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GEOLOGY OF ORDOVICIAN ROCKS, MELVILLE PENINSULA AND REGION, SOUTHEASTERN DISTRICT OF FRANKLIN

Thomas E. Bolton, B. V. Sanford, M. J. Copeland,
Christopher R. Barnes and J. Keith Rigby

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Preface

The seven papers comprising this bulletin describe the Ordovician rocks and faunas of the southeastern Arctic Platform. The strata are an erosional remnant of a once widespread sheet of sedimentary rocks that mantled the Canadian Shield. The descriptions of the varied fauna establish a paleontological sequence by which we may more precisely correlate the several widely separated basins of Paleozoic deposition of the Eastern Craton.

Studies such as these enable the Geological Survey to meet one of its principal objectives—to estimate the potential abundance and probable distribution of the mineral and fuel resources available to Canada.

D.J. McLaren
Director General
Geological Survey of Canada

Ottawa, 20 February 1976

Abstract

The stratigraphy and paleontology of the Ordovician Ship Point and Bad Cache Rapids formations and an unnamed reefal unit are presented. From these strata and correlative rocks of Baffin Island and Hudson Bay Lowland one coral, three cephalopods, six ostracodes, one conodont and three sponges are described for the first time.

Résumé

Les auteurs étudient la stratigraphie et la paléontologie des formations ordoviciennes de Ship Point et de Bad Cache Rapids et d'une unité récifale qui n'a pas reçu de nom. Provenant de ces couches et de roches du même âge de l'île Baffin et des basses-terres de la baie d'Hudson, un corail, trois céphalopodes, six ostracodes, un conodonte et trois éponges, sont décrits ici pour la première fois.

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GEOLOGY OF ORDOVICIAN ROCKS, MELVILLE PENINSULA AND REGION, SOUTHEASTERN DISTRICT OF FRANKLIN

Introduction

Thomas E. Bolton

Prior to the last decade the Paleozoic geology of Melville Peninsula was known principally through specimens gathered from beach deposits rather than from direct bedrock examination. Previous geological investigations undertaken within the Foxe Plain have been reviewed in detail by Teichert (1937) and Miller *et al.* (1954). The earliest record of fossiliferous Paleozoic rocks in the Melville Peninsula region is that of Parry (1824; 1826); during 1822–23 he wintered on Iglulik [Igloolik] Island. The first detailed reports on the rocks and fossils of the region were published by Mathiassen (1933, p. 69–75, 91) and Teichert (1937), still principally based, however, on material collected during the 1921–24 Fifth Thule Expedition from a series of coastal localities and nearby islands. The limestones of Igloolik Island were briefly described by Burns (1952, p. 14, 15); subsequently Blackadar (1963, p. 16, 17) reported on the Paleozoic strata exposed in northwestern and western Foxe Plain and Heywood (1967) described the flat-lying Ordovician and Silurian rocks on Simpson and southern Melville peninsulas. In 1968 and 1973 geological mapping of the Paleozoic rocks was carried out within Foxe Plain by Trettin (1974), who has prepared (1975) a geological map of Foxe Plain region that includes the detailed lithostratigraphic subdivisions recognized from this mapping. Sanford (1974) and Bolton also examined the Paleozoic rocks and fossils at various localities throughout the Igloolik–Hall Beach–Roche Bay region of eastern Melville Peninsula during the 1973 helicopter-supported reconnaissance geological mapping of the Precambrian by Heywood (1974).

The rocks and fossils collected during these recent investigations form the basis of this bulletin. The geological description has been prepared by B.V. Sanford, the descriptions of the megafauna by T.E. Bolton, ostracode microfauna by M.J. Copeland, conodont microfauna by C.R. Barnes (University of Waterloo) and sponges by J.K. Rigby (Brigham Young University). Data concerning comparative megafossil material were collected by J.D. Aitken farther west on Schwatka Islands, Sherman Inlet; W.W. Heywood from Committee Bay, western Melville Peninsula; B.G. Craig, J.E. Reesor and W.W. Heywood from Hoppner Inlet, southern Melville Peninsula; G.D. Jackson from Mary River area, northern Baffin Island; and R.G. Blackadar from Foxe Lowland, southern Baffin Island. These data have been included to complete the specific descriptions and geographic distribution for several of the fossil genera.

The assistance provided by W.W. Heywood and members of his field party is gratefully acknowledged. The paleontological studies have benefited from data provided by the collectors and by G.W. Sinclair, B.S. Norford, R.H. Flower and H.P. Trettin.

As a result of these surveys the Paleozoic rocks of Melville Peninsula and adjoining regions can be divided into three conformable lithic units. The lowest sequence of sandstones and dolomites, assigned to the Ship Point Formation, contains conodonts that, according to Barnes (this bulletin), are of late Lower and early Middle Ordovician age. The uppermost, unnamed reefal-interreefal complex contains conodonts and the coral *Paleofavosites okulitchi* Stearn that are late Upper Ordovician rather than Silurian (Trettin, 1974). On the basis of the ostracodes (Copeland, this bulletin) and conodonts (Barnes, this bulletin), the middle rock unit, herein regarded as a lithic equivalent of the more southern Bad Cache Rapids Group (as well as part of the more northern Member *B* of the Baillarge Formation), essentially is of late Middle Ordovician Wilderness age. The associated megafauna within the Bad Cache Rapids Formation confirms this assignment, but also includes younger elements favouring a Barneveldian age.

