21309	21319	20011	27100	20005	30265	22549	11038	20754	20745	20746	11042	20748	21320	20751	20752	20743	20744	22536	22538	22553	20736	20739	3038	20764	22416
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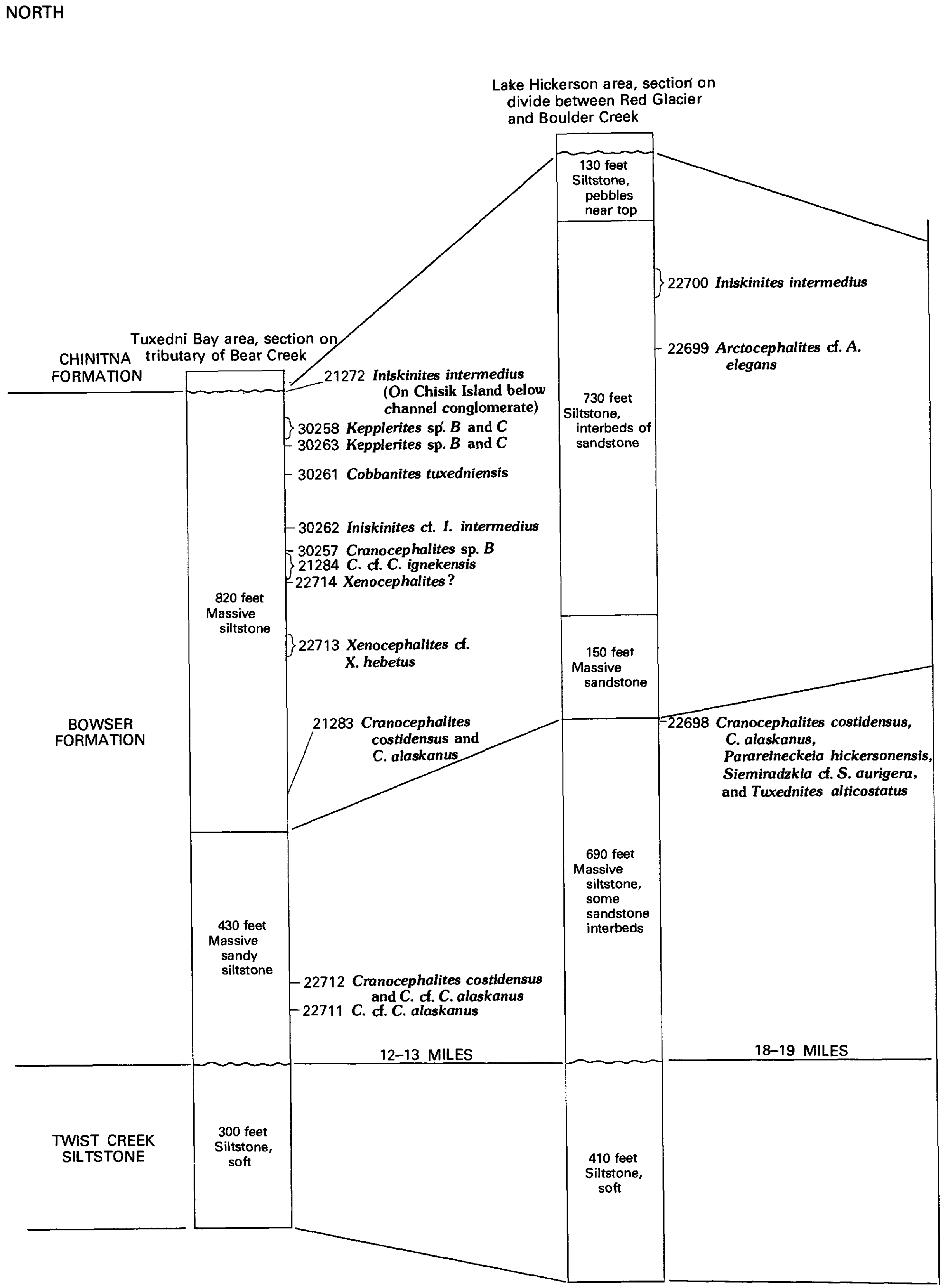

FIGURE 2.—Stratigraphic positions of some Bathonian ammonite localities in the Bowser Formation west of Cook Inlet between Tuxedni Bay and Iniskin Bay. Data from Detterman and Hartsock, 1966, p. 37–40, pl. 5. Approximate locations of sections are shown in figures 10 and 11.

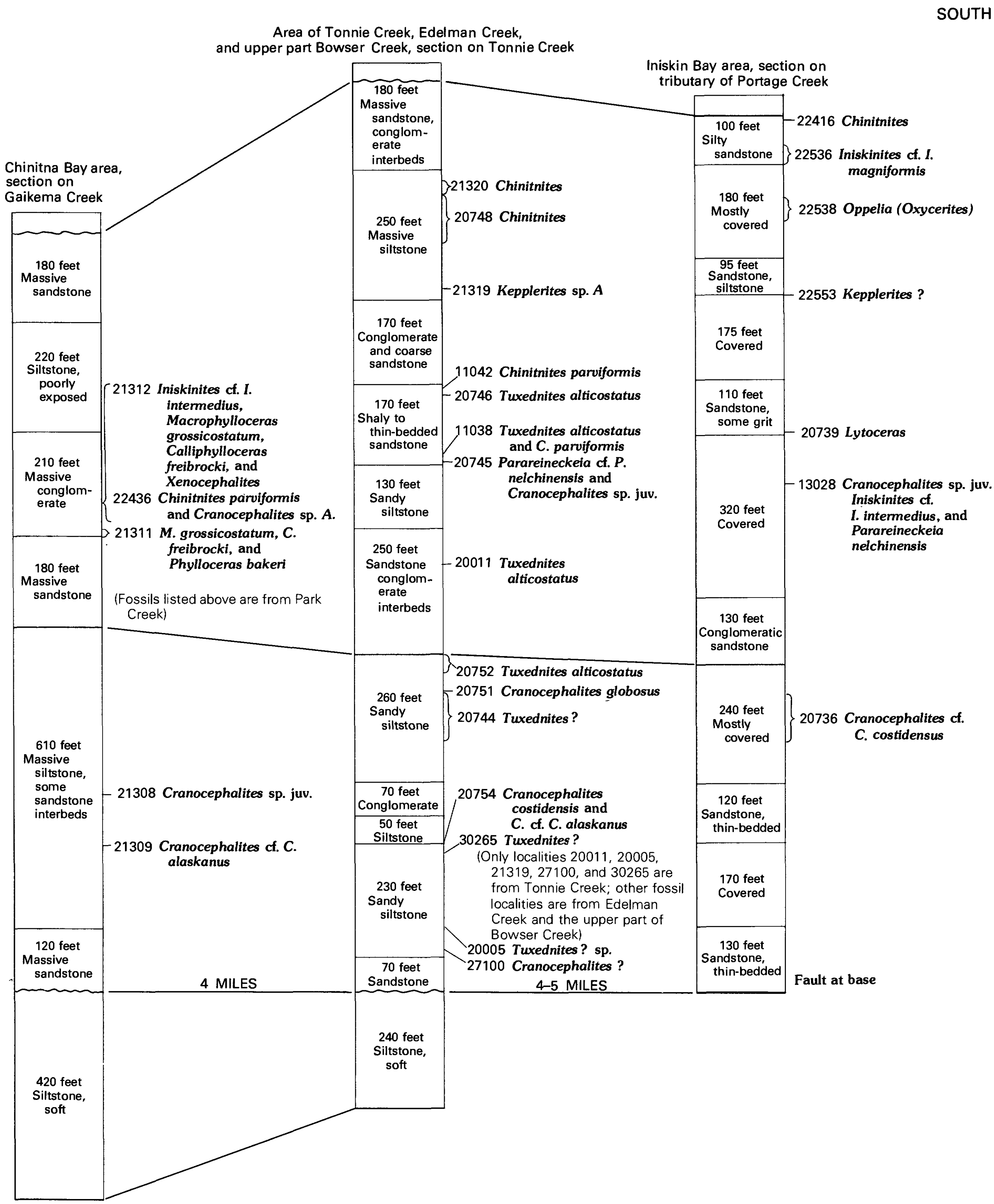

FIGURE 2.—Continued.

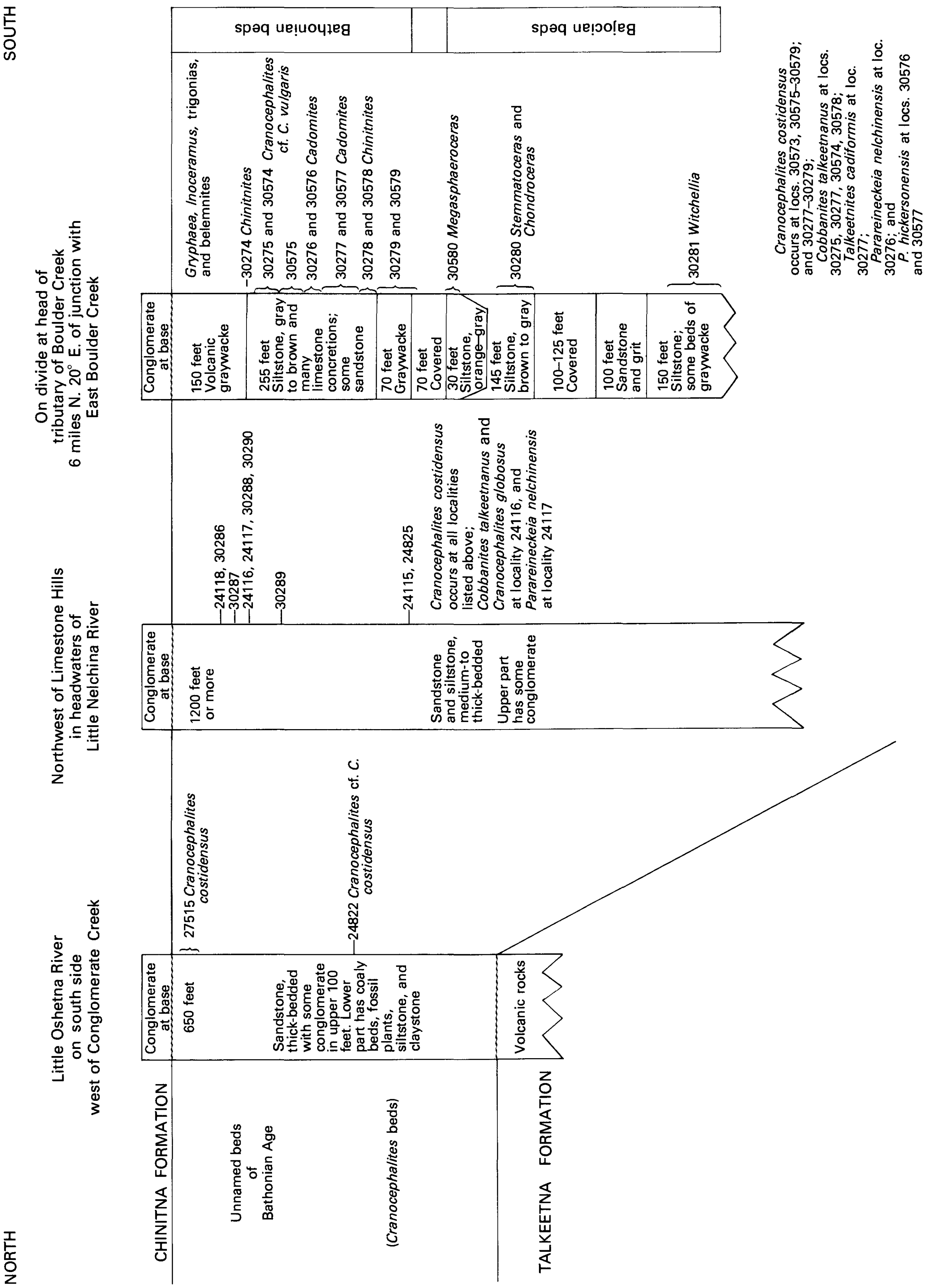

FIGURE 3.—Stratigraphic positions of some Bathonian ammonite localities in the Talkeetna Mountains. Data for Nelchina area furnished by Arthur Grantz, (written commun., 1972). Approximate locations of sections are shown in figure 9.

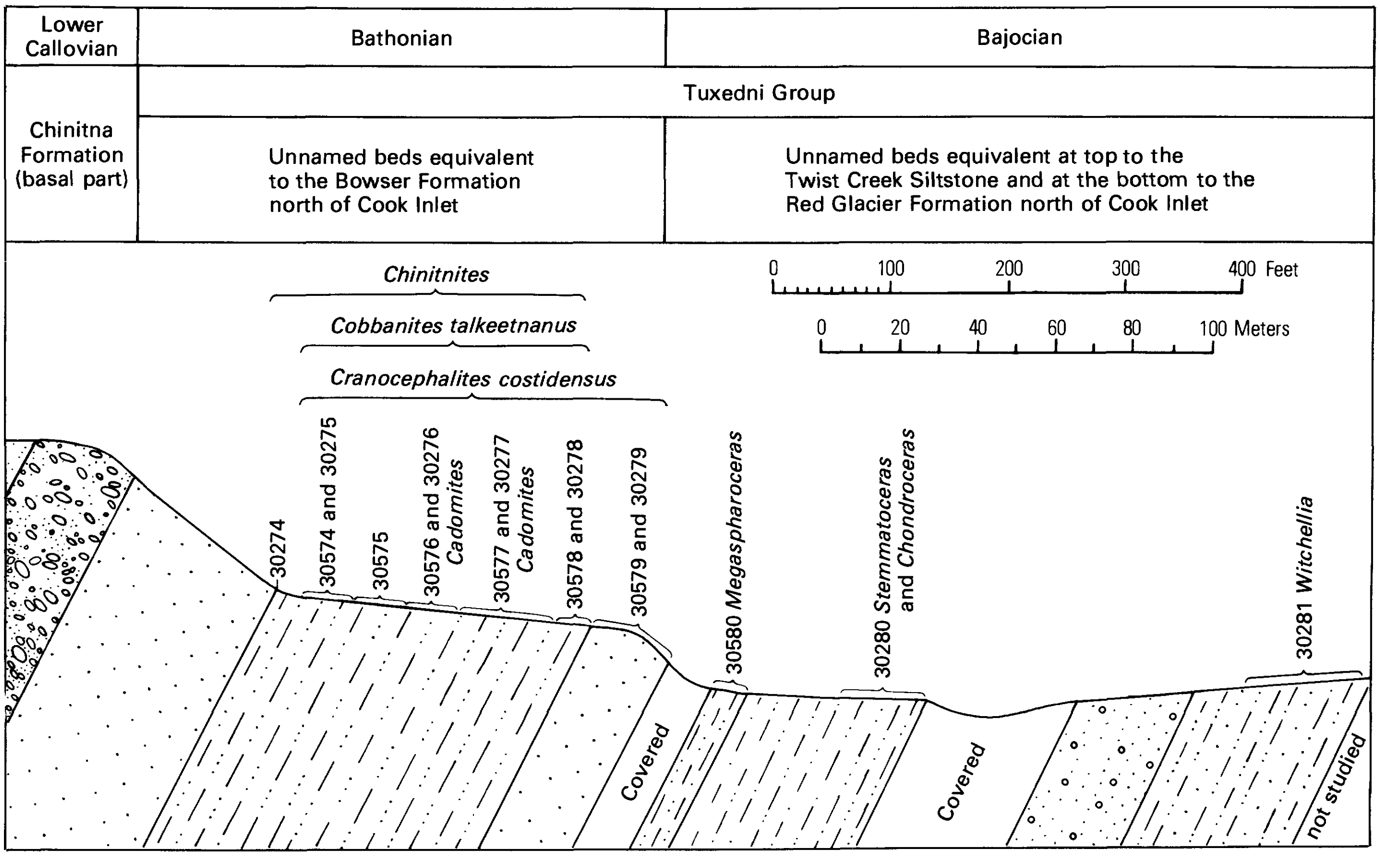

FIGURE 4.—Partial Middle Jurassic sequence including Bathonian beds exposed on a northwest-trending divide at head of a tributary of Boulder Creek near center of NW¼SE¼ sec. 26, T. 22 N., R. 7 E., Anchorage D–3 quadrangle, Talkeetna Mountains, Alaska.

These ranges show that the lower two-fifths, or lower 500–700 feet, of the formation is characterized by an abundance of *Cranocephalites costidensus* (Imlay). The overlying 300–450 feet of beds contain coarser ribbed species of *Cranocephalites,* which are associated with the lowermost occurrences of *Xenocephalites* and of *Chinitnites parviformis* (Imlay). The next higher 300–580 feet of beds at the top of the formation are characterized by species of *Iniskinites* including *I. intermedius* (Imlay) and some specimens of *Cobbanites, Chinitnites, Arctocephalites,* and *Kepplerites. Cobbanites* occurs about 150 feet below the top of the formation near Tuxedni Bay. (See figs. 2, 5.) *Chinitnites parviformis* (Imlay) and *Chinitnites* sp. range upward into the lower part of the overlying Chinitna Formation (Imlay, 1975, p. 23). *Arctocephalites* near Lake Hickerson occurs 360–380 feet below the top of the formation and 170–190 feet below *Iniskinites intermedius* (Imlay). *Kepplerites* occurs at two levels from 50 to 100 feet below the top of the formation near Tuxedni Bay, 420 feet below the top at Tonnie Creek, and is probably present 360 feet below the top at Iniskin Bay. These occurrences of *Kepplerites* are clearly within the upper part of the range of *Iniskinites.*

TALKEETNA MOUNTAINS

The stratigraphic occurrences of the Bathonian fossil collections within certain unnamed beds in the Talkeetna Mountains are described herein in table 4 and are depicted in columnar sections (fig. 3). This information, at least for the Boulder Creek area, makes possible the determination of the stratigraphic ranges of some species relative to each other and to the top and bottom of the lithologic unit in which they occur (fig. 6).

All the ammonite-bearing beds in the Nelchina area and most of them in the Boulder Creek area are characterized by an abundance of *Cranocephalites costidensus* and are equivalent to only the lower 500–700 feet of the Bowser Formation west of Cook Inlet. Also, the uppermost 65 feet of the siltstone sequence in the Boulder Creek area contain species of *Cranocephalites* that are similar to *C. vulgaris* Spath and to *C.* cf. *C. ignekensis* Imlay (USGS Mesozoic loc. 30275) and probably correlate with beds in the middle part of the Bowser Formation that contain similar coarsely ribbed forms of *Cranocephalites* (for example, USGS Mesozoic loc. 21284). Nonetheless, the absence of *Iniskinites* in the Talkeetna

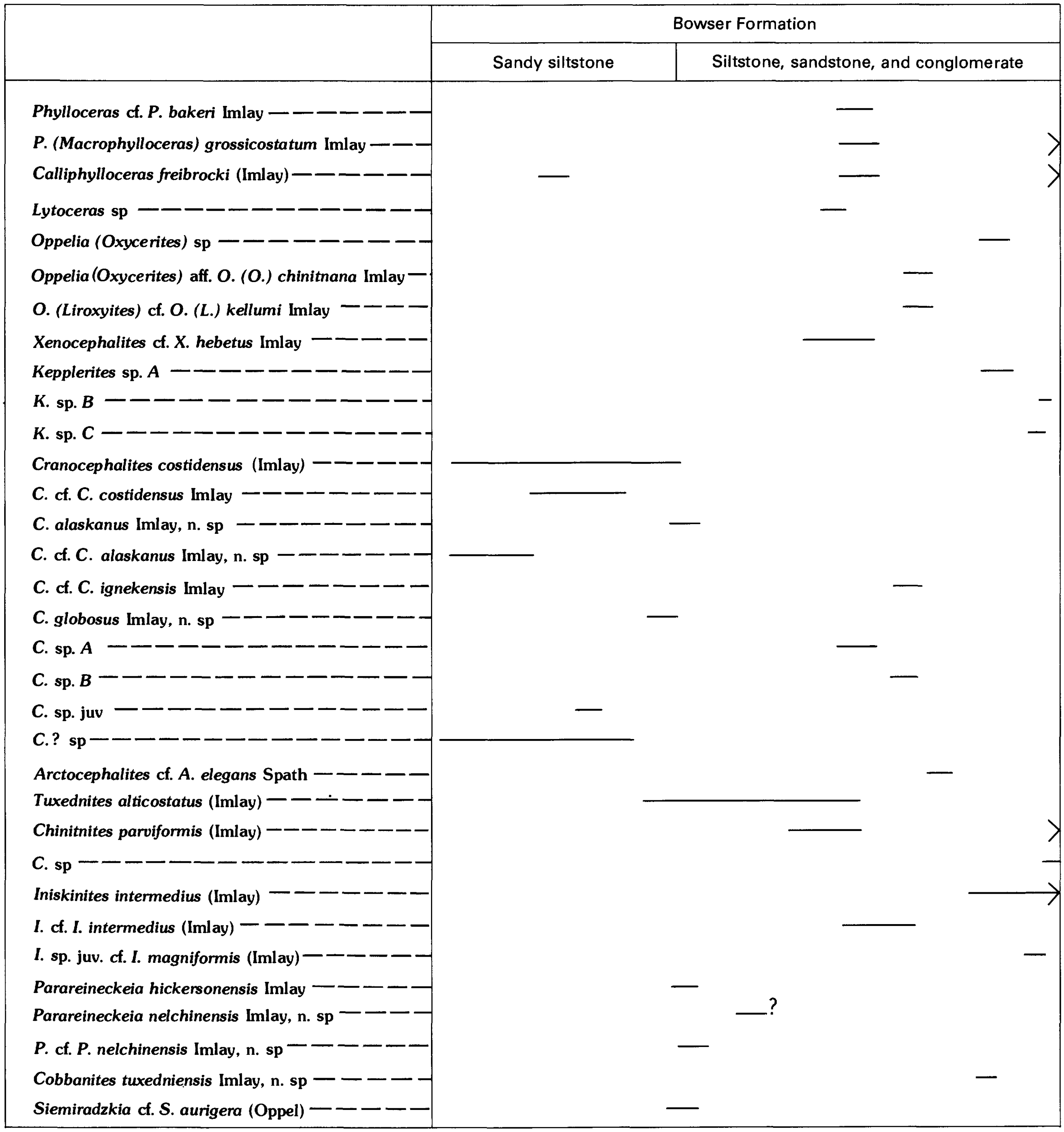

FIGURE 5.—Stratigraphic ranges of Bathonian ammonites in the Bowser Formation west of Cook Inlet, Alaska.

