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JURASSIC MICROFAUNAS AND BIOSTRATIGRAPHY OF NORTHEASTERN BRITISH COLUMBIA AND ADJACENT ALBERTA

M.M. BROOKE
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PREFACE

This report deals with some of the hitherto poorly known microfaunas in Jurassic rocks of the foothills of the Peace River region of northeastern British Columbia and adjoining parts of Alberta. Foraminifers and ostracodes from four stratigraphic sections are described and illustrated, and their significance is discussed. The three microfaunal assemblages distinguished may span all of Late Jurassic or alternatively be restricted to latest Jurassic time. Their identification and interpretation will aid in biostratigraphic correlation of western and northern Canadian Jurassic rocks and the mineral and fuel deposits within them.

The material used in this study was collected by the Geological Survey of Canada. The microfaunal study was carried out by two scientists of the University of Saskatchewan under contract to the Geological Survey.

D.J. McLaren
Director General
Geological Survey of Canada

Ottawa, September 1978

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JURASSIC MICROFAUNAS AND BIOSTRATIGRAPHY OF NORTHEASTERN BRITISH COLUMBIA AND ADJACENT ALBERTA

Abstract

Three microfaunal assemblages are recognized in the Jurassic strata of the Foothills of the Peace River region of northeastern British Columbia and the adjoining areas of Alberta. These assemblages are contained within that part of the Fernie Formation which overlies the Lower Jurassic beds.

The assemblages consist of 41 agglutinated and 32 calcareous foraminiferal species, and 14 ostracode species, and differ markedly from those microfaunas contained in Jurassic strata of the North American western Interior Plains.

Elements of the Peace River microfaunal assemblages have been recognized as far south as the Passage Beds of southeastern British Columbia and, to the north, in the northern Richardson Mountains and the Arctic Sverdrup Basin. Comparable, and some identical, species have been reported from Jurassic strata of northern Alaska, and from Upper Jurassic strata of western and northern Siberia.

The three microfaunal assemblages of the Peace River region may span almost all of Late Jurassic time, possibly extending from the latest Callovian, at the very earliest, through the Oxfordian and Kimmeridgian into the Portlandian. Alternatively, the microfauna may be restricted to the Kimmeridgian to Portlandian, i.e., a late Late Jurassic age.

Résumé

Selon les auteurs, on trouve une microfaune constituée de trois assemblages, dans les strates jurassiques des Foothills de la région de la Rivière-de-la-Paix, au nord-est de la Colombie-Britannique, et les zones voisines situées en Alberta. Ces assemblages appartiennent à la partie de la formation de Fernie postérieure aux couches du Jurassique inférieur.

La microfaune comprend 41 espèces de foraminifères à coquilles agglutinées et 32 espèces de foraminifères à coquilles calcaires ainsi que 14 espèces d'ostracodes, et elle se distingue assez nettement des microfaunes que l'on trouve dans les couches jurassiques des plaines Intérieures de l'Ouest nord-américain.

Certains éléments de la microfaune de la Rivière-de-la-Paix one été reconnus vers le sud jusqu'aux couches Passage du sud-est de la Colombie-Britannique et vers le nord, jusque dans la partie septentrionale des chaînons Richardson et du bassin Sverdrup. On a aussi signalé des espèces comparables, voire identiques, probablement en provenance des strates jurassiques du nord de l'Alaska et des strates jurassiques supérieures des parties occidentales et septentrionales de la Sibérie.

On en déduit donc que la microfaune de la région de la Rivière-de-la-Paix, date du Jurassique supérieur, on la rencontre à la toute fin du Callovien, jusqu'au Portlandien, en passant par l'Oxfordien et le Kimmeridgien. Il est toutefois possible que cette microfaune n'appartienne qu'au Kimmeridgien-Portlandien, c'est-à-dire, à la toute fin du Jurassique supérieur.

INTRODUCTION

The exposures of Jurassic rocks in the Foothills of the Peace River region of northeastern British Columbia and adjoining northwestern Alberta form the northernmost extension of an outcrop belt that extends, nearly uninterrupted, southward to the International Boundary and into the northwestern United States. To the north of the Peace River area, no other Jurassic outcrops are known for nearly 1600 km (1000 mi). There, beginning in the northern Richardson Mountains of the Arctic Coast, another belt comprising Jurassic sequences extends across the Sverdrup Basin of the Canadian Arctic Islands, both on the surface and in the subsurface.

The Jurassic sequences of the Peace River region are composed of shale, mudstone, silty mudstone and fine grained sandstone, all of which are predominantly grey to dark grey in colour, or weathered to various shades of brown. These sequences reach their greatest thicknesses in the western Foothills and thin to an erosional edge in the adjoining plains. They have been assigned to the Fernie Formation and have been divided into one lower member, the Nordegg, which is overlain by several unnamed lithologic units (Stott, 1967, p. 4). These units are overlain in turn by the more massive, coarser clastic sequences of the Monteith Formation, which constitute the basal part of the Minnes Group and are of latest Jurassic to Early Cretaceous (Valanginian) age (Stott, 1975, p. 21).

The microfauna recovered from these Fernie sequences consists of species that are most closely related to the Jurassic foraminiferal faunas of the Canadian and Siberian Arctic regions; at species level, they differ substantially from the Jurassic foraminiferal-ostracode assemblages of the central Interior Plains. This study draws attention, therefore, to a previously unreported but significant variation in the distribution of the Late Jurassic microfauna of western Canada.

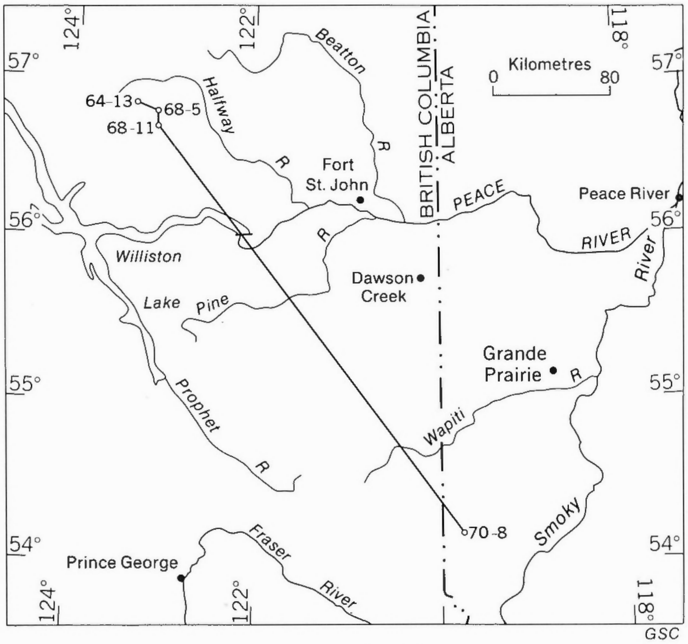
Study Area

The study area, which is referred to as the Peace River region throughout the text, covers those parts of the Foothills of northeastern British Columbia and northwestern Alberta that lie between latitudes 54° to 57° north and longitudes 119° to 124° west. The locations of the four outcrop sections analyzed for their microfaunal content are indicated on Figure 1, with their co-ordinates listed below. The shaded area in Figure 2 indicates the relative position of the study area in relationship to those major geologic features mentioned in the text.

Previous Work

The report of Stott (1967) on the Jurassic and Cretaceous sequences of northeastern British Columbia incorporated the results of a microfaunal investigation of outcrop Section 64-13 that had been carried out by Chamney. The present study was undertaken as a continuation and expansion of this initial microfaunal investigation.

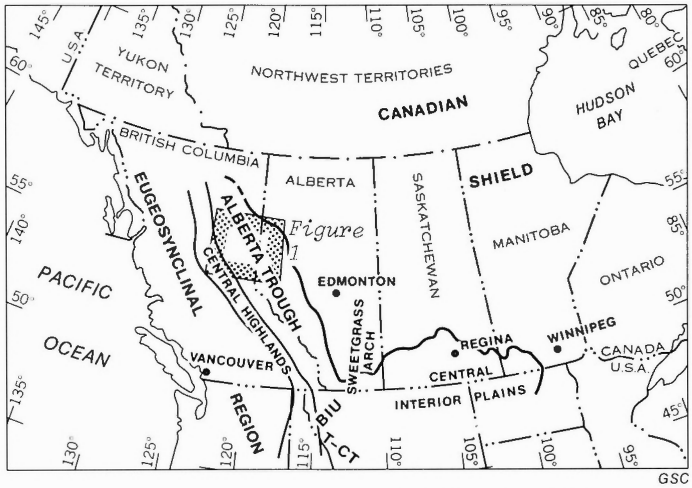
The material used for this study, with the exception of that from Section 70-8 of northwestern Alberta, was collected by Stott (and coworkers) during several years of fieldwork; the results of this work appear in Stott's 1967 and 1969 publications. Section 70-8 was measured and sampled by Stott at a later date. Two sections were subsequently renumbered, namely Section 68-5 (formerly 62-5) and Section 68-11 (formerly 62-13), and Section 68-11 was remeasured and redescribed. The descriptions and measurements of all four sections (adopted from Stott) appear in Appendix A. The microfossils of all the sections were picked from the rock residue in the Department of Geological Sciences of the University of Saskatchewan under the supervision of the writers.



SELECTED LOCALITIES

SI 64-13	56°51'N 123°19'W	SI 68-11	56°40'N 123°04'W
SI 68-5	56°48'N 123°05'W	SI 70-8	54°10'N 119°46'W

Figure 1 *Map of study area (Peace River region) (see Chart 6 for columnar sections).*



Twin-Creek Trough........T-CT *Belt Island Uplift*.......BIU

Erosional edge (of Jurassic strata).......

0 Kilometres 1000

Figure 2 *Major tectonic features of western Canada during Jurassic time (based on Springer et al., 1964 and Brooke and Braun, 1972).*

Tectonic and Stratigraphic Framework

The major tectonic features that influenced and controlled the pattern of sedimentation and faunal dispersion in the Canadian western interior regions during Jurassic time are shown in Figure 2. The shaded area indicates the extent of the study area that, at one time, lay within the Alberta Trough.

The Alberta Trough presumably provided a major gateway for the boreal seas that, intermittently and up until early Late Jurassic time, may have flooded southward also into the Twin Creek Trough and from there spread into the Interior Plains region of western North America. By Late Jurassic time, however, the seas had withdrawn from the Interior Plains with only the sea of the Alberta Trough remaining.

On the west, the trough was flanked by the Central Highlands (Mesocordilleran Geanticline of various authors), which probably existed in the form of a string of islands rather than as an extended land ridge and separated the miogeosynclinal and cratonic seas to the east from the eugeosynclinal region to the extreme west (Stott, 1967; Frebold and Tipper, 1970). To the southeast, the Sweetgrass Arch - Belt Island complex formed an intermittently effective barrier that separated the Alberta Trough from the Twin Creek Trough to the south (Peterson, 1957, 1958). During early Late Jurassic time (Callovian-Oxfordian), this barrier was submergent; however, since sediments and faunas of Kimmeridgian or later age are absent over the complex, it must be assumed either that this region had become fully emergent by this time or that sediments of a later age, if ever deposited, subsequently were removed by erosion. To the east and to the north, the Jurassic deposits terminate in an erosional edge.

The Jurassic rocks exposed in the Fernie Basin of southeastern British Columbia and in the adjoining parts of the Alberta Foothills have been referred summarily to the Fernie Group and have been divided into a number of lithologic units. These conventional divisions of the Fernie Group are shown in Figure 3 within their age-stage framework. Stott (1967) assigned a formational rank to the Fernie sequences of the Peace River region and divided the formation into six mappable lithologic units. A summary of these units is shown in Figure 4. In contrast to Stott's placement of the Callovian in the Middle Jurassic Series, it is regarded in the present report to be of Late Jurassic age.

The following summary of the stratigraphy and biostratigraphy of the Peace River region is based on Stott's (1967) report, with suggested modifications that have arisen as a result of this study.

Within the Peace River region, the Fernie sequences rest unconformably on beds of Triassic age, whereas the upper beds of the Fernie are gradational into the sandstone of the overlying Monteith Formation of the Minnes Group (uppermost Jurassic to Lower Cretaceous).

Stott's units can be correlated only in very general terms with those of the Fernie Group to the south, and only the basal unit (1), on the basis of ammonites as well as on lithologic similarity, is recognized formally as the Nordegg Member.

Stott considered that the Unit 2 - Nordegg Member contact probably is disconformable and, based on stratigraphic position and lithologic similarity, that this unit might be equivalent to the Toarcian Poker Chip Shales. However, confirmation of age and correlation of Unit 2 was not established definitely, and no microfaunas were recovered from the unit which might have aided in its correlation.

The contact of Unit 3 with the underlying Unit 2 may be disconformable as well. In addition, although an unconformable relationship between Unit 3 and the overlying Unit 4 was not readily apparent, there is a possibility of an hiatus between these two units.

On the basis of microfaunal evidence, Chamney (in Stott, 1967) interpreted Unit 3 to be equivalent to the Callovian Grey Beds, and possibly also to the Bajocian Rock Creek Member. The microfaunas from the present study indicate that an alternative correlation should be considered.

With reference to the index species used by Chamney in establishing the age and the stratigraphic placement of Unit 3, most, if not all, of these species are not particularly compatible with a Bajocian-Callovian dating for this unit.

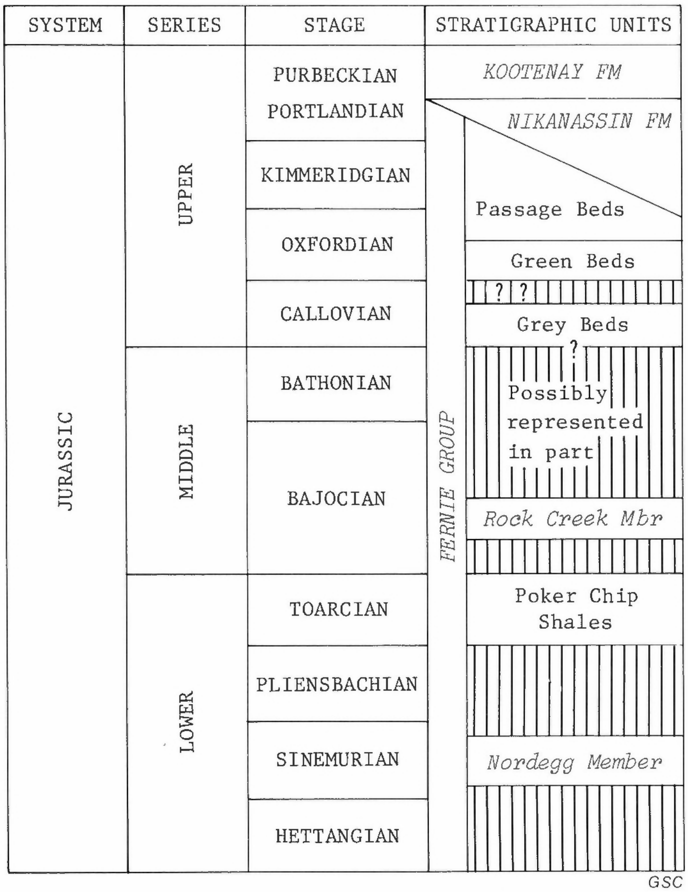


Figure 3 *Stratigraphic nomenclature, Fernie sequences (based on Springer et al., 1964).*

AGE	STRATIGRAPHIC UNITS			LITHOLOGY
EARLY CRETACEOUS	*MINNES GROUP*	*MONTEITH FORMATION*	Unit 1	Alternating units of thick-bedded, fine-grained sandstone and silty mudstones; few beds of conglomeratic sandstone
JURASSIC		*FERNIE FORMATION* 0-791'	Unit 6	Thinly interbedded sandstone, siltstone and mudstone
			Unit 5	Dark marine sideritic shales
			Unit 4	Glauconitic siltstones and mudstones; some sideritic concretions
			Unit 3	Dark grey to black, rusty-weathering marine shales; some fine-grained sandstone
			Unit 2	Black calcareous, fissile, papery shale
			Nordegg Member	Black calcareous interbedded siltstone and shale with thin dense black limestone; chert nodules and phosphatic chert
TRIASSIC	Erosional unconformity			

GSC

Figure 4 *Lithologic units, Fernie sequences, Peace River region (after Stott, 1967).*

The Foraminifera *Marginulina pinguicula* Tappan, 1955 and *Globulina topagorukensis* Tappan, 1955 were described from Upper Jurassic (probably Oxfordian or Lower Kimmeridgian) strata of northern Alaska (Tappan, 1955). The ostracode *Monoceratina sundancensis* Swain and Peterson, 1951 was described from Oxfordian sequences but was reported also from Upper Callovian strata of the western interior United States. Brooke and Braun (1972) reported rare occurrences of a similar form, *Monoceratina* cf. *M. sundancensis* from Upper Callovian strata of southern Saskatchewan but failed to recognize either form in the Peace River study area. With reference to the remaining indices, the Foraminifera *Eoguttulina* cf. *E. liassica* and *Astacolus* cf. *A. dubius*, *Eoguttulina liassica* (Strickland), 1864 ranges from the Lower Lias to the Upper Malm in Europe and was recognized by Tappan (1955) in Alaska in strata assigned an Early Jurassic (Late Pliensbachian - Early Toarcian) age. *Astacolus dubius* (Franke), 1936 was described from the Lias of Europe, and the species was reported by Tappan (1955) in strata considered to be of Toarcian age.

In addition to the reservations entertained as to the reliability of these various species for use as Bajocian-Callovian indicators, the fact that reliable western Canadian Callovian markers, such as *Marginulina phragmites* Loeblich and Tappan, 1950 and *Procytheridea exempla* Peterson, 1954, are not present in the Peace River region, immediately raises suspicions as to a Bajocian-Callovian age for Unit 3. Moreover, the marked similarities of various Unit 3 species to younger Late Jurassic species of Siberia further strengthen such doubts.

The Callovian-Oxfordian boundary was drawn by Chamney (in Stott, 1967) at the base of Unit 4. The correlation of this unit with the basal Green Beds of the southern Fernie Group may be compatible with both stratigraphic and lithologic evidence, but fossil evidence is inconclusive.

Stott (1967) stated that Unit 5 probably was conformable with the underlying Unit 4. Chamney dated the unit as "Late Jurassic" and considered it to include equivalents of the Green Beds - Passage Beds of the Fernie Group. By inference from the position of Unit 5 on Table 1 (in Stott, 1967) and from the reference to the ostracode *Aparchitocythere loeblichorum* (Swain and Peterson, 1951), "Late Jurassic" would seem to mean an Oxfordian age for this unit.

Aparchitocythere loeblichorum is characteristic of the Oxfordian sequences of the western interior United States, but this species has been identified only tentatively in extreme southern Saskatchewan (Brooke and Braun, 1972). This would appear to be its northernmost occurrence, for it was not recognized in any of the Peace River sections studied. However, the superficially similar *Camptocythere*? sp. 64 of this study does occur in the same interval of Section 64-13 in which Chamney (in Stott, 1967) reported *Aparchitocythere loeblichorum*.

The upper boundary of Unit 5 is gradational with Unit 6 and, in Section 70-8, no sufficiently pronounced lithologic change occurs that would permit a meaningful division of these sequences into two units. Consequently, the upper sequences of this section are referred to as a combined unit (Unit 5-6).

Stott (1967) considered the upper shales of Unit 5 possibly to be equivalent, in part, to the lower Passage Beds which, in the Fernie Basin, were placed by Frebold (1957) in the Upper Oxfordian to Lower Kimmeridgian. In the Pine Pass area farther south, the upper Fernie shales were considered by Jeletzky (in Stott, 1967, p. 13) to embrace Kimmeridgian to Portlandian time. Pelecypods (Appendix A, Sec. 70-8) indicate a Late Oxfordian to Early Kimmeridgian age for the middle sequences of Unit 5-6.

The upper boundary of Unit 6 and of the combined Unit 5-6 of Section 70-8 is gradational with the Lower Cretaceous Monteith Formation, and the lithology of the unit bears considerable resemblance to that of the upper Passage Beds of southwestern Alberta. These upper Passage Beds have been dated by Frebold (1957) as probably late Kimmeridgian to early Portlandian.

Chamney (Table 1 in Stott, 1967) seems to indicate a Late Oxfordian - Kimmeridgian - Portlandian? age for Unit 6, using *Lenticulina* cf. *L. dilecta* as an index fossil. *Lenticulina dilecta* Loeblich and Tappan, 1950 was described from Callovian strata of the western interior region of the United States. In the western Interior Plains of Canada, the species ranges through the Callovian into the Lower Oxfordian [reported as *Lenticulina quenstedti* (Gümbel), 1862 by Gordon (1967), and Brooke and Braun (1972)]. The species, whether reported as *Lenticulina dilecta* or *L. quenstedti*, has not been recognized in strata younger than Oxfordian in the western Interior Plains of North America, and no form sufficiently similar to be compared with this species was recovered in the present study.

The similarities of the Peace River Foraminifera to various foraminiferal species from Upper Jurassic strata of West Siberia points to a late Late Oxfordian - Kimmeridgian age for Unit 5, and a Portlandian age for Unit 6. This will be discussed in detail later.

Acknowledgments

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The laboratory work was carried out in the Department of Geological Sciences of the University of Saskatchewan, Saskatoon.

BIOSTRATIGRAPHIC PALEONTOLOGY

General Remarks

In the present study, 73 foraminiferal and 14 ostracode species were recognized. Of the Foraminifera, 41 species are agglutinated forms and 32 are calcareous. Agglutinated species are the dominant faunal element, appearing not only with greater regularity throughout the sections but also in greater diversity of species and in greater abundance of individuals. The calcareous species are few in number and sporadic in occurrence. The ostracodes are not only extremely rare but also very erratic in their distribution.

Preservation is poor compared to that of the Jurassic microfaunas of Saskatchewan, or of the northern Richardson Mountains and the Arctic Islands; the calcareous forms particularly (both Foraminifera and Ostracoda) are severely damaged and corroded. The disparity in numbers of calcareous as opposed to agglutinated tests could, to a greater or lesser extent, be the result of greater post-depositional destruction of the former as opposed to the latter. Even so, in their original proportions, there surely must have been a very strong bias toward greater numbers of agglutinated than of calcareous Foraminifera.

In composition, the foraminiferal fauna recovered represents a typical Late Jurassic, boreal microfauna (in contrast to a Tethyan microfauna), as outlined by Gordon (1970). Simple lituolids are dominant, with proportionately fewer ammodiscids and textulariids. The most common calcareous species are nodosariids, with the polymorphinids less commonly present.

Comparisons with North American and Other Microfaunas

Foraminiferal faunas from North America that have common or similar elements to microfaunas of the Peace River region have been reported from two widely separated regions: the northern Alaskan coast (Tappan, 1955), and the Fernie Basin of southeastern British Columbia (Weihmann, 1964). These localities are shown in Figure 5 (locs. 1, 4, respectively). Several of the species from the Passage Beds of the Fernie Basin, assigned to western Interior Plains species by Weihmann, are identical with species of the Peace River microfaunas. However, the Jurassic microfaunas of the Interior Plains (southern Alberta, southern Saskatchewan, Montana, North and South Dakota, and Wyoming), although they too are typically boreal in composition, consist of different foraminiferal and ostracode species from those of the Peace River microfauna. The comparable species considered to be of greatest biostratigraphic significance are listed in Table 1.

In addition to the foraminiferal faunas of the above-mentioned regions, species strikingly similar to those of the Peace River region are presently under study from the northern Richardson Mountains of the Northwest Territories and from the Sverdrup Basin of the Canadian Arctic Archipelago (Fig. 5, locs. 3, 5).

With respect to intercontinental comparisons, the strongest and the most consistent similarities were found to be with foraminiferal faunas of West Siberia (Fig. 5, loc. 7), which have been reported by Dain (1972). From among the Siberian Foraminifera, various species of the genus *Recurvoides* are of particular interest since they are not only closely comparable with species of the Peace River region, but, in addition, representatives of this genus have not been reported to date from Jurassic sequences of the North American western Interior Plains. Also of significance is the presence of the north Alaskan *Trochammina gryci* Tappan, 1955 in both western and northern Siberia [Dain, 1972, reported as *Recurvoides gryci* (Tappan); Gerke, 1969)]. This particular species is present in all four of the Peace River outcrops.

Comparisons were made with the foraminiferal faunas of the Russian Platform as reported by Myatliuk (1939), Fursenko and Polenova (1950), and by Dain and Kuznetsova (1971); although some minor similarities were noted, these microfaunas, on the whole, differ from those of the study area. The comparison with other central and northern European faunas (England, France, Germany, Poland) was largely negative: any similarities were confined either to species that were long-ranging, widespread, and rather featureless (e.g., *Pseudonodosaria humilis*, *Eoguttulina liassica*) or to forms that were comparable only tentatively (e.g., *Haplophragmoides* cf. *H. canui*, *Reophax* cf. *R. hounstoutensis)*.

As a result of the search for comparable foraminiferal faunas, it became increasingly evident that the answer to the age of the Peace River microfauna should best be sought in the north, in the Canadian Arctic and in northern Siberia, rather than in the south or in Europe.

Microfaunal Assemblages and Correlation

The microfauna recovered from the four sections studied does not lend itself readily to division into clearly defined assemblages. Although each distribution chart (Charts 1 - 4, in pocket) displays a shift in the faunal spectrum, a consistent, clearly defined change in the faunal pattern common to all the sections is not readily apparent.

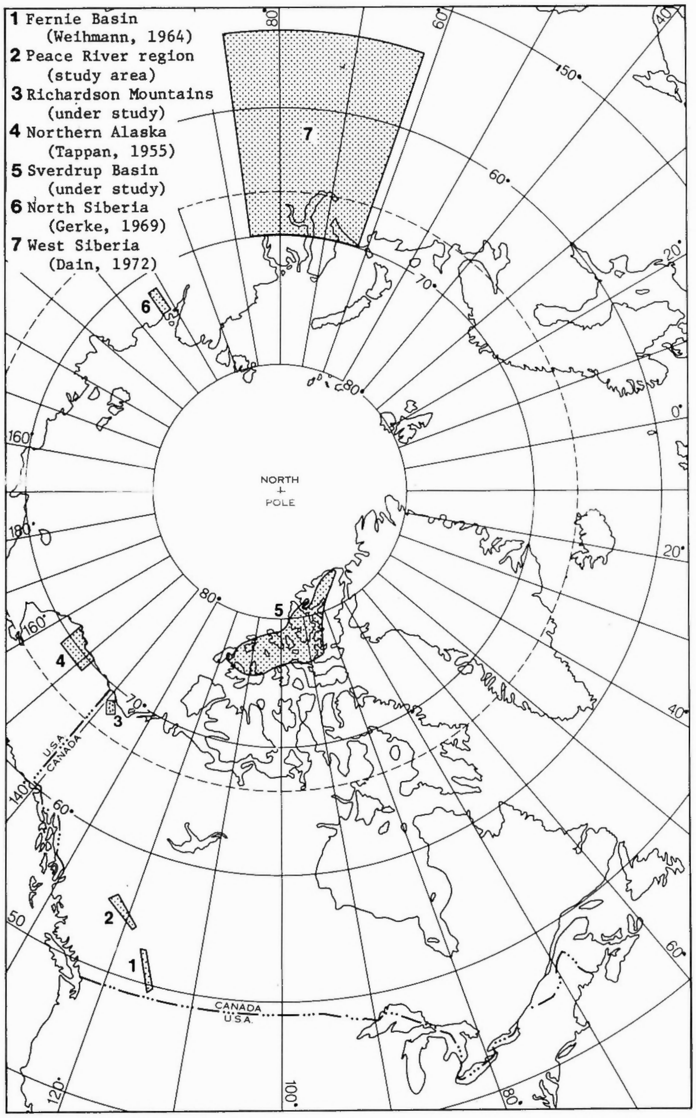

Figure 5 *Geographic distribution of foraminiferal faunas related to those of the Peace River region.*

However, three assemblages have been tentatively established, which are referred to as Assemblages I to III in ascending order (Chart 5, in pocket). These assemblages have been superimposed on the rock units in Correlation Chart 6 (in pocket). In the construction of this chart, the contact between Units 3 and 4 (Chamney's Callovian-Oxfordian boundary, in Stott, 1967, p. 26) has been used as a datum line, which seems to be the most readily identifiable lithologic marker in this area. The three assemblages can be traced through Sections 64-13, 68-5 and 68-11, but in Section 70-8, Assemblage II is recognized only tentatively. There, some 121 m (400 ft) of unfossiliferous siltstones and sandstones separate Assemblage I, the oldest, from the youngest Assemblage III.

Assemblage I essentially characterizes rock Unit 3. The assemblage is bounded at the base by the barren sequences of Unit 2 and terminates at the contact between rock Units 3 and 4. It is the most diversified of the assemblages, consisting of 76, possibly 78, taxa, of which 25 continue into the overlying sequences to form the background fauna of all three assemblages. Of the 37 species confined to this assemblage, only 20 to 25 per cent occur with any degree of regularity; the remaining species are represented by no more than one or two isolated specimens and, consequently, their geographic and stratigraphic distribution cannot, as yet, be assessed.

The species most diagnostic of Assemblage I are those tentatively referred to the genus *Recurvoides*, with some rare biserial or triserial textulariids. These species are listed below:

Recurvoides? cf. *R. disputabilis* Dain*
Recurvoides? sp. 149*
Recurvoides? sp. 208*
Recurvoides? sp. 226*
Spiroplectammina suprajurassica Kosyreva*
Spiroplectammina cf. *S. tobolskensis* Beljaevskaja and Komissarenko
Dorothia? sp. 181
Verneuilinoides sp. 233
Genus indeterminate sp. 183
Genus indeterminate sp. 193

The lower and upper boundaries of Assemblage II are set tentatively to coincide with the first and last appearance of the ostracode *Camptocythere*? sp. 64 (possibly Chamney's *Aparchitocythere loeblichorum*, in Stott, 1967, p. 26). This species appears directly above Unit 4 and ranges through Unit 5 in Sections 64-13 and 68-5, but in Section 68-11 it appears within Unit 4 and extends into Unit 5. Unfortunately, this index ostracode was not found in Section 70-8. There, the reduced microfauna that appears immediately above the barren, 1.2 m (4 ft) thick Unit 4 is designated tentatively as Assemblage II.

The boundary between Assemblages II and III does not coincide with a lithologic change but is placed at the disappearance of *Camptocythere*? sp. 64. Assemblage III terminates in the barren sequences that constitute the upper part of Unit 6 (Unit 5-6 of Sec. 70-8).

This assemblage characteristically contains the long-ranging species that are common to all three assemblages. Those most frequent and most consistent in occurrence are as follows:

Ammobaculites cf. *A. alaskensis* Tappan
Ammosphaeroidina? sp. 146
Glomospirella? sp. 174
Globulina cf. *G. alexandrae* Dain
Haplophragmoides cf. *H. canui* Cushman
Haplophragmoides(?) *canuiformis* Dain
Lenticulina cf. *L. wisniowskii* (Myatliuk)
Saracenaria sp. 176
Trochammina gryci Tappan

Age Implications

As previously discussed, species comparable to those recovered from the study area are present in the Passage Beds of the Fernie Basin (Weihmann, 1964), in coastal northern Alaska (Tappan, 1955), and in West and North Siberia (Dain, 1972; Gerke, 1969). Most of these species, with the ages attributed to them, have been listed in Table 1. The Passage Beds have been assigned an Oxfordian to Portlandian age; the Alaskan species were recovered from strata ranging in age from the Early into the Late Jurassic; the West Siberian species were from strata of Late Callovian to Middle Volgian (Portlandian); and the North Siberian species from strata of Callovian to Early Cretaceous age.

The majority of the northern Alaskan species that are similar to those of the study area are from Oxfordian sequences; the remaining few are long-ranging forms that extend from the Early into the Late Jurassic. Most of the comparable Siberian species cluster in the Kimmeridgian (Russian usage), with several additional species from the Oxfordian and with one each from the Upper Callovian and the Middle Volgian (Portlandian).

* May be present at higher levels

Table 1. Comparable interregional and intercontinental species

PEACE RIVER	COMPARABLE SPECIES
Ammobaculites cf. *A. alaskensis*	*A. alaskensis* Tappan, 1955 *Ammobaculites* sp. A Wall, 1960, Weihmann, 1964 *Ammobaculites* ex gr. *A. syndascoensis* Scharovskaja, Dain, 1972
Ammobaculites cf. *A. pokrovkaensis*	*Haplophragmoides pokrovkaensis* Kosyreva *in* Dain, 1972
Ammosphaeroidina? sp. 146	*Trochammina(?)* ex gr. *T. canningensis* Tappan, 1955, Dain, 1972
Haplophragmoides cf. *H. canui*	*H. canui* Cushman, 1930, Tappan, 1955 *Cribrostomoides canui* (Cushman), Dain, 1972
Haplophragmoides(?) canuiformis	*H.(?) canuiformis* Dain, 1972
Haplophragmoides cf. *H. volgensis*	*H. volgensis* Myatliuk, 1939 *H. volgensis* Myatliuk, Bielecka and Pozaryski, 1954 *H. volgensis* Myatliuk subsp. *inviolatus* Dain, 1972 *Haplophragmoides* sp. Weihmann, 1964
Recurvoides? cf. *R. disputabilis*	*R. disputabilis* Dain, 1972
Recurvoides? sp. 149	*R. sublustris* Dain, 1972
Recurvoides? sp. 226	*Recurvoides gryci* (Tappan), Dain, 1972
Spiroplectammina suprajurassica	*S. suprajurassica* Kosyreva *in* Dain, 1972 *Spiroplectammina* sp. Tappan, 1955
Spiroplectammina cf. *S. tobolskensis*	*S. tobolskensis* Beljaevskaja and Komissarenko *in* Dain, 1972
Trochammina cf. *T. canningensis*	*T. canningensis* Tappan, 1955
Trochammina gryci	*T. gryci* Tappan, 1955 *Recurvoides gryci* (Tappan), Dain, 1972 *T. gryci* Gerke, 1969
Geinitzinita cf. *G. praenodulosa*	*G. praenodulosa* Dain, 1972 *Frondicularia* sp. Tappan, 1955
Globulina cf. *G. alexandrae*	*G. alexandrae* Dain, 1972 *Globulina topagorukensis* Tappan, 1955
Lenticulina cf. *L. wisniowskii*	*L. wisniowskii* (Myatliuk), 1939, Tappan, 1955
Marginulinopsis cf. *M. subrusticus*	*Marginulina subrusticus* Dain, 1972

With respect to age comparisons between the Siberian and Canadian microfaunas of the Upper Jurassic, the differing opinions as to the placement of the upper boundary of the Kimmeridgian Stage can create considerable confusion. Russian authors place this boundary at the base of the *Gravesia*-Zone (Table 2, column 2), whereas Canadian authors tend to follow the English custom of placing this boundary at the base of the ***Zaraiskites albani***-Zone (Table 2, column 1). Additionally, in Russian usage, the Kimmeridgian is succeeded by the Volgian as opposed to Portlandian Stage. The relationship of the Russian Kimmeridgian to the classical western European stages is shown in Figure 6. Although it is used frequently in western Canadian literature, the Tithonian Stage is not included in this figure, for this stage name carries connotations of faunal relationships with the Tethyan realm, which is an impossible inference in connection with the typically boreal microfauna of the Peace River region.

