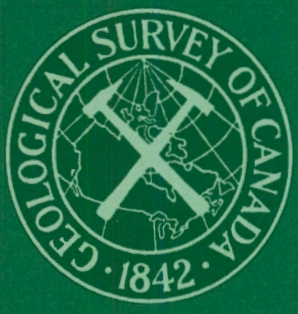

GEOLOGICAL
SURVEY
OF
CANADA

DEPARTMENT OF ENERGY,
MINES AND RESOURCES

BULLETIN 185

BARREMIAN TEXTULARIINA, FORAMINIFERIDA FROM LOWER CRETACEOUS BEDS, MOUNT GOODENOUGH SECTION, AKLAVIK RANGE, DISTRICT OF MACKENZIE

T. P. Chamney

Price $2.50

Ottawa
Canada
1969

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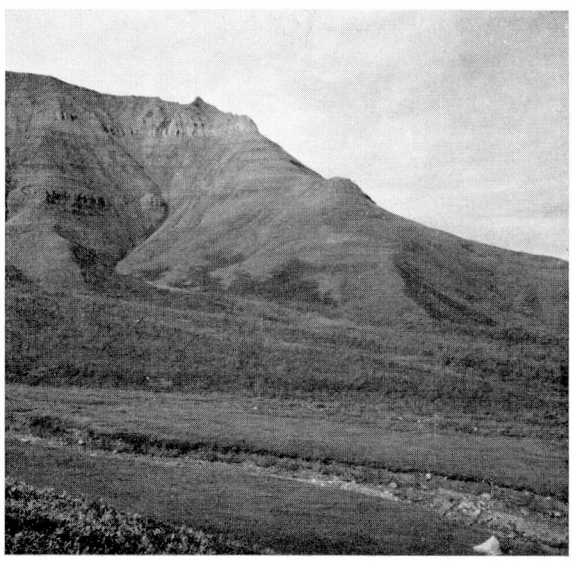
Mount Goodenough, Aklavik Range showing sampled section.



Ridge north of sampled section. Fly-camp tent on the valley floor of Mackenzie River Delta.

GEOLOGICAL SURVEY
OF CANADA

BULLETIN 185

BARREMIAN TEXTULARIINA, FORAMINIFERIDA FROM LOWER CRETACEOUS BEDS, MOUNT GOODENOUGH SECTION, AKLAVIK RANGE, DISTRICT OF MACKENZIE

By
T. P. Chamney

DEPARTMENT OF
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PREFACE

This bulletin records the results of a study of microfossils from precisely determined stratigraphic positions in a succession of Lower Cretaceous strata of Barremian age. The study provides a valuable reference section in addition to the paleontological dating and biostratigraphic criteria that contribute to the refinement of stratigraphic correlation.

Y. O. FORTIER,
Director, Geological Survey of Canada

OTTAWA, March 15, 1968

BULLETIN 185 — Textulariina des Barremiums, Foraminiferida aus Unterkreideschichten im Mount-Goodenough-Profil, Aklavik Range (Mackenzie-Distrikt)

Von T. P. Chamney

БЮЛЛЕТЕНЬ 185 — Барремские представители подотряда Textulariina (отряд Foraminiferida) из нижнемеловых слоев, района Маунт Гудинаф, хребет Аклавик, район Макензи.

Т. П. Чемный.

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Illustrations

BARREMIAN TEXTULARIINA, FORAMINIFERIDA FROM LOWER CRETACEOUS BEDS, MOUNT GOODENOUGH SECTION, AKLAVIK RANGE, DISTRICT OF MACKENZIE

Abstract

A Lower Cretaceous upper shale–siltstone division (Jeletzky, 1958) outcrops on the east flank of Mount Goodenough, west of Mackenzie River Delta. The basal beds contain abundant agglutinated forms of Foraminiferida. This microfauna comprises fourteen genera, twenty-eight determined species and one subspecies, and eight indefinite species taxa. Fourteen species and one subspecies are new. Some elements of the microfauna compare with the zone *Verneuilinoides sublithiformis* of Bartenstein (1954) from northwestern Germany, which is of Barremian (Upper Neocomian) age.

Résumé

Des couches supérieures de grès schisteux du Crétacé inférieur (Jeletzky, 1958) affleurent au flanc est du mont Goodenough, à l'ouest du delta du Mackenzie. Les couches inférieures renferment de nombreuses formes agglutinées de foraminifères. Cette microfaune comporte quatorze genres, vingt-huit espèces déterminées et une sous-espèce, ainsi que huit taxons d'espèce indéterminée. Quatorze espèces et une sous-espèce sont nouvelles. Quelques éléments de la microfaune rappellent la zone *Verneuilinoides sublithiformis* de Bartenstein (1954), dans le nord-ouest de l'Allemagne, laquelle est d'âge Barremien (Néocomien supérieur).

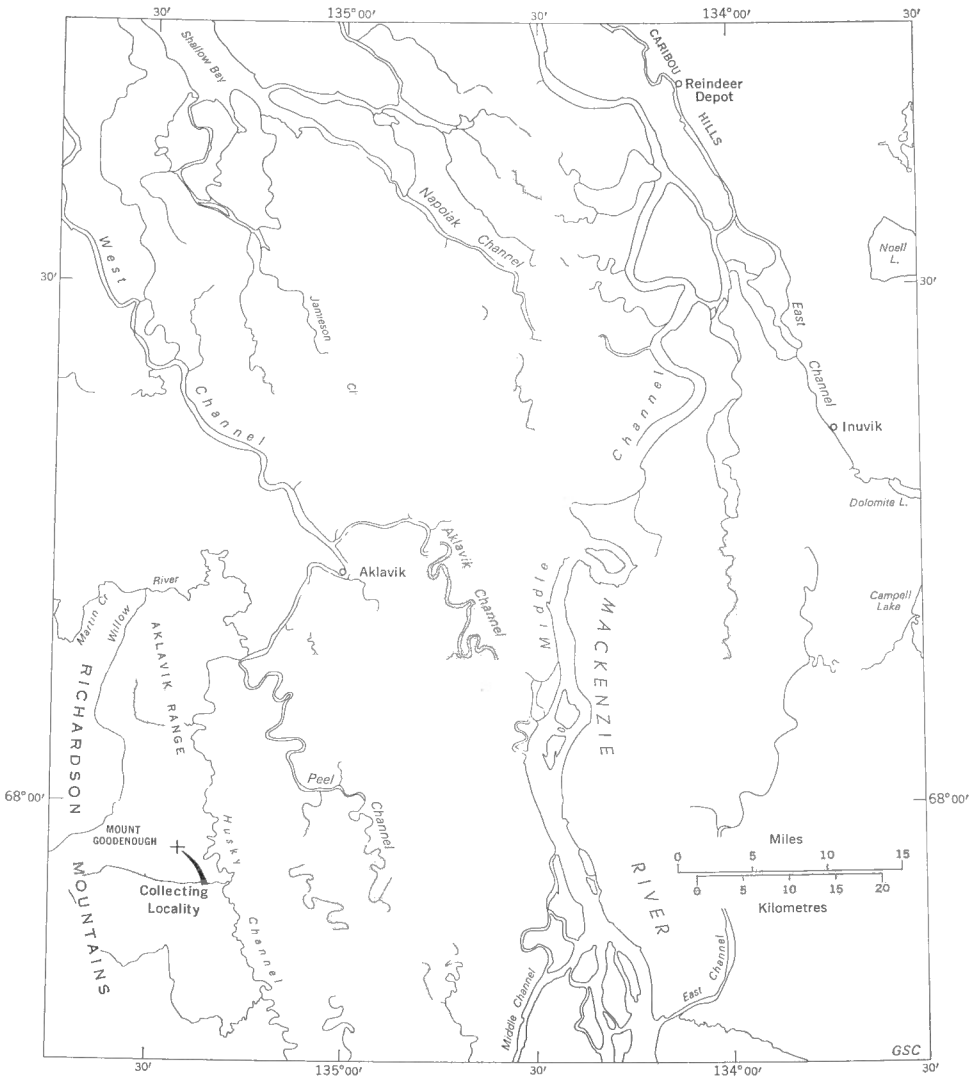

FIGURE 1. Map showing location of Mount Goodenough.

INTRODUCTION

Location and General Features of Area

The described Lower Cretaceous Foraminiferida are from the rock-stratigraphic interval designated by Jeletzky (1958) as the lower member of the upper shale–siltstone division. The samples were collected in July 1962 along the prominent spur running northeast from Mount Goodenough on the Aklavik Range of the Richardson Mountains, District of Mackenzie. This area is about 50 miles south of the Arctic Ocean on the west bank of the Mackenzie River Delta and about 2 miles north of Goodenough Creek, latitude 67°57′10″N, and longitude 135°25′19″W, Map 106 M5 of the National Topographic System. The microfossils were recovered from the rock unit 1 (Fig. 2).

The area was reached by helicopter from Operation Porcupine field camp at Horn Lake north of Rat River. Charter aircraft are obtainable at Inuvik or Aklavik approximately 50 and 25 air miles respectively to the east. Float-equipped aircraft can land on the West Channel within a mile of the Mount Goodenough section.

The main features of the geology and structure of the region have been described in a series of papers by J. A. Jeletzky (1958, 1960, 1961a, 1961b). The major structural feature is the Donna River Fault trending north-south, about 3½ miles west of Mount Goodenough. Between this fault and Mount Goodenough are the Goodenough Creek Fault, an unnamed fault, and the Jimmy Creek Fault. Jeletzky (1961a) states that the eastern flank of the Richardson Mountains forms a separate structural zone of intense faulting as opposed to the more regularly folded central area and is also distinct from the essentially stable belt to the east.

The immediate area contains Upper Jurassic to late Lower Cretaceous and possibly early Upper Cretaceous rocks, including marine deposits representing the Neocomian stage. To the south in the region of the Peel Plateau and Eagle Plains, this interval apparently is not represented and the younger Lower Cretaceous (Albian) sediments rest unconformably on older Mesozoic and Paleozoic rocks. The general geology of the area is shown on GSC Map 10-1963 based on data obtained during Operation Porcupine, 1962.

This report provides one of the first detailed descriptions of the microfauna from the Neocomian of Arctic America. Considerable data on the Alaskan Cretaceous have been published by the United States Geological Survey (Tappan,

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1957, 1961, 1962), but the foraminiferal zonation pertains only to beds younger than the Okpikruak Formation in which Foraminiferida were reported as rare. The writer has used the general stratigraphic and macrofossil framework of Jeletzky (1958, 1960, 1961a). Biochronological inferences from foraminiferal recovery are reported in the discussion of previously published species.

Acknowledgments

The writer gratefully acknowledges the laboratory assistance of D. L. Herron. M. J. Copeland and J. H. Wall contributed valuable critical comments, additional guides for general presentation were provided by J. A. Jeletzky and R. T. D. Wickenden. The new *Treatise on Invertebrate Paleontology,* Part C, Protista 2, had not been published prior to completion of the manuscript. A personal visit to the authors of the *Treatise,* A. R. Loeblich, Jr., and Helen Tappan, was most helpful. These authors kindly contributed a copy of the Foraminiferida classification used in their publication.

STRATIGRAPHY

Rock Unit Sequence

The term upper shale–siltstone division as introduced by Jeletzky (1958) is the only published rock-stratigraphic designation for the sequence of strata under investigation. He considers that these beds are equivalent in age to the upper part of the Isachsen sandstone in the Arctic islands.

The field section CR6-N62 (0 to 110 feet) of this report is equivalent approximately to the lower part of Jeletzky's zone B (1961a), underlying the *Crioceras* (*Crioceras*) cf. *emerici* subzone of the basal *Crioceras* (*Haplocrioceras*) cf. *remondi* zone of the Barremian. The microfossil control will contribute to a more exact correlation of the exposed sections within the faulted Aklavik Range where very few macrofossils have been collected. Jeletzky (1961a, Correl. Chart, Sec. 1) reports a "regional unconformity" between this upper shale–siltstone division and the underlying lower sandstone division. The section comprising this stratigraphic succession was measured and sampled by the writer on Treeless Creek (CR4-N62) about 10 miles southeast of Mount Goodenough. A tentative correlation of the upper shale–siltstone division at this time would place the unconformity about 250 feet stratigraphically below the base of rock unit 1.

The total section exposed at this Mount Goodenough location has been sampled, processed, and examined for microfossils. The upper limit of the stratigraphic interval used in this report was selected on the basis of the microfaunal change from predominantly agglutinated, benthonic foraminifers to a fauna containing increasing numbers of calcareous lagenid species. The lower contact occurs at the top of the grass-covered slope on the west bank of the Mackenzie River Delta (*see* Frontispiece).

Because of the alluvium and scree cover, samples were obtained from hand-dug pits and trenches throughout this lower part of the Mount Goodenough section. Micropaleontological samples were collected sequentially every 10 feet or less by means of trench sampling where lithological change occurred. The predominant lithologic type consists of moderately hard, resistant mudstone composed of equal proportions of silt and clay. Shale is present in the intervals from 10 to 20 feet, from 50 to 60 feet, and from 90 to 100 feet. Clay-ironstone concretions and 3-inch-thick clay-ironstone beds occur throughout the section, increasing in number towards the top. Figure 2 represents the lithological column of the total section with remarks on the more significant lithologic types. It also includes the time-stratigraphic equivalents of Jeletzky (Correl. Chart, 1961).