Mountains suggests that marine beds equivalent to the upper part of the Bowser Formation are either absent in those mountains or are represented in the Boulder Creek area by the upper 150 feet of volcanic graywacke that has not furnished any ammonites.

WRANGELL MOUNTAINS

The stratigraphic positions of many of the fossil collections within the Nizina Mountain Formation are not well known (table 4). Ammonites of probable early Bathonian

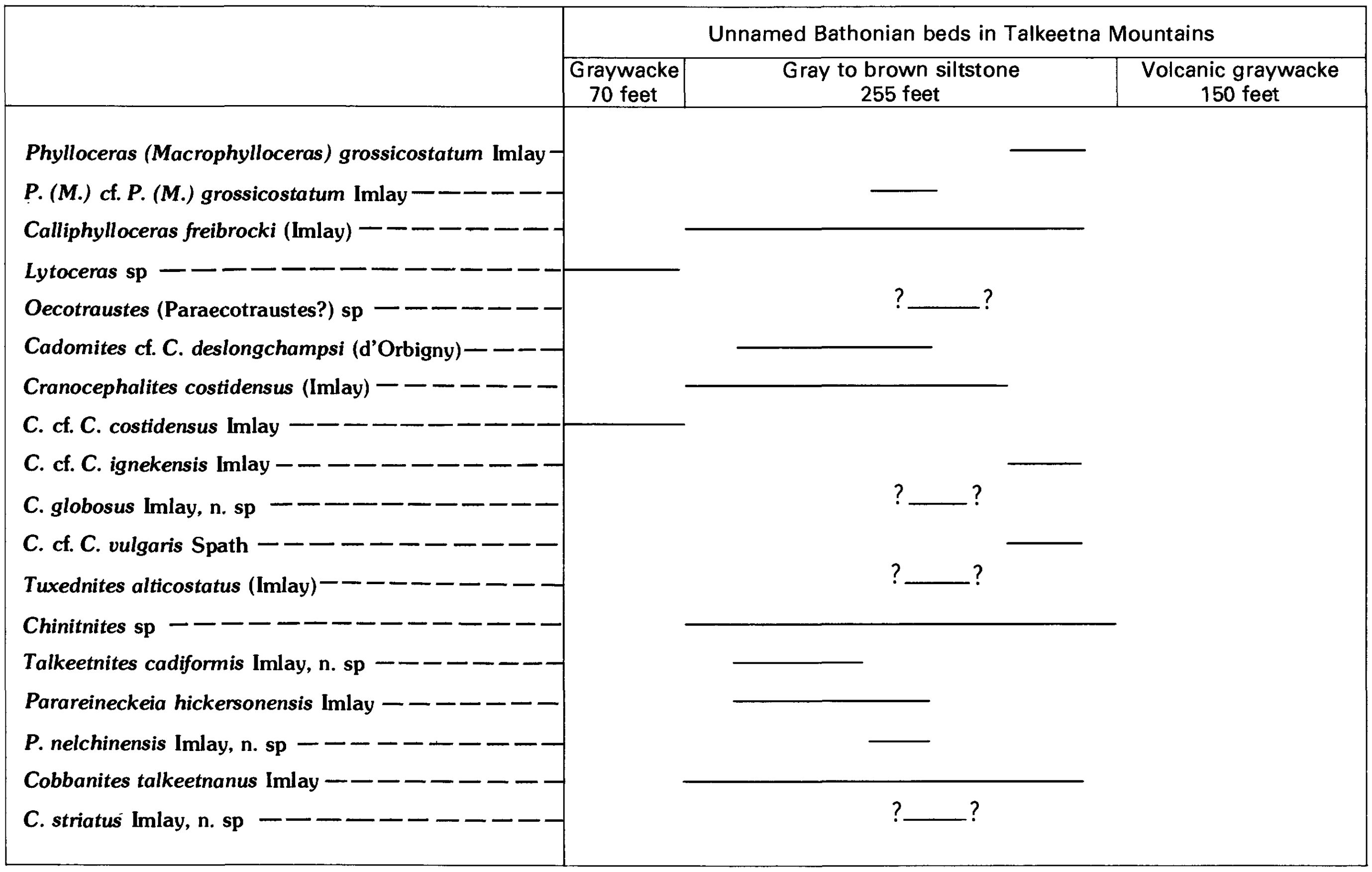

FIGURE 6.—Stratigraphic ranges of Bathonian ammonites in unnamed beds in the Talkeetna Mountains, Alaska. Ranges bounded by question marks indicate fossil occurrences in the Nelchina area. Other ranges indicate fossil occurrences in the Boulder Creek area.

Age have been obtained, however, from at least the lower 500 feet of that formation (table 3) and represent the same species as are associated with *Cranocephalites costidensus* in the Talkeetna Mountains and west of Cook Inlet. No faunal evidence for younger faunules of Bathonian or Callovian Age has yet been found in the Wrangell Mountains. The fact that one fossil collection, obtained mostly as float (USGS Mesozoic loc. 28682), includes specimens of *Teloceras*, *Normannites*, and *Chondroceras* (Imlay and Detterman, 1973, p. 24) shows that, at least locally, the formation is basally of late middle or early late Bajocian Age.

AGES AND CORRELATIONS

The lowermost beds of Bathonian, or probable Bathonian, Age in southern Alaska are characterized by *Cranocephalites costidensus* (Imlay) and are dated as early Bathonian for the following reasons: (1) They rest unconformably on beds of early late Bajocian Age or of older Jurassic Age (Detterman and Hartsock, 1966, p. 35, 40; Imlay and Detterman, 1973, p. 11, 14, 15; Grantz, 1961, written commun.). (2) They occur west of Cook Inlet in the basal part of an ammonite sequence that is similar to Bathonian ammonite sequences in northern Alaska, northern Canada, and East Greenland (fig. 7), except for the absence of *Arcticoceras* (Imlay, 1975, p. 14). (3) They contain the ammonite *Cadomites*, which ranges from uppermost Bajocian through most of the Bathonian (Hahn, 1971, p. 110), and *Siemeradzkia* (Imlay, 1962a, p. C-20, pl. 2, figs. 9, 10), which is known only from the Bathonian (Hahn, 1969, p. 39). (4) They contain several specimens of *Cadomites* similar to *C. deslongchampsi* (d'Orbigny), which in Europe ranges from the uppermost Bajocian into the lower Bathonian (Sturani, 1964, p. 20). (5) They contain one specimen of *Cadomites* similar to *C. rectelobatus* (v. Hauer), which in Europe ranges from the uppermost Bajocian through most of the Bathonian but is most common in the lower Bathonian (Sturani, 1966, p. 29; Kopik, 1974, p. 21, 22). (6) They underlie beds containing species of *Cranocephalites* similar to those in the *C. pompeckji* zone of East Greenland that is dated by Callomon (1959, p. 508) as early, but not earliest, Bathonian.

Against this early Bathonian Age assignment of the beds characterized by *Cranocephalites costidensus* is the

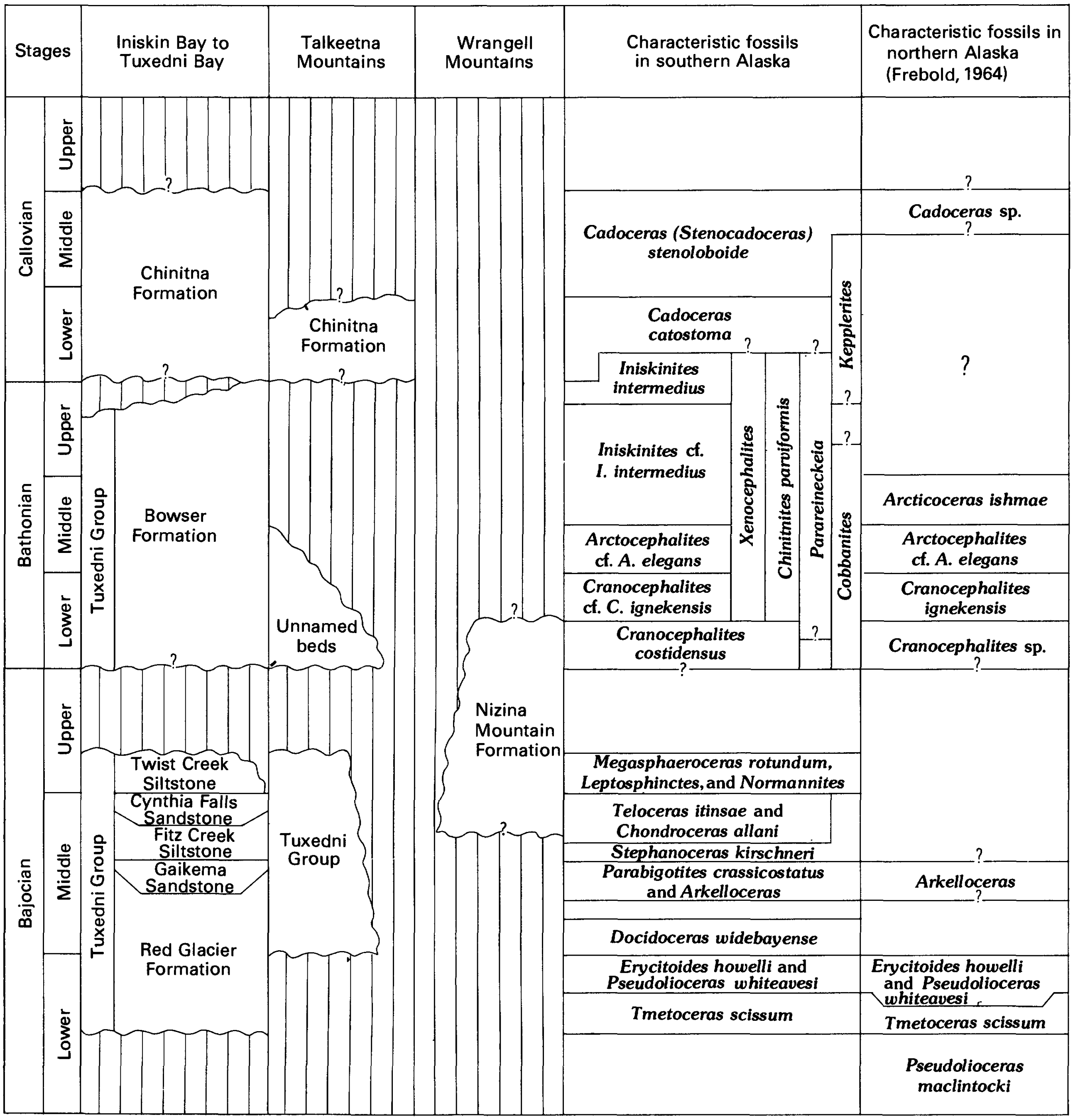

FIGURE 7.—Correlation of Middle Jurassic formations and ammonite faunas in southern Alaska with ammonite faunas of northern Alaska, Greenland, and northwest Europe.

presence of *Cobbanites,* whose resemblance to *Vermisphinctes* of the Leptosphinctinae suggests a late Bajocian Age. Against a late Bajocian assignment, however, is an occurrence of *Cobbanites,* described herein as *C. tuxedniensis* Imlay n. sp., only 150 feet below the top of the Bowser Formation, 50 feet below *Kepplerites,* 150–200 feet above *Cranocephalites* cf. *C. ignekensis* Imlay, and 600 feet above the uppermost occurrence of *Cranocephalites costidensus* (Imlay). *Cobbanites* at that stratigraphic position must be considerably younger than Bajocian and probably as young as late middle Bathonian. *Cobbanites* is not definitely known from higher beds, although some fragmentary ammonites from the basal part of the Chinitna Formation were once so assigned (Imlay, 1962a, p. C–26, C–27). That assignment now seems unreasonable because the ribs on those ammonites, originally described as *Procerites* by Imlay (1953, p. 102, pl. 53, figs. 1–3), do not weaken ventrally as on the type species of *Cobbanites* at a comparable size (Imlay, 1962a, pl. 8).

East Greenland (Donovan, 1957; Callomon, 1959; Surlyk and others, 1973)	Standard zones in northwest Europe (Callomon, 1964; Torrens, 1965; Gabilly and others, 1971; Parsons, 1974
	Quenstedoceras lamberti
Kosmoceras and *Longaeviceras*	*Peltoceras athleta*
Kosmoceras and *Pseudocadoceras*	*Erymnoceras coronatum*
	Kosmoceras jason
Sigaloceras calloviense	*Sigaloceras calloviense*
Cadoceras n. sp. *Cadoceras* n. sp.	*Macrocephalites macrocephalus*
Cadoceras calyx	*Clydoniceras discus*
Cadoceras variabile	*Oppelia aspidoides*
Arcticoceras n. sp. and *Kepplerites*	*Hecticoceras retrocostatum*
Arcticoceras ishmae	*Morrisiceras morrisi*
	Tulites subcontractus
Arctocephalites greenlandicus *Arctocephalites arcticus*	*Gracilisphinctes progracilis*
Cranocephalites pompeckji *Cranocephalites indistinctus*	*Zigzagiceras zigzag*
Cranocephalites borealis ?	*Parkinsonia parkinsoni*
	Garantiana garantiana
	Stenoceras subfurcatum
	Stephanoceras humphriesianum
	Otoites sauzei
	Witchellia laeviuscula
	Hyperlioceras discites
	Graphoceras concavum
	Ludwigia murchisonae
	Leioceras opalinum

FIGURE 7.—Continued.

Beds characterized by *Cranocephalites costidensus* (Imlay) are known outside Alaska only in west-central British Columbia and are likewise dated tentatively as early Bathonian (Frebold and Tipper, 1973, p. 1125–1130) rather than latest Bajocian. As in Alaska, the age evidence is not positive.

The next higher Bathonian beds west of Cook Inlet and in the Talkeetna Mountains of southern Alaska are characterized by *Cranocephalites* cf. *C. vulgaris* Spath and *C.* cf. *C. ignekensis* Imlay. These furnish a correlation with beds that in northern Alaska contain *C. ignekensis* Imlay (1976, p. 15, pl. 2, figs. 9, 11, 12), that in northern Canada contain *C. vulgaris* Spath (Frebold, 1957, p. 8, pl. 7, figs. 1, 2, pl. 8, fig. 1a–c), and that in East Greenland contain *C. vulgaris* Spath and *C. pompeckji* (Madsen) (Callomon, 1959, p. 508). All these ammonites occur in the upper part of the range of *Cranocephalites*. The beds in East Greenland that are characterized by *C. pompeckji* are considered to represent the lower Bathonian along with the underlying beds characterized by *C. indistinctus* Callomon (Surlyk and others, 1973, p. 9). The beds in southern Alaska that contain *C.* cf. *C. ignekensis* and *C.* cf. *C. vulgaris* are associated with the lowermost occurrences of *Xenocephalites*, *Iniskinites*, and the species *Chinitnites parviformis* Imlay, which taxa are unknown from the other areas mentioned and at the present time are of little value in intercontinental correlations.

The overlying Bathonian beds in the upper part of the Bowser Formation west of Cook inlet are in part of middle Bathonian Age, as shown by the presence of one specimen of *Arctocephalites* cf. *A. elegans* Spath obtained 360–380 feet below the top of the formation near Lake Hickerson. This ammonite provides a correlation with *Arctocephalites* beds in northern Alaska (Imlay, 1976, p. 3–5, 16) and in East Greenland (Callomon, 1959, p. 508) that are probably of middle Bathonian Age.

The uppermost beds in the Bowser Formation are tentatively assigned a late Bathonian Age, because they contain *Kepplerites* but no *Cadoceras*, a genus that occurs in abundance with *Kepplerites* in the basal part of the overlying Chinitna Formation. A similar faunal relationship occurs in East Greenland, where *Kepplerites* appears first in the upper part of the range of *Arcticoceras*, whereas *Cadoceras* appears first in the overlying beds (zone of *Cadoceras variabile*) (Callomon and others, 1972, p. 18).

If this dating of the uppermost part of the Bowser Formation is correct and if the Bathonian-Callovian boundary in East Greenland has been correctly chosen (Callomon and others, 1972, p. 18), then the uppermost Bathonian zones of *Cadoceras variabile* and *C. calyx* in Greenland have not been identified faunally in southern Alaska. Those zones could be represented in southern Alaska by an unconformity that is well developed at the base of the Chinitna Formation in the Talkeetna Mountains (Grantz, 1960a, b; 1965; written commun., 1972) and on the west side of Cook Inlet between Tuxedni Bay and Iniskin Bay and is possibly represented in the Iniskin Peninsula by a sharp contact between the Bowser and Chinitna Formations (Detterman and Hartsock, 1966, p. 40, 42, pl. 5). Those zones could also be represented by the basal beds of the Chinitna Formation west of Cook Inlet, as discussed elsewhere (Imlay, 1975, p. 14).

In summation, the beds containing *Cranocephalites costidensus* (Imlay) are either earliest Bathonian or latest Bajocian Age or both. An early Bathonian Age is favored by the fact that they rest unconformably on beds of early Bajocian Age, by the presence of an ammonite that probably represents *Siemeradskia*, and by the presence of a species of *Cadomites* similar to *C. rectolobatus* (v. Hauer). The overlying beds containing *Cranocephalites* are dated as probably late early Bathonian because they contain species of that genus that are similar to species in the *C. pompeckji* zone in East Greenland. Somewhat higher beds that contain *Arctocephalites* are dated as middle Bathonian by comparison with the faunal sequence in East Greenland. Still higher beds in southern Alaska that contain *Kepplerites* but no *Cadoceras* are probably of late Bathonian Age by comparison with East Greenland. The very latest Bathonian in southern Alaska could be represented by an unconformity between the Bowser and Chinitna Formations or by the basal beds of the Chinitna Formation that are characterized by *Iniskinites intermedius* (Imlay).

AMMONITE FAUNAL SETTING

The Bathonian ammonite genera found in southern Alaska represent a mixed assemblage of diverse geographic origin. Ammonites characteristic of the Boreal Realm include *Kepplerites*, *Cranocephalites*, and *Arctocephalites*. Ammonites characteristic of the Pacific Realm from southern Alaska to Oregon include *Xenocephalites*, *Cobbanites*, *Iniskinites*, and *Parareineckeia*. Ammonites found to date only in southern Alaska include *Tuxednites* n. gen., *Talkeetnites* n. gen., and *Chinitnites*. Ammonites that occur nearly worldwide in the Bathonian, but are uncommon in the arctic region, include *Phylloceras*, *Macrophylloceras*, *Calliphylloceras*, and *Lytoceras*. Ammonites that occurred nearly worldwide except in the arctic region include *Siemeradzkia*?, *Cadomites*, and perhaps *Oecotraustes*.

GEOGRAPHIC DISTRIBUTION

The geographic occurrences of the ammonites described herein are shown in figures 8–11 and tables 2 and 3. Detailed descriptions of the occurrences are given in table 4.

SYSTEMATIC DESCRIPTIONS

Family PHYLLOCERATIDAE Zittel, 1884
Subfamily PHYLLOCERATINAE Zittel, 1884
Genus PHYLLOCERAS Suess, 1865

Phylloceras cf. P. bakeri Imlay

Plate 1, figures 6, 10

Two small specimens have ribbing identical with that on *P. bakeri* Imlay (1953, p. 72, pl. 25, figs. 10, 14) at a comparable size and probably are immature forms of that species.

Figured specimen.—USNM 240705.

Occurrence.—Bowser Formation at USGS Mesozoic localities 21311 and 21312 on Gaikema Creek in the Chinitna Bay area. These occurrences are, respectively, 910–930 feet and 980 feet above the base of the formation, which at that place is 1,520 feet thick.

Subgenus MACROPHYLLOCERAS Spath, 1927

Phylloceras (Macrophylloceras) grossicostatum Imlay

Plate 1, figures 12, 13

Phylloceras (Macrophylloceras) grossicostatum Imlay, 1953, U.S. Geol. Survey Prof. Paper 249-B, p. 74, pl. 25, figs. 11–13, 15, 16.

This species is represented by 13 septate specimens of various sizes that match very well the type specimens from the Chinitna Formation.

Figured specimen.—USNM 240706.

Occurrence.—Bowser Formation at USGS Mesozoic localities 21311, 21312, and 22436 west of Cook Inlet. Equivalent unnamed beds in the Talkeetna Mountains at Mesozoic locality 30574.

Subfamily CALLIPHYLLOCERATINAE Spath, 1927
Genus CALLIPHYLLOCERAS Spath, 1927

Calliphylloceras freibrocki (Imlay)

Plate 1, figures 7–9, 11

Phylloceras (Calliphylloceras) freibrocki Imlay, 1953, U.S. Geol. Survey Prof. Paper 249-B, p. 73, pl. 26, figs. 7–11.

The species is represented by 12 specimens of various sizes; some show faint ribs or striae on the venter. These specimens are assigned to *Calliphylloceras* rather than *Holcophylloceras* because they lack distinct ribs on the venter and because their constrictions do not affect the test.

Types.—Holotype, USNM 108006; paratypes, USNM 108007, 108008; hypotypes, USNM 240707, 240708.

Occurrence.—Bowser Formation at USGS Mesozoic locality 21311, 21312, and 22712 west of Cook Inlet. Equivalent unnamed beds in the Talkeetna Mountains at Mesozoic localities 24117, 30275, and 30576–30578.

Family LYTOCERATIDAE Neumayr, 1875
Subfamily LYTOCERATINAE Neumayr, 1875
Genus LYTOCERAS Suess, 1875

Lytoceras sp.