The Upper Jurassic stages and substages, together with the classical ammonite zones of northwestern Europe, of Russia in general, and of West Siberia in particular, have been incorporated in Table 2. Dain (1972) established a foraminiferal zonal scheme that was correlated with the ammonite zones of West Siberia that in turn was compared with the standard Russian ammonite zones. Those of the Siberian zonal Foraminifera which have counterparts among

LOCATION	STAGE	ASSEMBLAGE (THIS REPORT)
North Alaskan coast Fernie Basin, British Columbia West Siberia	Lower-Upper Jurassic Upper Jurassic Upper Oxfordian	I-II-III
West Siberia	Oxfordian-Kimmeridgian*	I
	Lower Kimmeridgian*	I-II-III
North Alaskan coast West Siberia	Upper Jurassic (Upper Oxfordian) Upper Oxfordian	
West Siberia	Lower Kimmeridgian*	
Middle Volga region and Obschiy Syrt Central Poland West Siberia Fernie Basin, British Columbia	Volgian Upper Kimmeridgian Volgian Upper Jurassic	
West Siberia	Upper Oxfordian-Lower Kimmeridgian*	I (into II)?
	Lower Kimmeridgian*	I (into II and III)?
	Upper Callovian-Lower Oxfordian	I-II
West Siberia North Alaskan coast	Lower Kimmeridgian* Upper Jurassic	
West Siberia	Upper Oxfordian	I
North Alaskan coast	Lower-Upper Jurassic (Lower Lias-Kimmeridgian)	I-II
North Alaskan coast West Siberia North Siberia	Upper Oxfordian Upper Callovian-Lower Oxfordian Oxfordian	I-II-III
West Siberia North Alaskan coast	Upper Oxfordian-Kimmeridgian* Upper Jurassic (Oxfordian-L. Kimmeridgian)	II (into I)?
West Siberia North Alaskan coast	Upper Kimmeridgian* Upper Jurassic (Oxfordian-L. Kimmeridgian)	I-II-III
North Alaskan coast	Upper Jurassic (Oxfordian-L. Kimmeridgian)	
West Siberia	Kimmeridgian*-Volgian	I (into II)?

* of Russian authors

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the Peace River microfauna are shown, within their respective stages and zones, in column 5 of Table 2, with the comparable Canadian species listed in column 6. The Roman numerals following the Canadian species indicate the assemblages in which these species occur.

The cumulative evidence that arises from the age placement of the Siberian and the majority of northern Alaskan foraminiferal species, as well as of species from the Passage Beds of the Fernie Basin, can only be interpreted as indicating a Late Jurassic age for the Peace River microfauna, an age that possibly ranges downward into latest Callovian at the earliest, and upward into the Portlandian (Middle Volgian) at the latest. More particularly, the evidence points most strongly toward an Oxfordian-Early Kimmeridgian (Kimmeridgian of Siberia) age for the microfauna, with the unfossiliferous upper sequences of Unit 6 extending presumably into the Portlandian. This age interpretation presents an alternative to that of Chamney (in Stott, 1967); also, it is an interpretation not incompatible with the megafaunal evidence available.

Should this age assignment and northern relationship of the Peace River microfauna be confirmed (either by further microfaunal studies or by megafaunal evidence), various geologic problems arise. A major unconformity would have to be postulated that would separate Unit 2 of Toarcian age from the fossiliferous portion of Unit 3 of postulated Late

Table 2. Upper Jurassic ammonite zones of northwestern Europe, the Russian Platform and West Siberia, with selected zonal Foraminifera of West Siberia and comparable Foraminifera from the Peace River region

STAGES AND SUBSTAGES		N.W. EUROPE - W. CANADA Arkell, 1956; Frebold, 1957 AMMONITE ZONES
PURBECKIAN		No ammonites
PORTLANDIAN		*Titanites giganteus* *Glaucolithites gorei* *Zaraiskites albani*
KIMMERIDGIAN	UPPER	*Pavlovia pallasioides* *Pavlovia rotunda* *Pectinatites pectinatus*
KIMMERIDGIAN	MIDDLE	*Subplanites wheatleyensis* *Subplanites* spp. *Gravesia gigas* *Gravesia gravesiana*
KIMMERIDGIAN	LOWER	*Aulacostephanus pseudomutabilis* *Rasenia mutabilis* *Rasenia cymodoce* *Pictonia baylei*
OXFORDIAN		*Ringsteadia pseudocordata* *Decipia decipiens* *Perisphinctes cautisnigrae* *Perisphinctes plicatilis* *Cardioceras cordatum* *Quenstedtoceras mariae*
CALLOVIAN		*Quenstedtoceras lamberti* *Peltoceras athleta* *Erymnoceras coronatum* *Kosmoceras jason* *Sigaloceras calloviense* *Proplanulites koenigi* *Macrocephalites macrocephalus*

STAGES AND SUBSTAGES		RUSSIAN PLATFORM Gerasimov *et al.*, 1975; Mikhaylov, 1962 AMMONITE ZONES	
VOLGIAN	UPPER	*Craspedites nodiger*	*C. nodiger* *C. mosquensis*
VOLGIAN	UPPER	*Craspedites subditus*	
VOLGIAN	UPPER	*Kachpurites fulgens*	
VOLGIAN	MIDDLE	*Paracraspedites* sp. *Epivirgatites nikitini*	
VOLGIAN	MIDDLE	*Virgatites virgatus*	*V. rosanovi* *V. virgatus* (s. str.)
VOLGIAN	MIDDLE	*Dorsoplanites panderi*	*Zaraiskites zarajskensis* *Pavlovia pavlovi*
VOLGIAN	LOWER	*Ilovaiskya pseudoscythicus*	
VOLGIAN	LOWER	*Ilovaiskya sokolovi*	
VOLGIAN	LOWER	*Subplanites klimovi* *Gravesia* sp.	
KIMMERIDGIAN	UPPER	*Virgataxioceras fallax* *Aulacostephanus autissiodorensis* *Aulacostephanus eudoxus* *Aulacostephanus pseudomutabilis*	
KIMMERIDGIAN	LOWER	*Rasenia stephanoides* *Amoeboceras kitchini*	

STAGES AND SUBSTAGES		STANDARD ZONES Dain et al., 1972 AMMONITE ZONES	
VOLGIAN	UPPER	*Craspedites nodiger*	
VOLGIAN	UPPER	*Craspedites subditus*	
VOLGIAN	UPPER	*Kaschpurites fulgens*	
VOLGIAN	MIDDLE	*Epivirgatites nikitini*	
VOLGIAN	MIDDLE	*Virgatites virgatus*	*Virgatites rosanovi*
VOLGIAN	MIDDLE		*Virgatites virgatus*
VOLGIAN	MIDDLE	*Dorsoplanites panderi*	*Zaraiskites zaraiskensis*
VOLGIAN	MIDDLE		*Pavlovia pavlovi*
VOLGIAN	LOWER	*Subplanites pseudoscythicus*	
VOLGIAN	LOWER	*Subplanites sokolovi*	
VOLGIAN	LOWER	*Subplanites klimovi*	
KIMMERIDGIAN	UPPER	*Aulacostephanus autissiodorensis*	
KIMMERIDGIAN	UPPER	*Aulacostephanus eudoxus*	
KIMMERIDGIAN	UPPER	*Aulacostephanus mutabilis*	
KIMMERIDGIAN	LOWER	*Rasenia cymadoce*	
KIMMERIDGIAN	LOWER	*Pictonia baylei*	
OXFORDIAN	UPPER	*Ringsteadia pseudocordata*	
OXFORDIAN	UPPER	*Decipia decipiens*	
OXFORDIAN	UPPER	*Perisphinctes cautisnigrae*	
OXFORDIAN	UPPER	*Perisphinctes plicatilis*	
OXFORDIAN	LOWER	*Cardioceras cordatum*	
OXFORDIAN	LOWER	*Quenstedtoceras mariae*	
CALLOVIAN	U	*Quenstedtoceras lamberti*	
CALLOVIAN	U	*Peltoceras athleta*	
CALLOVIAN	M	*Erymnoceras coronatum*	
CALLOVIAN	M	*Kosmoceras jason*	
CALLOVIAN	L	*Sigaloceras calloviensis*	
CALLOVIAN	L	*Proplanulites koenigi*	
CALLOVIAN	L	*Macrocephalites macrocephalus*	

Jurassic age. This would mean that the Bajocian, the Bathonian and the major part of the Callovian sequences are missing or, if present, must be in such condensed form as to escape detection. Also, it would mean that any further studies of the Jurassic of the Peace River region perhaps should be oriented in relationship to the northern rather than to the southern Jurassic sequences of western Canada, except for those of the Passage Beds of the Fernie Basin.

Faunal Provincialism and Environmental Implications

Previously, attention has been drawn to the marked differences between the Late Jurassic foraminiferal fauna recovered from the Peace River region and foraminiferal-ostracode faunas of the western Interior Plains (southern Saskatchewan and adjoining regions). The latter microfaunas are comparable at a generic level to the faunas of northwestern Europe, although the similarity at a species level is much less pronounced. In contrast, the predominantly agglutinated foraminiferal fauna of the Peace River region is comparable and, in some instances, identical even at species level not only to species from northern Alaska and the Canadian Arctic regions (presently under study), but also to species from western and northern Siberia.

The presence in western Canada of these two strikingly different Late Jurassic microfaunas, at first glance, appears to indicate the presence of two boreal subprovinces within a major boreal faunal province. In considering

WEST SIBERIA Dain et al., 1972 — AMMONITE ZONES	SELECTED SPECIES FROM FORAMINIFERAL ZONATION Dain et al., 1972	COMPARABLE SPECIES FROM PEACE RIVER STUDY AREA, PEACE RIVER REGION
Craspedites subditus		*Ammobaculites* cf. *A. alaskensis* I-III *Ammobaculites* cf. *A. pokrovkaensis* I *Ammosphaeroidina?* sp. 146 I-III *Haplophragmoides(?) canuiformis* I-III *Haplophragmoides* cf. *H. volgensis* I-III *Recurvoides?* cf. *R. disputabilis* I-(II?) *Recurvoides?* sp. 149 I-(II-III)? *Spiroplectammina suprajurassica* I-II *Spiroplectammina* cf. *S. tobolskensis* I *Geinitzinita* cf. *G. praenodulosa* (I?)-II Genus indeterminate sp. 209 II *Marginulinopsis* cf. *M. subrusticus* I-(II?) *Pseudonodosaria humilis* I-III
Kaschpurites fulgens		
Laugeites(?) vogulicus	*Haplophragmoides volgensis* subsp. *inviolatus*	
Laugeites groenlandicus		
Crendonites spp.		
Dorsoplanites maximus		
Dorsoplanites ilovaiskii		
Pavlovia iatriensis / *Strajevskya strajevskyi*; *Pavlovia iatriensis*		
Pectinatites lideri		
Subdichotomoceras subcrassum		
Eosphinctoceras magnum		
Virgataxioceras spp.	*Marginulina polenovae* *Marginulinopsis subrusticus* *Recurvoides sublustris*	
Aulocostephanus eudoxus		
Aulacostephanus mutabilis		
Rasenia borealis	*Geinitzinita praenodulosa* *Haplophragmium pokrovkaensis* *Haplophragmoides(?) canuiformis* *Pseudonodosaria brandi* *Recurvoides disputabilis plana* *Recurvoides sublustris* *Spiroplectammina suprajurassica* *Trochammina(?) canningensis*	
Pictonia involuta		
Ringsteadia pseudocordata	*Ammobaculites* ex gr. *A. syndascoensis* *Recurvoides disputabilis* *Spiroplectammina tobolskensis*	
Amoeboceras alternans		
Amoeboceras alternoides		
Cardioceras cordatum	*Ammobaculites syndascoensis*	
Longaeviceras keyserlingi	Not included in zonal table *Globulina alexandrae* (Upper Kimmeridgian)	*Globulina* cf. *G. alexandrae* I-III
	Cribrostomoides canui (Upper Oxfordian)	*Haplophragmoides* cf. *H. canui* I-III
Cadoceras elatmae	*Recurvoides gryci* (Upper Callovian-Lower Oxfordian)	*Trochammina gryci* I-III *Recurvoides?* sp. 226 I-II
Arcticoceras ishmae		

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this interpretation, topographic as well as environmental barriers must be proposed in order to explain such provincialism. Even assuming that the environment of the Alberta Trough is inimical to calcareous organisms (both micro- and megafauna), it is difficult still to understand why there was no interchange between the agglutinated elements of the two regions, unless an insurmountable physical barrier was present. However, there is another interpretation, and that is that the two faunas in fact were not contemporaneous. In this case, separation into faunal subprovinces becomes inappropriate.

Assuming contemporaneity at least during the earlier part of Oxfordian time, one topographic barrier is known to have existed: the Sweetgrass Arch - Belt Island Uplift. This was a tectonically mobile complex which, even as a submarine swell, could have provided a deterrent, if not a definite barrier to faunal interchanges between the cratonic seas of the Interior Plains and the miogeosynclinal seas of the Alberta Trough. Only later, possibly during latest Oxfordian and Kimmeridgian time did the uplift become fully emergent.

Various paleoecological deterrents to intermingling of the two microfaunas can be inferred from the differing lithological characteristics of the two regions, as well as from the differing composition of the microfaunas.

The lower Upper Jurassic sequences of the Interior Plains are variably calcareous, containing a diverse megafauna (Paterson, 1968) as well as an extremely diverse

WESTERN CANADA N.W. EUROPE		RUSSIA	SIBERIA RUSSIAN PLATFORM
PURBECKIAN (LOWER)		VOLGIAN	UPPER
PORTLANDIAN			MIDDLE
KIMMERIDGIAN	UPPER		
	MIDDLE		LOWER
	LOWER	KIMMERIDGIAN	UPPER
			LOWER

GSC

Figure 6. *Upper Jurassic stages and substages.*

microfauna. During later Jurassic time, these calcareous sequences were replaced by sandy sequences that contain only the agglutinated remnant of the earlier faunas. The older, highly diversified microfaunas (Callovian - Lower Oxfordian), together with the calcareous rock sequences, indicate a typical open-marine, shallow, warm to temperate and well-oxygenated shelf environment. The later, coarser clastic sequences with their agglutinated foraminiferal remnant could be, and have been, interpreted to represent the end phase of sedimentation in the interior seas, whereas to the west, in the Alberta Trough, the miogeosynclinal seas persisted until the end of Jurassic and into Early Cretaceous time.

In contrast to the Interior Plains, the agglutinated foraminiferal fauna of the Peace River region is contained within moderately fine grained, noncalcareous, clastic rocks that are notoriously lacking in megafauna. The environmental implications of this microfauna are more difficult to assess. The composition of the fauna may be somewhat suspect, for postdepositional destruction of the calcareous elements could, in part, be responsible for their paucity. Still, the high proportion of agglutinated forms and the lack of megafauna must reflect, to some degree, the original composition of this fauna.

While keeping in mind that more equable climatic conditions characterized the Jurassic Period, in contrast to the harsh extremes of the present day, the probability of somewhat lower water temperatures in the Peace River region (and in the Trough) could provide a partial explanation for the paucity of all types of calcareous-shelled organisms. The similarity of the Peace River species to those of the northern Richardson Mountains and of the Arctic Sverdrup Basin point to north-south migration routes and, therefore, to prevailing north-south 'Arctic' currents. In addition, and taking into account the position and configuration of the North American continent during the Jurassic Period, the Peace River region still would have lain to the north of the central Interior Plains so that, along the north-south temperature gradient, cooler waters could be expected in the seas of the former region as opposed to those of the latter. It is conceivable also that the trough seas may have been slightly deeper, and bottom temperatures consequently slightly lower, and that there may have been a faster rate of sedimentation with a greater instability of bottom conditions. All of these factors would favor the development of a predominantly agglutinated fauna.

General knowledge of the Peace River microfauna is still insufficient to allow more than the establishment of a tentative age range for this fauna. The results from present studies of the Late Jurassic microfauna of the Fernie Basin and of the Arctic should go far toward solving this problem. As a further aid, attempts should be made to recover microfossils from regions farther west or northwest, particularly from localities where Late Jurassic megafossils have been reported.

SYSTEMATIC PALEONTOLOGY

General Remarks

The taxonomic placement of the Foraminifera follows the order proposed by Loeblich and Tappan (in Moore, 1964) with two exceptions. The coiled nodosariids, following in part the proposal of Putrja (1970), have been placed within the subfamily Lenticulininae Sigal, 1952, and the irregularly coiled agglutinated genus *Recurvoides* Earland, 1934 has been placed within the subfamily Recurvoidinae Alekseitchik, 1973 following, in part, the proposals of Alekseitchik-Mitskevich (1973).

The taxonomic placement of the Ostracoda is adopted from Benson et al. (in Moore, 1961), with the exception of the genus *Camptocythere* Triebel, 1950 which is placed in the subfamily Neocytherideidinae Puri, 1957.

All described and figured specimens, with the exception of specimen GSC 38852 which was lost during photography, are in the type collection of the Geological Survey of Canada, Ottawa.

It was considered worthwhile to record, figure and describe all forms recovered, regardless of poor preservation or fragmentation, or irrespective of the recovery of no more than one specimen. Open nomenclature has been used for single or for badly fragmented specimens, as well as for those species that could not be referred to published taxa; a formal description of the latter is deferred until better material becomes available. The numbers used in the designation of all these various problematic forms are those used for data processing in the Department of Geological Sciences, University of Saskatchewan. Many of these single or slightly damaged specimens could be assigned to genera, but the very badly damaged tests, or those in the form of internal moulds, could be recorded only under "Genus indeterminate". Nevertheless, each of these specimens has been provided with a species number, for they display features sufficiently distinctive, even in their present state, to be distinguishable as discrete forms and to be recognized at some future date by other workers who may have better material.

More detailed descriptions than normally would be considered necessary have been given for species not previously described in either English or French language publications. This is especially true for those species that have been compared with forms described from Russia and/or Poland, and for which English translations of the original text may not be readily available.

Problems Relating to Identification

A particularly frustrating problem in identification that relates directly to poor preservation stems from the obscured apertures of the tests here assigned to *Haplophragmoides* cf. *H. canui* Cushman, 1930. *Haplophragmoides canui* (sensu stricto) is characterized by distinctive apertural features that could not be distinguished in the specimens recovered from the Peace River region.

Haplophragmoides canui, or a very closely comparable form, is widespread throughout the far north. Tappan reported the species in 1955 from northern Alaska, and Dain reported *Cribrostomoides canui* (Cushman) from West Siberia in 1972. The specimens here designated as *Haplophragmoides* cf. *H. canui* are considered to be identical, in part, with Tappan's figures and description (Tappan also was unable to observe the aperture) and, as well, they resemble Dain's (in Dain, 1972) figures (for which no description was given). Dain's generic placement of the *canui* species in

Cribrostomoides Cushman is questioned, for the aperture of *Cribrostomoides* as described in Moore (1964) differs markedly from that of the genus *Haplophragmoides*, as well as from that of *H. canui* as described by Cushman. Possibly another species, very similar to *H. canui* in appearance and that may have to be assigned to another genus, is present in the far north. Recovery of tests with clearly visible, undamaged apertures is necessary before this problem can be solved.

Similar difficulties in identification arose with respect to the groups of specimens that have been placed provisionally in the genus *Recurvoides* Earland, 1934. Those species that are most closely comparable to the recovered tests are the various *Recurvoides* forms described and figured in Dain (1972), but again the obscured or destroyed apertures of the tests recovered prevented a firm generic identification.

In addition, it was in some cases very difficult to determine whether the mode of coiling in some tests was plectogyroidal or trochoid and, consequently, to decide whether these particular specimens were a form of *Recurvoides*?, or of *Trochammina*, or even asymmetrically evolute tests of *Haplophragmoides*. This posed a problem particularly in respect to *Trochammina gryci* Tappan, 1955. Although Dain (1972) apparently considered that no truly trochoid form existed and, therefore, placed the species under *Recurvoides*, in this study two species are considered to be present: one truly trochoid throughout, which is *Trochammina gryci*, and the other, very similar in appearance to *T. gryci*, but with irregularities of coiling. The latter form is designated *Recurvoides*? sp. 226 and appears to be closely comparable to *Recurvoides gryci* (in part) of Dain.

Systematic Descriptions

Foraminifera

Order Foraminiferida Eichwald, 1830

Suborder Textulariina Delage and Hérouard, 1896

Superfamily Ammodiscacea Reuss, 1862

Family Astrorhizidae Brady, 1881

Subfamily Rhizammininae Rhumbler, 1895

Genus *Bathysiphon* M. Sars, 1872

Bathysiphon sp. 219

Plate 1, figure 1

Description. Test an elongate, slightly curved, flattened tube, open at both ends; annular constrictions sometimes present. Wall finely agglutinated and relatively smooth. Aperture not preserved.

Remarks. The few broken tests recovered provided insufficient material either for comparison or for identification beyond generic level.

Distribution. The species was found in the upper sequences of Sections 64-13, 68-5 and 68-11.

Figured specimen.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38730	0.625	0.188	0.050	68-5	68.2 - 72.5† (224 - 238)

Abbreviations in tables of figured specimens

L	length
W	width
H	height
T	thickness
D	diameter
†	above top of Nordegg Member
*	above base of measured section

Family Saccamminidae Brady, 1884

Subfamily Saccammininae Brady, 1884

Genus *Saccammina* M. Sars, 1869

Saccammina cf. *S. lathrami* Tappan, 1960

Plate 1, figures 2 - 5

Remarks. The tests recovered have indistinct, poorly defined apertures that are either flush or with less elongate necks than displayed by Tappan's figured specimens of *S. lathrami*. In other respects they conform to the description and figures of Tappan (1960, p. 289, Pl. 1, figs. 1, 2; 1962, p. 129, Pl. 29, figs. 9 - 11). The lack of distinct necks also differentiates this species from *S.* cf. *S. lathrami* of North and Caldwell (1964, Pl. 1, fig. 3) of an Upper Cretaceous Lea Park sequence of Saskatchewan.

Tappan described *Saccammina lathrami* from Cretaceous (Albian-Cenomanian) strata of the northern Alaska coastal region. Chamney (in Stott, 1967, p. 26 - 28) also reported a *Saccammina* cf. *S. lathrami* from Section 64-13 of this report.

Distribution. The species, although relatively rare, was found in all four sections where it ranged throughout the sequences sampled.

Figured specimens.

GSC no.	D	T	Section	Footage
	mm			m (ft)
38731	0.425 - 0.488	0.163	70-8	54.8 - 72.2* (180 - 237)
38732	0.350 - 0.338	0.100	68-5	42.0 - 45.1† (138 - 148)
38733	0.325 - 0.338	0.188	64-13	61.5 - 67.0† (202 - 220)

Family Ammodiscidae Reuss, 1862

Subfamily Ammodiscinae Reuss, 1862

Genus *Ammodiscus* Reuss, 1862

Ammodiscus cf. *A. cheradospirus* Loeblich and Tappan, 1950

Plate 1, figures 6 - 9

Remarks. The specimens recovered compare well with *Ammodiscus cheradospirus* Loeblich and Tappan as figured in Tappan (1955, p. 38, Pl. 8, fig. 9); they differ, however, from Tappan's description in that the spiral suture is flush and indistinct, the walls are coarsely arenaceous, and the tests apparently attain much greater sizes. Other characteristics observed are the inconspicuous proloculus and the variation in the outline from circular to ovate. This variation is considered to be of genetic origin rather than the result of compressional distortion, for the tests retain their relative thickness regardless of outline. The ovate tests appear to be more strongly biconvex than are the more circular specimens.

Among European species, the Early Jurassic *Ammodiscus asper* (Terquem), 1863 of Barnard (1949, p. 351, Fig. 1a, i, ii), and *Involutina aspera* Terquem, 1863 of Bizon (1960, p. 4, Pl. 1, fig. 1) appear comparable to the tests studied. Barnard, in particular, noted and discussed variations in the shape of the tests from disclike to elongate, similar to those mentioned above, but did not mention the proloculus or the spiral suture. Bizon, although describing an inconspicuous proloculus and indistinct spiral suture, did not mention variations in shape comparable to those observed in the Canadian specimens.

Tappan (1955) reported *Ammodiscus cheradospirus* from Upper Jurassic strata of northern Alaska.

Distribution. *Ammodiscus* cf. *A. cheradospirus* is relatively rare. It is found in the lower part of the middle sequence of Section 64-13, and in the upper part of the middle sequence of Section 68-5, but was recognized only questionably in Section 68-11.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38734	0.563 - 0.563	0.150	68-5	51.2 - 54.2† (168 - 178)
38735	0.713 - 0.838	0.250	68-5	48.1 - 51.2† (158 - 168)
38736	1.55	0.850	68-5	42.0 - 45.1† (138 - 148)

Ammodiscus cf. *A. orbis* Lalicker, 1950

Plate 1, figures 10, 11

Remarks. The tests recovered differ from *Ammodiscus orbis* Lalicker, 1950 (p. 11, Pl. 1, fig. 2), and also from *Involutina orbis* (Lalicker) of Tappan (1955, p. 39, Pl. 8, fig. 14) in that the spiral suture is thickened and flush, rather than depressed. In other features, however, they seem to be identical with the specimens described and figured by Tappan. *Ammodiscus* cf. *A. orbis* figured by Brooke and Braun (1972, Pl. 8, figs. 11 - 13) is smaller and has a greater number of coils (maximum of eight as compared with a maximum of five).

Lalicker described *Ammodiscus orbis* from the Middle Jurassic Sawtooth Formation of southwestern Montana, whereas Tappan's specimens were reported from Upper Jurassic strata (Oxfordian or Kimmeridgian) of northern Alaska.

Distribution. This species was found in the upper part of Section 68-5 and was identified only tentatively in the lower and middle sequences of Sections 64-13 and 68-11.

Figured specimen.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38737	0.375 - 0.413	0.063	68-5	78.3 - 79.2† (257 - 260)

Ammodiscus sp. 196

Plate 1, figures 12 - 15

Description. Test planispirally coiled consisting of an indistinct proloculus and a long, undivided tubular second chamber forming up to four whorls; tube increases in diameter outward. Spiral suture indistinct, gently depressed. Wall agglutinated, transparent, fine to medium grained. Aperture open end of the tube.

Remarks. The tests recovered differ from *Ammodiscus* cf. *A. orbis* Lalicker of this study in their indistinct proloculus, depressed sutures and finer grained wall structure.

Distribution. This relatively rare species was found in Sections 64-13, 68-5 and 68-11 where it ranged from the upper into the lower sequences.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38738	0.388 - 0.400	0.038	68-5	78.3 - 79.2† (257-260)
38739	0.263 - 0.275	0.025	68-11	53.3 - 56.4† (175 - 185)

Genus *Ammovertellina* Suleymanov, 1959

Ammovertellina? sp. 170

Plate 1, figures 16, 17

Description. Proloculus hidden; visible portion of test consists of a tubular chamber which is streptospirally coiled in early stages, becoming planispiral later, and uncoils in the final stage. Spiral suture depressed. Wall finely agglutinated, smooth, transparent. Aperture not preserved.

Remarks. The generic assignment is tentative as only one damaged specimen was available for study.

Chamney (in Stott, 1967, p. 26 - 28) reported a *Glomospirella* sp. from the same sample in which *Ammovertellina*? sp. 170 was recovered. Without the final, uncoiled stage, which broke away during study, this specimen could equally well have been assigned to the genus *Glomospirella*.

Figured specimen.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38740	0.138 - 0.250	0.088	68-5	78.3 - 79.2† (257 - 260)

Genus *Glomospira* Rzehak, 1885

Glomospira sp. 161

Plate 1, figures 18 - 21

Description. Test small, proloculus hidden by early streptospiral coils of the tubular second chamber; early plane of coiling nearly perpendicular to the planispirally coiled later portion. Spiral suture distinct, depressed. Wall finely agglutinated, smooth. Aperture open end of tubular second chamber.

Remarks. The rather poor preservation of the one specimen recovered does not permit comparison or identification beyond the generic level.

Figured specimen.

GSC no.	D	T	Section	Footage
	mm			m (ft)
38741	0.300 - 0.325	0.213	64-13	12.5 - 14.6† (41 - 48)

Genus *Glomospirella* Plummer, 1945

Glomospirella sp. 174

Plate 1, figures 22 - 27

Description. Test discoidal with the proloculus hidden by the coils of the long, tubular second chamber; early coiling irregular, later becoming planispiral. Spiral suture indistinct. Wall finely agglutinated but with a large quartz grain more or less centrally incorporated in each test, and with smaller grains randomly distributed over the test surface. Aperture formed by open end of tubular second chamber.

Remarks. The tubular second chamber appears constricted at intervals, which could be the result of growth constrictions, but it is considered more likely to have been caused by changes in the direction of coiling.

Distribution. This relatively rare species occurs in the upper sequence of Section 68-5, in the lower middle to upper part of Section 68-11, and sporadically throughout Section 64-13.

Figured specimens.

GSC no.	D	T	Section	Footage
	mm			m (ft)
38742	0.525 - 0.613	0.250	64-13	12.5 - 14.6† (41 - 48)
38743	0.725 - 0.875	0.350	68-11	135.0 - 138.1† (443 - 153)

Subfamily Tolypammininae Cushman, 1928

Genus *Ammovertella* Cushman, 1928

Ammovertella? sp. 218

Plate 1, figures 28 - 31

Description. Test attached, consisting of proloculus and long, tubular second chamber. Tubular chamber planispirally coiled initially, but final coils of chamber irregularly twisted and partially covering one side of the earlier planispiral portion. Spiral suture flush in planispiral stage, later depressed. Wall finely agglutinated, transparent. Aperture not preserved.

Remarks. The specimen recovered differs from typical *Ammovertella* species in the irregular twisting or looping of the terminal coils.

Figured specimen.

GSC no.	D	T	Section	Footage
	mm			m (ft)
38744	0.188 - 0.313+	0.125	64-13	40.2 - 44.8† (132 - 147)

Superfamily Lituolacea de Blainville, 1825

Family Hormosinidae Haeckel, 1894

Subfamily Hormosininae Haeckel, 1894

Genus *Reophax* Montfort, 1808

Reophax cf. *R. hounstoutensis* Lloyd, 1959

Plate 1, figures 32 - 36

Remarks. In over-all shape, number and shape of chambers, coarsely grained wall texture and undetectable aperture, the tests recovered compare favorably with *Reophax hounstoutensis* Lloyd, 1959 (p. 308, Pl. 54, fig. 7a, b, Textfig. 5d, e) from the Kimmeridgian (type locality) of England. They differ from *R. hounstoutensis* in their larger and more rounded proloculus, which appears coillike in some specimens, and in the greater height attained by the terminal chambers. They differ from the North American *Reophax densa* Tappan, 1955(p. 35, Pl. 8, figs. 1 - 6) in having markedly fewer chambers, an unidentifiable aperture and a consistently very coarse grained wall structure.

Distribution. The species varies in occurrence from rare to common in three of the sections studied. It was found in the upper sequence of Section 68-5, and from the middle into the lower sequences of Sections 64-13 and 68-11.

Figured specimens.

GSC no.	L	D (max.)	Section	Footage
	mm			m (ft)
38745	1.80	1.00	68-11	56.4 - 59.4† (185 - 195)
38746	1.50	1.05	68-11	56.4 - 59.4† (185 - 195)
38747	1.50	0.70	64-13	23.5 - 24.7† (78 - 81)
38748	1.40	0.45	68-11	40.6 - 41.8† (133 - 135)

Family Lituolidae de Blainville, 1825

Subfamily Haplophragmoidinae Maync, 1952

Genus *Haplophragmoides* Cushman, 1910

Haplophragmoides cf. *H. barrowensis* Tappan, 1951

Plate 2, figures 1 - 8

Remarks. Although the specimens recovered are not well preserved, they appear to be identical with the smaller specimens figured by Tappan, 1955 (Pl. 11, figs. 2 - 5). They differ from Tappan's holotype (1951, p. 1, Pl. 1, fig. 5a, b; 1955, Pl. 11, fig. 1a, b) in their smaller size, fewer chambers, shape of terminal chamber and tendency to be asymmetrically evolute.

No more than eight chambers are present in the final whorl of the tests assigned to *Haplophragmoides* cf. *H. barrowensis*; coiling may be asymmetric in some forms resulting in one side of the test being more strongly evolute than the reverse side. These latter tests somewhat resemble *Trochammina sablei* Tappan, 1955 (p. 50, Pl. 14, figs. 6 - 9), but the mode of coiling is planispiral and concentric, not trochoid.

Tappan (1951, 1955) described *Haplophragmoides barrowensis* from Lower Toarcian - Upper Pliensbachian sequences of northern Alaska. Chamney (in Stott, 1967, p. 26 - 28) reported *Haplophragmoides* cf. *H. barrowensis* from the lower part of Section 64-13 of this report.

Distribution. This relatively rare species was found in the basal sequence of Section 70-8 and in the basal part of the upper third of Section 68-5.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38749	0.363 - 0.450	0.163	70-8	18.3 - 30.4* (60 - 100)
38750	0.363 - 0.438	0.175	68-5	51.2 - 54.2† (168 - 178)
38751	0.500 - 0.388	0.175	68-5	51.2 - 54.2† (168 - 178)

Haplophragmoides cf. *H. canui* Cushman, 1930

Plate 2, figures 9 - 21

Remarks. The tests tentatively assigned to this species appear to be closely related to *Haplophragmoides canui* of Tappan (1955, p. 42, Pl. 9, fig. 14a, b only). There are 9 to 10, as compared with Tappan's 9 to 11 triangular chambers in the final whorl; but in other respects the recovered tests conform closely with Tappan's description.