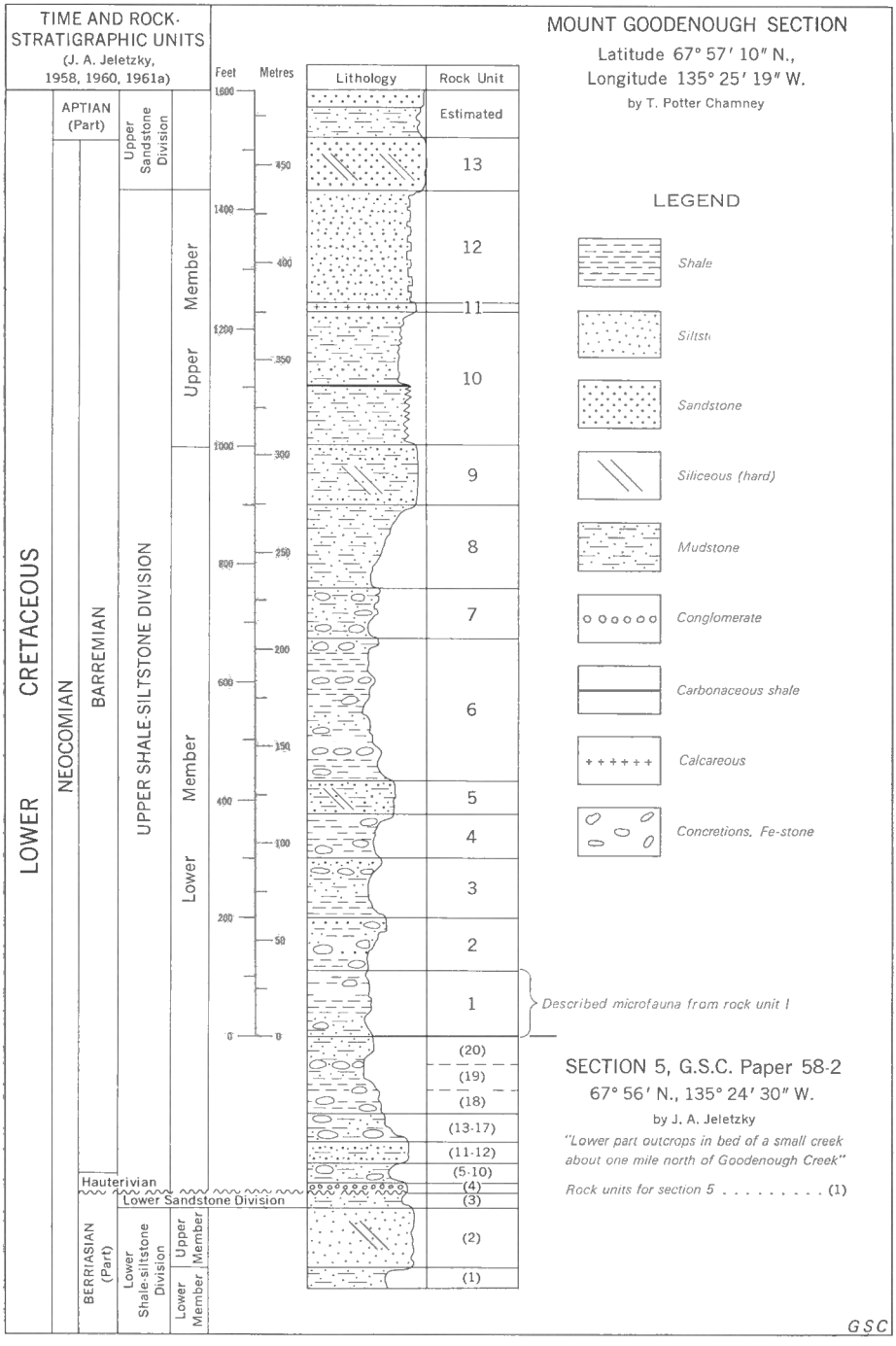

FIGURE 2. Stratigraphic relationships of the upper shale–siltstone division (Barremian) of the Mount Goodenough section.

Lithology

Section measured on northeast spur of Mount Goodenough 2 miles north of Goodenough Creek.

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Upper Sandstone Division		
13	Sandstone, light grey to buff, some rusty ferruginous staining, quartzose, hard, flaggy-weathering in upper part with 10-foot thick, massive, basal unit forming a vertical cliff. Additional section exposed above but inaccessible	65	1,505
	Upper Shale–Siltstone Division		
	Upper Member		
12	Siltstone and some interbedded sandstone, grey; alternating softer argillaceous and harder siliceous layers resulting in somewhat flaggy weathered surface. Many parts of the cliff face were scree-covered and inaccessible	180	1,440
11	Limestone, very arenaceous and argillaceous; abundance of pelecypod shells; hard, platy-weathering fragments	5	1,260
10	Siltstone, dark grey, becoming very sandy in the basal 25 feet, friable in part with poor exposures	250	1,255
	Lower Member		
9	Sandstone, grey to light grey when weathered; some yellow, ferruginous staining; some crossbedding and laminations; very silty in part; argillaceous intervals contain abundant worm burrows in reef-like masses; whole interval quite resistant, forming the first prominent ridge below unit 13	100	1,005
8	Mudstone, grey, alternating hard and soft, arenaceous intercalations, becoming more indurated at the base; interbedded ferruginous, stained shale; a minor ridge-former, covered in part	125	905
7	Mudstone, medium grey to dark grey, very shaly in part; few occurrences of ironstone concretions increasing in number towards the base; carbonaceous, intercalated shale beds at base associated with iron carbonate crystals, marcasite, and ferruginous staining	100	780
6	Shale, dark grey to dark brown, indurated, silty in part, iron-stained to lighter yellow-brown; abundant clay-iron concretions of very odd shapes from ¼ inch to 12 inches in diameter. Indurated shale part about 70 feet above base forms a prominent 15-foot cliff	250	680
5	Sandstone, ash-grey to grey, argillaceous and silty in the lower part with thin, black, underclay at the base; some 3-inch thick yellow, limonitic beds	60	430
4	Shale, dark grey, slightly silty, three to four major levels of clay-ironstone concretions, red-brown weathering; increasingly silty upward, more indurated at the top	70	370
3	Mudstone, dark grey, indurated, grading to softer, silty shale at the base with "rosette" siderite crystals; worm burrows, flow casts and clay-ironstone concretions in the upper part	100	300

Unit	Lithology	Thickness (feet)	Height above base (feet)
	Lower Member (cont.)		
2	Mudstone, grey, weathering ash-grey; clay-ironstone concretions in the lower part, fewer concretions in the upper part with increasing hardness and silt content; sandstone, silty and argillaceous at the top	90	200
1	Mudstone, grey to ash-grey, and interbedded dark grey shale; various sizes and shapes of clay-ironstone concretions at base with slightly more silt content	110	110

Economic Significance

The economic significance of this sedimentary sequence is based on its potential as a hydrocarbon reservoir. The regional evaluation of this depositional interval shows two favourable factors: (1) the sequence thins rapidly from northwest to southeast partly because of depositional thinning and partly because of pre-Albian erosion; (2) to the northwest, the sequence contains thick, marine, hydrocarbon source beds. The thinning of this wedge to the southeast reduces the stratigraphic separation between the basal sands of Late Jurassic and Early Neocomian ages and the overlying sands of Early Albian and Aptian ages. In the vicinity of the feather edge of the Neocomian these two porous sands are separated by the unconformity which should act as a passageway for migrating intrastratal fluids.

It is interesting to note the great similarity between the depositional setting of the Neocomian sequence in the Hudson Hope area of northeastern British Columbia and the present area. In northeastern British Columbia the Neocomian sediments comprise a much thicker sequence of coarser clastics. Few foraminiferida have been recovered from these strata probably because of inhospitable conditions owing to low salinity or brackish water. Here too, the wedge of Neocomian diminishes rapidly to the east.

PALEONTOLOGY

Microfauna and Correlation

The present study is a contribution to the northern mapping project of Operation Porcupine. It is a systematic description and illustration of Foraminiferida from the suborder Textulariina recovered from rock unit 1 (Fig. 2). This relatively thin, vertical interval was chosen because it shows maximum optimum frequency of occurrence of agglutinated foraminifers in the Barremian stage. The microfauna described is an integrated assemblage. Microfaunal subdivisions in the overlying sequence may show the disappearance of certain species from this microfauna and the first appearances of new species.

Related species of the suborder Textulariina are grouped because of the predominance of these benthonic, agglutinated forms throughout the Lower Cretaceous of western and northern Canada. They contribute up to ninety per cent of the recoverable microfauna and are often the only available fauna throughout relatively thick, stratigraphic sequences. Their application to field mapping as criteria for biostratigraphic correlation has proven most useful. Subdivisions of rock units based on the presence of these forms do not necessarily constitute biochronological indices. With sufficient density of control from additional stratigraphic sections, time-stratigraphic equivalencies can be interpreted.

The more primitive, agglutinated species of foraminifers are relatively more difficult to identify than the calcareous forms. When reporting microfauna micropaleontologists tend to ignore this group in favour of the more obviously different calcareous species. Another reason for this one-sided reporting is the erroneous belief that calcareous foraminifers are planktonic. On the contrary, of the many genera of Foraminiferida, there are approximately only twelve that are truly planktonic (Loeblich, *et al.,* 1957). Of these only three or four genera have been recovered from the pre-Tertiary rocks of western and northern Canada.

The textulariinid microfaunal assemblage of this report comprises fourteen genera with a total of twenty-eight species. The distribution of the species recovered within the stratigraphic interval of rock unit 1 is shown in Table I. Some of the descriptions in the taxonomic section indicate the biochronological significance of the fourteen previously established species. These fourteen species provide the only biochronological correlation by textulariinids available at present. The Neocomian stage in North America has had very little micropaleontological study; the classical reference for this age of microfauna is in northwestern Germany (Hecht, 1938). *Gaudryina tappanae* n. sp. has been compared with some of the indistinct figures of Hecht's *Verneuilina* D4 (*Verneuilinoides sublithiformis* Bartenstein, 1954). The basal beds of the Mount Goodenough section may then

be correlated within the zone *Verneuilina* D4 of the Barremian stage. The total stratigraphic range of *Ammobaculites reophacoides* Bartenstein (1953) has not been established in the Mount Goodenough section but is reported in rock unit 1 and it may range above and below this unit. Hecht (1938) has established a zone in the upper Barremian on the basis of this species but additional control is

Feet from base	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110
Ammobaculites reophacoides Bartenstein		/	/	•				×	/		
A. erectus Crespin					o	×		/	/		
A. sp.				/				×	o		
Ammodiscus mackenziensis n. sp.			o		o	/			o		/
A. sp.											/
Bathysiphon scintillata n sp.			/	o	•			×	o		
B. granulocoelia n. sp				•				×	/		
Gaudryina tappanae n. sp	/	o	/	o	×	o	×	•	×	×	/
Glomospira subarctica n. sp.		/	/	×	•	o	/	×	•		/
G. subarctica saturna n s sp		/	•	×		/					
Glomospirella arctica n sp.		o	•	/	•	/	o				/
G. sp		/	×	/			•				
? *Glomospirella elongata* n sp.				/	/						
Haplophragmium cf. *H. aequale* (Roemer)			•	•							
Haplophragmoides goodenoughensis n sp	o	o			/		/	o			/
H. inflatigrandis n. sp.	/	■	o	o	o	o	o	•	o	×	/
H. coronis n. sp	/	o	•	/	×						
H. duoflatis n. sp.		o	×		/	/	/		•	/	o
H. cf. *H. duoflatis*				/	/	/	/				
? *H.* sp		/		/	/				/		/
H. spp undif						×	×			×	
? *Hyperammina* cf. *H. acicula* (Parr)					/	•					
H. cf. *H. aljutovica* Reitlinger					/	×		/			
Hippocrepina cf. *H. barksdalei* (Tappan)					/	×					
Proteonina cf. *P. arenosa* Crespin	•	×									
? *Proteonina* sp		×	×								
? *Psamminopelta* cf. *P. bowsheri* Tappan			×		/		×				
Textulaxia cf. *T. topagorukensis* Tappan	/	×	•	/							
Reophax tundraensis n. sp				•	/	o	o	/			/
Thuramminoides septagonalis n. sp.		/			/		o				/
Trochammina squamata (Jones and Parker) var. *limbata* Chapman	×	/	/		/		•		•		/
Saccammina spp.	•		/		o						
Trochammina conicominuta n sp.			? ×	o	×	•	? ×				
T. spp.										×	×

GSC

LEGEND

Quantitative Legend for 100 gram disintegrate

Present . . . . . × *Rare (1)* . . . . . •

Few (2-5) . . . . . / *Common (6-20)* . . . . . o

Abundant (>20) . . . . . ● *Extremely abundant (>50)* . . . . . ■

TABLE I. ***Distribution of Textulariina from rock unit 1, lower member of upper shale–siltstone division.***

required from the upper beds of Mount Goodenough before such detailed biochronological subdivisions can be interpreted.

Calcareous species representing the subfamily Nodosariinae have been recovered from each sample collected from the beds on which this report is based. The genus *Lenticulina* is most common and a few fragments of *Nodosaria* sp. occur. Other calcareous species include *Quinqueloculina* sp., *?Quadrimorphina* sp., and representatives of the subfamily Polymorphininae.

Ostracods are rare, only two poorly preserved specimens having been found. Megaspores or large plant spore cases are fairly abundant and possibly present in sufficient numbers throughout the total section to provide an additional class of organisms for biostratigraphic application. The presence of a species of *Triletes,* a large, lobate form having three peripheral, bulbous lobes within each trilete sector, is noteworthy. *Triletes* spp. dominate the megaspore assemblages and are accompanied by rare *Chrysotheca* sp.

Preparation

The indurated nature of the rocks necessitated disintegration processes other than the standard method (Chamney, 1957). Extreme amounts of iron together with manganese staining and cementation were counteracted by the use of hydrogen peroxide (35%) and ultrasonic cleaning (2,000 vps) in an ionic dispersal reagent. The most effective utilization of reagents for rock matrix dispersion required the prior and complete extraction of connate or meteoric water from the rock sample. Residues containing abundant sand that impeded the picking process were subjected to electromagnetic separation with the Franz Isodynamic Separator. The most effective elimination of quartz grains was obtained by a setting of 20 degrees forward slope (tilt) and 5 degrees side slope (cant). Variation in electrical input was governed by the degree of mineralization by iron salts, such as pyrite, melanterite, siderite, and others. The range in input setting was from 0.4 to 1.4 amperes.

