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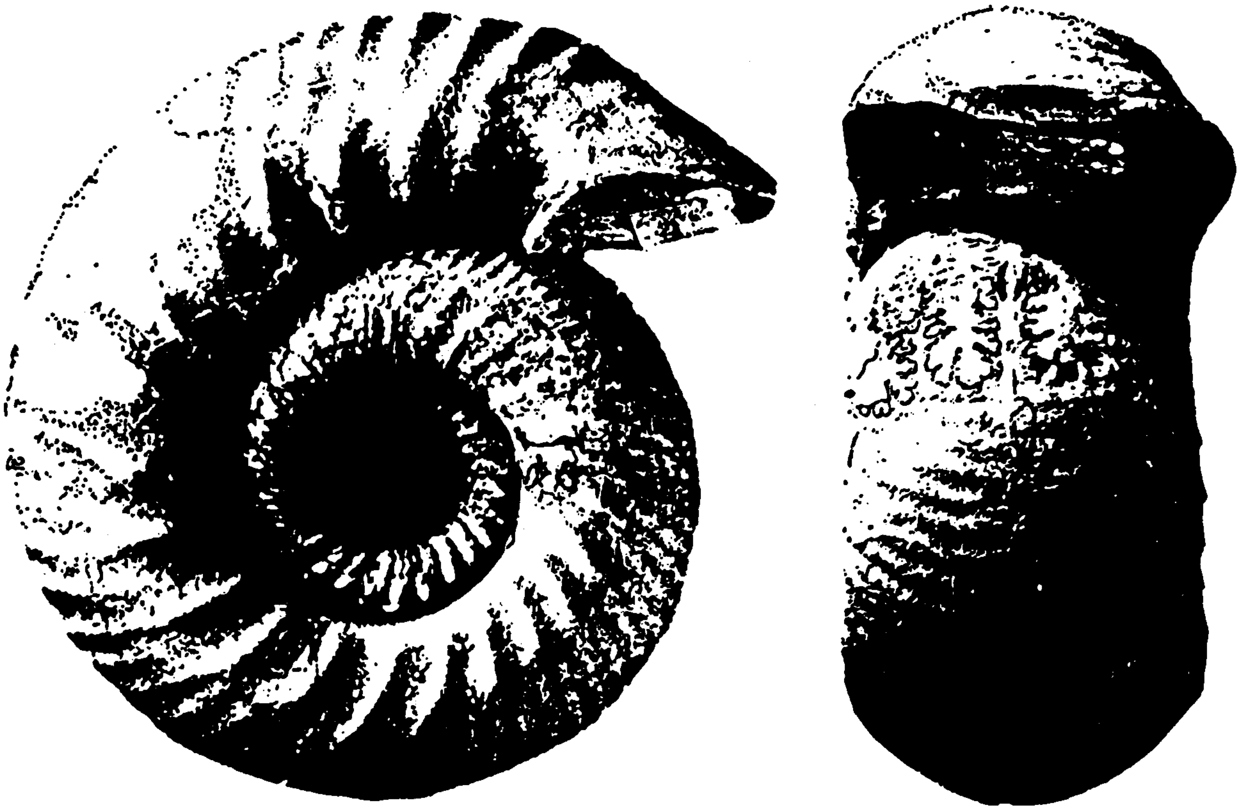

Early and Middle Bajocian (Middle Jurassic) Ammonites from Southern Alaska

By RALPH W. IMLAY

U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1322

Studies of the early and middle Bajocian ammonites of southern Alaska provide close age determinations and correlations with Europe, Arctic Alaska, Arctic Canada, and the Pacific Coast region in general

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EARLY AND MIDDLE BAJOCIAN (MIDDLE JURASSIC) AMMONITES FROM SOUTHERN ALASKA

By RALPH W. IMLAY

ABSTRACT

Early and middle Bajocian (Middle Jurassic) ammonites have been found in six areas in southern Alaska over a distance of about 500 mi (800 km) from the Wrangell Mountains on the east to the Wide Bay area of the Alaska Peninsula on the west. In the Wrangell Mountains, some float obtained near the base of the Nizina Mountain Formation has furnished the ammonites *Chondroceras*, *Normannites*, and *Teloceras*, which constitute good evidence for a late middle Bajocian age not older than the upper part of the *Stephanoceras humphriesianum* zone.

In the Nelchina area of the Talkeetna Mountains northeast of Anchorage, the Tuxedni Group has furnished ammonites ranging in age from latest early Bajocian to early late Bajocian. These ammonites from the base upward include (1) *Erycitoides howelli* (White), representing the *Graphoceras concavum* zone; (2) *Sonninia (Euhoploceras) bifurcata* Westermann, representing the lower part of the *Sonninia sowerbyi* zone; (3) *Parabigotites crassicostatus* Imlay, *Bradfordia costidensa* Imlay, and *Otoites*, representing the *Otoites sauzei* zone; (4) *Normannites variabilis* Imlay, *Stemmatoceras*, *Leptosphinctes*, and *Chondroceras*, representing the *Stephanoceras humphriesianum* zone; and (5) *Megasphaeroceras*, *Sphaeroceras*, *Cadomites*, and *Normannites*, representing the topmost *Strenoceras subfurcatum* zone of early late Bajocian age.

An even more complete ammonite succession of early to middle Bajocian age has been found on the west side of Cook Inlet between Tuxedni Bay and the eastern part of the Iniskin Peninsula just west of Chinitna Bay. Basally that succession differs from the succession in the Talkeetna Mountains by the presence of *Tmetoceras scissum* (Benecke) both below and along with occurrences of *Erycitoides howelli* (White) and by the presence of *Emileia*, *Sonninia*, and *S. (Papilliceras)* between the underlying beds containing *Parabigotites* and the overlying beds containing *Teloceras*, *Normannites*, and *Chondroceras*. The presence of *Tmetoceras* below the occurrences of *Erycitoides* favors an age slightly older than the *Graphoceras concavum* zone of latest early Bajocian age. The presence of *Sonninia* and *Emileia* is evidence of an age not younger than the zone of *Otoites sauzei*.

The Bajocian ammonite succession at Wide Bay is essentially the same as that on the west side of Cook Inlet as high as the bed containing *Sonninia tuxedniensis* Imlay. The succession at Wide Bay, however, has furnished more genera and species and has made possible a threefold faunule division of the beds characterized by *Docidoceras (Pseudocidoceras) widebayense*.

INTRODUCTION

Most of the early and middle Bajocian (Middle Jurassic) ammonite taxa present in southern Alaska were described by the writer in 1964 and by Gerd Westerman in 1964 and 1969 (figs. 1-7). The writer at that time dealt mainly with ammonites collected either northwest of Cook Inlet between Tuxedni Bay and Iniskin Bay or in the eastern part of the Nelchina area of the Talkeetna Mountains. Gerd Westermann at those times dealt mainly with ammonites of late early to early middle Bajocian age that had been collected near Wide Bay on the Alaska Peninsula. Most of those collections had been made by field geologists working for the U.S. Geological Survey, as listed by Imlay (1964, p. B1), who also made extensive collections from Bajocian sedimentary rocks in southern Alaska, in 1948, 1952, 1962, 1972, 1974, and 1977.

The stratigraphic occurrences of the ammonites (figs. 8-13) are based mainly on studies by R. L. Detterman (1963) and by J. K. Hartsock (1966, p. 20-34) in the area west of Cook Inlet; by Arthur Grantz (1965) in the Nelchina area of the Talkeetna Mountains; by E. M. MacKevett, Jr. (1971, p. 16, 17), in the Wrangell Mountains; and by R. L. Detterman and associates (1977, 1980, and 1981) in the Paule Bay and Wide Bay areas of the Alaska Peninsula.

Only those taxa are described herein that have not previously been identified or described, or for which new biologic, stratigraphic, or geographic data are now available.

BIOLOGICAL ANALYSIS

The U.S. Geological Survey's fossil collections from southern Alaska contain at least 1,224 ammonite specimens of early and middle Bajocian age. Their distribution by genus, subgenus, subfamily, and family is shown in table 1. Among the families, the Hammatoceratidae comprise about 28½ percent of the total number of specimens; the Stephaneroceratidae, nearly 19 percent; the Sonniniidae, 8½ percent; the Sphaeroceratidae and Perisphinctidae, each a little more than 8 percent; the Oppeliidae, 7½ percent; the Otoitidae, 6½ percent; the Phylloceratidae and Hildoceratidae, each

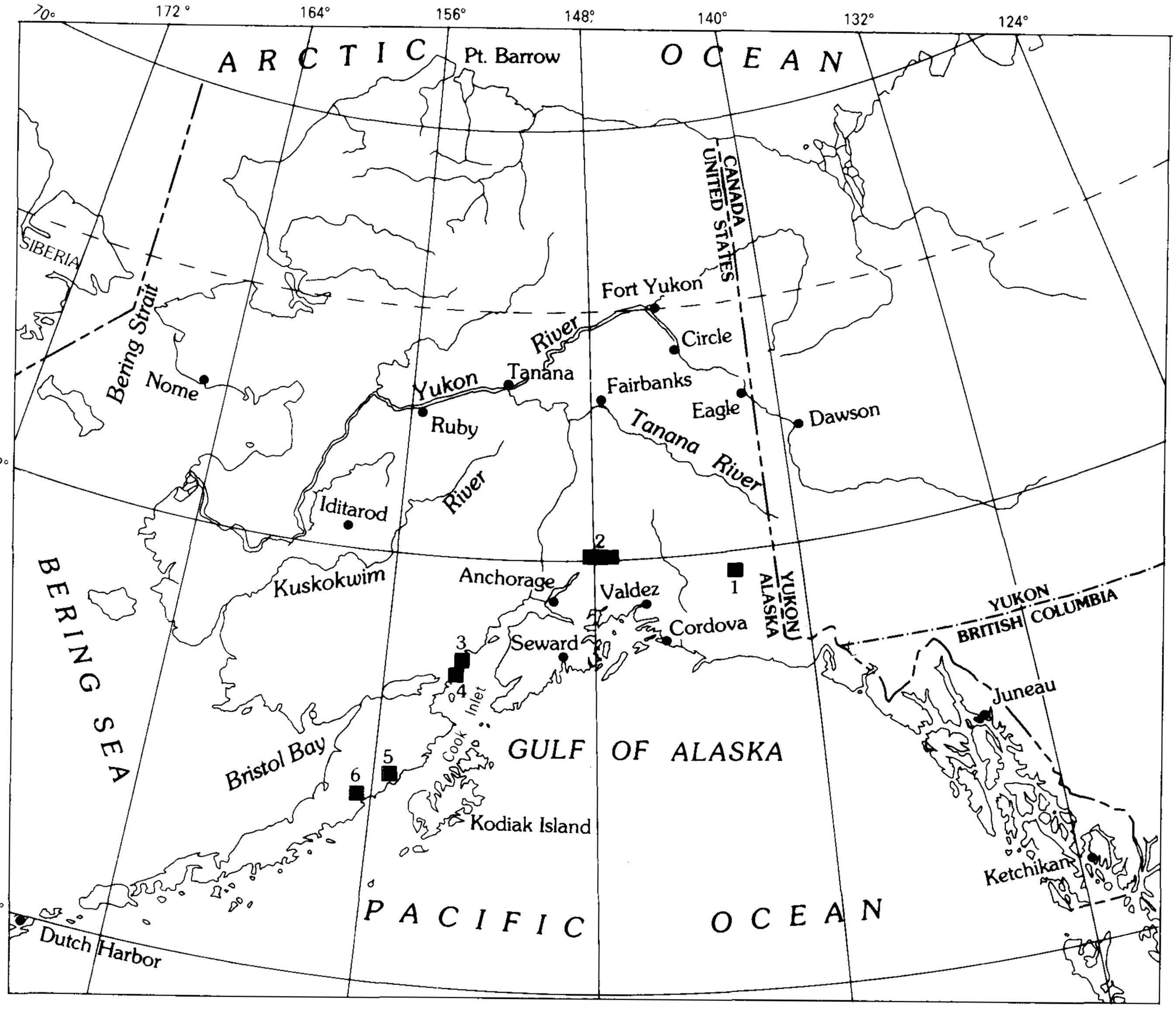


FIGURE 1.—Principal areas of outcrop of Bajocian marine rocks in southern Alaska: (1) Wrangell Mountains; (2) Talkeetna Mountains; (3) Peninsula between Tuxedni Bay and Chinitna Bay; (4) Iniskin Peninsula; (5) Puale Bay; and (6) Wide Bay.

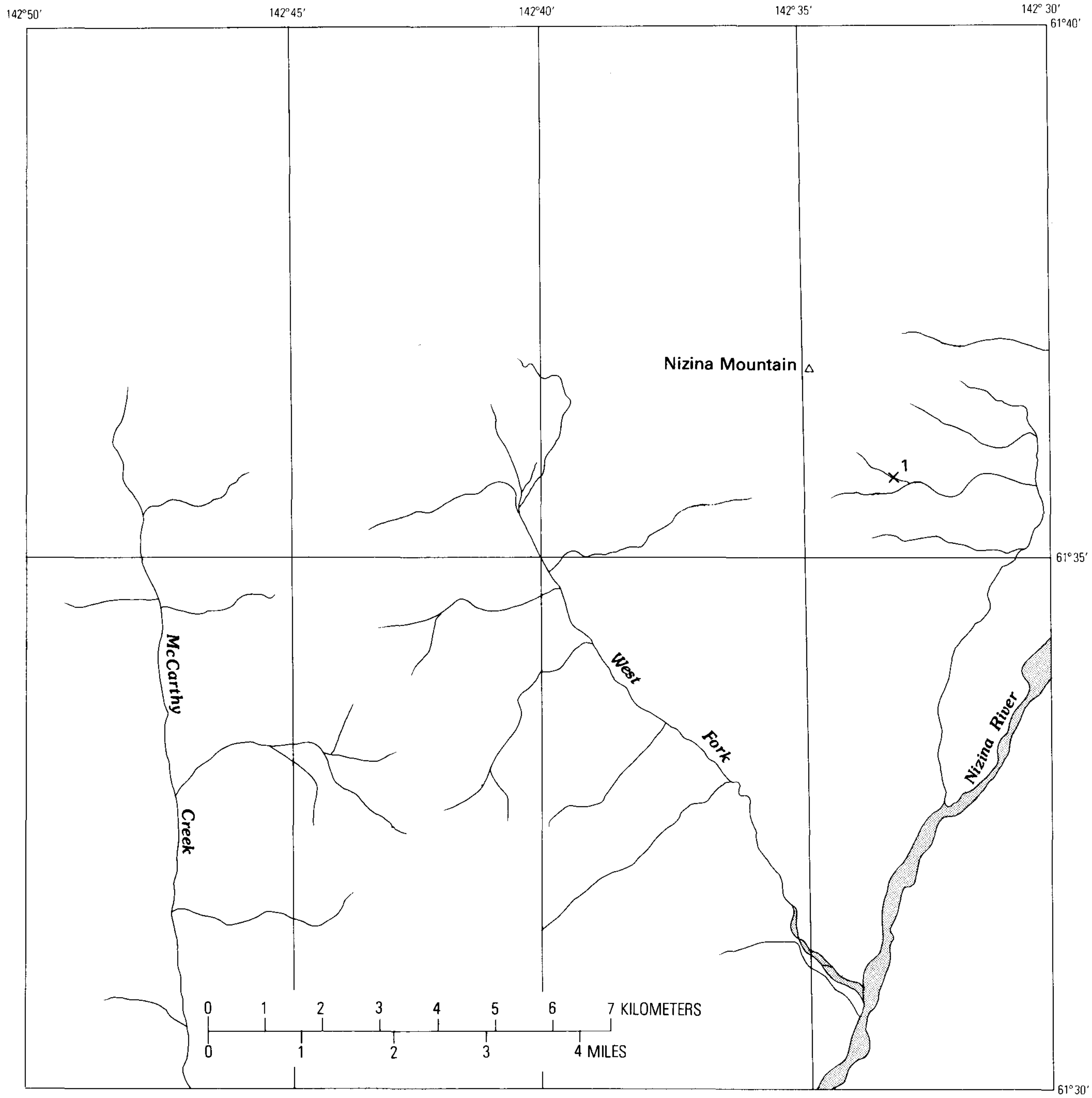


FIGURE 2.—Listed early and middle Bajocian ammonite locality in the Wrangell Mountains. Number refers to that given in table 5.

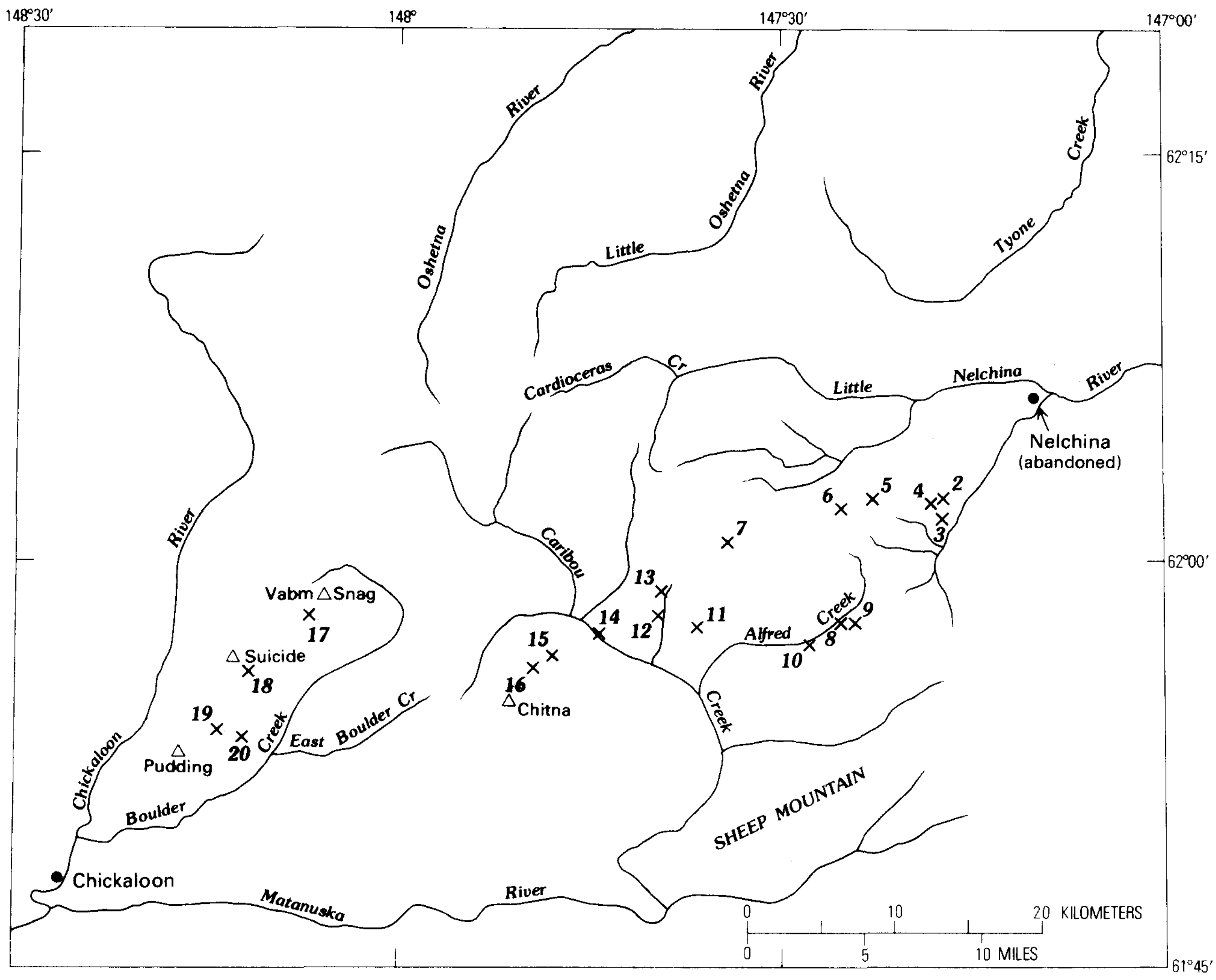


FIGURE 3.—Listed early and middle Bajocian ammonite localities in the Talkeetna Mountains. Numbers refer to those given in table 5.

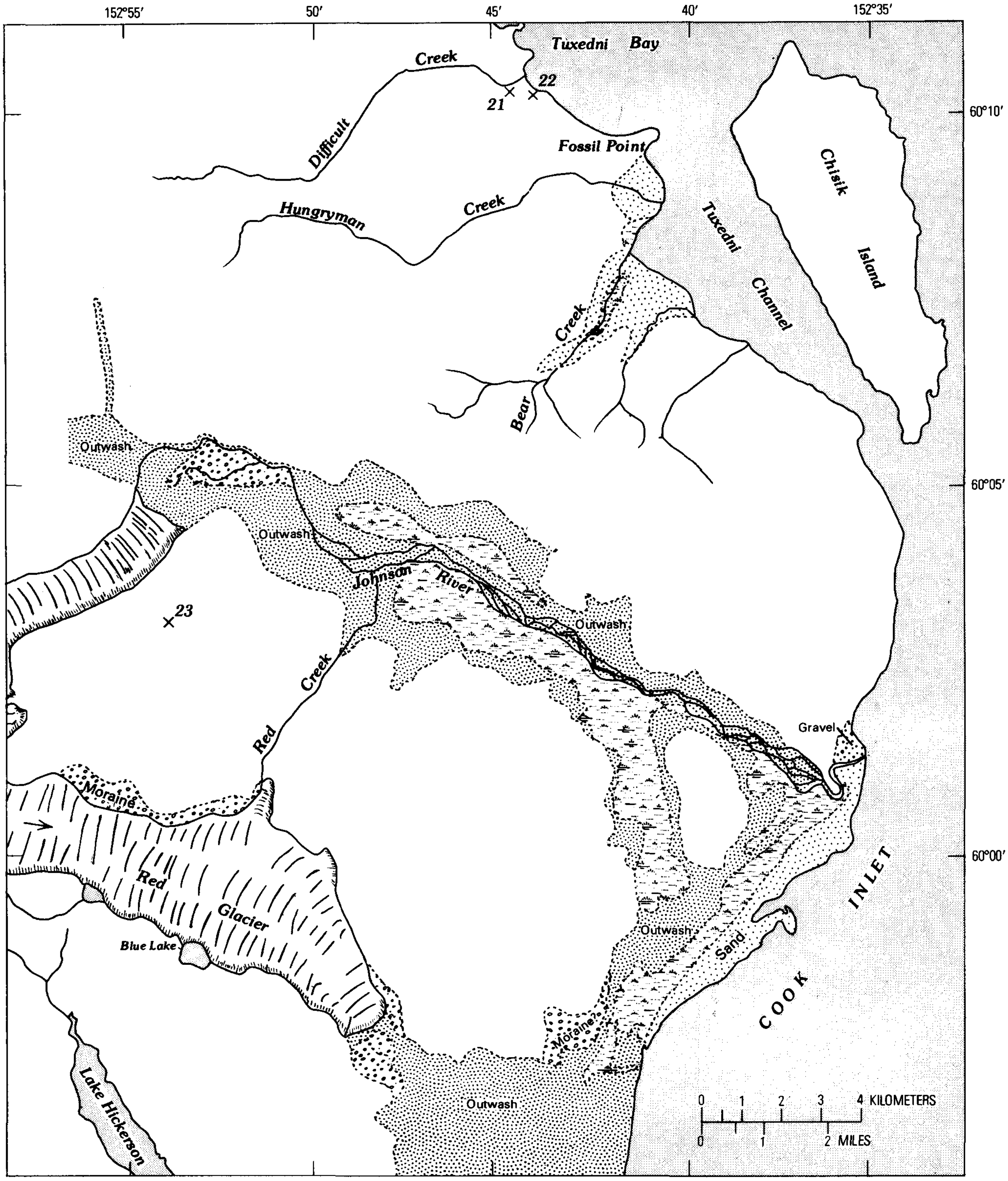


FIGURE 4.—Listed early and middle Bajocian ammonite localities at the west side of Cook Inlet between Tuxedni Bay and Chinitna Bay. Numbers refer to those given in table 5.