The texture of the walls of the tests recovered varied from fine grained and smooth, to medium grained and somewhat roughened. The test walls, in some specimens, are transparent, with the sutures thickened and readily visible as broad lines; more commonly the walls are translucent and of a smoky brown colour, with indistinct sutures which, in reflected light, appear as fine, weakly depressed lines. The aperture is poorly preserved and obscure but appears to be a simple arch or broad, low, crescentic opening at the base of the terminal chamber. Tests of this species recovered from Jurassic sequences of the Richardson Mountains have a lipped aperture located at the base of the terminal chamber. This aperture varies from a curved, elongate slit in some specimens to a flattened ovate shape in others.

Haplophragmoides cf. *H. canui* differs from *Haplophragmoides canui* Cushman 1930 (p. 133, Pl. 4, fig. 1a, b) essentially in the aperture that, in *H. canui*, is described not only as varying in shape but also as migrating upward from the base of the final chamber on to the terminal face. *Haplophragmoides* cf. *H. canui* appears to be closely related also to *Cribrostomoides canui* Cushman of Dain 1972 (Pl. 7, figs. 3 - 4) as far as can be judged from figures alone, but the aperture of the specimens studied does not appear to be that of the genus *Cribrostomoides*. There is, in addition, a similarity with *Haplophragmoides nonionoides* (Reuss) of Myatliuk (1939, p. 40, Pl. 1, figs. 1 - 3). This latter species, however, is described as having up to 11 chambers in the final whorl, and no mention is made of the thickened sutures that are a particularly conspicuous feature in transparent tests of *Haplophragmoides* cf. *H. canui*.

Tappan reported *Haplophragmoides canui* from Upper Jurassic strata of northern Alaska. *Cribrostomoides canui* of Dain is figured together with other Late Oxfordian Foraminifera of western Siberia. Myatliuk described *Haplophragmoides nonionoides* from the lower Volgian of the middle Volga region and Obschiy Syrt. *Haplophragmoides canui* Cushman was described from the Oxfordian of France.

Distribution. *Haplophragmoides* cf. *H. canui* is the most common and consistent in occurrence of the foraminiferal species studied. It was recovered from all four sections where it ranged throughout Sections 64-13, 68-11 and 70-8, but was found in only the upper third of Section 68-5.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38752	0.275 - 0.313	0.200	70-8	62.8 - 71.0* (216 - 233)
38753	0.488 - 0.600	0.313	70-8	62.8 - 71.0* (216 - 233)
38754	0.688 - 0.875	0.438	70-8	62.8 - 71.0* (216 - 233)
38755	0.713 - 0.800	0.300	64-13	12.5 - 14.6† (41 - 48)
38756	0.788 - 0.825	0.375	70-8	60.3 - 62.8* (198 - 216)
38757	0.863 - 1.06	0.400	70-8	207.3 - 213.7* (680 - 700)

Haplophragmoides (?) *canuiformis* Dain, 1972

Plate 2, figures 22 - 30

1972 *Haplophragmoides* (?) *canuiformis* Dain (p. 48, Pl. 8, figs. 2, 3).

Remarks. The tests recovered are plano-convex in shape with rounded peripheries, and are planispirally but asymmetrically coiled with two and one-half, possibly three overlapping whorls exposed on the convex side forming a partially evolute coil. On the reverse, the flattened side, the coiling is involute or nearly involute and, in general, only the final whorl is visible. There are up to 11 subrectangular to subtriangular chambers visible in the final whorl on the evolute side, but no more than 10 1/2 triangular chambers are exposed on the involute side. Although both the spiral and the septal sutures are flush and indistinct, the septal sutures are straight and appear to be thickened when the tests are wet. The walls are finely agglutinated, either colourless and clear, or translucent and brown. The aperture is indistinct but appears to lie at the base of the terminal face.

The tests studied do not seem to differ in any major feature from *Haplophragmoides* (?) *canuiformis* other than that Dain's specimens appear to be more coarsely arenaceous.

It is difficult at times to determine the mode of coiling in this species, particularly when dealing with the dark brown and slightly distorted tests. It is possible that some of the specimens considered to be low-spired, trochoid forms, and which therefore were assigned to *Trochammina gryci* Tappan, 1955, are in reality planispirally coiled with concentric overlapping whorls, in which case they should be transferred to *Haplophragmoides* (?) *canuiformis*.

This species differs from *Haplophragmoides* cf. *H. canui* of this study in the asymmetry of coiling, as well as in the greater number of chambers in the final whorl.

Haplophragmoides(?) *canuiformis* Dain was described from the Lower Kimmeridgian of West Siberia.

Distribution. This species, although rare, was recognized in all four sections. It was found throughout Section 70-8, through approximately the upper two thirds of Sections 64-13 and 68-11, but in only the upper one third of Section 68-5.

Hypotypes.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38758	0.350 - 0.400	0.175	68-5	48.1 - 51.2† (158 - 168)
38759	0.550 - 0.625	0.200	70-8	60.3 - 65.9* (198 - 216)
38760	0.625 - 0.725	0.300	68-5	78.3 - 79.2† (257 - 260)

Haplophragmoides cf. *H. topagorukensis* Tappan, 1962

Plate 2, figures 31 - 36

Remarks. The tests assigned to *Haplophragmoides* cf. *H. topagorukensis* resemble only figures 1 to 3, and 6 and 8 of *H. topagorukensis* (Tappan, 1962, p. 135, Pl. 31) from Lower Cretaceous sequences of northern Alaska. Not less than 9 1/2, but commonly 12 1/2 to 13 chambers have been observed in the final whorl of the specimens recovered. The tests are planispirally coiled and vary from deeply umbilicate and involute, to broadly umbilicate, partially evolute tests in which the inner whorls are more or less exposed. The triangular chambers are only slightly, if at all, inflated and the test walls are either colourless and clear, or are a translucent smoky brown colour. In other respects, the specimens recovered conform to Tappan's description of *H. topagorukensis.*

Distribution. *Haplophragmoides* cf. *H. topagorukensis,* although rare, was recognized in all four sections. It was found in the lower half of Sections 64-13, 68-11 and 70-8 and in the upper sequence of Section 68-5.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38761	0.500 - 0.525	0.250	70-8	65.8 - 71.0* (216 - 233)
38762	0.563 - 0.625	0.263	70-8	65.8 - 71.0* (216 - 233)
38763	0.438 - 0.513	0.250	70-8	65.8 - 71.0* (216 - 233)

Haplophragmoides cf. *H. volgensis* Myatliuk, 1939

Plate 2, figures 37 - 42

Remarks. The tests assigned to *Haplophragmoides* cf. *H. volgensis* closely resemble *H. volgensis* of Bielecka and Pozaryski (1954, p. 157, Pl. 2, fig. 1a, b). They differ from these Polish forms in having not more than seven and one-half, rarely eight widely triangular chambers in the final whorl, in their strongly involute tests, and in being more regularly coiled. The specimens recovered differ from the type specimens of Myatliuk (1939, p. 69, Pl.1, fig. 6a, b) in being strongly involute, and in that they are not as markedly asymmetric as Myatliuk's figures. *Haplophragmoides volgensis* Myatliuk subsp. *inviolatus* Dain (1972, Pl. 8, fig. 6), also appears very similar, but the chambers are not collapsed as is common in the Canadian specimens, and the asymmetry of coiling is more pronounced. From western Canada, *Haplophragmoides* sp. of Weihmann (1964, Pl. 1, fig. 20) appears to be identical with tests recovered in this study.

Weihmann's *Haplophragmoides* sp. was recorded from the Upper Jurassic Passage Beds of the Fernie Basin of southeastern British Columbia. Bielecka and Pozaryski (1954) reported *H. volgensis* from the Upper Kimmeridgian and Bononian of central Poland. Myatliuk (1939) described the species from the Volgian of the Middle Volga region and Obschiy Syrt. Dain (1972) figured *H. volgensis* Myatliuk subsp. *inviolatus,* together with other foraminiferal species, from the Volgian of western Siberia.

Distribution. *Haplophragmoides* cf. *H. volgensis,* although relatively rare, was recognized in all four sections. It was found throughout all but the lower quarter of Sections 64-13 and 70-8, but was present only in the upper sequences of Sections 68-5 and 68-11.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38764	0.363 - 0.413	0.188	70-8	60.3 - 65.8* (198 - 216)
38765	0.375 - 0.486	0.213	70-8	65.8 - 71.0* (216 - 233)
38766	0.438 - 0.525	0.225	70-8	18.3 - 30.4* (60 - 100)
38767	0.625 - 0.738	0.250	70-8	65.8 - 71.0* (216 - 233)
38768	0.725 - 0.875	0.375	68-11	143.9 - 146.6† (472 - 481)

Haplophragmoides sp. 143

Plate 3, figures 1 - 3

Description. Test planispiral, involute, strongly biumbilicate; periphery subangular. Up to 12 gradually enlarging, narrowly triangular chambers in final whorl; chambers frequently collapsed, but inner portions remain inflated forming a raised ridge around the umbilicus. Sutures radial, flush or slightly depressed, more or less straight. Wall finely agglutinated, transparent or translucent, smoky brown. Aperture obscure, probably a peripheral slit at base of terminal chamber.

Remarks. *Haplophragmoides* sp. 143 appears very similar to *Haplophragmoides canui* Cushman, 1930 of Tappan (1955, p. 42, Pl. 9, figs. 12, 13, 15a, b), but it has more chambers in the final whorl and the sutures are not thickened. It differs from *H. canui* Cushman, 1930 (p. 133, Pl. 4, fig. 1a, b) in having more chambers in the final whorl, and in the tests attaining a much larger size, and in showing no evidence of a migrating aperture. *Haplophragmoides* sp. 143 can be differentiated from the rather similar *Haplophragmoides* cf. *H. topagorukensis* Tappan of this study in that the latter form is more evolute, exposing the inner whorls, and it has more chambers and tends to be much smaller. Superficially there also appears to be a strong resemblance to *Haplophragmoides goodenoughensis* Chamney, 1969 (p. 23, Pl. 4, figs. 5, 6). Although it is rather broadly umbilicate, *Haplophragmoides* sp. 143 is not evolute, and the raised ridge around the umbilicus is formed by the inner tips of the partially collapsed chambers, not by thickening of the septa or by septal nodes as in *H. goodenoughensis*.

Distribution. This species occurs in the lower half of Sections 64-13, 68-11 and 70-8.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38769	0.625 - 0.775	0.350	70-8	65.8 - 71.0* (216 - 233)
38770	0.475 - 0.625	0.250	64-13	52.4 - 61.2† (172 - 201)

Haplophragmoides sp. 166

Plate 3, figures 4 - 11

Description. Test planispiral, involute; periphery broadly to narrowly rounded, dependent upon degree of compression. Up to eight and one-half triangular chambers in the final whorl; terminal chamber frequently damaged. Sutures flush, thickened, gently curved to sinuous initially, but last one or two sutures nearly straight. Aperture peripheral, a small, high arch at base of terminal face.

Remarks. There is a marked size difference between the smaller tests (figs. 4 - 7) and the otherwise identical but large specimens (figs. 8 - 11). This size difference could be due to environmental influences, or it could represent a microspheric-megalospheric relationship, or possibly indicates that two species have been incorporated in *Haplophragmoides* sp. 166.

Distribution. This relatively rare species was found in the lower sequence of Section 70-8 but was restricted to the upper part of Section 68-11. It was recognized only questionably in the upper part of Section 64-13.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38771	0.325 - 0.375	0.250	70-8	48.8 - 54.9* (160 - 180)
38772	0.475 - 0.563	0.325	68-5	68.3 - 72.2† (224 - 238)

Subfamily Lituolininae de Blainville, 1825

Genus *Ammobaculites* Cushman, 1910

Ammobaculites cf. *A. alaskenis* Tappan, 1955

Plate 4, figures 1 - 16

Remarks. A wide range of forms has been incorporated in this species including tests that consist of a coil only, intermediate forms having a coil and one or two uniserial chambers, and specimens in which the coil is followed by a well developed uniserial section of three or more chambers.

The tests consist of a biumbilicate coil, commonly with five but occasionally with six chambers visible, followed in the fully developed forms by a parallel-sided, uniserial section with up to three, rarely four, and in one specimen five chambers. The diameter of the coil may be equal to, but most commonly is greater than the diameter of the uniserial section. Peripheries are broadly rounded unless the tests have been flattened during fossilization. The uniserial chambers are equisize, broad and low, except for the terminal chamber in which breadth and height are more nearly equal. The coil sutures are curved gently, thickened and depressed; the sutures in the uniserial portion are horizontal and depressed. Wall texture varies from fine grained and smooth, to more coarsely grained with larger grains incorporated in a finer grained matrix. The tests range from transparent and nearly colourless to opaque and dark brown. The aperture is normally flush, circular and centrally located on the rounded terminal face, but in flattened specimens appears to be ovate.

The forms which appear comparable to, if not identical with *Ammobaculites* cf. *A. alaskensis*, and particularly to those tests that consist of a coil only, or of a coil and one or two uniserial chambers, are those represented by the specimen figured as *Ammobaculites* sp. A Wall, 1960 by Weihmann (1964, Pl. 1, fig. 23) and the figured specimens of *Ammobaculites* ex gr. *A. syndascoensis* Scharovskaja (in Dain, 1972, Pl. 16, figs. 1 - 4). The former species was from the Upper Jurassic Passage Beds of the Fernie Basin, and the latter species from the Upper Oxfordian of western Siberia. The fully developed tests of *A.* cf. *A. alaskensis* resemble only in part *Ammobaculites alaskensis* Tappan, 1955 (p. 43, Pl. 12, figs. 1, 4, 5, 9), described from Lower to Upper Jurassic strata of northern Alaska. No tests were recovered similar to Tappan's elongate and slender forms with the multichambered uniserial section, or similar to the form with the evolute multichambered coil (Tappan, 1955, Pl. 12, figs. 2, 3, 7, 8, respectively).

Ammobaculites alaskensis Tappan has been compared to or grouped with *Ammobaculites agglutinans* (d'Orbigny), 1846 and *Ammobaculites coprolithiformis* (Schwager), 1867 from the Jurassic sequences of Europe. *Ammobaculites agglutinans* (d'Orbigny) as recognized by various authors (Cushman, 1920, 1921; Franke, 1936; Bartenstein and Brand, 1937; Bartenstein, 1952b; Cifelli, 1959; Lloyd, 1959; Gordon, 1962, 1965) differs, in general, from *A.* cf. *A. alaskensis* in having a more broadly biumbilicate coil, in the greater number of coil chambers and, rarely, in being evolute with two whorls visible. In addition, the uniserial chambers of *A. agglutinans* tend to be more nearly equal in height and breadth, and the uniserial section itself is more slender. *Ammobaculites agglutinans* (d'Orbigny) of Bielecka and Pozaryski (1954, p. 158, Pl. 2, fig. 3a - c) has a more sharply truncated terminal chamber, and the test is strongly compressed.

The various forms referred to *Ammobaculites coprolithiformis* (Schwager), 1867 are more closely related to the specimens here designated as *A.* cf. *A. alaskensis* than are those referred to *A. agglutinans*. The most pronounced difference lies in the shape of the terminal chamber of *A. coprolithiformis*, which consistently is more strongly developed and markedly higher in proportion to breadth than is the terminal chamber of any specimen recovered in this study. Lindenberg (1967, p. 26) commented on the similarity between *Haplophragmium coprolithiforme* Schwager, 1867 forma *conostoma* Deecke, 1884 and certain type specimens of *Ammobaculites alaskensis* Tappan (excluding her figs. 3, 6, 8); he must have concluded, however, that the two forms were not identical for he did not place *A. alaskensis* in synonymy. *Ammobaculites* cf. *A. alaskensis*, as interpreted here, has a simple lituolid wall and differs from Lindenberg's figures in having a less tapered and less elongate terminal chamber, no extended aperture, and has a planispiral rather than a streptospiral coil (which is characteristic for the genus *Haplophragmium* Reuss, 1860). *Ammobaculites barrowensis* Tappan, 1955, considered by Lindenberg (1967) to be synonymous with *Ammobaculites alaskensis*, differs from *Ammobaculites* cf. *A. alaskensis* of this report in that it has a markedly pyriform terminal chamber, more strongly extended aperture, and a more loosely developed coil.

Although there appears to be more similarity between the specimens studied and the figured specimens of *Ammobaculites* ex gr. *A. syndascoensis* Scharovskaja (in Dain, 1972) than with *Ammobaculites alaskensis* Tappan, they are referred nevertheless to the latter species because it has not been possible to assess the full range of the morphological features of the *syndascoensis* group from the Russian literature presently available.

Distribution. *Ammobaculites* cf. *A. alaskensis* varies from rare to common in occurrence. It was found throughout Sections 64-13 and 68-11 and in the lower and possibly in the upper sequence of Section 70-8, but was recognized in the upper portion only of Section 68-5.

Figured specimens.

GSC no.	L (mm)	D (mm)	W (mm)	T (mm)	Section	Footage m (ft)
38787	-	0.500 - 0.500	-	0.313	70-8	30.4 - 37.6* (100 - 120)
38788	-	0.450 - 0.563	-	0.288	70-8	60.3 - 65.8* (198 - 216)
38789	-	0.488 - 0.638	-	0.350	70-8	30.4 - 36.6* (100 - 120)
38790	0.625	-	-	0.375	70-8	65.8 - 71.0* (216 - 233)
38791	0.688	0.475	0.375	0.400	64-13	14.6 - 18.6† (48 - 61)
38792	0.775	0.563	0.438	0.438	68-11	32.0 - 35.1† (105 - 115)
38793	0.813	0.575	0.438	0.250+	64-13	52.4 - 61.2† (172 - 201)
38794	0.950	0.625	0.450	0.375	64-13	52.4 - 61.2† (172 - 201)
38795	0.825	0.513	0.400	0.300	64-13	61.6 - 67.1† (202 - 220)
38796	1.025	0.588	0.500	0.450	68-11	39.3 - 40.6† (129 - 133)
38797	1.188	0.563	0.500	0.438	68-11	99.4 - 102.4† (326 - 336)
38798	1.225	0.563	0.563	0.338	68-11	40.6 - 41.8† (133 - 137)

Ammobaculites cf. *A. pokrovkaensis* (Kosyreva, 1972)

Plate 4, figures 17 - 21

Remarks. The tests recovered have a coil consisting of three indistinct chambers, followed by a uniserial section of up to three chambers which are rather broader than high, with the exception of the pyriform terminal chamber in which height and breadth are nearly equal. The coil and uniserial sections are nearly equal in diameter. The weakly depressed coil sutures are indistinct; the sutures of the uniserial portion are strongly depressed and transverse, but are sinuous where they are deflected by the grains incorporated in the otherwise fine grained matrix of the test walls. The aperture is terminal, simple and circular.

The specimens studied differ from *Haplophragmium pokrovkaensis* Kosyreva, 1972 (in Dain, 1972, p. 68, Pl. 18, figs. 1 - 7) of the Oxfordian-Kimmeridgian sequences of western Siberia in their larger size, and in having an apparently planispiral rather than streptospiral coil with only three chambers. However, those figures of *H. pokrovkaensis* that display no more than three coil chambers appear to be identical in their mode of coiling with the Canadian tests.

The specimens were assigned to the genus *Ammobaculites* rather than to the genus *Haplophragmium* Reuss, 1860 partly because of their mode of coiling, and partly because of the lack of distinctly labyrinthic walls.

Among European species, the Late Oxfordian *Ammobaculites subaequalis* Myatliuk, 1939 of Bastien and Sigal (1962, p. 88, Pl. 5, figs. 10, 11) appears comparable to the specimens recovered, but it has a more slender and elongate uniserial section with less depressed uniserial sutures, and a more tapered, elongate terminal chamber.

Distribution. *Ammobaculites* cf. *A. pokrovkaensis* was found only in the lower half of Sections 64-13 and 70-8.

Figured specimens.

GSC no.	L (mm)	D (mm)	W (mm)	T (mm)	Section	Footage m (ft)
38799	0.725	0.313	0.313	0.275	70-8	65.8 - 71.0* (216 - 233)
38800	0.655	0.375	0.363	0.350	64-13	36.6 - 40.2† (120 - 132)

Ammobaculites cf. *A. wenonahae* Tappan, 1960

Plate 4, figures 22 - 26

Remarks. The tests assigned to *Ammobaculites* cf. *A. wenonahae* consist of a biumbilicate coil followed by a squat, broadly rounded, parallel-sided uniserial section; in diameter the coil may be equal to, but usually exceeds, the breadth of the uniserial section. There are up to five, possibly six, usually indistinct coil chambers, followed by up to three, rarely four, equisize, closely appressed, broad and very low uniserial chambers. The tests commonly are distorted so that the uniserial chambers are slanted. Coil sutures are indistinct and flush to slightly depressed; uniserial sutures are depressed and normally horizontal, but commonly are irregularly transverse as the result of test deformation. Test walls medium to coarse grained in texture; aperture simple, circular, flush and centrally located on the flattened or very slightly convex terminal face.

These specimens resemble figure 1a, b and to a lesser extent figure 3 of *Ammobaculites wenonahae* Tappan, 1960 (see Tappan, 1962, p. 138, Pl. 32). Tappan's figure 3 differs from the tests assigned to *A.* cf. *A. wenonahae* in having more chambers in the uniserial portion, and the remaining figures 2 and 4 - 7 differ in that the uniserial chambers are markedly higher and less closely appressed, and the uniserial portion itself is more elongate and less robust.

Ammobaculites wenonahae was described from Lower Cretaceous strata of the Arctic Slope of northern Alaska.

Distribution. Although relatively rare, *Ammobaculites* cf. *A. wenonahae* was found in all four sections. It was present throughout the lower and into the basal part of the upper sequences in Sections 64-13, 68-11, and 70-8, but was found only in the mid-upper sequence of Section 68-5.

Figured specimens.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
38801	0.988	0.550	0.563	0.563	70-8	60.3 - 62.8* (198 - 216)
38802	0.875	0.750	0.525	0.525	70-8	65.8 - 71.0* (216 - 233)
38803	0.688	0.475	0.475	0.475	68-11	40.6 - 41.8† (133 - 137)

Ammobaculites sp. 152

Plate 4, figures 27 - 36

Description. Tests consist of a planispiral coil of up to five chambers, followed by a reduced uniserial portion commonly of one, rarely of two chambers; test peripheries lobulate. Coil generally involute, but in some specimens tending to be evolute on one side with the inner whorl partially exposed; diameter of coil greater than breadth of uniserial portion. Terminal chamber angular to subrhombohedral, somewhat tapered. Coil sutures depressed, thickened and radial; uniserial sutures depressed, slanted and sinuous. Tests agglutinated with irregular inclusions of large crystal grains in an otherwise transparent, fine grained matrix. Aperture inconspicuous, terminal, flush, circular.

Remarks. The tests recovered differ from the somewhat similar *Ammobaculites barrowensis* Tappan, 1955 (p. 45, Pl. 11, figs. 7 - 12) in their smaller size and better developed coil, in that no more than two uniserial chambers have been observed, and in the angular rather than pyriform shape of the terminal chamber.

Distribution. This relatively rare species was recognized in all four sections. It was found throughout the lower and into the middle sequences, with the exception of Section 68-11 where is was recovered only from the lower part.

Figured specimens.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
38804	0.400	0.350	-	0.250	70-8	65.8 - 71.0* (216 - 233)
38805	0.500	0.313	0.288	0.263	70-8	65.8 - 71.0* (216 - 233)
38806	0.538	0.388	0.325	0.250	70-8	65.8 - 71.0* (216 - 233)
38807	0.625	0.363	0.263	0.238	64-13	6.1 - 9.4† (20 - 31)
38808	0.750	0.375	0.313	0.375	64-13	61.5 - 67.0† (202 - 220)

Ammobaculites sp. 180

Plate 4, figures 37, 38

Description. Tests elongate, parallel-sided, subcircular in cross-section; coil composed of up to four or possibly five chambers, followed by a uniserial section of up to three chambers. Coil diameter equals or is slightly greater than diameter of linear portion. Uniserial chambers remain nearly constant in breadth but increase slightly in height; terminal face rounded. Coil sutures flush and indistinct, uniserial sutures slightly depressed and irregularly horizontal. Walls agglutinated, fine to medium grained and roughened. Aperture central, round and flush.

Remarks. Although the tests recovered appear similar to *Ammobaculites reophacoides* Bartenstein, 1952 (see Chamney, 1969, p. 28, Pl. 6, figs. 1 - 3), from the Lower Cretaceous of the District of Mackenzie, the sutures and chamber arrangement in the coil are obscure so that it cannot be ascertained if the coiling is asymmetric as Chamney observed in his specimens. *Ammobaculites reophacoides* Bartenstein (1952a, p. 307, Fig. 1a, b) differs from the specimens studied in having a coil that is smaller in diameter than that of the uniserial portion, and, in addition, the uniserial chambers increase more rapidly in height so that the terminal chamber is more elongate and more strongly tapered.

Distribution. *Ammobaculites* sp. 180 was found in three of the four sections studied. It ranges through the lower half of Section 64-13 and through the middle sequences of Sections 68-5 and 68-11.

Figured specimens.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
38809	0.563	0.238	0.213	0.188	68-5	51.2 - 54.2† (168 - 178)
38810	0.688	0.263	0.250	0.250	68-11	96.0 - 99.4† (315 - 326)

Ammobaculites sp. 220

Plate 5, figures 1, 2

Description. Test elongate, consisting of a small bi-umbilicate coil of up to four chambers, followed by a uniserial portion of up to five chambers; test peripheries rounded and lobulate. Uniserial section tapered, somewhat flattened probably as the result of compression; uniserial chambers increase more rapidly in breadth than height, terminal chamber rounded. Sutures depressed, radial and straight in the coil, uniserial sutures horizontal and irregular where deflected by the larger grains incorporated in test wall. Wall agglutinated, medium grained, rough. Aperture not observed.

Remarks. The one test recovered somewhat resembles *Ammobaculites erectus* Crespin, 1963 (see Chamney, 1969, p. 29, Pl. 6, figs. 4 - 6) from the Lower Cretaceous of the District of Mackenzie. *Ammobaculites* sp. 220 differs, however, in having four rather than three coil chambers, and it is only about two thirds the size of Chamney's specimen.

A greater number of specimens are needed to enable either adequate comparisons or identification beyond the generic level.

Figured specimen.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
38811	0.750	0.288	0.375	0.250	64-13	18.6 - 21.0† (61 - 69)

Genus *Ammomarginulina* Wiesner, 1931

Ammomarginulina sp. 158

Plate 5, figure 3

Description. Test compressed with subangular peripheries, consisting of an evolute, somewhat biumbilicate coil of six, or possibly seven chambers; early chambers indistinct and triangular, terminal chamber excavated and rectangular, terminal face truncated. Sutures indistinct, flush and appearing thickened if viewed under water. Wall agglutinated, medium to coarse grained, rough, transparent. Aperture terminal, an elongate slit.

Remarks. Only one complete test was recovered; the rest were fragments that consisted of compressed uniserial sections or of compressed coil sections that could be fragments of *Ammomarginulina* sp. 158, or of some other *Ammomarginulina* species, or even of some large crushed *Ammobaculites* species.

There is a superficial similarity between *Ammomarginulina* sp. 158 and *Ammomarginulina* sp. A Wall (1960, p. 56, Pl. 18, figs. 3, 4, 7 - 9), but the studied test differs in that it consists of one whorl only, and in that all of the chambers, other than the final one, are triangular rather than rectangular in shape.

Figured specimen.

GSC no.	D	T	Section	Footage
	mm			m (ft)
38812	0.625 - 0.675	0.263	70-8	60.3 - 65.8* (198 - 216)

Subfamily Recurvoidinae Alekseitchick, 1973

Genus *Recurvoides* Earland, 1934

Remarks. Alekseitchick-Mitskevich (1973) established the subfamily Recurvoidinae to contain those genera that display variations in the plane of coiling between successive whorls, and at the same time redescribed the genus *Recurvoides* and restricted it to only those forms in which the deviation in the plane of coiling between successive whorls approximates a 90 degree angle, in contrast to Dain (1972, p. 52, 53) who included forms with coils arranged at various angles. Although agreeing that this subfamily is a useful taxonomic unit, the exclusion of the irregularly coiled genus *Budashevaella* Loeblich and Tappan, 1964 is not as readily acceptable. The varying descriptions of *Recurvoides* and *Budashevaella*, together with that of the subfamily Recurvoidinae, are summarized briefly in Table 3.

For the present, those Peace River forms that display variations in the plane of coiling between successive whorls have been tentatively assigned to the various species of *Recurvoides* described and figured by Dain (1972), which they most closely resemble.

Genus *Recurvoides* Earland, 1934

Recurvoides? cf. *R. disputablis* Dain, 1972

Plate 3, figures 12 - 20

Remarks. The tests are subcircular in outline with rounded peripheries; no more than two or two and one-half coils are visible. Coiling is asymmetric, being partially evolute with the inner whorls more or less exposed on one side, and involute, or very nearly involute on the reverse side with a shallow umbilicus. Coiling initially is streptospiral in mode, becoming planispiral in the final whorl; the direction of coiling varies from specimen to specimen, being to the right in some tests and to the left in others. On the evolute side of the tests there are eight, possibly nine, gradually enlarging subtriangular chambers in the final whorl; on the involute side only the ultimate whorl is visible and consists of up to eight regularly enlarging, triangular chambers. The sutures are straight and somewhat depressed and appear to be thicker on the evolute than on the involute side. The test walls are fine grained and either transparent and clear, or a translucent brown. The aperture is obscure but appears to be a slit or low crescent at the base of the terminal face.

Within the species *Recurvoides disputabilis* Dain 1972 (p. 55, Pl. 10, figs. 6, 7; Pl. 11, figs. 1 - 4; Pl. 19, fig. 1) from western Siberia, two subspecies were isolated: *R. disputabilis disputabilis* from the Upper Oxfordian; and *R. disputabilis plana* (Dain, 1972, p. 56, Pl. 11, figs. 5, 6; Pl. 12, figs. 1, 2) from the Lower Kimmeridgian. The specimens studied conform rather more closely to the description and figures of the latter subspecies, but the material recovered is insufficient and too poorly preserved to permit a firm assignment to either the species or the subspecies.

The change in shape, as well as the change in the position of the aperture as described for the Russian specimens, from a basal, low, curved slit, to a small oval elevated above the chamber margin has not been observed in the Canadian specimens. With respect to the aperture, and also to the mode of coiling, the tests recovered are reminiscent of *Budashevaella* Loeblich and Tappan, 1964 (in Moore, 1964, p. 262, Fig. 175, No. 2a, b).

There is some resemblance also between *Recurvoides*? cf. *R. disputabilis* and *Haplophragmoides*? sp. of Chamney (1969, p. 27, Pl. 5, fig. 16a, b) from the Lower Cretaceous sequences of the District of Mackenzie. This latter species differs, however, in having a greater number of chambers in the final whorl.

Distribution. *Recurvoides*? cf. *R. disputabilis* occurs rarely. It was found in the basal sequences of Sections 64-13 and 70-8, and was identified only questionably in the midpart of Section 68-11.

Figured specimens.

GSC no.	D	T	Section	Footage
	mm			m (ft)
38773	0.500 - 0.633	0.313	70-8	62.8 - 71.0* (216 - 233)
38774	0.438 - 0.450	0.263	70-8	30.4 - 36.6* (100 - 120)
38775	0.625 - 0.713	0.325	64-13	12.4 - 14.6† (41 - 48)

Table 3. Comparison of the genera *Recurvoides* and *Budashevaella*

	Recurvoidinae Alekseitchik-Mitskevich, 1973	*Recurvoides* Earland, 1934 (Alekseitchik-Mitskevich, 1973)	*Recurvoides* Earland, 1934 (Moore, 1964)	*Recurvoides* Earland, 1934 (Dain, 1972)	*Budashevaella* Loeblich and Tappan, 1964 (Alekseitchik-Mitskevich, 1973)	*Budashevaella* Loeblich and Tappan, 1964 (Moore, 1964)
Type of coiling	Endothyrid	Whorls in planes at about 90° angles	Streptospiral, may vary from distinctly streptospiral throughout, to nearly planispiral, with an abrupt 90° change in the plane of coiling during development	1. Plectogyroidal, semi-evolute, asymmetrically evolute; coils 40°-90° relative to each preceding coil, last 1 or 2 coils in one plane 2. Plectogyroidal, trochoid during some stage of development, last coil typical of *Recurvoides*	Completely planispiral, or early whorls deviating from planispiral More or less evolute Equitubular whorls	Early portion streptospiral, later planispiral
Chambers			Few in each whorl		Between 8-10 and 16-18 in final whorl	Numerous
Aperture	Simple, arcuate, base of terminal surface, or raised, or compound, rounded, lipped apertures	Small, septal, some are lipped	Small, areal, with distinct bordering lip	Small, oval, areal (lipped sometimes)	Septal	Interiomarginal
Wall	Arenaceous, simple, calcareous, ferruginous or siliceous cement	Quartz grains often fine, large quantity of ferruginous cement	Agglutinated, thin	Agglutinated, fine grained, usually small quantity cement		Agglutinated, simple, considerable siliceous cement
Differences			Somewhat resembles *Trochammina*, but only earlier periphery and not all earlier whorls visible from spiral side	Differs from *Trochammina* in elevated dorsal spire; non-successive growth of chambers one on the other; shift of last coil typical of *Recurvoides*; aperture on septal surface		Differs from *Recurvoides* in evolute coiling, interio-marginal aperture, and in type of cement (*Recurvoides* is also evolute to varying degrees)

Recurvoides? sp. 149

Plate 3, figures 21 - 32

Description. Tests lenticular, ovate to subrectangular in outline; peripheries narrowly rounded. Tests asymmetrical, more strongly evolute on one side than on the other; two to two and one-half whorls visible on one side, one to one and one-half visible on the reverse. Plane of coiling varies with each succeeding whorl so that penultimate whorl is perpendicular, or nearly perpendicular, to final whorl. Up to nine and one-half equisize, irregularly rectangular chambers in ultimate whorl; commonly three to four chambers of penultimate whorl visible on both sides, but occasionally penultimate whorl is tilted so that up to seven chambers may be exposed on one side, with no more than three or four visible on the reverse side. Sutures thickened, flush to slightly depressed, straight to irregularly curved. Walls agglutinated, fine grained, transparent. Aperture not clearly observed, but appears to be located at base of terminal face.