Illustration

It was necessary to reduce light reflection from the lustrous, highly siliceous specimens for photomicrography. An effective method was developed by placing each specimen in a very small (No. 200) mesh screen spoon, immersing it in a boiling solution of Alconox and then in a hot solution of household bleach. When dried, a very thin, white, surface film remained on the specimen; excess whitening was easily removed with water and a very fine brush. Photomicrographs were taken with a bellows camera and Photar lens objectives in a quadruple nosepiece microscope. Illumination was obtained from a substage light source utilizing a suprastage parabolic mirror which reflected back to the specimen on the stage. Photo print retouching was primarily confined to elimination of dust and foreign particles adhering to the specimens. Excessive highlights were subdued and the suture lines impressed in some specimens.

Taxonomic Aids

Comparison of species from the present study with previously established species was made with the aid of graphs for the generic comparison of taxonomic criteria. Each species of a genus from Ellis and Messina and additional current publications was plotted on the graph by means of an index number system. The major taxonomic criteria selected for plotting varied with the genus but included measurable parameters such as length, width, thickness, diameter, height, number of chambers, number of whorls or coils. Most genera required two graphs, each with ordinate and abscissa values in order to record four major, taxonomic criteria. In many instances only three measurable parameters could be obtained for the purpose of constructing a generic graph; two of these such as length and width, completed one graph and a single third criterion such as numbers of chambers, could not be paired to complete the second graph. For this reason the "Taper Factor" was selected as a significant taxonomic feature applicable to linear serial forms of trocho-spiral forms. There is a definite advantage in recording a discrete factor for the tapering of many foraminiferal tests. The common method of describing the taper of a species as slight, rapid, gradual or flaring is a subjective value and is not consistent from one worker to another.

Many of the early nineteenth century species descriptions were found to be incomplete. To obtain the critical dimensions from these old publications a continuous Linear Enlargement Calculator was designed and constructed on clear celluloid. By placing this template over a figured specimen of known magnification the required dimensions were obtained with considerable accuracy. If only one dimension was given, the magnification could be determined and all other required dimensions obtained. The template was also useful in selecting magnifications for any size range of specimens in order to construct a uniform, figured, specimen size on the final plate.

Classification of Foraminiferida

Loeblich and Tappan (1961a, 1961b, 1964) have recently completed and published a most exhaustive international review and generic revision of the subphylum Sarcodina. They generously made available to the writer a mimeographed preprint placing all the genera within the emended systematics of the order Foraminiferida, so that this present research could be completed within the new framework of classification. The following classification is taken from the suprageneric classification of the Rhizopodea of Loeblich and Tappan (1961a).

Kingdom	PROTISTA
Phylum	PROTOZOA
Subphylum	SARCODINA
Class	RHIZOPODEA
Subclass	GRANULORETICULOSIA
Order	FORAMINIFERIDA
Suborder	TEXTULARIINA

SYSTEMATIC DESCRIPTIONS

Family ASTRORHIZIDAE Brady, 1881

Genus *Bathysiphon* M. Sars, 1872

Bathysiphon scintillata n. sp.

Plate I, figures 1–3

Description. Test free, elongate, consisting of an undivided tubular chamber with slight, irregularly spaced indentations and projections along the test; sides of test regularly parallel, conforming to the constrictions along the test wall; wall is 0.44 mm in average thickness and composed of agglutinated, fairly well sorted, fine, quartz grains with a scintillating lustre from minute quartz crystal faces; amount of siliceous cement is greater than that of agglutinated grains giving a slightly lustrous appearance; aperture terminal at open end of tube and usually oval due to slight compression of test.

Measurements in millimetres.

GSC Type Specimen	Illustration		Length	Width	Wall Thickness
	Pl.	fig.			
Holotype 19753	I	1	0.72	0.208	0.044
Paratype 19754	I	2	0.88	0.240	0.048
Paratype 19755	I	3	0.86	0.320	0.060

Distribution. The relatively resistant silica test wall enables recovery of this species in considerable quantity from several localities of equivalent strata. Recovery from rock unit 1 at Mount Goodenough is from 20 to 90 feet (Table I) indicating a common occurrence.

Discussion. The species is similar in size to the upper Paleozoic species of *Hyperammina* such as *H. elegans* Rauser-Chernousova, 1937, and *H. elongata* Brady var. *clavatula* Howchin, 1888. The nearly parallel sides and agglutinated test wall structure is similar to that of *B. anomalocoelia* Tappan, 1955, but *B. scintillata* n. sp. is much smaller and has a slightly more granular texture. There is also some similarity with the Middle Albian *Bathysiphon* sp. A Stelck and Wall, 1956, but the much thicker wall of *B. scintillata* n. sp. is very distinctive.

Bathysiphon granulocoelia n. sp.

Plate I, figure 4

Description. Test free, elongate, consisting of an undivided tubular chamber, slightly flattened; the sides are not always parallel throughout the segment length and some are very slightly tapered; test wall is thick and composed of poorly sorted, small- to medium-size, quartz grains embedded in silica cement; wall texture rough with irregularly adhering larger particles; aperture ovoid at open end of the tube.

Measurements. Holotype, GSC No. 19756, figure 4, length 0.96 mm, maximum width 0.40 mm, wall thickness variable but average 0.05 mm.

Distribution. This species is associated with *B. scintillata* but is not as common. Its larger size and coarser agglutinated test wall make it a more fragile species. The species is known to range in age from Late Jurassic to Late Neocomian and has been recovered from 30 to 90 feet in the Mount Goodenough section (Table I).

Discussion. The position of this species on the graph of taxonomic criteria is just below the general group of *B. anomalocoelia* Tappan, 1955, and *B. vitta* Nauss, 1947. It is smaller in all dimensions, more coarsely textured and thinner walled. Possibly this species is an intermediate form between the Jurassic *B. anomalocoelia* and the Upper Cretaceous *B. vitta.*

Genus *Hyperammina* Brady, 1878

?*Hyperammina* cf. *H. acicula* (Parr) *fide* Crespin, 1958

Plate I, figures 5a, b

Hyperamminoides acicula Parr, 1942, p. 105, Pl. II, fig. 4.
Hyperammina acicula (Parr) *fide* Crespin, 1958, p. 44, Pl. 5, fig. 11; Pl. 6, fig. 7.

Description. Test free, elongate, tubular, tapering, very narrow at initial end and flaring rapidly for about one half of the total length of the test, gradually widening thereafter; tube constricted at irregular intervals but not septate; at least three constrictions in the early test development and only one major constriction in the remaining two thirds of the test; wall smooth, thick, slightly translucent, composed of poorly sorted quartz grains with abundant siliceous cement, initial portion devoid of adventitious material in the figured specimen; aperture circular, but many specimens compressed, with an elongate aperture.

Measurements. Length of hypotype GSC No. 19757 is 0.96 mm, maximum diameter of the tube 0.34 mm, taper factor 2.8.

Distribution. Only a few specimens have been recovered from the middle part of rock unit 1 of the Mount Goodenough section where they are associated with *B. scintillata* n. sp. The hypotype illustrated was recovered from the 40- to 50-foot interval.

Discussion. This species somewhat resembles *H. acicula* Parr *fide* Crespin, 1958, except for the great length of *H. acicula* (6.00 mm). The species *H. protea* is reported by Crespin to be comparable to Parr's *H. acicula* but is very much smaller.

Hyperammina cf. *H. aljutovica* Reitlinger, 1950

Plate I, figure 6

Hyperammina aljutovica Reitlinger, 1950, Trudy Inst. Geol. Nauk., Akad-Nauk., SSSR, vyp. 126, Geol. Ser. No. 47, pp. 1–126, pls. 1–122.

Description. Test free, elongate, tubular, open at both ends; slight constrictions at irregular intervals along the test; wall is somewhat coarse with irregular areas of adventitious material contributing to the constricted appearance of the test.

Measurements. Hypotype GSC No. 19758, length of test 0.40 mm, greatest diameter 0.05 mm. Other specimens range in diameter up to 0.09 mm.

Distribution. This species has been recovered from beds in the 40- to 80-foot interval of rock unit 1 of the Mount Goodenough section, but is known to range stratigraphically higher in the overlying strata.

Discussion. The very minute specimens of this species are very similar in diameter to *H. aljutovica* Reitlinger; preserved segments vary considerably in length. Similar minute forms are quite common in other sections of the Lower Cretaceous and are considered to be biostratigraphically significant.

Genus *Hippocrepina* Parker in Dawson, 1870

Hippocrepina cf. *H. barksdalei* (Tappan), 1957

Plate I, figures 7a, b

Hyperamminoides barksdalei Tappan, 1957, U.S.Nat. Mus., Bull. 215, p. 202, Pl. 65, figs. 6–12. Tappan, 1962, U.S. Geol. Surv., Prof. Paper 236-c, p. 129, Pl. 29, figs. 21–27.

Description. Test free, flattened, elongate, consisting of one undivided chamber, somewhat flaring, apertural end slightly constricted; wall comparatively thin as indicated by the collapsed nature of all tests; finely arenaceous with more siliceous cement than agglutinated material resulting in a smooth surface; rounded aperture, with a faint indication of a collar around the opening.

Measurements. Length of hypotype GSC No. 19759 is 0.53 mm, width 0.30 mm, maximum thickness 0.18 mm.

Distribution. The species is rare in rock unit 1 of the Mount Goodenough section but numerous similar specimens have been obtained from younger Lower Cretaceous beds of the northwestern Canadian basin.

Discussion. There is a slight difference between the present specimens and the type material of *H. barksdalei* in that the constrictions of the elongate sack at the

apertural end are not very marked. This species appears to be a transitional form between the genus *Hippocrepina* (Parker) and the genus *Sacculinella* Crespin (not *H.* cf. *brosgei* Tappan *fide* Crespin, 1963).

Family SACCAMMINIDAE Brady, 1884

Genus ***Thuramminoides*** Plummer, 1945

Thuramminoides septagonalis n. sp.

Plate I, figures 8–11

Description. Test free, flattened, consisting of one ovate chamber, possibly inflated in its original state; outline distinctly seven-sided and test always collapsed centrally; wall composed of uniform, very fine, quartz grains, with a very high proportion of siliceous cement, somewhat lustrous, smooth surface, inner wall reticulate (fig. 8b), outer wall has incipient nodes at junction of septagonal angles; apertural protuberances rare on available specimens, incipient openings into apertures shown in Pl. I, figs. 8b and 11b.

Measurements in millimetres.

GSC Type Specimen	Illustration		Diameter		Thickness
	Pl.	fig.	Max.	Min.	
Holotype 19760	I	8	0.32	0.32	0.11
Paratype 19761	I	9	0.4	0.39	0.11
Paratype 19762	I	11	0.4	0.33	0.2
Paratype 19763	I	10	0.51	0.39	—

Distribution. The species ranges throughout rock unit 1 of the Mount Goodenough section from 10 to 110 feet and are few to common in occurrence (Table I). The septagonal outline is distinctive. This together with the primitive form and its tolerance to considerable environmental change makes it a valuable biostratigraphic marker.

Discussion. The dark areas shown in Plate I, figures 8b and 11b are caused by pyrite filling of the unilocular chamber. The illustrations have been oriented with the most prominent apertural protuberance uppermost. The dark areas can be seen to continue into some of the nodes formed by the junction of septagonal angles of the test shape; multiple apertures are thus indicated. This species is very similar to undescribed species of *Saccammina* (sp. 1300 Yorath, 1962) from the Deer Bay Formation of the Arctic Archipelago. It is smaller and has a thicker wall than *Thuramminoides sphaeroidalis seta* Plummer, 1945, and *Thurammina tendami* Bartenstein, 1952. *T. septagonalis* n. sp. does not have the abundant tuberosities and apertural protuberances of the latter species.

Family AMMODISCIDAE Reuss, 1862

Genus *Ammodiscus* Reuss, 1861

Ammodiscus mackenziensis n. sp.

Plate II, figures 1–5

Description. Test free, discoidal, consisting of a proloculus (0.10 mm), and long, undivided, planispiral, evolute second chamber of 4½ coils; slight overlap of the last two coils; the final coil is notably larger in diameter; wall with variable proportions of silica cement to quartz grains resulting in textures from moderately granular to coarsely agglutinated; thin, translucent in moderately granular specimen, easily fragmented in coarsely agglutinated specimen; aperture at the open end of the tubular chamber.

Coarsely agglutinated specimens (figs. 4, 5) appear to have approximately one less coil, but possibly the coarse, granular covering over the initial coils in the prolocular area obscures observation of all coils.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Thickness	No. of Coils
	Pl.	fig.	Max.	Min.		
Holotype 19764	II	1	0.80	0.80	0.128	4–5
Paratype 19765	II	2	?0.80	0.58	0.096	4–5
Paratype 19766	II	3	0.67	0.60	0.120	4–5
Paratype 19767	II	4	0.80	?0.80	0.122	4
Paratype 19768	II	5	0.78	0.56	0.140	4

Distribution. This species is usually associated with *Glomospirella* spp. in the Lower Cretaceous (Neocomian) of the northern Canadian sedimentary basins. The Mount Goodenough specimens were obtained from the interval from 20 to 110 feet and are common in occurrence. There is considerable pyrite in-filling of the tests. Very similar species have been recovered from the Early Albian.

Discussion. This species belongs to the general group of *A. mangusi* Tappan, 1957, and *A. cheradospirus* Loeblich and Tappan, 1950b, when the dimensions and number of coils are plotted. The wall composition appears more variable; changing from smooth and very siliceous with scattered, fine- to medium-sized, quartz grains, to granular and arenaceous. The test wall is thin, and the pyrite filling shows through the translucent wall. The thin wall is further indicated by the abundance of fragmentary remains. Distortion of the test is common and in laterally compressed specimens the plane of the initial coils is distorted to the extent that it simulates a glomospirellid arrangement. Other species related to this group are *A. gigantius* Myatliuk, 1939, and *A. pleurotomaroides* Chapman, 1894. A similar species has also been recorded from the Deer Bay Formation in the Canadian Arctic Archipelago as *Ammodiscus* sp. A Yorath (1962).

Ammodiscus sp.