The North American stadial nomenclature of Middle and Upper Ordovician has recently been reviewed and modified, particularly on the basis of the conodont faunal sequences. Middle Ordovician as herein used includes the North American standard sequence of Whiterock to Barneveld stages, with Upper Ordovician comprising the Edenian, Maysvillian and Richmondian stages. Barnes' (this bulletin) stadial terminology in contrast, follows that of Sweet and Bergström (1971).

Ordovician collecting localities, eastern Melville Peninsula

Sanford and Bolton examined forty-eight different exposures of Paleozoic rocks during their investigations; additional sections were examined during Trettin's 1967 and 1973 field work. The accompanying table details all exposures studied by Sanford and Bolton. Sanford's Figure 11 (this bulletin, p. 17)

(*text cont. on p. 5*)

Geol. Surv. Can., Bull. 269, 1977.

Ordovician sections examined, Melville Peninsula, District of Franklin
(*see* Sanford, this bulletin, Fig. 11)

Section	GSC loc.	
1	89829	East-facing escarpment 10 mi west of Hall Beach, 68°48′30″N, 81°37′50″W. *Ship Point* Formation (upper beds): platy- to thin-bedded, finely crystalline to sugary, light grey to orange mottled, yellowish orange to brown weathered unfossiliferous dolomite, 8 ft exposed, capped by 2 ft of thick-bedded, blocky-weathering dolostone.
2	89830	Creek section at shore ½ mi north of Hall Beach Eskimo village, 68°48′N, 81°14′30″W. *Bad Cache Rapids* Formation: thin-bedded, light to medium brown limestone, weathering medium grey with brown mottling, shale partings, fossiliferous, 10 to 15 ft exposed.
3	89831	Bulldozed exposures between Hall Beach runway and shore, 68°46′05″N, 81°13′W. *Bad Cache Rapids* Formation: thin-bedded, light grey to brown weathered, argillaceous limestone.
4	89832	Quilliam Bay section, 69°30′N, 82°50′15″W (Trettin, 1975, sec. 33). *Ship Point* Formation: thin- to thick-bedded, fine-grained, light grey, yellowish cream weathered unfossiliferous dolomite, abundant intraformational pebble conglomerate, ripple marks, 80 ft. Covered interval, 5 ft. Platy- to thin-bedded, fine-grained to granular, light grey unfossiliferous dolomite, slightly argillaceous, 5 ft. Covered interval, 15 ft. Thin-bedded, medium grey to red to grey-green mottled dolomite, sandy dolomite and dolomitic sandstone, argillaceous to shaly partings, unfossiliferous, abundant intraformational pebble conglomerate, 5 ft. Covered interval (debris around lemming burrows indicates this is sand), 30 ft. Salmon-pink and reddish to light grey orthoquartzitic sand and thin-bedded, medium-grained grey sandstone underlain by Precambrian (contact not exposed), 10 ft.
5	89833	Northeast-facing escarpment, stream section starting at lake level 4 mi south of Quilliam Bay, 69°27′25″N, 82°51′45″W (Trettin, 1975, southeast of sec. 34). *Bad Cache Rapids* Formation: thin- to thick-bedded, sublithographic to microcrystalline, light brown, yellowish orange mottled limestone, upper 40+ ft shale partings and fossiliferous, basal 10 ft thick-bedded to massive, lithographic, conchoidal fracturing, brown limestone with cephalopods (*Cyclendoceras*, *Gonioceras*), 95+ ft exposed. *Ship Point* Formation: thin-bedded, light greyish brown, yellowish orange mottled dolomite, some argillaceous zones, upper contact sharp, 30 ft. Covered interval, 30 ft. Uniformly platy-bedded, light grey, yellowish cream mottled dolomite, rarely argillaceous, some intraformational pebble conglomerate, gastropod steinkerns, 45 ft.
6	89834	Northeast-facing escarpment 2½ mi northeast of Lailor Lakes narrows, 69°17′30″N, 82°31′10″W. *Ship Point* Formation: uniformly bedded (1 to 6 in. thick), finely crystalline, light tan to grey-tan mottled, unfossiliferous dolomite, 10 ft exposed.
7	89835	Reefal complex approximately 6 mi south of Mogg Bay, 69°10′02″N, 82°15′05″W (Trettin, 1975, sec. 405*c*). Unnamed beds; massive light brown and tan fossiliferous limestone, large stromatolitic structures throughout the bioherm, corals in upper 30 ft, central atoll-like depressions, 100+ ft thick.
8	89836	Approximately 12½ mi south of Mogg Bay, 69°04′15″N, 82°04′45″W. Unnamed beds; thick-bedded, sugary, brownish tan limestone, dipping 5 to 10 degrees to the southeast, suggestion of quaquaversal dips in the mound of reef-flanking beds, 10 ft exposed.
9	89837	69°01′N, 82°41′W. *Ship Point* Formation: massive, algal mounds, finely crystalline, light brown to tan, weathering grey mottled, porous dolomite, 30 ft.
10	89838	69°02′N, 82°46′W. *Ship Point* Formation: platy-bedded, light brownish grey, argillaceous dolomite, 15 ft exposed.
11	89839	Stream cut, 69°01′N, 82°45′W. *Ship Point* Formation: platy- to thin-bedded, light brownish grey, dolomitic sandstone to sand, some quartz-pebble conglomerate, 15 ft exposed.
12	89840	Creek bed north of head of Foster Bay, 68°54′15″N, 82°01′30″W. *Bad Cache Rapids* Formation: thin-bedded, knobby weathering, fine-grained, light brown, yellowish orange mottled, fossiliferous limestone, argillaceous partings, 5 ft exposed.
13	89841	Shore section, island north end of Hall Lake, 68°53′N, 82°18′15″W. *Bad Cache Rapids* Formation: similar limestone, argillaceuous partings, 10 ft exposed.