Remarks. Although fewer chambers were observed in the final whorl, in general shape, shape of chambers, and in visibility of earlier whorls, these tests appear much like the Early Kimmeridgian *Recurvoides sublustris* Dain, 1972 (p. 57, Pl. 12, figs. 3 - 6). The material recovered, however, is insufficient to permit a firm commitment of these specimens to any one species.

The generic assignment of the specimens is tentative because the type, shape and exact position of the aperture are unknown.

Distribution. Recurvoides? sp. 149, although relatively rare, was recognized in all four sections. It was found in the lower parts of Sections 70-8 and 68-11, and in the lower part of Section 64-13 with one questionable specimen from the upper half of the section; it was recovered only from the base of the upper sequence of Section 68-5.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38776	0.313 - 0.438	0.175	70-8	30.4 - 36.6* (100 - 120)
38777	0.375 - 0.550	0.250	64-13	21.0 - 23.7† (69 - 78)
38778	0.550 - 0.788	0.375	70-8	77.1 - 82.0* (253 - 269)

Recurvoides? sp. 208

Plate 3, figures 33 - 43

Description. Tests plano-convex, ovate to subcircular in outline; peripheries rounded. Tests asymmetrical, one side evolute with sometimes up to three earlier whorls partially exposed, reverse side nearly involute with only two or three chambers of penultimate whorl partially visible. Coiling in varying planes; with each succeeding whorl the angle is increased with respect to the primary plane. Commonly 10, but occasionally up to 12 gradually enlarging, subtriangular to triangular chambers in ultimate whorl. Spiral sutures flush, thickened; septal sutures flush, thickened, straight to somewhat curved. Wall agglutinated, fine grained, transparent or translucent to opaque and brown. Aperture obscure, possibly a high arch or loop at base of terminal chamber.

Remarks. This form differs from the other associated *Recurvoides*? species in having more whorls that are less sharply angled with respect to the preceding whorls, as well as having more numerous and more triangular chambers.

Distribution. This rare species was found in the basal sequences of Sections 64-13 and 70-8, with one doubtful specimen in the upper part of Section 68-5.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38779	0.338 - 0.438	0.250	70-8	30.4 - 36.6* (100 - 120)
38780	0.350 - 0.463	0.263	70-8	30.4 - 36.6* (100 - 120)
38781	0.375 - 0.500	0.213	70-8	18.3 - 30.4* (60 - 100)

Recurvoides? sp. 226

Plate 3, figures 44 - 63

Description. Tests ovate to round in outline with rounded peripheries; two to two and one-half coils visible. Coiling asymmetric, evolute on one side, less strongly evolute to involute on the reverse; plane of coiling alters with each succeeding whorl so that final whorl can be at right angles approximately to earliest visible whorl. Nine to ten gradually enlarging, subrectangular to subtriangular chambers in final whorl. Spiral and septal sutures flush, the latter straight and somewhat thickened. Wall agglutinated, fine grained and transparent, or dark brown and translucent to opaque. Aperture obscure, appears to be an arched opening at base of terminal face.

Remarks. Dain (1972, p. 52, Pl. 9, figs. 1 - 7) commented on and figured tests that had trochamminal as well as plectogyroidal stages of coiling, and from among these combined various forms as *Recurvoides gryci* (Tappan). The tests here referred to as *Recurvoides*? sp. 226 appear similar to some figures of Dain's *R. gryci*. *Recurvoides*? sp. 226 was always found in association with trochoid specimens, and it was difficult to separate the two forms when dealing with poorly preserved, or dark brown and opaque tests. However, the clearly trochoid tests were assigned to *Trochammina gryci* (see Pl. 5, figs. 36 - 48 of this report) whereas the remaining tests, which display obvious changes in the plane of coiling from whorl to whorl, but still appear much like *T. gryci*, were questionably assigned to the genus *Recurvoides*.

Recurvoides gryci (Tappan) was reported by Dain from Upper Callovian and Lower Oxfordian strata of western Siberia.

Distribution. Although relatively rare, this species was recognized in all four sections. It was found in the basal sequence of Section 70-8, in the lower half of Section 64-13, and from the basal into the middle sequence of Section 68-11; it was recovered from only the top part of Section 68-5.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38782	0.275 - 0.375	0.263	64-13	6.1 - 9.4† (20 - 31)
38783	0.375 - 0.488	0.250	64-13	12.5 - 14.6† (41 - 48)
38784	0.463 - 0.500	0.263	64-13	12.5 - 14.6† (41 - 48)
38785	0.563 - 0.575	0.288	70-8	62.8 - 71.0* (216 - 233)
38786	0.400 - 0.438	0.300	64-13	18.6 - 21.0† (61 - 69)

Family Textulariidae Ehrenberg, 1838

Subfamily Spiroplectammininae Cushman, 1927

Genus *Spiroplectammina* Cushman, 1927

Spiroplectammina suprajurassica Kosyreva, 1972

Plate 5, figures 4 - 9

1972 *Spiroplectammina suprajurassica* Kosyreva in Dain, p. 74, Pl. 20, figs. 7 - 16.
?1955 *Spiroplectammina* sp. Tappan, p. 46, Pl. 13, fig. 12.

Remarks. The specimens recovered do not appear to differ in any essential feature from *Spiroplectammina suprajurassica* of the Lower Kimmeridgian of western Siberia other than for their larger size. There are nearly parallel-sided forms in which the coil diameter and the breadth of the biserial section are nearly equal, as well as tapered tests in which the coil diameter is less than the maximum diameter of the biserial portion. No more than seven chambers have been observed in the final whorl of the compressed, partially evolute coil, and up to nine chambers in the biserial section, which is somewhat flattened in the parallel-sided forms, but is ovate to round in the tapered forms. The proloculus was not observed. Wall texture of the parallel-sided forms is medium grained and rough; that of the tapered forms varies from medium to fine grained. The sutures throughout are weakly depressed and indistinct, radial in the coil, oblique and offset in pairs in the linear portion. The aperture was not observed in the parallel-sided specimens, but in the tapered tests it is a low slit or crescent at the base of the terminal face.

Spiroplectammina sp. of Tappan, from the Upper Jurassic strata of northern Alaska, has a wider planispiral than biserial portion, but otherwise compares closely with the parallel-sided tests studied.

Distribution. *Spiroplectammina suprajurassica* occurs rarely. It was found in the lower and middle sequences of Section 64-13, but was recognized in only one sample from the midportion of Section 68-11.

Hypotypes.

GSC no.	L (mm)	D (mm)	W (mm)	T (mm)	Section	Footage m (ft)
38813	0.312	0.188	0.188	0.175	64-13	28.6 - 32.6† (94 - 107)
38814	0.475	0.188	0.250	0.150	68-11	68.6 - 71.6† (225 - 235)
38815	0.488	0.188	0.213	0.188	64-13	40.2 - 44.8† (132 - 147)
38816	0.475	0.188	0.188	0.125	64-13	6.1 - 9.4† (20 - 31)
38817	0.488	0.163	0.188	0.150	64-13	21.0 - 23.8† (69 - 78)

Spiroplectammina cf. *S. tobolskensis* Beljaevskaja and Komissarenko, 1972

Plate 5, figures 10 - 14

Remarks. The tests recovered are jaggedly lobulate in outline, and are elongate, tapered and slightly curved. They consist of a tiny, compressed, planispiral coil of up to five chambers, followed by a biserial section of up to nine chambers that, in some specimens, terminates in a uniserial chamber. The coil diameter is smaller than the maximum width of the uniserial portion. The sutures are depressed, indistinct and masked by coarse grains; they are radial in the coil and oblique in the biserial part. The walls are agglutinated, semitransparent, coarse grained and rough. The aperture was not preserved.

Spiroplectammina cf. *S. tobolskensis* differs from the Russian specimens figured by Beljaevskaja and Komissarenko (in Dain, 1972, p. 72, Pl. 20, figs. 1 - 6) from the Upper Oxfordian of western Siberia, in their larger size, and in having a less elongate, biserial portion which consists of fewer chambers. It has not been possible to determine the shape or the position of the aperture in the Canadian specimens.

Spiroplectammina cf. *S. tobolskensis* differs from the very similar tests assigned to *Spiroplectammina suprajurassica* Kosyreva, with which it occurs, in having a smaller coil which consists of not more than four or, at the most, of five chambers, in the slight curvature of the biserial portion, and in the tendency to become uniserial.

Distribution. The few specimens recovered were found in the basal sequence of Section 64-13.

Figured specimens.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
38818	0.563	0.163	0.188	0.175	64-13	21.0 - 23.8† (69 - 78)
38819	0.500	0.188	0.200	0.150	64-13	21.0 - 23.8† (69 - 78)
38820	0.625	0.163	0.238	0.150	64-13	9.4 - 12.5† (31 - 41)
38821	0.463	0.125	0.188	0.125	64-13	6.1 - 9.4† (20 - 31)

Family Trochamminidae Schwager, 1877

Subfamily Trochammininae Schwager, 1877

Genus *Trochammina* Parker and Jones, 1859

Trochammina cf. *T. canningensis* Tappan, 1955

Plate 5, figures 15 - 25

Remarks. When not crushed or flattened, the tests recovered are globular and vary from an involute form with up to five inflated chambers visible, to an asymmetrically evolute form with one or two of the earlier chambers exposed on one or on both sides. *Trochammina* cf. *T. canningensis* resembles closely the type specimens figured by Tappan (1955, p. 49, Pl. 14, figs. 15, 17 - 19), with the exception of figure 16. It differs, however, from the description of the species, and from the specimen shown in figure 16, in the irregularity of the coiling which is often more nearly streptospiral than clearly trochoid, and also in having fewer chambers. With respect to shape of chambers, sutures, wall structure, texture and aperture, both forms appear closely related.

Dain (1972, Pl. 13, figs. 1, 2) figured a *Trochammina*(?) ex gr. *T. canningensis* Tappan from the Lower Kimmeridgian of western Siberia which, insofar as can be judged from illustrations alone, appears to resemble more closely the tests here assigned to *Ammosphaeroidina*? sp. 146 than to those assigned to *Trochammina* cf. *T. canningensis.*

Tappan described *Trochammina canningensis* from Lower and Upper Jurassic strata of northern Alaska. Chamney (in Stott, 1967, p. 26 - 28) reported a specimen of *Trochammina* cf. *T. canningensis* from the base of Section 64-13.

Distribution. *Trochammina* cf. *T. canningensis* is a relatively rare species. It was recovered from the basal into the middle sequences of Sections 64-13 and 70-8 but was found in only the middle part of Section 68-11.

Figured specimens.

GSC no.	D	T	Section	Footage
	mm			m (ft)
38822	0.300 - 0.338	0.188	70-8	30.4 - 60.9* (100 - 200)
38823	0.338 - 0.375	0.250	64-13	40.2 - 44.8† (132 - 147)
38824	0.400 - 0.488	0.250	70-8	65.8 - 71.0* (216 - 233)
38825	0.438 - 0.500	0.263	70-8	30.4 - 36.6* (100 - 120)

Trochammina? cf. *T. gatesensis* Stelck and Wall, 1956

Plate 5, figures 26 - 35

Remarks. The generic assignment is open to question, for both the type and position of the aperture could not be identified without doubt. One specimen recovered has a circular mark on the terminal face that might be an aperture, but also could be a depression or break in the chamber wall, whereas another specimen displays what could be a ventral notch at the base of the terminal chamber. No evidence of an aperture either on or at the base of the terminal face could be found in the remaining tests. In addition to the problem of the aperture, the specimens recovered differ from *Trochammina gatesensis* Stelck and Wall (in Stelck et al., 1956, p. 53, Pl. 4, figs. 9 - 11) in having only two and one-half whorls clearly visible on the spiral side, and not more than six and six and one-half chambers, resspectively, in the penultimate and ultimate whorls. Features observed in the studied tests but not mentioned in the original description of *Trochammina gatesensis* are the moderate to deep umbilicus and somewhat lobulate peripheries.

Trochammina gatesensis was described from Middle Albian strata of the Peace and Athabasca river drainage areas of western Canada.

Distribution. *Trochammina*? *cf. T. gatesensis* was recovered from the lower half of Section 64-13.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38826	0.313 - 0.400	0.250	64-13	40.2 - 44.8† (132 - 147)
38827	0.263 - 0.313	0.188	64-13	18.6 - 21.0† (61 - 69)
38828	0.363 - 0.375	0.188	64-13	40.2 - 44.8† (132 - 147)

Trochammina gryci Tappan, 1955

Plate 5, figures 36 - 48

1955 *Trochammina gryci* Tappan, p. 50, Pl. 14, figs. 12 - 14.
1967 *Trochammina gryci* Tappan, Chamney in Stott, p. 26 - 28.
part 1972 *Recurvoides gryci* (Tappan, 1955) in Dain, Pl. 9, fig. 6a - c, not figs. 1 - 5, 7.

Remarks. The specimens recovered are not all high-spired as described and figured by Tappan, but vary rather from high to low-spired. On the spiral side there are commonly nine, rarely ten, subrectangular equisize chambers visible in the ultimate whorl, and eight, rarely nine, triangular chambers on the umbilical side. Coiling may be either sinistral or dextral. In some specimens, on the umbilical side, the inner tips of early chambers can be seen in the umbilical area through the transparent test wall. The spiral sutures are depressed somewhat, the septal sutures are thickened, flush to slightly depressed, straight on the spiral side, radial and straight on the reverse. The aperture is a slit or low crescent at the base of the terminal face on the umbilical side. Test walls vary from transparent, with the chamber arrangement clearly visible, to a translucent or opaque, dark smoky brown. In the latter case, the details of whorl and chamber arrangement are obscure and it is difficult, if not impossible, to determine whether these tests should be assigned to *Trochammina gryci*, to *Recurvoides*? sp. 206, or possibly to *Haplophragmoides*? *canuiformis* Dain, 1972.

The specimens recovered differ from *Trochammina nana* (Brady) of Bartenstein and Brand (1937, p. 190, Pl. 2B, fig. 40a, b, Textfig. 20a - c), placed in synonymy with *T. gryci* by Tappan, in that on the spiral side the chambers are more strongly rectangular in shape, and the sutures are straight rather than curved.

Tappan described *Trochammina gryci* from Upper Oxfordian strata of northern Alaska. Chamney (in Stott, 1967, p. 26 - 28) reported the species in the lower sequences of Section 64-13. Gerke (1969, p. 56) recorded *Trochammina gryci* in Oxfordian strata of north-central Siberia, and Dain (1972) reported *Recurvoides gryci* (Tappan) in Upper Callovian into Lower Oxfordian strata of western Siberia.

Distribution. *Trochammina gryci* varies from rare to common in occurrence and was recognized in all four sections. It was found in the lower half of Sections 64-13 and 70-8, and from the basal into the upper sequences of Section 68-11; it was recovered from only the upper part of Section 68-5.

Hypotypes.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38829	0.250 - 0.300	0.175	64-13	6.1 - 9.4† (20 - 31)
33830	0.375 - 0.463	0.313	70-8	36.6 - 42.6* (120 - 140)
33831	0.550 - 0.588	0.375	70-8	42.6 - 48.8* (140 - 160)
38832	0.500 - 0.600	0.388	64-13	21.0 - 23.8† (69 - 78)

Trochammina cf. *T. sablei* Tappan, 1955

Plate 5, figures 49 - 52

Remarks. The one specimen recovered differs from *Trochammina sablei* Tappan, 1955 (p. 50, Pl. 14, figs. 6 - 9) in that only two whorls are visible on the spiral side, the penultimate whorl having four, possibly five, and the ultimate whorl having seven chambers. Also, it is not markedly evolute on the umbilical side, in this respect resembling Tappan's Plate 14, figure 7 more closely than the remaining figured specimens of *T. sablei*. The spiral suture and the early septal sutures are flush and indistinct, the later septal sutures are somewhat depressed. The aperture was not preserved.

Trochammina sablei was described from Lower Jurassic strata of northern Alaska.

Figured specimen.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38833	0.450 - 0.550	0.275	68-11	59.4 - 62.5† (195 - 205)

Trochammina sp. 153

Plate 5, figures 53 - 56

Description. Tests trochoid, low spired, with shallow umbilicus on umbilical side; periphery subangular. Three whorls visible on spiral side, nine and one-half to ten uniformly enlarging subrectangular chambers in final whorl, up to nine triangular chambers distinguishable in penultimate whorl. Final whorl only visible on umbilical side, of up to nine triangular, uniformly enlarging chambers. Sutures distinct, flush, thickened, curved on spiral side, radial and straight on umbilical side. Aperture not observed.

Remarks. The damaged condition of the few specimens recovered does not permit either adequate comparison or identification beyond the generic level.

Distribution. The few specimens recovered were found in the basal sequence of Section 70-8.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38834	0.275 - 0.300	0.175	70-8	65.8 - 71.0* (216 - 233)
38835	0.213 - 0.250	0.163	70-8	65.8 - 71.0* (216 - 233)

Genus *Ammosphaeroidina* Cushman, 1910

Ammosphaeroidina? sp. 146

Plate 6, figures 1 - 38

Description. Fully developed tests plano-convex, involute, with final whorl enclosing all earlier whorls; earlier, hidden whorls coiled in various planes. Four or five subglobular, rapidly enlarging chambers visible on convex side, three to four chambers exposed on flattened side. Incompletely developed tests irregularly globose to ovate in shape; plane of coiling rotating as much as 90° to 180° as each new whorl develops; up to four rapidly enlarging chambers in each whorl. Sutures depressed, somewhat thickened. Walls agglutinated, fine grained, smooth, opaque and grey. Aperture obscure, a low crescent or slit at base of terminal chamber in early stages, not observed in fully developed tests.

Remarks. In peripheral view, the chamber arrangement in some of the incompletely developed tests may appear to be verging on the biserial (e.g., Pl. 6, figs. 19 - 20) but, in fact, the plane of coiling in these specimens has rotated so that two successive whorls have developed back to back.

The generic status of species 146 is considered tentative, for the fully developed specimens have more chambers in the final whorl than the types of *Ammosphaeroidina* Cushman, 1948 (p. 205; in Moore, 1964, p. 259).

Trochammina(?) ex gr. *T. canningensis* Tappan figured by Levina (in Dain, 1972, Pl. 13, figs. 1, 2) appears to be more comparable to the tests here assigned to *Ammosphaeroidina*? sp. 146 than to those identified as *Trochammina* cf. *T. canningensis*.

Distribution. Although rare, the species was found in all four sections. It was recovered from the basal sequences of Sections 64-13 and 70-8, and from the middle part of Section 68-11, but was recognized in only one sample from near the top of Section 68-5.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38836	0.350 - 0.388	0.250	70-8	30.4 - 36.6* (100 - 120)
38837	0.413 - 0.438	0.363	70-8	30.4 - 36.6* (100 - 120)
38838	0.475 - 0.513	0.313	70-8	65.8 - 71.0* (216 - 233)
38839	0.363 - 0.475	0.263	70-8	60.3 - 65.8* (198 - 216)
38840	0.363 - 0.413	0.300	70-8	48.8 - 54.4* (160 - 180)

Figured specimens (cont.)

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38841	0.325 - 0.375	0.300	70-8	60.3 - 65.8* (198 - 216)
38842	0.250 - 0.325	0.225	68-11	68.6 - 71.6† (225 - 235)
38843	0.313 - 0.325	0.250	70-8	60.3 - 65.8* (198 - 216)
38844	0.238 - 0.263	0.200	64-13	12.5 - 14.3† (41 - 48)

Family Ataxophragmiidae Schwager, 1877

Subfamily Verneuilininae Cushman, 1911

Genus *Verneuilinoides* Loeblich and Tappan, 1949

Verneuilinoides sp. 233

Plate 6, figures 39 - 41

Description. Test elongate, tapered and flattened. Chamber arrangement appears triserial; chambers somewhat inflated, increasing in size toward apertural end. Sutures distinct, depressed, oblique. Wall agglutinated, fine grained, roughened. Aperture not observed.

Remarks. On the basis of one rather poorly preserved specimen, identification beyond generic level was not attempted.

Figured specimen.

GSC no.	L (mm)	W (mm)	T (mm)	Section	Footage m (ft)
38845	0.400	0.263	0.150	68-11	35.1 - 38.1† (115 - 125)

Subfamily Globotextulariinae Cushman, 1927

Genus *Dorothia* Plummer, 1931

Dorothia? sp. 181

Plate 6, figures 42 - 46

Description. Test elongate, tapered, rarely rounded, more often flattened. Initial chamber arrangement indistinct, appears to be triserial or trochoid, later becoming biserial; early chambers obscure, later chambers inflated, subglobular. Initial sutures flush, indistinct, later sutures depressed. Wall agglutinated, fine to medium grained, rough. Aperture appears to be a slit at base of terminal chamber.

Remarks. Because the early chamber arrangement and aperture could not be observed clearly, the generic assignment of these specimens is regarded as tentative.

Distribution. The species was recovered from the lower part of the upper sequence of Section 68-5.

Figured specimens.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38846	0.400	0.238	0.125	68-5	54.2 - 57.3† (178 - 188)
38847	0.463	0.338	0.125	68-5	51.2 - 54.2† (168 - 178)
38848	0.513	0.238	0.125	68-5	51.2 - 54.2† (168 - 178)

Family indeterminate

Genus indeterminate sp. 183

Plate 6, figures 47 - 51

Description. Test elongate, parallel-sided to gently tapered, round to ovate in section. Initial chamber arrangement triserial or possibly biserial, biserial in later stages, finally becoming uniserial. Sutures indistinct, flush initially, later depressed. Walls agglutinated, fine to medium grained, rough. Aperture not observed.

Remarks. Because of the obscure arrangement of the initial chambers, as well as the unknown position and type of aperture, generic assignment of these specimens was not attempted.

Distribution. This species was found in the lower part of the upper sequence of Section 68-5 and was identified only questionably at the base of Section 70-8.

Figured specimens.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38849	0.338	0.138	0.118	68-5	54.2 - 57.3† (178 - 188)
38850	0.375	0.163	0.150	68-5	54.2 - 57.3† (178 - 188)
38851	0.500+	0.225	0.125	68-5	48.1 - 51.2† (158 - 168)

Genus indeterminate sp. 193

Plate 6, figures 52 - 54

Remarks. The one specimen recovered was lost during photography. It could be assigned to the genus *Verneuilinoides* Loeblich and Tappan, 1949 or *Gaudryina* d'Orbigny, 1839.

Figured specimen.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38852	0.475	0.225	0.175	68-5	51.2 - 54.2† (168 - 178)

Genus indeterminate sp. 232

Plate 6, figures 55, 56

Remarks. Lituolid fragments consisting of uniserial chambers having fine grained agglutinated walls.

Distribution. These fragments were recovered from the lower sequences of Section 70-8.

Figured specimens.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38853				70-8	48.8 - 54.9* (160 - 180)
38854				70-8	60.3 - 65.8* (198 - 216)

Suborder Rotaliina Delage and Hérouard, 1896

Superfamily Nodosariacea Ehrenberg, 1838

Family Nodosariidae Ehrenberg, 1838

Subfamily Nodosariinae Ehrenberg, 1838

Genus *Nodosaria* Lamarck, 1812

Nodosaria cf. *N. detruncata* Schwager, 1867

Plate 7, figures 1, 2

Remarks. The specimens recovered were either damaged or in the form of calcite moulds to which fragments of the test walls were still attached. The more complete tests compare favourably with the description and figures of *Nodosaria detruncata* Schwager, 1867 of Tappan (1955, p. 69, Pl. 26, figs. 19, 20) from Upper Jurassic rocks of northern Alaska, but generic placement and specific identification are tentative in view of the poorly preserved state of the tests.

Distribution. *Nodosaria* cf. *N. detruncata* was found in the upper sequences of Sections 64-13, 68-5 and 68-11, but was recognized only questionably in the upper part of Section 70-8.

Figured specimens.

GSC no.	L	T	Section	Footage
	mm			m (ft)
38855	0.575	0.225	68-5	74.7 - 78.3† (245 - 257)
38856	0.563	0.300	68-11	68.6 - 71.6† (225 - 235)

Genus *Geinitzinita* Sellier de Civrieux and Dessauvagie, 1965

Geinitzinita cf. *G. praenodulosa* Dain, 1972

Plate 7, figures 3 - 5

Remarks. The tests and fragments of tests recovered are compressed moderately and tapered, with rounded peripheries and arched, weakly depressed sutures. Strong, longitudinal median furrows extend the length of each lateral surface but do not extend onto the large rounded proloculus. The apertures are terminal, central and elongate-ovate.

Other than for two complete but poorly preserved specimens, which are considered to be juveniles for they consist of a proloculus and no more than two chambers, only fragments of tests were recovered. Dain (1972, p. 108, Pl. 33, fig. 4) figures a small test of *G. praenodulosa* which, in general shape, appears similar to the two complete Canadian specimens, but Dain's specimens differ in having ridgelike swellings bordering the median furrow, wide sutures, and the aperture is described as simple and oval.

According to Gerke (1969), the possession of distinctive median furrows and the type of aperture are of major importance in distinguishing species of the genus *Geinitzinita*. The aperture of *Geinitzinita* is described as more or less extended, oval to slitlike in shape, and with lateral lips. In shape, the apertures of the recovered tests conform to this description, but there is no evidence remaining of lateral lips. Such features, however, together with weak ridges bordering the median furrow, or any other weakly developed surface ornamentation, could have been present originally and subsequently obliterated during fossilization.

Appearing closely comparable also is *Frondicularia* sp. Tappan (1955, p. 82, Pl. 27, fig. 10), although this form too has clearly developed ridges bordering the median furrow. *Geinitzinita nodulosa* (Fursenko and Polenova, 1950) of Gerke (1969, p. 54, Pl. 1, figs. 5-9, Pl. 2, figs. 1-6) and of Dain (1972, Pl. 33, figs. 6-10), although similar in general shape, has clearly developed but seemingly discontinuous bordering ridges and a proportionately small proloculus. *Geinitzinita arctocretacea* (Gerke), 1969 (p. 56, Pl. 2, figs. 7-11, Pl. 3, figs. 1-7) is more closely comparable to the Canadian tests in respect to the size of the proloculus and has less prominent bordering ridges, but the aperture possesses strongly developed lateral lips. All figures of the above species show no less than three chambers in addition to the proloculus and presumably have reached a later stage in their development than the two complete Canadian specimens.

Other somewhat similar species are *Lingulina tenera* Bornemann, 1854 of Barnard (1949, p. 365, Fig. 6a, c, f, g; 1956, p. 274, Pl. 1, figs. 1, 2, 9a, b, 10a, b), *Lingulina groupe tenera* of Espitalie and Sigal (1960, p. 53, Pl. 1, fig. 11, Pl. 2, fig. 1), and *Frondicularia tenera tenera* of Bartenstein and Brand (1937, p. 156, Pl. 1A, figs. 11, 19, Pl. 2A, fig. 10a-c, Pl. 2B, fig. 18a, b, Pl. 3, figs. 25, 26, Pl. 5, fig. 67a, b). The specimens assigned here to *G.* cf. *G. praenodulosa* differ from the above listed forms in their rounded peripheries and in having no extension of the furrow on to the much larger, rounded proloculus.

Gerke reported *Paralingulina nodulosa* (Fursenko and Polenova) from north-central Siberia in strata ranging in age from Middle Callovian into the Late Volgian (but most characteristically in the Lower to Upper Oxfordian sequences), and *P. arctocretacea* from the same area, but in strata ranging from the Volgian into the Valanginian. Tappan's (1955) *Frondicularia* sp. was from Upper Jurassic sequences of northern Alaska, and Chamney (in Stott, 1967, p. 26-28) found this species of Tappan in his Zone F of Section 64-13. Dain (1972) described *Geinitzinita praenodulosa* from Upper Oxfordian and Kimmeridgian strata of western Siberia.

Distribution. Although very rare, the species was found in the middle sequences of Sections 64-13 and 68-11, and at the base of the upper sequences of Section 68-5.

Figured specimens.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38857	0.363	0.238	0.175	68-11	68.6 - 71.6† (225 - 235)
38858	0.388	0.263	0.188	68-11	116.1 - 118.6† (381 - 389)

Genus *Lagena* Walker and Jacob in Kanmacher, 1798

Lagena? cf. *L. hispida* (Reuss, 1861)

Plate 7, figure 6

Remarks. Among Jurassic species, the tests recovered resemble most closely the figures and description of *Lagena hispida* (Reuss, 1861) of Bartenstein and Brand (1937, p. 167, Pl. 14A, fig. 4a, b,. Pl. 14B, fig. 9) from the Middle Jurassic *parkinsoni*-zone of northwestern Germany. However, generic placement of the specimens recovered is tentative because there are indications that the aperture may have been radiate.

Distribution. Although relatively rare, *Lagena*? cf. *L. hispida* ranges from the basal into the upper sequences of Section 70-8, through the midportion of Section 64-13, and through the upper sequences of Section 68-5.

The species may be more common than is evident from the listed occurrences, for some of the single globular chambers and calcite moulds recorded as *Nodosaria* fragments could be tests of *Lagena*? cf. *L. hispida.*

Figured specimen.

GSC no.	L	D	Section	Footage
	mm			m (ft)
38859	0.538	0.400	70-8	62.8 - 71.0* (216 - 233)

Lagena liasica (Kübler and Zwingli, 1866)

Plate 7, figure 7

1955 *Lagena liasica* (Kübler and Zwingli, 1886) Tappan, p. 82, Pl. 28, fig. 12.

Remarks. The tests recovered appear to be identical with *Lagena liasica* of Tappan from Upper Jurassic strata of northern Alaska.

Distribution. *Lagena liasica* was found at the base, and (questionably) close to the top of Section 70-8, as well as in the middle sequences of Sections 64-13 and 68-11.

The species could be more common than indicated, for some of the single globular chambers, or some of the globular calcite moulds recorded as *Nodosaria* fragments, could be tests of either this species or of *Lagena*? cf. *L. hispida.*

Figured specimen.

GSC no.	L	D	Section	Footage
	mm			m (ft)
38860	0.713	0.475	68-11	68.6 - 71.6† (225 - 235)

Genus *Pseudonodosaria* Boomgart, 1949

Pseudonodosaria humilis (Roemer, 1841)

Plate 7, figures 8, 9

1936 *Glandulina pygmaea* Terquem, 1858, Franke, p. 55, Pl. 5, fig. 10a - c.
1937 *Pseudoglandulina humilis* (Roemer, 1841), Bartenstein and Brand, p. 150, Pl. 8, fig. 18.
1951 *Pseudoglandulina humilis* (Roemer, 1841), Bartenstein and Brand, p. 315, Pl. 10, figs. 268, 269, not figs. 266, 267, 270, 271.
1955 *Rectoglandulina brandi* Tappan, p. 74, Pl. 26, fig. 12.
1960 *Rectoglandulina humilis* (Roemer, 1841), Lutze, p. 481, Pl. 29, figs. 8, 9.
1963 *Rectoglandulina brandi* Tappan, 1955, Espitalie and Sigal, p. 63, Pl. 30, figs. 7, 8.
1964 *Nodosaria mecista* Loeblich and Tappan, 1950, Weihmann, p. 597, Pl. 1, fig. 18, not fig. 17.
1972 *Pseudonodosaria brandi* (Tappan, 1955) Dain, p. 111, Pl. 34, figs. 1 - 4, 6.

Remarks. The Canadian specimens do not seem to differ in any major feature from those species listed in synonymy, other than for their apertures, which appear to be somewhat more extended. The maximum number of chambers observed did not exceed five, whereas figures 266, 267 and 270 of Bartenstein and Brand (1951, Pl. 10) display up to nine chambers, nor were there any tests recovered similar to their figure 271. Lutze (1960, p. 481) included *Pseudoglandulina tutowskii* Myatliuk (1939, p. 65, Pl. 4, figs. 57, 58) in synonymy for *Pseudonodosaria humilis*, but the chambers of *P. tutowskii* are more numerous, and Myatliuk's figure 57 in particular differs markedly in shape from the Canadian specimens.

Distribution. Although rare, *Pseudonodosaria humilis* has been recognized in three of the four sections studied. It was found in the basal sequences of Section 70-8; it was questionably identified in the lower part, with one specimen recovered close to the top of Section 64-13; and it ranges through the upper half of Section 68-11.

Figured specimens.

GSC no.	L (mm)	T (mm)	Section	Footage m (ft)
38861	0.800	0.363	68-11	68.6 - 71.6† (225 - 235)
38862	0.638	0.250	64-13	100† (328)

Pseudonodosaria? sp. 189

Plate 7, figure 10

Description. Uniserial test is more or less compressed, elongate-ovate in outline, subovate to rounded in cross-section. Test consists of a large, rounded, apiculate proloculus and subpyriform terminal chamber. Suture strongly constricted. Wall calcareous, smooth. Aperture terminal, slightly off-centre, extended, radiate.

Remarks. The best preserved specimens recovered consist of only two chambers, but fragments consisting of two or more chambers, as well as single chambers occurring in the same samples with *P.?* sp. 189, suggest that it may be a multichambered form. The flattening of the tests could be either a function of compression or could be of genetic origin.

Rectoglandulina cf. *R. mutabilis* (Reuss), 1863 of Bartenstein et al. (1966, p. 154, Pl. 3, figs. 248, 249; not 1957) from the Lower Cretaceous of Trinidad is comparable in its general shape and outline, peculiar flattening, and deeply constricted terminal suture. However, the material recovered was insufficient and too poorly preserved to permit more than a tentative generic identification.

Distribution. The few specimens recovered were found at the base of Section 64-13 and in the upper half of Section 68-11. The species was recognized only tentatively at the base of Section 68-11 as well as near the top of Section 68-5.

Figured specimen.