Plate II, figures 6a, b

Description. Test free, discoidal, consisting of a proloculus and long, undivided, planispiral, evolute second chamber forming three to four coils that increase gradually in diameter; wall very thin, composed of a large proportion of silica cement and a small proportion of very fine to fine quartz grains; texture smooth and lustrous, translucent and light yellow-brown; aperture at open end of tube which is slightly offset from the plane of coiling.

Measurement. Figured specimen GSC No. 19769, maximum diameter of 0.40 mm, minimum diameter 0.35 mm, thickness 0.032 mm, three to four coils.

Distribution. A few specimens have been obtained from the upper part of rock unit 1 of the Mount Goodenough section, from 100 to 110 feet.

Discussion. It is possible that this rather rare species is a small variety of *A. mackenziensis* but a similar species has been recovered in abundance from overlying beds dated as Early Albian to Aptian. Thus, this smaller species may be of considerable significance in the biostratigraphic sequence. When the parameters of this species are plotted on the graph for the genus *Ammodiscus* its position is within the group including *A. milletianus* Chapman, 1898, from the Lower Cretaceous Gault beds of England. Additional specimens are required for specific determination.

Genus *Glomospira* Rzehak, 1885

Glomospira subarctica n. sp.

Plate II, figures 7a, b, 8, 9

Description. Test free, subspherical, consisting of a proloculus and long, tubular, undivided second chamber coiling in various planes with the outer coils forming a helical spire; in many specimens the end of the tube protrudes laterally (figs. 7a, b); suture distinct, depressed; wall very finely to finely arenaceous with considerable siliceous cement; thin, commonly translucent; texture variable from smooth and lustrous to finely granular, light brown; aperture formed by open end of the tube.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Thickness	No. of Coils
	Pl.	fig.	Max.	Min.		
Holotype 19770	II	7	0.33	0.24	0.35	5
Paratype 19771	II	8	0.33	0.32	0.25	5+
Paratype 19772	II	9	0.35	0.30	0.36	?5

PLATES I TO VI

All specimens illustrated are from rock unit 1
of the Mount Goodenough section.

PLATE I

Bathysiphon scintillata n.sp. x60 PAGE 11

Figures 1a, b — Side and end views of the holotype GSC No. 19753 from sample 20 to 30 feet.

Figures 2, 3 — Side views of paratypes GSC Nos. 19754 and 19755 from samples 100 to 110 feet and 80 to 90 feet respectively.

Bathysiphon granulocoelia n.sp. x60 PAGE 12

Figure 4 — Side view of holotype GSC No. 19756 from sample 30 to 40 feet.

?*Hyperammina* cf. *H. acicula* (Parr) *fide* Crespin, 1958 x60 PAGE 12

Figures 5a, b — Side and apertural views of hypotype GSC No. 19757, recovered from sample 40 to 50 feet.

Hyperammina cf. *H. aljutovica* Reitlinger, 1950 x60 PAGE 12

Figure 6 — Side view of hypotype GSC No. 19758, from sample 40 to 50 feet.

Hippocrepina cf. *H. barksdalei* (Tappan), 1957 x 60 PAGE 13

Figures 7a, b — Side and apertural views of hypotype GSC No. 19759, from sample 40 to 50 feet.

Thuramminoides septagonalis n.sp. x100 PAGE 14

Figures 8a, b — Side views of holotype GSC No. 19760, dry with reflected lighting and oiled with incident lighting from sample 20 to 30 feet.

Figure 9 — Side view of paratype GSC No. 19761, from sample 20 to 30 feet.

Figure 10 — Side view of paratype GSC No. 19763, from sample 40 to 50 feet.

Figures 11a, b — Side views of paratype GSC No. 19762, dry with reflected lighting and oiled with incident lighting, from sample 100 to 110 feet.

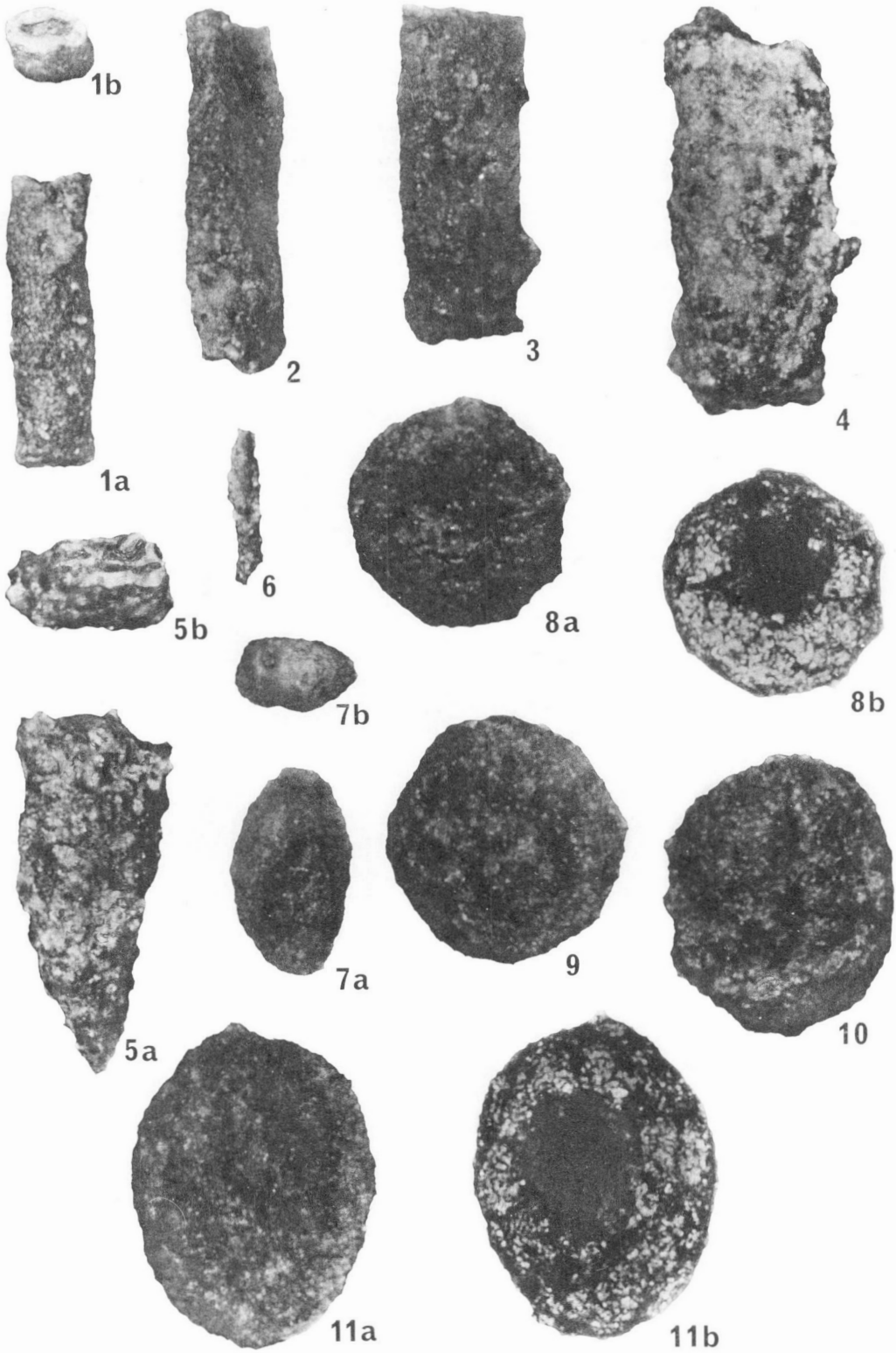
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PLATE II

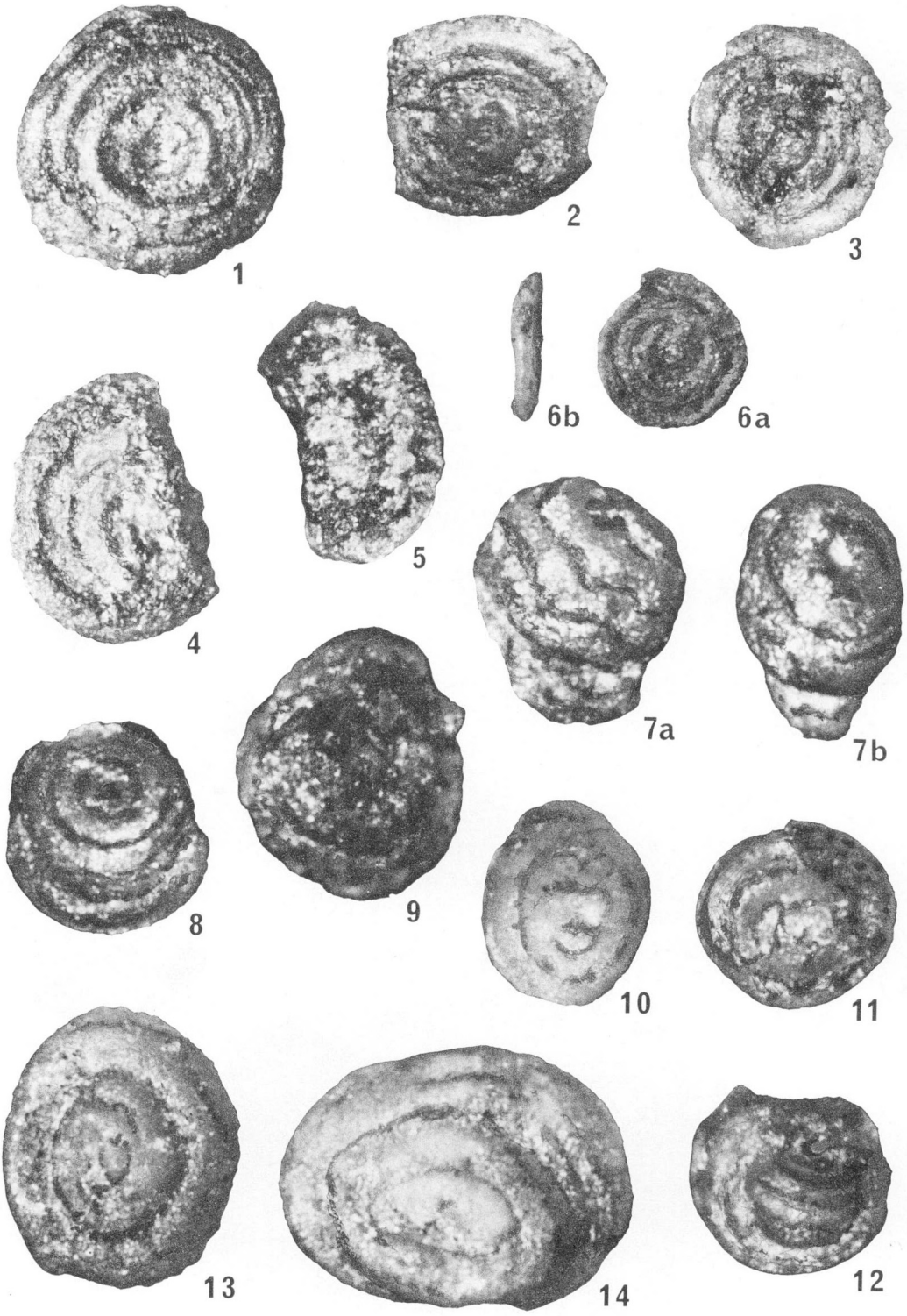

PLATE II

Ammodiscus mackenziensis n.sp. x50 — PAGE 15

Figure 1 — Side view of holotype GSC No. 19764, from sample 40 to 50 feet.

Figures 2 to 5 — Side views of paratypes showing various forms of fragmentation and distortion; fig. 2 GSC No. 19765, 50 to 60 feet; fig. 3 GSC No. 19766, 100 to 110 feet; fig. 4 GSC No. 19767, 20 to 30 feet; fig. 5 GSC No. 19768, 80 to 90 feet.

Ammodiscus sp. x90 — PAGE 16

Figures 6a, b — Side and edge view of fig. spec. GSC No. 19769, from sample 100 to 110 feet.

Glomospira subarctica n.sp. x100 — PAGE 16

Figures 7a, b — Side and top views of holotype GSC No. 19770, from sample 10 to 20 feet.

Figures 8, 9 — Top views of paratypes GSC Nos. 19771 and 19772, from sample 10 to 20 feet.

Glomospira subarctica saturna n. subsp. x100 — PAGE 17

Figures 10, 11 — Top view of paratypes GSC Nos. 19774 and 19775, from sample 10 to 20 feet.

Figure 12 — Top view of holotype GSC No. 19773, from sample 50 to 60 feet.

Glomospirella arctica n.sp. — PAGE 18

Figure 13 — Top view of holotype GSC No. 19776, from sample 40 to 50 feet (x60).

Figure 14 — Top view of paratype GSC No. 19777, from sample 50 to 60 feet (x100).

PLATE III

Glomospirella arctica n.sp. PAGE 18

Figures 1a, b, c — Top, side and bottom views respectively of paratype GSC No. 19778, from sample 60 to 70 feet (x100).

Figure 2 — Bottom view of paratype GSC No. 19779, from sample 100 to 110 feet (x100).

Figures 3a, b — 3a top view, dry with reflected lighting; 3b top view, oiled with incident lighting; paratype GSC No. 19780, from sample 50 to 60 feet (x60).

Figure 4 — Top view, oiled with incident lighting; paratype GSC No. 19780, from sample 50 to 60 feet (x60).

Glomospirella sp. x100 PAGE 20

Figures 5a, b — Top and edge view of fig. spec. GSC No. 19781, from sample 10 to 20 feet.

Figure 6 — Top view of fig. spec. GSC No. 19782, from sample 10 to 20 feet.

?*Glomospirella elongata* n.sp. x60 PAGE 20

Figures 7a, b — Top and edge view of holotype GSC No. 19783, from sample 30 to 40 feet.

Figures 8, 9 — Top views of paratypes GSC Nos. 19784, 19785, from samples 30 to 40 and 40 to 50 feet respectively.