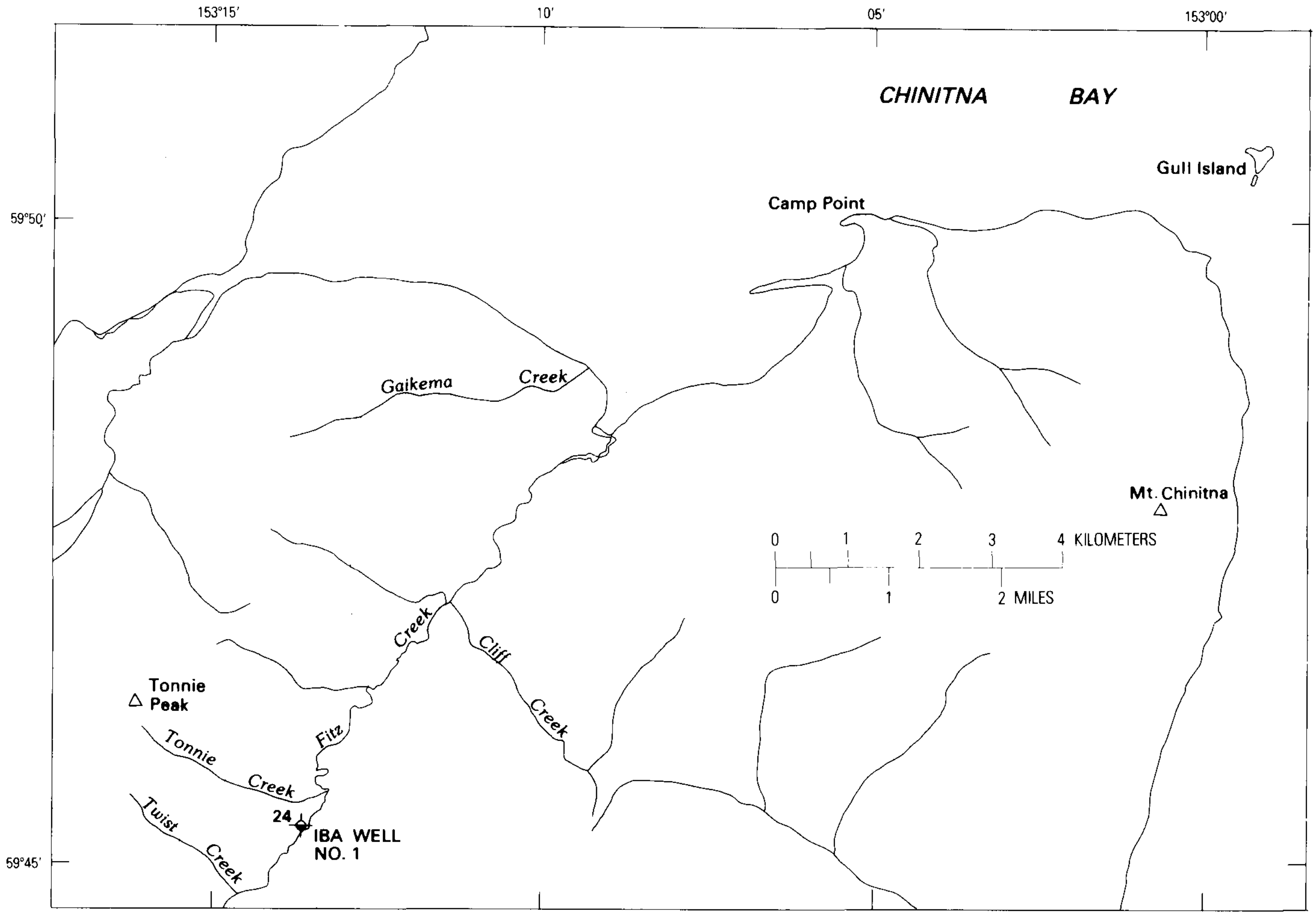


FIGURE 5.—Listed early and middle Bajocian ammonite locality west of Cook Inlet on the Iniskin Peninsula in the Iniskin Bay Association well 1. Number refers to that given in table 5.

about 6 percent; and the Lytoceratidae, Strigoceratidae, and Haploceratidae combined, only 1½ percent. The characteristics of most of the genera, subgenera and species present have been discussed by the writer in previous publications (Imlay, 1964, p. B3–B6; 1973, p. 3–8), and are not repeated herein.

STRATIGRAPHIC SUMMARY

WRANGELL MOUNTAINS

The Middle Jurassic is represented in the Wrangell Mountains (fig. 8) only by the Nizina Mountain Formation, which consists mostly of medium-bedded graywacke, attains a maximum thickness of 1,500 ft (457 m), is overlain unconformably by the Root Glacier Formation of Oxfordian to Kimmeridgian (Late Jurassic) age, and is underlain unconformably by the Lubbe Creek Formation of Hettangian to Pliensbachian (Early Jurassic) age (MacKevett, 1969, p. A42–A46; 1971, p. 16, 17, 30, 31; Imlay and Detterman, 1973, p. 11A). From the base to near the middle part of the Nizina Mountain Formation, ammonites have been obtained that are probably of earliest Bathonian age (Imlay, 1980, p. 4, 12–14, 16). In addition, a few ammonites (fig. 2) of middle Bajocian age have been collected as float, along with many ammonites of probable early Bathonian age at U.S. Geological Survey Mesozoic loc. 28682 (MacKevett, 1969, p. A42–A43; 1971, p. 16, 17, 30, 31; Imlay, 1980, p. 12–17, 21). These middle Bajocian ammonites were probably derived from the basal part of the Nizina Mountain Formation, or from underlying beds.

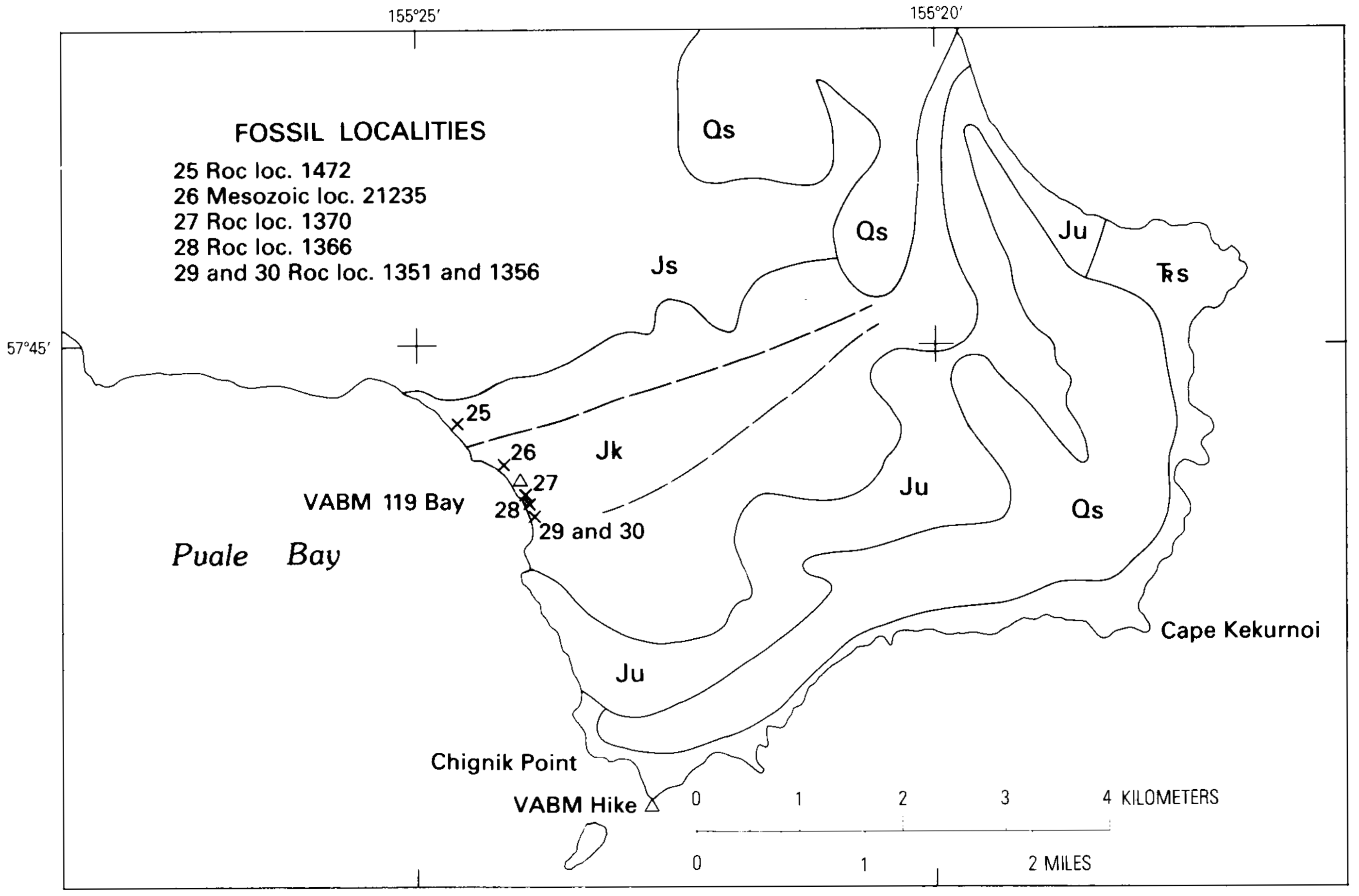


FIGURE 6.—Listed early and middle Bajocian ammonite localities northeast of Puale Bay on the Alaska Peninsula. The ROC localities represent fossil collections of the Richfield Oil Company. Qs, Quaternary sediments; Js, Shelikof Formation (Middle Jurassic); Jk, Kialagvik Formation (Lower and Middle Jurassic); Ju, unnamed Lower Jurassic beds; ꞒU, unnamed Triassic beds. Dashed lines indicate major faults. Formational boundaries determined on the basis of unpublished field data obtained in 1980 and 1981 by R.C. Detterman and associated USGS geologists.

TALKEETNA MOUNTAINS

In the Talkeetna Mountains, the Tuxedni Group is listed as 700-1,200 ft (213-366 m) thick (Imlay and Detterman, 1973, p. 11), and it has been identified at many places over a distance of 30 mi (48 km) from the Nelchina area in the east to the Boulder Creek area in the west (fig. 3). In the Nelchina area as far west as Sheep Creek, the Tuxedni Group, according to Arthur Grantz (written commun., 1981), consists basally of a sandstone that is more than 500 ft (152 m) thick at the headwaters of Flat Creek and about 850 ft (260 m) thick near Sheep Creek. Above the sandstone is siltstone that locally contains a few sandstone beds and is about 100 ft (30 m) thick.

In the Boulder Creek area of the Talkeetna Mountains the Tuxedni Group is not exposed basally, but is at least 550 ft (168 m) thick and well exposed on a divide 9.6 km N. 20° E. of the junction of Boulder Creek with East Boulder Creek (loc. 17 on fig. 3). Its uppermost beds consist of orange-red siltstone that is at least 30 ft (9 m) thick locally and is probably as much as 131 ft (40 m) thick. Below the orange-red siltstone the Tuxedni Group is represented by about 511 ft (159 m) of sedimentary rocks, consisting, from top to bottom, of 145 ft (44 m) of brown-to-gray siltstone, 100-136 ft (30-41 m) covered, 100 ft (30.5 m) of sandstone and grit, and 150 ft (46 m) of siltstone containing some beds of graywacke. This sequence has been illustrated previously (Imlay, 1980, figs. 3, 4; p. 10, 11).

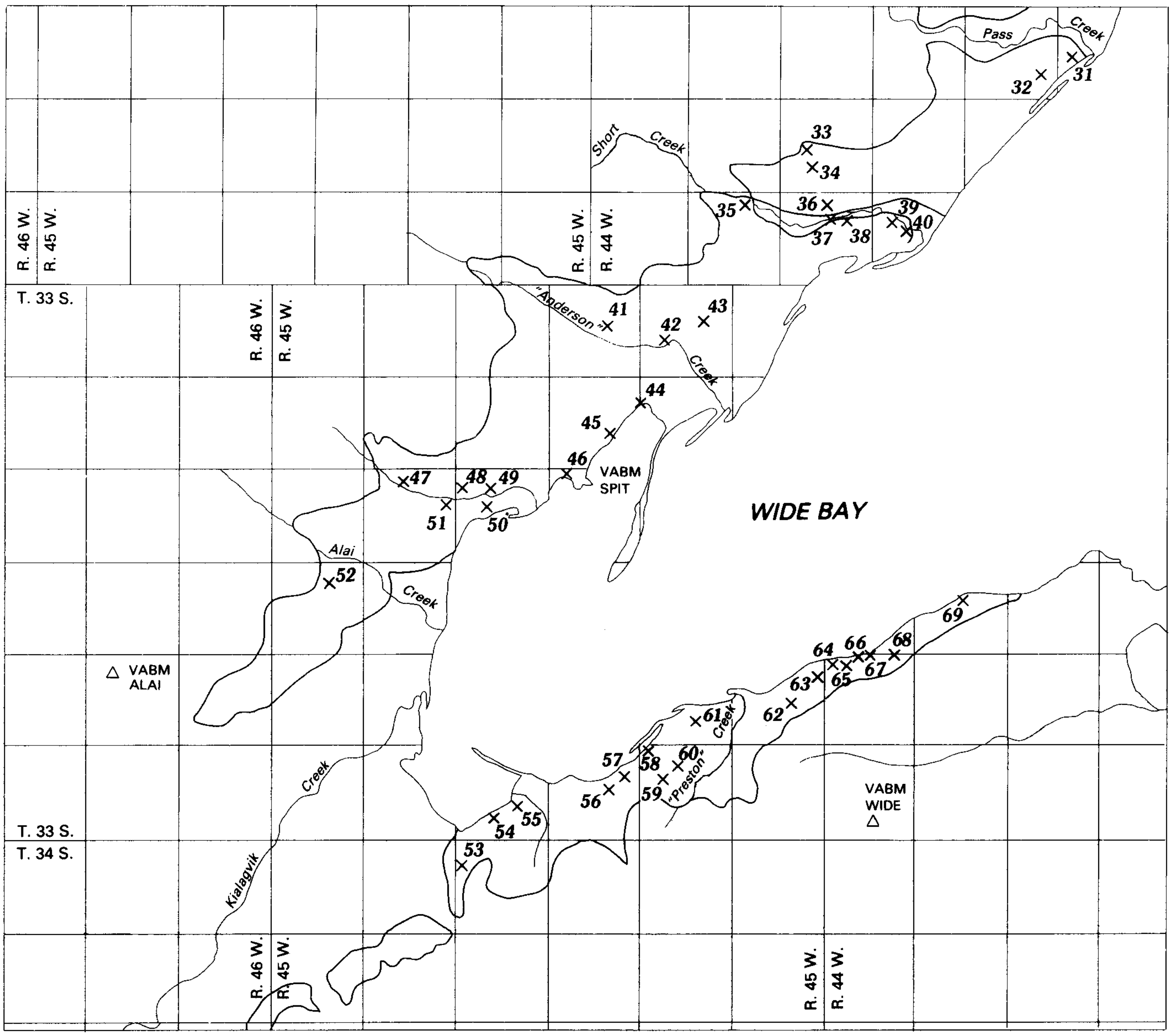


FIGURE 7.—Listed early and middle Bajocian ammonite localities at Wide Bay on the Alaska Peninsula. Heavy lines indicate contact of Kialagvik Formation. Numbers refer to those given in table 5.

TABLE 1.—*Early and middle Bajocian (Middle Jurassic) ammonite genera and subgenera in southern Alaska showing biological relationships and relative numbers available for study*

Family	Subfamily	Genus or subgenus	Number of specimens
Phylloceratidae	Phylloceratinae	*Phylloceras*	3
		Partschiceras	33
	Calliphyloceratinae	*Holcophyloceras*	33
Lytoceratidae	Lytoceratinae	*Lytoceras*	15
Hildoceratidae	Harpoceratinae	*Pseudolioceras*	35
	Grammoceratinae	*Asthenoceras*	4
	Tmetoceratinae	*Tmetoceras*	34
		(Tmetoites)	11
Hammatoceratidae	Hammatoceratinae	*Erycites*	3
		Erycitoides	207
		(Kialagvikes)	57
		Eudmetoceras	6
		(Eudaptetoceras	40
		Hammatoceras	1
		Planammatoceras	4
Sonniniidae		*Sonninia*	16
		(Euhoploceras)	38
		(Papilliceras)	14
		(Alaskinia)	12
		(Sonninites)	2
		Dorsetensia	3
		Fontannesia	1
		Witchellia	11
		Pelekodites	2
Strigoceratidae		*Hebetoxyites*	2
		Strigoceras	2
Haploceratidae		*Lissoceras*	4
Oppeliidae	Oppeliinae	*Bradfordia*	66
		Praeoppelia	8
Otoitidae		*Docidoceras*	1
		(Pseudocidoceras)	53
		Zemistephanus	100
		Otoites	6
		Pseudotoites	10
		Abbasites	5
		Emileia	9
Sphaeroceratidae		*Chondroceras*	79
		Labrinthoceras	13
Stephanoceratidae		*Normannites*	92
		Teloceras	30
		Stemmatoceras	10
		Arkelloceras	1
		Stephanoceras	9
		(Skirroceras)	46
Perisphinctidae		*Leptosphinctes*	1
		Parabigotites	92
Total			1,224

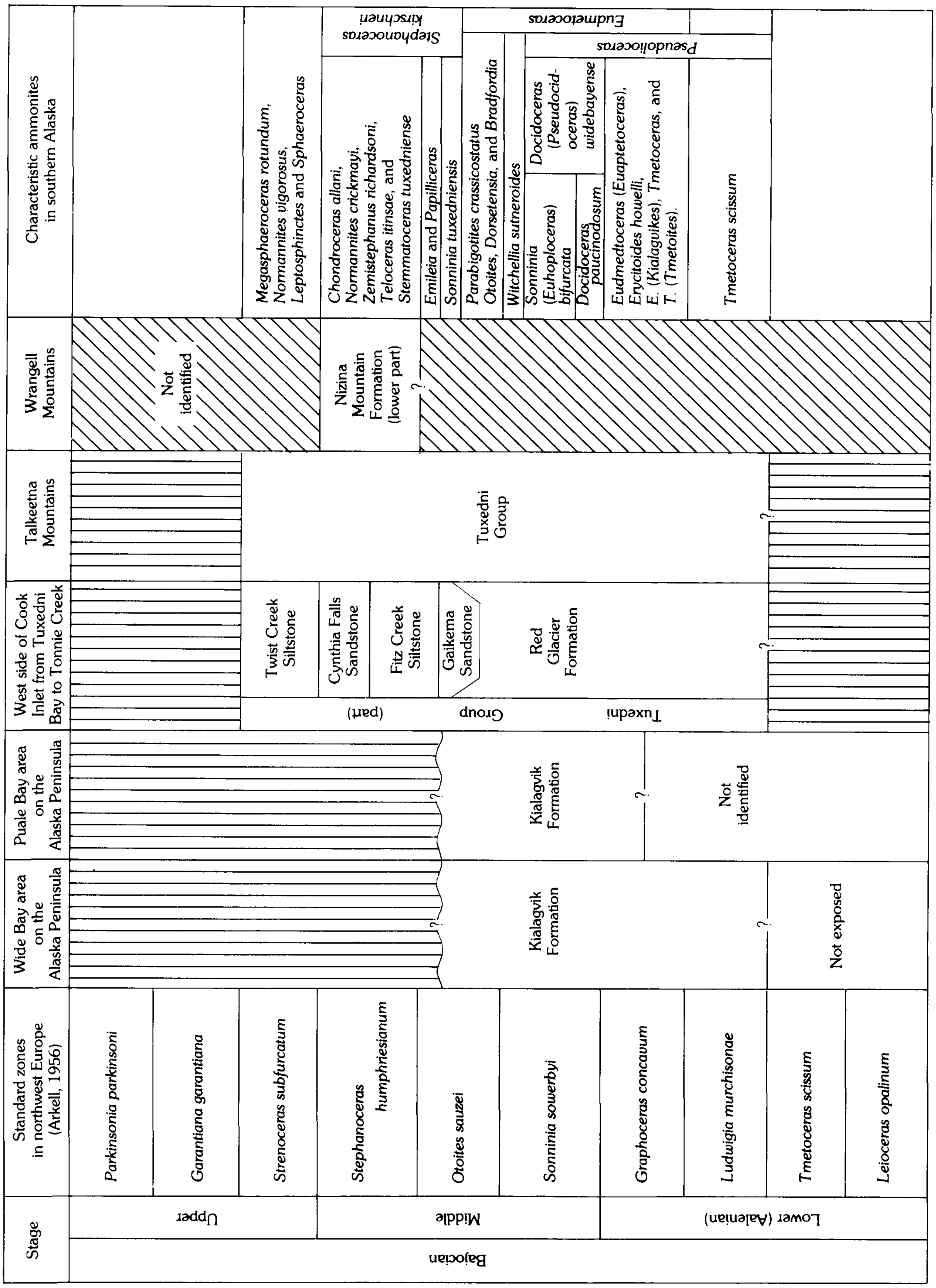


FIGURE 8.—Stratigraphic positions and correlations of Bajocian rocks in southern Alaska.

WEST SIDE OF COOK INLET

Lower and middle Bajocian beds are well exposed on the west side of Cook Inlet between Tuxedni Bay and Iniskin Bay (figs. 4, 9). They are represented from bottom to top by the Red Glacier Formation, the Gaikema Sandstone, the Fitz Creek Siltstone, and the Cynthia Falls Sandstone of the Tuxedni Group (figs. 8-9). These formations in combination thicken southward, from about 4,000 ft (1,219 m) north of Fossil Point on the south shore of Tuxedni Bay to nearly 8,000 ft (2,438 m) near Red Glacier, about 11 mi (17.6 km) southwest of Fossil Point, but more than half of this thickening occurs in the Red Glacier Formation (Detterman and Hartsock, 1966, p. 22, 27, 30, 33). These formations, and the overlying Twist Creek Siltstone of early late Bajocian age constitute a conformable sequence overlain unconformably by the Bowser Formation of early to late Bathonian age (Imlay, 1980, p. 5-11), and underlain with angular unconformity by the Talkeetna Formation of Early Jurassic age. The evidence for the basal unconformity is well shown by exposures along the south shore of Tuxedni Bay north of Fossil Point and near Red Glacier. Farther south, the Red Glacier Formation in many places is in fault contact with older formations, and in other places its lower part is not exposed. Considerably more lithologic and stratigraphic data concerning these formations have been presented by Detterman and Hartsock (1966, p. 20-34, tables 1-7).