Plate 2, figures 10–12

One septate internal mold shows evolute coiling, a nearly round whorl section, and crinkled riblets that incline gently forward on the flanks but cross the venter transversely. Constrictions are not present. The specimen closely resembles *Lytoceras eudisianum* (d'Orbigny)

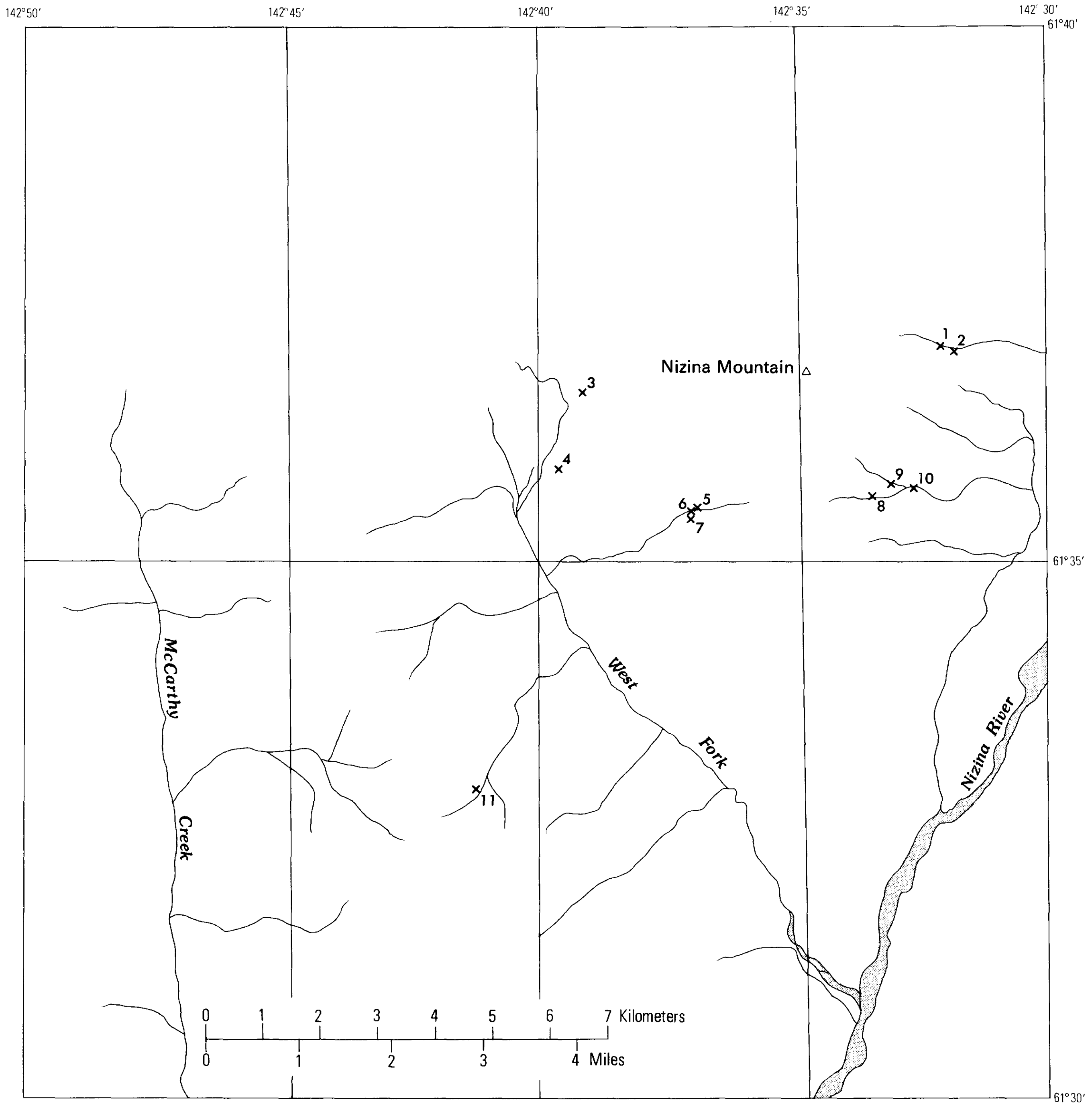

FIGURE 8.—Index map of listed Bathonian fossil localities in the Nizina Mountain Formation in the Wrangell Mountains, Alaska. Numbers on map refer to those given in table 4.

as figured by J. Wendt (1963, p. 116, pl. 17, fig. 2) but lacks the flared ribs of the holotype as figured by d'Orbigny (1845, pl. 128).

Figured specimen.—USNM 240709.

Occurrence.—Unnamed beds in the Talkeetna Mountains at USGS Mesozoic locality 30579. One small fragment of *Lytoceras* occurs also in the Bowser Formation on the Iniskin Peninsula at Mesozoic locality 20739.

Family OPPELIIDAE Bonarelli, 1894
Subfamily OPPELIINAE Bonarelli, 1894
Genus OPPELIA Waagen, 1869
Subgenus OXYCERITES Rollier, 1909

Oppelia (Oxycerites) aff. O. (O.) chinitnana Imlay

Plate 3, figures 1–5

One septate specimen differs from *O.* (*O.*) *chinitnana* Imlay (1953, p. 74, pl. 26, figs. 3–6) from the Chinitna

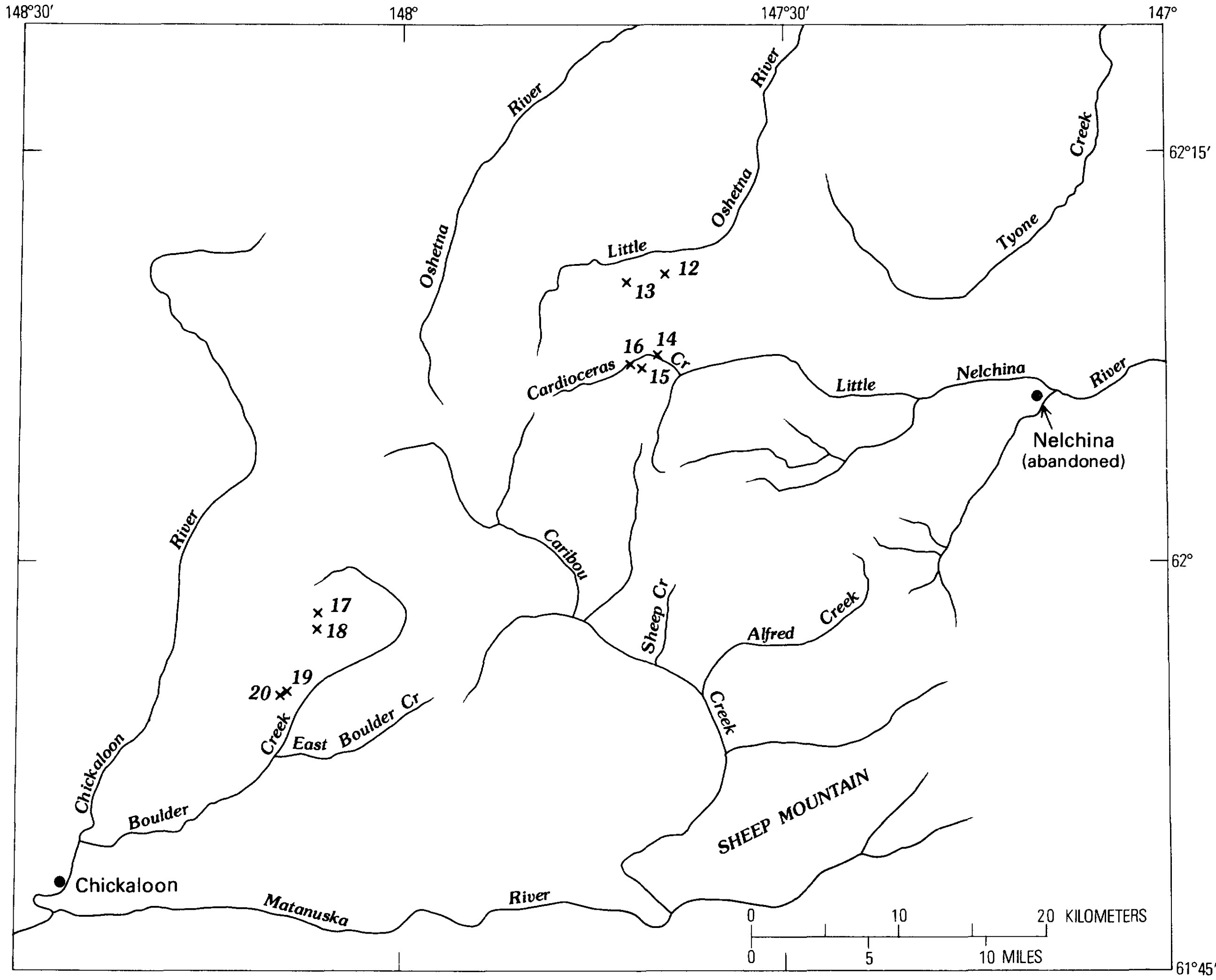

FIGURE 9.—Index map of listed Bathonian fossil localities in unnamed beds in the Talkeetna Mountains, Alaska. Numbers on map refer to those given in table 4.

Formation in southern Alaska by having much weaker and more widely spaced sickle-shaped ribs on the upper parts of its flanks. Those ribs are stronger and appear earlier than in another specimen of O. (*Oxycerites*) from that formation (Imlay, 1953, p. 75. pl. 26, figs. 1, 2).

Figured specimen.—USNM 240710.

Occurrence.—Bowser Formation, 160–210 feet below top in the Tuxedni Bay area at USGS Mesozoic locality 22538.

Subgenus LIROXYITES Imlay, 1962

Oppelia (Liroxyites) cf. O. (L.) kellumi Imlay

Plate 3, figure 6

One fragmentary ammonite differs from the most coarsely ribbed specimens of *O.* (*L.*) *kellumi* Imlay (1962b, p. A–8, pl. 2, figs. 7, 10) at a comparable size by its ribs being almost falcate and somewhat broader and stronger on the upper part of the flank. One spiral band occurs near the middle of the flank where the ribs bend rather abruptly. The keel is pinched at its base. The umbilicus is not preserved but must have been very small.

Figured specimen.—USNM 240711.

Occurrence.—Bowser Formation, 300 feet below top, at USGS Mesozoic locality 30257 in the Tuxedni Bay area.

Family SPHAEROCERATIDAE Buckman, 1920
Genus CADOMITES Munier-Chalmas, 1892

Cadomites cf. C. deslongchampsi (d'Orbigny)

Plate 4, figures 1, 2, 4–12

cf. *Ammonites deslongchampsi* (d'Orbigny), 1846, Paleontologie Francaise, Terrains Jurassiques, v. 1, p. 405, pl. 138, figs. 1, 2.

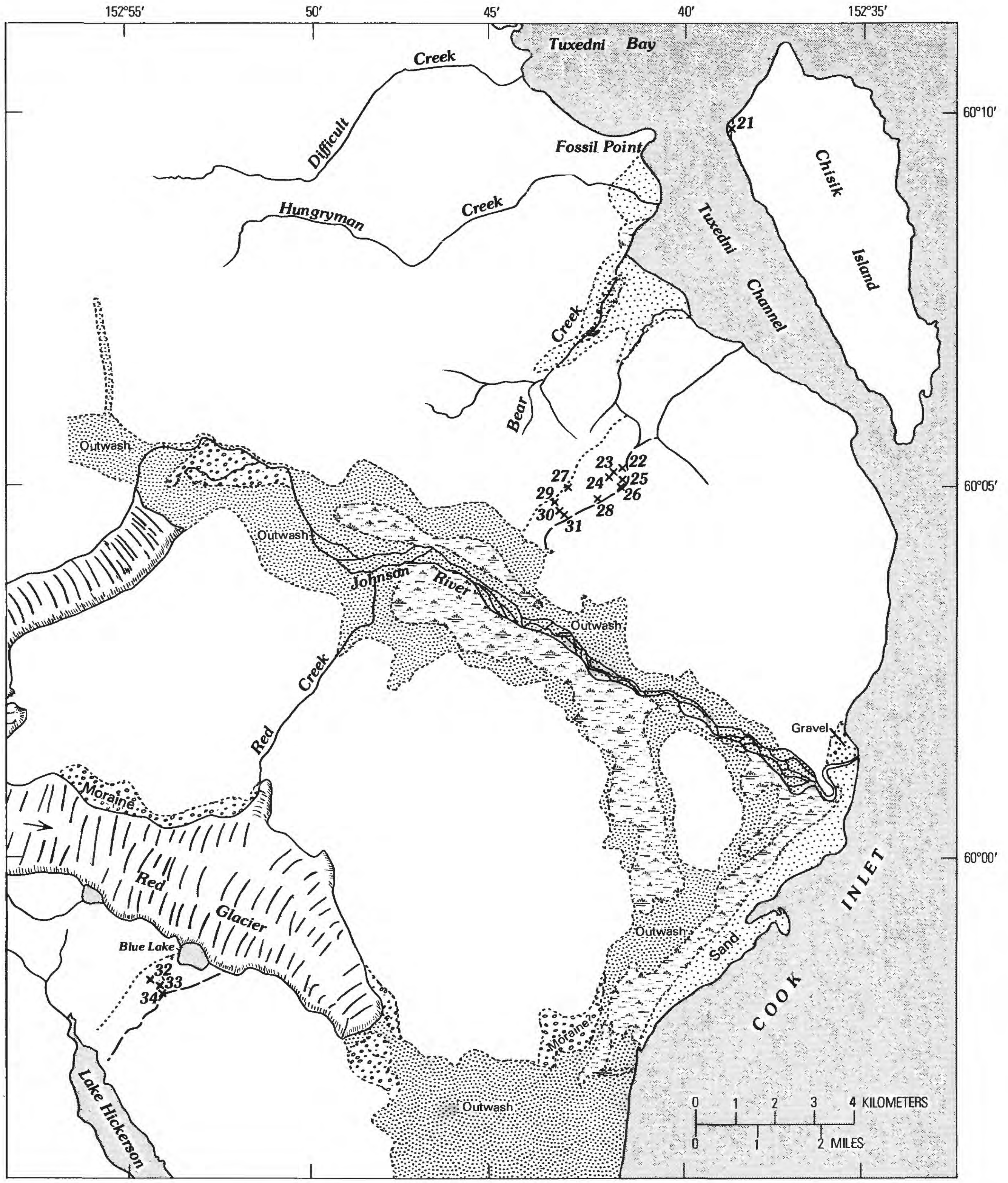

FIGURE 10.—Index map of listed Bathonian fossil localities in the Bowser Formation on Chisik Island and on the peninsula between Tuxedni Bay and Cook Inlet, Alaska. Numbers on map refer to those given in table 4. Base of Chinitna Formation is indicated by dashed lines. Base of Bowser Formation is indicated by dotted lines.

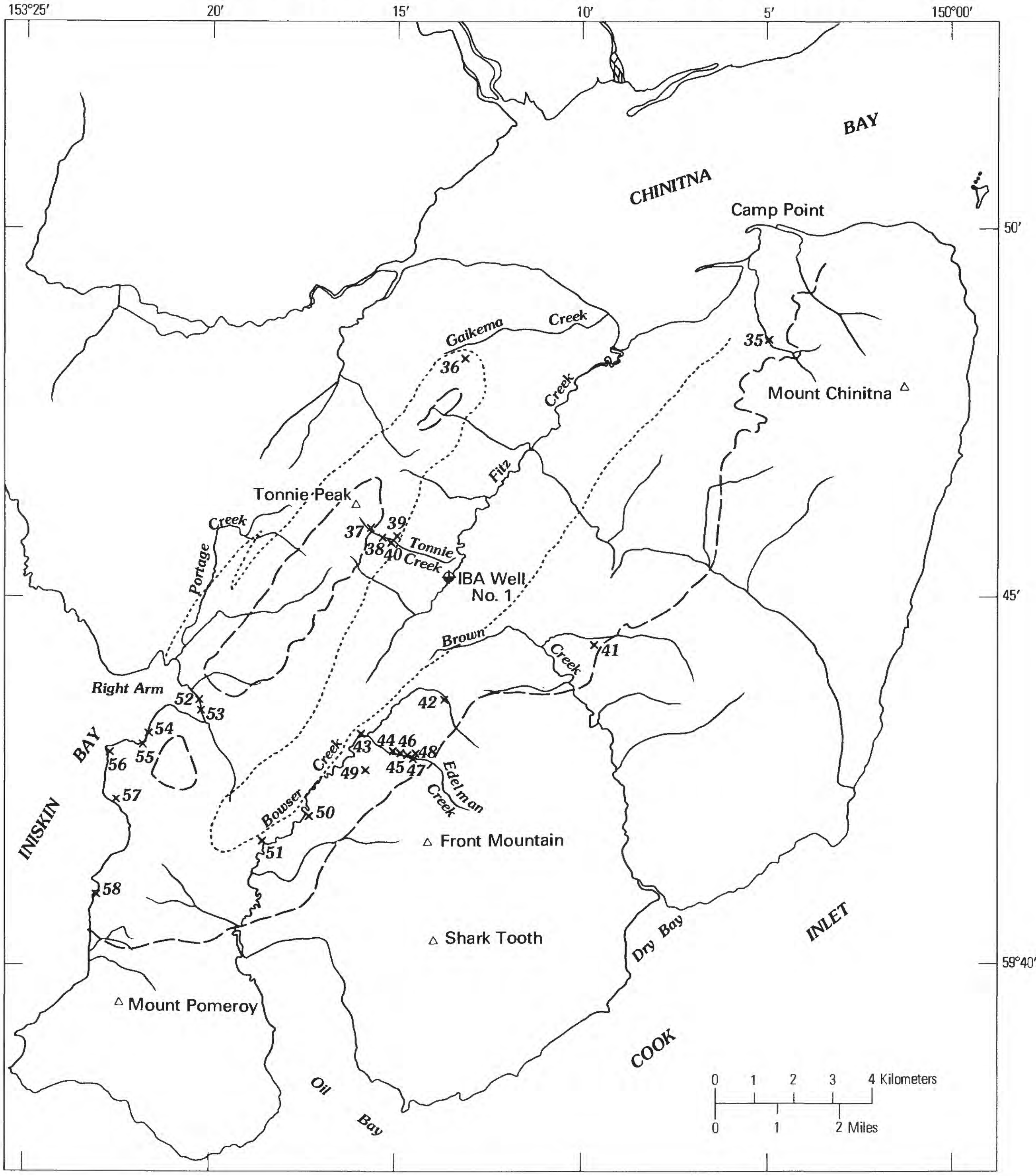

FIGURE 11.—Index map of listed Bathonian fossil localities in the Bowser Formation on Iniskin Peninsula west of Cook Inlet, Alaska. Numbers on map refer to those given in table 4. Base on Chinitna Formation is indicated by dashed lines. Base of Bowser Formation is indicated by dotted lines.

cf. *Cadomites* cf. *C. deslongchampsi* (d'Orbigny). Arkell, 1952, English Bathonian Ammonites, pt. 3, p. 79–81, text fig. 21, pl. 9, fig. 3a, b.

cf. *Cadomites deslongchampsi* Defrance in Roman and Petourand, 1927, Travaux, Lyon Univ. Lab. Geol., pt. 11, mem. 9, p. 44, pl. 7, figs. 5a, b.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
1	28524	F28	E.M. MacKevett, D.L. Jones, and M. C. Blake, 1961. Wrangell Mountains. McCarthy (C-5) quad. SE. cor. sec. 8, T. 3 S., R. 16 E., Nizina Mountain Formation.
2	28525	61-60	D. L. Jones, 1961. Wrangell Mountains. McCarthy (C-5) quad. SW. cor. sec. 9, T. 3 S., R. 16 E., Nizina Mountain Formation.
3	28527	61 ABC 19	M. C. Blake, Jr., 1961. Wrangell Mountains. McCarthy (C-5) quad. SW. cor. NW¼ sec. 14, T. 3 S., R. 15 E., Nizina Mountain Formation, lower part, a few hundred feet above the Lubbe Creek Formation.
3	28699	62 AMK 48	R. W. Imlay and E. M. MacKevett, 1962, Wrangell Mountains. Float from Nizina Mountain Formation at same place as locality 28527.
4	28526	62 ABC 33	M. C. Blake Jr., 1961. Wrangell Mountains. McCarthy (C-5) quad. SW¼NE¼NE¼ sec. 22, T. 3 S., R. 15 E., Nizina Mountain Formation about 500 ft above the Lubbe Creek Formation.
5	28692	62 AMK 32	E. M. MacKevett, 1962. Wrangell Mountains. McCarthy (C-5) quad. West-central part of NE¼SW¼ sec. 24, T. 3 S., R. 15 E. Float from Nizina Mountain Formation, probably obtained below middle.
6	28698	62 AMK 46	R. W. Imlay, 1962. Wrangell Mountains. McCarthy (C-5) quad. SE¼NW¼SW¼ sec. 24, T. 3 S., R. 15 E., Nizina Mountain Formation, float from lower part probably about 300 ft above base.
7	28696	62 AMK 43	E. M. MacKevett, 1962. Wrangell Mountains. McCarthy (C-5) quad. NE. cor. SW¼SW¼ sec. 24, T. 3 S., R. 15 E., float from Nizina Mountain Formation, probably from lower part.
8	28681	62 AMK 52	R. W. Imlay, 1962. Wrangell Mountains. McCarthy (C-5) quad. Near creek in SE¼SW¼NW¼ sec. 20 T. 3 S., R. 16 E., Nizina Mountain Formation, probably middle part.
9	28682	62 AMK 53	R. W. Imlay, 1962. Wrangell Mountains. McCarthy (C-5) quad. Near creek in center SE¼NW¼ sec. 20, T. 3 S., R. 16 E., Nizina Mountain Formation, mostly float.
9	28701	62 AMK 53A	E. M. MacKevett, 1962. Wrangell Mountains. About 500 ft west of Mesozoic loc. 28682.
10	28683	62 AMK 54A	E. M. MacKevett, 1962. Wrangell Mountains. McCarthy C-5 quad. Near creek in center SW¼NE¼ sec. 20, T. 3 S., R. 16 E., Nizina Mountain Formation, near base.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*—Continued