GSC no.	L (mm)	W (mm)	T (mm)	Section	Footage m (ft)
38863	0.675	0.388	0.338	68-11	107.6 - 110.3† (353 - 362)

Subfamily Lenticulininae Sigal, 1952

Genus *Lenticulina* Lamarck, 1804

Lenticulina cf. *L. biexcavata* (Myatliuk, 1939)

Plate 7, figures 11 - 16

Remarks. The specimens recovered differ from *Lenticulina biexcavata* (Myatliuk) 1939 (p. 72, Pl. 4, figs. 41a, b, 42), from the Upper Jurassic (Lower Volgian?) of the Middle Volga region, in having no more than eight chambers in the final whorl. Also, judging from figure 41a, *L. biexcavata* appears to have markedly angled shoulders bordering the apertural face, whereas the specimens studied have rounded or, at most, subangular terminal shoulders. Further, although *L. biexcavata* is described as evolute, in Myatliuk's figured specimens only the final whorl is visible, as is the case in the specimens designated as *L.* cf. *L. biexcavata*. The tests recovered are only slightly biumbilicate with acute, not keeled, peripheries and with curved, weakly depressed sutures and a radiate aperture.

A resemblance is evident as well between the tests studied and the figured *Lenticulina (Lenticulina)* aff. *L. audax* Loeblich and Tappan, 1950 of Ziegler (1959, p. 102, Pl. 5, fig. 10) from the Lower Callovian and Upper Bathonian of Bavaria (West Germany); however, lacking a description, a detailed comparison with this form could not be made. The specimens recovered differ strongly from *L. audax* Loeblich and Tappan in that the latter has more numerous chambers, is inclined to be biumbonate, has flush sutures, is keeled, and has a differently shaped terminal chamber.

Distribution. *Lenticulina* cf. *L. biexcavata* occurs rather rarely and sporadically. It was found at the base of Section 70-8 and was identified tentatively at the top of the section. It occurs sporadically throughout the lower two thirds of Section 68-11, and one specimen only was found in the middle part of Section 64-13.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38864	0.500 - 0.725	0.388	68-5	60.3 - 68.0† (198 - 223)
38865	0.275 - 0.363	0.188	68-11	116.1 - 118.6† (381-389)

Figured specimens (cont.)

38866	0.250 - 0.338	0.188	64-13	40.2 - 44.8† (132 - 147)
38867	0.200 - 0.300	0.175	68-11	39.3 - 40.6† (129 - 133)

Lenticulina cf. *L. wisniowskii* (Myatliuk, 1939)

Plate 7, figures 17 - 22

Remarks. The specimens recovered appear, in part, to be closely related to *Lenticulina wisniowskii* of Tappan (1955, p. 54, Pl. 16, fig. 2, not figs. 1, 3) from Upper Jurassic strata of northern Alaska. They differ from Tappan's figured specimens 1 and 3 in that the coiling is not asymmetrical and the sutures, although thickened, are indistinct and flush. The Canadian specimens differ from the types (Myatliuk 1939, p. 73, Pl. 4, fig. 43a, b), from the Kimmeridgian of the Middle Volga region and Obschiy Syrt, in that the coiling is unmistakably involute, there is no withdrawal of the final chambers from the umbilical region, nor is there an umbilical boss on all specimens. There also is some resemblance to the Early Cretaceous *Lenticulina subangulata* (Reuss), 1863 (p. 74, Pl. 8, fig. 7a, b), but the type of aperture in this species is obscure and, in addition, the sutures of *L. subangulata* are nearly straight rather than curved as are the sutures in the tests recovered. Insofar as can be judged from figures alone, *Lenticulina splendita* Beljaevskaja, 1972 (in Dain, 1972, Pl. 36, fig. 2), from the Kimmeridgian of western Siberia, resembles the specimens recovered in the number and shape of chambers visible, as well as in the angled terminal shoulders and somewhat recessed terminal face, but the terminal shoulders of the Canadian specimens curve inward toward the umbilicus, those of *L. splendita* remain straight. In addition, it is not possible to determine from the figures alone whether the sutures of the Russian specimens are flush or depressed. The specimen figured by Weihmann (1964, Pl. 1, fig. 21) as *Lenticulina audax* Loeblich and Tappan, 1950 from the lower Passage Beds (Oxfordian-Kimmeridgian) of southeastern British Columbia appears to be identical with the tests here assigned to *L.* cf. *L. wisniowskii*. *Lenticulina audax* Loeblich and Tappan, 1950b (p. 43, Pl. 11, figs. 18 - 21) differs from the tests studied in having more numerous and smaller chambers in the final whorl, by the later chambers withdrawing from the umbilicus, by the terminal shoulders being less angular, and in having an umbilical boss.

Distribution. Although relatively rare and sporadic in occurrence, *Lenticulina* cf. *L. wisniowskii* is one of the most widespread of the calcareous species recovered, being present in all four sections. It was recognized only tentatively in the basal part, but ranged through the middle and upper sequences of Section 68-11 as well as through the middle into the upper sequences of Sections 64-13 and 70-8, but was found in the upper sequences only of Section 68-5.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
38868	0.500 - 0.625	0.313	68-11	116.1 - 118.6† (381 - 389)
38869	0.350 - 0.475	0.250	68-11	80.8 - 83.9† (265 - 275)
38870	0.350 - 0.438	0.213	70-8	60.3 - 63.8* (198 - 216)

Genus *Astocolus* de Montfort, 1808

Astocolus sp. 178

Plate 7, figures 23 - 29

Description. Test moderately compressed, planispiral, elongate subovate in outline; ventral face convex, ventral shoulders rounded, dorsal periphery acute. Up to nine radially arranged, triangular chambers visible; later chambers increase rapidly in breadth, but height remains nearly constant. Sutures indistinct, may be slightly raised in coil or flush throughout, but appear somewhat limbate in transmitted light. Wall calcareous, smooth. Aperture at dorsal angle, slightly extended, round, radiate.

Remarks. The specimens recovered compare closely with *Lenticulina (Lenticulina) subangulata* (Reuss, 1863) of Bartenstein and Brand (1951, p. 283, Pl. 5, fig. 111a, b) from the Lower Cretaceous Valendis of northwestern Germany. They are alike in overall shape and outline, shape and arrangement of chambers, and type and curvature of sutures, but *L. (L.) subangulata* differs with respect to the aperture and appears to be more prominently umbonate. *Cristellaria subangulata* Reuss, 1863 (p. 74, Pl. 8, fig. 7a, b) differs in outline and shape, in the straight thin sutures, angular ventral shoulders, and small, rounded, flush aperture. *Cristellaria pulchella* Reuss, 1863 (p. 71, Pl. 8, fig. 1a, b) compares closely in overall shape, but the sutures are not thickened, there appears to be a deeply excavated umbilical area, and there is a greater number of chambers. The form group referred to *Cristellaria (Lenticulina) varians* Bornemann, 1854 by Franke (1936, p. 112, Pl. 11, figs. 9 - 12, not fig. 13) again compares in shape, but the sutures are thin, becoming depressed in later stages, and the periphery appears to be keeled.

Distribution. The species occurs rarely in the upper sequences of Sections 64-13 and 68-5, and sporadically through the upper half of Section 68-11.

Figured specimens.

GSC no.	L (mm)	W (mm)	T (mm)	Section	Footage m (ft)
38871	0.563	0.413	0.250	68-11	68.6 - 71.6† (225 - 235)
38872	0.500	0.363	0.188	68-5	60.3 - 68.3† (198 - 224)
38873	0.413	0.263	0.175	68-11	116.1 - 118.6† (381 - 389)

Astacolus sp. 188

Plate 7, figures 30 - 33

Description. Test moderately compressed, elongate-auriculate in outline; ventral peripheries rounded, terminal face convex, dorsal periphery acute. Early part consisting of an incomplete coil of up to five chambers, followed by an uncoiled section of up to three chambers. Chambers in uniserial part slightly inflated, broad and low with greatest height dorsal, tilting down toward coil along ventral side. Sutures not thickened, indistinct, flush in coil, gently depressed, oblique and curved in uniserial portion. Wall calcareous, smooth. Aperture damaged, at dorsal angle.

Remarks. Chamney (in Stott, 1967, p. 26 - 28) reported the presence of *Astacolus* cf. *A. dubius* (Franke) from the same section (64-13) in which these specimens were found.

Astacolus (A.) dubius (Franke), 1936 (p. 107, Pl. 10, fig. 17) appears somewhat similar to *Astacolus* sp. 188, but differs in having more chambers (11 - 12), a better developed coil of one and one-half whorls, a narrower uniserial section, and is keeled or carinate. *Planularia beierana* (Gümbel), figured by Kosyreva and Dain (1972, Pl. 37, fig. 5), appears comparable in overall shape and in the number and arrangement of chambers, and differs only in that the sutures appear to be limbate. However, the tests recovered differ markedly from both the description and figures of *Marginulina beierana* Gümbel (1862, p. 221, Pl. 3, fig. 20a, b).

Distribution. The few tests recovered were found in the upper half of Section 64-13.

Figured specimens.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38874	0.525+	0.363+	0.255+	64-13	40.2 - 44.8† (132 - 147)
38875	0.438+	0.300	0.188	64-13	78.0 - 91.1† (256 - 301)

Astacolus sp. 224

Plate 7, figure 34

Description. Test compressed, auriculate; peripheries subangular. Test consists of small coil of up to four, possibly five, indistinct chambers, followed by a uniserial portion of five or six oblique, broad, low chambers. Early sutures indistinct, flush, later sutures somewhat depressed, oblique, curved. Wall calcareous, smooth. Aperture destroyed.

Remarks. The one specimen recovered differs from those assigned in this study to *Planularia* cf. *P. fraasi* (Schwager), 1865 in having a better developed coil and in being less strongly compressed.

Figured specimen.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38876	0.463	0.238	0.138	64-13	61.6 - 67.1† (202 - 220)

Genus *Marginulina* d'Orbigny, 1826

Marginulina cf. *M. pinguicula* Tappan, 1955

Plate 7, figures 35 - 37

Remarks. The single specimen recovered is proportionately more slender and has a more tapered, less globular and less highly inflated terminal chamber than Tappan's (1955, p. 61, Pl. 18, fig. 4a, b) specimen from Upper Jurassic strata of northern Alaska. In addition, the early sutures are indistinct and flush, rather than distinct and depressed, so that the number of chambers in the incomplete coil is obscure. Under water in transmitted light, there appear to be only two chambers in the coil.

Figured specimen.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38877	0.338	0.225	0.213	68-11	39.3 - 40.6† (129 - 133)

Marginulina cf. *M. pletha* Tappan, 1955

Plate 7, figures 38 - 40

Remarks. Other than that the periphery of the weakly developed coiled portion appears to be somewhat more angular and that the sutures are indistinct and flush rather than distinct and slightly depressed, this one specimen appears to be comparable to *Marginulina pletha* Tappan, 1955 (p. 60, Pl. 18, figs. 10, 11a, b) from Lower Jurassic (Upper Pliensbachian) strata of northern Alaska.

Figured specimen.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38878	0.463	0.275	0.225	68-11	93.0 - 96.0† (305 - 315)

Marginulina sp. 156

Plate 7, figures 41, 42

Description. Test robust, elongate, curvate; periphery rounded. Test apparently consists of a large round proloculus, followed by a ventrally inflated, tapered, terminal chamber that is higher than wide. Suture indistinct, weakly depressed, nearly straight. Wall calcareous, smooth. Aperture at dorsal angle, extended, round, radiate.

Remarks. The one specimen found somewhat resembles *Marginulina thuringica* (Franke, 1936) of Tappan (1955, p. 63, Pl. 21, figs. 12 - 22) from Lower Jurassic strata of northern Alaska. It differs, however, in the shape of the terminal chamber, in the large round proloculus and in that it has only two chambers.

Figured specimen.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
38879	0.525	0.288	0.275	70-8	65.8 - 71.0* (216 - 233)

Marginulina sp. 179

Plate 7, figures 43, 44

Description. Test elongate, uniserial, somewhat tapered and curved; cylindrical in cross-section. Test consists of relatively large, rounded proloculus and three uniserial chambers. Early chambers low, much broader than high, final chamber moderately inflated, height markedly greater than breadth. Sutures indistinct, horizontal, straight, flush initially, later weakly depressed. Wall calcareous, no ornamentation. Aperture damaged, situated at dorsal angle, extended, round, possibly radiate.

Remarks. *Marginulina thuringica* (Franke, 1936, p. 103, Pl. 10, fig. 7a, b), and *M. thuringica* (Franke) of Tappan (1955, p. 63, Pl. 21, figs. 12 -22) display a morphological range within which this one specimen could fall. In general shape, *Marginulina* sp. 179 particularly resembles Tappan's figures 13 and 21, differing from them mainly in that it has fewer chambers. It also could be compared favourably with figure 3 of *Marginulina utricula* Terquem and Berthelin, 1875 of Tappan (1955, p. 63, Pl. 21), but *M. utricula* is distinguished by its prolocular spine or spines, of which there is no remaining evidence on the studied test.

Marginulina thuringica and *M. utricula* both were reported by Tappan (1955) from Lower Jurassic strata of northern Alaska. Franke described *M. thuringica* from the middle Lias of Germany.

Figured specimen.

GSC no.	L	W	T	Section	Footage
	mm				m (ft)
42296	0.550	0.238	0.213	70-8	225.5 - 231.6* (740 - 760)

Genus *Marginulinopsis* Silvestri, 1904

Marginulinopsis cf. *M. subrusticus* Dain, 1972

Plate 7, figures 45, 46

Remarks. The few tests recovered are elongate and curvate in outline; the dorsal periphery is acute and the ventral peripheries are rounded. The tests consist of a comparatively well developed, weakly keeled coil of five triangular chambers, followed by an uncoiled portion of two chambers that is subovate to subtriangular in cross-section. The uncoiled chambers are swollen ventrally, broader than high with greatest height dorsal and are compressed dorsally. The ventral face of the terminal chamber is strongly convex. Sutures in the coil are indistinct, flush, curved and slightly thickened, but distinct, depressed and curved in the uncoiled portion. The calcareous wall is semitransparent and smooth. The aperture in all specimens had been damaged but was located at the dorsal angle.

This species differs from *Marginulinopsis subrusticus* Dain (1972, p. 133, Pl. 37, fig. 10) from Kimmeridgian into Middle Volgian strata of western Siberia, mainly in that there is no umbilical depression of the coil, the coil sutures are indistinct and flush, and the coil periphery is acute. The proloculus has not been observed.

In the overall outline of the test, in the curvature of the sutures, and in the keeled coil, there is some resemblance also to *Saracenaria topagorukensis* Tappan, 1955 (p. 65, Pl. 26, fig. 26) from the Upper Jurassic of northern Alaska, but *Marginulinopsis* cf. *M. subrusticus* lacks ridgelike elevations subjacent to the sutures, and the uncoiled portion is more nearly ovate than triangular in cross-section.

Distribution. The few specimens recovered were found in the midportions of Sections 64-13 and 68-11. The species was identified only tentatively in the upper sequence of Section 68-5.

Figured specimen.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
42297	0.500	0.263	0.313	0.263	68-11	86.9 - 89.9† (285 - 295)

Marginulinopsis sp. 212

Plate 7, figures 47, 48

Description. Test elongate, tapered, consisting of a somewhat compressed coil of about four indistinct chambers, followed by a uniserial section of two chambers; coil and rectilinear portion nearly equal in diameter; coil periphery angular, periphery of uniserial portion rounded. Initial uniserial chamber strongly inflated, breadth greater than height; terminal chamber attenuated, tapered, less inflated. Coil sutures flush, indistinct, sutures of uniserial portion constricted, horizontal. Wall calcareous, smooth. Aperture destroyed.

Remarks. *Marginulina matutina* (d'Orbigny) of Dain (1934, Pl. 3, fig. 22a, b) from the Lower Volgian Stage (Temir region), displays the same rather loose coil and inflated initial uniserial chamber as the specimen recovered, but it has a less attenuated terminal chamber.

Distribution. This test was found in the top sequence of Section 64-13.

Figured specimen.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
42298	0.525	0.250	0.263	0.212	64-13	75.5 - 78.0† (238 - 256)

Marginulinopsis sp. 229

Plate 7, figure 49

Description. Test elongate, straight, consisting of a somewhat compressed coil of three or four triangular chambers followed by a rectilinear, parallel-sided section of three chambers; coil diameter greater than diameter of uniserial portion; coil periphery subangular, periphery of uniserial section rounded. Width of initial uniserial chamber greater than height, width of tapered terminal chamber less than height. Sutures in coil flush and radiate, sutures in uniserial portion depressed, horizontal and sinuous. Wall calcareous, smooth. Aperture destroyed, at dorsal angle.

Remarks. The tests recovered were too poorly preserved to permit comparison beyond the generic level.

Distribution. One specimen was found in the upper part of Section 68-5, and two more (both questionable) were recovered, one from the upper part of Section 68-5 and the other from the top of Section 70-8.

Figured specimen.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
42299	0.588	0.263	0.238+	0.250	68-5	68.3 - 72.5† (224 - 238)

Genus *Planularia* Defrance, 1826

Planularia cf. *P. fraasi* (Schwager, 1865)

Plate 7, figures 50 - 53

Remarks. The few tests recovered are elongate and strongly compressed with subangular peripheries. They vary in outline from nearly parallel-sided and lanceolate to subtriangular or ovate. Along the ventral margin the eight or nine strongly oblique, broad, low chambers either touch the ovate proloculus, or reach sharply back toward it. The sutures are gently curved dorsally, thickened and flush in the early stages, later becoming somewhat depressed. The radiate aperture is located at the dorsal angle.

These tests can be compared favourably with any one of the following three Oxfordian species: *Planularia protracta* (Bornemann, 1854) of Barnard (1952, p. 343, Fig. Ca - d; not 1953); *Lenticulina (Planularia) lanceolata* (Schwager, 1865) of Seibold and Seibold (1956, p. 113, 138, Fig. 6p, q), or *Planularia fraasi* (Schwager, 1865) of Gordon (1962, p. 529, Textfig. 2(7); 1965, p. 841, Textfigs. 6-11, 12). The small number of specimens, together with their poor state of preservation, does not permit an unqualified assignment to any one species but, following Gordon (1962, 1965), who considered the first two species to be synonymous with *P. fraasi*, we have assigned the recovered specimens to the latter species.

Distribution. Although rare, this species was found in the upper sequences of Sections 64-13, 68-5 and 68-11.

Figured specimens.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
42300	0.563+	0.288	0.125	68-5	74.7 - 78.3† (245 - 257)
42301	0.425	0.175	0.088	68-11	107.6 - 110.3† (353 - 362)

Genus *Saracenaria* Defrance, 1824

Saracenaria sp. 176

Plate 7, figures 54 - 69

Description. Tests consist of small, compressed, weakly developed coils of four, possibly five chambers, followed by widely flaring uncoiled sections of three, occasionally four, low, abruptly broadening chambers. Uncoiled portion broadly triangular in cross-section; chambers increase more rapidly in height dorsally than ventrally, terminal chamber tilted sharply downward toward coil. Dorsal periphery acute, ventral periphery rounded; terminal face triangular in outline, varying from strongly inflated and convex with broadly rounded shoulders to planar, or plano-convex with narrowly rounded shoulders that, in some tests, may form a bordering ridge along the lateral edges of the recessed terminal face. Sutures indistinct throughout, flush and radial in coil, oblique and gently curved in later portion; final suture sometimes slightly depressed. Aperture radiate, at dorsal angle, may be slightly extended.

Remarks. Two species, differentiated from each other mainly on the basis of the variations in the shape of the terminal face, were at first suspected to be present. However, transitional forms that always were found together with the extreme variants led to the assumption that these varying forms could belong to one species.

The only species that seems somewhat to resemble *Saracenaria* sp. 176, and, in particular, those tests that have markedly swollen terminal faces with broadly rounded shoulders, appears to be the Early Cretaceous *Saracenaria dutroi* Tappan, 1962 (p. 164, Pl. 41, figs. 16, 17a, b, not 15a, b) from northern Alaska. However, the tests recovered differ in their strongly compressed coiled portion and very tiny inconspicuous proloculus.

Chamney (in Stott, 1967, p. 26-28) reported a *Saracenaria* cf. *S. dutroi* Tappan in the upper sequence of Section 64-13.

Distribution. Although rather rare, this species was found in the mid-lower to upper sequences of all four sections.

Figured specimens.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
42302	0.275	0.200	0.200	68-11	71.6 - 74.7† (235 - 245)
42303	0.363	0.325	0.225	68-11	86.9 - 89.9† (285 - 295)
42304	0.438	0.188	0.188	68-11	107.6 - 110.3† (353 - 362)
42305	0.450	0.263	0.250	68-11	68.6 - 71.6† (225 - 235)
42306	0.425	0.238	0.213	68-11	99.4 - 102.4† (326 - 336)
42307	0.300	0.225	0.200	68-5	60.3 - 68.0† (198 - 223)
42308	0.525	0.375	0.325	68-11	68.6 - 71.6† (225 - 235)

Genus *Vaginulina* d'Orbigny, 1826

Vaginulina sp. 165

Plate 8, figures 1, 2

Description. Test elongate, curvilinear, compressed; dorsal periphery angular, ventral periphery rounded. Test consists of a tiny incomplete coil of about three chambers, followed by a uniserial portion of three, possibly four, progressively enlarging chambers that are wider than high; final chamber somewhat inflated. Sutures indistinct, flush in initial portion, in uniserial portion slightly depressed, oblique and curved. Wall calcareous, smooth. Aperture damaged, at dorsal angle.

Remarks. Only one rather featureless specimen was recovered, so that comparison beyond the generic level was not attempted.

Figured specimen.

GSC no.	L	W	T	Section	Footage
		mm			m (ft)
42309	0.413	0.175	0.125	70-8	48.8 - 54.9* (160 - 180)

Genus *Vaginulinopsis* Silvestri, 1904

Vaginulinopsis sp. 197

Plate 8, figure 3

Description. Test consists of moderately well developed coil followed by a curvilinear, compressed, uniserial part. Test subovate in cross-section; coil periphery subangular, peripheries of uniserial section rounded, ventral face truncated. Coil consists of five or six progressively enlarging chambers; followed by five chambers in uniserial portion, initial chambers equisize and broader than high, terminal chamber weakly inflated with height and breadth nearly equal. Sutures indistinct, flush, radiate in coil, nearly horizontal in uniserial portion; final suture weakly depressed or constricted. Wall calcareous, smooth. Aperture radiate, at dorsal peripheral angle.

Remarks. *Marginulina vetusta* (d'Orbigny) of Bielecka and Pozaryski (1954, p. 181, Pl. 7, fig. 33a, b) from the Kimmeridgian and Bononian of central Poland appears to be the most closely comparable form to the one specimen recovered. *Vaginulinopsis* sp. 197, however, differs in that the coil is not as well developed and has fewer chambers, and in that only the final suture is depressed.

This species has been assigned to the genus *Vaginulinopsis* rather than to either *Marginulinopsis* or *Marginulina* because of its comparatively well developed coil in contrast to the weakly developed coil of *Marginulina*, and because of its compressed uniserial portion in contrast to the rounded uniserial section of *Marginulinopsis*.

Figured specimen.

GSC no.	L	D	W	T	Section	Footage
	mm					m (ft)
42310	1.10+	0.313	0.413	0.313	68-11	86.9 - 89.9† (285 - 295)

Family Polymorphinidae d'Orbigny, 1839

Subfamily Polymorphininae d'Orbigny, 1839

Genus *Eoguttulina* Cushman and Ozawa, 1930

Eoguttulina cf. *E. liassica* (Strickland, 1846)

Plate 8, figures 4 - 6

Remarks. The few specimens recovered were internal moulds to which test fragments were still attached. In shape of test, arrangement and shape of chambers, type of sutures and of aperture, these specimens fall within the range of variation displayed by either of the two species: *Eoguttulina liassica* (Strickland) of Tappan (1955, p. 83, Pl. 28, figs. 17 - 19) and of various European authors, or *Eoguttulina oolithica* (Terquem), 1874 as described and figured by Cordey (1962, p. 392, Pl. 48, fig. 36a, c), or by Bartenstein and Brand (1937, p. 179, Pl. 8, fig. 34a, b, Pl. 10, fig. 43a, b, Pl. 11A, fig. 18a - c, Pl. 11B, fig. 24a, b, Pl. 12B, fig. 18, Pl. 15A, fig. 37a, b). Following Ciffeli (1959, p. 333), who placed *E. oolithica* of Bartenstein and Brand in synonymy with *E. liassica*, we assigned the specimens recovered to the latter species.

Chamney (in Stott, 1967, p. 26 - 28) reported an *Eoguttulina* cf. *E. liassica* from Section 64-13 of this report. Tappan's (1955) *E. liassica* comes from Lower Jurassic strata of northern Alaska; in Europe (England, Scotland, central Poland, France-Alsace, Germany, Switzerland) the species has been recognized in strata ranging in age from Early Lias into Late Malm. *Eoguttulina oolithica* was recognized by Cordey in the Oxfordian of Scotland, and by Bartenstein and Brand (1937) in the Dogger of northwestern Germany.

Distribution. This relatively rare species occurs sporadically throughout the lower half of Section 64-13. It was recognized in only one sample from the middle part of Section 68-11.

Figured specimen.

GSC no.	L	W	T	Section	Footage
	mm				m (ft)
42311	0.475	0.200	0.188	68-11	77.7 - 80.8† (255 - 265)

Genus *Globulina* d'Orbigny, 1839

Globulina cf. *G. alexandrae* Dain, 1972

Plate 8, figures 7 - 18

Remarks. The tests recovered are ovate to asymmetrically globular in shape and commonly consist of three, or four, rapidly enlarging, greatly inflated chambers, which are added in spiral series. Each succeeding chamber overlaps the earlier chambers so that only the final two chambers are readily visible. The sutures are inconspicuous and flush or slightly depressed. Test walls are calcareous, smooth and semitransparent in some specimens with the aperture of the penultimate chamber faintly visible through the wall of the final chamber. The aperture is terminal, slightly extended and radiate.

These Canadian specimens differ from *Globulina alexandrae* Dain (1972, p. 148, Pl. 44, figs. 7, 8) from the Upper Kimmeridgian of western Siberia in that none were recovered that have more than four chambers (such as the seven-chambered, microspheric form described by Dain), and there is a greater range in size. There is also a resemblance to *Globulina topagorukensis* Tappan, 1955 (p. 84, Pl. 28, fig. 22), from Upper Jurassic strata of northern Alaska, but Tappan's species has a maximum of only three chambers and is much smaller in size.

Chamney (in Stott, 1967, p. 26 - 28) reported *Globulina topagorukensis* and *Globulina* cf. *G. topagorukensis* from the lower midsequence of Section 64-13.

Distribution. Although rather rare, the species occurs in Sections 64-13, 68-5 and 68-11, where it was recovered from the upper two thirds of Section 64-13, the upper one half of Section 68-11, and the upper one third of Section 68-5.

Figured specimens.

GSC no.	L	W	Section	Footage
	mm			m (ft)
42312	0.363	0.263 - 0.288	64-13	36.6 - 40.2† (120 - 132)
42313	0.413	0.275 - 0.300	68-11	104.9 - 107.6† (344 - 353)
42314	0.425	0.263 - 0.313	68-11	110.3 - 113.1† (362 - 371)
42315	0.438	0.313 - 0.325	68-11	99.4 - 102.4† (326 - 336)
42316	0.563	0.363 - 0.388	68-11	104.9 - 107.6† (344 - 353)
42317	0.625	0.363 - 0.400	68-11	77.7 - 80.8† (255 - 265)
42318	0.625	0.438 - 0.463	68-11	110.3 - 113.1† (362 - 371)

Superfamily Globigerinacea
Carpenter, Parker and Jones, 1862

Genus indeterminate sp. 216

Plate 8, figure 19

Description. Test trochospiral, low spired, of two and one-half whorls; deeply umbilicate on umbilical side.

Periphery broadly rounded, lobate. Chambers globular, six chambers in ultimate and penultimate whorls. Sutures constricted, radial. Wall calcareous, punctate. Aperture destroyed.

Remarks. Dependent upon the position of the aperture, these specimens could belong either to the genus *Hedbergella* Bronnimann and Brown, 1958 (family Rotaliporidae Sigal, 1958), or to the genus *Globigerina* d'Orbigny, 1826 (family Globigerinidae Carpenter, Parker and Jones, 1862).

These tests could be contaminants, for globigerinids commonly are not known from the Jurassic of the western and northwestern Canadian Interior Plains.

Distribution. The few tests recovered were found in one sample from the basal sequence of Section 64-13.

Figured specimen.

GSC no.	D (mm)	Section	Footage m (ft)
42319	0.288 - 0.363	64-13	23.8 - 24.7† (78 - 81)

Family indeterminate

Genus indeterminate sp. 231

Plate 8, figure 20

Remarks. The one fragmented specimen recovered consists of a series of calcareous uniserial chambers reminiscent of a nodosariid.

Figured specimen.

GSC no.	L (mm)	T (mm)	Section	Footage
42320	1.40	0.50	68-11	33.2 - 34.4† (109 - 113)

Genus indeterminate sp. 202

Plate 8, figures 21 - 23

Remarks. Calcareous, apiculate, uniserial fragments, probably from some form of nodosariid.

Distribution. Apiculate fragments such as these were recovered from the top sequences of Sections 64-13 and 68-5, and in the middle part of Section 68-11.

Figured specimens.

GSC no.	L (mm)	T (mm)	Section	Footage m (ft)
42321	0.475	0.238	64-13	100.0† (328)
42322	0.738	0.325	68-5	74.7 - 78.3† (245 - 257)
42323	0.563	0.300	68-11	68.6 - 71.6† (225 - 235)

Genus indeterminate sp. 209

Plate 8, figures 24 - 26

Remarks. The single inflated chambers are reminiscent of *Marginulina polenovae* Dain (1972, Pl. 34, fig. 12) from the Upper Kimmeridgian of western Siberia. They appear to be inflated terminal chambers to which fragments of the immediately preceding chambers, with their apertures still visible, are attached.

Distribution. These fragments were recovered from a single sample near the middle of Section 68-11.

Figured specimens.

GSC no.	L (mm)	T (mm)	Section	Footage m (ft)
42324	0.513	0.300	68-11	107.6 - 110.3† (353 - 362)
42325	0.488	0.263	68-11	107.6 - 110.3† (353 - 362)

Genus indeterminate sp. 186

Plate 8, figure 27

Remarks. The one specimen recovered is a calcitic steinkern with the coil almost completely destroyed. It would appear to be some form of *Saracenaria.*

Figured specimen.

GSC no.	L (mm)	W (mm)	T (mm)	Section	Footage m (ft)
42326	0.500+	0.263	0.250	68-5	74.7 - 78.3† (245 - 257)

Genus indeterminate sp. 225

Plate 8, figures 28, 29

Remarks. This one poorly preserved specimen is probably some form of trochoid rotaliid.

Figured specimen.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
42327	0.375 - 0.425	0.213	64-13	61.5 - 67.0† (202 - 220)

Genus indeterminate sp. 215

Plate 8, figures 30 - 33

Remarks. Only steinkerns of this species were found. They are trochoid with two and one-half, possibly three, whorls on the spiral side, but only the final whorl, of up to four rapidly enlarging chambers, is visible on the umbilicate side. On the spiral side there are up to four rapidly enlarging chambers distinguishable in the final whorl, and about five in the penultimate whorl. The aperture appears to have been in the form of loop-shaped openings at the base of each chamber on the umbilical side, rather like the apertural arrangement seen in *Reinholdella.*

Distribution. These relatively few specimens were recovered from the lower sequence of Section 64-13.

Figured specimens.

GSC no.	D (mm)	T (mm)	Section	Footage m (ft)
42328	0.200 - 0.250	0.138	64-13	23.8 - 24.7† (78 - 81)
42329	0.225 - 0.275	0.188	64-13	32.6 - 36.5† (107 - 120)
42330	0.238 - 0.275	0.175	64-13	21.0 - 23.8† (69 - 78)

Genus indeterminate sp. 230

Plate 8, figures 34, 35

Remarks. This one steinkern appears to be that of a polymorphinid species.

Figured specimen.

GSC no.	L (mm)	T (mm)	Section	Footage m (ft)
42331	0.525	0.238 - 0.288	64-13	52.4 - 61.3† (172 - 201)

Ostracoda

Class Crustacea Pennant, 1777

Subclass Ostracoda Latreille, 1806

Order Podocopida Müller, 1894

Suborder Podocopina Sars, 1888

Superfamily Cypridacea Baird, 1845

Family Paracyprididae Sars, 1923

Genus *Paracypris* Sars, 1886

Paracypris sp. 65

Plate 9, figures 1, 2

Description. Carapace in lateral view elongate sublanceolate, in dorsal view narrowly elliptical. Greatest height anteromedian, greatest length below midheight; cardinal angles poorly defined. Dorsal margin strongly convex, ventral margin concave to sinuous; anterior margin broadly rounded, posterior end sharply acuminate posteroventrally.

Carapace moderately biconvex. Left valve slightly larger than right, overlapping the right peripherally.

Valve surfaces smooth.

Central muscle scars a poorly defined, faintly visible cluster in the ventromedian area. Other internal features unknown.

Remarks. Two specimens only were recovered, both internal moulds and from the same sample; fragments of carapace were attached to one. The poor preservation of the specimens does not allow a firm comparison, but in size and outline they resemble *Paracypris projecta* Peterson, 1954 (p. 163, Pl. 17, figs. 14, 15) that occurs in strata of Callovian age throughout the Central Interior Basin of North America.

Figured specimen.

GSC no.	L (mm)	H (mm)	T (mm)	Section	Footage m (ft)
42332	0.625	0.275	0.150	68-11	77.7 - 80.8† (255 - 265)

Superfamily Cytheracea Baird, 1850

Family Cytherideidae Sars, 1925

Subfamily Neocytherideidinae Puri, 1957

Genus *Camptocythere* Triebel, 1950

Camptocythere? sp. 64

Plate 9, figures 3 - 11

Description. Carapace in lateral view ovate-rhomboidal, in dorsal view broadly ovate. Greatest height anterior, greatest length at midheight; cardinal angles poorly defined. Dorsal margin of left valve straight, margin somewhat convex in right valve and projecting above left; ventral outline convex, ventrum hidden by ventrolateral overhang; anterior margin broadly rounded, posterior less broadly rounded; narrow anterior and posterior marginal rims.

Carapace markedly swollen posteroventrally with the left valve larger than the right and overlapping the right along free margins, but right valve extending above left along dorsal margin.