PUALE BAY AREA ON THE ALASKA PENINSULA

The lithologic and stratigraphic features of the Kialagvik Formation exposed on the northeast side of Puale Bay have been described by Capps (1922, p. 90-94), Smith and Baker (1924, p. 169-173), Smith (1926, p. 66-72), Martin (1926, p. 182-186), and Kellum, Davies, and Swinney (1945). A summary description of those features has been presented more recently by Imlay and Detterman (1977, p. 607-611). As shown herein on figure 10, the Kialagvik Formation consists from bottom to top of three units. The lower unit is 1,300 ft (396 m) thick, consists mostly of dark-gray-to-black sandy siltstone, but includes many limestone concretions in its upper 850 ft (259 m). The middle unit is about 100 ft (30 m) thick, consists partly of igneous pebbles and boulders, but includes much coarse sandstone. The upper unit is about 500 ft (152 m) thick, consists mostly of gray siltstone, contains some ash and limestone concretions, and weathers gray. The basal beds of the formation near the beach rest sharply on beds of Early Jurassic age, but inland toward Alinchak Bay the basal beds are reported by R. L. Detterman (personal commun., 1981) to pass conformably downward into beds of Early Jurassic age.

WIDE BAY AREA ON THE ALASKA PENINSULA

The Kialagvik Formation exposed along the northwest side of Wide Bay has been described by Kellum, Davies, and Swinney (1945, p. 4-8, figs. 1, 2) mainly on the basis of the sequences on and near Short Creek and Anderson Creek. They note that the formation on Short Creek is about 1,750 ft (533 m) thick, consists mostly of shale, siltstone, and sandy shale but includes some sandstone and conglomerate, and its basal 600 ft (183 m) of beds is older than the basal beds exposed elsewhere near Wide Bay. According to Kellum, Davies, and Swinney, the Kialagvik Formation at Short Creek from top to bottom is divisible into the following lithologic units (fig. 11):

Unit 1, at the top, consists of about 331 ft (91 m) of calcareous concretionary shaly siltstone and sandy shale that includes one bed of limestone about 60 ft (18 m) below the top and one bed of sandstone about 200 ft (61 m) below the top. This unit has furnished *Inoceramus lucifer* Eichwald, a few fragmentary ammonites, and a well-preserved specimen of *Sonninia tuxedniensis* Imlay.

Unit 2 consists of about 128 ft (58 m) of siltstone and sandy shale that contains some concretions, becomes sandier upwards, and contains beds of sandstone at its top and bottom. The upper half of this unit has furnished the ammonite genera *Parabigotites, Bradfordia, Eudmetoceras, Stephanoceras, Stemmatoceras,* and *Arkelloceras.*

Unit 3 consists of about 164 ft (50 m) of blocky dark-gray shale that has not furnished any ammonites.

Unit 4 consists of about 190 ft (58 m) of interbedded sandstone and sandy shale that is coarser toward the top and includes several beds of conglomerate whose pebbles were derived from metamorphic rocks and attain diameters of 75-100 mm. This unit has furnished such ammonites as *Erycitoides howelli* (White), *E. (Kialagvikites) kialagvikensis* (White), *Pseudolioceras whiteavesi* (White), *Tmetoceras kirki* Westermann, and *T. (Tmetoides) tenue* Westermann.

Unit 5 is 366 ft (126 m) thick and is mostly covered. It apparently consists, however, mostly of poorly exposed gray-to-black shale, siltstone, and sandy shale. The unit also includes four widely spaced, fairly well exposed beds of gray sandstone that are interbedded with some sandy shale and have furnished ammonites. Such beds, from 240 to 259 ft (73-79 m) below the top of the unit, have furnished the same kinds of ammonite that occur in unit 4. Similar beds at the base of the unit and also about 328 ft (100 m) higher have furnished the ammonite *Tmetoceras scissum* (Benecke).

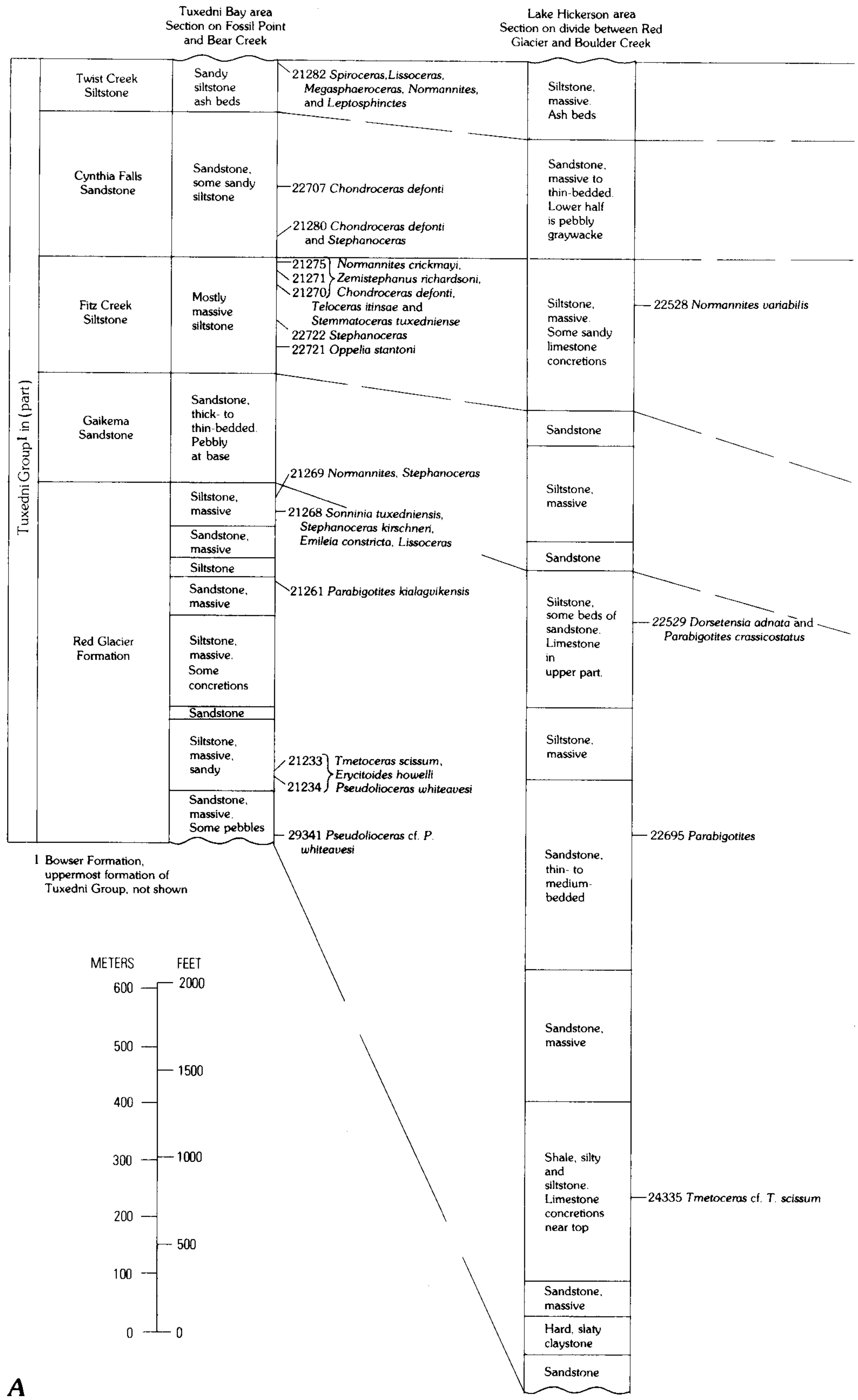
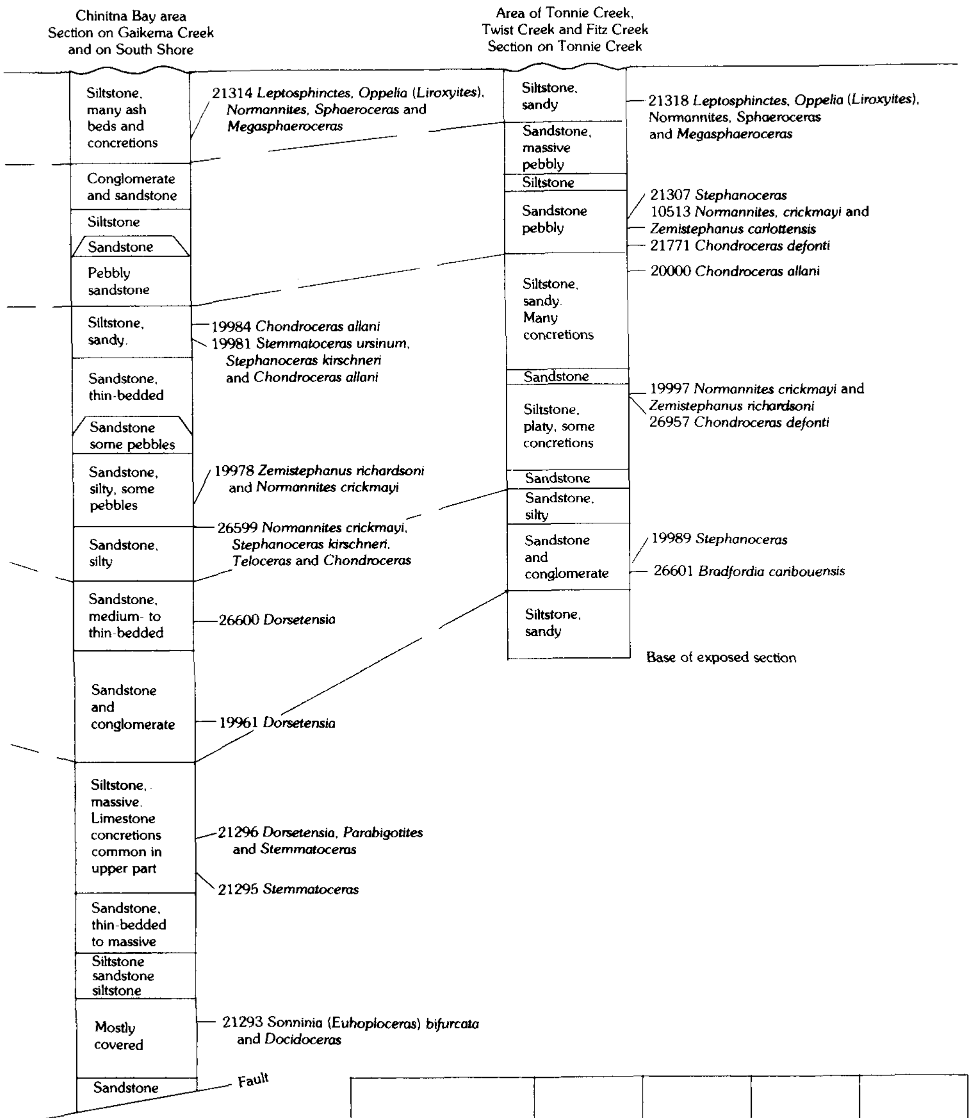


FIGURE 9.—*A*, Stratigraphic positions of some Bajocian ammonite localities west of Cook Inlet between Survey Mesozoic localities. *B*, Chart showing



Formations of Bajocian age west of Cook Inlet	Tuxedni Bay area	Lake Hickerson—Red Glacier area	Chinitna Bay area South Shore and Gaikema Creek	Tonnie Creek-Twist Creek and Fitz Creek area
Twist Creek Siltstone	300 ft 91 m	410 ft 125 m	420 ft 128 m	240 ft 73 m
Cynthia Falls Sandstone	765 ft 232 m	660 ft 201 m	645 ft 197 m	600 ft 183 m
Fitz Creek Siltstone	640 ft 195 m	825 ft 251 m	1275 ft 389 m	1090 ft 332 m
Gaikema Sandstone	600 ft 183 m	880 ft 268 m	850 ft 259 m	500 ft 152 m
Red Glacier Formation	1760 ft 518 m	4540 ft 1385 m	1530 ft+ 466 m+	300 ft+ 91 m+

B

Tuxedni Bay and Iniskin Bay (data from Detterman and Hartsock, 1966). Numbers refer to U.S. Geological
thicknesses of formations in various areas.

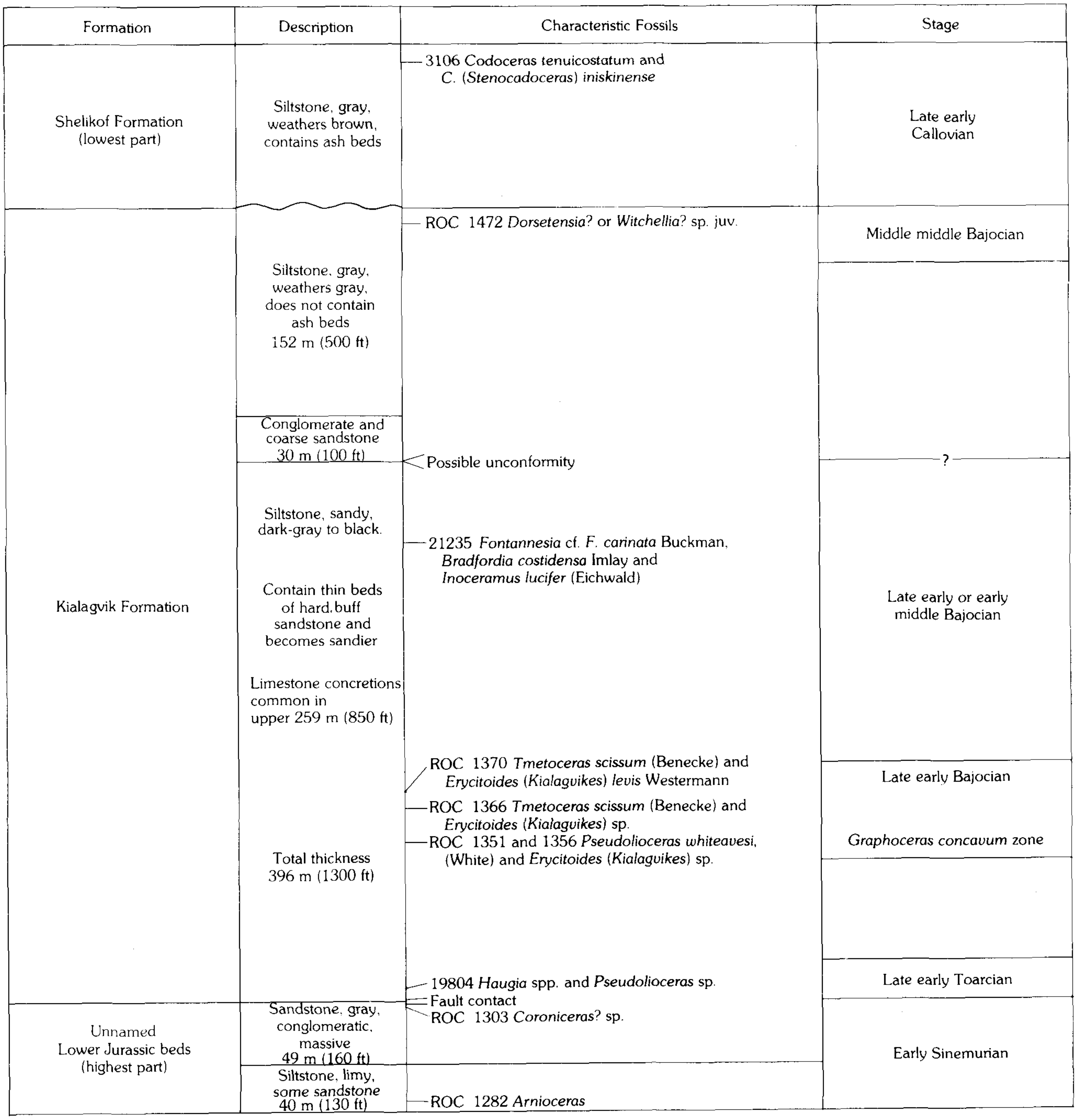


FIGURE 10.—Stratigraphic positions of some Bajocian ammonite localities on the northeast side of Puale Bay on the Alaska Peninsula. Localities marked ROC were collected by the Richfield Oil Company.

The sections measured by Kellum and others (1945, fig. 2) along the northwest side of Wide Bay show that unit 1 of the Short Creek section passes southwestward within 5 km of Anderson Creek, into a sequence consisting mostly of pebbly sandstone. Unit 2, as determined by ammonites, passes southwestward at Anderson Creek into a sequence that consists mostly of siltstone and shaly-to-thin-bedded sandstone but that contains some pebbly beds at its top and some thin coal seams at its base. Unit 3 apparently passes southwestward on Anderson Creek into the lower part of some shaly beds that bear coal seams, but probably passes also into 60 ft (18 m) of beds represented mostly by a covered interval. Unit 4 is represented by cliff-forming conglomeratic sandstone on both creeks.

On an unnamed creek about 9 km (6 mi) southwest of Short Creek and 1.5–2.0 km north of Alai Creek, the Kialagvik Formation near its top bears pebbly sandstone similar in position to that at the top of the formation on Anderson Creek. At least 400 ft (122 m) lower occur nearly 200 ft (61 m) of cliff-forming pebbly beds similar to the beds in unit 4 on Anderson Creek and Short Creek. The intervening beds are poorly exposed, are broken by faults, and are difficult to compare with the sequences exposed farther northeast.

On the southeast side of Wide Bay the same ammonites that are present in unit 2 at Short Creek are present in cliff-forming sandstone northeast of Preston Creek in the NW 1/4 sec. 30, T. 33 S., R. 44 W. (USGS Mesozoic locs. 19822–19825) and in the NE corner of sec. 25, T. 33 S., R. 45 W. (USGS Mesozoic loc. 32290). Southwest of Preston Creek, unit 2 is likewise represented by ammonite-bearing cliff-forming sandstone in the south-central part of sec. 26, T. 33 S., R. 45 W. (USGS Mesozoic loc. 19798) and in the south-central part of sec. 33, T. 33 S., R. 45 W. (USGS Mesozoic locs. 19742 and 19796). This sandstone is characterized faunally by the ammonites *Parabigotites crassicostatus* Buckman and *Bradfordia costidensa* Imlay.

On the southeast side of Wide Bay northeast of Preston Creek occur other beds that are probably equivalent to unit 3 of the Short Creek sequence. These beds consist mostly of fossiliferous shale that bears concretions, include two sandstone beds and some sandy-to-silty beds, and are at least 174 ft (59 m) thick. They are characterized faunally by the ammonites *Docidoceras (Pseudocidoceras) widebayensis* Westermann, *Sonninia (Euhoploceras) bifurcata* Westermann, and many other ammonite taxa (USGS Mesozoic locs. 19862, 19863, 19869, 21251, 21252, 31966, 32292, 32293, 32295, and 32296).

On the southeast side of Wide Bay, about 3 km southwest of the mouth of Preston Creek (loc. 61 on fig. 15), the beds just mentioned are underlain at the base of a high bluff at Shell Oil Co. loc. L154 by beds containing the ammonites *Tmetoceras kirki flexicostatum* Westermann and *T. (Tmetoites)* cf. *T. (T.) tenue* Westermann (1964, p. 354; 1969, p. 12). Such ammonites are characteristic of the upper part of the beds containing *Erycitoides howelli* (White), as in unit 4 of the Short Creek sequence. *E. howelli* (White) itself has been found near the south end of the southeast side of Wide Bay in the SE 1/4 sec. 33, T. 34 S., R. 45 W. at Shell Company loc. L555.

These data indicate that the lithologic units within the Kialagvik Formation change laterally within fairly short distances and, therefore, are difficult to correlate without fossils.

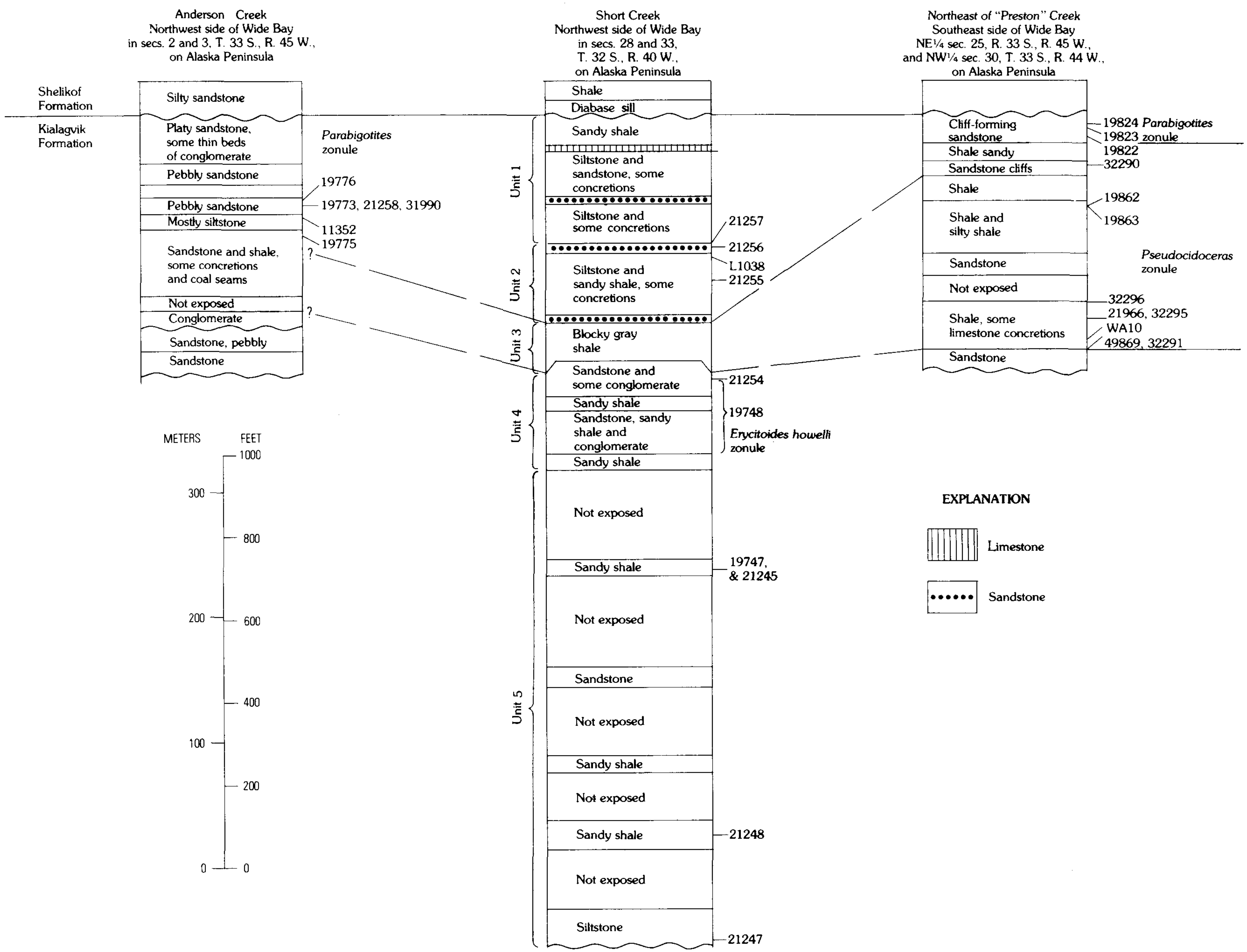
AGES AND CORRELATIONS

WRANGELL MOUNTAINS

The existence of beds of middle Bajocian age in the Wrangell Mountains is based on a few ammonites (fig. 8) representing the genera *Chondroceras*, *Normannites*, and *Teloceras*. These ammonites were collected as float at one place near the base of the Nizina Mountain Formation (USGS Mesozoic loc. 28682).