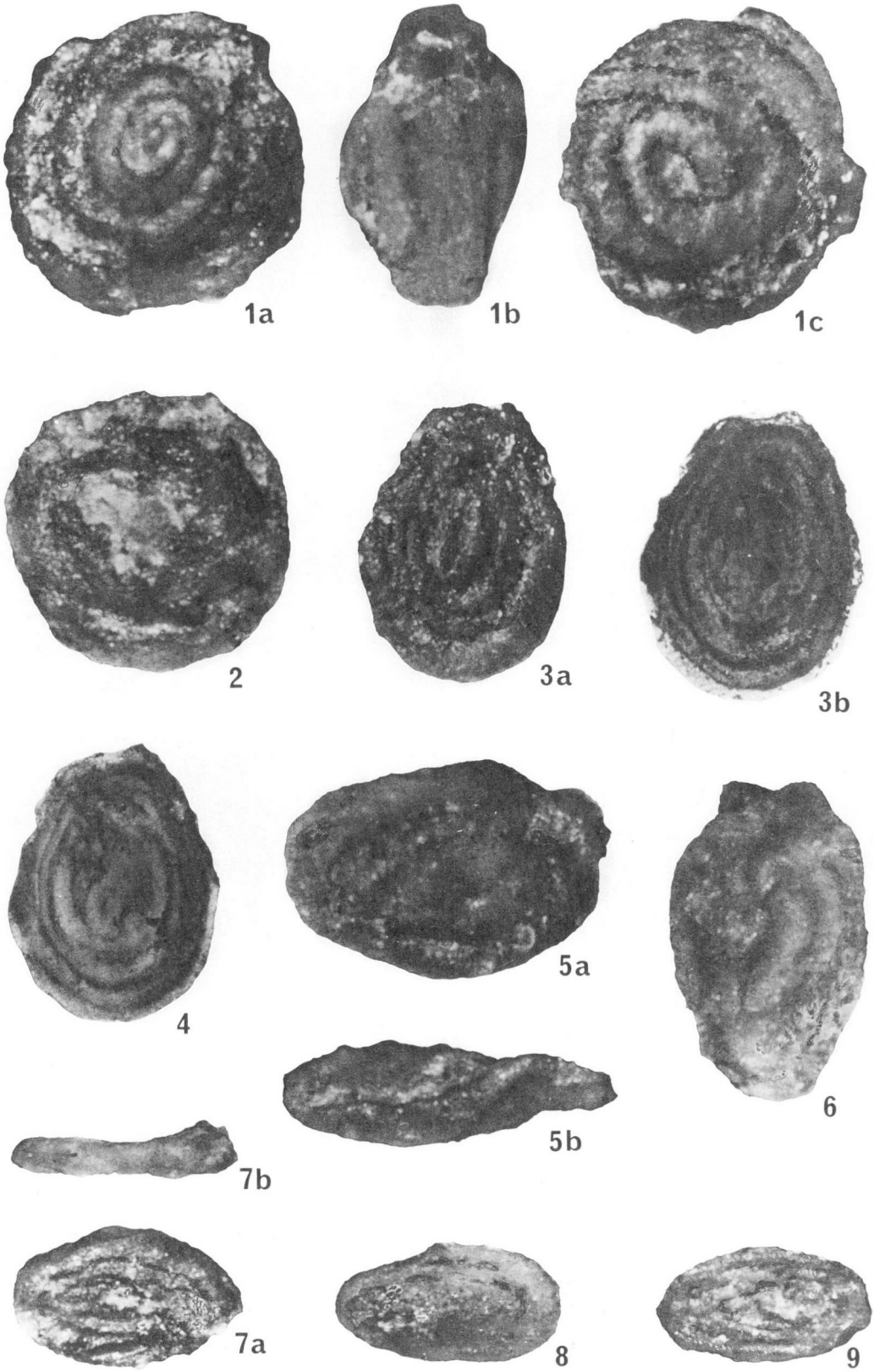
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PLATE IV

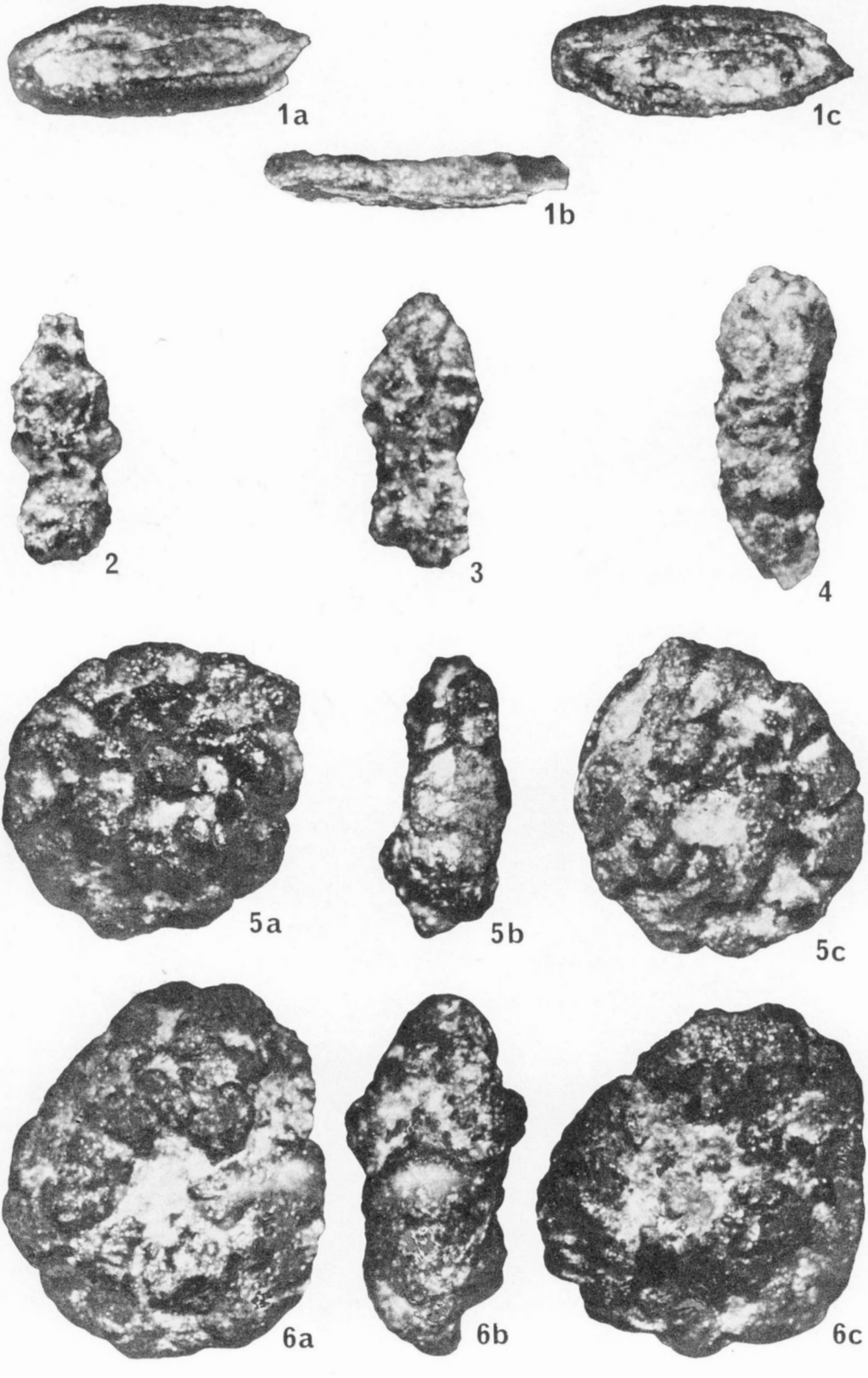

PLATE IV

?*Psamminopelta* cf. *P. bowsheri* Tappan, 1957 x60 PAGE 21

Figures 1a, b, c — Side 1, edge and side 2 views of hypotype GSC No. 19786, from sample 40 to 50 feet.

Reophax tundraensis n.sp. x60 PAGE 22

Figure 2 — Side view of holotype GSC No. 19787, from sample 100 to 110 feet.

Figures 3, 4 — Side views of paratypes GSC Nos. 19788, 40 to 50 feet, 19789, 110 to 120 feet.

Haplophragmoides goodenoughensis n.sp. x50 PAGE 23

Figures 5a, b, c — Side 1, edge and side 2 of holotype GSC No. 19790, from sample 0 to 10 feet.

Figures 6a, b, c — Side 1, edge and side 2 of paratype GSC No. 19791, from sample 100 to 110 feet.

PLATE V

Haplophragmoides inflatigrandis n.sp. x60 — PAGE 24

Figures 1a, b — Side and apertural edge views of paratype GSC No. 19794, from sample 0 to 10 feet.

Figures 2a, b — Side and apertural edge views of holotype GSC No. 19793. from sample 60 to 70 feet.

Figure 3 — Side view of paratype GSC No. 19795, from sample 60 to 70 feet.

Haplophragmoides coronis n.sp. x60 — PAGE 25

Figure 4 — Side view of holotype GSC No. 19796, from sample 0 to 10 feet.

Figure 5 — Side view of paratype GSC No. 19797, from sample 30 to 40 feet.

Haplophragmoides duoflatis n.sp. x60 — PAGE 25

Figure 6 — Side view of holotype GSC No. 19798, from sample 60 to 70 feet.

Figures 7, 8 — Side view of paratypes GSC Nos. 19799 and 19800, from sample 10 to 20 feet.

Figures 9a, b — Side and apertural edge views of paratype GSC No. 19801, from sample 10 to 20 feet.

Figures 10a, b — Side and apertural edge views of paratype GSC No. 19803, from sample 10 to 20 feet.

Figures 11a, b — Side and apertural edge views of paratype GSC No. 19802, from sample 30 to 40 feet.

Figures 12, 13 — Side views of paratypes GSC Nos. 19804 and 19805, from sample 80 to 90 feet.

Haplophragmoides cf. *H. duoflatis* n.sp. x60 — PAGE 26

Figures 14a, b — Side and apertural edge view of hypotype GSC No. 19806, from sample 50 to 60 feet.

Figure 15 — Side view of hypotype GSC No. 19807, from sample 60 to 70 feet.

?*Haplophragmoides* sp. x60 — PAGE 27

Figures 16a, b — Side and apertural edge view of fig. spec. GSC No. 19808, from sample 10 to 20 feet.