Section	GSC loc.	
14	89842	Ridge west side of first lake immediately west of north end of Hall Lake, 68°52′30″N, 82°25′30″W. *Ship Point* Formation: platy- to thin-bedded, light brown to grey, sandy dolomite and dolomite, intraformational pebble conglomerate, 30 ft exposed. Massive, grey, yellowish orange weathered dolomitic sandstone, 55 ft thick. Thin-bedded, white to light grey, blue-grey-weathered, orthoquartzitic sandstone, 25 ft thick.
15	89843	Ridge farther west of sec. 14, 68°53′15″N, 82°29′45″W. *Ship Point* Formation: thick-bedded, finely crystalline, light brownish tan to tan, yellowish grey mottled dolomite, capped by numerous algal mounds, each individually up to 10 ft high and at least 100 ft in diameter, separated by and underlain by platy, grey to brown, fine-grained dolomite, 15 ft exposed. Intervening ridge between secs. 14 and 15 exposes at least 25 ft of platy Ship Point dolomite.
16	89844	Creek section east shore of Hall Lake, 68°42′45″N, 81°56′15″W. *Bad Cache Rapids* Formation: thin-bedded, knobby-weathering, microcrystalline, light to medium greyish brown to pinkish grey, fossiliferous limestone, argillaceous partings, 5 ft exposed.
17	89845	Gorge (eastern) section north shore Foster Bay, 68°59′50″N, 81°40′15″W (Trettin, 1975, sec. 405*e*). *Bad Cache Rapids* Formation: thick-bedded to massive, light grey, grey mottled to yellowish orange weathered, fine-grained fossiliferous limestone, argillaceous partings and fossils abundant in upper 20 ft of recessive thin-bedded limestone, 50+ ft exposed.
18	89846	Creek section west of Pinger Point, Foster Bay, 69°05′20″N, 81°28′30″W. *Bad Cache Rapids* Formation: limestone, 5 ft exposed.
19	89847	69°08′05″N, 81°36′15″W. *Bad Cache Rapids* Formation: limestone, 5 ft exposed.
20	89848	69°05′30″N, 81°40′45″W. *Bad Cache Rapids* Formation: limestone, few feet only exposed.
21	89849	Northeast-facing escarpment southeast of Mogg Bay, stream section, 69°14′20″N, 81°46′30″W. *Bad Cache Rapids* Formation: thin-bedded, medium greyish brown, fossiliferous limestone, 30 ft exposed.
22	89850	Southeast-facing escarpment section, Hooper Inlet, 69°22′10″N, 82°15′30″W. *Bad Cache Rapids* Formation: fossiliferous limestone, 30 ft exposed. *Ship Point* Formation: platy, grading upward into massive algal, light grey to tan dolomite, 100 ft exposed.
23	89851	East side Igloolik Island near coast, 69°24′N, 81°30′15″W. *Ship Point* Formation: platy to massive algal, finely crystalline, medium brown, yellowish orange to grey-mottled weathered dolomite, 20 ft exposed.
24	89852	Eastern Igloolik Island, 69°22′30″N, 81°30′15″W. *Bad Cache Rapids* Formation: typical thin-bedded limestone, low exposure.
25	89853	Hill northeast of Igloolik settlement, 69°23′45″N, 81°46′W. *Ship Point* Formation (upper beds): thin- to medium-bedded, finely crystalline, light grey-brown, grey mottled to yellowish tan weathered dolomite, 10 ft exposed.
26	89854	69°25′45″N, 83°06′W. *Ship Point* Formation: thinly laminated dolomite, 5 ft exposed.
27	89855	6 mi north of head of Lailor Lakes, 69°22′45″N, 83°00′30″W. *Ship Point* Formation: platy- to thin-bedded dolomite, low exposure.
28	89856	South-facing escarpment 1 mi north of upper Lailor Lakes, 69°18′30″N, 82°51′15″W. *Ship Point* Formation: medium- to thick-bedded algal, finely crystalline, light brown, light grey to yellowish orange weathered dolomite, 20 ft exposed.
29	89857	Creek section south-central shore upper Lailor Lakes, 69°15′30″N, 82°47′30″W. *Bad Cache Rapids* Formation: thin- to medium-bedded, finely crystalline, light greyish brown, yellowish orange weathered limestone with rare *Maclurites* sp. only, 40 ft exposed.
30	89858	River section 4 mi south of Lailor Lakes narrows, 69°12′30″N, 82°39′15″W. *Bad Cache Rapids* Formation: typical limestone with *Receptaculites* sp., 6 ft exposed.
31	89859	Shore section north side of lake 2½ mi south of Lailor Lakes narrows, 69°14′15″N, 82°38″W. *Bad Cache Rapids* Formation: typical limestone, 20 ft exposed.
32	89860	River section south-central shore, lower Lailor Lakes, 69°13′45″N, 82°28′45″W (Trettin, 1975, sec. 405*d*).