Of these genera, *Chondroceras* is common nearly worldwide in the *Stephanoceras humphriesianum* zone of the middle Bajocian (Imlay, 1973, p. 19) and is known from beds of late Bajocian age. *Normannites* ranges upward from the uppermost part of the *Otoites sauzei* zone of middle Bajocian age to the *Strenoceras subfurcatum* zone of early late Bajocian age. *Teloceras* ranges upward from the *Stephanoceras humphriesianum* zone to the *Garantia garantiana* zone of the middle late Bajocian (Imlay, 1973, p. 19; Arkell, 1956, p. 483). The presence of *Chondroceras* is good evidence for a late middle Bajocian age. The presence of a species resembling *Teloceras blagdeni* (Sowerby) favors an age assignment not older than the upper part of the *Stephanoceras humphriesianum* zone (Weisert, 1932, p. 185; Arkell, 1956, p. 483). Such an age assignment seems reasonable provided the three genera occur in association.

In addition, another ammonite faunule of slightly younger age has been found at the same locality as the 3 genera just listed as well as at 10 other localities ranging from the base to near the middle of the Nizina Mountain Formation (Imlay, 1980, p. 4). This younger faunule is herein considered to represent the earliest Bathonian rather than the latest Bajocian because (1) it does not contain typical late Bajocian ammonites, such as *Spiroceras*, *Leptosphinctes*, and *Sphaeroceras* (Imlay, 1980, p. 4); (2) it does contain species typical of the earliest Bathonian, such as *Cranocephalites costidensus* (Imlay, 1980, p. 8); and (3) in the Lake Hickerson



Anderson Creek
Northwest side of Wide Bay
in secs. 2 and 3, T. 33 S., R. 45 W.,
on Alaska Peninsula
Short Creek
Northwest side of Wide Bay
in secs. 28 and 33,
T. 32 S., R. 40 W.,
on Alaska Peninsula
Northeast of "Preston" Creek
Southeast side of Wide Bay
NE¼ sec. 25, R. 33 S., R. 45 W.,
and NW¼ sec. 30, T. 33 S., R. 44 W.,
on Alaska Peninsula
Shelikof Formation
Kialagvik Formation
Silty sandstone
Platy sandstone, some thin beds of conglomerate
Pebbly sandstone
Pebbly sandstone
Mostly siltstone
Sandstone and shale, some concretions and coal seams
Not exposed
Conglomerate
Sandstone, pebbly
Sandstone
Parabigotites zonule
19776
19773, 21258, 31990
11352
19775
?
?
Shale
Diabase sill
Sandy shale
Siltstone and sandstone, some concretions
Siltstone and some concretions
Siltstone and sandy shale, some concretions
Blocky gray shale
Sandstone and some conglomerate
Sandy shale
Sandstone, sandy shale and conglomerate
Sandy shale
Not exposed
Sandy shale
Not exposed
Sandstone
Not exposed
Sandy shale
Not exposed
Sandy shale
Not exposed
Siltstone
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
21257
21256
L1038
21255
21254
19748
Erycitoides howelli zonule
19747, & 21245
21248
21247
Cliff-forming sandstone
Shale sandy
Sandstone cliffs
Shale
Shale and silty shale
Sandstone
Not exposed
Shale, some limestone concretions
Sandstone
19824 Parabigotites
19823 zonule
19822
32290
19862
19863
Pseudocidoceras zonule
32296
21966, 32295
WA10
49869, 32291
METERS
FEET
1000
300
800
200
600
400
100
200
0
0
EXPLANATION
Limestone
Sandstone

Ammonites found in the Anderson Creek area are listed from youngest to oldest at the following U.S. Geological Survey Mesozoic localities:

19776 *Bradfordia costidensa* Imlay
19773 *Bradfordia costidensa* Imlay, *Eudmetoceras amplectens* Buckman, *Parabigotites crassicostatus* Imlay, and *Parabigotites kialagvikensis* (Imlay)
21258 *Parabigotites crassicostatus* Imlay and *Eudmetoceras amplectens* Buckman
31990 *Parabigotites* sp.
11352 *Parabigotites crassicostatus* Imlay
19775 *Sonninia* (*Papilliceras*) cf. *S.* (*P.*) *arenata* Quenstedt and *Bradfordia costidensa* Imlay

Ammonites found in the Short Creek area are listed from youngest to oldest at the following U.S. Geological Survey Mesozoic localities:

21257 *Bradfordia costidensa* Imlay, *Otoites* cf. *O. contractus* (J. de C. Sowerby), and *Stephanoceras* (*Skirroceras*) cf. *S.* (*S.*) *leptogyrale* Buckman
21256 *Parabigotites* cf. *P. crassicostatus* Imlay and *Bradfordia* cf. *B. costidensa* Imlay
21255 *Arkelloceras* sp., *Pelekodites*? sp., *Lytoceras* sp., and *Macrophylloceras* sp.
21254 *Pseudolioceras whiteavesi* (White), *Tmetoceras kirki* Westermann, *T. kirki flexicostatum* Westermann, *T.* (*Tmetoides*) *tenue* Westermann, *Erycitoides howelli* (White), *E.* (*Kialagvikes*) *kialagvikensis* (White), and *E.* (*K.*) *spinatus* Westermann
19748 *Erycitoides howelli* (White), *E.* (*Kialagvikes*) *kialagvikensis* (White), *E.* (*K.*) *spinatus* Westermann, *E.* (*K.*) *levis* Westermann, *Pseudolioceras whiteavesi* (White)
19755 *Erycitoides* (*Kialagvikes*) *kialagvikensis* and *Abbasites* sp. juv.
19747 *Erycitoides howelli* (White), *E.* (*Kialagvikes*) *profundus* Westermann, *E. teres* Westermann, *E.* (*K.*) *kialagvikensis* (White), *E.* (*K.*) *levis* Westermann and *Pseudolioceras whiteavesi* (White)
21245 *Pseudolioceras whiteavesi* (White), *Erycitoides howelli* (White), *E. teres* Westermann, *E.* (*Kialagvikes*) *kialagvikensis* (White), *E.* (*K.*) *spinatus* Westermann
21248 *Pseudolioceras* sp., *Tmetoceras scissum* (Benecke)
21247 *Tmetoceras scissum* (Benecke)

In addition, the Shell Oil Companies locality L1038 in the same unit as Mesozoic loc. 21255 includes *Dorsetensis adnata* (Imlay) and *Eudmetoceras amplectens* Buckman (Westermann, 1969, p. 13, 14, 16, 22)

Ammonites found from 1 to 1.5 miles northeast of "Preston" Creek are listed from youngest to oldest at the following U.S. Geological Survey Mesozoic localities plus McMaster University locality WA10.

19824 *Parabigotites crassicostatus* Buckman
19823 *Bradfordia costidensa* Imlay, *Stemmatoceras* sp., and *Parabigotites* cf. *P. crassicostatus* Buckman
19822 *Eudmetoceras amplectens* Buckman

32290 *Parabigotites crassicostatus* Imlay and *P. kialagvikensis* (Imlay)

19862 *Holcophylloceras costisparsum* Imlay, *Praeoppelia oppeliformis* Westermann, *Pseudolioceras fastigatum* Westermann, *P. costistriatum* Westermann, *Sonninia* (*Euhoploceras*) *bifurcata* Westermann, *Docidoceras* aff. *D. longalvum* (Vacek), *D.* (*Pseudocidoceras*) *widebayensis* Westermann, *D.* (*P.*) *camachoi* Westermann, *Pseudotoites* cf. *argentinus* Arkell, and *P. transatlanticus* (Tornquist)
19863 *Praeoppelia oppeliformis* Westermann, *Eudmetoceras* (*Euaptetoceras*) *klimakomphalum discoidale* Westermann, *Docidoceras* (*Pseudocidoceras*) *camachoi* Westermann

32296 *Docidoceras* (*Pseudocidoceras*) *widebayensis* Westermann
31966 *Sonninia* (*Euhoploceras*) *bifurcata* Westermann
32295 *Sonninia* (*Euhoploceras*) *bifurcata* Westermann and *Docidoceras* (*Pseudocidoceras*) cf. *S.* (*E.*) *camachoi* Westermann
32292 *Pseudolioceras maclintochi fastigatum* Westermann, *Eudometoceras* (*Euapatetoceras*) *klimakomphalum discoidale* Westermann, *Praeoppelia oppeliformis* Westermann
WA10 *Holcophylloceras costisparsum* Imlay, *Pseudlioceras costistriatum* Westermann, *Sonninia* (*Euhoploceras*) *bifurcata* Westermann, *S.* (*Alaskinia*) *alaskensis* Westermann, *Witchellia sutneroides* Westermann, *Docidoceras* (*Pseudocidoceras*) *widebayense* Westermann, *D.* (*P.*) *camachoi* Westermann

FIGURE 11.—Statigraphic positions of some Bajocian ammonite localities near Wide Bay on the Alaska Peninsula and lists of ammonites found at Anderson Creek, Short Creek, and "Preston" Creek.

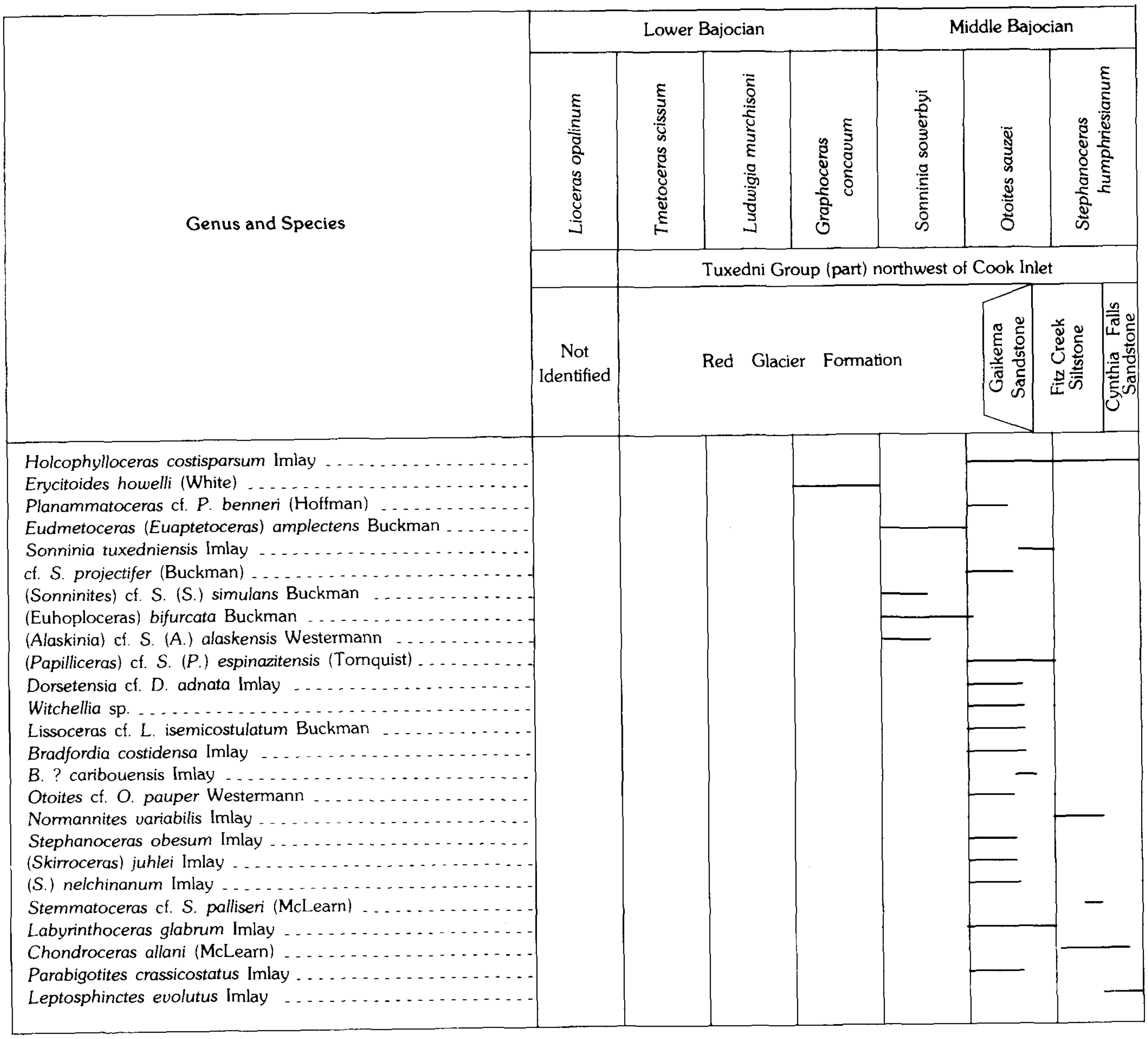


FIGURE 12.—Stratigraphic and chronologic correlations of some early and middle Bajocian ammonites present in the Talkeetna Mountains with ammonites present in the Tuxedni Group west of Cook Inlet.

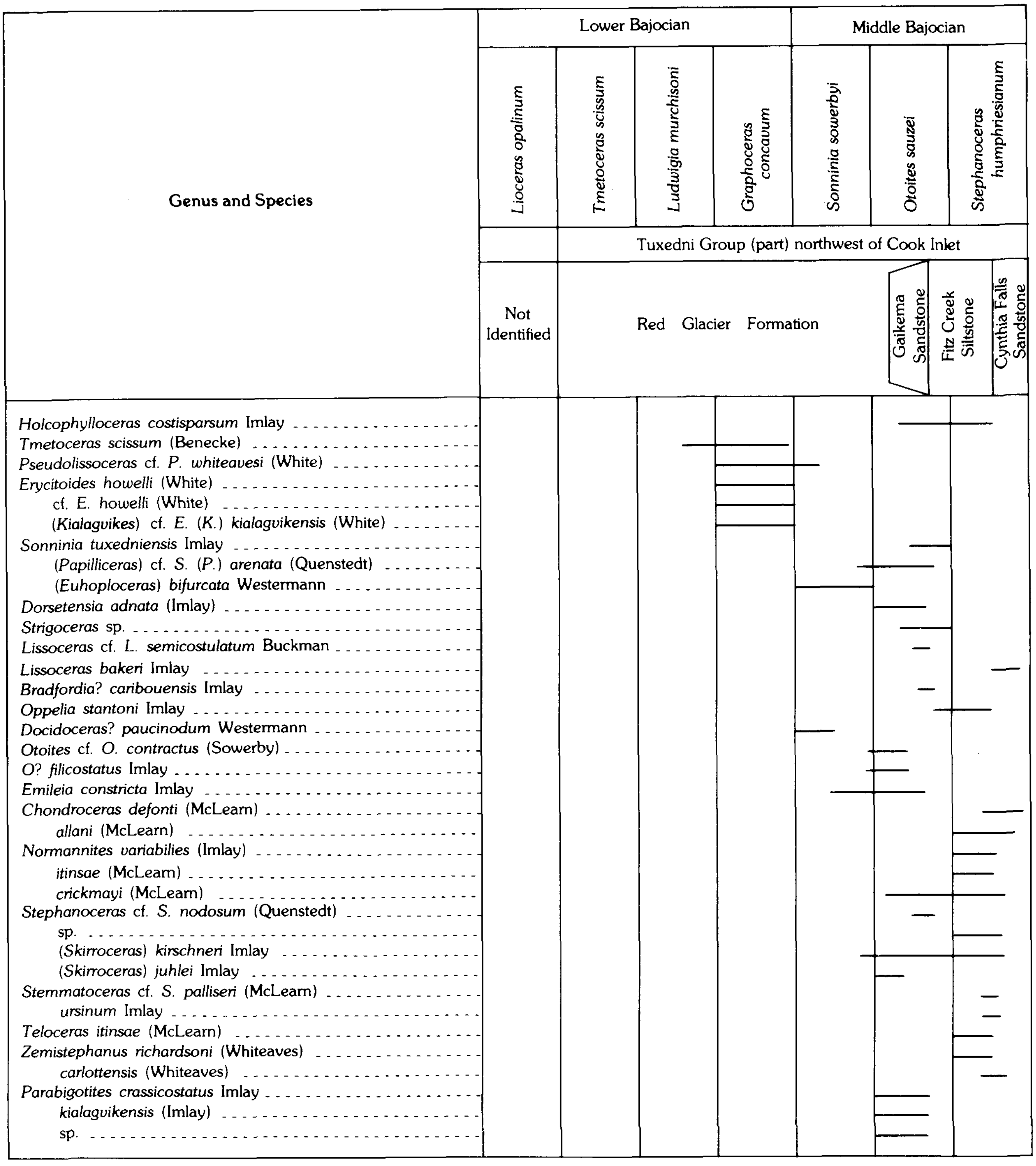


Figure 13.—Stratigraphic and chronologic correlations of some early and middle Bajocian ammonites present along the west side of Cook Inlet between the Fitz Creek and Tuxedni Bay areas in south-central Alaska.

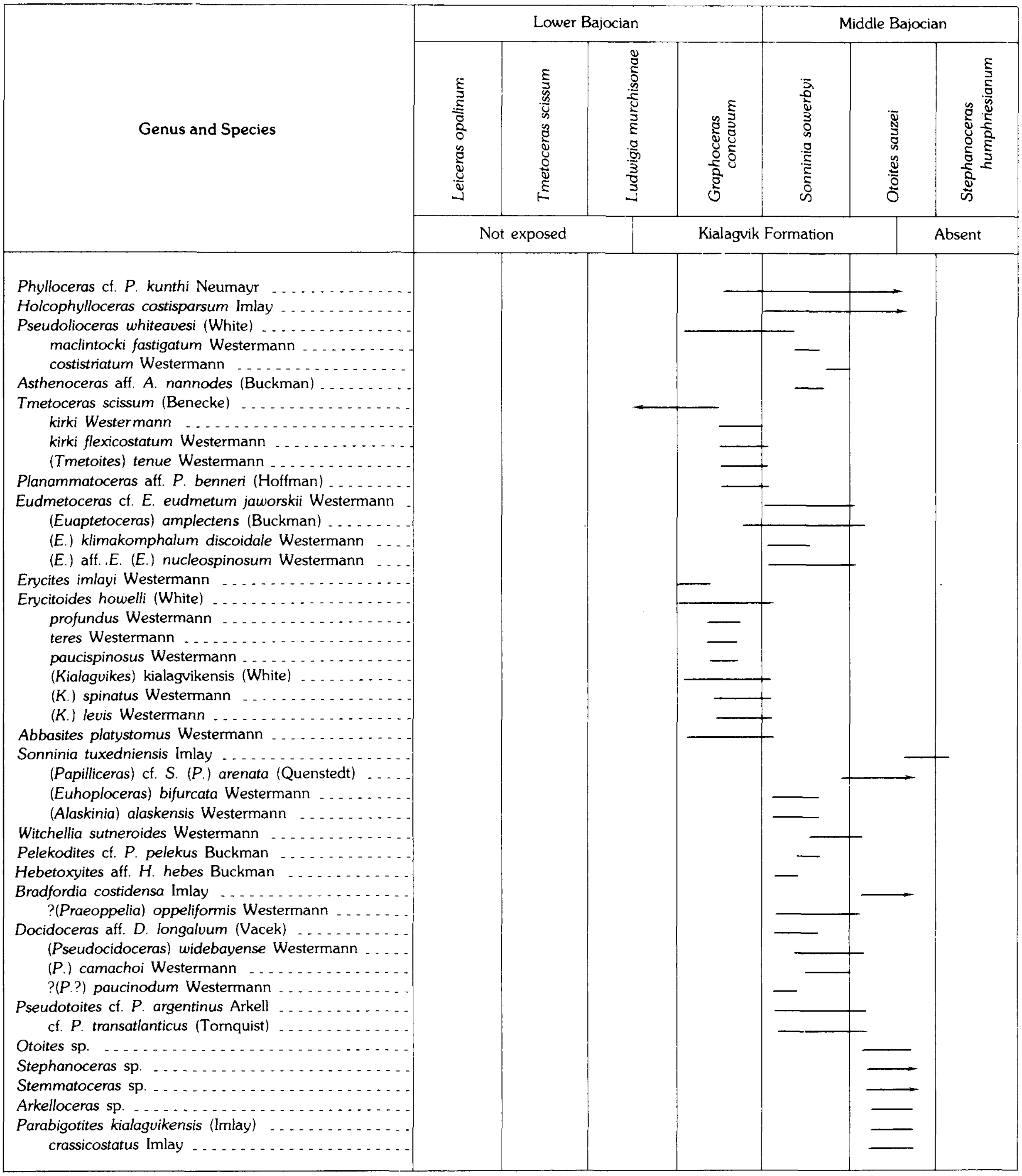


FIGURE 14.—Stratigraphic and chronologic correlations of some early and middle Bajocian ammonites present near Wide Bay on the Alaska Peninsula.

Stage	Substage	Standard zones in northwest Europe (Arkell, 1956)	Characteristic ammonites in the Wide Bay area on the Alaska Peninsula	Characteristic ammonites in the west side of Cook Inlet between Tuxedni Bay and Iniskin Bay	Ranges	Characteristic ammonites in the Talkeetna Mountains
Bajocian	Upper	*Parkinsonia parkinsoni*				
		Garantiana garantiana				
		Strenoceras subfurcatum		*Megasphaeroceras rotundum*, *Normannites vigorosus*, *Leptosphinctes*, *Sphaeroceras*, and *Liroxyites*		*Leptosphinctes*
	Middle	*Stephanoceras humphriesianum*		*Chondroceras allani* *Normannites crickmayi*, *Zemistephanus richardsoni*, *Teloceras itinsae*, and *Stemmatoceras tuxedniense*	*Stephanoceras kirschneri*	*Chondroceras allani*, *Normannites variabilis*, *Stemmatoceras*
		Otoites sauzei	*Sonninia tuxedniensis* *Parabigotites crassicostatus*, *Otoites*, *Bradfordia costidensa*, and *Stephanoceras*	*Emileia* and *Sonninia* (*Papilliceras*) *Sonninia tuxedniensis* *Parabigotites crassicostatus*, *Stemmatoceras*, and *Dorsetensia adnata*	*Stephanoceras kirschneri*; *Eudmetoceras*	*Parabigotites crassicostatus*, *Otoites pauper*, *Bradfordia costidensa*, *Stephanoceras juhlei*, *Dorsetensia*, *Witchellia*, *Lissoceras*, and *Sonninia*
		Sonninia sowerbyi	*Witchellia sutneroides* *Sonninia* (*Euhoploceras*) *bifurcata* *Docidoceras* (*Paucinodosum*) *Docidoceras* (*Pseudocidoceras*) *widebayense*	*Sonninia* (*Euhoploceras*) *bifurcata*	*Eudmetoceras*; *Pseudolioceras*	*Sonninia* (*Euhoploceras*) *bifurcata*, *S.* (*Alaskoceras*), and *S.* (*Sonninites*)
	Lower (Aalenian)	*Graphoceras concavum*	*Erycitoides howelli*, *E.* (*Kialagvikes*) *kialagvikensis*, *Tmetoceras* (common), *Abbasites* (rare), and *Eudmetoceras* (*Euaptetoceras*)	*Erycitoides howelli* and *Tmetoceras scissum*	*Eudmetoceras*; *Pseudolioceras*	*Erycitoides howelli*
		Ludwigia murchisonae	*Tmetoceras scissum* and *Pseudolioceras*	*Tmetoceras scissum*	*Pseudolioceras*	
			?	?		
		Tmetoceras scissum				
		Leioceras opalinum				

FIGURE 15.—Correlations and comparisons of Bajocian ammonite faunas in southern Alaska.

area west of Cook Inlet the species *C. costidensus* is associated with the Bathonian genera *Siemeradzkia*.