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
11	28691	62 AMK 28	E. M. MacKevett, 1962. Wrangell Mountains. McCarthy (C-5) quad. South-central part NE¼SE¼ sec. 4, T. 4 S., R. 15 E., Nizina Mountain Formation, float from near base.
12	27515	RAL 115	R. A. Lyon, 1959. Nelchina area. Talkeetna Mountains (A-2) quad. Lat 62°10'36"N., long 147°40'09" W. South of Little Oshetna River at altitude of 4,800 ft. Tuxedni Group, upper part. Conglomerate and sandstone 35-55 ft below base of Chinitna Formation.
13	24822	53AG 216	Arthur Grantz and L. F. Fay, 1953, Nelchina area. Talkeetna Mountains (A-2) quad. Lat 62°10'21"N., long 147°42'25"W. South of Little Oshetna River at altitude of 4,500 ft Tuxedni Group, upper part. From sandstone 325 ft below base of Chinitna Formation.
14	24115	52aGz152	Arthur Grantz, R. D. Hoare, and R. W. Imlay, 1952. Nelchina area. Talkeetna Mountains (A-2) quad. Lat 62°07'33"N., long 147°40'20"W., North fork of upper part of Little Nelchina River. Tuxedni Group, upper part, 400 ft below base of Chinitna Formation.
15	24825	53AFy14	L. F. Fay and Arthur Grantz, 1953. Nelchina area. Talkeetna Mountains (A-2) quad. Lat 62°07'15"N., long 147°41'29"W. North fork of upper part of Little Nelchina River. Tuxedni Group, upper part, about 400 ft below base of Chinitna Formation.
16	24116	52AGz154	Arthur Grantz, R. D. Hoare and R. W. Imlay, 1952. Nelchina area. Talkeetna Mountains (A-2) quad. Lat 62° 07'15"N., long 147° 42' 02"W. North side of north fork of upper part of little Nelchina River. Tuxedni Group, upper part, 115 ft below base of Chinitna Formation.
16	24117	52AGz154A	Arthur Grantz, R. D. Hoare, and R. W. Imlay, 1952. Same description as Mesozoic loc. 24116 except for location on south side of stream.
16	24118	52AGz155	Arthur Grantz, 1952. Nelchina area. Talkeetna Mountains (A-2) quad., about 0.18 mile farther upstream than Mesozoic loc. 24116. Tuxedni Group, upper part, about 75 ft below base of Chinitna Formation.
16	30286	72ADt15-1	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Nelchina area. Talkeetna Mountains (A-2) quad. On Cardioceras Creek in SW¼SW¼ sec. 31, T. 24 N., R. 10 E. Probably same place as Mesozoic loc. 24118. Tuxedni Group, upper part. Graywacke and sandstone about 75 ft below base of Chinitna Formation.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*—Continued

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
16	30287	72ADt15-2	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Same location as Mesozoic loc. 30286. Tuxedni Group, upper part. Graywacke and brown siltstone containing limy concretions about 100 ft below base of Chinitna Formation.
16	30288	72ADt15-3	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Tuxedni Group, upper part. Same location as Mesozoic loc. 30286. In siltstone containing limy concretions about 115 ft below base of Chinitna Formation.
16	30289	72ADt16-1	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Nelchina area. Talkeetna Mountains (A-2) quad. On south side of Cardioceras Creek directly across river from Mesozoic loc. 30288. Near southern boundary of south-central part of SW¼SW¼ sec. 31, T. 24 N, R. 10 E. Tuxedni Group, upper part. Massive graywacke about 165 ft below base of Chinitna Formation.
16	30290	72ADt16-2	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Nelchina area. Talkeetna Mountains (A-2) quad. Near Mesozoic loc. 30289 but about 50 ft higher stratigraphically. Tuxedni Group, upper part. Siltstone 165 ft below base of Chinitna Formation.
17	30274	72ADt11-1	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Boulder Creek area. Talkeetna Mountains. Anchorage (D-3) quad. On ridge trending northwest from peak that is 1.2 miles S. 35° W. of VABM Snag near center of NW¼SE¼ sec. 26, T. 22 N., R. 7 E., Tuxedni Group, upper part. From base of 150 ft of volcanic graywacke underlying basal conglomerate of Chinitna Formation.
17	30275	72ADt11-2	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Boulder Creek area in Talkeetna Mountains. Same location as Mesozoic loc. 30274 but from 170-215 ft below base of Chinitna Formation in gray siltstone bearing limy concretions.
17	30276	2ADt11-3	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Same description as Mesozoic loc. 30275 but from 255 to 295 ft below base of Chinitna Formation.
17	30276	72ADt11-3	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Same description as Mesozoic loc. 30275 but from 255 to 295 ft below base of Chinitna Formation.
17	30277	72ADt11-4	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Same description as Mesozoic loc. 30275 but from 293-375 ft below base of Chinitna Formation.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*—Continued

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
17	30278	72ADt11-5	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Same description as Mesozoic loc. 30275 but from 375 to 405 ft below base of Chinitna Formation in brown siltstone.
17	30279	72ADt11-6	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Same description as Mesozoic loc. 30275 but from 405 to 475 ft below base of Chinitna Formation in graywacke.
17	30574	74AI2	R. W. Imlay and Jordan Pflaker, 1974. Same description as Mesozoic loc. 30275.
17	30575	74AI3	R. W. Imlay and Jordan Pflaker, 1974. Same description as Mesozoic loc. 30275 but from 215 to 260 ft below base of Chinitna Formation.
17	30576	74AI4	R. W. Imlay and Jordan Pflaker, 1974. Same description as Mesozoic loc. 30276, but most fossils are from upper 40 ft.
17	30577	74AI5	R. W. Imlay and Jordan Pflaker, 1974. Same description as Mesozoic loc. 30277, but most fossils are from upper 40 ft.
17	30578	74AI6	R. W. Imlay and Jordan Pflaker, 1974. Same description as Mesozoic loc. 30278.
17	30579	74AI7	R. W. Imlay and Jordan Pflaker, 1974. Same description as Mesozoic loc. 30279.
17		RAL65	R. A. Lyons, 1960?. On same ridge and same sequence as USGS Mesozoic locs. 30275-30279.
18	30292	72ADt 18	R. W. Imlay and Don Hartman, 1972. Boulder Creek area in Talkeetna Mountains. Anchorage (D-4) quad. On east side of tributary of Boulder Creek, 5.2 miles N. 17° E. of junction of main creek with East Boulder Creek in south-central part of NW¼ sec. 35 T. 22 N., R. 7 E. Tuxedni Group, upper part. In siltstone and some interbedded graywacke lying at least 150 ft below base of Chinitna Formation.
19	8573	13AMa 22	Martin, G. C., 1913. Boulder Creek area in Talkeetna Mountains. Anchorage (D-4) quad. South-central part of NW¼ sec. 10, T. 21 N., R. 7 E., at altitude of 3,400 ft on north side of knob, 1 mile northwest of Boulder Creek and 3 miles N. 11° E. of mouth of East Boulder Creek. Tuxedni Group, upper part, underlying Chinitna Formation.
20	30271	72ADt10-1	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Boulder Creek area in Talkeetna Mountains. Anchorage (D-4) quad. In gully 2.6 miles N. 7° E. of junction of Boulder and East Boulder Creeks in west-central part of SW¼ sec. 10, T. 21 N., R. 6 E. Tuxedni Group, upper part. Siltstone-bearing cannonball concretions beneath Tertiary lava flows.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*—Continued

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
20	30272	72ADt10-2	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Same place as Mesozoic loc. 30271, but about 30 ft lower stratigraphically.
20	30273	72ADt10-3	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Tuxedni Group, upper part. Float in gulley about 1,000 ft north of Mesozoic loc. 30271 in NW. cor. SW¼ sec. 10, T. 21 N., R. 6 E.
21	3014	918	T. W. Stanton, 1904. North side of Cook Inlet in Tuxedni Bay area at north end of Chisik Island; Kenai (A-8) quad. 1.25 miles S. 81° E. of Fossil Point in sec. 19, T. 1 N., R. 19 W. Bowser Formation 1 ft below top, just below conglomerate at base of Chinitna Formation.
21	21272	48AI 68	D. J. Miller and R. W. Imlay, 1948. Tuxedni Bay area. Kenai (A-8) quad. Same place as Mesozoic loc. 3014.
22	30263	72ADt 8	R. W. Imlay and R. L. Detterman, 1972. Tuxedni Bay area. Kenai (A-8) quad. 1.4 miles S. 40° W. of mouth of small stream entering Tuxedni Channel from southwest opposite Chisik Island. South-central part of NE¼ sec. 10, T. 1 S., R. 20 W. Bowser Formation 100 ft below top in siltstone containing sandstone interbeds.
23	30262	72ADt 7	R. L. Detterman, and R. W. Imlay, 1972. Tuxedni Bay area. Kenai (A-8) quad. Near center SW¼NE¼ sec. 10, T. 1 S., R. 20 W. Bowser Formation about 300 ft below top.
24	30257	72ADt3	R. L. Detterman and R. W. Imlay, 1972. Tuxedni Bay area. Kenai (A-8) quad. SW. cor. NE¼ sec. 10, T. 1 S., R. 20 W., about 1.6 miles S. 43° W. of mouth of stream. Bowser Formation about 300 ft below top in brownish siltstone.
25	30261	72ADt6A	R. L. Detterman and R. W. Imlay, 1972. Tuxedni Bay area. Kenai (A-8) quad. SW. corn. SE¼NE¼ sec. 10, T. 1 S., R. 20 W., 1.6 miles S. 38° W. of mouth of stream. Bowser Formation about 150 ft below top in brownish siltstone.
26	21284	48AI84	R. W. Imlay and D. J. Miller, 1948. Tuxedni Bay area. Kenai (A-8) quad., 4.1 miles S. 12° W. of Fossil Point in NE¼NW¼SE¼ sec. 10, T. 1 S., R. 20 W. Bowser Formation 900-950 ft above base and 300-350 ft below top in brownish siltstone.
27	21283	48AI 82	R. W. Imlay and D. J. Miller, 1948. Tuxedni Bay area. Kenai (A-8) quad. First outcrop above mouth of stream entering Bear Creek from southeast 4.2 miles S. 20° W. of Fossil Point, slightly south of center of NE¼SE¼ sec. 9, T. 1 S., R. 20 W. Bowser Formation about 500 ft above base and 750 ft below top in gray siltstone.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*—Continued

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
28	30258	72ADt 4	R. W. Imlay and D. J. Miller, 1948. Tuxedni Bay area. Kenai (A-8) quad., 2.1 miles S. 40° W. of mouth of small stream entering Tuxedni Channel from southwest. North-central part of NW¼SE¼SW¼ sec. 10, T. 1 S., R. 20 W. Bowser Formation 50-75 ft below top in brownish siltstone.
29	22711	51AGz142	Arthur Grantz, 1951. Tuxedni Bay area. Kenai (A-8) quad., 0.38 mile above mouth of tributary entering Bear Creek from southeast. Near center SW¼SE¼ sec. 9., T. 1 S., R. 20 W. Bowser Formation about 100 ft above base.
29	22712	51AGz143	Arthur Grantz, 1951. Tuxedni Bay area. Kenai (A-8) quad., 0.45 mile above mouth of tributary entering Bear Creek from southeast. East-central part SW¼SE¼ sec. 9, T. 1 S., R. 20 W., Bowser Formation about 150 ft above base.
30	22713	5Agz144	Arthur Grantz, 1951. Tuxedni Bay area. Kenai (A-8) quad., 0.62 mile above mouth of tributary entering Bear Creek from southeast. East central part SE¼SW¼ sec. 9, T. 1 S., R. 20 W. Bowser Formation about 750 ft above base and 500 ft below top.
31	22714	51AGz145	Arthur Grantz, 1951. Tuxedni Bay area. Kenai (A-8) quad., 0.67 mile above mouth of same tributary described under Mesozoic loc. 22711. SW. cor. SE¼SE¼ sec. 9, T. 1 S., R. 20 W. Bowser Formation about 900 ft above base and 350 ft below top.
32	22698	51AGz115	Arthur Grantz, 1951. Lake Hickerson area. Seldovia (D-8) quad., on ridge 1.5 miles N. 39° 50'E. of head of Lake Hickerson. NW. cor. SW¼ sec. 28, T. 2 S., R. 21 W., Bowser Formation 690 ft above base and 1,010 ft below top.
33	22699	51AGz116	Arthur Grantz, 1951. Lake Hickerson area. Seldovia (D-8) quad., on ridge 1.62 miles N. 51° E. of head of Lake Hickerson. East-central part NE¼SW¼ SW¼ sec. 28, T. 2 S., R. 21 W., Bowser Formation 360-399 ft below top.
34	22700	51AGz117	Arthur Grantz, 1951. Lake Hickerson area. Seldovia (D-8) quad., on ridge 1.7 miles N. 51° E. of head of Lake Hickerson. SW. cor. SE¼SW¼ sec. 28, T. 2 S., R. 21 W., Bowser Formation about 240 ft below top.
35	21311	48AI16	R. W. Imlay and D. J. Miller, 1948. Iniskin Peninsula. Iliamna (D-1) quad., 1.92 miles N. 89° E. of dock at mouth of Fitz Creek. West central part NW¼NW¼ sec. 28, T. 4 S., R. 22 W. Bowser Formation 550-600 ft below top and 920-970 ft above base.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*—Continued

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
35	21312	48AI17	R. W. Imlay and D. J. Miller, 1948. Iniskin Peninsula. Iliamna (D-1) quad., 1.9 miles N. 86° E. of dock at mouth of Fitz Creek near center NW¼NW¼ sec. 28, T. 4 S., R. 22 W. Bowser Formation about 70 ft higher than Mesozoic loc. 21311.
35	22436	50AHa32	J. K. Hartsock, 1950. Iniskin Peninsula. Same description as Mesozoic loc. 21312. Bowser Formation about 380 ft above base.
36	21308	48AI1	R. W. Imlay and D. J. Miller, 1948. Iniskin Peninsula. Iliamna (D-1) quad., 2.4 miles S. 84° W. of dock at mouth of Fitz Creek. SW. cor. SE¼NW¼ of sec. 27, T. 4 S., R. 23 W. Bowser Formation about 380 ft above base and 1,140 ft below top.
36	21309	48AI2	R. W. Imlay and D. J. Miller, 1948. Iniskin Peninsula. Iliamna (D-1) quad., 2.3 miles S. 86° W. of dock at mouth of Fitz Creek. West-central part SE¼NW¼ sec. 27, T. 4 S., R. 23 W. Bowser Formation. Float about 100 ft lower in gulch than at Mesozoic loc. 21308.
37	21319	48AI36	R. W. Imlay and D. J. Miller, 1948. Iniskin Peninsula. Iliamna (D-1) quad., 0.65 mile S. 35° E. of Tonnie Peak. Near center NE¼NW¼ sec. 7, T. 5 S., R. 23 W. Bowser Formation about 410 ft below top.
38	20011	44AWw	Helmuth Wedow and L. B. Kellum, 1944. Iniskin Peninsula. Iliamna (D-1) quad., 1 mile up Tonnie Creek from trail just above crest of third falls. Near center NE¼NW¼ sec. 7, T. 5 S., R. 23 W., Bowser Formation about 840 ft above base and 990 ft below top.
39	27100	58ADt3	R. L. Detterman, 1958. Iniskin Peninsula. Iliamna (D-1) quad. On Tonnie Creek, 0.94 mile N. 61° W. of I. B. A. No. 1 well. Near center of NE¼ sec. 7, T. 5 S., R. 23 W. Bowser Formation about 90 ft above base.
40	20005	44AWwF72	L. B. Kellum, 1944. Iniskin Peninsula. Iliamna (D-1) quad. Southwest side of Tonnie Creek about 700 ft upstream from lower cascade and 0.85 mile S. 56 ° E. of Tonnie Peak. North central part NE¼ sec. 7. T. 5 S., R. 23 W. Bowser Formation 125 to 150 ft above base.
40	30265	72ADt 9	R. W. Imlay and R. L. Detterman, 1972. Iniskin Peninsula. Iliamna (D-1) quad. On Tonnie Creek 0.6 mile S. 40° E. of Tonnie Peak. West-central part of NW¼NE¼ sec. 7, T. 5 S., R. 23 W. Bowser Formation about 300 ft above base in brownish siltstone.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*—Continued

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
41	22549	50AHa 63	J. K. Hartsock, 1950. Iniskin Peninsula. Iliamna (C-1) quad., 4.08 miles N. 41° E. of Front Mountain on tributary to Brown Creek. NE. cor. SW¼ sec. 14, T. 5 S., R. 23 W. Bowser Formation 280-380 ft below top.
42	11038	21AB46	A. A. Baker, 1921. Iniskin Peninsula. Iliamna (C-1) quad., about 2.2 miles N. 8° E. of Front Mountain. South-central part SE¼ sec. 20, T. 5 S., R. 23 W. Bowser Formation 700-800 ft below top.
43	20754	46AKr 177	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad., 2.0 miles N. 32°W. of Front Mountain. North-central part of NW¼ sec. 30, T. 5 S., R. 23 W. Bowser Formation 300 ft above base.
44	20745	46AKr 155	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad. On Edelman Creek, 1.5 miles N 22° W. of Front Mountain. North-central part of NE¼ SE¼ sec. 30, T. 5 S., R. 23 W., Bowser Formation about 1,050 ft above base and 780 ft below top.
45	20746	46AKr156	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad. On Edelman Creek, 1.4 miles N. 22° W. of Front Mountain. NE. cor. SE¼ sec. 30, T. 5 S., R. 23 W. Bowser Formation about 1,200 ft above base and 630 ft below top.
46	11042		A. A. Baker, 1921. Iniskin Peninsula. Iliamna (C-1) quad., 1.4 miles N. 15° W. of Front Mountain. NW¼NW¼SW¼ sec. 29, T. 5 S., R. 23 W. Bowser Formation about 610 ft below top.
47	20748	46AKr158	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad. Near Center NW¼SW¼ sec. 29, T. 5 S., R. 23 W. Bowser Formation 230-280 ft below top.
48	21320	48AI49	R. W. Imlay and D. J. Miller, 1948. Iniskin Peninsula. Illiamna (C-1) quad., 4.7 miles (7.5 km) S. 15° E. of Tonnie Peak; SE¼NW¼SW¼ sec. 29, T. 5 S., R. 23 W. Bowser Formation 180-230 ft below top.
49	20751	46AKr164	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad., 1.4 miles N. 40° W. of Front Mountain; near center SE¼SW¼ sec. 30, T. 5 S., R 23 W. Bowser Formation about 600 ft (183 m) above base and 1,230 ft below top.
49	20752	46AKr166	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad. Nearly same location as Mesozoic loc. 20751. Bowser Formation 650-680 ft above base.
50	20743	46AKr152	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad., 1.8 miles N. 85° W. of Front Mountain; near center SW¼ sec. 36, T. 5 S., R. 24 W. Bowser Formation 500-600 ft above base.

TABLE 4.—*Description of Bathonian fossil localities in southern Alaska*—Continued

Number on figs. 8-11	USGS Mesozoic localities	Collector's field numbers	Collector, year of collection, description of locality, and stratigraphic assignment
51	20744	46AKr154	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad., 2.7 miles S. 84o W. of Front Mountain. NE. cor. NW¼NE¼ sec. 2, T. 6 S., R. 24 W. Bowser Formation 500-600 ft above base.
52	22536	50AHi5b	D. M. Hill and R. W. Juhle, 1950. Iniskin Peninsula. Iliamna (C-1) quad. On Right Arm Iniskin Bay. About 4.25 miles N. 58o W. of Front Mountain. South-central part of SE¼ sec. 22. T. 5 S., R. 24 W. Bowser Formation 60-110 ft below top and 1,650-1,700 ft above base.
52	22538	50AHi5a	David Hill, 1950. Iniskin Peninsula. Iliamna (C-1) quad. Same location as Mesozoic loc. 22536, but about 100 ft lower stratigraphically.
53	22553	50AHi6	D. M. Hill, 1950. Iniskin Peninsula. Iliamna (C-1) quad. Right Arm of Iniskin Bay. North central part of NE¼NE¼ sec. 27, T. 5 S., R. 24 W. Bowser Formation about 360 ft below top.
54	20736	46AMd32	J. P. Minard, 1946. Iniskin Peninsula. Iliamna (C-1) quad. East-central part of NE¼ sec. 28, T. 5 S., R. 24 W. Bowser Formation 500-600 ft above base and 1,160-1,260 ft below top.
55	20739	46AKr134	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-1) quad., 4.65 miles N. 72o W. of Front Mountain. NW. cor. NE¼SE¼ sec. 28, T. 5 S., R. 24 W. Bowser Formation about 1,110 ft above base and 640 ft below top.
56	3038	933b	T. W. Stanton and G. C. Martin, 1904. Iniskin Peninsula. Iliamna (C-2) quad., 5.25 miles N. 74o W. of Front Mountain. Shore of Iniskin Bay at entrance to Right Arm. Probably south-central part NW¼ sec. 28, T. 5 S., R. 24 W. Bowser Formation, probably from middle part.
57	20764	46AKr187	C. E. Kirschner, 1946. Iniskin Peninsula. Iliamna (C-2) quad., 5 miles N. 83o W. of Front Mountain. SE¼NW¼ sec. 33, T. 5 S., R. 24 W. Float from Bowser Formation.
58	22416	50AHa10	R. D. Hoare, 1950. Iniskin Peninsula. Iliamna (C-2) quad. East side of Iniskin Bay. SW¼SW¼ sec. 4, T. 6 S., R. 24 W. Near top of Bowser Formation.

cf. *Cadomites deslongchampi* (d'Orbigny). Sturani, 1964, Univ. Padova Ist. Geolgia Mineralogia Mem., v. 24, p. 19, 20, pl. 2, fig. 7a, b; 1966, Soc. Paleont. Italiano Boll., v. 5, p. 28, pl. 6, fig. 1.
cf. *Cadomites deslongchampsi* (d'Orbigny). Hahn, 1971, Geol. Jahrb. Landesamt Baden-Württemberg, v. 13, Abt. 13, pl. 9, fig. 16.

This species in the Talkeetna Mountains is represented by three specimens of which the smallest is attached to an umbilical plug of a much larger specimen that is septate except for its outermost half whorl. The third specimen consists of the adoral part of an adult body chamber. In addition, the species may be represented by one laterally crushed external mold from the Wrangell Mountains.

These specimens have a coronate whorl section and a broad, flattened venter. Their primary ribs are sharp, fairly widely spaced; they become less widely spaced during growth, curve gently forward on the umbilical wall, and generally terminate in prominent nodes. The secondary ribs on the septate whorls are fine, closely spaced and average about four for each primary rib, but one of these four may arise freely between nodes instead of being attached to a node. Adorally on the body chamber the secondary ribs become fewer with respect to the primary ribs, and near the aperture number only two for each primary rib. The nodes also become variable in strength adorally on the body chamber.

The adoral end of the body chamber is imperfectly preserved but is marked by two single ribs that are separated and followed by broad shallow furrows.