Ordovician sections *(cont.)*

Section	GSC loc.	
		Bad Cache Rapids Formation: thin-bedded to massive, light brown and grey fossiliferous limestone, 25+ ft exposed.
33	89861	Escarpment, 69°09′10″N, 82°23′45″W. *Ship Point* Formation: thick-bedded to massive, tan, grey mottled and yellowish orange weathered dolomite, 4 ft exposed.
34	89862	69°04′35″N, 82°33′W. *Ship Point* Formation: platy, uniformly bedded, finely crystalline, light brown, grey mottled and yellowish orange weathered dolomite, 7 ft exposed.
35	89863	Escarpment, 69°03′30″N, 82°25′45″W. *Ship Point* Formation: thin-bedded, finely crystalline, light buff-grey dolomite, algal, 4 ft exposed.
36	89864 and C-27890	East-facing escarpment 10.5 mi west-southwest Hall Beach, 68°45′N, 81°38′W (Trettin, 1975, sec. 406*a*). *Bad Cache Rapids* Formation: thin-bedded, knobby-weathered, light brown fossiliferous limestone, argillaceous partings, low gentle dip westward, 10 ft exposed. *Ship Point* Formation: thin-bedded, finely crystalline, light grey-tan and brown, yellowish orange mottled dolomite, 4 ft exposed.
37	89865	Creek section north of Quarman Point, 68°32′15″N, 81°31′30″W. *Bad Cache Rapids* Formation: knobby-weathered, finely crystalline to semilithographic, medium greyish brown to greenish mottled, argillaceous limestone, shaly partings, 5+ ft exposed.
38	89866	Small stream cut near shore south of Quarman Point, 68°30′15″N, 81°47′45″W. *Bad Cache Rapids* Formation: thin-bedded, knobby-weathered, finely crystalline, light brown to grey, yellowish orange weathered, argillaceous limestone, *Receptaculites* sp., 3 ft exposed.
39	89867	Narrows between Hall Lake and Roche Bay, 68°31′45″N, 82°35′W. *Ship Point* Formation: thin-bedded dolomite, nearly vertical, 30 ft exposed.
40	89868, 67711, C-2826	Inland east-facing cliff section south of Roche Bay, 68°20′15″N, 82°22″W (Trettin, 1975, southeast of sec. 35). *Bad Cache Rapids* Formation: thick-bedded to massive, knobby-weathered, finely crystalline to semilithographic, light brown to grey fossiliferous limestone, shaly partings and lenses, at least 15 ft capping the main face, possibly 75 ft maximum thickness. *Ship Point* Formation: platy- to thin-bedded, yellowish orange weathered dolomite, 5 ft exposed (more than 100-ft covered interval between the two formations).
41	89869	East-facing section near shore of Ignertok Point, 68°21′30″N, 82°W. *Bad Cache Rapids* Formation: thin-bedded, knobby-weathered, medium greyish brown, argillaceous fossiliferous limestone, shale partings and lenses, 5 ft exposed.
42	89870, 66716, 66754, C-2827	Cliff section from water level up in three faces, westernmost bay, south shore of Roche Bay, 68°22′45″N, 82°18′45″W (Trettin, 1975, sec. 36). *Bad Cache Rapids* Formation: massive- to thick-bedded, fossiliferous limestone, upper face (GSC locs. C-2827, 66754), at least 25 ft thick. Thin- to thick-bedded, sublithographic to finely crystalline, brown fossiliferous limestone, middle face (GSC locs. 66716, 89870), at least 30 ft thick. Similar limestone with large orthoconic cephalopods, 8 ft thick, underlain at water level by 3 ft of argillaceous limestone with shale partings (GSC loc. 89870).
43	89871	2½ mi northeast of head of Hall Lake, 68°57′40″N, 82°14′45″W. *Bad Cache Rapids* Formation: uniformly thin-bedded, laminated dolomite, pavement exposure only.
44	89872	East-facing escarpment west of upper Hall Lake, 68°50′N, 82°28′W. *Ship Point* Formation: thin- to medium-bedded, algal, grey to light brown mottled, yellowish orange weathered dolomite, 15+ ft exposed.
45	89873	Stream section, west-central shore upper Hall Lake, 68°51′45″N, 82°20′45″W. *Bad Cache Rapids* Formation: thin-bedded, microcrystalline, medium brown, orange-mottled limestone, 8 ft exposed.
46	90544	East-central shore Hall Lake, 68°40′N, 81°54′W. *Bad Cache Rapids* Formation: thin-bedded, brown argillaceous limestone.
47	90545	North side of river 4 mi south of lower Lailor Lakes, 69°10′N, 82°30′W. *Bad Cache Rapids* Formation.
48	90546 and 28688	Near mouth of river between Lailor Lakes and Mogg Bay, 69°14′N, 82°15′W. *Bad Cache Rapids* Formation: thin-bedded, finely crystalline, light brown to grey, argillaceous limestone, at least 15 ft exposed.

shows the location of the principal fossil collecting localities. I have listed the megafossils collected from these sections elsewhere in this bulletin (p. 24, 25).

The following additional GSC collections gathered from the Melville Peninsula region were reviewed during the present study:

GSC loc. C-2847
South of Igloolik settlement, 69°20′ N, 81°47′W, H.P. Trettin 1967 collector. **Bad Cache Rapids** Formation: typical limestone, fossils collected include *Receptaculites* sp. (Bolton, this bulletin, p. 27, Pl. 1, fig. 2), *Grewingkia* sp., *Glyptorthis* sp. (*ibid.*, Pl. 11, figs. 4, 5), *Sowerbyella* sp. (*ibid.*, Pl. 13, fig. 8), *Rhynchotrema* sp., *Maclurites* sp., *Deiroceras*(?) sp. (*ibid.*, Pl. 12, figs. 8, 9), *Probillingsites*(?) sp. (*ibid.*, Pl. 16, figs. 2, 7), *Illaenus lacertus*. **Ship Point** Formation: microcrystalline dolomite, 27+ ft exposed.