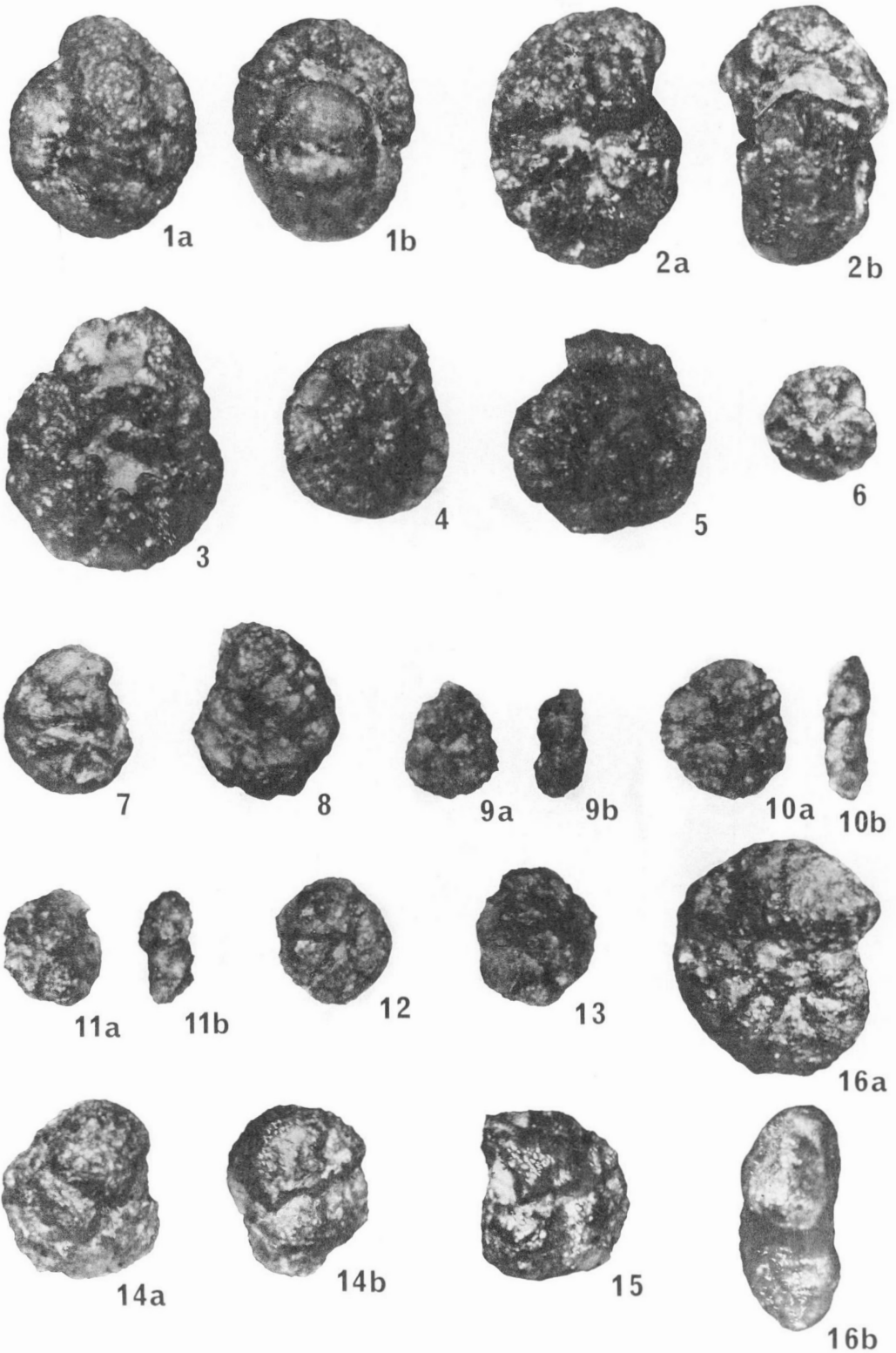
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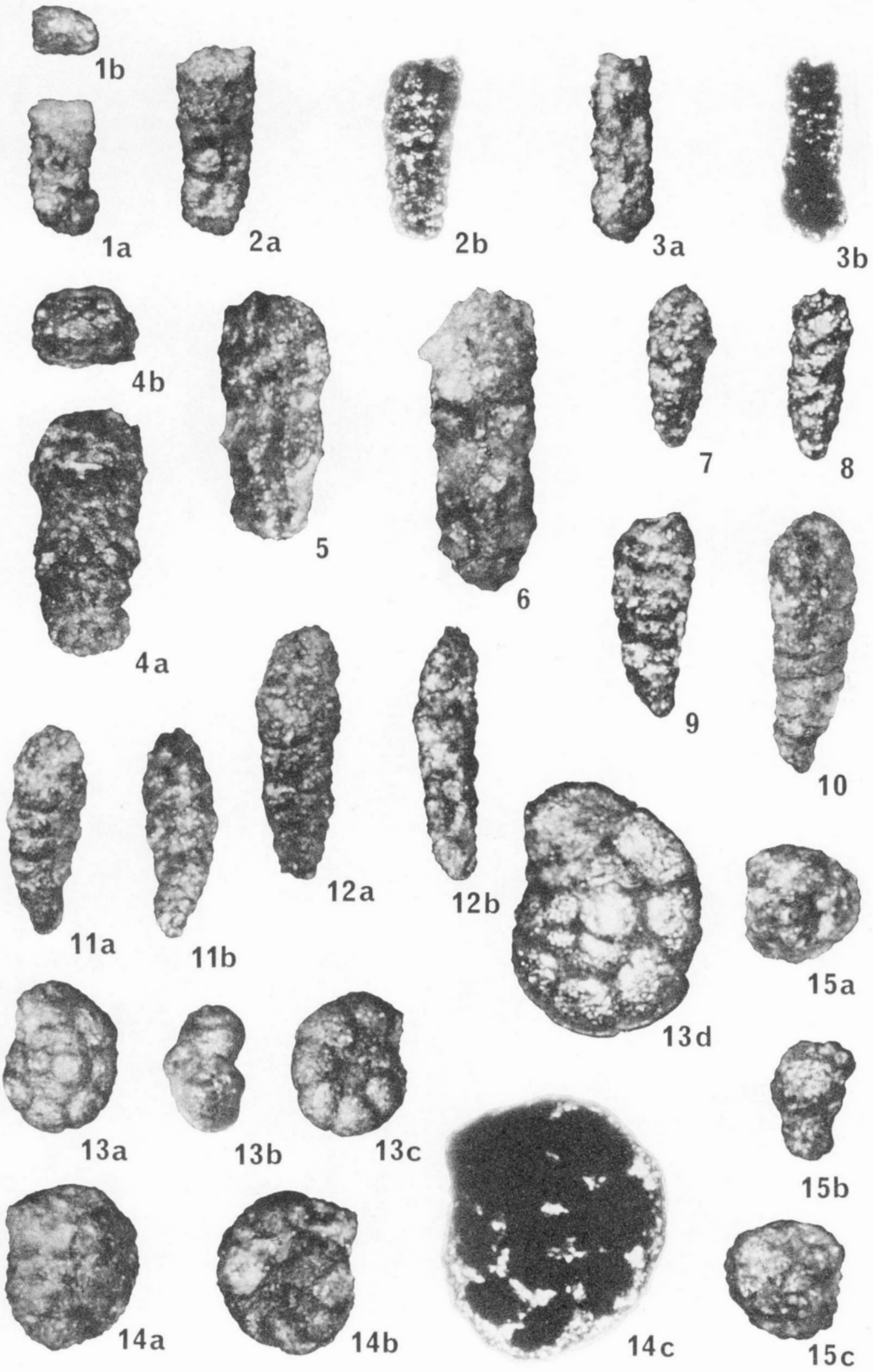
PLATE VI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14b
14c
15c

PLATE VI

Ammobaculites reophacoides Bartenstein, 1952 x60 — PAGE 28

Figures 1a, b — Side and apertural views of hypotype GSC No. 19809, from sample 10 to 20 feet.

Figures 2, 3 — Side views respectively showing dry mount with reflected lighting (figures "a") and oiled with incident lighting (figures "b") for hypotypes GSC Nos. 19810 and 18911, from sample 30 to 40 feet.

Ammobaculites erectus Crespin, 1963 x60 — PAGE 29

Figures 4a, b — Side and apertural views of hypotype GSC No. 19812, from sample 40 to 50 feet.

Figures 5, 6 — Side views of hypotypes GSC Nos. 19813 and 19814, from sample 80 to 90 feet.

Textularia cf. *T. topagorukensis* Tappan, 1962 x60 — PAGE 30

Figures 7, 8 — Side views of hypotypes GSC Nos. 19815 and 19816, from sample 30 to 40 feet.

Gaudryina tappanae n. sp. x60 — PAGE 31

Figure 9 — Side view of holotype GSC No. 19817, from sample 0 to 10 feet.

Figure 10 — Side view of paratype GSC No. 19818, from sample 50 to 60 feet.

Figures 11, 12 — Side ("a") and edge ("b") views of paratypes GSC Nos. 19819 and 19820, from sample 0 to 10 feet.

Trochammina squamata (Jones and Parker) subsp. *limbata* Chapman, 1894 — PAGE 32

Figures 13a, b, c — Dorsal, apertural and ventral views of hypotype GSC No. 19821, from sample 100 to 110 feet (x60).

Figure 13d — Dorsal view, oiled with reflected lighting, hypotype GSC No. 19821, from sample 100 to 110 feet (x100).

Figures 14a, b — Ventral and dorsal views of hypotype GSC No. 19883, from sample 40 to 50 feet (x60).

Figure 14c — Dorsal view, oiled with incident lighting, hypotype GSC No. 19883, from sample 40 to 50 feet (x100).

Trochammina conicominuta n. sp. x100 — PAGE 33

Figures 15a, b, c — Ventral, apertural and dorsal views of holotype GSC No. 19884, from sample 30 to 40 feet.

Distribution. The species ranges throughout rock unit 1 of the Mount Goodenough section from 10 to 110 feet and is abundant in some samples. Its occurrence in such quantity indicates that it may be a good local marker for biostratigraphic correlation.

Discussion. The tendency of the test shape towards an oblate spheroid, the slight irregularity of the tubular helical winding and smaller dimensions but greater number of visible coils, distinguish these specimens from *Glomospira corona* Cushman and Jarvis, 1928. Both have irregular terminal tube parts with the latter species showing the most extreme crown-like development. The Alaska specimens referred to this species by Tappan (1962) show considerable variation, but the U.S. National Museum specimen No. 5935 (Tappan, Pl. 29, fig. 16) appears to be somewhat similar to *G. subarctica.*

G. perplexa Franke, 1936, *fide* Tappan (1955) from the Kingak Shale of Jurassic age is smaller, more regularly coiled and averages one or two more visible coils of very small diameter. Yorath (1962) compared this latter species with a *Glomospira* from 370 feet below the top of the Deer Bay Formation from the Arctic Archipelago but the writer considers it to be more comparable to *Glomospira subarctica* n. sp.

Glomospira subarctica saturna n. subsp.

Plate II, figures 10, 11, 12

Description. Test free, discoidal, consisting of a proloculus and a long, tubular, undivided second chamber with the plane of coiling variable and with the later whorls, up to the penultimate coil, forming a tight, helical spire about the inner coils; ultimate coil planispiral about the long axis in the holotype (fig. 12) but apparently variable in its position in other specimens; spiral suture fairly distinct, depressed; wall agglutinated, composed of very fine quartz grains with much silica cement; very thin walled, commonly translucent; texture smooth, lustrous appearance, light brown; aperture formed by the open end of the tube.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Height
	Pl.	fig.	Max.	Min.	
Paratype 19774	II	10	0.32	0.267	0.176
Paratype 19775	II	11	0.32	0.270	0.128
Holotype 19773	II	12	0.32	0.270	0.176

Distribution. This species is restricted to the lower half of Mount Goodenough, rock unit 1. The figured specimens were recovered from samples from 10 to 60 feet and are rare to few.

Discussion. The distinguishing feature of this new subspecies is the discoid test shape resulting from the planispiral plan of the ultimate coil about the preceding helical spire arrangement. The helical spire part of this new subspecies is identical with *G. subarctica* n. sp. Many specimens of *G. subarctica* exhibit a slight angular displacement of the final tube part which indicates a tendency towards aberrant arrangement after completion of the helical spire plan.

Genus *Glomospirella* Plummer, 1945

Genotype: *Glomospira umbilicata* Cushman and Waters, 1927

Berthelin (1880) noted the *Glomospira*-type coiling of the tubular second chamber in the initial coiling stages of *Ammodiscus gaultinus*. But numerous workers did not detect, or ignored, this criterion for many years and included species with this morphological feature in both *Ammodiscus* and *Glomospira*. In the northern Canadian sedimentary basins *Glomospirella* makes its first appearance and reaches an acme of development in the Permian (Kandik Basin and Yukon panhandle). It is very common to abundant in parts of the Neocomian and gradually diminishes in abundance during Albian time. The taxonomic criterion of a planispiral portion is somewhat subjective and is difficult to determine in compressed specimens.

Glomospirella arctica n. sp.

Plate II, figures 13, 14; Plate III, figures 1–4

Description. Test free, subelliptical, consisting of a proloculus and long, tubular, undivided, second chamber, commonly forming a plug of tight, streptospiral coils in the initial stage; the final stage is less tight and approaches a nearly planispiral coil; the ultimate coil consists of a nearly planispiral tube of larger diameter encircling the previous coils to form an equatorial ring; wall siliceous, lustrous, light brown, with very fine to fine, agglutinated, quartz grains; wall thinner in later stages with final coil compressed to a broad equatorial ring; aperture at open end of the tube.

Examination of numerous specimens of this species indicates what appears to be a consistent dorso-ventral orientation in relation to the final position of the apertural opening. The dorsal side usually exhibits a pronounced, convex plug of the initial, tight, streptospiral coils with four to five coils visible. The ventral side is less convex and the open apertural end of the tube is nearly flush with the surface and has only three to four visible coils. Dorso-ventrally compressed specimens may show more visible coils and the final coils are compressed to a flatter plane. Plate III, figure 3 illustrates this condition with what appears to be more than one planispiral, equatorial coil. When the specimen is oiled and observed with incident lighting (fig. 4), only the ultimate coil can be traced about the periphery; the preceding coils disappear from view as evidence of the various planes of coiling.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Height	Visible Coils	
	Pl.	fig.	Max.	Min.		"Dorsal"	"Ventral"
Holotype 19776	II	13	0.69	0.59	0.330	4+	3
Paratype 19777	II	14	0.54	0.40	0.224	4+	3–4
Paratype 19778	III	1	0.51	0.47	0.288	4–5	3
Paratype 19779	III	2	0.48	0.44	0.170	Indistinct	
Paratype 19780	III	3,4	0.69	0.52	0.230	4	3–4

Distribution. This is the most abundant species of the Ammodiscinae recovered from the Neocomian of Arctic America. It is common to abundant in the interval from 10 to 70 feet in rock unit 1 of the Mount Goodenough section.

Discussion. The two different plans of tubular arrangement are most distinctive. The initial part of streptospiral coiling forms a central plug and the final, nearly planispiral plan forms the discoid ring about the plug (Pl. III, fig. 1b). Specimens referred to *Glomospirella gaultina* (Berthelin), 1880, by Tappan (1962) from the Albian strata of Alaska include taxonomic parameters of considerable range in size, number of visible whorls, and tubular arrangement. The dimensions and tube arrangement of one of these figured specimens (Pl. 29, fig. 18) compare favourably with *G. arctica* n.sp. but do not conform to the original description of *G. gaultina*. This latter species is much larger, coarsely agglutinated, averages one or more visible whorls, and has not the pronounced central, streptospirally coiled plug.

McGill and Loranger (1961) have described three species of *Glomospira* from the Albian of the eastern District of Mackenzie. The planispiral arrangement of the final two or three coils of these species defines them as *Glomospirella*. Redescription and illustration of these specimens are also required to show the fragmentary and distorted nature of *Glomospirella obesa* (McGill and Loranger) and *G. eucalla* (McGill and Loranger).

G. obesa is similar to *G. scaphoidea* in all dimensions, wall composition, and chamber arrangement. The plug of initial, acute, various planes of coiling is also prominent.

G. eucalla differs from *G. scaphoidea* (McGill and Loranger) in the absence of the prominent plug. The same number and acute angle of the initial planes of coiling are still present and the final stage of two and one-half to three planispiral coils are visible.

Thus *G. obesa* and *G. eucalla* should be placed in synonomy of *G. scaphoidea*. This last species exhibits a prominent central plug of the streptospirally coiled tube in the initial portion with the final two and one-half to three coils nearly planispiral forming a discoid test shape with the central plug. *G. arctica* n. sp. does not exhibit as prominent a central plug of streptospiral coiling and only the

ultimate coil approaches the planispiral plan. The wall compositions and texture also differ markedly. There is, however, a relationship between the two species if *G. arctica* n. sp. was to continue the growth plan of the ultimate coil for an additional two convolutions. The preceding coils might then simulate the prominent plug of *Glomospirella scaphoidea* (McGill and Loranger).

Glomospirella sp.
Plate III, figures 5a, b, 6

Description. Test free, discoidal, thin and distorted, consisting of a proloculus and a long tubular, undivided chamber with depressions along the outer tube; initial coils bend back sharply at the point of one-half volution with two coils visible from both sides; aboral side with slightly raised central part, oral side flush; later coiling nearly planispiral with two to three coils visible on aboral side, three to four coils visible on oral side; wall thin, considerable silica cement and sparse, very fine to fine, agglutinated quartz grains; lustrous, light brown, translucent in very thin specimens; aperture at open end of loosely coiled terminal part of tube which may be slightly offset from the plane of the ultimate coil; apertural end of tube flush with the side opposite to the slightly raised initial coiled part.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Height
	Pl.	fig.	Max.	Min.	
Fig. spec. 19781	III	5	0.52	0.32	0.128
Fig. spec. 19782	III	6	0.50	0.31	0.144

Distribution. Samples from the interval from 10 to 70 feet of the Mount Goodenough section (Table I) provided only a few specimens with another single specimen occurring in the 60- to 70-foot sample.