On the largest septate specimen at a diameter of about 55 mm, the whorl height is 21 mm and the whorl thickness is 35 mm. The ratio of whorl height to thickness is about 60 percent, both on the septate whorl and on the adult body chamber.

These Alaskan specimens of *Cadomites* are similar to *C. deslongchampsi* (d'Orbigny) in whorl shape and ribbing. They differ mainly by having sparser ribbing on their adult body chamber. That species in Europe ranges from the highest Bajocian zone of *Parkinsonia parkinsoni* into the lowest Bathonian *Zigzagiceras zigzag* zone (Westermann and Rioult, 1975, p. 876) and probably is most common in the highest Bajocian (Hahn, 1971, p. 111; Kopik, 1974, p. 19).

Figured specimens.—USNM 240712–240715.

Occurrence.—Unnamed beds in the Talkeetna Mountains at USGS Mesozoic localities 30277, 30576, 30577 (contains part of same ammonite as at locality 30277). Nizina Mountain Formation in the Wrangell Mountains at Mesozoic locality 28682.

Cadomites cf. C. rectelobatus (v. Hauer)

Plate 4, figure 3

One external mold of an outer whorl bears somewhat denser secondary ribs than the specimens herein compared with *C. deslongchampsi* (d'Orbigny) and is more similar in that respect to forms illustrated as *C. rectelobatus* (v. Hauer) by Sturani (1964, p. 22, pl. 2, figs. 6, 8; 1966, p. 29, pl. 13, figs. 1a, b); as *C. daubenyi* (Gemmellaro) in Buckman (1922, pl. 311); and as *C. rectelobatus* (v. Hauer) in Hahn (1971, p. 112, pl. 9, fig. 9a, b). It also resembles *C. exstinctus* (Quenstedt) (1887, p. 630, pl. 74, figs. 30, 32–34; Hahn, 1971, p. 110, pl. 9, figs. 10–13) in density of ribbing.

Of these species, *C. exstinctus* is reported to range from the uppermost upper Bajocian zone of *Parkinsonia parkinsoni* into the lower part of the lower Bathonian zone of *Zigzagiceras zigzag* (Hahn, 1971, p. 59, 111) and is most common in the lower Bathonian. *C. rectelobatus* ranges from the uppermost Bajocian through most of the Bathonian but is most common in the lower Bathonian (Arkell, 1958, p. 232; Sturani, 1966, p. 29; Kopik, 1974, p. 21, 22).

Figured specimen.—USNM 240716.

Occurrence.—Nizina Mountain Formation at USGS Mesozoic locality 28682 in the Wrangell Mountains.

Family MACROCEPHALITIDAE Buckman, 1922
Genus XENOCEPHALITES Spath, 1928

Xenocephalites cf. X. hebetus Imlay

Plate 2, figures 1–9

Four specimens from the Bowser Formation bear ribbing that is nearly identical with that on the type specimens of *X. hebetus* Imlay (1953, p. 78, pl. 29, figs. 6–8, 11) from the Chinitna Formation of southern Alaska. They differ mainly by having moderately compressed to stout rather than globose whorls. Also, the body chamber, represented by at least three-fourths of a whorl, does not develop quite as strong ribbing. On the largest fragment of a body chamber (pl. 2, figs. 8, 9) the whorl section is broad and depressed, the ribbing high, sharp, and sparse, and the body chamber itself is markedly retracted from the inner tightly coiled septate whorls. These features are all similar to those on the adoral part of the body chamber of *X. hebetus* Imlay (1953, pl. 29, figs. 6, 7) and on the South American species, *X. neuquensis* (Stehn) (1924, p. 86, text fig. 11 on p. 87, pl. 1, fig. 3).

Figured specimens.—USNM 240717–240720.

Occurrences.—Bowser Formation, upper part, at USGS Mesozoic localities 21312, 22436, and 22713 west of Cook Inlet.

Genus CHINITNITES Imlay, 1975

Chinitnites parviformis (Imlay)

Kheraiceras? parviforme Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 82, pl. 33, figs. 3, 6, 8–10, 12.

Chinitnites parviformis (Imlay), 1975, U.S. Geol. Survey Prof. Paper 836, p. 23, pl. 3, figs. 1, 2, 5–7.

This species is represented in the Bowser Formation by five specimens whose characteristics have been summarized recently (Imlay, 1975, p. 23).

Types.—Holotype, USNM 108052; paratypes, USNM 108053a–c; hypotypes, USNM 180734 and 180735.

Occurrences.—Bowser Formation, upper part at USGS Mesozoic localities 11038, 11042, and 22436. Chinitna Formation, lower part at Mesozoic localities 21334 and 22427.

Family KOSMOCERATIDAE Haug, 1887
Genus KEPPLERITES Neumayr and Uhlig, 1892

Kepplerites sp. A

Plate 1, figures 1, 2, 4, 5

cf. *Kepplerites tychonis* Ravn, Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 96, pl. 48, figs. 14–17.

cf. *Kepplerites chisikensis* Imlay, 1975, U.S. Geol. Survey Prof. Paper 836, p. 15, pl. 1, figs. 1–5.

This species is represented by two fragmentary immature, septate specimens. The smallest specimen is undeformed and consists of two whorls. Of these, the innermost whorl at a diameter of 15 mm has a round whorl section that is as wide as it is high, a nearly evenly rounded venter that is not distinctly flattened, and a low vertical umbilical wall that rounds evenly into the flanks. Its primary ribs are moderately low, trend radially on the umbilical wall, curve strongly forward on the lower fifth of the flanks and then pass into two or three weaker flexuous secondary ribs. Between rib bundles occur one or two secondary ribs that arise freely low on the flanks. All secondary ribs incline gently forward on the flanks, arch forward on the venter, and are strongest on the venter.

The next larger whorl of the smallest specimen has a whorl height of 21 mm, an estimated diameter of 18 mm, and an umbilical width of 5 mm. Its umbilical wall is fairly low, vertical, and rounds rather abruptly into the flanks. Its flanks are flattened below and round evenly above into a moderately broad rounded venter. Its primary ribs are weak on the umbilical wall but become higher and sharper ventrally. They curve backward on the umbilical wall, curve sharply forward low on the flanks, and pass into two to three somewhat weaker secondary ribs at about one-third of the height of the flanks. Other secondary ribs arise near the zone of furcation on the flanks, resulting in three to four secondary ribs for each primary rib. All secondary ribs incline forward on the flanks and become slightly stronger ventrally.

The largest fragment is much worn and represents a slightly later growth stage than shown on the small specimen just described. Most of it appears, however, to be essentially identical in umbilical width, flank shape, and rib characteristics. The adoral fifth of the specimen is nonseptate, retains very little shell material, is broken ventrally and bears long, weak primary ribs. Secondary ribs are barely visible at only one place.

This species, once compared with a finely ribbed species of *Kepplerites* from Greenland (Imlay, 1962a, p. C–3; Ravn, 1911, p. 490, pl. 37, fig. 1), differs from most described species of *Kepplerites* by lacking a distinctly flattened venter. On the smallest specimen, however, the ventral ribs form a pattern suggestive of incipient flattening. Also, the species greatly resembles *K. chisikensis* Imlay (1975, pl. 1, figs. 1–5), which occurs near the base of the Chinitna and Shelikof Formations, except for the absence of tubercles even on its inner whorls.

Figured specimens.—USNM 180716 and 240721.

Occurrence.—Bowser Formation at USGS Mesozoic locality 21319. The specimens were collected about 420 feet below the top of the formation and 810 feet above the uppermost occurrence of *Cranocephalites* (Mesozoic locality 20751).

Kepplerites sp. B.

Plate 3, figure 9

This species is represented near the top of the Bowser Formation by one specimen that has a moderately stout adult body chamber and the crushed adoral end of the outermost septate whorl. The body chamber occupies half a whorl, terminates adorally in a broad, shallow, forwardly inclined constriction; has an ovate whorl section that is slightly wider than high; and retracts markedly from the inner septate whorls.

The ribbing on the flanks of the septate whorl is fine and dense. On the body chamber the primary ribs are narrow, incline slightly adapically on the umbilical wall, incline adorally on the lower third of the flanks, and terminate ventrally in weak tubercles from which pass bundles of three to four much weaker secondary ribs. Other ribs arise freely along the zone of tuberculation, resulting in the presence of four secondary ribs for each primary rib. All secondary ribs incline slightly adorally on the flanks and are eroded on the venter.

The body whorl of this species bears a general resemblance to that of *Kepplerites mcevoyi* (McLearn) (1928, p. 20, pl. 4, figs. 1, 2; Imlay, 1953, p. 97, pl. 51, figs. 3, 5–8) but has much weaker tubercles, fewer secondary ribs, and a more strongly retracted body chamber. *K. multus* (McLearn) (1929, p. 7, pl. 3, fig. 2) has a more inflated whorl section, a higher umbilical wall, and stronger tubercles. *K. chisikensis* Imlay (1975, p. 15, pl. 1, figs. 1–5) has a more compressed whorl section, finer, denser ribbing, and much weaker tubercles.

Figured specimen.—USNM 240722.

Occurrence.—Bowser Formation, 50–70 feet below top at USGS Mesozoic locality 30258 south of Tuxedni Bay.

Kepplerites sp. C.

Plate 1, figure 3

One nucleus of *Kepplerites* from the Bowser Formation has more evolute coiling and stronger ribbing than other specimens of *Kepplerites* found in that formation. It bears some resemblance to the innermost known whorls of *K. gitinsi* (McLearn) as figured by Imlay (1953, pl. 52, figs. 1, 2).

Figured specimen.—USNM 240723.

Occurrence.—Bowser Formation, upper part, about 100 feet below top, at USGS Mesozoic locality 30263 south of Tuxedni Bay.

Family CARDIOCERATIDAE Siemiradzki, 1891
Subfamily CADOCERATINAE Hyatt, 1900
Genus CRANOCEPHALITES Spath, 1932

Cranocephalites costidensus (Imlay)

Plate 7, figures 1–12

Arctocephalites (*Cranocephalites*) *costidensus* Imlay, 1962a, U.S. Geol. Survey Prof. Paper 374–C, p. C–24, pl. 2, figs. 11–19.

Arctocephalites (*Cranocephalites*) *costidensus* Imlay. Frebold and Tipper, 1973, Canadian Jour. Earth Sci., v. 10, no. 7, p. 1115, pl. 2, fig. 2; pl. 4, fig. 2–7.

This species is represented in the U.S. Geological Survey collections by 108 specimens of which 15 are from west of Cook Inlet, 85 from the Talkeetna Mountains, and 8 from the Wrangell Mountains. It is characterized by having fine dense ribbing on its septate whorls and on most body chambers such as on the holotype (Imlay, 1962a, pl. 2, figs. 14, 15). Some moderately stout to stout specimens (pl. 7, figs, 5, 8, 11; Imlay, 1962a, pl. 2, fig. 19) have somewhat coarser ribs on their adult body chambers than those found on most specimens of the species.

Types.—Holotype, USNM 130745; paratypes, USNM 130746, 130748, and 130749; hypotypes, USNM 240724–240728.

Occurrences.—Bowser Formation west of Cook Inlet at USGS Mesozoic localities 20754, 21283, 22698, and 22712 and probably at Mesozoic localities 20736 and 20754. Unnamed beds in the Talkeetna Mountains at Mesozoic localities 8573, 24117, 27515, 30271, 30273, 30276–30278, 30286–30290, and 30575–30579 and probably at Mesozoic localities 24822, 24825, 30279, and 30292. Nizina Mountain Formation in the Wrangell Mountains at Mesozoic localities 28681 and 28682, and probably at Mesozoic localities 28525 and 28699.

Cranocephalites alaskanus Imlay n. sp.

Plate 5, figure 1–5

Arctocephalites (*Cranocephalites*) *pompeckji* (Madsen) of Imlay, 1962a, U.S. Geol. Survey Prof. Paper 374–C, p. C–23, pl. 1, figs. 4, 6, 8, 10 (not figs. 7, 9, 11–12).

Associated with *Cranocephalites costidensus* (Imlay) (1962a, p. C–24, pl. 2, figs. 11–19) in southern Alaska is a much less common species that has much higher and sparser ribs and fewer secondary ribs per primary rib. This species was formerly identified by Imlay (1962a, p. C–23) as *C. pompeckji* (Madsen) (1904, p. 189, pl. 8, figs. 5, 6a, b; Spath, 1932, p. 16, pl. 4, figs. 8–10, pl. 5, figs. 6–8, pl. 13, figs. 1a, b; Donovan, 1953, p. 83, pl. 17, figs. 2a, b, 3a, b). It differs, however, by having finer denser ribs on its septate whorls; lower, blunter, and sparser ribs on its adult body chamber; and by attaining a much smaller adult size. In these respects it is intermediate between *C. pompeckji* (Madsen) and *C. indistinctus* Callomon (1959, p. 510, pl. 17, figs. 3, 4, pl. 18, figs. 1, 2) from East Greenland.

Types.—Holotype, USNM 240729; paratypes, USNM 130752 and 130753.

Occurrences.—Bowser Formation, lower two-fifths, west of Cook Inlet at USGS Mesozoic localities 21283 and 22698 and possibly at Mesozoic localities 20754, 21309, 22711, and 22712. Nizina Mountain Formation in the Wrangell Mountains at Mesozoic locality 28682 and possibly at Mesozoic localities 28525, 28527, 28681, and 28698.

Cranocephalites cf. C. ignekensis Imlay

Plate 5, figures 9–11

Arctocephalites (*Cranocephalites*) *pompeckji* (Madsen) of Imlay, 1962a, U.S. Geol. Survey Prof. Paper 347–C, p. C–23, pl. 1, figs. 1, 11–13 (not figs. 5–8, 10).

cf. *Cranocephalites ignekensis* Imlay, 1976, U.S. Geol. Survey Prof. Paper 854, p. 15, 16, pl. 2, figs. 1–9, 11, 12.

In southern Alaska only two ammonites similar to *C. pompeckji* (Madsen) have been found above the range of *C. costidensus* (Imlay). One of these (pl. 5, fig. 9), an external mold of the adoral part of a body chamber, bears coarse, fairly broad, forwardly inclined ribs of which about half bifurcate fairly low on the flanks and all cross the venter transversely without diminution in strength. The other specimen (pl. 5, figs. 10, 11; Imlay, 1962a, pl. 1, figs. 9, 11–13) has identical coarse ribbing on its body chamber. It differs from some specimens, herein described as *C. alaskanus* Imlay n. sp., by attaining a larger adult size and by having slightly coarser ribbing on its adult body chamber. Compared with the holotype of *C. pompeckji* (Madsen, 1904, pl. 8, figs. 6a, b), it appears to have finer ribbing on the septate part of the adult body whorl, blunter ribbing on the nonseptate part, and a less strongly retracted body chamber.

These two specimens from southern Alaska are likewise similar to *Cranocephalites ignekensis* Imlay (1976, pl. 2, figs. 1–9, 11, 12) that occurs in northern Alaska just below beds containing *Arctocephalites*. They differ mainly by attaining a larger adult size, by having blunter and sparser ribbing on the adult body chamber, and by having a slightly more complicated suture line. They may be within the range of variation of that species.

Figured specimens.— USNM 130751 and 240730.

Occurrences.—Bowser Formation, near base of upper fourth, west of Cook Inlet at USGS Mesozoic locality

21284. Unnamed beds in the Talkeetna Mountains at Mesozoic locality 30275.

Cranocephalites globosus Imlay n. sp.

Plate 6, figures 1–3, 5, 6, 8–13

This species is represented by three specimens. It is characterized by a globose form; by much depressed whorls that are widest at about one-fourth of their height; by fairly coarse ribbing on its smallest whorls; by fine, sharp, fairly dense ribbing on its outer whorls; by a very narrow, funnel-shaped umbilicus on its septate whorls; and by a scaphitoid body chamber. Its umbilical wall is vertical basally but rounds fairly evenly into the flanks. Its adult body chamber represents about three-fifths of a whorl. The aperture is marked by a constriction that is followed by a swelling.

On septate whorls the primary ribs trend nearly radially and divide at about the top of the lower fourth of the flanks into two or three much weaker secondary ribs that cross the venter transversely or with a slight forward arching. Other secondary ribs arise freely near the zone of furcation, resulting in about three secondary ribs for each primary.

No ribbing is preserved on the adapical part of the body whorl. Near the aperture, however, are found several strong widely spaced primary ribs that are most prominent where the whorl section is widest and that fade out gradually ventrally. The midventral area near the aperture bears several patches of smooth shelly material.

This species resembles *Cranocephalites costidensus* (Imlay) (1962a, p. C–24, pl. 2, figs. 11–19) in the fineness of ribbing on its outer whorls. It differs, however, by being much more globose and by certain features of its primary ribs. Those ribs fork much lower on the flanks, are stronger relative to the secondary ribs, and are much more prominent near the adult aperture. *Arctocephalites orientalis* Krimholz (1939, p. 32, 59, pl. 2, figs. 5, 6) has similar fine ribbing but has a more compressed whorl section that is widest at about half of the whorl height.

Types.—Holotype, USNM 240731; paratypes, USNM 240732 and 240733.

Occurrence.—Bowser Formation, 620 feet above base, at USGS Mesozoic locality 20751 on the Iniskin Peninsula; unnamed beds in the Talkeetna Mountains at Mesozoic localities 24116 and 24117.

Cranocephalites cf. C. vulgaris Spath

Plate 3, figures 7, 8, 10, 11

This species is represented by one undeformed internal mold of an adult body whorl. It has a compressed whorl section, a highly arched venter, flattened flanks, a low nearly vertical umbilical wall that rounds rather abruptly into the flanks, and a contracted body chamber that occupies three-fifths of a whorl and is terminated by a shallow constriction.

The ribs on the septate part of the body whorl are sharp and fairly closely spaced. The primary ribs trend backward on the umbilical wall, curve forward on the lower third of the flanks, and give rise to pairs of slightly weaker secondary ribs. These secondary ribs incline forward on the flanks but cross the venter transversely.

On the body chamber are found long simple ribs that either bifurcate at about the top of the lower third of the flanks or alternate with one of two short intercalated ribs. The simple ribs on the lower third of the flanks are sharp, widely spaced, curve adapically at the umbilical edge, and curve adorally rather strongly on the flanks. All ribs incline forward on the upper two-thirds of the flanks, cross the venter transversely, become weaker and broader above the middle of the flanks, and almost fade out on the venter. This reduction in strength does not appear to be due to weathering or abrasion.

The specimen, at an estimated maximum diameter of 90 mm, has a whorl height of 37 mm, a whorl thickness of 33 mm, and an umbilical width of 20 mm. About one-third of a whorl adapically, the same dimensions are 72, 32, 28, and 13 mm.

This species is characterized by its compressed shape, by the presence of fine, sharp ribs on the septate part of the shell, and by the faintness of all ribs on the venter of the adult body chamber. The last feature distinguishes it from all other known species of *Cranocephalites* in Alaska but is fairly common in species of that genus in the Arctic region (Spath, 1932, p. 14; Voronets, 1962, pls. 5, 6). For example, the Alaskan species under discussion matches fairly well a compressed variant of *C. vulgaris* Spath (1932, pl. 5, figs. 1a, b) from East Greenland except for having somewhat weaker ribbing. It also greatly resembles the holotype of *C. vulgaris* Spath (1932, pl. 1, figs. 4a, b) except for being more compressed.

Figured specimen.—USNM 240734.

Occurrence.—Unnamed beds in the Talkeetna Mountains at USGS Mesozoic locality 30275.

Cranocephalites sp. A.

Plate 5, figures 6–8

One worn adult specimen differs from the specimen herein figured (pl. 3, figs. 7, 8, 10, 11) as *C.* cf. *C. vulgaris* Spath by having a stouter whorl section and somewhat stronger primary ribs and by its secondary ribs arching adorally on the venter near the aperture.

Figured specimen.—USNM 240735.

Occurrence.—Bowser Formation at USGS Mesozoic locality 22436 on the Iniskin Peninsula.

Cranocephalites sp. B.

Plate 6, figures 4, 7

One undeformed body whorl shows most of the septate part and a little of the adoral end of the body chamber. This whorl is ovate and slightly wider than it is high. Its aperture is marked on the flanks by a deep constriction. Its umbilicus is extremely narrow but widens appreciably near the aperture as the body chamber contracts. Apparently the body chamber occupies about half a whorl.

The ribbing on the septate part of the shell is sharp and moderately spaced. Its primary ribs trend radially and divide at one-fourth to one-third of the height of the flanks into two or three slightly weaker secondary ribs. A few secondary ribs arise freely between the forked ribs. All secondary ribs incline adorally on the flanks and then cross the venter transversely.

The ribbing near the aperture consists only of faint, broad, primary ribs and even fainter secondary ribs that are barely visible on the venter.

This Alaska specimen was obtained at nearly the same stratigraphic position as a specimen herein described as *Cranocephalites* cf. *C. ignekensis* Imlay that was colleeted nearby on another tributary of Bear Creek. It differs, however, by being smaller and more robust, by having more secondary ribs per primary rib, and by its ribbing becoming faint near the aperture. These features match much better those of some robust specimens of *C. vulgaris* Spath (1932, p. 1, figs. 3a, b, 4a, b, pl. 4, figs. 3a, b, pl. 8, figs. 1a, b) from East Greenland.

Figured specimen.—USNM 240736.

Occurrence.—Bowser Formation, 300 feet below top at USGS Mesozoic locality 30257 near Tuxedni Bay.

Genus ARCTOCEPHALITES Spath, 1928

Arctocephalites cf. A. elegans Spath

Plate 8, figures 18–21

Arctocephalites is represented in southern Alaska by one ammonite that consists of a fairly complete septate finely ribbed whorl and about one-third of a nonseptate nearly smooth outer whorl.

The septate whorl has a fairly narrow umbilicus, a subquadrate whorl section that is as wide as it is high, and fine, rather closely spaced ribs that incline strongly forward on the lower half of the flanks but cross the venter transversely. The primary ribs trend radially on the umbilical wall, curve forward low on the flanks and divide into two or three slightly weaker secondary ribs at about the top of the lower fourth of the flanks. Other ribs arise freely along the zone of furcation, resulting in about three secondary ribs for each primary rib.

The nonseptate whorl is fragmentary and worn, and its junction with the septate whorl is not preserved by half a whorl. Its surface, exposed at several places, is nearly smooth except for the presence of a few weak primary ribs low on the flanks.