GSC loc. 91955
Most northern Paleozoic exposure west side of Hoppner Inlet, approximately 66°55′N, 84°W (*see* GSC Map 14–1966), J.E. Reesor 1973 collector. **Bad Cache Rapids** Formation: 20+ ft exposed at top of long ridge, 40+ ft high; fossils collected from foot of exposure include *Receptaculites* sp., *Plasmoporella lambei* (Bolton, this bulletin, p. 30, Pl. 6, figs. 3, 4), *Catenipora* sp., columnal debris, *Strophomena*(?) sp., *Trochonema* sp., calymenid and encrinurid trilobite fragments, and *Krausella* sp.

GSC loc. 66758
Top of southern exposure west side of Hoppner Inlet, 66°55′N, 83°55′W (*see* GSC Map 14–1966), B.G. Craig 1964 collector. **Bad Cache Rapids** Formation: 4- to 6-ft exposure; fossils collected include crinoidal debris, *Resserella* sp., *Maclurites* sp., *Trochonema* sp., *Illaenus lacertus* (Bolton, this bulletin, p. 37, Pl. 18, fig. 4) and leperditiid ostracodes indet.

GSC loc. 66725
Central-east shore of Hoppner Inlet, 66°51′N, 83°50′W (*see* GSC Map 14–1966), W.W. Heywood 1964 collector. **Bad Cache Rapids** Formation: 25 ft of rubbly limestone exposed; fossils collected include *Receptaculites* sp., *Dinorthis* sp., *Sowerbyella* sp., *Zygospira* sp., *Maclurites* sp., *Gorbyoceras baffinense* and lerperditiid ostracodes indet.

GSC loc. 66726
Red Point, southeastern end of Hoppner Inlet, 66°47′N, 83° 54′W (*see* GSC Map 14–1966), W.W. Heywood 1964 collector. **Bad Cache Rapids** Formation: fossils collected include *Grewingkia* sp., *Calapoecia* sp., *Catenipora aequabilis*, *Dinorthis* sp., *Rhynchotrema* sp., *Hormotoma* sp., *Maclurites* sp., *Trochonema* sp., *Cyclendoceras* sp., *Metaspyroceras*(?) sp., *Gorbyoceras* sp., isotelid trilobite fragment and leperditiid ostracodes indet.

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Ordovician Rocks of Melville Peninsula, Southeastern District of Franklin

B.V. Sanford

Introduction

The Lower Paleozoic terrane of Melville Peninsula is composed of relatively flat-lying dolomite, limestone and sandstone up to 520 ft (160 m) thick. Three major Ordovician rock units are recognizable, in ascending order: (*i*) Ship Point Formation (Early and early Middle Ordovician), (*ii*) Bad Cache Rapids Formation (late Middle Ordovician) and (*iii*) unnamed reefal unit (Late Ordovician). The Paleozoic rocks of the region were mapped by H.P. Trettin in 1968 and 1973 (Trettin, 1975).

Eastern Melville Peninsula forms the western part of Foxe Plain (Bostock, 1970), a broad physiographic province that embraces eastern Melville Peninsula, the lowland areas of western Baffin Island and numerous islands of central and northern Foxe Basin. On Melville Peninsula, the plain rises gradually from sea level in the east to 500 ft (150 m) in the west, where the Paleozoic terrane is bounded by Precambrian rocks that rise abruptly above the lowland along a contact bounded by fault-line scarps.

Although relatively flat, the surface character of eastern Melville Peninsula is variable. There are extensive areas of low swampy and grassy tundra with numerous lakes, of which Hall Lake, in the southwestern part of the lowland, is the largest. The tundra gives place at slightly higher elevations to gravel locally derived from the more resistant Paleozoic carbonate strata exposed on the peninsula. This gravel occurs as raised beaches (Fig. 1) that developed during isostatic rebound along the receding shoreline of the Pleistocene Tyrrell Sea (Craig, 1969). Finally, within Paleozoic terrane prominent escarpments and buttes are locally developed in resistant late Middle Ordovician carbonate rocks that overlie early Middle Ordovician strata.

Although the Paleozoic rocks of Melville Peninsula dip in random directions because of block faulting, the dominant regional dip is eastward beneath Foxe Basin. The tectonic setting of Foxe Basin (Fig. 2) is not fully understood, nor is it known whether the present structural depression was a basin per se in Ordovician and Silurian times, or whether its present definition is a result of subsequent tectonism. The basin is bounded mainly by normal faults along which Precambrian crystalline rocks have been uplifted relative to Paleozoic strata. Foxe Plain thus apparently falls within the definition of a stable interior basin formed and preserved as a taphrogenic graben because of extensive basement adjustment in post-Middle Silurian time.

Regional paleogeological setting of Melville Peninsula in Ordovician time

The Paleozoic basins and grabens that form the present Hudson Platform and southeastern Arctic Platform (Foxe Plain) are erosional remnants of a much broader cratonic

Figure 1. Raised beaches near Roche Bay, section 41, GSC loc. 89869.

Geol. Surv. Can., Bull. 269, 1977.