Lateral surfaces coarsely reticulate; reticulations form a semiconcentric pattern around a weak median node that is separated from the posterior lateral surface by a more or less distinct furrow or sulcus. Superimposed over the reticulations are weakly developed longitudinal ridges that extend around the free margins of the valves. These ridges are developed most strongly along the ventrum but fade out dorsally so that ornamentation in the dorsal region is weakly developed or absent.

Internal features unknown.

Remarks. As the internal features of the valves could not be observed, the generic assignment therefore is tentative.

Based on external morphology, the carapaces recovered compare well with *Camptocythere pusilla* Triebel, 1950 (p. 206, Pl. 3, figs. 31 - 34) from the Dogger of northern Germany. *Camptocythere*? sp. 64 differs, however, in that the median node is less strongly developed and is bordered by a sulcus on the posterior side only, as compared with the sulci bordering the median node of *C. pusilla*. In addition, the surface ornamentation of the Canadian specimens is reticulate rather than coarsely pitted. Chamney (in Stott, 1967, p. 26 - 28) reported an *Aparchitocythere loeblichorum* from Section 64-13 and from the same interval in which several of the specimens here assigned to *Camptocythere*? sp. 64 were found. There is a resemblance to *A. loeblichorum* (Swain and Peterson, 1951), but this species lacks the median node with bordering sulcus and, in addition, the lateral surfaces are finely pitted rather than reticulate.

Distribution. Although rare, this species was the most widespread of the ostracodes recovered in this study. It was found in the upper sequences of Sections 64-13, 68-11, and at the base of the upper sequences in Section 68-5.

Figured specimens.

GSC no.	L	H (mm)	T	Section	Footage m (ft)
42333	0.775	0.488	0.488	68-11	118.6 - 121.9† (389 - 400)
42334	0.813	0.488	0.525	68-11	118.6 - 121.9† (389 - 400)
42335	0.338	0.250	0.200	68-11	118.6 - 121.9† (389 - 400)

Family indeterminate

Genus indeterminate sp. 62

Plate 9, figures 12 - 15

Description. Carapace in lateral view elongate, subquadrate, in dorsal view narrowly elliptical. Greatest height anterior, greatest length below midheight; anterior cardinal angle clearly defined, posterior cardinal angle poorly defined. Anterior two thirds of dorsal margin straight to slightly concave, posterior one third curving toward ventrum; ventral margin weakly concave, hidden by convex ventrolateral overhang; anterior margin broadly rounded, posterior end acuminate and extended below midheight.

Valves equisize, posteroventrally alate.

Lateral surfaces appear to be faintly and irregularly reticulate.

Internal features unknown.

Remarks. The general external characteristics of the one specimen recovered (smallness, acuminate posterior, posterior ventrolateral expansion, lateral outline) are suggestive of some genus of the Cytheruridae, but without knowledge of the internal structures, comparisons are purely speculative. In general shape this carapace is rather similar to *Paracytheridea polyornata* Peterson, 1954 (p. 169, Pl. 18, figs. 20, 21), but little evidence remains of any surface ornamentation that could be comparable to the polygonal reticulation and fine nodes of *P. polyornata*.

Figured specimen.

GSC no.	L	H (mm)	T	Section	Footage m (ft)
42336	0.388	0.188	0.175	68-5	79.2 - 80.2† (260 - 263)

Genus indeterminate sp. 63

Plate 9, figures 16 - 20

Description. Carapace in lateral view subquadrate, in dorsal outline ovate. Greatest height anterior, greatest length midheight, cardinal angles subacute. Dorsal margin nearly straight, ventral margin straight; anterior end broadly rounded, bearing narrow marginal rim, posterior end more narrowly rounded.

Carapaces somewhat swollen lateroventrally. Valves appear equisize, with a slightly to moderately well developed median node bordered by a more or less distinct posterior furrow. Weak anterodorsal vertical ridge or node flanked by a posterior sulcus.

Surface somewhat roughened, original ornamentation largely obliterated, but traces of a ridged or reticulate pattern remaining.

Internal features unknown.

Remarks. In general shape and outline these specimens resemble *Dolocythere* Mertens, 1956, but *Dolocythere* lacks a posteromedian sulcus and anterodorsal node or ridge. These two features are present in *Amphicythere semisulcata* Triebel, 1954, but this latter genus is less alike in general shape.

Distribution. This species was found in the mid-lower sequence of Section 64-13 and in one sample from the middle part of Section 68-11.

Figured specimens.

GSC no.	L	H (mm)	T	Section	Footage m (ft)
42337	0.538	0.350	0.263	64-13	28.6 - 32.6† (94 - 107)
42338	0.550	0.375	0.288	68-11	89.9 - 93.0† (295 - 305)

Genus indeterminate sp. 66

Plate 9, figures 21 - 24

Description. Carapace in lateral view subovate to subtriangular, in dorsal outline elliptical. Greatest height anteromedian, greatest length below midheight; cardinal angles poorly defined. Dorsal margin convex, ventral margin straight to slightly convex; anterior end broadly rounded, posterior end more narrowly rounded.

Carapace slightly biconvex; left valve extending slightly beyond right along free margins, but right valve overlaps left dorsally.

Valve surfaces smooth.

Internal features unknown.

Remarks. These carapaces appear as though they might have been compressed with resultant valve slippage so that the present overlap may not be the normal relationship. This possibility, together with the unknown internal features, precluded identification or comparison.

Distribution. This species was found in the midsequence of Section 68-11 but was identified only questionably near the top of Section 68-5.

Figured specimen.

GSC no.	L	H (mm)	T	Section	Footage m (ft)
42339	0.525	0.313	0.250	68-11	89.9 - 93.0† (295 - 305)

Genus indeterminate sp. 67

Plate 9, figures 25 - 29

Description. Carapace in lateral view subrectangular, in dorsal outline subovate. Greatest height anterior, greatest length below midheight; cardinal angles poorly defined. Dorsal margin straight, sloping distinctly toward posterior, ventral margin straight, partially hidden by ventrolateral overhang; anterior margin broadly rounded, posterior narrowly rounded and strongly compressed.

No overlap of valves along free margins, but right valve extends slightly above left dorsally. Vaguely defined, shallow dorsomedian depression present. Distinct ventral overhang, sharply angled between ventral and lateral surfaces and having a ridgelike border extending strongly upward across two thirds of the posterior lateral surface.

Valve surfaces smooth to faintly reticulate in the better preserved specimen.

Internal features unknown.

Remarks. These carapaces appear somewhat similar to *Monoceratina sundancensis* Swain and Peterson, 1951 (p. 803, Pl. 114, figs. 7 - 15; 1952, p. 11, Pl. 2, figs. 1 - 7), but lack of free valves prevents close comparison or firm identification. The carapaces are thicker, higher, less elongate in proportion to height and have a more strongly developed ventrolateral expansion than *Monoceratina* cf. *M. sundancensis* of Brooke and Braun, 1972 (Pl. 4, figs. 12 - 16).

Swain and Peterson (1951) described *Monoceratina sundancensis* from Upper Jurassic strata of the northwestern interior of the United States. Chamney (in Stott, 1967, p. 26 - 28) reported a *Monoceratina* cf. *M. sundancensis* from the basal part of Section 64-13.

Distribution. This species was found in the upper part of Section 68-11.

Figured specimens.

GSC no.	L	H (mm)	T	Section	Footage m (ft)
42340	0.425	0.225	0.163	68-11	118.6 - 121.9† (389 - 400)
42341	0.438	0.250	0.213	68-11	128.6 - 132.0† (422 - 433)

Genus indeterminate sp. 68

Plate 9, figures 30 - 33

Description. Carapace in lateral view elongate subrectangular, in dorsal outline flattened ovate. Greatest height anterior, greatest length below midheight; cardinal angles well defined. Dorsal margin damaged, but left margin appears to have been more or less straight; ventral outline convex. Anterior end broad, bluntly rounded, posterior end narrow and blunt; narrow anterior and posterior marginal rims.

Valves appear equisize along free margins, but dorsal relationship is unknown. Distinct vertical dorsomedian sulcus; moderate ventrolateral expansion.

Valves abraded, surfaces may have been punctate or pitted.

Internal features unknown.

Remarks. External damage, in addition to the unknown internal features, prevented either effective comparison or even tentative identification of this one specimen.

Figured specimen.

GSC no.	L	H (mm)	T	Section	Footage m (ft)
42342	0.825	0.425	0.438	68-11	89.9 - 93.0† (295 - 305)

Genus indeterminate sp. 69

Plate 9, figures 34 - 37

Description. Carapace in lateral outline elongate subtriangular, in dorsal outline elliptical to ovate. Greatest height anterior, greatest length slightly below midheight; cardinal angles poorly defined. Dorsal margin straight, posteriorly sloping sharply downward toward the ventrum; ventral margin weakly convex; anterior margin broadly rounded, posterior more narrowly rounded.

Valve equisize with weakly developed vertical, dorsomedian depression.

Valve surfaces pitted.

Internal features unknown.

Remarks. Poor preservation, together with lack of free valves prevented identification or close comparison of the one carapace found.

Figured specimen.

GSC no.	L	H (mm)	T	Section	Footage m (ft)
42343	0.688	0.425	0.338	68-11	38.1 - 39.3† (125 - 129)

Genus indeterminate sp. 70

Plate 9, figures 38, 39

Remarks. The posteroventral part of the single carapace that was recovered has been destroyed. However, the distinctive ornamentation of the remainder of the carapace might permit identification of this species if a complete specimen is found.

A meshwork of irregular, short, horizontally oriented ridges, joined by less conspicuous crossbars extends along the lateral sufaces of the valves. Two or three vertical, more strongly developed ridges run parallel to the anterior margin; these ridges coalesce at the anterior cardinal angle into a single ridge, which turns sharply backward along the dorsal margin.

Figured specimen.

GSC no.	L	H (mm)	T	Section	Footage m (ft)
42344	0.575+	0.313+	-	64-13	24.7 - 28.6† (81 - 94)

Genus indeterminate sp. 71

Plate 9, figure 40

Remarks. The one specimen recovered is a damaged pyrite steinkern. The left lateral surface has been crushed and the dorsal margin broken, but the sharply angled posterodorsal outline appears to be a distinctive feature that is not the result of damage to the mould.

In addition to the ventrolateral expansion of the mould that suggests more or less strongly developed alae on the original carapace, the elongate, subrectangular lateral outline, straight ventral margin, blunt, broadly rounded anterior and the strong posterodorsal slope are all reminiscent of some of the Cretaceous *Alatacythere* species (e.g., *Alatacythere robusta langi* Kaye, 1965, Pl. 10, fig. 4).

Figured specimen.

GSC no.	L	H	T	Section	Footage
		mm			m (ft)
42345	0.750	0.288+	0.263	68-13	24.7 - 28.6† (81 - 94)

Genus indeterminate sp. 72

Plate 9, figures 41 - 46

Description. Carapace in lateral view elongate subtriangular, in dorsal outline compressed elliptical. Greatest height anterior, greatest length above midheight; anterior cardinal angle well defined, posterior angle poorly defined. Dorsal margin straight, ventral outline convex, extending towards dorsum posteriorly. Anterior end broadly rounded, posterior narrowly rounded; anterior and posterior margins compressed to form marginal rims.

Valves equisize; angular ridge bordering the inflated lateral surfaces conspicuously developed anteriorly; vertical dorsomedian sulcus extending below midheight; weakly developed anterodorsal sulcus.

Lateral surfaces smooth.

Internal features unknown.

Remarks. In general shape these specimens appear to be comparable with species of the genus *Eucytherura*, but they lack identifiable eye spots and, in addition, the median sulcus and lack of ornamentation are atypical of this genus. They could, judging from shape alone, be a particularly small species of *Monoceratina* but, without knowledge of the hinge, comparisons are speculative only.

Distribution. This species was recognized in Section 64-13, where it was found in the lower part of the sequence.

Figured specimens.

GSC no.	L	H	T	Section	Footage
		mm			m (ft)
42346	0.400	0.188	0.150	64-13	23.8 - 24.7† (78 - 81)
42347	0.388	0.188	0.150	64-13	23.8 - 24.7† (78 - 81)

Genus indeterminate sp. 73

Plate 9, figures 47 - 50

Description. Carapace in lateral view subtriangular, in dorsal outline broadly ovate. Greatest height anterior, greatest length median; cardinal angles well defined. Dorsal margin straight, sloping toward ventrum posteriorly; ventral outline convex, ventrum hidden by ventrolateral overhang. Anterior end broadly rounded, more strongly convex in ventral third than in dorsal portion, posterior end more narrowly and symmetrically rounded. Anterior margin compressed to form narrow, marginal rim.

Valves equisize; left valve slightly overlaps right dorsally. Carapace inflated, both valves bearing distinct posteroventral spines.

Lateral surfaces smooth to weakly punctate.

About 10 straight, simple marginal pores can be seen through the marginal rim. Other internal features unknown.

Remarks. The single specimen recovered is somewhat reminiscent of inflated, smooth-surfaced, brackish-water ostracodes. From among Jurassic species, no comparable form having posteroventral spines on both the right and left valves could be found but, from among Cretaceous species, some specimens of *Paracyprideis* Klie, 1929 are known with posteroventral spines on one or both valves. In outline *Paracyprideis*, however, appears to be more elongate and subtriangular than the recovered specimen.

Figured specimen.

GSC no.	L	H	T	Section	Footage
		mm			m (ft)
42348	0.550	0.375	0.325	64-13	28.6 - 32.6† (94 - 107)

Genus indeterminate sp. 74

Plate 9, figures 51 - 54

Description. Carapace in lateral view narrow, elongate, subtriangular, in dorsal outline elongate, compressed, elliptical. Greatest height in anterior third, greatest length below midheight; anterior cardinal angle better defined than posterior cardinal angle. Dorsal margin nearly straight, converging toward ventrum posteriorly; ventral margin slightly sinuous. Narrow anterior and posterior marginal rims; anterior margin broadly but unevenly rounded, with dorsal two thirds more gently sloping than the sharply curved ventral third; posterior end subacute.

Valves equisize but dorsally right valve extends slightly above left. Weakly developed dorsomedian sulcus; incipient ridge bordering lateral surface along free peripheries.

Lateral surfaces may have been finely punctate.

Internal features unknown.

Remarks. The weakly developed surface features and the small size of the two specimens recovered suggest that both may be molts.

Distribution. One specimen was recovered from the midportion of Section 68-11. A second, smaller carapace, only tentatively assigned to this species, was found near the base of Section 70-8.

Figured specimen.

GSC no.	L	H	T	Section	Footage
		mm			m (ft)
42349	0.488	0.250	0.175	68-11	74.7 - 77.7† (245 - 255)

Genus indeterminate sp. 75

Plate 9, figure 55

Remarks. Poor preservation of the one carapace recovered precludes identification. However, ornamentation of the valve fragments is distinctive so that identification might be possible if better material were found.

Figured specimen.

GSC no.	L	H	T	Section	Footage
		mm			m (ft)
42350	0.463+	0.263+	0.238+	68-11	68.6 - 71.6† (225 - 235)

SUMMARY AND CONCLUSIONS

Two Late Jurassic microfauna are present in the Canadian western interior: one restricted to the Alberta Trough and the other widespread throughout the North American western Interior Plains. Both are boreal in composition but, whereas the western interior microfaunas have elements comparable, at generic level, with those of northwestern Europe, the Foraminifera of the Peace River region (which is situated within the Alberta Trough) display marked similarities even at species level with Foraminifera of certain Arctic regions such as northern Alaska, the Sverdrup Basin of the Canadian Arctic Archipelago, and western and northern Siberia.

The Peace River microfauna is contained within those sequences of the Fernie Formation that succeed the Lower Jurassic Nordegg Member and map unit 2 of Stott (1967). This microfauna has been divided tentatively into three assemblages, numbered I to III from oldest to youngest, but more data are required to establish a firm zonal scheme.

Insofar as has been determined, elements of the Peace River microfauna can be found as far south as the Fernie Basin of southeastern British Columbia (in the Passage Beds), and possibly may be present on the northern flank of the Belt Island Uplift in northwestern Montana; but they do not seem to have reached the Interior Plains.

The age of the Peace River microfauna, as inferred from the ages of comparable or identical foraminiferal faunas, might possibly extend from the latest Callovian, but more probably extends from the Oxfordian through the Kimmeridgian and into the Portlandian. If this age assignment is correct, the microfaunas from the Peace River and central Interior Plains regions could have been contemporaneous at least during the early part of Oxfordian time. It is difficult in such a case to account for the lack of migratory interchanges between the Alberta Trough and the Interior Plains for, during at least the early part if not all of the Oxfordian, the Sweetgrass Arch-Belt Island complex was submergent. Either insurmountable barriers existed of which there is no present-day knowledge or, alternatively, an even later age, Kimmeridgian to Portlandian, must be considered for the microfauna of the Peace River region.

Accepting that either of these assumptions for the age range of the northern Peace River microfauna is correct, a major unconformity involving Middle and early Late Jurassic time must then separate the Early Jurassic Unit 2 of postulated Toarcian age from the overlying Upper Jurassic sequences of the Fernie Formation.

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APPENDIX A

LITHOLOGIC DESCRIPTIONS

Unit	Lithology	Thickness m	(ft)	Height above base m	(ft)
	Section 64-13				
	North of Cypress Creek, latitude 56°51'N, longitude 123°19'W; Halfway River map area, British Columbia. Measured and described by D.F. Stott.				
	FERNIE FORMATION				
	Unit 6				
29	Mudstone: silty, platy: interbedded platy siltstone, 40%; sandier at top with some sandstone	10.9	(36)	223.1	(732)
28	Sandstone: fine grained, laminated; platy to flaggy; some platy siltstone and mudstone	5.5	(18)	212.1	(696)
27	Mudstone: platy; rusty-weathering; some platy siltstone	3.0	(10)	206.3	(678)
26	Sandstone: fine grained, laminated, platy; some mudstone	1.5	(5)	203.3	(668)
25	Mostly covered. Mudstone with interbedded platy siltstone; some sandstone	22.8	(75)	202.1	(663)
24	Sandstone: fine grained, grey, laminated; thick-bedded; grey-weathering	1.2	(4)	179.2	(588)
23	Covered	3.6	(12)	178.0	(584)
22	Sandstone: fine grained; platy to thin-bedded	1.2	(4)	174.3	(572)
21	Covered	12.2	(40)	173.1	(568)
20	Sandstone: fine grained, laminated, platy to thin-bedded; some interbedded mudstone	4.6	(15)	160.9	(528)
19	Partly covered. Mudstone, blocky; becoming siltier at top with some interbedded sandstone and shale. GSC loc. C - 71921 (424)	15.2	(50)	153.3	(513)
18	Sandstone: medium grained, grey to greenish grey, very argillaceous at base; glauconitic. GSC loc. C - 71920 (423)	0.6	(2)	141.1	(463)
	Unit 5				
17	Mostly covered. Mudstone, silty	6.1	(20)	140.5	(461)
16	Siltstone and mudstone: platy	1.5	(5)	134.4	(441)
15	Mudstone: silty; blocky to platy; black; rusty-weathering. GSC loc. C - 71919 (422)	13.7	(45)	132.9	(436)
14	Mudstone: black; blocky to rubbly; slightly rusty-weathering; topped by 15 cm (6 in.) concretionary bed. GSC locs. C - 71918 (421), top 5.4 m (18 ft); C - 71917 (420), middle 5.5 m (18 ft); C - 71916 (419), lower 5.5 m (18 ft)	16.4	(54)	119.2	(391)
	Unit 4				
13	Mudstone: very sandy, with small pebbles; glauconitic. GSC loc. C - 71915 (418)	0.3	(1)	102.7	(337)
	Unit 3				
12	Mudstone: hard, flaky to rubbly, black; rusty-weathering. GSC loc. C - 71914 (417)	8.8	(29)	102.4	(336)

Unit	Lithology	Thickness m	(ft)	Height above base m	(ft)
11	Mudstone: very silty; some platy siltstone	0.9	(3)	93.6	(307)
10	Shale to mudstone: hard, dark grey; flaky to rubbly; rusty-weathering. GSC loc. C-71913 (416) from Units 10 and 11	6.7	(22)	92.6	(304)
9	Mudstone: rubbly, black; rusty-weathering; several bentonite seams. GSC loc. C-71912 (415)	4.6	(15)	85.9	(282)
8	Mudstone: black, rubbly; few concretionary layers; few thin bentonite seams. GSC locs. C-71911 (414), top 3.7 m (12 ft); C-71910 (413), 8-11.8 m (26-39 ft) above base; C-71909 (412), 4-8 m (13-26 ft) above base; C-71908 (411), lower 4 m (13 ft)	15.5	(51)	81.4	(267)
7	Mudstone: black, greenish-weathering, glauconitic. GSC loc. C-71907 (410)	0.9	(3)	65.8	(216)
6	Mudstone: rubbly, black; rusty-weathering; few concretions. GSC locs. C-71906 (409), top 2.7 m (9 ft); C-71905 (408), lower 2.4 m (8 ft)	5.2	(17)	61.9	(213)
5	Mudstone: rubbly; rusty-weathering; few concretions and concretionary layer at top. GSC loc. C-71904 (407)	3.9	(13)	59.7	(196)
4	Mudstone: black, rubbly; blocky, glauconitic mudstone at top. GSC loc. C-71903 (406)	2.1	(7)	55.8	(183)
3	Mudstone to shale: black, rubbly; yellow efflorescence; rusty-weathering; glauconitic at base. GSC locs. C-71902 (405), top 3 m (10 ft); C-71901 (404), lower 3.3 m (11 ft)	6.4	(21)	53.6	(176)
	Unit 2				
2	Mostly covered. Shale, black, flaky; yellow efflorescence	6.1	(20)	47.2	(155)
	Nordegg Member				
	Unit 1				
1	Mostly talus covered. Black calcareous shale and platy siltstone some phosphatic mudstone; traces of breccia at base	41.1	(135)	41.1	(135)
	Contact not exposed				

Section 68-5

Cypress Creek, latitude 56°48'N, longitude 123°05'W; Halfway River map area, British Columbia, between Cypress and Chowade rivers. Measured and described by D.F. Stott.

	Overlying beds are thick-bedded sandstone of the Monteith Formation				
	FERNIE FORMATION				
	Unit 6				
29	Mostly covered. Siltstone and mudstone with some beds of fine grained, laminated, thin- to medium-bedded sandstone. Flaggy sandstone and interbedded siltstone and mudstone at top	10.4	(34)	148.4	(487)
28	Sandstone: fine grained, grey, thin-bedded; rusty-weathering	1.2	(4)	138.1	(453)

Unit	Lithology	Thickness m	(ft)	Height above base m	(ft)
27	Covered. Mostly siltstone and mudstone	3.9	(13)	136.8	(449)
26	Sandstone: fine grained, grey, thin-bedded, rusty-weathering	1.5	(5)	132.9	(436)
25	Mostly covered. Siltstone and mudstone	2.1	(7)	131.4	(431)
24	Sandstone: fine grained, grey; thin-bedded, rusty-weathering	1.5	(5)	129.2	(424)
23	Mudstone: very silty, blocky, dark grey; grey-weathering; much yellow efflorescence; some interbedded laminated siltstone	3.0	(10)	127.7	(419)
22	Sandstone: fine grained, siliceous, laminated, brownish-grey; flaggy to thin-bedded; rusty-weathering; interbedded siltstone and mudstone, 35%, platy, dark grey, rusty-weathering	3.3	(11)	124.7	(409)
	Unit 5				
21	Mudstone: dark grey, silty; rubbly to blocky; becoming siltier at top with platy siltstone and few thin, concretionary beds. GSC locs. C -71958 (82) top 7.1 m (24 ft), C - 71957 (81), 1 - 2 m (3 - 6 ft) above base, C - 71956 (80), basal 1 m (3 ft).	9.1	(30)	121.3	(398)
20	Mudstone: dark grey, sandy at base; concretionary and silty at top with thin platy beds, orange-weathering. GSC loc. C - 71955 (79)	3.6	(12)	115.2	(368)
19	Sandstone: fine grained, glauconitic?, poorly bedded; greenish-weathering; some large chert cobbles at base; interbedded siltstone and mudstone. GSC loc. C - 71954 (78)	2.1	(7)	108.5	(356)
18	Mudstone: dark grey to black; rubbly; rusty-weathering; some orange-weathering concretions. GSC loc. C - 71953 (77)	4.3	(14)	106.4	(349)
17	Cobbles: chert, rounded, somewhat irregularly shaped; as much as 10.1 cm (4 in.) in longest diameter; mudstone matrix	0.3	(1)	102.1	(335)
16	Mudstone: rubbly, dark grey to black; rusty-weathering; some orange-weathering concretions. GSC loc. C - 71952 (76) from Units 15 - 1	7.6	(25)	101.8	(334)
	Unit 4				
15	Siltstone: glauconitic, greenish-grey	0.6	(2)	94.2	(309)
	Unit 3				
14	Covered	1.5	(5)	93.6	(307)
13	Siltstone: hard, blocky, dark grey to black, brittle; yellow efflorescence. GSC loc. C - 7195(75)	0.9	(3)	92.0	(302)
12	Mudstone: dark grey, rubbly; grey-weathering; some yellowish efflorescence; rare concretions. GSC locs. C - 71942 (66) to C - 71950 (74) made sequentially upward at 3 m (10 ft) intervals	27.4	(90)	91.1	(299)
11	Mudstone: dark grey; rubbly to blocky; grey-weathering; some yellowish efflorescence. GSC loc. C - 71941 (65)	4.9	(16)	63.7	(209)
10	Mudstone: rubbly to flaky; rusty-weathering. GSC locs. C - 71940 (64), upper half; C - 71939 (63), lower half	4.3	(14)	55.8	(183)
9	Partly talus covered. Appears to be platy siltstone and mudstone, flaky; very rusty weathering; much yellow efflorescence; sandy, platy siltstone at top. GSC locs. C - 71938 (62), upper half; C - 71937 (61), lower half	4.6	(15)	54.5	(179)

Unit	Lithology	Thickness m	(ft)	Height above base m	(ft)
8	Mudstone; dark grey; rubbly; rusty-weathering; grading upward into interbedded mudstone and platy siltstone, rusty-weathering; very resistant at top; breccia zone about 2.4 m (8 ft) from top -- shear? GSC locs. C-71936 (60), upper half; C-71935 (59), lower half	6.7	(22)	50.0	(164)
	Unit 2				
7	Mudstone: silty, platy, to argillaceous siltstone, platy and interbedded, black papery shale. GSC locs. C-71934 (58), upper half; C-71933 (57), lower half	7.3	(24)	43.3	(142)
6	Mudstone; dark grey, blocky, rusty-weathering; yellow efflorescence; calcareous siltstone to argillaceous limestone at top, grey. GSC loc. C-71932 (56)	2.1	(7)	36.0	(118)
	Nordegg Member				
	Unit 1				
5	Limestone: dense, black, argillaceous to siltstone, black, calcareous; platy; cherty, phosphatic; interbeds of black calcareous shale, flaky; very phosphatic at top; numerous ammonites and *Oxytoma*? in lower beds				
	GSC loc. 82582: *Pleuroceras*? sp. indet. aff. *P. quadratum* Howard and *P. apyrenum* (S. Buckman) *Pleuroceras*? spp. indet. *Ostrea* sp. indet. brachiopod fragments indet. age: *Pleuroceras spinatum* Zone, Upper Pliensbachian				
	GSC locs. C-71931 (55), top 1.2 m (4 ft); C-71930 (54), middle 1.2 m (4 ft); C-71929 (53), lower 1.2 m (4 ft)	3.6	(12)	30.8	(111)
4	Limestone: dense, black, silty, light brown to grey-weathering; platy to thin-bedded; interbedded shale and siltstone, 40%, black, calcareous, grey-weathering; phosphatic chert nodules. GSC locs. C-71928 (53B), top half; C-71927 (52), lower half	5.5	(18)	30.2	(99)
3	Siltstone: clacareous, black, platy, to limestone, silty; interbedded black, flaky shale, calcareous. Partly talus covered. GSC locs. C-71926 (51), top 3.6 m (12 ft); C-71925 (50), middle 3.5 m (11 ft); C-71924 (49), lower 3.6 m (12 ft)	10.7	(35)	24.7	(81)
2	Mostly covered. Platy, argillaceous, calcareous, black siltstone and thin,platy, dense limestone. Mostly covered. GSC loc. C-71923 (48), top 2.4 m (8 ft)	13.1	(43)	14.0	(46)
1	Sandstone: very fine grained, to siltstone, argillaceous, black, calcareous; very argillaceous in some layers. GSC loc. C-71922 (47)	0.9	(3)	0.9	(3)

Section 68-11

North of Christine Falls, latitude 56°40'N, longitude 123°04'W; Halfway River map area, British Columbia, south of Chowade River. Measured and described by D.F. Stott.

Unit	Lithology	Thickness m	Thickness (ft)	Height above base m	Height above base (ft)
	MONTEITH FORMATION (part)				
4	Shale; rubbly, dark grey; rusty-weathering. GSC loc. C - 72000 (250)	3.0	(10)	210.9	(692)
3	Sandstone: fine grained, laminated; thick-bedded; siliceous, grey-weathering	4.3	(14)	207.9	(682)
2	Sandstone: fine grained, laminated, grey, siliceous, silty and interbedded silty mudstone, flaggy; banded appearance; grey-weathering; very sandy at top with medium-bedded sandstone	10.7	(35)	203.6	(668)
1	Sandstone: fine to medium grained, laminated, grey, siliceous; brown-weathering; thin- to thick-bedded; coarse grained at top	1.5	(5)	192.9	(633)
	FERNIE FORMATION				
	Unit 6				
23	Sandstone: silty, fine grained; flaggy;grey, laminated; 2.5 cm (1 in.) gritty unit about 76 cm (30 in.) from base; interbedded siltstone and mudstone, silty 30%. Appears shaly on cliffs and sandy in gully	12.5	(41)	191.4	(628)
22	Mudstone: silty; rusty-weathering; grading into overlying unit. GSC loc. C - 71999 (249) from Units 21 and 22	1.5	(5)	178.9	(587)
21	Conglomerate and gritty, sandy, mudstone; chert pebbles; grades upward into mudstone	0.3	(1)	177.4	(582)
20	Sandstone: fine grained, laminated, grey, siliceous; platy to flaggy; rusty-weathering; interbedded siltstone and silty mudstone 30%; thin-bedded sandstone at top. GSC locs. C - 71998 (248), from top 2.4 m (8 ft); C - 71997 (247), from 5.5 - 8.2 m (18 - 27 ft) above base; C - 71996 (246), from 2.7 - 5.5 m (9 - 18 ft) above base; C - 71995 (245), from basal 2.7 m (9 ft)	10.7	(35)	177.1	(581)
	Unit 5				
19	Mudstone: rubbly; rusty-weathering; gritty bed 1.2 m (4 ft) above base becoming siltier at top grading into overlying unit. GSC locs. C - 71994 (244), from top 1.5 m (5 ft); C - 71993 (243), from 6.1 - 7.6 m (20 - 25 ft) above base; C - 71992 (242), from 3.0 - 6.1 m (10 - 20 ft) above base; C - 71991 (241), from basal 3 m (10 ft)	9.1	(30)	166.4	(546)
18	Mudstone: silty and blocky at base; rubbly; dark grey; rusty-weathering; 0.3 m (1 ft) gritty bed at 33 cm (1 ft) above base; chert pebbles and cobbles; grading upward into sandstone, fine grained, laminated, silty, flaggy, with interbedded silty mudstone. GSC locs. C - 71990 (240), from top 3.4 m (11 ft); C - 71989 (239), from 3.4 - 10.1 m (11 - 33 ft) above base; C - 71988 (238), from basal 3.4 m (11 ft)	13.4	(44)	157.3	(516)
	Unit 4				
17	Sandstone: sandy, gritty, greenish-grey; poorly bedded	0.3	(1)	143.5	(472)
16	Mudstone: rubbly; rusty-weathering; silty at base; worm casts at top. GSC locs. C - 71987 (237), from top 2.1 m (7 ft) and Unit 17; C - 71986 (236), from lower 2.7 m (9 ft) and Unit 15	4.9	(16)	143.2	(471)
15	Sandstone: argillaceous, gritty, greenish; poorly bedded; chert cobbles	0.3	(1)	138.7	(455)

Unit	Lithology	Thickness m	(ft)	Height above base m	(ft)
	Unit 3				
14	Mudstone; rubbly; rusty-weathering; some yellow efflorescence; becoming hard and blocky in upper 4.5 m (15 ft), somewhat sandy. GSC locs. C-71985 (235), from top 2.7 m (9 ft); C-71984 (234), from 11.6-14.3 m (38-47 ft) above base; C-71983 (233), from 8.8-11.6 m (29-38 ft) above base; C-71982 (232), from 6.4-8.8 m (21-29 ft) above base; C-71981(231), from 3.4-6.4 m (11-21 ft) above base; C-71980 (230), from basal 3-4 m (11 ft)	17.1	(56)	138.4	(454)
13	Mudstone: rubbly; rusty-weathering; yellow efflorescence (most of this has some resemblance to Grey Bed lithology). GSC locs. C-71971 (221) to C-71979 (229) made from sequential (upward) 3 m (10 ft) intervals	27.4	(90)	121.3	(398)
12	Mudstone: rubbly; rusty-weathering; few light rust to orange-weathering beds. GSC locs. C-71970 (220) and C-71969 (219) from upper and lower halves	6.1	(20)	93.9	(308)
11	Mudstone: rubbly; rusty-weathering. GSC locs. C-71968 (218), C-71967 (217), C-71966 (216) from top, middle and basal thirds	9.1	(30)	87.8	(288)
10	Mudstone: rubbly; rusty-weathering; few orange-weathering concretion beds. GSC locs. C-71965 (215), top 6.1 m (20 ft); C-71964 (214), 3.7-9.1 m (12-30 ft) above base; C-71963 (213), 2.4-3.7 m (8-12 ft) above base; C-71962 (212), 1.2-2.4 m (4-8 ft) above base; C-71961 (211), basal 1.2 m (4 ft)	15.2	(50)	78.6	(258)
9	Mudstone: rubbly; rusty-weathering. GSC locs. C-71960 (210), upper half; and C-71959 (209), lower half	6.1	(20)	63.4	(208)
8	Shale: rubbly; rusty-weathering	10.7	(35)	57.3	(188)
7	Covered. Part of this is shale; rubbly up slope (contact of Units 2 and 3 lies within this interval)	21.3	(70)	46.6	(153)
	Nordegg Member				
	Unit 1				
6	Mostly covered. Some platy, argillaceous, limestone and siltstone	6.1	(20)	25.3	(83)
5	Siltstone: black, calcareous; platy and interbedded shale, flaky to papery	5.2	(17)	19.2	(63)
4	Partly covered. Shale, black, calcareous; siltstone, black, calcareous; platy	7.3	(24)	14.0	(46)
3	Limestone: dense, hard, argillaceous, dark grey; grey- to brown-weathering; some thin layers of shale at top; phosphatic GSC loc. 82580: ammonite sp. indet. fragment ?*Pleuroceras*	1.5	(5)	6.7	(22)
2	Limestone: argillaceous to siltstone, calcareous, black; platy; interbedded shale; partly covered	4.9	(16)	5.2	(17)
1	Covered	0.3	(1)	0.3	(1)

Unit	Lithology	Thickness m	(ft)	Height above base m	(ft)
	TRIASSIC				
	PARDONET FORMATION				
	Limestone: dense, bluish-grey, thick-bedded; brown-weathering; laminated; layers of *Monotis* more abundant at top				
	GSC loc. 82596: *Monotis subcircularis* Gabb; age: Late Norian, Lower Suessi Zone				

Section 70-8

Latitude 54°10'N, longitude 119°46'W, Stinking Springs; Wapiti map area Alberta. Measured and described by D.F. Stott.