This ammonite shows considerable resemblance to some ammonites from northern Canada that have been assigned to *Arctocephalites elegans* Spath by Frebold (1961, p. 10, 11, pls. 9–11 in part; 1964, p. 3, pls. 1 and 2 in part). The ribbing on its septate whorl appears to be slightly finer and denser than on most of the Canadian specimens but matches fairly well with that on the adapical end of one specimen (Frebold, 1961, pl. XI, figs. 1a, b). The smoothness of its outer whorl matches very well with that of the body whorl of *A. elegans* Spath. The presence of weak primary ribs on the flanks of the nonseptate whorl suggest that the fragment is the adapical part of the adult body chamber of *Arctocephalites*. It appears, therefore, that the ammonite from west of Cook Inlet is either a finely ribbed variant of *A. elegans* Spath as defined by Frebold (1961, p. 11) or a closely related species. This is borne out by comparisons with a specimen of *A.* cf. *A. elegans* Spath from northern Alaska (Imlay, 1976, p. 16, pl. 4, figs. 1–3).

Figured specimen.—USNM 180743.

Occurrence.—Bowser Formation, upper part, at USGS Mesozoic locality 22699 west of Cook Inlet. The specimen was collected 360–380 feet below the top of the formation, 170–190 feet below an occurrence of *Iniskinites* (Mesozoic loc. 22700) and about 850 feet above *Cranocephalites costidensus* (Imlay) (Mesozoic loc. 22698).

Genus TUXEDNITES Imlay n. gen.

Tuxednites is characterized by fairly small, moderately compressed to stout shells; a fairly small umbilicus that does not become wider on the body whorl; an adult body chamber that occupies about three-fourths of a whorl; an apertural constriction that is conspicuous only low on the flanks; and high, sharp, gently flexuous ribs that cross the venter transversely. The primary ribs become high on the lower fourth of the flanks where most of them pass into pairs of weaker secondary ribs that become high and sharp on the venter. The suture line is poorly preserved and cannot be traced accurately. *Tuxednites alticostatus* (Imlay), described previously as *Arctocephalites? alticostatus* Imlay (1962a, p. C–22), is designated as the type species.

Tuxednites differs from *Chinitnites* (Imlay, 1975, p. 17, 18) by its septate whorls having stronger primary ribs and a slightly wider umbilicus and by its adult body whorl not contracting from the septate whorls.

Tuxednites alticostatus (Imlay)

Plate 8, figures 1–9

Arctocephalites? alticostatus Imlay. 1962a, U.S. Geol. Survey Prof. Paper 374–C, p. C–22, pl. 2, figs. 1, 2, 4–8 [not fig. 3].

This species is represented by 18 specimens that vary considerably in coarseness of ribbing and in stoutness in ways similar to that shown by *Chinitnites chinitnaensis* Imlay (1975, p. 22, pl. 2). It does not include a specimen from USGS Mesozoic locality 24116, referred to previously (Imlay, 1962a, p. C–23), which may represent the inner whorls of *Cranocephalites globosus* Imlay n. sp. from the same locality. Similarly the small specimen from USGS Mesozoic locality 21308 (see Imlay, 1962a, pl. 2, fig. 3) may represent the inner whorls of a globose form of *Cranocephalites*. The other specimens of *T. alticostatus* (Imlay) that were previously illustrated are all stout to fairly stout, are coarsely ribbed, and are representative of 13 of the 18 specimens herein assigned to the species. The other five specimens, present only at USGS Mesozoic localities 20746 and 30290, differ only by being a little less stout and a little finer ribbed. (See pl. 8, figs. 3, 4.)

The species is possibly also represented by an even more finely ribbed, more compressed specimen that was once illustrated (Imlay, 1962a, pl. 1, fig. 7) as *Arctocephalites* (*Cranocephalites*) *pompeckji* (Madsen). That specimen, refigured herein on plate 8, figures 16, 17, is considerably finer ribbed and more compressed than the holotype of *Tuxednites alticostatus* (Imlay), with which it is associated at USGS Mesozoic locality 22698, but is only a little finer ribbed than some specimens that are herein assigned to that species (compare pl. 8, figs. 3, 4).

Types.—Holotype, USNM 103757; paratypes, USNM 103758 and 103759; hypotypes, 240737–240739.

Occurrence.—Bowser Formation, lower part at USGS Mesozoic localities 11038, 20011, 20746, 20752, and 22698 west of Cook Inlet; at Mesozoic localities 30288 and 30290 in the Talkeetna Mountains, and at Mesozoic locality 28682 in the Wrangell Mountains. This species ranges from the upper part of the beds characterized by *Cranocephalites costidensus* through the overlying beds containing other species of *Cranocephalites* into the lower part of the range of *Chinitnites parviformis* (Imlay) at USGS Mesozoic localities 11038 and 20746.

Tuxednites? sp. ind.

Plate 8, figures 10–15

Tuxednites is possibly represented by a number of small globose narrowly umbilicate sharply ribbed immature ammonites that occur in the beds characterized by *Cranocephalites costidensus* (Imlay). These ammonites show some resemblance to *Xenocephalites* but differ by having a wider umbilicus and much stronger, sharper ribs on their septate whorls. They show more resemblance to *Tuxednites alticostatus* (Imlay) (1962a, p. C–22, pl. 2, figs. 3–8) in coiling and in rib plan but differ by being much stouter and by having sparser, stronger, less flexuous ribs. Their features suggest that they belong to *Tuxednites*, but their preservation does not permit a definite taxonomic assignment. Also, the fact that none of the specimens bears an apertural constriction suggests that all of the specimens may be immature forms and, therefore, could represent the early growth stages of much larger ammonites such as *Cranocephalites globosus* Imlay n. sp., as described herein.

Figured specimens.—USNM 240741 and 240742.

Occurrence.—Bowser Formation, lower part at USGS Mesozoic localities 20005, 20744, and 30265 west of Cook Inlet; at Mesozoic locality 24116 in the Talkeetna Mountains; and at Mesozoic locality 28682 in the Wrangell Mountains.

Genus INISKINITES Imlay, 1975

Iniskinites cf. I. intermedius (Imlay)

Plate 8, figures 22, 26–28

cf. *Kheraiceras intermedium* Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 81, pl. 31, figs. 1–4, pl. 32, figs. 2, 3, 5, 7, 8.
cf. *Iniskinites intermedius* (Imlay), 1975, U.S. Geol. Survey Prof. Paper 836, p. 24, pl. 3, figs. 3, 4.

Iniskinites intermedius (Imlay) is represented (1) at the very top of the Bowser Formation on Chisik Island by the holotype (Imlay, 1953, pl. 31, figs. 3, 4) at USGS Mesozoic locality 21272; (2) probably 240 feet below the top near Lake Hickerson (see pl. 8, fig. 26) at Mesozoic locality 22700; (3) probably 300 feet below the top (pl. 8, figs. 22, 27, 28) at Mesozoic locality 30262 on an unnamed creek east of Bear Creek south of Tuxedni Bay; and (4) probably about 540 feet below the top at Mesozoic locality 21313 on Park Creek near Chinitna Bay.

Types.—See listing in Imlay (1975, p. 24); figured specimens USNM 240743 and 240744.

Iniskinites cf. I. magniformis (Imlay)

Plate 8, figures 23–25

Two immature specimens of *Iniskinites* have very fine dense ribbing and a globose form as on the inner whorls of *I. magniformis* Imlay (1975, pl. 4, figs. 2, 7). The inner whorls of *I. abruptus* (Imlay) (1953, pl. 33, figs. 1, 7; 1975, pl. 5, figs. 1, 2) have slightly coarser ribbing.

Figured specimen.—USNM 240745.

Occurrence.—Bowser Formation at USGS Mesozoic locality 22536 near Iniskin Bay on the Iniskin Peninsula.

Genus TALKEETNITES Imlay n. gen.

Talkeetnites is characterized by fairly large shells that change during growth from globose to cadicone; by a deep, rather narrow funnel-shaped umbilicus; by a slightly retracted body chamber; by a vertical umbilical wall that rounds evenly into the flanks; by its septate inner whorls bearing sharp ribs that bifurcate along the line of greatest whorl thickness and become sharper ventrally; by its outermost whorls bearing secondary ribs that weaken adorally and primary ribs that become stronger adorally; by the lack of tubercles on the septate whorls; and by the primary ribs becoming swollen and comma shaped on the body chamber. The suture line is poorly exposed.

Talkeetnites cadiformis Imlay, described herein, is designated as the type species.

Talkeetnites resembles cadicone species of *Tulites* and *Cadoceras* in the shape of its outer whorl. Its inner whorls differ from those of *Tulites*, however, by lacking a sharp or distinct umbilical edge, by not bearing nodes, and by bearing sharp ribs (compare Arkell, 1952, pl. 9, figs. 4a, b, 6a, b, pl. 11, figs. 6a–d; 1954, pl. 12, figs. 2a, b, 4a, b, pl. 13, figs. 6a, b). Its body whorl differs from that of *Cadoceras* by lacking a distinct umbilical edge and by contracting from the septate whorls. Its small inner whorls are more tightly coiled than in *Cadoceras* but are comparable in that respect with those of *Cranocephalites* with which they are associated. Overall the genus appears to be more closely related to *Cranocephalites* than to *Cadoceras* or *Tulites*.

Talkeetnites cadiformus Imlay n. sp.

Plate 9, figures 1–10

This species is represented by two specimens whose outer whorls are extremely wide and depressed (cadicone) and whose inner whorls are globose. Umbilicus deep, moderately narrow, funnel shaped. Umbilical wall, vertical at base, gently inclined above, rounding evenly into flanks on all whorls but becoming more narrowly rounded on body whorl. Body chamber incompletely preserved, but occupies at least three-fifths of a whorl on the largest specimen, and its adoral part is slightly retracted from the septate whorls. Aperture unknown.

On the smallest preserved whorls, the ribs are sharp, high, moderately spaced, and gently flexuous. Primary ribs trend nearly radially on the umbilical wall and generally bifurcate along the line of greatest whorl thickness. Secondary ribs are slightly sharper than the primary ribs, curve forward on the flanks, and then cross the venter transversely or with a slight forward arching.

Adorally on the penultimate and body whorls, the secondary ribs gradually become weaker on the venter but persist to the end of the largest specimen and arch forward considerably on the body chamber. The primary ribs, by contrast, gradually become stronger adorally along the line of greatest whorl thickness, and near the adoral end of the body chamber develop into comma-shaped swellings from which pass broad faint secondary ribs.

The dimensions of the holotype, in millimeters, and ratios of the diameter are as follows:

Diameter	Whorl height	Whorl thickness	Umbilical width
31	15 (0.48)	27 (0.87)	6.5 (0.21)
55	23 (.42)	51 (.93)	10.0 (.18)
81	32 (.39)	80 (.99)	25.0 (.31)

The suture line cannot be traced.

Types.—Holotype, USNM 240746; paratype, USNM 240747.

Occurrence.—Unnamed beds in the Talkeetna Mountains at USGS Mesozoic locality 30277.

Family REINECKEIIDAE Hyatt, 1900
Genus PARAREINECKEIA Imlay, 1962

Parareineckeia hickersonensis Imlay

Plate 10, figures 1–10

Parareineckeia hickersonensis Imlay, 1962a, U.S. Geol. Survey Prof. Paper 374–C, p. C–25, pl. 7, figs. 1–5.

?*Parareineckeia* cf. *P. hickersonensis* Imlay. Frebold and Tipper, 1973, Canadian Jour. Earth Sci., v. 10, p. 1119, pl. 6, fig. 6.

This species, in addition to the holotype from the Lake Hickerson area west of Cook Inlet, is represented by 4 septate and 1 adult specimen (microconch) from the Talkeetna Mountains and 22 fragmentary, compressed specimens from the Wrangell Mountains. These show that the rib pattern as preserved on the holotype gradually becomes stronger during further growth. On the largest specimen available (pl. 10, fig. 10), the body chamber occupies three-fifths of a whorl and terminates simply. On one of the small specimens (pl. 10, fig. 3), some tubercles form the base of prominent spines that project ventrally.

Types.—Holotype, USNM 130756; hypotypes, USNM 240748–240752.

Occurrence.—Nizina Mountain Formation in the Wrangell Mountains at USGS Mesozoic localities 28524, 28681, 28682, 28696, 28698, and 28701. Unnamed beds in the Talkeetna Mountains at Mesozoic localities 30272, 30576, and 30577. Bowser Formation west of Cook Inlet at Mesozoic locality 22698.

Parareineckeia nelchinensis Imlay n. sp.

Plate 11, figures 1–16

Parareineckeia cf. *P. shelikofana* (Imlay), 1962a, U.S. Geol. Survey Prof. Paper 374–C, p. C–26, pl. 7, fig. 6, 7.

Parareineckeia cf. *P. shelikofana* (Imlay), Frebold and Tipper, 1973, Canadian Jour. Earth Sci., v. 10, p. 1117, pl. 4, fig. 1, pl. 6, figs. 3–5.

This species is represented by 30 specimens of which 4 are from the Talkeetna Mountains, 25 from the Wrangell Mountains, and 1 from the Iniskin Peninsula. These specimens, although most are crushed and fragmentary, do represent various growth stages including part of an adult body chamber. They show that the species is intermediate in characteristics between *P. hickersonensis* Imlay (1962a, p. C–25, pl. 7, figs. 1–5) and *P. shelikofana* (Imlay) (1953, p. 101, pl. 55, figs. 1, 8). It differs from *P. hickersonensis* Imlay by having considerably weaker and denser ribbing and a slightly higher whorl section. It differs from *P. shelikofana* (Imlay) by having slightly sparser and sharper ribs at comparable sizes and by its lateral tubercles persisting to a much later growth stage.

Types.—Holotype, USNM 240753; paratypes, USNM 130750, 240754–240760.

Occurrences.—Nizina Mountain Formation in the Wrangell Mountains at USGS Mesozoic localities 28524, 28527, and 28681–28683. Unnamed beds in the Talkeetna Mountains at Mesozoic localities 24117, 30272, and 30276. Bowser Formation in the Iniskin Peninsula at Mesozoic locality 3038 and possibly at 20745. The species is commonly associated with *Cranocephalites costidensus* (Imlay) and *Parareineckeia hickersonensis* Imlay. These occurrences, however, are much lower stratigraphically than those with *P. shelikofana* (Imlay, 1953, p. 101, 102).

Family PERISPHINCTIDAE Steinmann, 1890
Subfamily LEPTOSPHINCTINAE Arkell, 1950
Genus COBBANITES Imlay, 1962

Cobbanites talkeetnanus Imlay

Plate 12, figures 2–4, 7–9

Cobbanites talkeetnanus Imlay, 1962a, U.S. Geol. Survey Prof. Paper 374–C, p. C–27, pl. 7, figs. 8–13, pl. 8, fig. 1.

Cobbanites talkeetnanus Imlay. Frebold and Tipper, 1973, Canadian Jour. Earth Sci., v. 10, no. 7, p. 1123, pl. 7, figs. 1–4.

This species is represented by 7 fairly well preserved specimens from the Talkeetna Mountains and 12 fragmentary septate specimens from the Wrangell Mountains. Its characteristic features, as shown on the original type specimens, are herein supplemented by views of inner septate whorls. Note particularly that on the smallest specimen (pl. 12, figs. 8, 9) the primary ribs terminate ventrally in weak swellings and that the ribs are reduced in strength along the midline of the venter.

The outer septate whorl of this species bears considerable resemblance to that of *Leptosphinctes (Vermisphinctes?) reparator* Buckman (1923, p. 366), which Arkell (1958, p. 168) assigns to *Prorsisphinctes*, but is more compressed, more involute, and its ribs more widely spaced. The inner septate whorls of *C. talkeetnanus* Imlay in comparison with *L. (V.) vermiformis* Buckman (1920, pl. 162) are more involute and have sparser, weaker ribs that arch forward more strongly on the venter.

Types.—Holotype, USNM 130743; paratype, USNM 130744; hypotypes, USNM 240761–240763.

Occurrences.—Nizina Mountain Formation in the Wrangell Mountains at USGS Mesozoic localities 28525, 28682, and 28699; unnamed beds in the Talkeetna Mountains at Mesozoic localities 24116, 30277, 30574, and 30578.

Cobbanites striatus Imlay n. sp.

Plate 12, figures 1, 5, 10, 11

This species is represented by one moderately small septate specimen and by one smaller fragment. It is distinguished from *C. talkeetnanus* Imlay by having much finer, weaker, and denser ribbing and by its secondary ribs outnumbering the primary ribs about 3 to 1 instead of 2 to 1. On the adoral end of the largest preserved septate whorl the secondary ribs are only faintly connected with the primary ribs. This ribbing is appreciably finer and denser than in *Leptosphinctes (Vermisphinctes) subdivisus* Buckman (1920, pl. 190) from the upper Bajocian of England or on *Cobbanites talkeetnanus* var. *densicostatus* Frebold and Tipper (1973, p. 1125, pl. 7, figs. 5, 6) of British Columbia.

Holotype.—USNM 240764; paratype, UCLA 4988.

Occurrences.—Nizina Mountain Formation in the Wrangell Mountains at USGS Mesozoic localities 28682 and probably 28699; unnamed beds in the Talkeetna Mountains at Union Oil Co. locality RAL 65 in association with *Cranocephalites costidensus* (Imlay).

Cobbanites tuxedniensis Imlay n. sp.

Plate 12, figures 6, 12–15

This species is represented by one septate specimen that shows nearly five whorls at diameters between 12 and 112 mm. Shell compressed and moderately involute. Whorls embrace from one-third to two-fifths of the preceding whorl and become more evolute and more compressed during growth. At the diameter of 56 mm, the whorl section is subquadrate and 16 mm in height and width. Half a whorl adorally at a diameter of 78 mm the whorl section is 24 mm in height and 19 mm in width. Umbilicus very wide and shallow. Umbilical wall low and steeply inclined. Flanks gently convex on innermost exposed whorls but become nearly flat on outer septate whorls. Venter evenly rounded on inner whorls but becomes moderately arched on largest septate whorl.

The ornamentation, as exposed in the umbilicus, consists of stout radially trending primary ribs and some weak constrictions. These primary ribs are nearly as wide as the interspaces, thicken slightly ventrally, and are mostly not tuberculate, although most furcation points are hidden by the succeeding whorls.

On the outer two septate whorls the primary ribs likewise trend radially, become slightly weaker adorally, generally pass into pairs of slightly weaker secondary ribs at about three-fifths of the height of the flank, and are slightly swollen at the furcation points. Some secondary ribs arise freely on the flanks near the zone of furcation and others are indistinctly connected with the primary ribs. All secondary ribs arch forward moderately on the venter, but this arching becomes less pronounced during growth. Six weak to moderately strong constrictions occur on the outermost complete whorl. Slight reduction of ribbing along the midventral line is apparent at a few places.

The suture line, exposed only on the lower two-thirds of the flank, has long slender lobes similar to that on *Cobbanites talkeetnanus* Imlay (1962a, pl. 7, fig. 8).

This species is intermediate in most characteristics between *Cobbanites talkeetnanus* Imlay from Alaska (Imlay, 1962a, p. C–27, pl. 7, figs. 8–13) and *C.* aff. *C. talkeetnanus* Imlay from eastern Oregon (Imlay, 1964, p. D–16, pl. 4, figs. 10–13). It differs from both by having somewhat weaker constrictions; longer, denser, nearly radial primary ribs that bifurcate higher on the flanks; and fewer and stronger secondary ribs. Its general appearance is similar to that of the paratype of *C. engleri* Frebold (1957, p. 65, 76, pl. 40, figs. 1a, b) from western Alberta, but it has weaker constrictions, apparently higher points of rib furcation, and more distinct arching of ribs on its venter. It likewise resembles *Leptosphinctes (Vermisphinctes) reparator* Buckman (1923, pl. 366) at a comparable size but differs in having nearly radial primary ribs and in being more involute. In those features it resembles *L.* (*Prorsisphinctes*) *omphalicus* Buckman (1922, v. 4, pl. 326).

Holotype.—USNM 240765.

Occurrence.—Bowser Formation, about 150 feet below top at USGS Mesozoic locality 30261 west of Cook Inlet.

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INDEX

[Italic page numbers indicate descriptions and major references]

PLATES

Contact photographs of the plates in this report are available,
at cost, from U.S. Geological Survey Library, Federal Center,
Denver, Colorado 80225

PLATE 1

[Figures natural size unless otherwise indicated]

FIGURES 1, 2, 4, 5. *Kepplerites* sp. A (p. 31).

1, 2, 4. Figured specimens USNM 240721 from Mesozoic loc. 21319. Figures 1 and 2 (× 2) represent inner whorl of specimen shown on figure 4.

5. Figured specimen, USNM 180716 from USGS Mesozoic loc. 21319. Note absence of lateral tubercles.

3. *Kepplerites* sp. C (p. 31).

Lateral view (× 2). Figured specimen, USNM 240723 from USGS Mesozoic loc. 30263.

6, 10. *Phylloceras* cf. *P. bakeri* Imlay (p. 16).

Figured specimen, USNM 240705 from USGS Mesozoic loc. 21311.