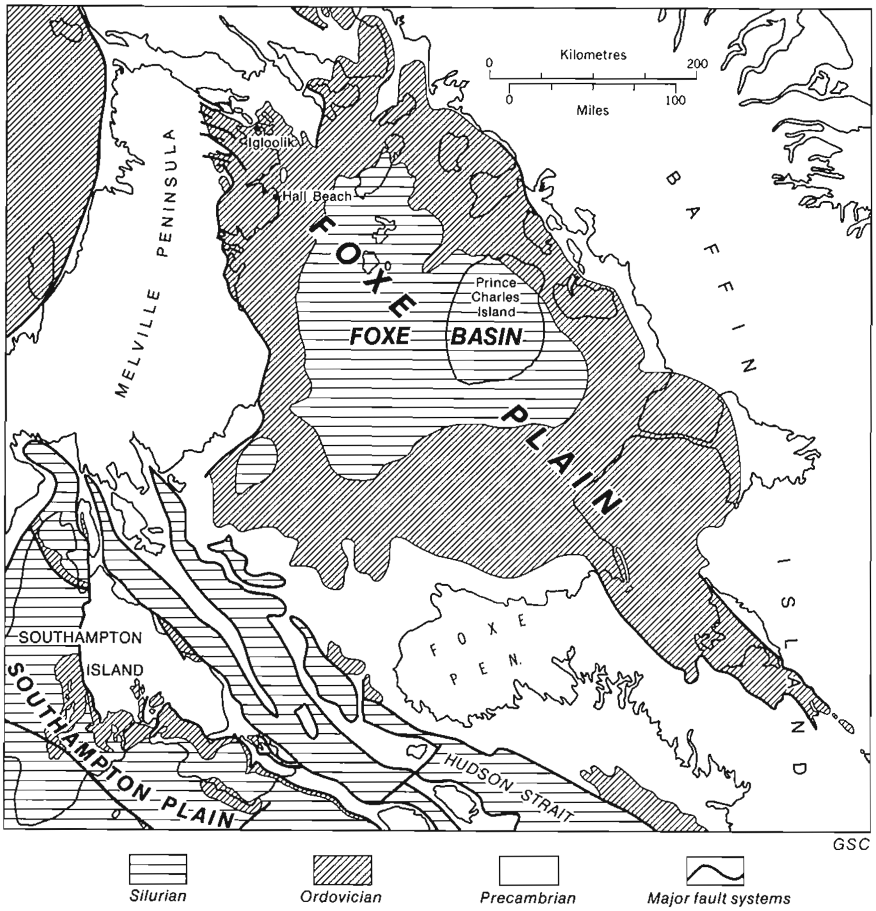


Figure 2. Index map showing the distribution of Ordovician and Silurian rocks in Foxe Basin and immediately adjacent areas.

cover that once mantled much of the Canadian Shield (hereinafter referred to as *Eastern Craton*). It connected the Paleozoic rocks of the St. Lawrence Platform to the south, the Arctic Platform to the northwest and the Interior Platform to the west (Figs. 3, 4). The Precambrian terrane lying within and immediately adjacent to the Hudson Platform and nearby Foxe Plain is known to have been tectonically active at various intervals during the Phanerozoic. The resulting positive uplifted areas are referred to (in order of significance) as Fraserdale, Bell, Severn and Cape Henrietta Maria arches (Fig. 3).

A proto-Atlantic ocean is assumed to have been present in early Paleozoic time, off the continental margins of eastern North America. Initially, in Cambrian and Early and early Middle Ordovician times, the continental margins may have been similar to the present Atlantic miogeocline with the dispersal of clastics essentially away from the craton and into a spreading ocean basin. In the late Middle Ordovician and later when the proto-Atlantic presumably was contracting, allochthonous slices were stacked and tectonic land (Appalachian Orogen) ultimately emerged along the southeastern margins of North America. Terrigenous clastics from late Middle Ordovician time onward were dispersed onto the craton instead of away from it, where they gave place to a variety of carbonate and, locally in the northwest, evaporitic facies.

On the bases of detailed and broad regional studies of Paleozoic terranes over much of eastern Canada, some reconstruction of ancient shorelines, facies and paleogeography is possible. The five major Ordovician marine inundations of the Eastern Craton that deposited the carbonate and sandstone strata presently preserved on Melville Peninsula and adjacent areas of Foxe and Hudson Bay basins are briefly described and illustrated in the following sections (Figs. 5–9).

Early Ordovician (Canadian) transgression-regression

Although parts of the St. Lawrence and Arctic platforms are known to have been covered by Cambrian seas, the initial marine inundation of Foxe Basin was probably not until the Early Ordovician Canadian Stage. The reconstructed limit of marine transgression, the facies that developed during that period and the ensuing process of regression are illustrated in Figure 5. Remnants of strata of assumed Canadian age are preserved in Foxe Plain and eastern Labrador (Barnes, 1974, p. 228); the latter region provides possible evidence that eastern Arctic and St. Lawrence platforms were connected during the Early Ordovician Period. On Melville Peninsula, Lower Ordovician rocks rest directly on Precambrian rocks and comprise a basal unit of orthoquartzitic sandstone succeeded by sandy dolomites here referred to informal units 1 and 2 of the Ship Point Formation. The beds are relatively unfossiliferous and are tentatively considered to be of Early Ordovician Canadian age, on the basis of their stratigraphic position and minor discordant relationship to well dated succeeding strata of early Middle Ordovician age. Large carbonate erratics found in two widely separated parts of Labrador are assumed to be representative of sediments