Unit	Lithology	Thickness m	(ft)	Height above base m	(ft)
	FERNIE FORMATION				
	Unit 5-6				
23	Mudstone: silty; platy to rubbly; dark grey; interbedded platy, very fine grained sandstone, 20%, rusty- to brown-weathering	10.7	(35)	283.1	(929)
22	Sandstone as below	3.0	(10)	272.5	(894)
21	Mudstone: silty, dark grey; platy; grey-weathering; interbedded sandstone toward top	9.4	(31)	269.4	(884)
20	Sandstone: fine grained, laminated, siliceous; flaggy to thin-bedded; brownish-grey weathering; some thin interbedded mudstone	6.1	(20)	260.0	(853)
19	Sandstone: fine grained, laminated, siliceous, platy; interbedded mudstone, 35%, rusty-weathering	5.5	(18)	253.9	(833)
18	Mudstone: dark grey, silty, sandy toward top; rusty-weathering. GSC loc. C-10112 (315)	10.7	(35)	248.4	(815)
17	Mudstone: silty, dark grey; light yellow weathering concretionary body at top	12.2	(40)	237.7	(780)
	GSC loc. 85657: *Buchia (Anaucella)* n. sp. aff. *B. concentrica* (Sowerby) sensu lato; *Buchia (Anaucella) concentrica* (Sowerby) sensu lato; *Camptonectes (Boreionectes)* sp. indet.; age: Late Oxfordian to Early Kimmeridgian.				
	GSC locs. C-10111 (314) and C-10110 (313) from upper and lower halves				
16	Mudstone: dark grey; rubbly; a few interbeds of sandstone becoming sandier at top with platy, fine grained, siliceous, sandstone. GSC locs. C-10109 (312) to C-10107 (310), from upper, mid and lower thirds	18.3	(60)	225.5	(740)
15	Interbedded mudstone and sandstone, 70-30%; platy. GSC loc. C-10106 (309)	6.1	(20)	207.3	(680)
14	Sandstone and mudstone: as below, 60-40%; very sandy at top, some small-scale crossbedding				
	GSC loc. 85660: *Buchia (Anaucella)* n. sp. aff. *B. concentrica* (Sowerby) sensu lato; *Buchia (Anaucella) concentrica* (Sowerby) sensu lato (?advanced forms); *Camptonectes (Boreionectes)* sp. indet.; *Tancredia* sp. indet.; indeterminate pelecypods; indeterminate gastropods; age: Late Oxfordian to Early Kimmeridgian				

Unit	Lithology	Thickness m	Thickness (ft)	Height above base m	Height above base (ft)
	GSC loc. 85665: *Buchia (Anaucella)* n. sp. aff. *B. concentrica* (Sowerby) sensu lato *Buchia (Anaucella) concentrica* (Sowerby) sensu lato ?*Aucellina* n. sp. ex. aff. ?*A. schmidti* Sokolov ?*Meleagrinella* sp. indet. indeterminate pelecypods age: Late Oxfordian to Early Kimmeridgian	25.9	(85)	201.2	(660)
13	Sandstone, as below, and mudstone, 35%	12.2	(40)	175.3	(575)
12	Mudstone: silty rubbly to blocky; dark grey; small channel sandstone	2.4	(8)	163.1	(535)
11	Sandstone: fine grained, laminated, siliceous, grey; medium-bedded; rusty- to brownish-grey weathering; interbedded mudstone, silty, platy, rusty-weathering, 20%	8.2	(27)	160.6	(527)
10	Mudstone: 70%, grading upward into sandstone, very fine grained, laminated, grey, siliceous, rusty-weathering; flaggy to thin-bedded, small-scale crossbedding; some channeling	14.3	(47)	152.4	(500)
9	Mudstone: dark grey to brownish-grey; rubbly to blocky, slightly rusty weathering; few sandier intervals. GSC locs. C-10105 (308), from top 5.2 m (17 ft); C-10104 (307), from 18.3-23.8 m (60-78 ft) above base; C-10103 (306), from 12.2-18.3 m (40-60 ft) above base; C-10102 (305), from 6.1-12.2 m (20-40 ft) above base; C-10101 (304), from lowest 6.1 m (20 ft)	29.0	(95)	138.1	(453)
8	Mostly talus covered. Appears to be mainly mudstone capped by sandstone; platy to flaggy; very fine grained; rusty- to grey-weathering	11.9	(39)	109.1	(358)
7	Sandstone: fine grained, laminated, grey, siliceous, calcareous; flaggy; grey-weathering; poorly exposed	4.9	(16)	97.2	(319)
6	Mudstone: blocky; rusty-weathering; flaky to rubbly. GSC locs. C-10100 (303), from top 5.5 m (18 ft); C-10099 (302), from 9.8-14.6 m (32-48 ft) above base; C-10098 (301), from 4.9-9.8 m (16-32 ft) above base; C-10097 (300), from lower 4.9 m (16 ft)	20.1	(66)	92.3	(303)
	Unit 4				
5	Siltstone: argillaceous, sandy, dark grey; blocky. GSC loc. C-10096 (299B)	1.2	(4)	72.2	(237)
	Unit 3				
4	Shale: dark grey; grey- to olive-grey weathering; flaky and rubbly. GSC locs. C-10095 (299), from whole interval; C-10093 (297), from 11.0-16.2 m (36-53 ft) above base; C-10094 (298), from 5.5-11.0 m (18-36 ft) above base	16.2	(53)	71.0	(233)
3	Mudstone: dark grey to black; slightly rusty weathering; rubbly to blocky. GSC locs. C-10089 (293) to C-10092 (296) made at sequential (upward) 6.1 m (20 ft) intervals	24.4	(80)	54.9	(180)
2	Partly covered. Mudstone, black; rubbly; small orange-weathering concretions and greenish sandy mudstone near base. GSC loc. C-10088 (292)	12.2	(40)	30.4	(100)
	Units 1 and 2				
1	Covered. Talus of dark grey, dense limestone overlain by black, flaky shale. GSC loc. C-10087 (291)	18.3	(60)	18.3	(60)

APPENDIX B
GENERIC INDEX

PLATES

Unless otherwise specified, all specimens have been stained with methylene blue and coated with ammonium hydroxide for photography.
Specimens designated **wet** were photographed under water to reveal sutures and chamber arrangement. All figures are approximately x45.

Plate 1

Bathysiphon sp. 219 (Page 11)

Figure 1. Figured specimen GSC 38730, GSC loc. C - 71953, side view.

Saccammina cf. *S. lathrami* Tappan, 1960 (Page 11)

Figures 2, 3. Figured specimen GSC 38731, GSC loc. C - 10095, side views.
Figure 4. Figured specimen GSC 38732, GSC loc. C - 71946, side view with aperture.
Figure 5. Figured specimen GSC 38733, GSC loc. C - 71916, side view with aperture.

Ammodiscus cf. *A. cheradospirus* Loeblich and Tappan, 1950 (Page 11)

Figure 6. Figured specimen GSC 38734, GSC loc. C - 71949, side view.
Figure 7. Figured specimen GSC 38735, GSC loc. C - 71948, side view.
Figures 8, 9. Figured specimen GSC 38736, GSC loc.C - 71946, side views (9 wet).

Ammodiscus cf. *A. orbis* Lalicker, 1950 (Page 12)

Figures 10, 11. Figured specimen GSC 38737, GSC loc. C - 71956, side views (11 wet).

Ammodiscus sp. 196 (Page 12)

Figures 12 - 14. Figured specimen GSC 38738, GSC loc. C - 71956, side views (14 wet).
Figure 15. Figured specimen GSC 38739, GSC loc. C - 71966, side view.

Ammovertellina? sp. 170 (Page 12)

Figures 16, 17. Figured specimen GSC 38740, GSC loc. C - 71956, side views (17 wet).

Glomospira sp. 161 (Page 12)

Figures 18 - 21. Figured specimen GSC 38741, GSC loc. C - 71903, side views (19 and 21 wet).

Glomospirella sp. 174 (Page 13)

Figures 22 - 25. Figured specimen GSC 38742, GSC loc. C - 71903, side views (23 and 25 wet).
Figures 26, 27. Figured specimen GSC 38743, GSC loc. C - 71992, side views.

Ammovertella? sp. 218 (Page 13)

Figures 28 - 31. Figured specimen GSC 38744, GSC loc. C - 71912, side views (29 and 31 wet).

Reophax cf. *R. hounstoutensis* Lloyd, 1959 (Page 13)

Figure 32. Figured specimen GSC 38745, GSC loc. C - 71967, side view.
Figure 33. Figured specimen GSC 38746, same locality, side view.
Figures 34, 35. Figured specimen GSC 38747, GSC loc. C - 71907, side views.
Figure 36. Figured specimen GSC 38748, GSC loc. C - 71963, side view.

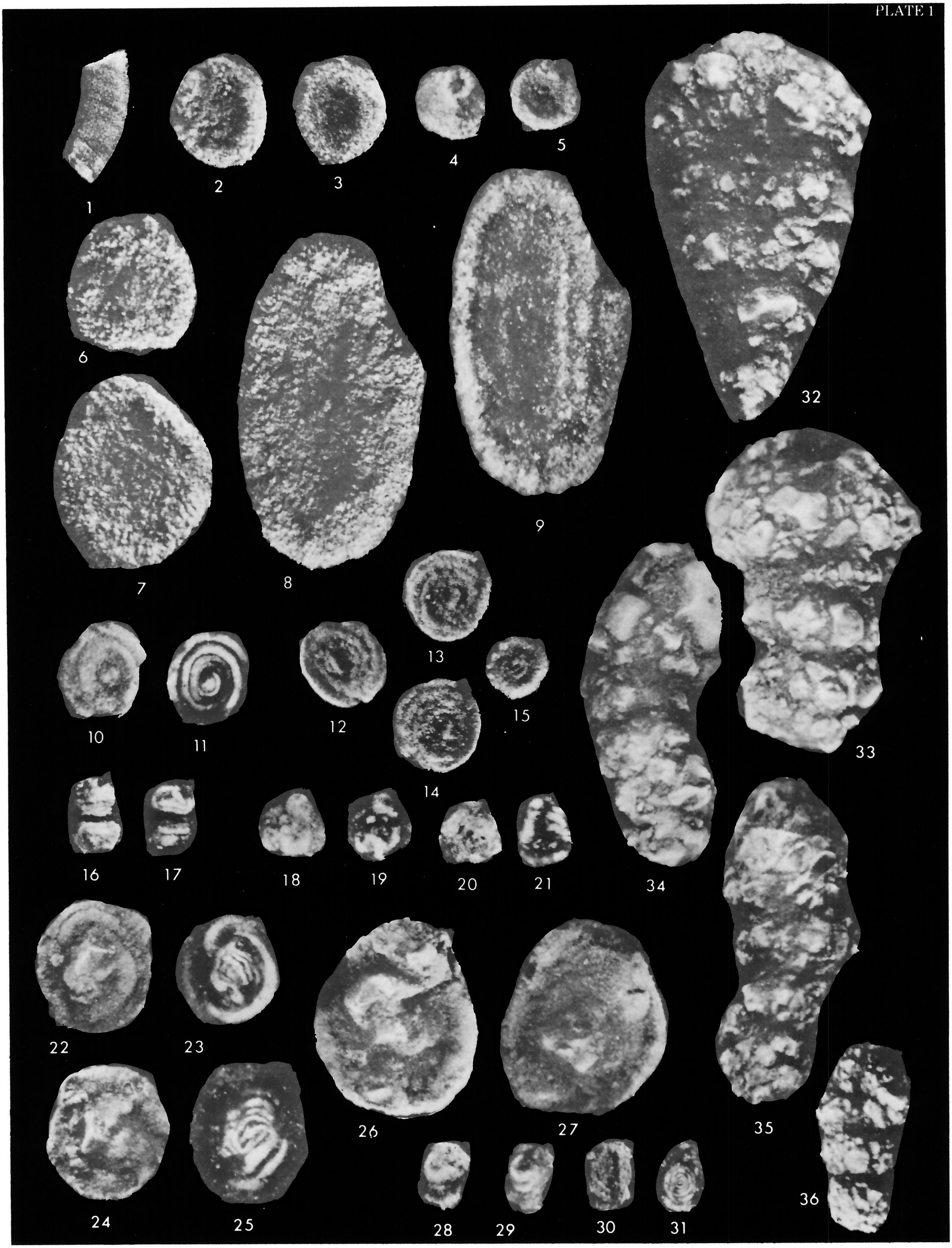
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Plate 2

Haplophragmoides cf. *H. barrowensis* Tappan, 1951 (Page 13)

Figures 1 - 4. Figured specimen GSC38749, GSC loc. C - 10088, side views (2 and 4 wet).
Figures 5 - 7. Figured specimen GSC 38750, GSC loc. C - 71949, side views (7 wet).
Figure 8. Figured specimen GSC 38751, same locality, side view.

Haplophragmoides cf. *H. canui* Cushman, 1930 (Page 14)

Figures 9, 10. Figured specimen GSC 38752, GSC loc. C - 10093, side and peripheral views.
Figures 11 - 13. Figured specimen GSC 38753, same locality, side and peripheral views (12 wet).
Figure 14. Figured specimen GSC 38754, same locality, side view, test peripherally compressed.
Figures 15 - 17. Figured specimen GSC 38755, GSC loc. C - 71903, side views (16 wet) test laterally compressed.
Figures 18 - 20. Figured specimen GSC 38756, GSC loc. C - 10094, side view (20 wet).
Figure 21. Figured specimen GSC 38757, GSC loc. C - 10107, test peripherally compressed with partial chamber collapse.

Haplophragmoides(?) *canuiformis* Dain, 1972 (Page 14)

Figures 22, 23. Figured specimen GSC 38758 GSC loc. C - 71948, side views (23 wet).
Figures 24 - 26. Figured specimen GSC 38759, GSC loc. C - 10094, side views (25 wet).
Figures 27 - 30. Figured specimen GSC 38760, GSC loc. C - 71956, side views (28 - 30 wet).

Haplophragmoides cf. *H. topagorukensis* Tappan, 1962 (Page 15)

Figure 31. Figured specimen GSC 38761, GSC loc. C - 10093, side view.
Figures 32 - 34. Figured specimen GSC 38762, same locality, side and peripheral views (33 wet).
Figures 35,36. Figured specimen GSC 38763, same locality, side views (36 wet).

Haplophragmoides cf. *H. volgenis* Myatliuk, 1939 (Page 15)

Figure 37. Figured specimen GSC 38764, GSC loc. C - 10094, side view.
Figure 38. Figured specimen GSC 38765, GSC loc. C - 10093, side view.
Figure 39. Figured specimen GSC 38766, GSC loc. C - 10088, side view, inflated test.
Figures 40, 41. Figured specimen GSC 38767, GSC loc. C - 10093, side views, coiling asymmetric (41 wet).
Figure 42. Figured specimen GSC 38768, GSC loc. C - 71996, side view.

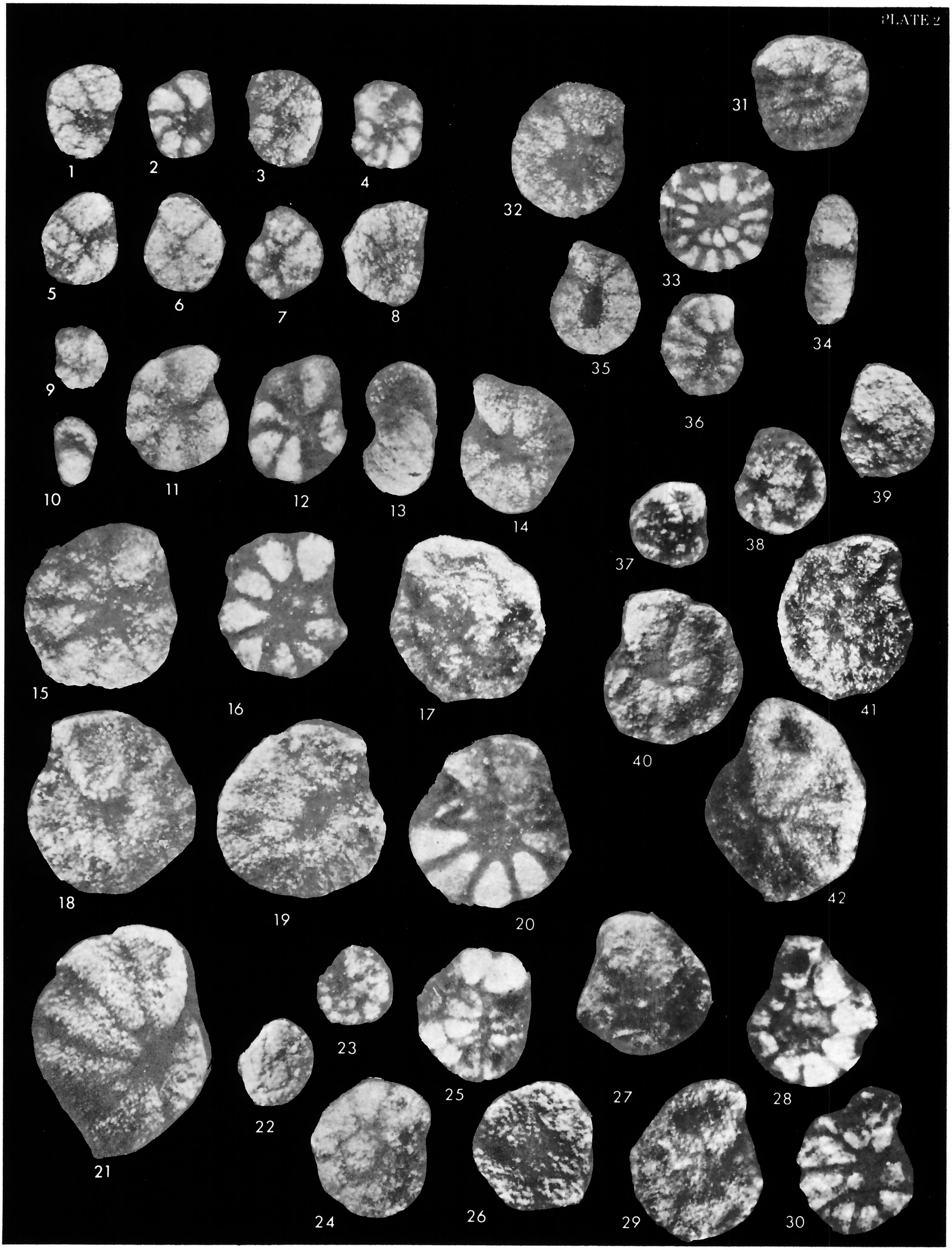
PLATE 2
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Plate 3

Haplophragmoides sp. 143 (Page 15)

Figures 1, 2. Figured specimen GSC 38769, GSC loc. C - 10093, side views.
Figure 3. Figured specimen GSC 38770, GSC loc. C - 71914, side view, peripheral distortion.

Haplophragmoides sp. 166 (Page 16)

Figures 4 - 7. Figured specimen GSC 38771, GSC loc. C - 10092, side and peripheral views (6 wet).
Figures 8 - 11. Figured specimen GSC 38772, GSC loc. C - 71953, side views (9 and 11 wet).

Recurvoides? cf. *R. disputabilis* Dain, 1972 (Page 19)

Figures 12 - 14. Figured specimen GSC 38773, GSC loc. C - 10093, spiral and umbilical views (14 wet).
Figures 15, 16. Figured specimen GSC 38774, GSC loc. C - 10089, apertural views (16 wet).
Figures 17 - 20. Figured specimen GSC 38775, GSC loc. C - 71903, spiral and umbilical views (18 and 20 wet).

Recurvoides? sp. 149 (Page 20)

Figures 21 - 25. Figured specimen GSC 38776, GSC loc. C - 10089, lateral and peripheral views (22 and 24 wet).
Figures 26 - 29. Figured specimen GSC 38777, GSC loc. C - 71906, lateral views (27 and 29 wet).
Figures 30 - 32. Figured specimen GSC 38778, GSC loc. C - 10098, lateral views (32 wet).

Recurvoides? sp. 208 (Page 20)

Figures 33 - 38. Figured specimen GSC 38779, GSC loc. C - 10089, lateral and apertural views (34, 36 and 38 wet).
Figures 39, 40. Figured specimen GSC 38780, same locality, lateral views (40 wet).
Figures 41 - 43. Figured specimen GSC 38781, GSC loc. C - 10088, lateral views (43 wet).

Recurvoides? sp. 226 (Page 21)

Figures 44 - 49. Figured specimen GSC 38782, GSC loc. C - 71901, lateral and peripheral views (45, 47 and 49 wet).
Figures 50 - 52. Figured specimen GSC 38783, GSC loc. C - 71903, lateral views (51 wet).
Figures 53 - 56. Figured specimen GSC 38784, same locality, lateral views (54 and 56 wet).
Figures 57 - 60. Figured specimen GSC 38785, GSC loc. C - 10093, lateral views (58 and 60 wet).
Figures 61 - 63. Figured specimen GSC 38786, GSC loc. C - 71905, lateral views (62 wet).

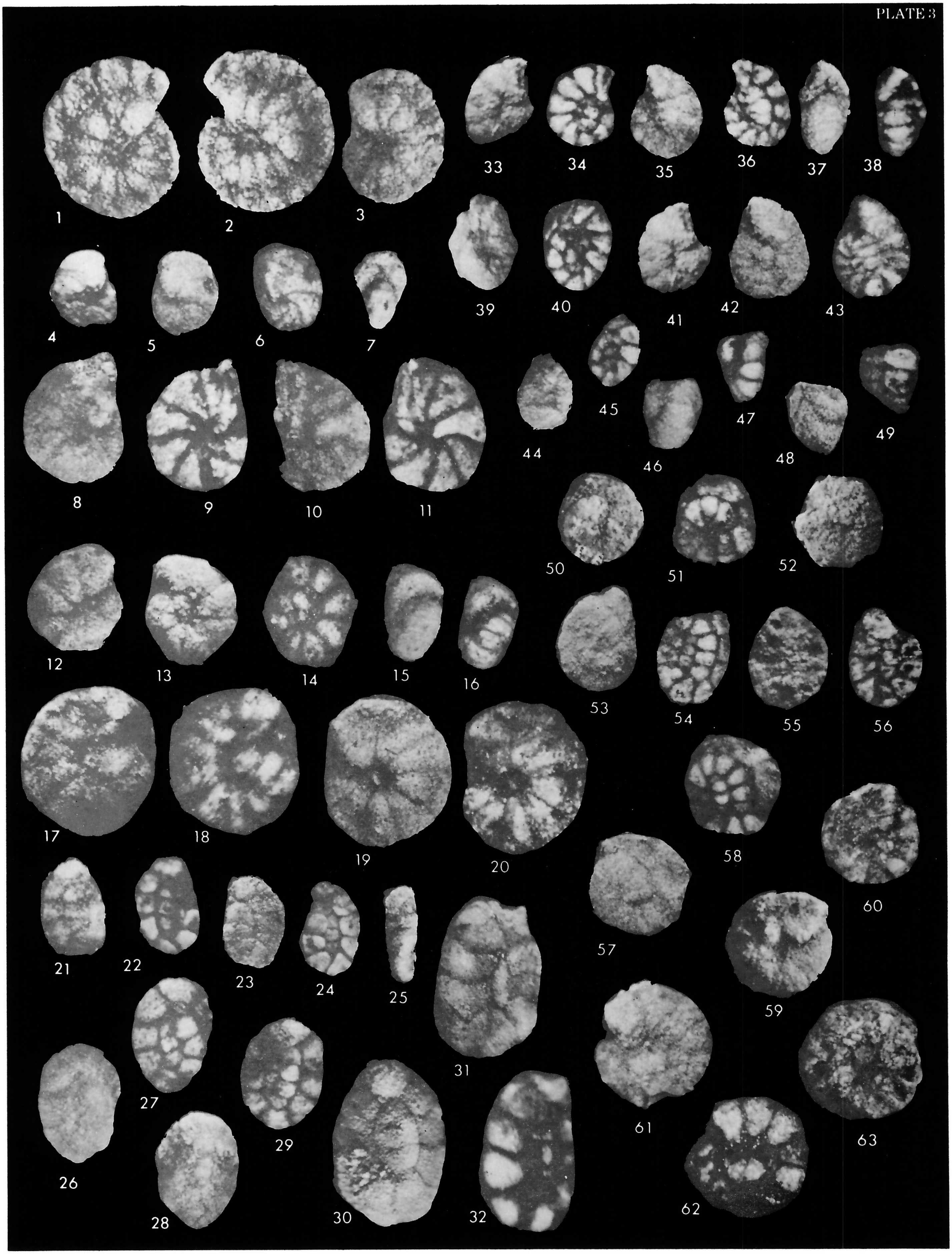
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Plate 4

Ammobaculites cf. *A. alaskensis* Tappan, 1955 (Page 16)

Figure 1. Figured specimen GSC 38787, GSC loc. C - 10089, side view.
Figures 2, 3. Figured specimen GSC 38788, GSC loc. C - 10094, side views.
Figure 4. Figured specimen GSC 38789, GSC loc. C - 10089, side view.
Figure 5. Figured specimen GSC 38790, GSC loc. C - 10093, apertural view.
Figures 6, 7. Figured specimen GSC 38791, GSC loc. C - 71904, side views (7 wet).
Figure 8. Figured specimen GSC 38792, GSC loc. C - 71959, side view, distorted.
Figure 9. Figured specimen GSC 38793, GSC loc. C - 71914, side view, lateral compression.
Figures 10, 11. Figured specimen GSC 38794, same locality, side views (11 wet).
Figure 12. Figured specimen GSC 38795, GSC loc. C - 71916, side view.
Figure 13. Figured specimen GSC 38796, GSC loc. C - 71962, side view.
Figure 14. Figured specimen GSC 38797, GSC loc. C - 71981, side view.
Figures 15, 16. Figured specimen GSC 38798, GSC loc. C - 71963, side views, lateral compression.

Ammobaculites cf. *A. pokrovkaensis* (Kosyreva), 1972 (Page 17)

Figures 17 - 19. Figured specimen GSC 38799, GSC loc. C - 10093, side views (18 wet).
Figures 20, 21. Figured specimen GSC 38800, GSC loc. C - 71911, side views (21 wet).

Ammobaculites cf. *A. wenonahae* Tappan, 1960 (Page 17)

Figures 22, 23. Figured specimen GSC 38801, GSC loc. C - 10094, side views (23 wet).
Figures 24, 25. Figured specimen GSC 38802, GSC loc. C - 10093, side views.
Figure 26. Figured specimen GSC 38803, GSC loc. C - 71963, side view.

Ammobaculites sp. 152 (Page 18)

Figures 27 - 29. Figured specimen GSC 38804, GSC loc. C - 10093, side views (29 wet).
Figures 30, 31. Figured specimen GSC 38805, same locality, side views (31 wet).
Figures 32 - 34. Figured specimen GSC 38806, same locality, side views (34 wet).
Figure 35. Figured specimen GSC 38807, GSC loc. C - 71901, side view.
Figure 36. Figured specimen GSC 38808, GSC loc. C - 71916, side view.

Ammobaculites sp. 180 (Page 18)

Figure 37. Figured specimen GSC 38809, GSC loc. C - 71949, side view.
Figure 38. Figured specimen GSC 38810, GSC loc. C - 71980, side view.

PLATE 4

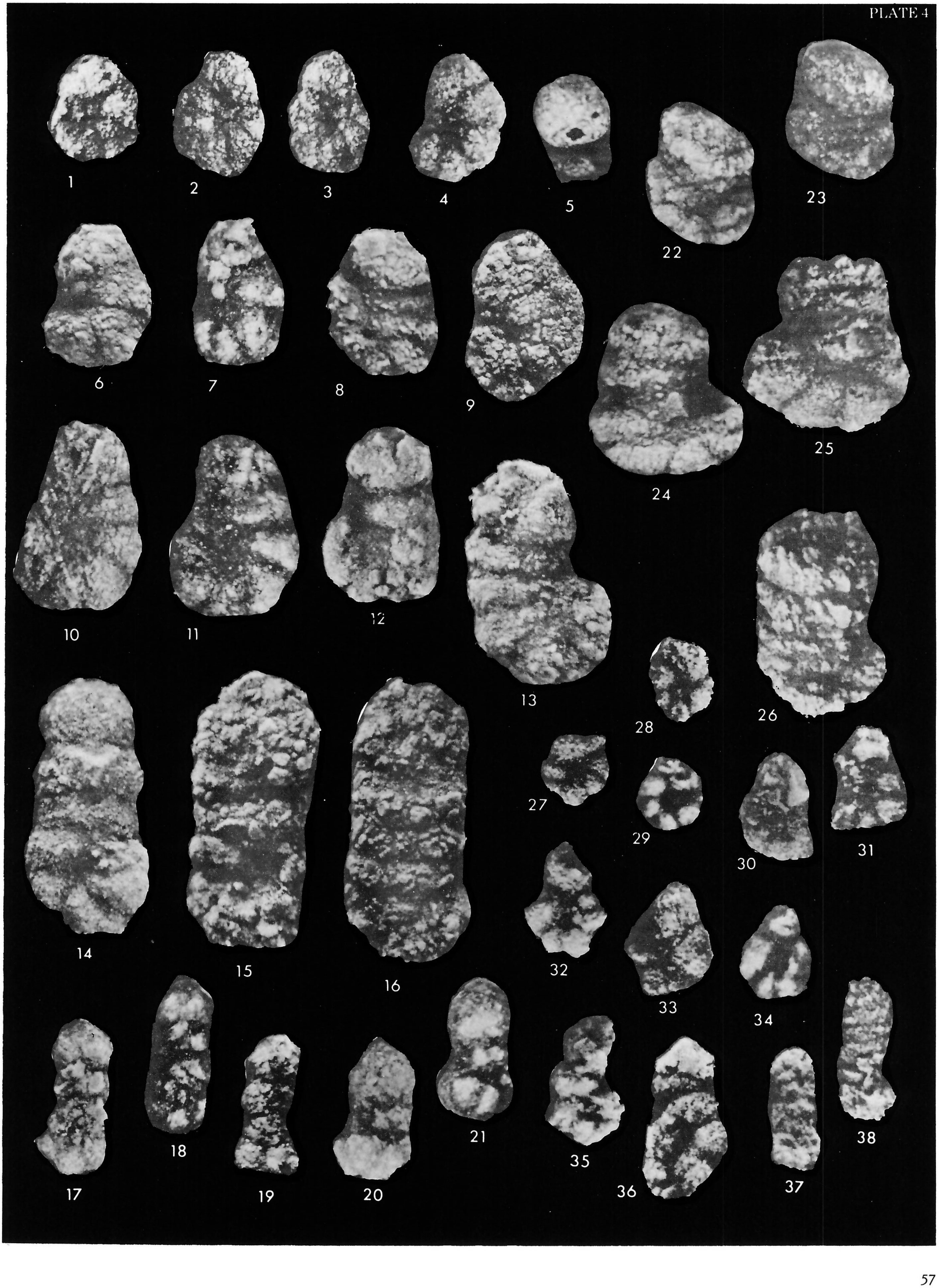
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Plate 5

Ammobaculites sp. 220 (Page 18)

Figures 1, 2. Figured specimen GSC 38811, GSC loc. C - 71905, side views.

Ammomarginulina sp. 158 (Page 19)

Figure 3. Figured specimen GSC 38812, GSC loc. C - 10094, side view.

Spiroplectammina suprajurassica Kosyreva, 1972 (Page 21)

Figures 4, 5. Hypotype GSC 38813, GSC loc. C - 71909, side views.
Figure 6. Hypotype GSC 38814, GSC loc. C - 71971, side view.
Figure 7. Hypotype GSC 38815, GSC loc. C - 71912, side view.
Figure 8. Hypotype GSC 38816, GSC loc. C - 71901, side view.
Figure 9. Hypotype GSC 38817, GSC loc. C - 71906, side view.

Spiroplectammina cf. *S. tobolskensis* Beljaevskaja and Komissarenko, 1972 (Page 22)

Figures 10, 11. Figured specimen GSC 38818, GSC loc. C - 71906, side and peripheral views.
Figure 12. Figured specimen GSC 38819, same locality, side view.
Figure 13. Figured specimen GSC 38820, GSC loc. C - 71902, side view.
Figure 14. Figured specimen GSC 38821, GSC loc. C - 71901, side view.

Trochammina cf. *T. canningensis* Tappan, 1955 (Page 22)

Figures 15 - 17. Figured specimen GSC 38822, GSC loc. C - 10088, lateral views (17 wet).
Figure 18. Figured specimen GSC 38823, GSC loc. C - 71912, lateral view.
Figures 19 - 22. Figured specimen GSC 38824, GSC loc. C - 10093, lateral views (20 and 22 wet).
Figures 23 - 25. Figured specimen GSC 38825, GSC loc. C - 10089, lateral views (25 wet).