TALKEETNA MOUNTAINS

In the Nelchina area of the Talkeetna Mountains, ammonites of latest early Bajocian to early late Bajocian ages have been found in the Tuxedni Group (figs. 8, 12, 15). The latest early Bajocian zone of *Graphoceras concavum* is represented by one specimen of *Erycitoides howelli* (White) obtained as float from the basal 99 ft (30 m) of sandstone at Sheep Creek (USGS Mesozoic loc. 24135). The next younger zone of *Sonninia sowerbyi* is represented by *Sonninia (Euhoploceras) bifurcata* Westermann obtained from the upper part of the same sandstone (USGS Mesozoic loc. 26723). The next younger zone of *Otoites sauzei* is represented in gray siltstone by *Parabigotites crassicostatus* Imlay (USGS Mesozoic locs. 24113 and 27577), by *Bradfordia costidensa* Imlay (USGS Mesozoic locs. 31728, 24113, 24215, and 25345), by *Otoites* (USGS Mesozoic loc. 24113), and by *Stephanoceras juhlei* Imlay (USGS Mesozoic locs. 24113 and 24120). The next younger zone of *Stephanoceras humphriesianum* is represented in gray siltstone by *Normannites variabilis* Imlay (USGS Mesozoic loc. 8567), *Stemmatoceras* (USGS Mesozoic loc. 30280), *Chondroceras* (USGS Mesozoic locs. 8567, 30280, 30594), and *Leptosphinctes* (USGS Mesozoic loc. 8567). Above follows reddish-gray siltstone that contains ammonites of early late Bajocian age, such as *Megasphaeroceras*, *Sphaeroceras*, and *Cadomites*, in association with *Normannites* and *Stemmatoceras* (Imlay, 1952, p. 978, chart 8C opposite p. 998; Imlay, 1982, p. 1, 7–11).

Among the fossil collections listed, only those from USGS Mesozoic localities 24175 and 26723 are definitely from the lower sandstone unit of the Tuxedni Group. The others are from the upper siltstone unit, with the possible exceptions of USGS Mesozoic localities 27577, 24113, and 31728. As the fossils at the last two localities are on landslide scars and the word "sandstone" is not used in their locality descriptions, the fossils could be from the upper siltstone unit.

In the Boulder Creek area of the Talkeetna Mountains an incomplete Bajocian sequence about 550 ft (168 m) thick was measured on a divide at the head of a tributary of Boulder Creek and 6 mi (9.6 km) N. 20° E. of the junction of that tributary with East Boulder Creek (Imlay, 1980, fig. 3). That incomplete sequence, representing the upper part of the Tuxedni Group, contains ammonites ranging in age from middle middle Bajocian to early late Bajocian. From the uppermost 30 ft (9 m) of orange-gray siltstone was collected the ammonite *Megasphaeroceras* of early late Bajocian age. From 69 to 133 ft (21 to 44 m) lower in the sequence at USGS Mesozoic loc. 30281 was collected a specimen of *Witchellia*, which genus in Europe ranges through most of the zone of *Sonninia sowerbyi* and all of the zone of *Otoites sauzei*.

Elsewhere in the Boulder Creek area the middle Bajocian zone of *Otoites sauzei* is represented at USGS Mesozoic loc. 30582 by an occurrence of *Sonninia tuxedniensis* Imlay, which west of Cook Inlet occurs in the upper part of the Red Glacier Formation. In addition, the zone of *Stephanoceras humphriesianum* is represented at USGS Mesozoic locs. 30594 and 8567 by *Chondroceras allani* (McLearn), which west of Cook Inlet occurs in the Fitz Creek Siltstone and in the overlying Cynthia Falls Sandstone. Furthermore, the association of that taxon with *Normannites variabilis* Imlay and *Leptosphinctes evolutus* Imlay at USGS Mesozoic loc. 8567 is good evidence for correlation with only the upper part of the zone of *Stephanoceras humphriesianum*.

The ages of the early and middle Bajocian ammonites that have been found in the Talkeetna Mountains are shown herein on figures 12 and 15. Concerning the taxa listed on figure 12, the following name changes should be noted:

1. *Planammatoceras* aff. *P. berneri* (Hoffman) was originally described as *Sonninia* cf. *S. patella* Waagen by Imlay (1964, p. B33, pl. 3, figs. 2–4), but was revised by Westermann (1969, p. 24).
2. *Eudmetoceras (Euaptetoceras) amplectens* Buckman was originally described as *Witchellia? aguilonia* Imlay (1964, p. B35, pl. 4, figs. 1–4, fig. 9, pl. 5, figs. 4, 7–9), but was revised by Westermann (written commun., 1964).
3. *Sonninites* cf. *S. simulans* Buckman was originally described as *Witchellia* cf. *W. laeviuscula* (J. de C. Sowerby) by Imlay (1964, p. B35, pl. 7, figs. 1–5).
4. *Sonninia (Euhoploceras) bifurcata* Westermann was originally described as *Sonninia?* n. sp. undet. by Imlay (1964, p. B33, pl. 4, figs. 5, 6, 10–12), but was revised by Westermann (1969, p. 94).
5. *Sonninia (Alaskinia)* cf. *S. (A.) alaskensis* Westermann was originally described as *Sonninia* cf. *S. nodata* Buckman by Imlay (1964, p. B33, pl. 2, figs. 1, 2), but was revised by Westermann (1969, p. 24, 103).

WEST SIDE OF COOK INLET BETWEEN TUXEDNI BAY AND INISKIN BAY

The uppermost lower Bajocian zone of *Graphoceras concavum* is fairly well represented on the south side of Tuxedni Bay (see figs. 9, 13, 15). North of Fossil Point it is represented by an association of *Tmetoceras scissum* (Benecke), *Erycitoides howelli* (White), and *Pseudolioceras whiteavesi* (White) at USGS Mesozoic localities 21233 and 21234, which occur from 150 to 480 ft (46 to 146 m) above the base of the Red Glacier Formation (see fig. 9). In the Lake Hickerson area, about 11 mi (17.6 km) southwest of Fossil Point, *Tmetoceras scissum* (Benecke) occurs at USGS Mesozoic locality 24335 from 900 to 1,100 ft (273 to 334 m) above the base of the Red Glacier Formation. Considerably farther south, on the Iniskin Peninsula, the ammonite *Erycitoides (Kialagvikes)* cf. *E. (K.) kialagvikensis* (White) (Mesozoic loc. 21244F) occurs in a well core drilled at a depth of 5,495-5,515 ft (1,675-1,681 m) in Iniskin Bay Association well 1 (fig. 5). These ammonites in association favor an age assignment to the latest early Bajocian (Westermann, 1964, p. 345, 346, fig. 5; 1969, p. 15, 18), although in southern Alaska *Pseudolioceras* ranges a little higher (Westermann, 1969, p. 17, 52-58) into beds characterized by *Sonninia (Euhoploceras) bifurcata* Westermann, and *Tmetoceras* ranges throughout the lower Bajocian.

The ages of the middle Bajocian ammonites west of Cook Inlet have been discussed in previous publications (Imlay, 1964, p. 10-14; Imlay, 1973, p. 32, 33; Dettermann and Hartsock, 1966, p. 23, 28, 31, 34) and are shown herein in figures 13 and 15.

Concerning the taxa listed on figure 13, *Dorsetensia adnata* (Imlay) was originally described as *Witchellia adnata* Imlay (1964, p. B34, pl. 6, figs. 6-10), and *Parabigotites kialagvikensis* (Imlay), as *Normannites kialagvikensis* Imlay (1964, p. B43, pl. 13, figs. 1-8, 10, 11, 17).

PUALE BAY AREA

The Kialagvik Formation present near and on the beach along the northeast side of Puale Bay ranges in age from early Toarcian near its base to middle Bajocian near its top (figs. 8 and 10). These ages are based on the presence of (1) the early late Toarcian ammonite *Haugia* 30 ft (9 m) above the base of the formation (USGS Mesozoic loc. 19804), (2) the early Bajocian ammonites *Tmetoceras* and *Erycitoides (Kialagvikes)* 300-400 ft (122-152 m) above the base of the formation, or 900-950 ft (244-274 m) below the massive conglomerate (ROC locs. 1351, 1366, and 1370), (3) the middle Bajocian ammonites *Bradfordia costidensa* Imlay and *Fontannesia* cf. *F. carinata* Buckman about 200 ft (61 m) below the massive conglomerate (USGS Mesozoic loc. 21235), and (4) *Dorsetensia?* or *Witchellia?* of probable late middle Bajocian age near the top of the formation and about 500 ft (152 m) above the massive conglomerate (Imlay and Detterman, 1977, p. 609-611).

WIDE BAY AREA

The ammonites found in the Kialagvik Formation in the Wide Bay area can be grouped into at least four and perhaps five faunal subdivisions, or zonules, which from the base up include (1) *Tmetoceras scissum*, (2) *Erycitoides howelli*, (3) *Docidoceras (Pseudocidoceras) widebayense*, (4) *Parabigotites crassicostatus*, and, possibly, (5) *Sonninia tuxedniensis* (figs. 8, 11, 14, and 15).

The *Tmetoceras scissum* zonule is represented n the lower 328 ft (100 m) of the Kialagvik Formation exposed on Short Creek only by *Tmetoceras scissum* (Benecke) and *Pseudolioceras* sp. Of these genera, *Tmetoceras* in Eurasia ranges from the zones of *Leioceras opalinum* to *Graphoceras concavum*, inclusive. Pseudolioceras ranges from the *Hildoceras bifrons* zone in the upper Toarcian to the *Sonninia sowerbyi* zone in the lower Bajocian. As *Tmetoceras scissum* (Benecke) in southern Alaska occurs only a little below the beds characterized by *Erycitoides howell*, it probably is equivalent in age to the zones of *Ludwigia murchisonae* and *Graphoceras concavum* of northwest Europe.

The zonule of *Erycitoides howelli* is characterized throughout by many occurrences of *E. howelli* White, *E. (Kialagvikes) kialagvikensis* (White), and *Pseudolioceras whiteavesi* (White), and by rare occurrences of *Abbasites platystomus* Westermann and *Eudmetoceras (Euaptetaoceras) amplectens* Buckman. *Erycitoides howelli* is associated in the lower part of its range with rare occurrences of *Erycites imlayi* Westermann and some occurrences of *Tmetoceras;* in only the middle part by many occurrences of *Erycitoides profundus* Westermann and *E. teres* Westermann and a few occurrences of *E. paucispinosus* Westermann; in the middle to upper parts by *E. (Kialagvikes) spinatus* Westermann; and in only the upper part by a few occurrences of *Eudmetoceras* cf. *E. eudmetum jaworskii* Westermann, *E. nuleospinosum* Westermann, *Tmetoceras kirki* Westermann, *T. kirki flexicostatum* Westermann, and *T. (Tmetoites) tenue* Westermann (Westermann, 1964, p. 345-352, figs. 3 and 5).

Based on these stratigraphic occurrences and on an abundance of well-preserved ammonites, the faunal subdivision characterized by *E. howelli* was raised by Westermann (1964, p. 345-352, fig. 3) to the rank of a zone and was divided into three subzones or zonules. Of these, the lower zonule is characterized by an abundance of *E. howelli* and by some *Tmetoceras;* the middle zonule, by *Erycitoides profundus* and *E. teres;* and the upper zonule, by *Tmetoceras tenue* and *T. flexicostatum.* This division is probably valid, but needs to be checked by more field work. Furthermore, the name *Erycitoides howelli* cannot be applied to both a zone and a subzone, as was done by Westermann (1964, p. 345).

The beds characterized by these ammonites are correlated by Westermann (1964, p. 346) with the upper part of the lower Bajocian of Europe and, probably, with the zone of *Graphoceras concavum*, as is shown by the presence of *Tmetoceras*, which is not known above the *concavum* zone in Europe, and of *Eudmetoceras (Euaptetoceras)*, a subgenus that in Europe ranges from the middle of the *Ludwigia murchinsonae* zone into the lower fourth of the *Sonninia sowerbyi* zone (see Imlay, 1973, p. 19, 31).

The *Docidoceras (Pseudocidoceras) widebayense* zonule, identified to date only on the southeast side of Wide Bay, is characterized throughout its lower 372 ft (114 m) by an association of the following ammonite species:

Holcophylloceras costisparsum Imlay
Pseudolioceras fastigatum Westermann
P. maclintocki (Haughton)
P. costistriatum Westermann
Asthenoceras cf. *A. nannodes* Buckman
Planammatoceras aff. *P. benneri* Hoffman
Sonninia (Euhoploceras) bifurcata Westermann
S. (Alaskinia) alaskensis Westermann
Witchellia sutneroides Westermann
Fontannesia intermedia Imlay
Praeoppelia oppeliformis Westermann
Docidoceras (Pseudocidoceras) widebayense Westermann
cf. *D. (P.) widebayense* Westermann
D. (P.) camachoi Westermann
D.? (P.?) pauchinodosum Westermann
Eudmetoceras (Euaptetoceras) discoidale Westermann
Pseudotoites cf. *P. argentinus* Arkell
P. P. transatlanticus (Tornquist)

The beds characterized by these ammonites were correlated by Westermann (1969, p. 20-22, 26) with the European zone of *Sonninia sowerbyi* based on the association of the taxa *Pseudolioceras, Sonninia (Euhoploceras), Witchellia,* and *Docidoceras* and on the absence of such taxa as *Chondroceras, Normannites,* and *Stemmatoceras* (Imlay, 1973, p. 19, 21, 31).

The *Parabigotites crassicostatus* zonule is characterized throughout by an association of the following taxa:

Phylloceras cf. *P. kunthi* Neumayr
Holcophylloceras costisparsum Imlay
Eudmetoceras amplectens Buckman
Sonnina (Papilliceras) cf. *S. (P.) arenata* (Quenstedt)
Dorsetensia adnata (Imlay)
Bradfordia costidensa Imlay
Otoites cf. *O. contractus* (J. de C. Sowerby)
Stephanoceras (Skirroceras) cf. *S. (S.) leptogyrale* Buckman
Stemmatoceras sp.
Arkelloceras sp.
Parabigotites kialagvikensis (Imlay)
P. crassicostatus Imlay
P. cf. *P. crassicostatus* Imlay

The *Parabigotites crassicostatus* zonule is characterized by many occurrences of *Eudmetoceras amplectens* Buckman, *Bradfordia costidensa* Imlay, *Parabigotites crassicostatus* Imlay, and *P. kialagvikensis* (Imlay). Among the other taxa present, *Sonninia (Papilliceras)* has been found at three localities and the other genera at only one or two localities.

The ammonite zonule characterized by *Parabigotites crassicostatus* Imlay and *Bradfordia costidensa* Imlay has been found elsewhere in southern Alaska on the west side of Cook Inlet and in the Talkeetna Mountains. West of Cook Inlet those taxa occur in the upper part of the Red Glacier Formation at stratigraphic positions ranging from 252 to 654 ft (77 to 214 m) below its top (Imlay, 1964, p. B10-B12). In both areas the beds containing those ammonites have been correlated with the lower to middle parts of the zone of *Otoites sauzei* by the presence of such genera as *Sonninia, Dorsetensia,* and *Lissoceras* and by their occurrence below such ammonites as *Normannites* and *Chondroceras.*

The highest beds in the Kialagvik Formation above those containing *Parabigotites* are dated by the presence of *Inoceramus lucifer* Eichwald as being not younger than the zone of *Otoites sauzei* in Europe. That correlation is based on the fact that west of Cook Inlet, *I. lucifer* ranges through the Red Glacier Formation into the Gaikema Sandstone but no higher; and that the Gaikema Sandstone on the basis of ammonites is correlated with the upper part of the zone of *Otoites sauzei* (Imlay, 1964, p. B7, B12).

The highest beds in the Kialagvik Formation could be dated also by the presence of one specimen of *Sonninia tuxedniensis* Imlay, collected at the southwest end of Wide Bay from a sandstone unit exposed on a creek that enters the bay from the northwest about 1 mi north of Alai Creek (USGS Mesozoic loc. 10809). The same species of *Sonninia* has been found elsewhere in southern Alaska west of Cook Inlet and also in the Talkeetna Mountains above beds containing *Parabigotites.* West of Cook Inlet in the Tuxedni Bay area it has been collected in place from 100 to 230 ft (30.5 to 70 m) below the top of the Red Glacier Formation and is possibly represented 562 ft (172 m) below the top of the Red Glacier Formation (Imlay, 1964, p. B11). In the Tuxedni Bay area it has also been reported from the upper fourth of the Fitz Creek Siltstone on the basis of four specimens from two localities. Collections from one of these localities (USGS Mesozoic loc. 2999) are definitely float and from the other locality (USGS Mesozoic loc. 3000) include one specimen that appears to be worn and could be float (Imlay, 1964, p. B11, B13, B33). Evidently both stratigraphic and faunal evidence favors correlation of the highest beds in the Kialagvik Formation above the *Parabigotites crassicostatus* zonule with the highest few hundred feet of the Red Glacier Formation, which itself is correlated with the upper part of the zone of *Otoites sauzei* (Imlay, 1964, p. B7, B12; 1973, p. 10, 32).

The Kialagvik Formation is definitely represented in surface exposures at Wide Bay by one fairly well preserved specimen (see pl. 1, figs. 5, 6) of *Hammatoceras* of latest Toarcian age and by several float fragments of *Erycitoides* of late early Bajocian age (USGS Mesozoic loc. 10806). Those genera, judging by the faunal sequence at Puale Bay, are separated stratigraphically by beds at least 300 ft (91 m) thick. Their association at USGS Mesozoic loc. 10806 could be related to the presence of a fault that is uplifted on its south side and has possibly brought rocks of late Toarcian age to the surface. Their association could also be related to erosion of beds of late Toarcian age at Wide Bay during times when sea level was appreciably lower than it is today, such as occurred in Alaska during major glacial advances (Karlstrom, 1964, pl. 7) of Late Tertiary time.

AMMONITE FAUNAL SETTING

The early and middle Bajocian ammonites found in southern Alaska belong mostly to 20 genera that are common in Europe and occur nearly worldwide, except possibly in the Arctic region. Ammonite genera or subgenera that are characteristic of the Pacific region include *Alaskinia, Pseudotoites, Praeoppelia, Arkelloceras, Parabigotites, Pseudocidoceras,* and probably *Erycitoides.* The faunal succession in southern Alaska differs from that in Europe by the absence of any genera representing the Graphoceratidae.

GEOGRAPHIC DISTRIBUTION

Early and middle Bajocian ammonites have been found at many localities in southern Alaska, as described by the writer in 1964 and by Gerd Westermann in 1964 and 1969. Collections made subsequently in the Talkeetna and Wrangell Mountains have provided much new locality data, as shown in detail in table 2.

In contrast, the region west of Cook Inlet between Tuxedni Bay and Iniskin Bay has furnished very few fossil collections since the middle Bajocian ammonites of that area were described by the writer in 1964 (USGS Prof. Paper 418-B). As the locality descriptions concerning those ammonites are readily available to the reader (Imlay, 1964, p. B22–B29), only those localities in that area that have furnished early Bajocian ammonites are described herein (table 3, in part). The few ammonites found at Puale Bay are also listed in table 3. The many ammonites found near Wide Bay are listed in table 4. The geographic location and stratigraphic positions of all the fossil localities thus listed are described herein in table 5. The geographic postions of most of those localities are shown also, in figures 2–7.

SYSTEMATIC DESCRIPTIONS

Family Hildoceratidae Hyatt, 1867

Genus Pseudolioceras Buckman, 1889

Pseudolioceras cf. P. whiteavesi (White)

Plate 2, figure 11

cf. *Ammonites (Amaltheus) whiteavesi* White, 1889. U.S. Geol. Survey Bull. 51, p. 69, pl. 13, figs. 1–5.

cf. *Pseudolioceras mclintocki whiteavesi* (White), Westermann, 1964, Bulls. American Paleontology, v. 47, no. 216, p. 421–425, pl. 68, fig. 2, pl. 69, figs. 1–6, pl. 70, figs. 1–4, pl. 71, figs. 1–2, text figs. 30–31.

Two laterally crushed, weathered specimens resemble *Pseudolioceras mclintocki whiteavesi* (White) in shape, coiling, strongly falcoid ribs, a fairly high keel, and the presence in one specimen of a slightly raised umbilical edge.

Figured specimen.—USNM 336000.

Occurrence.—Red Glacier Formation, silty sandstone on shoreline overlying Lower Jurassic volcanic rocks of the Talkeetna Formation at USGS Mesozoic loc. 29341. In SE cor. NE¼SW¼ sec. 15, T. 1 N., R. 20 W., Kenai (A-8) quad., on southwest side of Tuxedni Bay, west of Cook Inlet.

Genus Asthenoceras Buckman, 1899

Asthenoceras cf. A. delicatum Imlay

Plate 1, figures 1, 2

cf. *Asthenoceras* sp. aff. *A. nannodes* Buckman, Westermann, 1969, p. 61, pl. 14, figs. 1–7.

cf. *Asthenoceras delicatum* Imlay, 1973, p. 55, pl. 3, figs. 1–32, pl. 4, figs. 3–6.

The genus *Asthenoceras* is represented at USGS Mesozoic loc. 19862 in the Wide Bay area by four specimens that were collected at or near the place (WA10) where *Asthenoceras* was collected by Westermann (1969, p. 61, pl. 14, figs. 1–7). The specimens in hand, however, differ from those described by Westermann by having appreciably coarser ribbing that is comparable with that on some specimens of *Asthenoceras delicatum* Imlay (1973, pl. 3, figs. 1, 4–11) from Oregon.