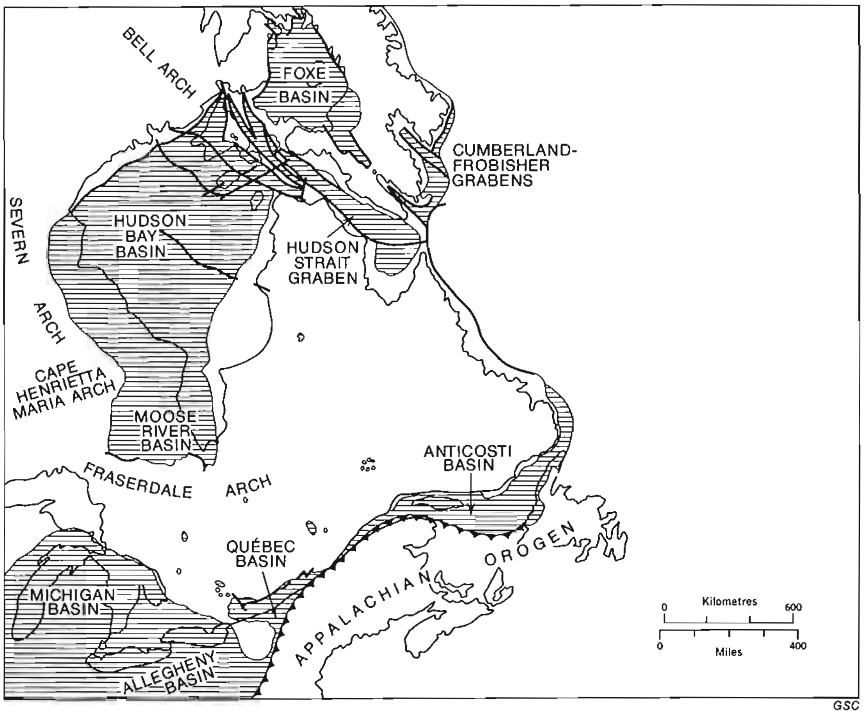


Figure 3. Lower Paleozoic tectonic provinces of eastern Canada.

deposited in that region; their contained fossils correlate with rocks of well established Canadian age in the St. Lawrence Platform (Romaine Formation and St. George Group of Anticosti Basin) and elsewhere in eastern North America.

In the initial phase of sedimentation, sand derived from the Canadian Shield was deposited locally along the shoreline of the transgressing sea, giving place to carbonate in a basinward direction. As the sea regressed, carbonate sedimentation representative of a variety of tidal flat, shelf lagoon and open marine depositional environments prevailed. Fluvial deltaic deposits of fine and coarse terrigenous clastics are commonly associated with the carbonate regimes and the former were probably transported into the system by a network of rivers and streams originating on the Canadian Shield.

Near the close of Early Ordovician time, the sea had retreated completely from the craton and adjacent continental shelf, resulting in a period of varied but widespread erosion including the area now occupied by Melville Peninsula.

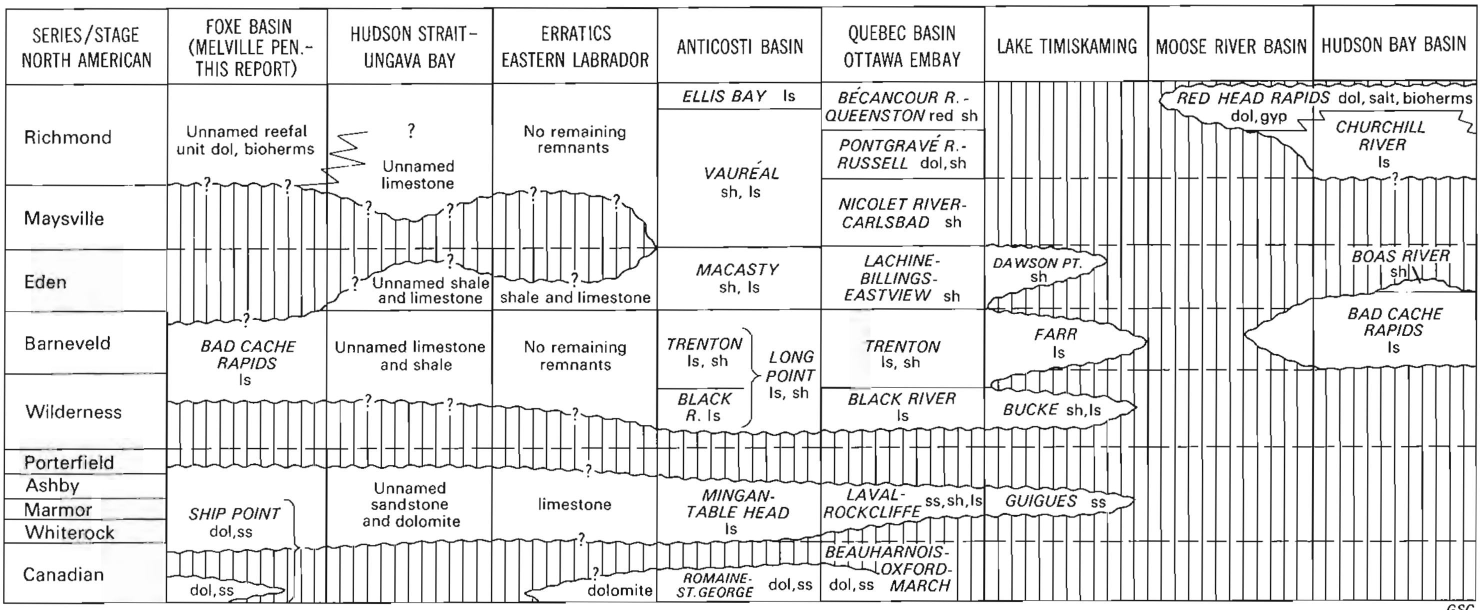


Figure 4. Classification and correlation of Ordovician rocks in eastern Canada.