Discussion. This species is more elongate than *Glomospira gordialis* (Jones and Parker) and, thus, resembles *Glomospirella elongata* n. sp. It is much thinner and somewhat translucent with one or two additional visible coils. It is much larger than *Glomospirella parammodiscus* McGill and Loranger having more coils in the initial variable plane part and fewer coils in the planispiral part.

Glomospirella? elongata n. sp.
Plate III, figures 7a, b, 8, 9

Description. Test free, elongate; an undivided tubular chamber winding about an elongate axis; thickness of the prolocular area can accommodate an early stage

with variable plane coiling which is only slightly visible, the last four whorls are planispiral with some overlapping of preceding coils; diameter of the ultimate coil increases rather rapidly; wall extremely siliceous, translucent with vitreous lustre; rigid with very little distortion of the ovate tubular chamber; aperture at the open end of the tube.

Measurements in millimetres.

GSC Type Specimen	Illustration Pl.	fig.	Length	Width	Thick	No. of Coils Planispiral
Holotype 19783	III	7	0.59	0.35	0.096	4–5
Paratype 19784	III	8	0.59	0.31	0.096	3–4
Paratype 19785	III	9	0.56	0.32	0.112	4+

Distribution. The few specimens recovered are restricted in occurrence to the interval from 30 to 50 feet in the Mount Goodenough section (Table I). Similar elongate species have been recovered from equivalent strata in Arctic America.

Discussion. Glomospirella species published to date are more discoidal than this new species. The first impression is that it is similar to a laterally compressed *Ammodiscus* sp. but there is no distortion of the tubular coils to indicate such compression. It has no constrictions or any indication of chambering as in the genus *Psamminopelta* which has one chamber for each half coil. There are, however, indications of variable plane coiling of the small diameter, initial tube winding, which would place this species in the genus *Glomospirella.*

Superfamily LITUOLACEA de Blainville, 1825

Family RZEHAKINIDAE Cushman, 1933

Genus ***Psamminopelta*** Tappan, 1957

Psamminopelta? cf. *P. bowsheri* Tappan, 1957

Plate IV, figures 1a, b, c

Psamminopelta bowsheri Tappan, 1957, U.S. Nat. Mus., Bull. 215, pp. 211, 212, Pl. 67, figs. 11–18, 22–24.

Description. Test free, elongate, straight, vertical axis, truncated periphery, consisting of long, narrow and tubular planispirally arranged chambers, each one-half coil long, and considerably overlapping earlier coils; sutures depressed; wall thin, finely agglutinated with large amount of silica cement giving a brown, lustrous appearance; aperture at the open end of the tubular chamber.

Measurement. Hypotype GSC No. 19786, length 0.82 mm, width 0.28 mm, thickness 0.17 mm.

Distribution. The species is very rare and poorly preserved, with only one complete specimen available for study. Specimens were recovered from 20 to 70 feet in rock unit 1 of the Mount Goodenough section.

Discussion. The taxonomic feature of one-half coil chamber is most difficult to establish for this specimen but the planispiral, tubular chamber arrangement is unquestionable. Few species have been published for the more primitive, coiled tube forms and this limits comparison of new forms exhibiting taxonomic features somewhat obscure or akin to possibly more than one genus. The generic assignment of the present material is uncertain but at the species level it resembles *P. bowsheri.*

Miliammina Heron-Allen and Earland may have a very loose quinquiloculine plane of coiling simulating a near-planispiral arrangement but the tube is one chamber throughout the total coiling. *Rzehakina* Cushman is planispirally coiled but each chamber is not exactly one-half coil long resulting in a sigmoidal, vertical axis. Aberrant forms of *Glomospirella* Plummer exhibit an elongate axis of planispiral coiling with very obscure, initial, streptospiral coiling. In this latter situation the absence of one-half coil chambering is sufficient criteria to distinguish from *Psamminopelta.*

Family HORMOSINIDAE Haeckel, 1894

Genus ***Reophax*** Montfort, 1808

Reophax tundraensis n. sp.

Plate IV, figures 2, 3, 4

Description. Test free, short, consisting of two to four uniserial chambers increasing gradually in size and followed by a well-developed neck on well-preserved specimens; very slight taper; wall coarsely agglutinated in a faint mosaic pattern, larger quartz grains adhering to test somewhat distort the outline; sutures masked by coarse grains but sufficiently depressed to indicate chamber terminations, last formed chamber slightly more elongate; aperture simple, rounded, terminal, central at end of neck.

Measurements in millimetres.

GSC Type Specimen	Illustration		Length	Width (max.)	Height Chamber (max.)	No. of Chambers
	Pl.	fig.				
Holotype 19787	IV	2	0.65	0.27	0.34	3–4
Paratype 19788	IV	3	0.72	0.31	0.40	2–3
Paratype 19886	Not illust.		0.80	0.32	0.40	fragment
Paratype 19789	IV	4	0.80	0.31	0.32	4

Distribution. The species is fairly common from 30 to 110 feet in rock unit 1 of the Mount Goodenough section. Very similar species have been obtained from strata of equivalent age and, possibly, younger strata of Albian age from Arctic America. Paratype 19886 is not illustrated but was recovered from 110 to 120 feet.

Discussion. Reophax tundraensis n. sp. has the same number of chambers as *Reophax* sp. A Wall, 1960, but is less tapered, much larger, and has a coarser wall texture. *R. polyeides* Deeke, 1884, is more coarsely agglutinated and more rapidly tapering. *R. coonensis* Berry, 1929, is also similar in test shape and chamber number, but is smoother and has slightly smaller dimensions. *R. tundraensis* is possibly the ancestral stock in the early Cretaceous to which *R. coonensis* of the Upper Cretaceous is related.

Family LITUOLIDAE de Blainville, 1825

Genus ***Haplophragmoides*** Cushman, 1910

Haplophragmoides goodenoughensis n. sp.

Plate IV, figures 5, 6

Description. Test free, large, planispiral, very slightly evolute, biumbilicate, periphery rounded, slightly lobate in compressed specimens; nine to twelve chambers in the ultimate whorl, slightly increasing in size as added; inflation retained by strong, fairly thick septa (0.05 mm); sutures straight, radial, becoming depressed in the umbilical area, terminating in nodes which form a ring around the umbilical plug; wall composed of a large proportion of silica cement to agglutinated fine and medium quartz grains, rare coarser grains protrude at random from the test surface, somewhat lustrous, light brown; aperture recurved, extending laterally at the base of the terminal chamber face.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Thickness	No. of Chambers
	Pl.	fig.	Max.	Min.		
Holotype 19790	IV	5	0.97	0.88	0.33	11
Paratype 19791	IV	6	1.16	0.99	0.41	10
Paratype 19792	Not figured		0.88	0.72	0.29	10–11
	Average for graph		1.00	0.86	0.34	9–12

Distribution. The frequency of occurrence is not high in each sample but the species is fairly consistent throughout the Mount Goodenough section from 0 to 110 feet (Table I). The acme of development appears to be in the basal beds of the section. Numerous specimens of this species have been obtained from

strata of equivalent age in northwest Canada and the Arctic Archipelago. Paratype 19792 is not illustrated and was recovered from 0 to 10 feet.

Discussion. The dimensions of this large species indicate a relationship to the *H. gigas* Cushman group of species. In comparison with the *H. gigas, H. goodenoughensis* n. sp. is, on the average, somewhat smaller in diameter but thicker through the test due to the strong septa. It is also straight-sutured with prominent septal nodes; the chambers are not as collapsed as in *H. gigas*. It is possibly the ancestral stock of an early Cretaceous form from which the late Middle Albian *H. gigas* was derived. Similar species have been recovered from the Deer Bay Formation of the Arctic Archipelago which has been reported to be of late Jurassic or Neocomian age.

Haplophragmoides inflatigrandis n. sp.

Plate V, figures 1, 2, 3

Description. Test free, medium sized, planispiral, very slightly evolute, biumbilicate, inflated, rounded periphery, consisting of eight to nine chambers in ultimate whorl, the last two to three chambers increasing in size rapidly with terminal chamber overlapping the periphery of the preceding whorl; septa strong; sutures straight, radial and moderately thick, meeting in the umbilicial area to form a translucent raised ring; wall composed of a large proportion of silica cement to agglutinated, very fine to fine quartz grains; light brown, lustrous finish but finely roughened surface; aperture a curved slit at the base of the terminal chamber face.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Thickness	No. of Chambers
	Pl.	fig.	Max.	Min.		
Paratype 19794	V	1	0.57	0.48	0.528	9–10
Holotype 19793	V	2	0.65	0.48	0.27	9–10
Paratype 19795	V	3	0.68	0.56	0.33	8–9

Distribution. This is the most abundant species recovered in rock unit 1 of the Mount Goodenough section from 0 to 110 feet. It reaches its acme of development in the interval from 10 to 20 feet with 30 to 40 specimens recovered from 100 grams of sample material.

Discussion. The dimensions of this medium-sized species lie within the extremely large dimension area on the graph of the parameters for *H. gigas minor* Nauss (1946) group of the Middle Albian. *H. inflatigrandis* n. sp. is much more inflated with rounded periphery. The regional graph for internationally published species indicates a relationship with *H. canui* Cushman, 1930, of the Upper Jurassic.

This latter species is slightly smaller, less inflated and has less depressed sutures. *H. inflatigrandis* n. sp. is possibly an early Cretaceous form relating the late Jurassic *H. canui* and the Middle Albian *H. gigas minor*.

Haplophragmoides coronis n. sp.

Plate V, figures 4, 5

Description. Test free, medium size, planispiral, evolute, biumbilicate; chambers deflated to collapsed with eight to nine in the ultimate coil and six to seven chambers in the visible part of the penultimate coil; penultimate coil is slightly raised and bulbous chambers form a crown-like ring about the prolocular area; sutures limbate with wide, strong septa, straight and radial; periphery lobate in the more inflated specimens; wall composed of very fine quartz grains agglutinated with silica cement, resulting in a very fine, granular texture with slight lustrous, light brown finish; aperture at base of final chamber.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters			No. of Chambers	
	Pl.	fig.	Max.	Min.	Thickness	Ult.	Penult.
Holotype 19796	V	4	0.49	0.35	0.08	8–9	6–7
Paratype 19797	V	5	0.54	0.48	0.048	8–9	6

Distribution. This distinctive species has been recovered from several sections of equivalent age in the Richardson Mountains area and from possibly older strata in the same area. The range of the species in rock unit 1 of the Mount Good-enough section is restricted to the interval from 0 to 50 feet.

Discussion. The position of this species on the graph of taxonomic parameters for the genus *Haplophragmoides* lies within the group of *H. howardense* subsp. *manifestum* and *H. spiritense* Stelck and Wall (1954). *H. howardense* subsp. *manifestum* of the Upper Cretaceous is larger in all dimensions with more numerous, inflated chambers. *H. spiritense* has deflated chambers much closer in dimensions and chamber number but lack the distinctive corona about the prolocular area formed by the penultimate coil.

Haplophragmoides duoflatis n. sp.

Plate V, figures 6–13

Description. Test free, small, involute, umbilical area slightly depressed; five to seven chambers usually inflated, enlarging gradually, final chamber slightly expanded and overlapping previous whorl, apertural face tending to triangular; sutures depressed and covered in part with adventitious material, straight, radial;

wall is composed of fine quartz grains agglutinated with siliceous cement, finely textured surface, compressed specimens slightly more lustrous; aperture arched at base of final chamber but may be covered by adherent foreign material.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Thickness	No. of Chambers Ult. Coil
	Pl.	fig.	Max.	Min.		
Holotype 19798	V	6	0.300	0.250	0.165	5–6
Paratype 19799	V	7	0.384	0.320	0.208	6–7
Paratype 19800	V	8	0.410	0.395	0.230	5–6
Paratype 19801	V	9	0.310	0.255	0.064	5–6
Paratype 19803	V	10	0.350	0.300	0.112	5
Paratype 19802	V	11	0.289	0.256	0.096	5–6
Paratype 19804	V	12	0.320	0.288	0.192	?7
Paratype 19805	V	13	0.350	0.288	0.160	?7

Distribution. This species is abundant in rock unit 1 of the Mount Goodenough section and appears to have cyclical maxima of abundance near the base and at the top of the section. It is associated with *H. inflatigrandis* throughout the interval from 10 to 110 feet.

Discussion. The illustrated paratypes were chosen to show the rather extreme variation in size of *H. duoflatis*. The larger specimens are inflated chambered forms which, when their parameters are plotted on the graph for species of *Haplophragmoides,* lie within the group of *H. neocomiana* (Chapman). The character of the smaller deflated forms is similar to that of the group of *H. linki* Nauss. The number of chambers and thickness of the test remain relatively constant and these parameters when plotted on the graph compare closely with *H. linki* Nauss except for having one to two fewer chambers. It is possible that *H. duoflatis* n. sp. is an intermediate form relating the older Neocomian *H. neocomiana* with the younger Albian *H. linki.*

Haplophragmoides cf. *H. duoflatis* n. sp.

Plate V, figures 14, 15

Description. Test free, small, planispiral, biumbilicate, periphery rounded, lobate as a result of inflated chambers, four to eight chambers per coil; chambers increase gradually in size with terminal chamber notably larger; sutures depressed, slightly recurved; wall composed of fine to medium quartz grains with minor amount of silica cement; fine, granular texture, light grey; aperture at base of final chamber.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Thickness	No. of Chambers
	Pl.	fig.	Max.	Min.		
Hypotype 19806	V	14	0.48	0.39	0.28	4–5
Hypotype 19807	V	15	0.48	0.39	0.20	5–6

Distribution. *H.* cf. *H. duoflatis* n. sp. occurs in the interval from 30 to 70 feet in rock unit 1 of the Mount Goodenough section. Other very similar forms have been recorded from the whole section under investigation.