Trochammina? cf. *T. gatesensis* Stelck and Wall, 1956 (Page 22)

Figures 26 - 29. Figured specimen GSC 38826, GSC loc. C - 71912, spiral and umbilical views (27 and 29 wet).
Figures 30 - 33. Figured specimen GSC 38827, GSC loc. C - 71905, spiral and peripheral views (31 and 33 wet).
Figures 34, 35. Figured specimen GSC 38828, GSC loc. C - 71912, umbilical views (35 wet).

Trochammina gryci Tappan, 1955 (Page 23)

Figures 36, 37. Hypotype GSC 38829, GSC loc. C - 71901, spiral views (37 wet).
Figures 38 - 41. Hypotype GSC 38830, GSC loc. C - 10090, spiral and umbilical views (39 and 41 wet).
Figures 42 -44. Hypotype GSC 38831, GSC loc. C - 10091, spiral and apertural views (43 wet).
Figures 45 - 48. Hypotype GSC 38832, GSC loc. C - 71906, spiral and umbilical views (46 and 48 wet).

Trochammina cf. *T. sablei* Tappan, 1955 (Page 23)

Figures 49 - 52. Figured specimen GSC 38833, GSC loc. C - 71968, spiral and umbilical views (50 and 52 wet).

Trochammina sp. 153 (Page 23)

Figures 53, 54. Figured specimen GSC 38834, GSC loc. C - 10093, spiral views (54 wet).
Figures 55, 56. Figured specimen GSC 38835, same locality, umbilical views (56 wet).

PLATE 5

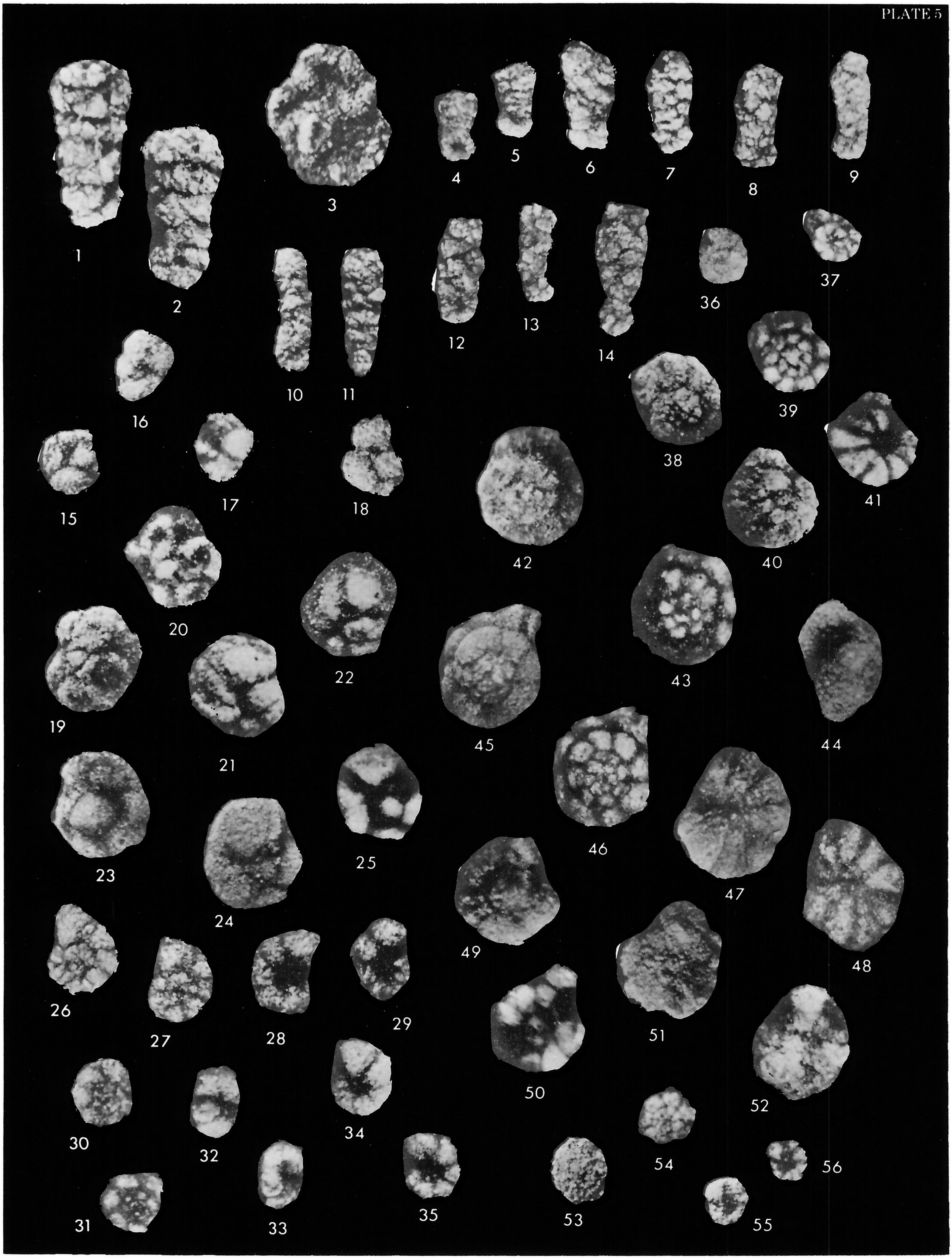

Plate 6

Ammosphaeroidina? sp. 146 (Page 24)

Figures 1, 2. Figured specimen GSC 38836, GSC loc. C - 10089, mature stage, lateral views.
Figures 3 - 6. Figured specimen GSC 38837, same locality, mature stage, lateral views (5 and 6 test broken, inner whorls visible).
Figures 7, 8. Figured specimen GSC 38838, GSC loc. C - 10093, mature stage, lateral views.
Figures 9 - 15. Figured specimen GSC 38839, GSC loc. C-10094, early stage, lateral and peripheral views (11, 13 and 15 wet).
Figures 16 - 22. Figured specimen GSC 38840, GSC loc. C - 10092, early stage, lateral and peripheral views (17, 20 and 22 wet).
Figures 23 - 28. Figured specimen GSC 38841, GSC loc. C - 10094, early stage, lateral and peripheral views (27 and 28 apertural? views) (24 and 28 wet).
Figures 29 - 33. Figured specimen GSC 38842, GSC loc. C - 71971, early stage 29, 30 , apertural? views, 31-33 lateral and peripheral views (30 and 33 wet).
Figures 34, 35. Figured specimen GSC 38843, GSC loc. C - 10094, early stage, lateral views (35 wet).
Figures 36 - 38. Figured specimen GSC 38844, GSC loc. C - 71903, early stage, lateral views (37 wet).

Verneuilinoides sp. 233 (Page 24)

Figures 39 - 41. Figured specimen GSC 38845, GSC loc. C - 71960, lateral views.

Dorothia? sp. 181 (Page 24)

Figures 42, 43. Figured specimen GSC 38846, GSC loc. C - 71950, lateral views.
Figure 44. Figured specimen GSC 38847, GSC loc. C - 71949, lateral view.
Figures 45, 46. Figured specimen GSC 38848, same locality, lateral views.

Genus indeterminate sp. 183 (Page 25)

Figure 47. Figured specimen GSC 38849, GSC loc. C - 71950, lateral view.
Figures 48, 49. Figured specimen GSC 38850, same locality, lateral views.
Figures 50, 51. Figured specimen GSC 38851, GSC loc. C - 71948, lateral views.

Genus indeterminate sp. 193 (Page 25)

Figures 52 - 54. Figured specimen GSC 38852, GSC loc. C - 71949, lateral and peripheral views.

Genus indeterminate sp. 232 (Page 25)

Figure 55. Figured specimen GSC 38853, GSC loc. C - 10092.
Figure 56. Figured specimen GSC 38854, GSC loc. C - 10094.

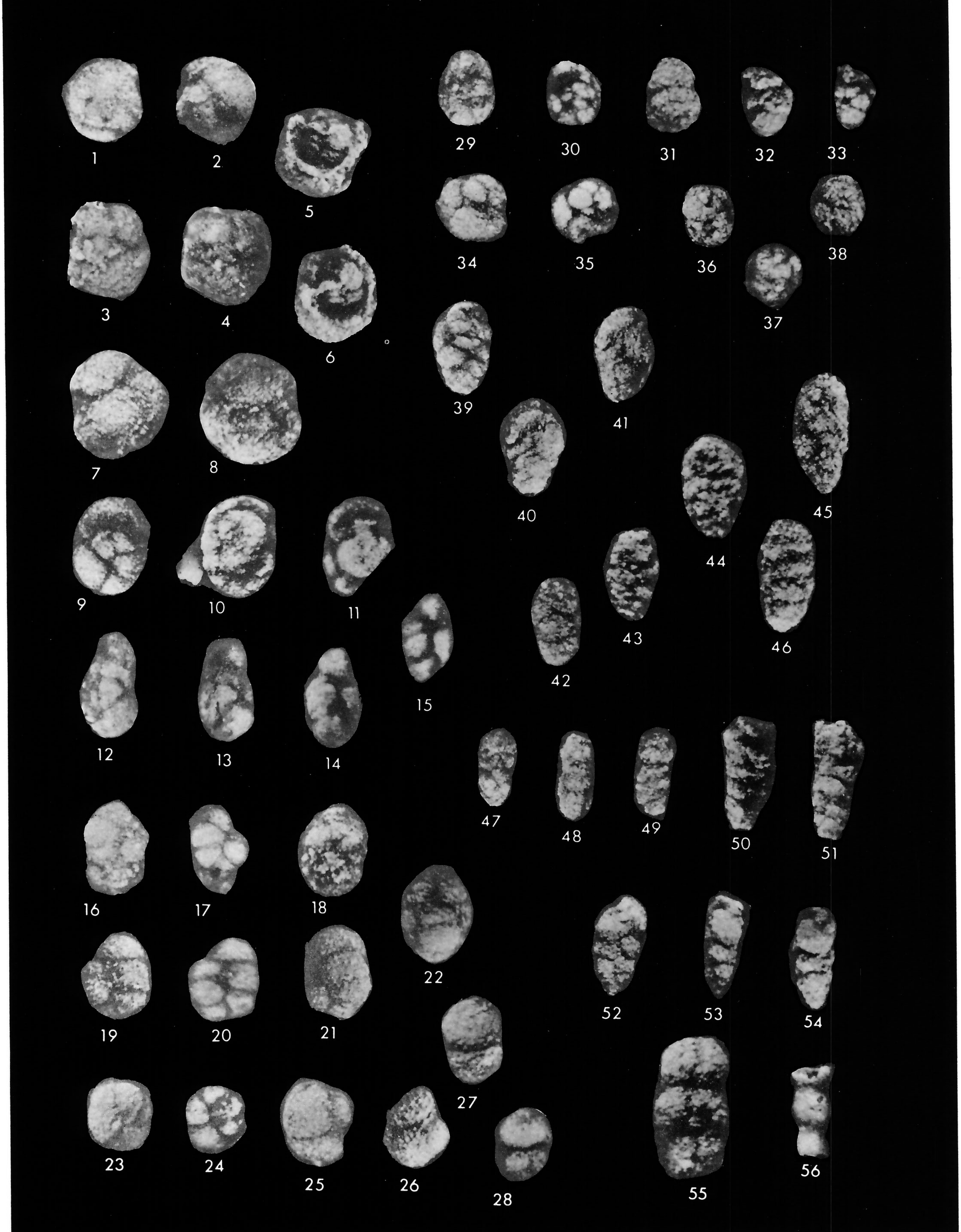
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Plate 7

Nodosaria cf. *N. detruncata* Schwager, 1867 (Page 25)

Figure 1. Figured specimen GSC 38855, GSC loc. C-71955.
Figure 2. Figured specimen GSC 38856, GSC loc. C-71971.

Geinitzinita cf. *G. praenodulosa* Dain, 1972 (Page 25)

Figures 3, 4. Figured specimen GSC 38857, GSC loc. C-71971, side views.
Figure 5. Figured specimen GSC 38858, GSC loc. C-71987, side view.

Lagena? cf. *L. hispida* (Reuss), 1861 (Page 26)

Figure 6. Figured specimen GSC 38859, GSC loc. C-10093.

Lagena liasica (Kübler and Zwingli), 1886 (Page 26)

Figure 7. Figured specimen GSC 38860, GSC loc. C-71971.

Pseudonodosaria humilis (Roemer), 1841 (Page 27)

Figure 8. Figured specimen GSC 38861, GSC loc. C-71971.
Figure 9. Figured specimen GSC 38862, GSC loc. C-71921.

Pseudonodosaria? sp. 189 (Page 27)

Figure 10. Figured specimen GSC 38863, GSC loc. C-71984.

Lenticulina cf. *L. biexcavata* (Myatliuk), 1939 (Page 27)

Figures 11-13. Figured specimen GSC 38864, GSC loc. C-71952, side and peripheral views (12 wet).
Figure 14. Figured specimen GSC 38865, GSC loc. C-71987, side view.
Figure 15. Figured specimen GSC 38866, GSC loc. C-71912, side view.
Figure 16. Figured specimen GSC 38867, GSC loc. C-71962, side view.

Lenticulina cf. *wisniowskii* (Myatliuk), 1939 (Page 28)

Figures 17, 18. Figured specimen GSC 38868, GSC loc. C-71987, side and peripheral views.
Figures 19-21. Figured specimen GSC 38869, GSC loc. C-71975, side views (21 wet).
Figure 22. Figured specimen GSC 38870, GSC loc. C-10094, side view.

Astacolus sp. 178 (Page 28)

Figures 23-25. Figured specimen GSC 38871, GSC loc. C-71971, side and peripheral views (24 wet).
Figures 26, 27. Figured specimen GSC 38872, GSC loc. C-71952, side views (27 wet).
Figures 28, 29. Figured specimen GSC 38873, GSC loc. C-71987, side and peripheral views.

Astacolus sp. 188 (Page 28)

Figure 30. Figured specimen GSC 38874, GSC loc. C-71912, side view.
Figure 31-33. Figured specimen GSC 38875, GSC loc. C-71919, side views (33 wet).

Astacolus sp. 224 (Page 29)

Figure 34. Figured specimen GSC 38876, GSC loc. C-71916, side view.

Marginulina cf. *M. pinguicula* Tappan, 1955 (Page 29)

Figures 35-37. Figured specimen GSC 38877, GSC loc. C-71962, side and peripheral views.

Marginulina cf. *M. pletha* Tappan, 1955 (Page 29)

Figures 38-40. Figured specimen GSC 38878, GSC loc. C-71979, side views (40 wet).

Marginulina sp. 156 (Page 29)

Figures 41, 42. Figured specimen GSC 38879, GSC loc. C-10093, side views.

Marginulina sp. 179 (Page 29)

Figures 43, 44. Figured specimen GSC 42296, GSC loc. C-10111, side views.

Marginulinopsis cf. *M. subrusticus* Dain, 1972 (Page 30)

Figures 45, 46. Figured specimen GSC 42297, GSC loc. C-71977, side views.

Marginulinopsis sp. 212 (Page 30)

Figures 47, 48. Figured specimen GSC 42298, GSC loc. C-71918, side views.

Marginulinopsis sp. 229 (Page 30)

Figure 49. Figured specimen GSC 42299, GSC loc. C-71953, side view.

Planularia cf. *P. fraasi* (Schwager), 1865 (Page 30)

Figures 50, 51. Figured specimen GSC 42300, GSC loc. C-71955, side views (51 wet).
Figures 52, 53. Figured specimen GSC 42301, GSC loc. C-71984, side views (53 wet).

Saracenaria sp. 176 (Page 31)

Figures 54, 55. Figured specimen GSC 42302, GSC loc. C-71972, side and peripheral views.
Figures 56, 57. Figured specimen GSC 42303, GSC loc. C-71977, side and peripheral views.
Figures 58-61. Figured specimen GSC 42304, GSC loc. C-71984, side and peripheral views (61 wet).
Figures 62, 63. Figured specimen GSC 42305, GSC loc. C-71971, side and peripheral views.
Figures 64, 65. Figured specimen GSC 42306, GSC loc. C-71981, side views (65 wet).
Figures 66, 67. Figured specimen GSC 42307, GSC loc. C-71952, side views (67 wet).
Figures 68, 69. Figured specimen GSC 42308, GSC loc. C-71971, side and peripheral views.

PLATE 7

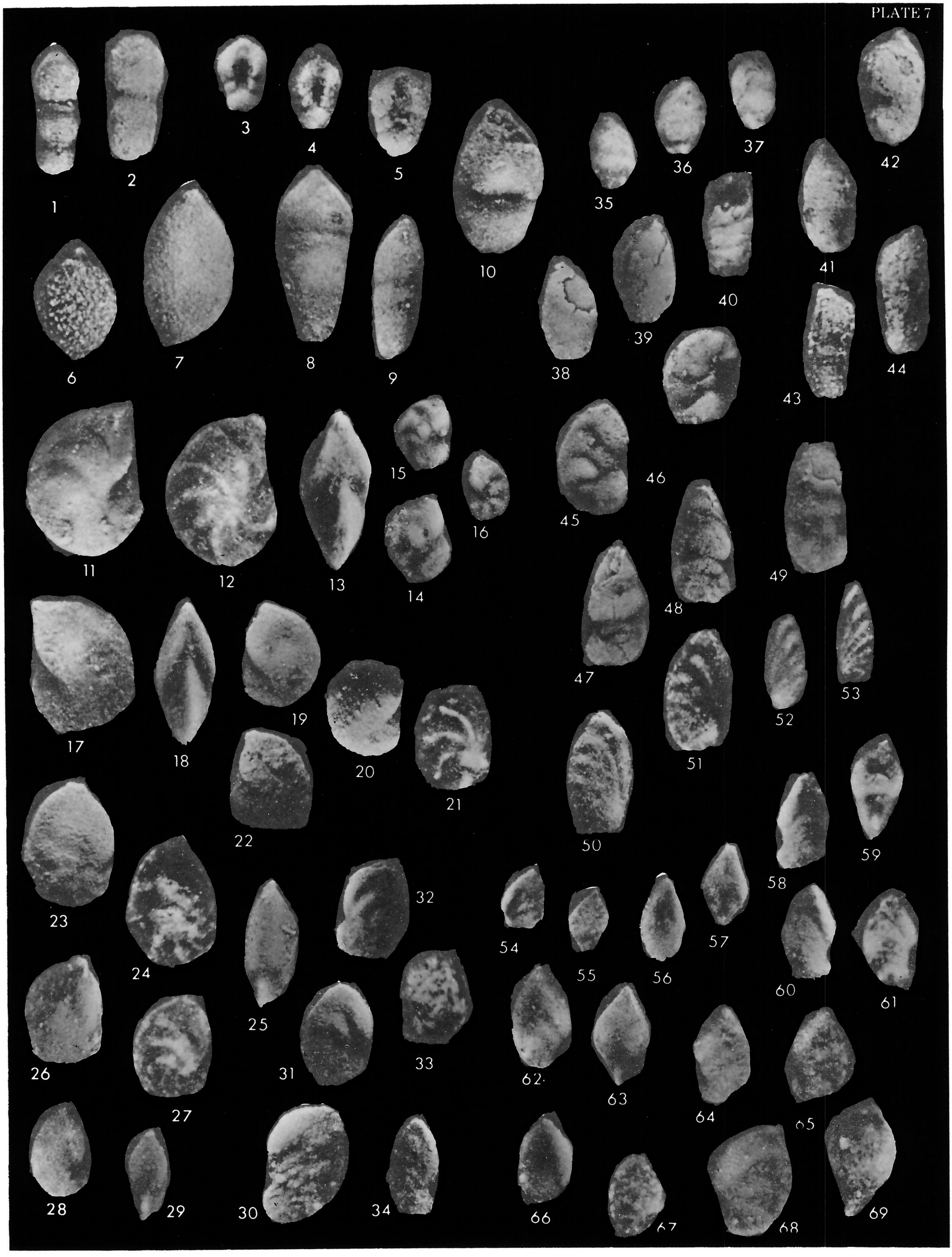
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Plate 8

Vaginulina sp. 165 (Page 31)

Figures 1, 2. Figured specimen GSC 42309, GSC loc. C - 10092, side views.

Vaginulinopsis sp. 197 (Page 31)

Figure 3. Figured specimen GSC 42310, GSC loc. C - 71977, side view.

Eoguttulina cf. *E. liassica* (Strickland), 1846 (Page 32)

Figures 4 - 6. Figured specimen GSC 42311, GSC loc. C - 71974, side views.

Globulina cf. *G. alexandrae* Dain, 1972 (Page 32)

Figure 7. Figured specimen GSC 42312, GSC loc. C - 71911, prolocular view.
Figures 8, 9. Figured specimen GSC 42313, GSC loc. C - 71983, side views.
Figures 10, 11. Figured specimen GSC 42314, GSC loc. C - 71985, side views.
Figures 12, 13. Figured specimen GSC 42315, GSC loc. C - 71981, side views.
Figure 14. Figured specimen GSC 42316, GSC loc. C - 71983, side view.
Figures 15, 16. Figured specimen GSC 42317, GSC loc. C - 71974, steinkern, side views.
Figures 17, 18. Figured specimen GSC 42318, GSC loc. C - 71985, steinkern, side views.

Genus indeterminate sp. 216 (Page 32)

Figure 19. Figured specimen GSC 42319, GSC loc. C - 71907, spiral view.

Genus indeterminate sp. 231 (Page 33)

Figure 20. Figured specimen GSC 42320, GSC loc. C - 71964, side view.

Genus indeterminate sp. 202 (Page 33)

Figure 21. Figured specimen GSC 42321, GSC loc. C - 71921, side view.
Figure 22. Figured specimen GSC 42322, GSC loc. C - 71955, side view.
Figure 23. Figured specimen GSC 42323, GSC loc. C - 71971, side view.

Genus indeterminate sp. 209 (Page 33)

Figures 24, 25. Figured specimen GSC 42324, GSC loc. C - 71984, side views (25, penultimate aperture visible).
Figure 26. Figured specimen GSC 42325, same locality, side view (penultimate aperture visible).

Genus indeterminate sp. 186 (Page 33)

Figure 27. Figured specimen GSC 42326, GSC loc. C - 71955.

Genus indeterminate sp. 225 (Page 33)

Figures 28, 29. Figured specimen GSC 42327, GSC loc. C - 71916, side views.

Genus indeterminate sp. 215 (Page 33)

Figures 30, 31. Figured specimen GSC 42328, GSC loc. C - 71907, steinkern, spiral and umbilical views.
Figure 32. Figured specimen GSC 42329, GSC loc. C - 71910, steinkern, umbilical view.
Figure 33. Figured specimen GSC 42330, GSC loc. C - 71906, steinkern, spiral view.

Genus indeterminate sp. 230 (Page 34)

Figures 34, 35. Figured specimen GSC 42331, GSC loc. C - 71914, steinkern, side views.

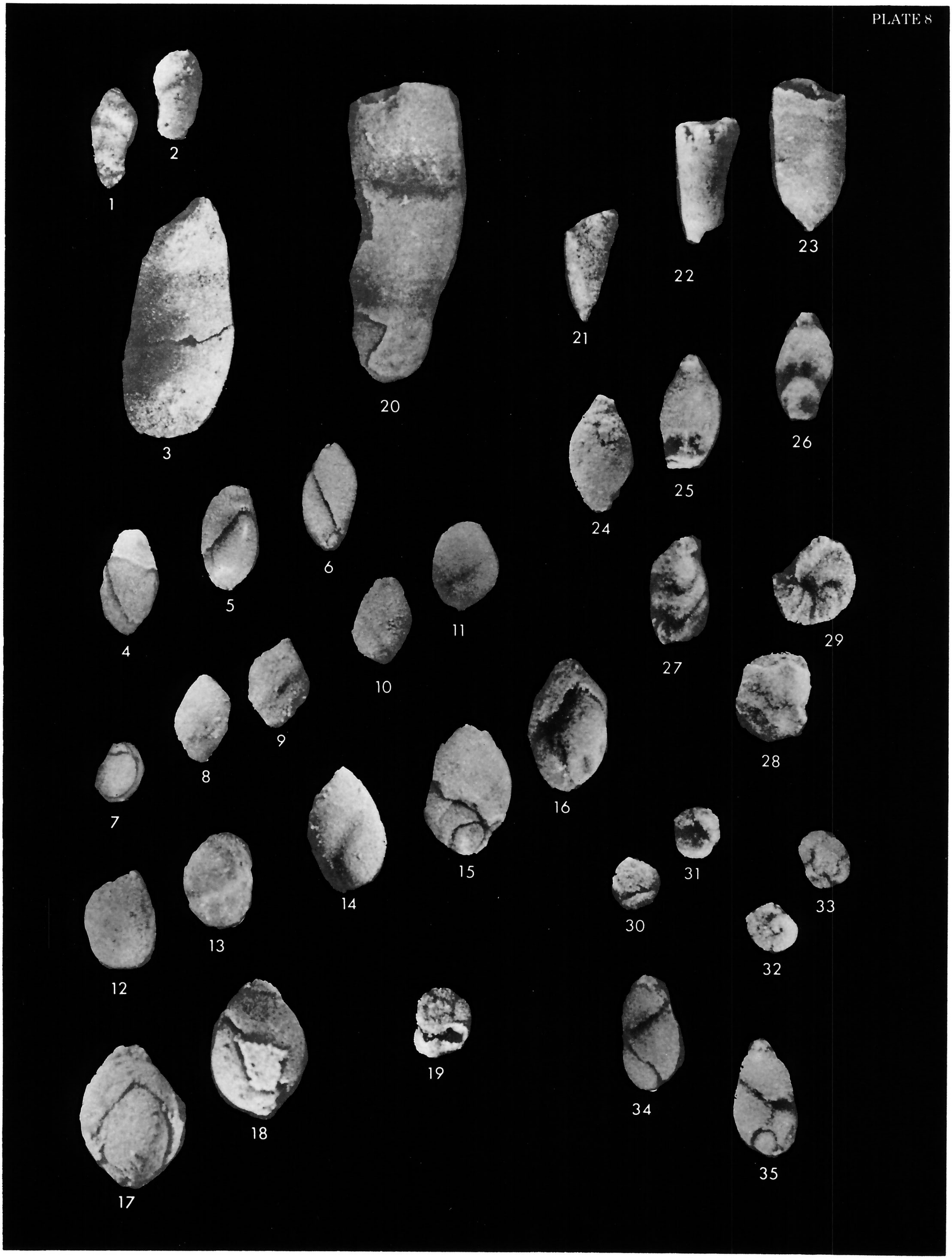
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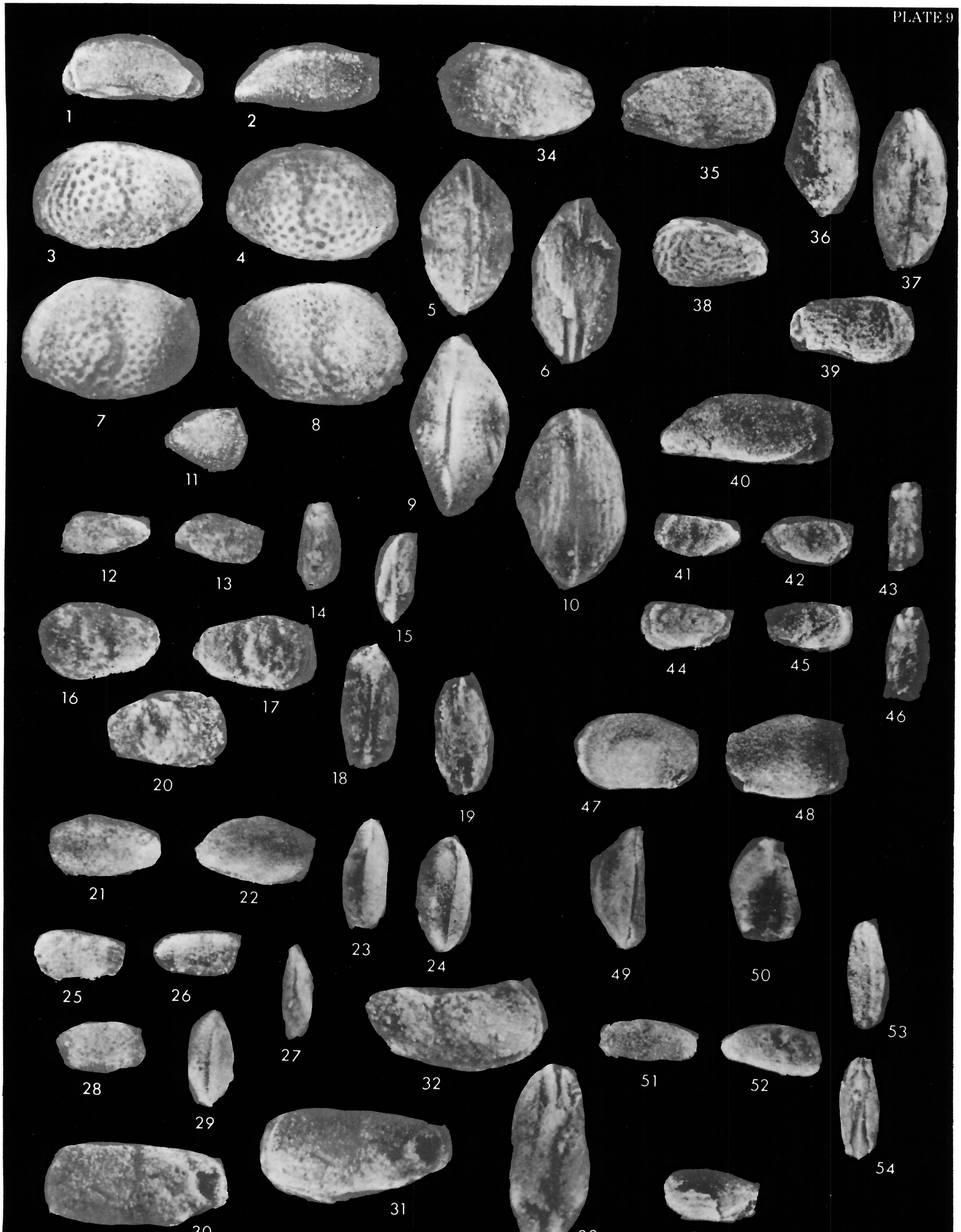
Plate 9

	Paracypris sp. 65	(Page 34)
Figures 1, 2.	Figured specimen GSC 42332, GSC loc. C - 71974, 1L, 2R.	
	Camptocythere? sp. 64	(Page 34)
Figures 3 - 6.	Figured specimen GSC 42333, GSC loc. C - 71988, 3L, 4R, 5D, 6V.	
Figures 7 - 10.	Figured specimen GSC 42334, same locality, 7L, 8R, 9D, 10V.	
Figure 11.	Figured specimen GSC 42335, same locality, 11R, molt?	
	Genus indeterminate sp. 62	(Page 35)
Figures 12 - 15.	Figured specimen GSC 42336, GSC loc. C - 71957, 12L, 13R, 14D, 15V.	
	Genus indeterminate sp. 63	(Page 35)
Figures 16 - 19.	Figured specimen GSC 42337, GSC loc. C - 71909, 16L, 17R, 18D, 19V.	
Figure 20.	Figured specimen GSC 42338, GSC loc. C - 71978, 20R.	
	Genus indeterminate sp. 66	(Page 35)
Figures 21 - 24.	Figured specimen GSC 42339, GSC loc. C - 71978, 21L, 22R, 23D, 24V.	
	Genus indeterminate sp. 67	(Page 35)
Figures 25 - 27.	Figured specimen GSC 42340, GSC loc. C - 71988, 25L, 26R, 27D.	
Figures 28, 29.	Figured specimen GSC 42341, GSC loc. C - 71990, 28R, 29D.	
	Genus indeterminate sp. 68	(Page 36)
Figures 30 - 33.	Figured specimen GSC 42342, GSC loc. C - 71978, 30, 31L, 32R, 33V.	
	Genus indeterminate sp. 69	(Page 36)
Figures 34 - 37.	Figured specimen GSC 42343, GSC loc. C - 71961, 34L, 35R, 36D, 37V.	
	Genus indeterminate sp. 70	(Page 36)
Figures 38, 39.	Figured specimen GSC 42344, GSC loc. C - 71908, 38L, 39R.	
	Genus indeterminate sp. 71	(Page 36)
Figure 40.	Figured specimen GSC 42345, GSC loc. C - 71908, 40R.	
	Genus indeterminate sp. 72	(Page 37)
Figures 41 - 43.	Figured specimen GSC 42346, GSC loc. C - 71907, 41L, 42R, 43D.	
Figures 44 - 46.	Figured specimen GSC 42347, same locality, 44L, 45R, 46D.	
	Genus indeterminate sp. 73	(Page 37)
Figures 47 - 50.	Figured specimen GSC 42348, GSC loc. C - 71909, 47L, 48R, 49D, 50V.	
	Genus indeterminate sp. 74	(Page 37)
Figures 51 - 54.	Figured specimen GSC 42349, GSC loc. C - 71973, 51L, 52R, 53D, 54V.	
	Genus indeterminate sp. 75	(Page 37)
Figure 55.	Figured specimen GSC 42350, GSC loc. C - 71971, 55L.	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ADDENDUM

Further research carried out in the central and southern reaches of the Alberta Trough has confirmed the conclusions in this report. Moreover, this research has contributed additional information on the geographic and stratigraphic distribution of the two distinctive, successive microfaunal components contained within the upper Fernie sequences.

Only the younger of the two microfauna is present in the Peace River region (in Stott's Units 3-6). This microfauna extends the length of the Trough. In the south it is found in the Passage Beds, and may be present, but in a limited form, in the Green Beds. The latter beds, where they consist of glauconitic sediments only, are almost devoid of microfauna, but research is continuing on material from outcrops that have shales incorporated within glauconitic intervals.

The older microfauna is restricted to the Grey Beds and to the southern reaches of the Trough. This is the same microfauna as the one in the Rierdon and lower Vanguard sequences of the Interior Plains (specifically Assemblages IV_S-V of Brooke and Braun, 1972).

Assemblages I-III, which were tentatively established within the Peace River region, have been identified as far south as Jasper, British Columbia. Here, species newly appearing within the assemblages and recognized as well in the Passage Beds in the extreme south (Fernie area), may provide the means by which this framework of assemblages could become applicable the length of the Trough.

The ages now postulated for the Assemblage I-III microfauna are still as proposed in the present bulletin, with the following restriction that the age range in the north could possibly extend into latest Callovian whereas in the south it could not extend below Oxfordian.