TABLE 2.—*Geographic distribution of early and middle Bajocian ammonites in the Wrangell and Talkeetna Mountains*

Genus and Species	Wrangell Mtns	Talkeetna Mountains																								
		Nelchina area																				Boulder Creek area				
	1	2	3	4	5	6	7		8	9		10		11	12	13	14			15		16	17		18	19	20
	28682	27577	24113	31728	25945	26723	25345	25346	24176	25946	24137	24215	25942	24134	24235	24149	8585	24120	24220	3696	3697	30600	30280	30281	30582	8567	30594
Phylloceras cf. *kunthi* Neumayr			X																								
Partschiceras sp.			X																	X	X					X	
Calliphylloceras sp.																						X				X	
Holcophylloceras costisparsum Imlay			X																			X					
sp.									X																	X	
Lytoceras cf. *L. eudisianum* d'Orbigny			X																X							X	
sp.												X						X	X								
Asthenoceras cf. *A. delicatum* Imlay											X																
Pleydellia? sp.																X											
Erycitoides howelli (White)															X												
Planammatoceras cf. *P. benneri* (Hoffman)																		X			X						
Eudmetoceras (*Euaptetoceras*) *amplectens* Buckman			X	X																							
Sonninia tuxedniensis Imlay																									X		
cf. *S. projectifer* Buckman			X																								
sp. juv.																					X						
(*Sonninites*) cf. *S. simulans* Buckman			X															X									
(*Euhoploceras*) *bifurcata* Westermann						X																					
(*Alaskinia*) cf. *S.* (*A.*) *alaskensis* Westermann																		X									
(*A.*) sp.																						X					
(*Papilliceras*) cf. *S.* (*P.*) *espinazitenes* (Tornquist)			X																								
Dorsetensia cf. *D. adnata* (Imlay)			X									X															
Witchellia sp.																						X		X			
Fontannesia? sp.					X															X							
Lissoceras cf. *L. semicostatum* Buckman																									X		
? sp.			X																								
Bradfordia costidensa Imlay			X	X			X					X															
? *cariboensis* Imlay																				X							
Otoites cf. *O. pauper* Westermann			X																								
Emileia? sp.			X							X												X					
Normannites variabilis Imlay	X																									X	
Teloceras cf. *T. blagdeni* (Sowerby)	X																										
Stephanoceras obesum Imlay			X																								
(*Skirroceras*) *juhlei* Imlay			X															X									
(*S.*) *nelchinanum* Imlay			X														X	X				X					
(*S.*) sp.														X				X			X						
Stemmatoceras cf. *S. palliseri* (McLearn)																							X				
sp.								X																			
Labyrinthoceras glabrum Imlay												X	X														
Chondroceras allani (McLearn)																										X	X
cf. *C. allani* (McLearn)																							X				
cf. *C. marshalli* (McLearn)																										X	
cf. *C. colnetti* (McLearn)	X																										
Parabigotites crassicostatus Imlay		X	X																								
Leptosphinctes evolutus Imlay																										X	

TABLE 3.—*Geographic distribution of some early and middle Bajocian ammonites west of Cook Inlet and northeast of Puale Bay on the Alaska Peninsula*

[Number 21–23 are keyed to locality numbers on figure 12; number 24 to locality 24 on figure 13; and numbers 25–30 to localities 25–30 on figure 14]

Genus and species	West of Cook Inlet					Northeast of Puale Bay					
	Red Glacier Formation					Kialagvik Formation					
	21		22	23	24	25	26	27	28	29	30
	21233	21234	29341	24335	21244F	ROC1472	21235	ROC1370	ROC1366	ROC1351	ROC1356
Pseudolioceras whiteavesi (White)	X	X								X	X
cf. *P. whiteavesi* (White)			X								
Tmetoceras scissum (Benecke)	X	X		X				X	X		
Erycitoides howelli (White)	X	X									
(*Kialagvikes*) cf. (*K.*) *kialagvikensis* (White)					X					X	X
(*K.*) *levis* Westermann								X			
(*K.*) cf. *K. spinatus* Westermann									X		
Dorsetensia? sp.						X					
Fontannnesia cf. *F. carinata* (Buckman)							X				
Bradfordia costidensa Imlay							X				

Figured specimens.—USNM 335956 and 335957.

Occurrence.—Kialagvik Formation at USGS Mesozoic loc. 19862 in SE cor. sec. 19, T. 33 S., R. 44 W., on the southeast side of Wide Bay, on the Alaska Peninsula.

Genus Tmetoceras Buckman, 1892

Tmetoceras scissum (Benecke)

Plate 1, figures 18, 19

(For synonymy, see Westermann, 1964, Bulls. American Paleontology, v. 47, no. 216, p. 428, 429).

This species is represented northwest of Cook Inlet by 21 specimens, of which most are small and fragmented. In shape and ribbing they fit very well with a detailed description made by Westermann (1964, p. 429–437, pl. 72, figs. 1a,b; 2a,b), and with a summary description by Imlay (1973, p. 59, pl. 2, figs. 1–6).

Hypotypes.—USNM 335965 and 335966.

Occurrence.—Red Glacier Formation, lower part, at USGS Mesozoic localities 21233, 21234, and 24335. *Tmetoceras scissum* (Benecke) is associated with *Erycitoides howelli* (White) at USGS Mesozoic locs. 21233 and 21234, southwest of Tuxedni Bay on the west side of Cook Inlet.

Tmetoceras kirki flexicostatum Westermann

Plate 1, figures 21–23

Tmetoceras kirki flexicostatum Westerman, 1964, Bulls. American Paleontology, v. 47, no. 216, p. 440, pl. 72, figs. 8–10.

This subspecies is characterized by having fine, densely spaced, flexuous ribs, whereas the species *T. kirki* has fairly strong, moderately spaced, nearly straight ribs, according to Westermann (1964, p. 438–440).

Type.—Hypotypes USNM 335968 and 335969.

Occurrence.—Kialagvik Formation, at USGS Mesozoic loc. 21254 on tributary of Short Creek on northwest side of Wide Bay, in north-central part of sec. 28, T. 32 S., R. 44 W., Agashik (B-2) quad., Alaska.

Family Hammatoceratidae Buckman, 1887

Genus Hammatoceras Hyatt, 1867

Hammatoceras sp.

Plate 1, figures 5, 6

One ammonite collected from the Kialagvik Formation on the northwest side of Wide Bay at USGS esozoic loc. 10806 was identified by T. W. Stanton (Capps, 1921, p. 96) as "*Hammatoceras*" and compared with *H. variabile* (d'Orbigny). That species is now considered to be the genotype of *Haugia*, but the specimen from Wide Bay differs from *Haugia* by having (1) a stouter whorl section; (2) weaker tubercles that arise from the primary ribs at about one-fourth the height of the flanks; and (3) finer and denser secondary ribs on the middle and upper parts of the flanks. The ammonite from USGS Mesozoic loc. 10806 by contrast shows considerable resemblance to the genotype of *Hammatoceras* (Arkell and others, 1957, p. L267, fig. 307c–e).

The occurrence of *Hammatoceras* at USGS Mesozoic loc. 10806 definitely favors an age as old as latest

TABLE 4.—*Geographic distribution of early and middle*

[Numbers 31–69 are keyed to locality numbers on figure 15.

Genus and Species	Kialagvik Formation on northwest side of Wide Bay																													
	31		32		33				34	35	36				37		38			39	40	41	42				43		44	45
	19766	21246	19757	19767	21255	21257	L1038	31976	21256	19786	19755	21254	31978	31979	19748	A 454	21245	19747	21250	21248	21247	19776	11352	19773	21258	19775	31987	10806	21253	31982
Partschiceras ellipticum Westermann																														
Holcophylloceras costisparsum Imlay																														
Pseudolioceras whiteavesi (White)												X	X		X		X	X												
maclintocki fastigatum Westermann																														
costistriatum Westermann																														
Asthenoceras aff. *A. nannodes* (Buckman)																														
A. cf. *delicatum* Imlay																														
Tmetoceras scissum (Benecke)												X	X							X	X									
kirki Westermann												X																		
kirki flexicostatum Westermann												X																		
(*Tmetoites*) *tenue* Westermann												X																		
Hammatoceras ? sp.																												X		
Planammatoceras aff. *P. benneri* (Hoffman)																														
Eudmetoceras cf. *E. eudmetum jaworskii* Westermann																														
(*Euaptetoceras*) *amplectens* (Buckman)							X																	X	X					
(*E.*) *klimakomohalum discoidale* Westermann																			X											
(*E.*) aff. *E.* (*E.*) *nucleospinosum* Westermann																														
Erycites imlayi Westermann		X																												
Erycitoides howelli (White)	X		X									X	X	X	X			X											X	X
cf. *E. howelli* (White)																				X							X	X		
profundus Westermann																X		X												
teres Westermann		X														X	X	X												
paucispinosus Westermann																X														
(*Kialaguikes*) *kialaguikensis* (White)	X			X							X	X		X	X	X	X	X											X	
(*K.*) *spinatus* Westermann												X			X		X	X												
(*K.*) *levis* Westermann															X	X		X												
Abbasites platystomus Westermann		X									X																			
Sonninia tuxedniensis Imlay																														
(*Papilliceras*) cf. *S.* (*P.*) *arenata* (Quenstedt)																										X				
(*Euhoploceras*) *bifurcata* Westermann																														
(*Alaskinia*) *alaskensis* Westermann																														
Witchellia sutneroides Westermann																														
cf. *sutneroides* Westermann																														
Dorsetensia adnata (Imlay)							X																							
Fontannesia cf. *F. intermedia* Imlay																														
Pelekodites cf. *P. pelekus* Buckman																														
Hebetoxyites aff. *H. hebes* Buckman																														
Bradfordia constidensa Imlay						X			X	X												X		X		X				
Praeoppelia oppeliformis Westermann																														
Docidoceras aff. *D. longalvum* (Vacek)																														
(*Pseudocidoceras*) *widebayense* Westermann																														
(*P.*) *camachoi* Westermann																														
(*P.*) cf. (*P.*) *camachoi* Westermann																														
?(*P.*) *paucinodosum* Westermann																														
Pseudotoites cf. *P. argentinus* Arkell																														
cf. *P. transatlanticus* (Tornquist)																														
Otoites sp.						X																								
Stephanoceras (*Skirroceras*) cf. *S.* (*S.*) *leptogyrale* Buckman						X																								
Arkelloceras sp.					X																									
Parabigotites kialaguikensis (Imlay)									X															X	X					
crassicostatus Imlay																							X	X	X					
cf. *P. crassicostatus* Imlay								X	X																					

Bajocian ammonites near Wide Bay on the Alaska Peninsula

Higher numbers are USGS Mesozoic locality numbers]

Kialagvik Formation on northwest side of Wide Bay										Kialagvik Formation on southwest side of Wide Bay																																								
46	47	48	49	50			51	52		53	54		55			56	57	58	59			60	61	62	63			64			65					66				67								68		69
31980	10809	31955	31956	31950	31951	31949	31947	31957	31958	19926	19742	19796	11349	12404	19884	L 556	L 555	19798	19836	19840	19850	19852	L 154	19811	31969	32287	32290	19801	WA 5	WA 8	19863	19822	19823	19824	19825	31965	31966	32291	32292	19869	WA 10	19862	32293	32295	32296	19876	19877	21251	21252	12405
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TABLE 5.—*Descriptions of middle and lower Bajocian fossil localities in southern Alaska*

Locality No.	USGS Mesozoic locality	Collector's field No.	Collector, year of collection, description of locality, and stratigraphic assignment
1	28682	62AMK53	R. W. Imlay, 1962. Wrangell Mountains. McCarthy (C-5) quad. Near creek in center SE¼ NW¼ sec. 20, T. 3 S., R. 16 E., Nizina Mountain Formation, mostly float. Probably from the basal part of the formation.
2	27577		Western Gulf Oil Co., 1959. Talkeetna Mountains (A-1) quad., near Crooked Creek south of Nelchina, lat. 62°02′00″ N., long. 147°18′00″ W., Tuxedni Group, lower part (probably siltstone).
3	24113	52AGz-85	Arthur Grantz, Richard Hoare, and R. W. Imlay, 1952. Talkeetna Mountains (A-1) quad. From a landslide scar 1.63 mi (2.6 km) north of the mouth of Albert Creek. Tuxedni Group 200–250 ft (61–76 m) above base.
4	31728	79AGz-98	Arthur Grantz, 1979. Talkeetna Mountains (A-1) quad., lat. 62°01′4″ N., long. 147°17′36″ W., Tuxedni Group (same locality as 24113).
5	25945	55AGz-245a	Arthur Grantz, 1955. Talkeetna Mountains (A-1) quad., lat. 62°02′28″ N., long. 147°22′59″ W., Tuxedni Group, upper half of lower sandstone.
6	26723	57AGz43N	Arthur Grantz, 1957. Talkeetna Mountains (A-1) quad., lat. 62°02′00″ N., long. 147°25′15″ W., Tuxedni Group, upper half of basal sandstone.
7	25345	54AFy28	L. F. Fay, 1954. Talkeetna Mountains (A-2) quad., lat. 62°00′46″ N., long. 147°34′02½″ W., Tuxedni Group, upper siltstone.
7	25346	54AFy29	L. F. Fay, 1954. Talkeetna Mountains (A-2) quad., lat. 62°00′41″ N., long. 147°34′16½″ W., Tuxedni Group, upper siltstone.
8	24176	52AHr51	Richard Hoare, 1952. Anchorage (D-2) quad., Pass Creek, 0.35 mi (0.56 km) above its mouth. Tuxedni Group, basal sandstone, 100–200 ft (30–61 m) above base.
9	25946	55AGz309	Arthur Grantz and W. H. Condon, 1955. Anchorage (D-2) quad., lat. 61°57′47″ N., long. 147°24′21″ W., Tuxedni Group, 200–300 ft (61–91 m) above base.
9	24137	52AGz284	Arthur Grantz, R. W. Imlay, and D. Hoare, 1952. Anchorage (D-2) quad., 0.53 mi (0.9 km) S. 74½° E. of mouth of Pass Creek and 0.16 km south of USGS Mesozoic loc. 25946. Tuxedni Group, basal sandstone 200–300 ft (61–91 m) above base.
10	24215	52AGz182	Richard Hoare and Arthur Grantz, 1952. Anchorage (D-2) quad., Alfred Creek, 0.8 mi (1.3 km) east of Papoose Creek. Tuxedni Group, upper siltstone.
10	25942	55AGz163	Arthur Grantz and W. H. Condon, 1955. Anchorage (D-2) quad., lat. 61°57′09″ N., long. 147°27′56″ W., Tuxedni Group, upper siltstone.
11	24134	52AGz275	Arthur Grantz, Richard Hoare, and R. W. Imlay, 1952. Anchorage (D-2) quad., 2.63 mi (4.2 km) N. 51½° E. of mouth of Sheep Creek. Tuxedni Group, base of upper siltstone.
12	24235	52AGz240	Arthur Grants, Richard Hoare, and R. W. Imlay, 1952. Anchorage (D-2) quad., Sheep Creek, 2.20 mi (3.32 km) N. 16½° E. of its mouth. Tuxedni Group, float from the lower 30.5 m of the basal sandstone.
13	24149	52AGz233	Arthur Grantz, Richard Hoare, and R. W. Imlay, 1952. Anchorage (D-2) quad., 3 mi (4.8 km) N. 9° E. of the mouth of Sheep Creek on a small west tributary. Tuxedni Group, float from the lower 100 ft (30.5 m) of the basal sandstone.
14	8585	13AM36	G. C. Martin, 1913. Anchorage (D-2) quad., north bank of Caribou Creek 0.75 mi (1.2 km) east of mouth of Billy Creek. Tuxedni Group, upper siltstone.
14	24120	52AGz198	Arthur Grantz, Richard Hoare, and R. W. Imlay, 1952. Anchorage (D-3) quad., Caribou Creek 0.62 mi (1 km) east of Billy Creek. Tuxedni Group, upper siltstone.
14	24220	52AGz215	Arthur Grantz, Richard Hoare, and R. W. Imlay, 1952. Anchorage (D-2) quad., north side of Caribou Creek, 0.73 mi (1.17 km) east of mouth of Billy Creek. Tuxedni Group, upper siltstone.
15	3696	6AK88A	Adolph Knopf, 1906. Anchorage (D-3) quad., at altitude of 4,050 ft, on tributary of Caribou Creek that joins main creek from south 0.25 mi (0.40 km) above mouth of Billy Creek. Tuxedni Group, upper siltstone.
15	3697	6AK88B	Adolph Knopf, 1906. Anchorage (D-3) quad., boulder in stream bed at same location as Mesozoic loc. 3696.
16	30600	74APr60b	George Pflaker, 1974. Anchorage (D-3) quad., 1.5 mi N. 45° E. of VABM Chitna in sec. 4, T. 21 N., R. 9 E., elev. 5,250 ft. Tuxedni Group, dark shale that contains a few sandstone beds and is intruded by a basaltic dike.
17	30280	72AD7-11 #6	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Anchorage (D-3) quad. From southern part of divide north of peak (elev. 5,900 ft) north of Boulder Creek, 1.2 mi (1.9 km) S. 35° W. of VABM Snag. SE¼ sec. 26, T. 22 N., R. 7 E., Tuxedni Group, upper part, from lower 75 ft (23 m) of 175 ft (53 m) of brown-to-gray siltstone that underlies 80 ft (24 m) of volcanic graywacke.
17	30281	72AD7-12	R. L. Detterman, R. W. Imlay, and Don Hartman, 1972. Anchorage (D-3) quad., 1.1 mi (1.8 km) S. 38° W. of VABM Snag near center of sec. 26, T. 22 N., R. 7 E., Tuxedni Group, sandstone, grit, and conglomerate with siltstone interbeds about 250–300 ft (76–91 m) below siltstone listed under USGS Mesozoic loc. 30280.

TABLE 5.—*Descriptions of middle and lower Bajocian fossil localities in southern Alaska—Continued*

Locality No.	USGS Mesozoic locality	Collector's field No.	Collector, year of collection, description of locality, and stratigraphic assignment
18	30582	74AD7-95	R. L. Detterman, 1974. Anchorage (D-3) quad., on ridge south of tributary of Boulder Creek in sec. 4, T. 21 N., R. 7 E., 0.88 mi (1.4 km) S. 40° E. of VABM Suicide. Tuxedni Group, near middle, from interbedded brown sandstone, siltstone, and siltstone and shale containing limestone concretions.
19	8567	113AM16	G. C. Martin, R. M. Overbeck, and J. B. Mertie, Jr., 1913. Anchorage (D-4) quad., in north-central part of NE¼ sec. 19, T. 21 N., R. 7 D., Tuxedni Group.
20	30594	74ADT130A	R. L. Detterman, 1974. Anchorage (D-4) quad. SE¼ NE¼ sec. 20, T. 21 N., R. 7 E., 2.8 mi (4.48 km) N. 73° E. of VABM Pudding, elev. 5,400 ft on ridge west of Boulder Creek. Tuxedni Group, high in sequence of dark-greenish sandstone bearing volcanic clasts.
21	21233	48AI77	R. W. Imlay and D. J. Miller, 1948. South side of Tuxedni Bay. West central part of NW¼ SW¼ sec. 15, T. 1 N., R. 21 W., Kenai (A-8) quad., on creek entering Tuxedni Bay from south 2.25 mi (3.6 km) N. 77° W. of Fossil Point. Red Glacier Formation, 380-480 ft (116-146 m) above base and 1,500 ft (457 m) below top in sandy siltstone interbedded with sandstone. Location is indicated by number (830) on pl. 3 of U.S. Geol. Survey Prof. Paper 512.
21	21234	48AI78	R. W. Imlay and D. J. Miller, 1948. South side of Tuxedni Bay. Float from same place and probably from same bed as USGS Mesozoic loc. 21233. Red Glacier Formation.
22	29341	Ken 72	British Petroleum Exploration Co., 1962. South side of Tuxedni Bay, SE cor. NE¼, SW¼ sec. 15, T. 1 N., R. 20 W., Kenai (A-8) quad. Red Glacier Formation, first exposure of silty sandstone overlying Lower Jurassic volcanic rocks to the northwest.
23	24335	52AJU516A	R. W. Imlay, 1952. On low divide north of Red Glacier, 2.5 mi (4 km) west of Red Creek and 5.2 mi (8.3 km) N. 5° W. of Blue Lake. North-central part NE¼ NW¼ sec. 33, T. 1 S., R. 21 W., Kenai (A-8) quad. Red Glacier Formation, lower siltstone member, about 900-1,000 ft (274-335 m) above base and 3,400-3,600 ft (1,036-1,097 m) below top. Location is indicated by number (×40) on pl. 3 of U.S. Geol. Survey Prof. Paper 512.
24	21244F	48AI32	R. W. Imlay, J. K. Hartsock, and D. J. Miller, 1948. By Iniskin Peninsula on Fitz Creek near Tonnie Creek. Iniskin Bay Assoc. well 1 in SE¼ sec. 8, T. 5 S., R. 23 W., Seward Meridian. Red Glacier Formation, hard gray-to-black siltstone, at 5,495-5,515 ft (2,225-2,231 m) below top. Detterman and Hartsock, 1966, p. 72, 73, table 4 on p. 24, and pl. 4; location is indicated by number (×41) on pl. 3.
25	ROC1472	1962	W. T. Rothwell and associates of the Richfield Oil Co. Collected about 2,800 ft (853 m) N. 50° W. of VABM 119 Bay on northeast side of Puale Bay in the Karluk (C-4 and C-5) quad., on the Alaska Peninsula. Kialagvik Formation, near top, and about 500 ft (152 m) above a massive conglomerate.
26	21235	48AI110	Ralph Imlay, 1948. Sea cliff on northeast side of Puale Bay, 2.24 mi (3.58 km) N. 19° W. of Cape Kekurnoi on the Alaska Peninsula. Kialagvik Formation, from a concretion in siltstone about 200 ft (61 m) below base of massive conglomerate.
27	ROC1370		Richfield Oil Co., 1962. Southeast shore of Puale Bay, about 2 mi (3.2 km) N. 18½° W. of Cape Kekurnoi on the Alaska Peninsula. Kialagvik Formation, about 100 ft (30.5 m) below top of ashy beds and about 800 ft (244 m) below the base of a massive conglomerate.
28	ROC1366		Geologists of the Richfield Oil Co., 1962. Northeast shore of Puale Bay, about 650 ft (198 m) S. 25° E. of VABM 119 Bay. Kialagvik Formation, about 40 ft (12 m) below ROC loc. 1370.
29	ROC1351		Geologists of the Richfield Oil Co., 1962. Northeast shore of Puale Bay, about 1,250 ft (381 m) S. 25° E. of VABM 119 Bay. Kialagvik Formation, about 900-950 ft (274-290 m) below massive conglomerate.
30	ROC1356		Geologists of the Richfield Oil Co., 1962. Northeast side of Puale Bay, near locality ROC1351.
31	19766	44AKmF36	L. B. Kellum, 1944. Float from base of cliffs. About ¼ mile south of mouth of Pass Creek and 3.6 mi (6 km) N. 45° W. of west end of Hartman Island. Kialagvik Formation, about 480 ft (146 m) below top.
31	21246	48AI95	R. W. Imlay and D. J. Miller, 1948. SE¼ NW¼ of sec. 24, T. 32 S., R. 44 W., sea cliff along beach 3.1 mi (5 km) N. 50° W. of west end of Hartman Island. About 0.2 mi (0.32 km) northeastward along a cliff composed of sandstone and siltstone. Kialagvik Formation, about 800 ft (244 m) below top.
32	19757	44AKmF23	L. B. Kellum and assistants, 1944. Float at base of sea cliff between Pass Creek and Short Creek northeast of small waterfall and 0.5 mi (0.2 km) southwest of Pass Creek. SE¼ sec. 23, T. 32 S., R. 44 W. Kialagvik Formation, 880-995 ft (268-303.5 m) below top.
32	19767	44AKm37	L. R. Kellum, 1944. SE¼ sec. 23, T. 32 S., R. 44 W., Kialagvik Formation, about 1,050 ft (320 m) below top.
33	21255	48AI89	R. W. Imlay and D. F. Miller, 1948. Southwest bank of tributaries entering Short Creek about 1 mi (1.6 km) northwest of beach. North-central part of SW¼ sec. 28, T. 32 S., R. 44 W. Kialagvik Formation, from gray siltstone about 400 ft (122 m) below top.