Discussion. Specimens tentatively referred to *Haplophragmoides* cf. *H. duoflatis* n. sp. differ from the typical species in the development of more chambers and, hence, larger dimensions. In size it is between *H. inflatigrandis* n. sp. and *H. duoflatis* n. sp., but, as it has no tendency towards evolute coiling, it is compared to *H. duoflatis* n. sp.

Haplophragmoides? sp.

Plate V, figures 16a, b

Description. Test free, medium size, partly evolute, tending to trochospiral coiling in last four to five chambers; periphery rounded, slightly lobate as a result of wide, depressed sutures; fifteen chambers in ultimate whorl, five to seven chambers are somewhat obscured in penultimate coil on concave side; sutures straight, wide, darker grey in contrast to light brown chambers; wall consists of very fine, agglutinated, quartz grains with abundant silica cement; texture rather smooth with large quartz particles adhering to test; aperture at the inner margin of the slightly offset final chamber.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Thickness	No. of Chambers
	Pl.	fig.	Max.	Min.		
Fig. spec. 19808	V	16	0.59	0.48	0.20	15
Unfig. spec.		—	0.40	0.38	0.18	11

Distribution. This species is associated with the general occurrence of *Haplophragmoides* spp. from 30 to 110 feet in rock unit 1 of the Mount Goodenough section. Only a few specimens were recovered from the samples designated in Table I and the unfigured specimen was obtained from the sample from 80 to 90 feet.

Discussion. This form is considered to be related to *H. inflatigrandis* n. sp. The latter species is slightly evolute with five to six fewer chambers, but the last chamber enlarges rapidly and some specimens show a slightly asymmetrical growth plan. The position of *Haplophragmoides*? sp. on a graph of taxonomic parameters is within the *H. spissus* Stelck and Wall (1956) group of the Middle Albian. It has the same number of chambers, the thick, straight, radial sutures, and differs only in its smaller size, visible evolute coiling, and apparent asymmetrical plan of the last few chambers.

Genus *Ammobaculites* Cushman, 1910

Ammobaculites reophacoides Bartenstein, 1952

Plate VI, figures 1, 2, 3

Ammobaculites D4 Hecht, 1938; Abhandl. Senckenberg. 443, p. 19, Pl. 8, figs. 1–5.
Ammobaculites reophacoides Bartenstein, 1952, Abhandl. Senckenberg. Band 33, No. 416, p. 297.

Description. Test free, medium size, elongate, ovate in outline, consisting of a coiled part of three chambers on dorsal side and four chambers on ventral side followed by a uniserial portion of three to five chambers, enlarging uniformly; sutures depressed, slightly oblique, indistinct due to abundance of agglutinated grains; wall composed of very fine to fine quartz grains with abundant silica cement; surface somewhat roughened but some specimens exhibit a slightly lustrous, light brown appearance; aperture rounded, terminal, appears to be centrally located, predominantly flush with the periphery of the last-formed chamber but in some specimens showing a slight projection of the ultimate chamber.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Width	No. of Chambers	
	Pl.	fig.	Length	Coil	Serial	Coil	Serial
Hypotype 19809.....	VI	1	0.368	0.176	0.160	3–4	3+
Hypotype 19810.....	VI	2	0.480	0.144	0.192	3+	3–4
Hypotype 19811.....	VI	3	0.500	0.160	0.160	3	4–5

Distribution. This species was recovered from the interval from 10 to 90 feet of rock unit 1 of the Mount Goodenough section. The acme of development occurred in the sample from 30 to 40 feet where more than twenty specimens were recovered from each 100 grams of sample. Hecht (1938) described the species from the *Crioceras aegoceras* and *Crioceras bedentatum*–zone of the uppermost Barremian in northwestern Germany. Revision by Bartenstein (1952)

extended the range of the species into older Barremian beds by revision of *Bigenerina* D2 Hecht to *A. reophacoides* Bartenstein.

Discussion. Bartenstein's species was originally described as of slightly greater length but it is similar to the Mount Goodenough specimens in all other features. An *Ammobaculites* (sp. 1300 Davidson, 1960) from the Neocomian of the Richardson Mountains, District of Mackenzie, is considered to be the same species. *A. reophacoides* appears to be a persistent index species for the early Lower Cretaceous which will greatly assist both in regional correlation and intercontinental chronology.

Ammobaculites erectus Crespin, 1963

Plate VI, figures 4, 5, 6

Ammobaculites erectus Crespin, 1963, Bur. Mineral Res., Bull. 66, pp. 36, 37, Pl. 8, figs. 9–12.

Description. Test free, medium size, elongate, slightly flattened ovoid outline, one-quarter of total test comprised of a coil of three chambers followed by a uniserial portion of three to four chambers; coil planispiral, closely packed, rather small chambers, ultimate chamber of coil much larger; uniserial chambers enlarging uniformly; sutures depressed, horizontal but interrupted by coarser, agglutinated grains in part; wall composed of medium to coarse quartz grains, some clear, aphanitic with minor amount of silica cement; surface rough, very light brown; aperture round, terminal with slightly raised cone on ultimate chamber.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diameters		Width Serial	No. of Chambers	
	Pl.	fig.	Length	Coil		Coil	Serial
Hypotype 19812.....	VI	4	0.650	0.208	0.288	3	4
Hypotype 19813.....	VI	5	0.730	0.304	0.320	3	3
Hypotype 19814.....	VI	6	0.784	0.240	0.288	3–4	3–4

Distribution. The occurrence of this species appears to be restricted to the upper part of rock unit 1 from 40 to 90 feet of the Mount Goodenough section. It can be compared with a similar species from the Neocomian portion of the Deer Bay Formation. Several sections of equivalent age in the Richardson Mountains have yielded this species, which indicates its persistent nature as a potential biostratigraphic marker.

Discussion. There is very little difference in the external test features between the coiled and uniserial parts of this species when they are observed dry in reflected lighting. The coil is then about the same width as, or slightly larger than, the

uniserial part. This feature assists in distinguishing it from *Ammobaculites fragmentarius* Cushman. This latter species has a smaller coiled part with more numerous chambers but a much longer uniserial part with more numerous chambers. The coiled part is more distinct in Crespin's Aptian? forms and the test is slightly longer but sufficient similarities exist in the Mount Goodenough specimens for specific determination. An *Ammobaculites* (sp. C. Yorath, 1962) from the Neocomian part of the Deer Bay Formation is similar to the Mount Goodenough forms.

Note: Additional poorly preserved and rare specimens of a smaller species of *Ammobaculites* were recovered from beds near the top of rock unit 1, Mount Goodenough section, but more specimens are required to allow a thorough study of this species.

Family TEXTULARIIDAE Ehrenberg, 1838

Genus *Textularia* Defrance in DeBlainville, 1824

Textularia cf. *T. topagorukensis* Tappan, 1962

Plate VI, figures 7, 8

Textularia topagorukensis Tappan 1962, U.S. Geol. Surv., Prof. Paper 236–C, p. 141, Pl. 33, figs. 7–11.

Description. Test free, small, elongate, early chambers in a planispiral coil (microspheric generation), later chambers biserially arranged, test taper is gradual; chambers in minute initial coil are very small, biserial chambers increasing gradually in size, the final two to three pairs increasing more rapidly in relative height, three to four chambers in coil, five to six pairs of biserial chambers; sutures depressed, slightly oblique, fairly distinct, but require incident lighting to reveal initial chamber arrangement; wall finely agglutinated with abundant silica cement, light brown, lustrous finish; aperture indistinct, a low arch at the base of the final chamber.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Length	Test Width (max.)	Taper Factor	No. of Biserial Chambers
	Pl.	fig.				
Hypotype 19815	VI	7	0.432	0.176	2.6	12
Hypotype 19816	VI	8	0.432	0.160	2.7	12

Distribution. A few specimens of this species were recovered from the interval from 0 to 40 feet in rock unit 1 of the Mount Goodenough section.

Discussion. The specimens described here are within the smaller dimension area of the parameters for *Textularia topagorukensis*. But the planispiral coil in these

specimens is much smaller, with very minute chambers and thicker test. Specimens more typical of *T. topagorukensis* have been recovered from beds stratigraphically higher than the Mount Goodenough section in the Peel River area. In order to validate identification or a new species, better preserved specimens are required.

Family ATAXOPHRAGMIIDAE Schwager, 1877

Genus *Gaudryina* d'Orbigny, 1839

Gaudryina tappanae n. sp.

Plate VI, figures 9–12

Description. Test free, elongate, slightly triangular in the early portion of three to four whorls with three chambers in each whorl, angles obtuse to slightly rounded; adult portion biserial, moderately flaring, ovate in cross-section with noticeable axial twist at the juncture of the initial triangular and the later biserial parts; chambers small, compact in initial part, larger, more rounded and distinct in biserial part gradually increasing in size; sutures fairly distinct, nearly horizontal, depressed in well-preserved specimens; wall agglutinated, consists of fine to medium quartz grains with variable, but commonly large, amount of silica cement, appearance lustrous, light brown; aperture somewhat indistinct but most specimens have a slight re-entrant indicating a loop-shaped aperture at the base of the inner face of the final chamber.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Length	Test Width (max.)	Taper factor	No. of Biserial Chambers
	Pl.	fig.				
Holotype 19817	VI	9	0.530	0.239	2.25	12–14
Paratype 19818	VI	10	0.672	0.240	2.75	12–14
Paratype 19819	VI	11	0.544	0.192	2.75	10–12
Paratype 19820	VI	12	0.672	0.240	2.75	12–14

Distribution. *G. tappanae* n. sp. occurs throughout rock unit 1 of the Mount Goodenough section from 0 to 110 feet. A few specimens are recovered from most samples which indicates the persistent nature of this species. Numerous occurrences of the species are being recorded by the writer in unpublished studies on equivalent strata in Arctic America.

Discussion. The distinctive axial twist at the point of juncture between the initial triserial and the final biserial parts distinguishes this species from others of similar size and chamber number whose taxonomic parameters are within the same group. *Gaudryina tappanae* n. sp. is usually larger than the Valanginian species *G. chettabaensis* Sigal, 1952, and the Early Albian *G. tailleuri* (Tappan), 1962.

Illustrations of the latter species show considerable variation but the specimens recovered from the Fortress Mountain Formation compare, in size and taper, with *G. tappanae* n. sp. Illustrations of Hecht's *Verneuilina* D4 (1938), revised by Bartenstein as *Verneuilinoides sublithiformis* (1952), are very indistinct. This Barremian species appears to be similar to *G. tappanae* n. sp., but examination of the original specimen is necessary to make reliable comparisons.

Family TROCHAMMINIDAE Schwager, 1877

Genus ***Trochammina*** Parker and Jones, 1859

Trochammina squamata (Jones and Parker) subsp. *limbata* Chapman, 1894

Plate VI, figures 13a–d, 14a–c

Trochammina squamata (Jones and Parker) subsp. *limbata* Chapman, 1894, Quart. Geol. Soc. London, vol. 50, p. 697, Pl. 34, figs. 4a–c.

Description. Test small, plano-convex and concavo-convex, deep umbilicus on ventral side in some specimens, plugged in others; two and one-half whorls, ventral surface flat, dorsal surface slightly convex, periphery rounded with margin slightly lobate; chambers inflated and small in first two whorls becoming large, high and overlapping in the ultimate whorl, increasing gradually to a large terminal chamber which is commonly collapsed in many specimens; sutures distinct, thickened, straight in final whorl, constricted, giving slight, lobate outline to peripheral margin; wall thin, finely arenaceous, surface smooth; aperture on inner margin of last-formed chamber on the ventral side.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diam.	Test Height	Taper Factor	No. of Whorls	No. of Chambers	
	Pl.	fig.					Dors.	Vent.
Hypotype 19821	VI	13	0.310	0.208	0.67	2–3	5	7
Hypotype 19883	VI	14	0.368	0.250	0.69	3	5	7–8

Distribution. Figured specimens were recovered from beds from 40 to 110 feet in rock unit 1 of the Mount Goodenough section. The species is present throughout rock unit 1 and has been recovered from the whole section under investigation as well as from strata of equivalent age in other northern areas.

Discussion. The position of this species on the graph is within the group of *T. wetteri* Stelck and Wall, 1955. It is possible that *T. squamata* subsp. *limbata* of the Neocomian is part of the stock from which *T. wetteri* was derived. Hecht has recorded *T. limbata* from the late Barremian of Germany, and that form is similar to *T. squamata* subsp. *limbata.*

Trochammina conicominuta n. sp.

Plate VI, figures 15a–c

Description. Test very small, plano-convex with deep umbilicus in some specimens; two whorls visible, ventral surface flat, dorsal surface conical and the periphery rounded with the margin slightly lobate in the area of the last two chambers of the ultimate whorl; chambers inflated, the final two chambers increasing rapidly in size resulting in an asymmetrical cone in side view; sutures indistinct; wall very siliceous, light brown, lustrous; aperture indistinct.

Measurements in millimetres.

GSC Type Specimen	Illustration		Test Diam.	Test Height	Taper Factor	No. of Whorls	No. of Ch/Whorl	
	Pl.	fig.					Penult.	Ult.
Holotype 19884	VI	15	0.176	0.128	0.7	2	5–6	5+
Paratype 19885	—	—	0.208	0.144	0.7	2	6+	6

Distribution. Detailed examination under high magnification and with the application of oil to the specimen in order to obtain translucency was only made on minute specimens from samples 20 to 60 feet. The species may also be present above and below this recorded interval. Specimens are common but most difficult to distinguish from *Haplophragmoides duoflatis* n. sp.

Discussion. Trochammina conicominuta n. sp. is much smaller in all dimensions than *T. squamata* subsp. *limbata* and has a higher cone as is shown by the taper factor. Its position on the graph indicates a relationship to the *T. albertensis* Wickenden group but it lies at the extreme end of the smaller dimensions and is asymmetrically conical.

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