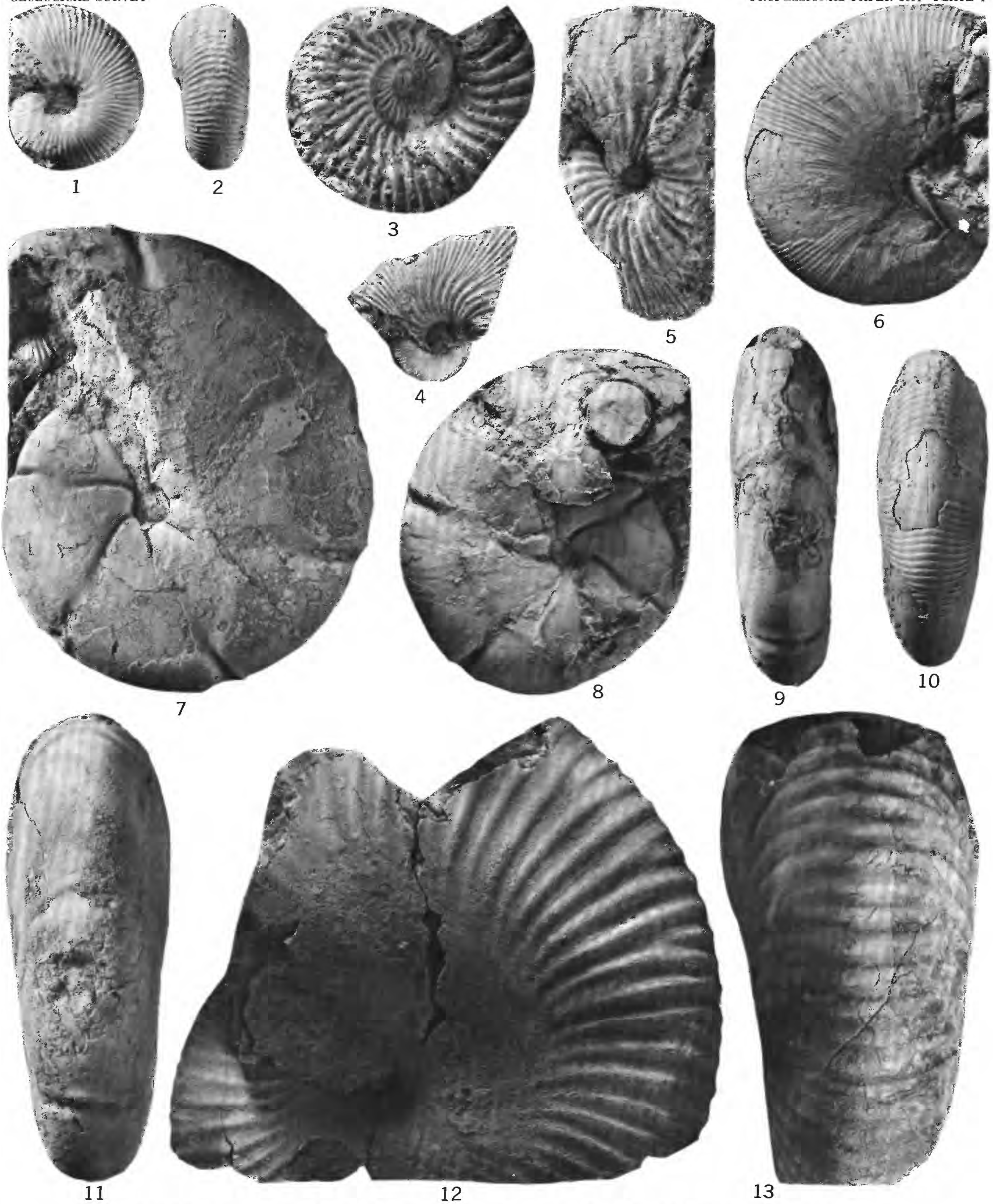
7–9, 11. *Calliphylloceras freibrocki* Imlay (p. 16).

7, 11. Hypotype, USNM 240708 from USGS Mesozoic loc. 30578.

8, 9. Hypotype, USNM 240707 from USGS Mesozoic loc. 21311.

12, 13. *Phylloceras* (*Macrophylloceras*) *grossicostatum* Imlay (p. 16).

Hypotype, USNM 240706 from USGS Mesozoic loc. 30574.



KEPPLERITES, *PHYLLOCERAS*, *CALLIPHYLLOCERAS*, AND *MACROPHYLLOCERAS*

PLATE 2

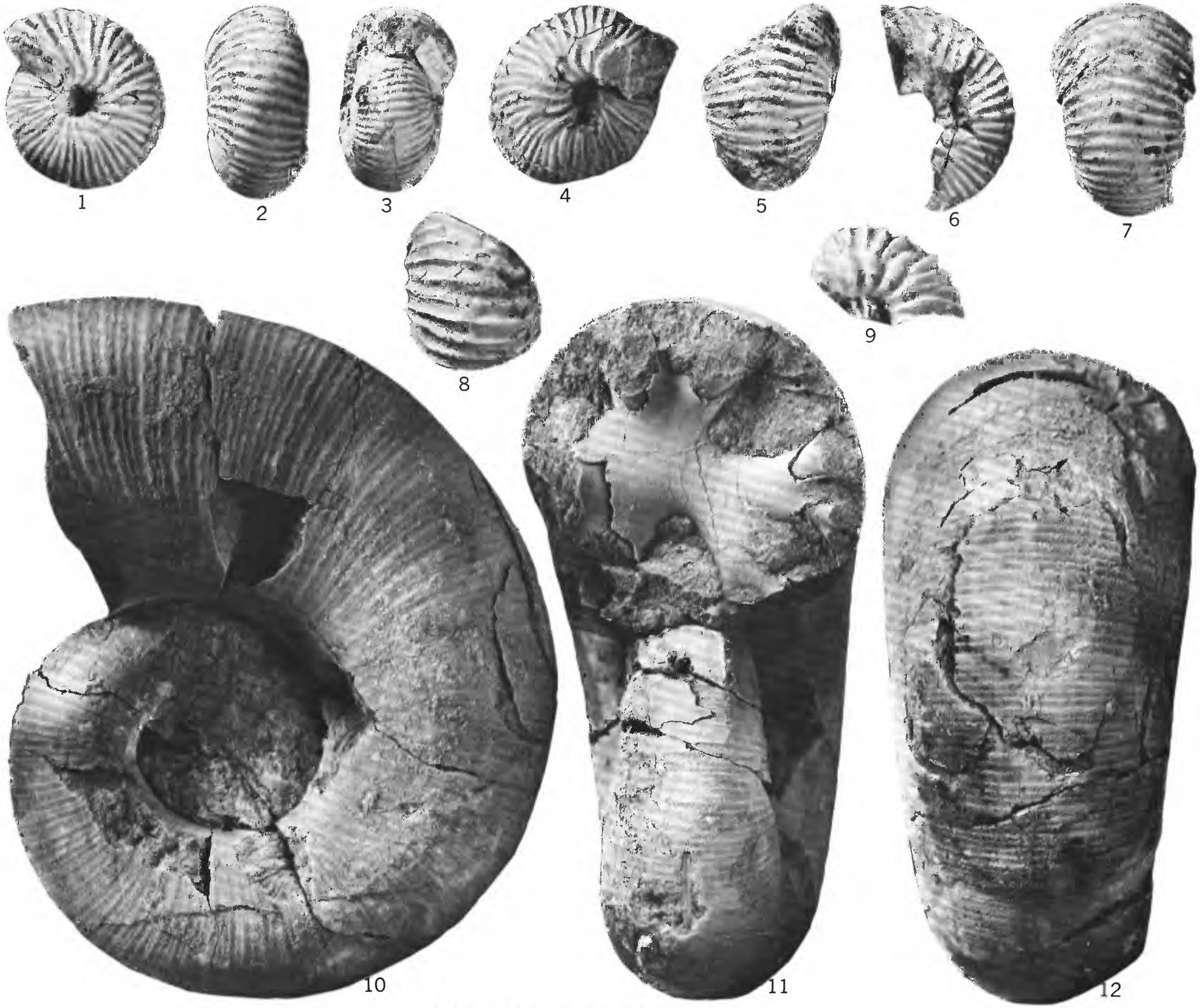
[All figures are natural size]

FIGURES 1–9. *Xenocephalites* cf *X. hebetus* Imlay (p. 30).

- 1–3. Figured specimen, USNM 240719 from USGS Mesozoic loc. 21312.
- 4, 5. Figured specimen, USNM 240717 from USGS Mesozoic loc. 22436.
- 6, 7. Figured specimen, USNM 240718 from USGS Mesozoic loc. 21312.
- 8, 9. Figured specimen, USNM 240720 from USGS Mesozoic loc. 22713. Shows part of adult body chamber.

10–12. *Lytoceras* sp. (p. 16).

Figured specimen, USNM 240709 from USGS Mesozoic loc. 30579.



XENOCEPHALITES AND *LYTOCERAS*

PLATE 3

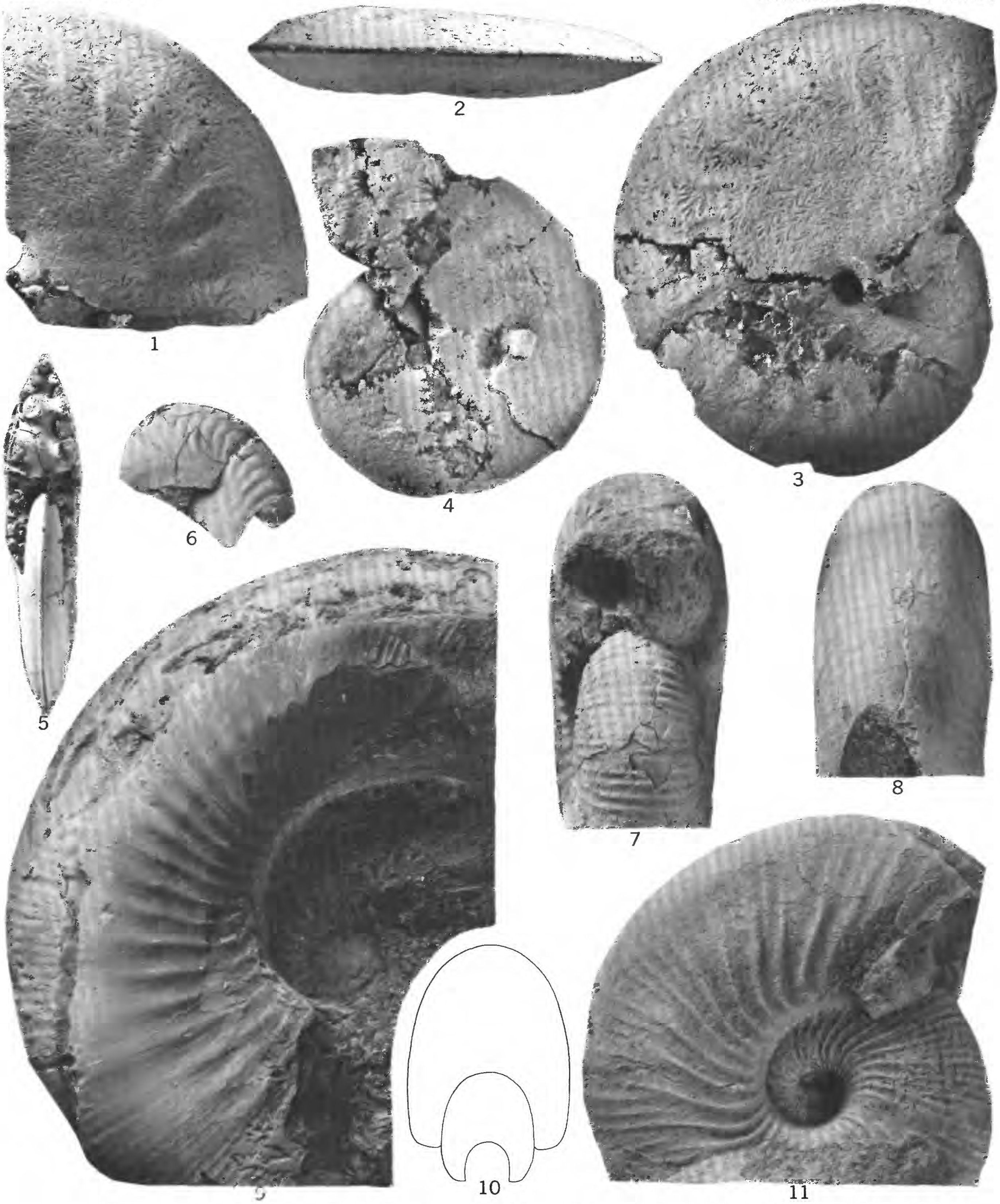
[All figures are natural size]

FIGURES 1–5. *Oppelia* (*Oxycerites*) aff. *O.* (*O.*) *chinitnana* Imlay (p. 17).
Figured specimen, USNM 240710 from USGS Mesozoic loc. 22538.

6. *Oppelia* (*Liroxyites*) cf *O.* (*L.*) *kellumi* Imlay (p. 18).
Figured specimen, USNM 240711 from USGS Mesozoic loc. 30257.

7, 8, 10, 11. *Cranocephalites* cf. *C. vulgaris* Spath (p. 33).
Figured specimen, USNM 240734 from USGS Mesozoic loc. 30275. Shows apertural, ventral, cross-sectional, and lateral views of adult body chamber.

9. *Kepplerites* sp. B (p. 31).
Figured specimen, USNM 240722 from USGS Mesozoic loc. 30258. Shows adult body chamber.



OPPELIA (*OXYCERITES*), *O.* (*LIROXYITES*), *CRANOCEPHALITES*, AND *KEPPLERITES*

PLATE 4

[All figures are natural size]

FIGURES 1, 2, 4–12. *Cadomites* cf. *C. deslongchampsi* (d'Orbigny) (p. 18).

1, 2, 4, 5. Nonseptate specimens, USNM 240714 from USGS Mesozoic loc. 30576. Shows lateral views (figs. 1 and 2), ventral view (fig. 4), and rubber latex imprint of dorsal surface of adoral part of adult body chamber (fig. 5).

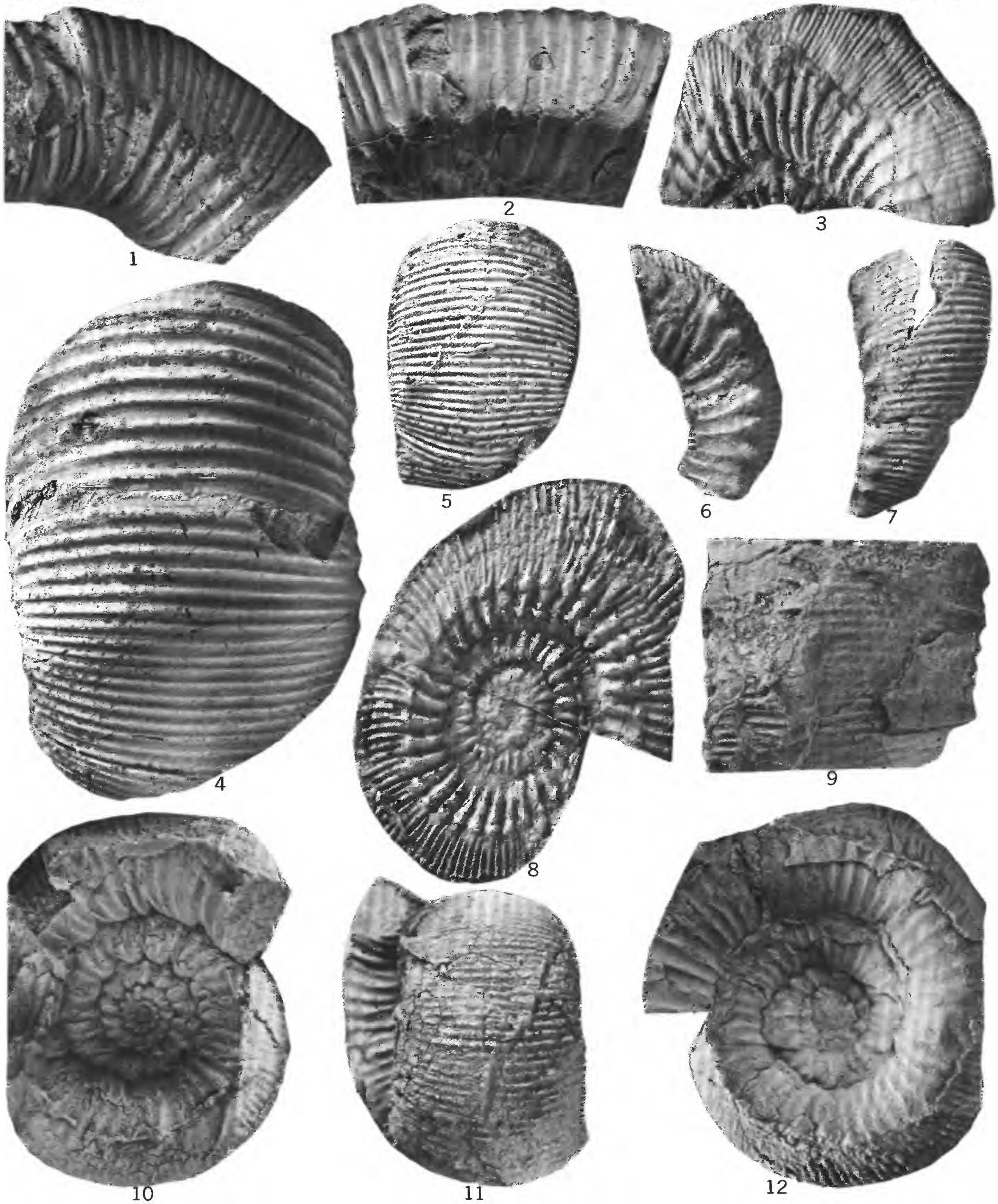
6, 7. Septate specimen, USNM 240713 from USGS Mesozoic loc. 30577. This small specimen was part of an umbilical plug that was detached from the specimen shown in figures 9–12.

8. Rubber imprint of external mold of specimen, USNM 240715 from USGS Mesozoic loc. 28682.

9–12. Ventral and lateral views of specimen, USNM 240712 from USGS Mesozoic loc. 30277. Note that the adoral end has been crushed vertically.

3. *Cadomites* cf. *C. rectelobatus* (v. Hauer) (p. 30).

Rubber imprint of laterally crushed external mold of specimen, USNM 240716 from USGS Mesozoic loc. 28682.



CADOMITES

PLATE 5

[All figures are natural size]

FIGURES 1–5. *Cranocephalites alaskanus* Imlay n. sp. (p. 32).

1–4. Lateral, apertural, and ventral views of holotype, USNM 240729 from USGS Mesozoic loc. 22698.

5. Immature paratype, USNM. 130753 from USGS Mesozoic loc. 22698.

6–8. *Cranocephalites* sp. A (p. 33).

Lateral and ventral views of specimen, USNM 240735 from USGS Mesozoic loc. 22436.

9–11. *Cranocephalites* cf. *C. ignekensis* Imlay (p. 32).

9. Rubber imprint of external mold of specimen, USNM 240730 from USGS Mesozoic loc. 30275.

10, 11. Lateral views of specimen, USNM 130751 from USGS Mesozoic loc. 21284

CRANOCEPHALITES

PLATE 6

[All figures except suture line are natural size]

FIGURES 1–3, 5, 6, 8–13. *Cranocephalites globosus* Imlay n. sp. (p. 33).

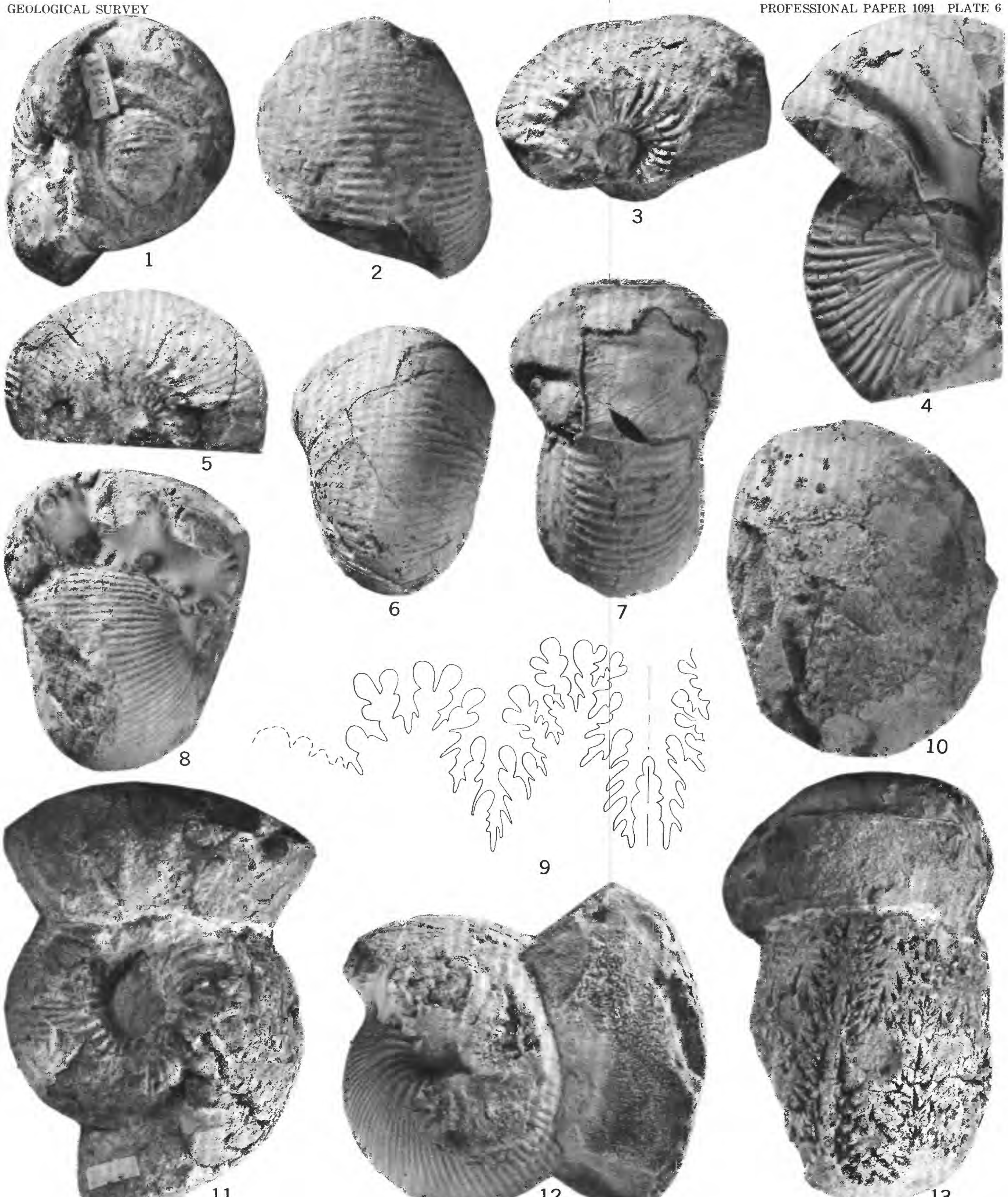
1–3. Cross-sectional, ventral and lateral views of paratype, USNM 240732 from USGS Mesozoic loc. 20751.

5, 6. Paratype, USNM 240733 from USGS Mesozoic loc. 24117.