TABLE 5.—*Descriptions of middle and lower Bajocian fossil localities in southern Alaska—Continued*

Locality No.	USGS Mesozoic locality	Collector's field No.	Collector, year of collection, description of locality, and stratigraphic assignment
33	21257	48AI91	R. W. Imlay and D. J. Miller, 1948. North-central part of SW¼ sec. 28, T. 32 S., R. 44 W. Kialagvik Formation, from base of silty sandstone, overlying sandstone whose top is 400 ft (122 m) below top of formation.
33		L1038	Geologists of the Shell Oil Co. On the tributary entering Short Creek from the north in the SW¼ sec. 28, T. 32 S., R. 44 W. Kialagvik Formation, from lower third of 490 ft (150 m) of silty shale.
33	31976	80ACe199B	Jim Case, 1980. North-central part of SW¼ sec. 28, T. 32 S., R. 44 W., 1 mi (0.6 km) N. 58° W. of Tri. Station Creek. Kialagvik Formation, sandstone and limestone beds.
34	21256	48AI90	R. W. Imlay, 1948. On ridge south of tributary entering Short Creek, 4.6 mi N. 75½° W. of west end of Hartman Island. SE¼ SW¼ sec. 28, T. 32 S., R. 44 W. Kialagvik Formation, 320 ft (98 m) below top.
35	19786	44AKMF56	L. B. Kellum, 1944. NW¼ NE¼ sec. 3, T. 32 S., R. 44 W., 5.75 mi (9.2 km) N. 76° W. of west end of Hartman Island. In canyon of Short Creek, 0.5 mi (0.8 km) above first rapids. Kialagvik Formation, 100 ft (30 m) below top in a shale bed interbedded with sandstone.
36	19755	44AKMF21	L. B. Kellum, 1944. North-central part of sec. 33, T. 32 S., R. 44 W., about 100 ft (0.2 km) north of intersection of stream entering Short Creek from the north and 0.75 mi downstream from first falls. Kialagvik Formation, 603 ft (184 m) below top in 2 ft (0.6 m) of shabby sandstone 30 ft (9 m) below top of falls.
36	21254	48AI109	R. W. Imlay, 1948. North-central part of sec. 33, T. 37 S., R. 44 W. Above the falls on a tributary entering Short Creek 1 mi (1.6 km) northwest of the beach. Kialagvik Formation, about 600 ft (183 m) below top in gray calcareous sandstone.
36	31978	80ACe200	Jim Case, 1980. North-central part of sec. 33, T. 32 S., R. 44 W., 0.67 mi (1 km) N. 84° W. of Tri. Station Creek. Kialagvik Formation.
36	31979	80A	Jim Case, 1980. Location is the same as Mesozoic loc. 31978. Kialagvik Formation.
37	19748	44AKmF13	L. B. Kellum, 1944. SW¼ NE¼ sec. 33, T. 32 S., R. 44 W., on south side of Short Creek about 1.5 mi (2.4 km) from its mouth and 750 ft (229 m) below the first rapids. Kialagvik Formation, 800 ft (244 m) below top, at top of a coarse conglomerate.
37		A454	Shell Oil Co., 1953. On Short Creek probably at same location as USGS Mesozoic loc. 19748 (see map by Westermann, 1964, text-fig. 2, opposite p. 332). Kialagvik Formation, about 160 m below top.
38	21245	48AI86	R. W. Imlay and D. J. Miller, 1948. South-central part of NE¼ sec. 33, T. 32 S., R. 44 W., on south side of Short Creek. Kialagvik Formation, about 1,050 ft (317 m) below top, fossils from a gray sandstone bed, dark-gray siltstone.
38	19747	44AKmF12	L. B. Kellum, 1944. South side of Short Creek at same location as USGS Mesozoic loc. 21245. Kialagvik Formation, 317 m below top.
38	21250	48AI88	R. W. Imlay and D. J. Miller, 1948. Short Creek at head of first falls near USGS Mesozoic loc. 21245. Kialagvik Formation, 600 ft (183 m) below top, gray sandstone at top of a sandstone sequence.
39	21248	48AI108	R. W. Imlay and D. J. Miller, 1949. Central part of NW¼ sec. 34, T. 32 S., R. 44 W., on south side of Short Creek about 0.5 mi (0.8 km) from beach. Kialagvik Formation, about 1,700 ft (518 m) below top, gray siltstone.
40	21247	48AI107	R. W. Imlay and D. J. Miller, 1948. SE corner of NE¼ sec. 34, T. 32 S., R. 44 W., 0.2 mi (0.3 km) from beach. Kialagvik Formation, about 2,000 ft (610 m) below top, dark-gray siltstone.
41	19776	44AKmF46	L. B. Kellum, 1944. NW¼ NE¼ sec. 3, T. 33 S., R. 45 W., on northeast side of Anderson Creek at base of a bluff. Kialagvik Formation, about 200 ft (62 m) below top, shaly sandstone.
42	11352	15	W. R. Smith, 1922. North-central part of SW¼ sec. 2, T. 32 S., R. 45 W., on high knob on north side of Anderson Creek, about 1 mi (1.6 km) from Wide Bay. Kialagvik Formation.
42	19773	44AKmF43	L. B. Kellum, 1944. Same location as USGS Mesozoic loc. 11352. Kialagvik Formation, about 220 ft (67 m) below top.
42	19775	44AKmF45	L. B. Kellum, 1944. Same location as USGS Mesozoic loc. 11352. Kialagvik Formation, about 300 ft (91 m) below top, shaly sandstone near base of a cliff.
42	21258	48AI96	R. W. Imlay and D. J. Miller, 1948. Same location as USGS Mesozoic loc. 11352. Kialagvik Formation, about 225 ft (69 m) below top.
43	31987	8ACe202A	Terry Poulton, 1980. South-central part of NE¼ sec. 2, T. 33 S., R. 45 W., 1.95 mi (3.2 km) N. 45° E. of Triangulation Station Spit in Ugashik B-2 quad. Kialagvik Formation.
43	10806	1-107	S. R. Capps, 1921. Probably same location as USGS Mesozoic loc. 31987 and about 1 mi (1.6 km) north-northwest of mouth of "Anderson" Creek. Kialagvik Formation (partly float specimens collected at base of bluff on west side of a spit).

TABLE 5.—*Descriptions of middle and lower Bajocian fossil localities in southern Alaska—Continued*

Locality No.	USGS Mesozoic locality	Collector's field No.	Collector, year of collection, description of locality, and stratigraphic assignment
44	21253	48AI105	R. W. Imlay and D. J. Miller, 1948. Sea cliff in west-central part of NW¼ sec. 11, T. 33 S., R. 45 W., about 1 mi (1.7 km) northeast of Triangulation Station Spit. Kialagvik Formation, probably about 500 ft (152 m) below top of formation.
45	31982	80ACe202	Jim Case, 1980. NW¼ SE¼ sec. 10, T. 33 S., R. 45 W., 0.57 mi (0.9 km) N. 30° E. of Triangulation Station Spit. Kialagvik Formation, calcareous sandstone.
46	31980	80ACe201	Jim Case, 1980. On beach in NW¼ sec. 15., T. 33 S., R. 45 W., 0.18 mi (0.3 km) N. 84 W. of Triangulation Station Spit in Ugashik B-2 quad. Kialagvik Formation, conglomerate.
47	10809	1-113	S. R. Capps, 1921. North-central part of sec. 17, T. 33 S., R. 45 W., 1.5 mi (2.4 km) from mouth of creek that enters Wide Bay from the southwest. Kialagvik Formation, upper part.
48	31955	80ACe163B	Jim Case, 1980. NE corner of sec. 16, T. 33 S., R. 45 W., 1.4 mi (2.3 km) S. 77° W. of Triangulation Station Spit in Ugashik B-2 quad. Kialagvik Formation, brownish mudstone.
49	31956	80ACe164	Jim Case, 1980. East-central part of NW¼ sec. 16, T. 33 S., R. 45 W., 1.1 mi (1.8 km) S. 73° W. of Triangulation Station Spit. Kialagvik Formation, float block of massive sandstone.
50	31951	80ACe163	Jim Case, 1980. Near beach in SE¼ NW¼ sec. 16, T. 33 S., R. 45 W., 1.3 mi (2.1 km) S. 73° W. of Triangulation Station Spit. Kialagvik Formation, calcareous sandstone concretions.
50	31949	80ACe162	Jim Case, 1980. Same data as for USGS Mesozoic loc. 31951. Kialagvik Formation, float.
51	31947	80ACe161	Jim Case, 1980. SE¼ NE¼ sec. 17, T. 33 S., R. 45 W., 1.5 mi (2.5 km) S. 65° W. of Triangulation Station Spit. Kialagvik Formation, pebbly sandstone.
52	31957	80ACe174	Jim Case, 1980. West-central part of NE¼ sec. 19, T. 33 S., R. 45 W., 2.5 mi (4 km) N. 68° E. of Triangulation Station Alai in Ugashik R-2 quad. Kialagvik Formation, massive sandstone.
52	31958	80ACe174A	Jim Case, 1980. Same locality as USGS Mesozoic loc. 31957. Kialagvik Formation, massive sandstone.
53	19926	45AKmF116	L. B. Kellum, 1945. Cliff east of Kialagvik Creek below a glacier. West-central part of NW¼ sec. 4, T. 34 S., R. 45 W. Kialagvik Formation.
54	19742	44AKmF3	L. B. Kellum, 1944. Southeast shore of Wide Bay in south-central part of sec. 33, T. 33 S., R. 34 W. Kialagvik Formation, float blocks of sandstone.
54	19796	44AKmF66	L. B. Kellum, 1944. Southeast shore of Wide Bay at same location as USGS Mesozoic loc. 19742. Kialagvik Formation, float from a bluff.
55	11349	F13	W. R. Smith, 1922. Near beach on south side of small creek in north-central part of SE¼ of sec. 33, T. 33 S., R. 45 W. Kialagvik Formation.
55	12404	F26	W. R. Smith, 1924. Same location as USGS Mesozoic loc. 11349. Kialagvik Formation.
55	19884	45AKmF74	L. B. Kellum, 1945. Sea cliff 0.25 mi (0.4 km) southeast from SW corner of Wide Bay at same location as USGS Mesozoic loc. 11349. Kialagvik Formation, an *Inoceramus* bed 50 ft (15 m) below top of cliff.
56		L556	Shell Oil Co. 0.25 mi (0.3 km) southwest of L555 and 15 m lower stratigraphically. SW¼ NE¼ sec. 34, T. 33 S., R. 45 W.
57		L555	Shell Oil Co. NE¼ sec. 34, T. 33 S., R. 45 W., 0.25 mi (0.3 km) northeast of Shell loc. L556. Kialagvik Formation.
58	19798	44AKmF68	L. B. Kellum, 1944. On beach in northwest corner of sec. 35, T. 33 S., R. 45 W. Kialagvik Formation, float from sea cliffs.
59	19836	45AKmF29	L. B. Kellum, 1945. Spur west of most easterly of two large streams on southeast shore. South-central part of NW¼ sec. 35, T. 33 S., R. 45 W. Elev. 475 ft. Kialagvik Formation, 192 ft (58 m) below top of formation in shaly, crumbly sandstone.
59	19840	45AKmF33	L. B. Kellum, 1945. Same location as USGS Mesozoic loc. 19836. Elev. 636 ft (194 m). Kialagvik Formation, 130 ft (40 m) below top of formation.
59	19850	45AKmF43	L. B. Kellum, 1945. Same location as USGS Mesozoic loc. 19836. Elev. 600 ft (183 m). Kialagvik Formation, float collected in a gully.
60	19852	45AKmF45	L. B. Kellum, 1945. In east-central part of NW¼ sec. 35, T. 33 S., R. 45 W. Elev. 736 ft (224 m). Kialagvik Formation, talus.
61		L154	Shell Oil Co. On shore in west-central part of SE¼ sec. 26, T. 33 S., R. 45 W., about 3 mi (5 km) east of mouth of Kialagvik Creek, 60 m below top.
62	19811	45AKmF4	L. B. Kellum, 1945. NW¼ SE¼ sec. 25, T. 33 S., R. 45 W., about 3,000 ft (0.9 km) east of mouth of more easterly of two large creeks. Kialagvik Formation, 45 ft (13.7 m) below top in a shaly sandstone bed, at elev. of 134 ft (41 m).
63	31969	80ACe177A	Jim Case, 1980. NE¼ sec. 25, T. 33 S., R. 45 W., 3.25 mi (5.2 km) S. 50° E. of Triangulation Station Spit. Kialagvik Formation, mudstone about 25 ft (3.6 m) below the cliff-forming sandstone.
63	32287	81JCH11	J. H. Callomon, 1981. Same location as USGS Mesozoic loc. 31969. 1.7 mi (2.7 km) N. 15° W. of Triangulation Station Wide, 60 m above a sandstone cliff. Kialagvik Formation, 198 ft (60 m) above a sandstone cliff.

TABLE 5.—*Descriptions of middle and lower Bajocian fossil localities in southern Alaska—Continued*

Locality No.	USGS Mesozoic locality	Collector's field No.	Collector, year of collection, description of locality, and stratigraphic assignment
63	32290	815HC14	J. H. Callomon, 1981. Same location and formation as USGS Mesozoic loc. 32289, but 201 ft (63.5 m) above the sandstone cliff.
64	19801	44Akm72	S. N. Davies, 1944. NW corner sec. 30, T. 33 S., R. 44 W., on southeast side of Wide Bay, about 1 mi (1.6 km) east of Preston Creek. Kialagvik Formation, from base of a shale unit that bears limestone concretions and underlies an unconformity.
64		WA5	G. E. G. Westermann, 1944. About 1.1 mi (1.75 km) east of Preston Creek. Kialagvik Formation, talus from greywacke and some silty shale.
64		WA8	G. E. G. Westermann, 1944. Same location as USGS Mesozoic loc. 19801, about 1.1 mi (1.75 km) east of Preston Creek. Kialagvik Formation, from uppermost and lowermost massive greywacke overlain by shale and underlain by sandstone and siltstone.
65	19863		L. B. Kellum, 1945. About 6,850 ft (2.1 km) east of Preston Creek in north-central part of NW¼ sec. 30, T. 33 S., R. 44 W. Kialagvik Formation, float about 62 ft (19 m) below top at elevation of 140 ft (43 m).
65	19822	45AKmF15	L. B. Kellum, 1945. North-central part of NW¼ sec. 30, T. 33 S., R. 44 W., about 5,700 ft (1,737 m) northeast of Preston Creek at elevation of 170 ft (52 m). Kialagvik Formation, fossils found in float 30 ft (9.1 m) below top.
65	19823	45AKmF16	L. B. Kellum, 1945. Same location as USGS Mesozoic loc. 19822, at elevation of 351 ft (107 m). Kialagvik Formation, 15 ft (4.7 m) below top.
65	19824	45AKmF17	L. B. Kellum, 1945. Same location as USGS Mesozoic loc. 19822, at elevation of 371 ft (113 m). Kialagvik Formation, 5 ft (1.5 m) below top.
65	19825	45AKmF18	L. B. Kellum, 1945. Same location as USGS Mesozoic loc. 19822, at elevation of 385 ft (117 m). Kialagvik Formation, 25 ft (7.6 m) below top.
66	31965	80ACe175A	Jim Case, 1980. NE¼ NW¼ sec. 30, T. 33 S., R. 44 W., 1.75 mi (2.8 km) due north of Triangulation Station Wide. Kialagvik Formation, shale containing limestone concretions about 75 ft (15.23 m) above lowest sandstone.
66	31966	80ACe175B	Jim Case, 1980, Same location as USGS Mesozoic loc. 31965, but 20 ft (6 m) higher in the Kialagvik Formation.
66	32292	81JHC16	J. H. Callomon, 1981. Same location as USGS Mesozoic loc. 31965. 1.78 mi (2.85 km) due north of Triangulation Station Wide. Kialagvik Formation, 30–35 ft (9–11.5 m) above the beach.
66	32291	81JHC15	J. H. Callomon, 1981. Same location as USGS Mesozoic loc. 31965. Collected 10 ft (3 m) above beach. Kialagvik Formation.
67	19869	45AKmF62	L. B. Kellum, 1945. Same location as USGS Mesozoic loc. 31965, but 1.4 mi (2.3 km) east of Preston Creek in a gully near shoreline. Kialagvik Formation, 480 ft (145 m) below top, in dark-grey concretionary shale interbedded with some thin beds of grey limestone.
67		WA10	G.E.G. Westermann, 1944. NW corner of NE¼ of sec. 30, T. 33 S., R. 44 W., 1.5 mi (2.45–2.55 km) east of Preston Creek. Kialagvik Formation, from 69 ft (21 m) of dark-grey concretionary shale exposed in sea cliff on both sides of a small stream.
67	19862	45AKmF55	L. B. Kellum, 1945. Same sea cliffs at same place as listed in locality WA10. Kialagvik Formation, 143 ft (43 m) below top and 23 ft (9 m) above beach in shale bearing sandstone stringers above massive sandstone.
67	32293	81JHC17	J. H. Callomon, 1981. Same location as in locality WA10. 1.8 mi (3 km) N. 3° E. of Triangulation Station Wide. Kialagvik Formation, about 33 ft (10 m) above beach.
67	32295	81JHC19	J. H. Callomon, 1981. Same location as USGS Mesozoic loc. WA10 and 32293. Kialagvik Formation, 82 ft (25 m) above beach.
67	32296	81JHC20	J. H. Callomon, 1981. Same location as USGS Mesozoic loc. 32293. Kialagvik Formation, 134 ft (40 m) above beach.
67	19876	45AKmF69	L. B. Kellum, 1945. NW corner NE¼ sec. 30, T. 33 S., R. 44 W., near boundary with sec. 19. 7,600 ft (2.3 km) east of Preston Creek. Kialagvik Formation, at elevation of 120 ft (37 m).
67	19877	45AKmF70	L. B. Kellum, 1945. Same location as USGS Mesozoic loc. 19876. Kialagvik Formation, at elevation of 150 ft (45.7 m).
68	21251	48AI103	R. W. Imlay and D. J. Miller, 1948. Sea cliff 1.7 mi (2.85 km) east of Preston Creek in NE¼ sec. 30, T. 33 S., R. 44 W., near boundary with sec. 19. Kialagvik Formation, about 500 ft (150 m) below top, in grey siltstone.
68	21252	48AI104	R. W. Imlay and D. J. Miller, 1948. Same location as USGS Mesozoic loc. 21251. Kialagvik Formation, 25 ft (7.6 m) above a massive sandstone. Probably lower than loc. 21251.
69	12405	24ASF27	W. R. Smith, 1924. Near center of sec. 20, T. 33 S., R. 44 W., on southeast side of Wide Bay, about 1.5 mi (2.4 km) west of the cape. Kialagvik Formation.

Toarcian for the lowest part of the Kialagvik Formation as exposed at Wide Bay. Nonetheless, it could represent float, as shown (1) by its association with three fragments of *Erycitoides* of late early Bajocian age, (2) by the occurrence of *Erycitoides howelli* (White) only 100 m farther south along the shore at USGS Mesozoic loc. 10807, and (3) by a field label written by S. R. Capps on Aug. 13, 1921, stating that the fossils collected at USGS Mesozoic loc. 10806 "[m]ay be partly erratic. Part came from talus at base of a bluff." It is possible, also, that the specimen of *Hammatoceras* was originally collected from upper Toarcian beds at Puale Bay, or that it was derived after early Bajocian time by erosion of Lower Jurassic beds that underlie Wide Bay and that to date have furnished the ammonite *Waehneroceras* of Hettangian age (Imlay, 1981, p. 12, pl. 2, figs. 14, 15). It is also possible that the specimen of *Hammatoceras* was collected along the south side of a fault that is uplifted on its south side.

Figured specimen.—USNM 335958.

Occurrence.—Kialagvik Formation, at USGS Mesozoic loc. 10806 at west base of a spit about 3 mi (4.8 km) from the southwest end of Wide Bay, Alaska Peninsula. Probably in SE¼SW¼ sec. 10, T. 33 S., R. 45 W., of the Ugashik (B-2) quad.

Genus Erycitoides Westermann, 1964

Erycitoides howelli (White)

Plate 1, figure 7

One small, laterally crushed specimen closely resembles the coarsely ribbed inner whorls of certain lectotypes of *E. howelli* (White) (1889, p. 68, pl. 12, figs. 1, 2; pl. 14, figs. 2, 3) as figured by Westermann (1964, pl. 44, pl. 45, figs. 2a,b; pl. 47). The specimen has a fairly wide umbilicus. It bears strong, fairly widely spaced primary ribs that pass near the middle of the flanks into pairs of slightly weaker secondary ribs that weaken ventrally. A few fairly strong ribs arise high on the flanks between the rib pairs. All secondary ribs weaken near the midline of the venter, which bears a fairly sharp, low keel. All ribs incline gently forward on the flank and incline more strongly forward on the venter.

The species is possibly also represented at USGS Mesozoic loc. 22718 by one poorly preserved fragment of an outer whorl that bears ribbing similar to that on the adult lectotype (Westermann, 1964, pl. 44).

Occurrence.—Red Glacier Formation, float at USGS Mesozoic loc. 21234 and probably also at the same place as USGS Mesozoic loc. 21233 about 380-480 ft (126-146 m) above Lower Jurassic volcanic rocks exposed southwest of Tuxedni Bay on the west side of Cook Inlet.

Subgenus Kialagvikes Westermann, 1964

Erycitoides (Kialagvikes) cf. E. kialagvikensis (White)

Plate 1, figure 8

One laterally crushed specimen preserved on a slab of black shale represents parts of two whorls. The outermost whorl bears ribbing similar to that near the adapical end of the body chamber on finely ribbed specimens of *Erycitoides (Kialagvikes) kialagvikensis* (White) as figured by Westermann (1964, pl. 62, figs. 2a,b, and 3; pl. 63, figs. 1a,b). Its primary ribs incline forward on the lower parts of the flanks and are of variable strength. Its strongest ribs terminate in weak, radially elongate tubercles near the middle of the flanks. Its secondary ribs are uniform in strength, curve backward on the upper part of the flanks, and then curve slightly forward on the margins of the venter. On the inner whorl the primary ribs appear to be weak and nearly uniform in strength.

Figured specimen.—USNM 335960.

Occurrence.—Red Glacier Formation, 2,200-2,300 ft above base, at USGS Mesozoic loc. 21244F in Iniskin Bay Assoc. well 1 at a depth of 6,339-6,359 ft in SE¼ sec. 8, T. 5 S., R. 23 W., near Fitz Creek in the Iniskin Peninsula.

Family Sonniniidae Buckman, 1892

Genus Sonninia Bayle, 1879

Sonninia tuxedniensis Imlay

Plate 2, figure 1

Sonninia tuxedniensis Imlay, n. sp., 1964, U.S. Geol. Survey Prof. Paper 418-B, p. B32, pl. 2, figs. 5-10.

This species is represented to date in the Kialagvik Formation by one small septate specimen that in shape and ornamentation is identical with the inner whorls of the holotype (Imlay, 1964, pl. 2, fig. 10). The specimen, at a diameter of 54 mm, has a whorl height of 20 mm, a whorl thickness of 16 mm, and an umbilical width of 20 mm. The whorls bear prominent ribs that trend radially, or slightly adorally on flanks, become less prominent adorally, and nearly fade out adorally on the upper third of the outermost preserved whorl.

Sonninia tuxedniensis in the Wide Bay area has not to date been found with other genera and therefore cannot be dated precisely. By contrast, in the Cook Inlet area of southern Alaska it occurs with *Normannites, Teloceras, Chondroceras,* and *Zemistephanus* (USGS Mesozoic locs. 2999, 3000, and 21266), which association is good evidence for correlation with the zone of *Stephanoceras humphriesianum* of Europe.

Hypotype.—USNM 335970.

Occurrence.—Kialagvik Formation at USGS Mesozoic loc. 10809 in the north-central part of sec. 17, T. 33

N., R. 45 W., at the southwest side of Wide Bay in the Alaska Peninsula.

Genus Fontannesia Buckman, 1902

Fontannesia cf. F. carinata Buckman

Plate 2, figure 9

cf. *Fontannesia carinata* Buckman, 1905. Palaeontographical Soc. of London, p. CLXXXIX (p. 189): 1892, pl. 47, figs. 13, 14.
Fontannesia cf. *F. carinata* Buckman. Imlay, 1973, U.S. Geol. Survey Prof. Paper 956, p. 58, pl. 5, figs. 4-13.

One small ammonite from Puale Bay is characterized by fairly evolute coiling, a keeled venter, and fairly broad, flexuous ribs that are faint on the lowest part of the flanks but become much stronger and broader ventrally and fade out rather abruptly before reaching the keel. This ammonite shows considerable resemblance to small specimens of *Fontannesia* from eastern Oregon that were figured by Imlay (1973, p. 5, figs. 4 and 10). Its ribs do not curve backward nearly as much as in specimens of *Pelekodites* figured by Westermann (1969, p. 126, pl. 32, figs. 1 and 2).

Figured specimen.—USNM 335997.

Occurrences.—Kialagvik Formation, at USGS Mesozoic loc. 21235 on the northeast side of Puale Bay (see figs. 6 and 10) about 200 ft (61 m) below massive conglomeratic sandstone.

Family Oppeliidae Bonavelli, 1894

Genus Bradfordia Buckman, 1910

Bradfordia costidensa Imlay

Plate 1, figures 9-12

Bradfordia costidensa Imlay, n. sp. 1964, U.S. Geol. Survey Prof. Paper 418-B, p. B39, pl. 8, figs. 1-10.

This species is fairly common in the Wide Bay area in association with the ammonites *Otoites*, *Stephanoceras*, *Parabigotites*, *Eudmetoceras (Euaptetoceras)*, and *Sonninia (Papilliceras)*. It is represented in the Puale Bay area by one small, immature specimen that is associated with *Fontannesia*.

This species is characterized by an elliptical whorl section, gently convex flanks, a narrowly rounded venter, a fairly narrow umbilicus, a vertical umbilical wall, a sharp umbilical edge, and fine to fairly fine falcoid ribs that are strongest on the upper part of the flanks and become much weaker adorally on the body chamber. Small, immature forms of *Bradfordia costidensa* Imlay show more resemblance to *Lissoceras bakeri* Imlay (1962, pl. 1, figs. 1-6, 9-12), but differ by having much stronger ribbing at a comparable size and by its umbilical wall rounding more abruptly into its flanks.

Types.—Hypotype USNM 335961 and 335962.

Occurrences.—Kialagvik Formation in the Wide Bay area at USGS Mesozoic locs. 19742, 19786, 19798, 19823, 19850, 19852, 19884, 21256, 21257, and many other localities (see table 4). It occurs in the Kialagvik Formation in the Puale Bay area at USGS Mesozoic loc. 21235.

Family Otoitidae Mascke, 1907

Docidoceras (Pseudocidoceras) widebayense Westermann

Plate 1, figs. 20, 24

Docidoceras (Pseudocidoceras) widebayense Westermann, 1969, Bulls. American Paleontology, v. 57, no. 255, p. 137-146, pls. 34-37.

This species is characterized (1) by a depressed whorl section, (2) by its adult body chamber becoming more evolute adorally, (3) by its ribs changing adorally from fairly weak and closely spaced on the septate whorls to very strong and widely spaced on the body chamber, (4) by its primary ribs on the outermost whorl inclining forward on the lower third of the flanks where they terminate in small tubercles, (5) by the tubercles passing into pairs of slightly weaker secondary ribs, and (6) by the secondary ribs curving strongly adorally on the venter of the body whorl.

This species has been found at many places on the southeast side of Wide Bay and at one place on the northwest side. Associated taxa include *Sonninia (Alaskina) alaskensis* Westermann, *S. (Euhoploceras) bifurcata* Westermann, *Praeoppelia oppeliiformis* (Westermann), *Pseudolioceras maclintochi fastigatum* Westermann, and *Eudmetoceras (Euaptetoceras) klimakomphalum discoidale* Westermann. These in association show that the beds containing *D. (P.) widebayense* Westermann correlate with the European zone of *Sonninia sowerbyi.*

Hypotype.—USNM 335965.

Occurrences.—Kialagvik Formation at USGS Mesozoic locs. 12405, 19801, 19862, 19869, 21251, 21252, 31958, 32293, and 32296.

Otoites cf. O. contractus (J. de C. Sowerby)

Plate 1, figures 13-17

This genus is represented on the Alaska Peninsula by four fragments, of which two fit together as part of the body whorl and are somewhat crushed laterally. The other two specimens are much smaller, and bear very fine, closely spaced secondary ribs that outnumber the slightly stronger primary ribs about 4 to 1. Those secondary ribs greatly resemble the secondary ribs on the inner whorls of the holotype of *Otoites contractus* (J. de C. Sowerby) from England (Buckman, 1920, pl. 158) and of specimens from eastern Oregon (Imlay, 1973, pl. 39, figs. 1 and 7) and from Germany (Westermann, 1954, p. 92, pl. 1, figs. 4, 5).

The ribs on the body whorl become much coarser and sparser adorally. They arise by threes from the primary ribs at the adapical end of the body chamber and by twos at the adoral end of that chamber. The secondary ribs arise from weak tubercles on the small septate whorls and from prominent tubercles on the body chamber. The coarseness of ribbing on the body whorl is likewise comparable to that on the specimens illustrated by Buckman and Westermann as just listed.

Figured specimens.—USNM 335963 and 335964.

Occurrence.—Upper part of the Kialagvik Formation at USGS Mesozoic loc. 21257 in the Wide Bay area on the Alaska Peninsula.

Family Sphaeroceratidae Buckman, 1920

Genus Chondroceras Mascke, 1907

Chondroceras cf. C. colnetti (McLearn)

Plate 2, figures 10, 13

Two laterally crushed adult specimens resemble *Chrondroceras colnetti* (McLearn) (1929, p. 15, pl. 13, figs. 4, 5) by having high, sharp ribs that do not weaken adorally. Most of their primary ribs bifurcate, or trifurcate a little below the middle of the flanks. Most forked ribs are separated by a single rib that arises freely near the middle of the flanks. The ribbing differs from that on *C. marchandi* McLearn (1929, p. 14, p. 12, figs. 4, 5) by being much sharper and higher.

Figured specimens.—USNM 335998 and 335999.

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

Family Stephanoceratidae Neumayr, 1875

Genus Normannites Munier-Chalmas, 1892

Subgenus Itinsaites McLearn, 1927

Normannites (Itinsaites?) variabilis Imlay

Plate 2, figures 6–8

Normannites (Itinsaites?) variabilis Imlay, 1964, U.S. Geol. Survey Prof. Paper 418–B, p. B44, pl. 13, figs. 9, 12–16; pl. 14, figs. 12, 14.

Six specimens from the Wrangell Mountains are assigned to this species mainly because their ribbing changes from fine and dense on their septate whorls to fairly coarse and sparse on their body chamber. This is shown well on one lappeted adult (pl. 2, fig. 6), which greatly resembles certain paratypes (Imlay, 1964, pl. 13, fig. 13 and pl. 14, fig. 12). Because of lateral crushing the tubercles appear to be lower on the flanks of the specimens from the Wrangell Mountains than on the type specimens from north of Cook Inlet.

Hypotypes.—USNM 335973-335975.

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

Genus Stephanoceras Wadgen, 1869

Subgenus Skirroceras Mascke, 1907

Stephanoceras (Skirroceras) cf. S. (S.) leptogyrale (Buckman)

Plate 2, figures 2–5

Stephanoceras (Skirroceras) cf. *S. (S.) leptogyrale* (Buckman). Imlay, 1973, p. 88, pl. 46, fig. 15.

This species is represented by two internal molds which show the characteristics of the inner whorls very well. Those whorls bear ribs nearly as fine as those in *S. (S.) leptogyrale* (Buckman) (1924, pl. 576) from England. The outermost preserved whorl bears somewhat coarser and more widely spaced ribs than on *S. (S.) leptogyrale.*

Figured specimen.—USNM 335971 and 335972.

Occurrences.—Kialagvik Formation at USGS Mesozoic loc. 19823 and 21257, which are respectively in the NW cor. sec. 30, T. 33 S., R. 44 W., and in the NE¼SW¼ sec. 28, T. 32 S., R. 44 W., near Wide Bay on the Alaska Peninsula.

Genus Teloceras Mascke, 1907

Teloceras cf. T. blagdeni (Sowerby)

Plate 2, figures 12, 14

This species is represented by two crushed and distorted molds of which both exhibit fairly evolute coiling, coarse, widely spaced primary ribs, somewhat weaker secondary ribs, and prominent lateral tubercles. One of the specimens is an internal mold, which shows parts of three whorls of which the inner two are septate. The other specimen is an external mold, which shows parts of two whorls that closely resemble the outer two whorls shown on the internal mold. Presumably, the outermost whorl on each specimen represents part of the body chamber. On the outermost septate whorl of the internal mold the secondary ribs arise in bundles of three from four successive lateral tubercles. In addition, one secondary rib arises freely between the branched ribs along the zone of furcation. All these ribs appear to incline slightly forward.

Adorally on the outermost whorl of the external mold the ribs and tubercles become considerably stronger and more widely spaced, but the secondary ribs remain relatively much weaker than the primary ribs. The secondary ribs outnumber the primary ribs about three to one and arise mostly from the tubercles, but a few arise freely between the tubercles. All secondary ribs incline forward on the upper parts of the flanks. Similar secondary ribs are apparent on the fragmentary outermost whorl of the internal mold.

These specimens of *Teloceras* have appreciably stronger ribs and tubercles than occur on *T. itinsae* McLearn at comparable sizes (Imlay, 1964, pl. 23, figs. 9, 10, pl. 24, figs. 1-5, 7). In this respect, they show more resemblance to *T. blagdeni* (Sowerby) (Weisert, 1932, p. 168, pl. 18, fig. 2; Arkell, 1933, pl. 34, fig. 5), which in Europe characterizes the upper part of the zone of *Stephanoceras humphriesianum* (Weisert, 1932, p. 185), but has been recorded as high as the middle of the upper Bajocian (Arkell, 1956, p. 99, 278, 483).

Figured specimens.—USNM 336001 and 336000.

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

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PLATES 1 AND 2

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PLATE 1

[Figures natural size unless otherwise indicated]

FIGURES 1–4. *Asthenoceras* cf. *A. delicatum* Imlay (p. 25).

1, 2. Ventral and lateral views of specimen, USNM 335956 from USGS Mesozoic loc. 19862.

3, 4. Ventral and lateral views of specimen, USNM 335957 from USGS Mesozoic loc. 19862.

5, 6. *Hammatoceras* sp. (p. 27). Ventral and lateral views of specimen, USNM 335958 from USGS Mesozoic loc. 10806.

7. *Erycitoides howelli* (White) (p. 35). Lateral view of hypotype USNM 335959 from USGS Mesozoic loc. 21234.

8. *Erycitoides (Kialagvikes)* cf *E. (K.) kialagvikensis* (White) (p. 35). Lateral view, USNM 335960 from USGS Mesozoic loc. 21244F.

9–12. *Bradfordia costidensa* Imlay (p. 36).

9, 10. Lateral and ventral views of hypotype, USNM 335961 from USGS Mesozoic loc. 19742.

11, 12. Lateral and ventral views (× 2) of hypotype, USNM 335962 from USGS Mesozoic loc. 21235.

13–17. *Otoites* cf. *O. contractus* (J. de C. Sowerby) (p. 36).

13–15. Lateral and ventral views of adoral end of the body whorl. The fragment shown in figure 15 fits only the adapical end of the specimen shown in fig. 13, USNM 335963 from USGS Mesozoic loc. 21257.

16, 17. Lateral and ventral views (× 2) of inner whorl, USNM 335964 from USGS Mesozoic loc. 21257.

18, 19. *Tmetoceras scissum* (Benecke) (p. 27).

18. Lateral view of hypotype, USNM 335965 from USGS Mesozoic loc. 21233.

19. Lateral view of hypotype, USNM 335966 from USGS Mesozoic loc. 21234.

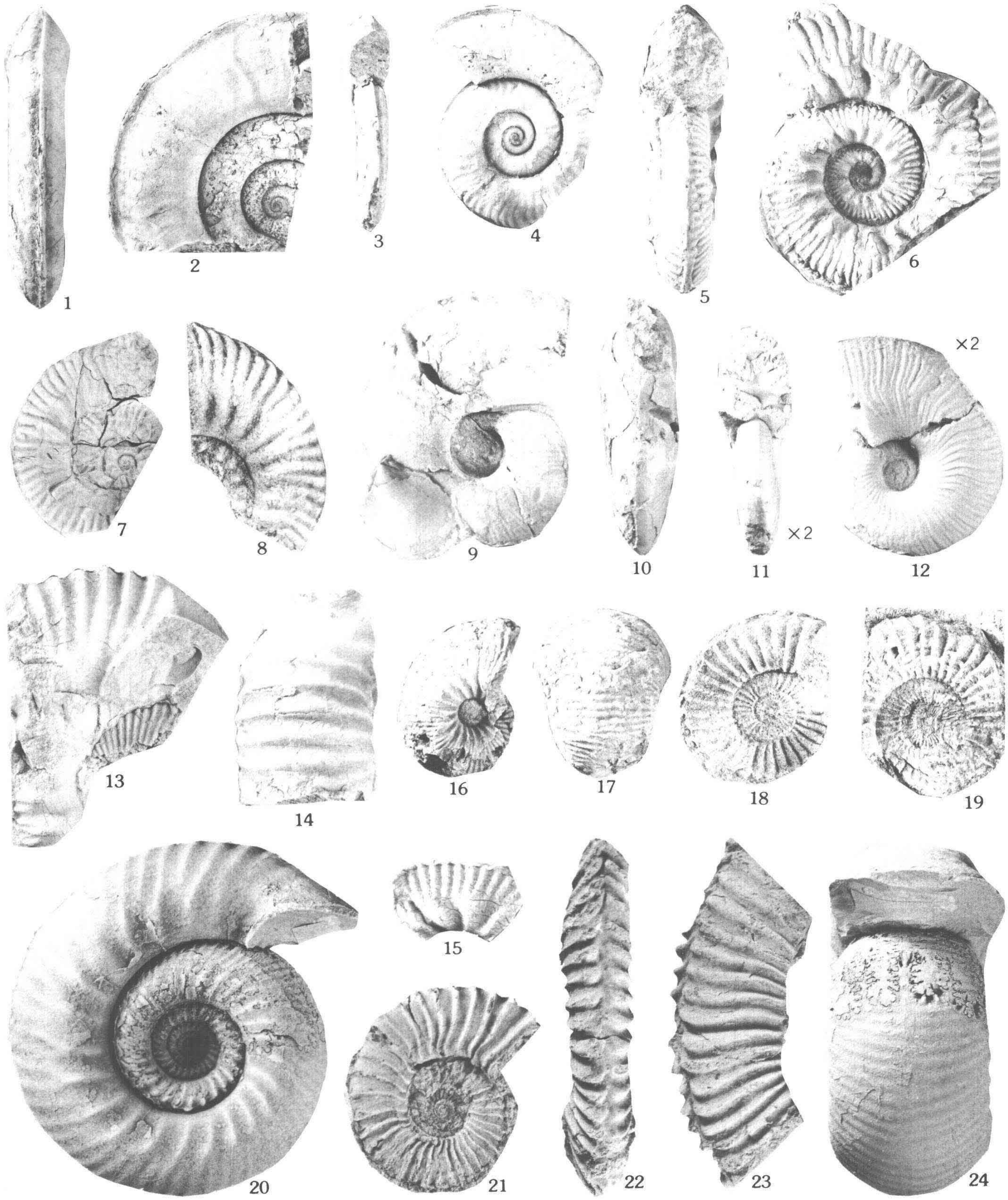
20, 24. *Docidoceras (Pseudocidoceras) widebayense* Westermann (p. 36).

Lateral and ventral views of hypotype, USNM 335967 from USGS Mesozoic loc. 19862.

21–23. *Tmetoceras kirki flexicostatum* Westermann (p. 27).

21. Lateral view of hypotype, USNM 335968 from USGS Mesozoic loc. 21254.

22, 23. Ventral and lateral view of part of an outer whorl of hypotype USNM 335969 from USGS Mesozoic loc. 21254.



ASTHENOCERAS, TMETOCERAS, HAMMATOCERAS, ERYCITOIDES, E. (KIALAGVIKES), BRADFORDIA, AND OTOITES

PLATE 2

[Figures natural size unless otherwise indicated]

FIGURE 1. *Sonninia tuxedniensis* Imlay (p. 35).
Hypotype, USNM 335970 from USGS Mesozoic loc. 10809. (p. 35).

2–5. *Stephanoceras* (*Skirroceras*) cf. *S.* (*S.*) *leptogyrale* Buckman (p. 37).
2–4. Lateral and ventral views of specimen, USNM 335971 from USGS Mesozoic loc. 19823.
5. Lateral view of inner whorls of specimen, USNM 335972 from USGS Mesozoic loc. 21257.

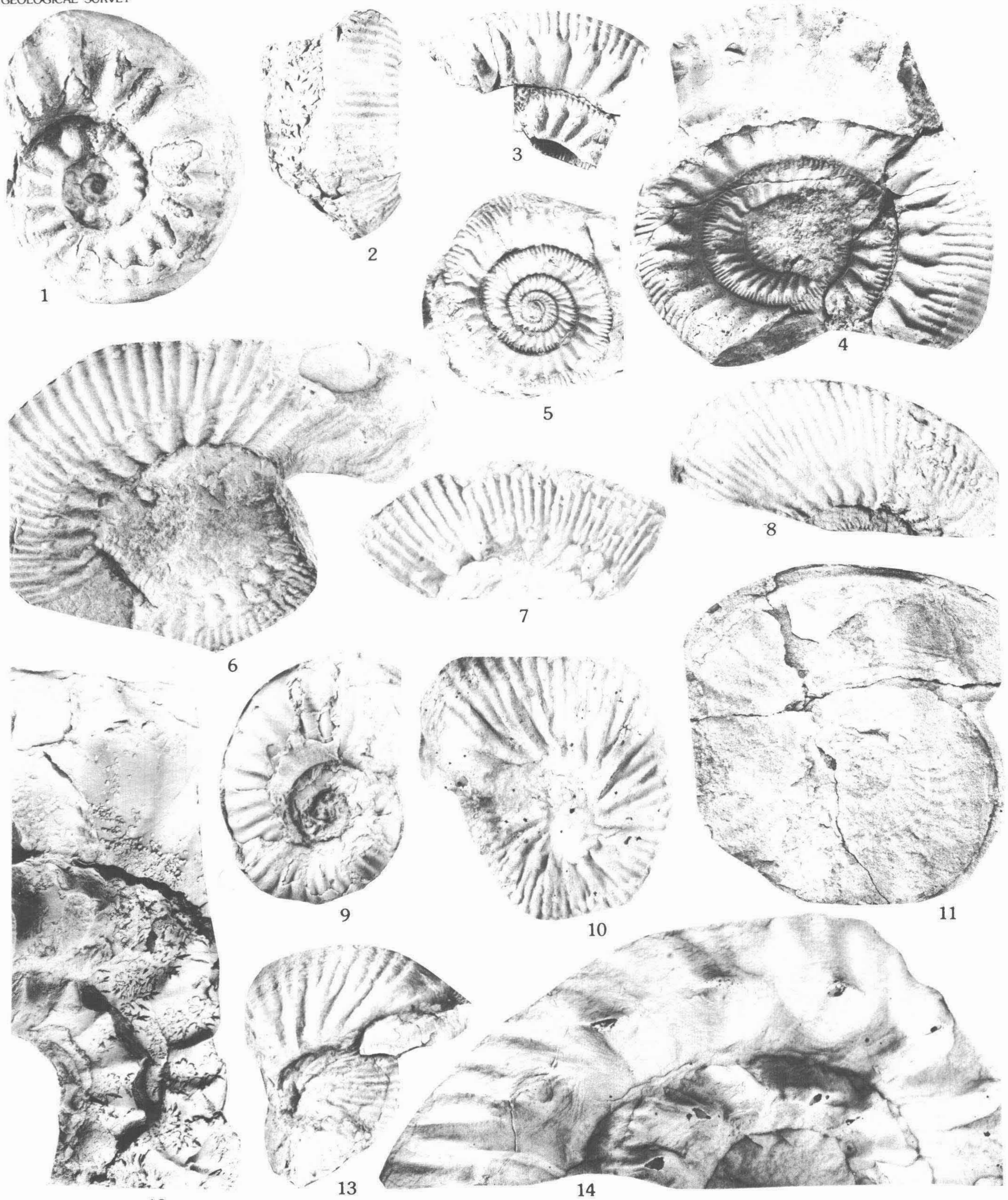
6–8. *Normannites* (*Itinsaites?*) *variabilis* Imlay (p. 37).
6. Hypotype of adult body chamber, USNM 335973 from USGS Mesozoic loc. 28682.
7. Hypotypes of adapical end of body whorl, USNM 335974 from USGS Mesozoic loc. 28682.
8. Hypotype of part of an outer whorl, USNM 335975 from USGS Mesozoic loc. 28682.

9. *Fontannesia* cf. *E. carinata* Buckman (p. 36).
Lateral view (× 2) of specimen, USNM 335997 from USGS Mesozoic loc. 21235.

10, 13. *Chondroceras* cf. *C. colnetti* (McLearn) (p. 37).
10. Lateral view of rubber cast of external mold of body whorl, USNM 335998 from USGS Mesozoic loc. 28682.
13. Lateral view of body whorl, USNM 335999 from USGS Mesozoic loc. 28682.

11. *Pseudolioceras* cf. *P. whiteavesi* (White) (p. 25).
Laterally crushed specimen, USNM 336000 from USGS Mesozoic loc. 29341.

12, 14. *Teloceras* cf. *T. blagdeni* (Sowerby) (p. 37).
12. Internal mold of specimen, USNM 336001 from USGS Mesozoic loc. 28682.
14. Rubber cast of external mold of specimen USNM 356002 from USGS Mesozoic loc. 28682.



PSEUDOLIOCERAS, SONNINIA, FONTANNESIA, CHONDROCERAS, NORMANNITES, STEPHANOCERAS (*SKIRROCERAS*), AND *TELOCERAS*

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