8–13. Holotype, USNM 240731 from USGS Mesozoic loc. 24116. Figure 9 shows suture line (× 2) drawn at diameter of 53 mm, whorl height of 15 mm, and whorl thickness of 43 mm. On Figures 10 and 13 note smoothness of venter near the apertural constriction. On Figure 11 note persistence of ribs on the flanks almost to the apertural constriction.

4, 7. *Cranocephalites* sp. B (p. 34).

Lateral and apertural views of specimen, USNM 240736 from USGS Mesozoic loc. 30257.



CRANOCEPHALITES

PLATE 7

[All figures natural size except suture lines]

FIGURES 1–12. *Cranocephalites costidensus* (Imlay) (p. 32).

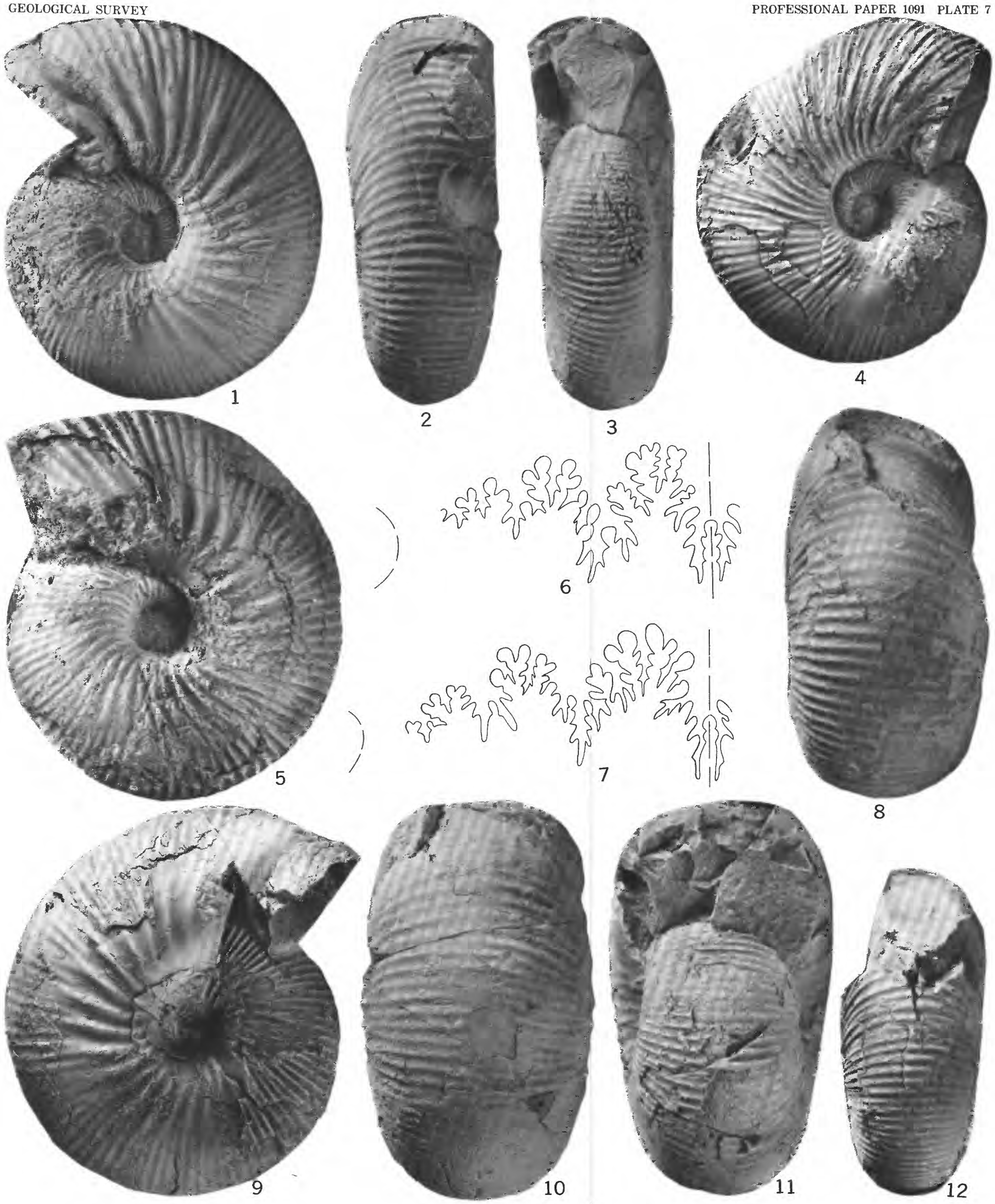
1–3, 6. Hypotype, USNM 240724 from USGS Mesozoic loc. 30273 has a compressed form and moderately strong ribbing. Figure 6 shows suture lines (× 2) drawn at adapical end of body chamber.

4, 12. Hypotype, USNM 240727 from USGS Mesozoic loc. 30277, has a compressed form and fairly fine ribbing.

5, 8. Hypotype, USNM 240725 from USGS Mesozoic loc. 30289, has a fairly stout form and moderately strong ribbing.

7. Suture line (× 2) on hypotype, USNM 240728 from USGS Mesozoic loc. 30277.

9–11. Hypotype, USNM 240726 from USGS Mesozoic loc. 30277, has a very stout form and fairly fine ribbing.



CRANOCEPHALITES

PLATE 8

[All figures are natural size]

FIGURES 1–9. *Tuxednites alticostatus* (Imlay) (p. 34).

1, 2. Holotype, USNM 130757 from USGS Mesozoic loc. 20752.

3, 4. Hypotype, USNM 240739 from USGS Mesozoic loc. 30290.

5, 6. Hypotype, USNM 240738 from USGS Mesozoic loc. 30288.

7–9. Hypotype, USNM 240737 from USGS Mesozoic loc. 11038.

10–15. *Tuxednites?* sp. ind. (p. 35).

10, 11. Ventral and lateral view of internal mold of specimen, USNM 240742 from USGS Mesozoic loc. 30265.

12, 13. Rubber cast of external mold of same specimen shown in figures 10 and 11.

14, 15. Nonseptate specimen, USNM 240741 from USGS Mesozoic loc. 20744.

16, 17. *Tuxednites* cf. *T. alticostatus* (Imlay) (p. 35).

Specimen, USNM 240740 from USGS Mesozoic loc. 22698. Whorl section is slightly crushed.

18–21. *Arctocephalites* cf. *A. elegans* Spath (p. 34).

Specimen, USNM 108743 from USGS Mesozoic loc. 22699. Partial, nearly smooth body chamber is shown in figures 18 and 21. On figure 21 the adoral end of body chamber is pointed upward.

22, 26–28. *Iniskinites* cf. *I. intermedius* (Imlay) (p. 35).

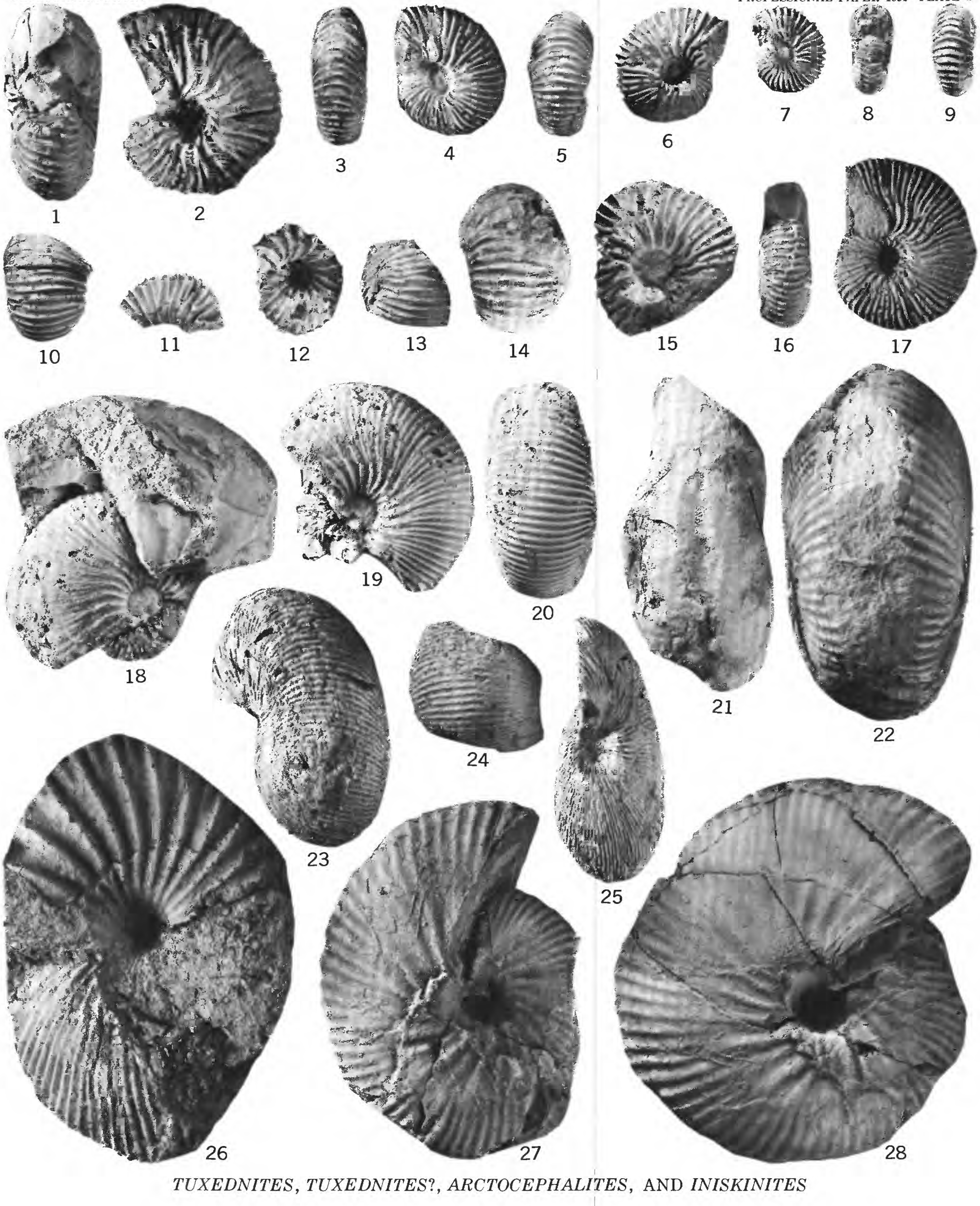
22, 27, 28. Ventral and lateral views of specimen, USNM 240744 from USGS Mesozoic loc. 30262.

26. Specimen, USNM 240743 from USGS Mesozoic loc. 22700.

23–25. *Iniskinites* cf. *I. magniformis* (Imlay) (p. 35).

23, 25. Crushed immature septate specimen, USNM 240745a from USGS Mesozoic loc. 22536.

24. Ventral view of uncrushed specimen, USNM 240745b from USGS Mesozoic loc. 22536.



TUXEDNITES, TUXEDNITES?, ARCTOCEPHALITES, AND *INISKINITES*

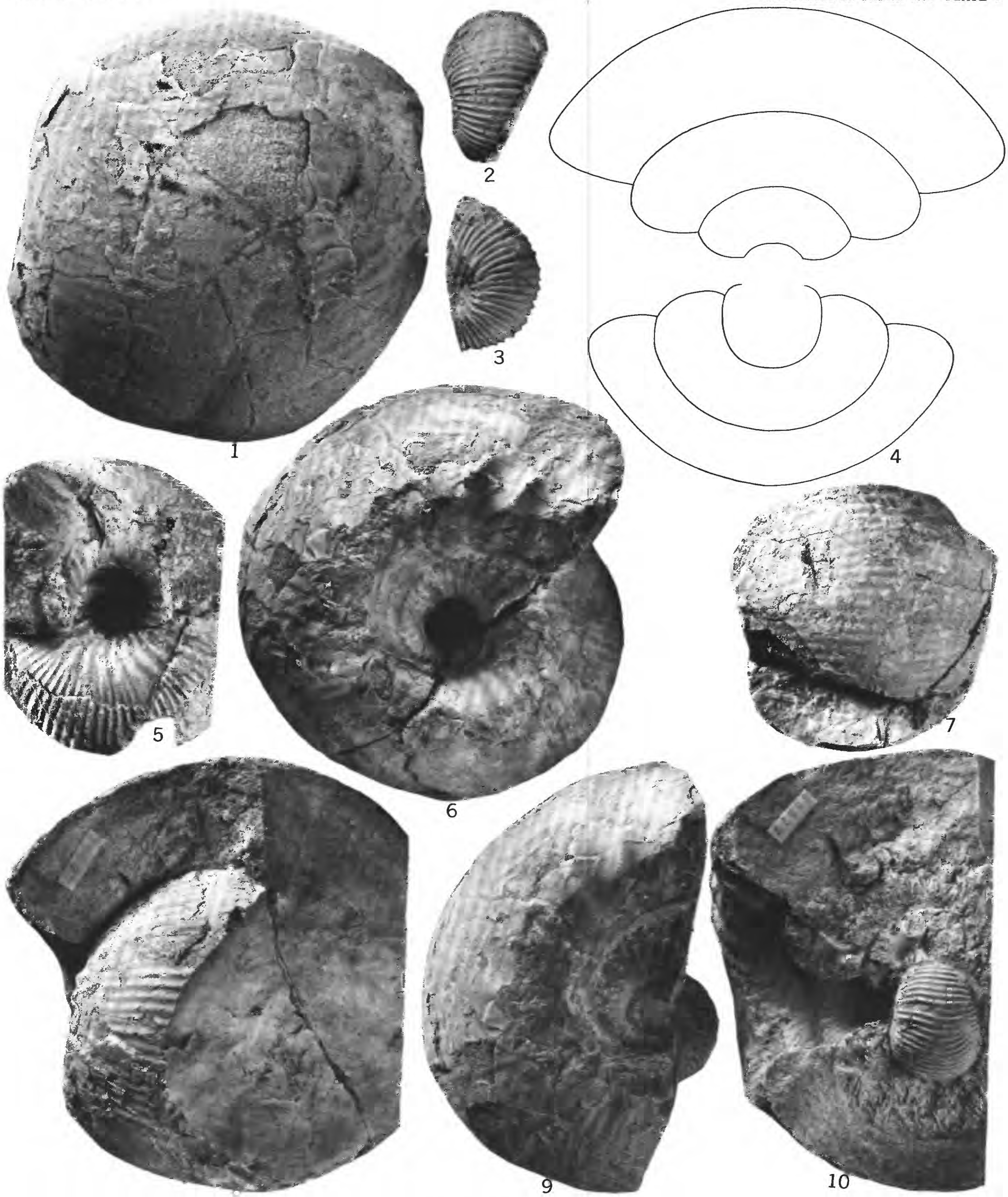
PLATE 9

[All figures are natural size]

FIGURES 1–10. *Talkeetnites cadiformis* Imlay, n. sp. (p. 36).

1–4, 6, 8–10. Holotype, USNM 240746 from USGS Mesozoic loc. 30277. Shows ventral, cross-sectional, and apertural views of incomplete body whorl. On Figure 1 the adoral part of the body chamber is pointed downward. Figure 4 is a line drawing cross-sectional view. Figures 9 and 10 represent the adoral half of the holotype split along the crack shown in figure 6. Figures 2, 3, and 10 show the ribbing on a small inner whorl.

5, 7. Paratype, USNM 240747 from USGS Mesozoic loc. 30277. Lateral and ventral views of intermediate-sized septate whorl.



TALKEETNITES

PLATE 10

[Figures natural size unless otherwise indicated]

FIGURES 1–10. *Parareineckeia hickersonensis* Imlay (p. 36).

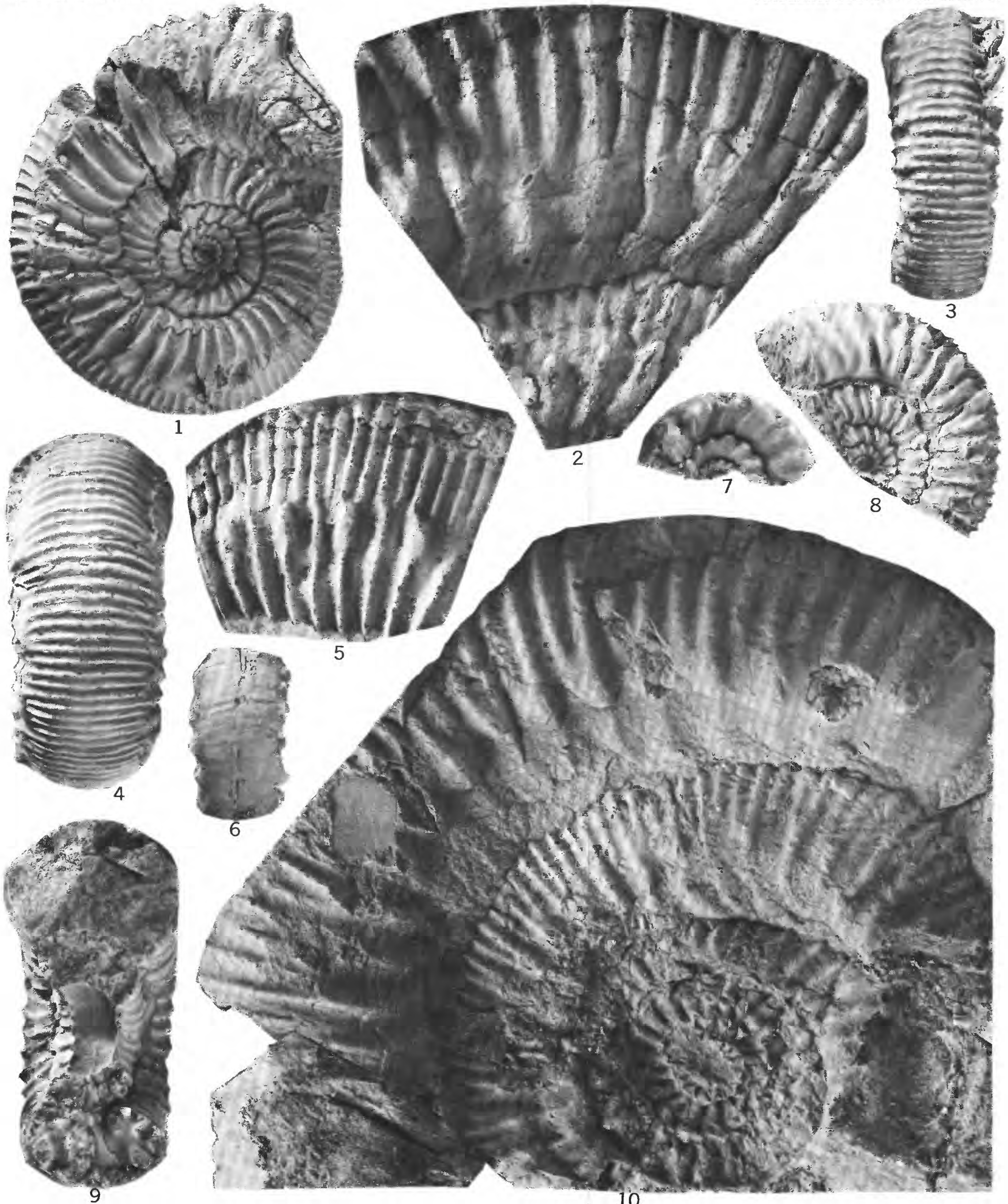
1, 4, 6, 7, 9. Hypotype, USNM 240751 from USGS Mesozoic loc. 30576. Figures 6 and 7 (× 2) depict three inner whorls whose place of attachment is shown on Figure 9. Figures 1, 4, and 9 depict the outermost whorl of a microconch as shown by presence of a lateral lappet.

2. Rubber imprint of external mold of laterally crushed hypotype, USNM 240750 from USGS Mesozoic loc. 28682.

3, 8. Ventral and lateral views of hypotype, USNM 240752 from USGS Mesozoic loc. 30272. Note prominent spines in figure 3.

5. Rubber imprint of laterally crushed external mold of hypotype, USNM 240749 from USGS Mesozoic loc. 28682.

10. External and internal molds of laterally crushed hypotype, USNM 240748 from USGS Mesozoic loc. 28682. At least two-fifths of the outer whorl is nonseptate.



PARAREINECKEIA

PLATE 11

[All figures are natural size]

FIGURES 1–16. *Parareineckeia nelchinensis* Imlay n. sp. (p. 36).

1. Rubber imprint of external mold of paratype, USNM 240754 from USGS Mesozoic loc. 28527.

2–5. Internal mold of immature paratype, USNM 240760 from USGS Mesozoic loc. 3038.

6. Laterally crushed paratype, USNM 240756 from USGS Mesozoic loc. 28682.

7, 13–16. Holotype, USNM 240753 from USGS Mesozoic loc. 30272. Figures 7 and 14 represent the septate whorls. On figure 16 about half of outer whorl is nonseptate.

8. Laterally crushed paratype, USNM 240755 from USGS Mesozoic loc. 28527. Probably represents part of adult body chamber.

9. Laterally crushed paratype, USNM 240759 from USGS Mesozoic loc. 28524.

10, 11. Paratype, USNM 240758 from USGS Mesozoic loc. 28682.

12. Paratype, USNM 240757 from USGS Mesozoic loc. 28682.

PARAREINECKEIA

PLATE 12

[All figures natural size except suture lines]

FIGURES 1, 5, 10, 11. *Cobbanites striatus* Imlay n. sp. (p. 37).

1. Internal and external molds of holotype, USNM 240764 from USGS Mesozoic loc. 28682.

5, 10, 11. Internal mold of immature paratype, UCLA 4988 at loc. RAL 65.

2–4, 7–9. *Cobbanites talkeetnanus* Imlay (p. 37).

2–4. Hypotype, USNM 240761 from USGS Mesozoic loc. 30277.

7. Hypotype, USNM 240762 from USGS Mesozoic loc. 28699.

8, 9. Hypotype, USNM 240763 from USGS Mesozoic loc. 28525.

6, 12–15. *Cobbanites tuxedniensis* Imlay n. sp. (p. 37).

Holotype, USNM 240765 from USGS Mesozoic loc. 30261. Figure 6 shows suture line (× 2) drawn at diameter of 80 mm. Figure 12 shows a ventral view at diameter of about 67 mm. Figure 13 shows a ventral view at diameter of 80 mm.

COBBANITES

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