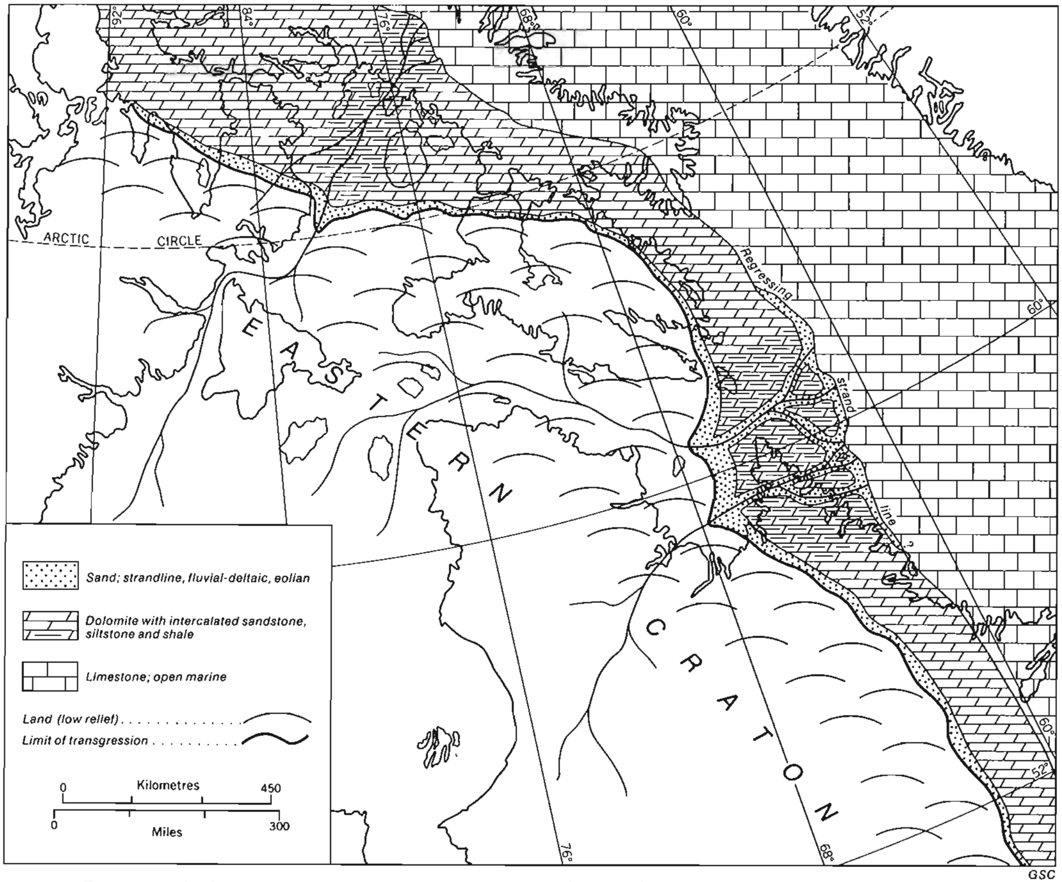


Figure 5. Early Ordovician (Canadian) paleogeography and facies.

Early Middle Ordovician (Whiterock-Marmor-Ashby-Porterfield) transgression-regression

The second, more widespread, inundation prevailed throughout the early Middle Ordovician Whiterock to Porterfield stages. The reconstructed limit of transgression of the Whiterock–Marmor–Ashby–Porterfield sea may have slightly overlapped previously deposited Lower Ordovician sediments in Foxe Plain and extended southward through Labrador to Anticosti Basin, thence westward along the St. Lawrence Platform. In Foxe Plain, rocks representative of this transgression are dolomite with minor sandstone, siltstone and shale of informal units 3 and 4 of the Ship Point Formation (Fig. 6). Equivalent strata resting on Precambrian rocks were encountered in a drillhole on Akpatok Island in Ungava Bay. There the beds consist of sandstone, siltstone, shale and silty dolomite, approximately 1000 ft thick and dated as Middle Ordovician. Conodonts of Whiterockian age have been identified at depths of 968–1067 ft in the drillhole (C.R. Barnes, GSC Fossil Report 04–1974–CRB). The beds are nowhere exposed in that area, but are believed to form the bedrock surface beneath Ungava Bay and along the northern part of Hudson Strait (Sanford *et al.*, *in press*). Limestone erratics with early Middle Ordovician fossils have been found at two widely separated localities in Labrador (C.R. Barnes, GSC Fossil reports 01–1970–CRB and 02–1974–CRB). We presume that rocks of this lithology, such as the Ship Point strata of Melville Peninsula, were deposited penecontemporaneously with limestone, minor sandstone and shale of the Mingan and Table Head formations of Anticosti Basin and equivalent strata in Quebec Basin and Ottawa Embayment (Laval and Rockcliffe formations, respectively).

During the early Middle Ordovician Period (Whiterock to Porterfield stages) deposition consisted largely of carbonate with a thin basal sand presumably composed of reworked Lower Ordovician sands, and primary sand, the latter derived from the Canadian Shield as the sea initially encroached upon it. Many of the carbonate sediments represent a variety of tidal flat and lagoonal environments and apparently were deposited during regression of the early Middle Ordovician sea. At the same time, river systems originating on the Canadian Shield were transporting fine and coarse clastics toward the continental shelf where they were deposited in a variety of lagoonal, fluvial-deltaic and prodeltaic marine environments.

At the close of the Whiterock–Marmor–Ashby–Porterfield stages, the sea again withdrew completely from the Eastern Craton, initiating a period of subaerial erosion throughout the Arctic and St. Lawrence platforms and intervening areas of the craton.

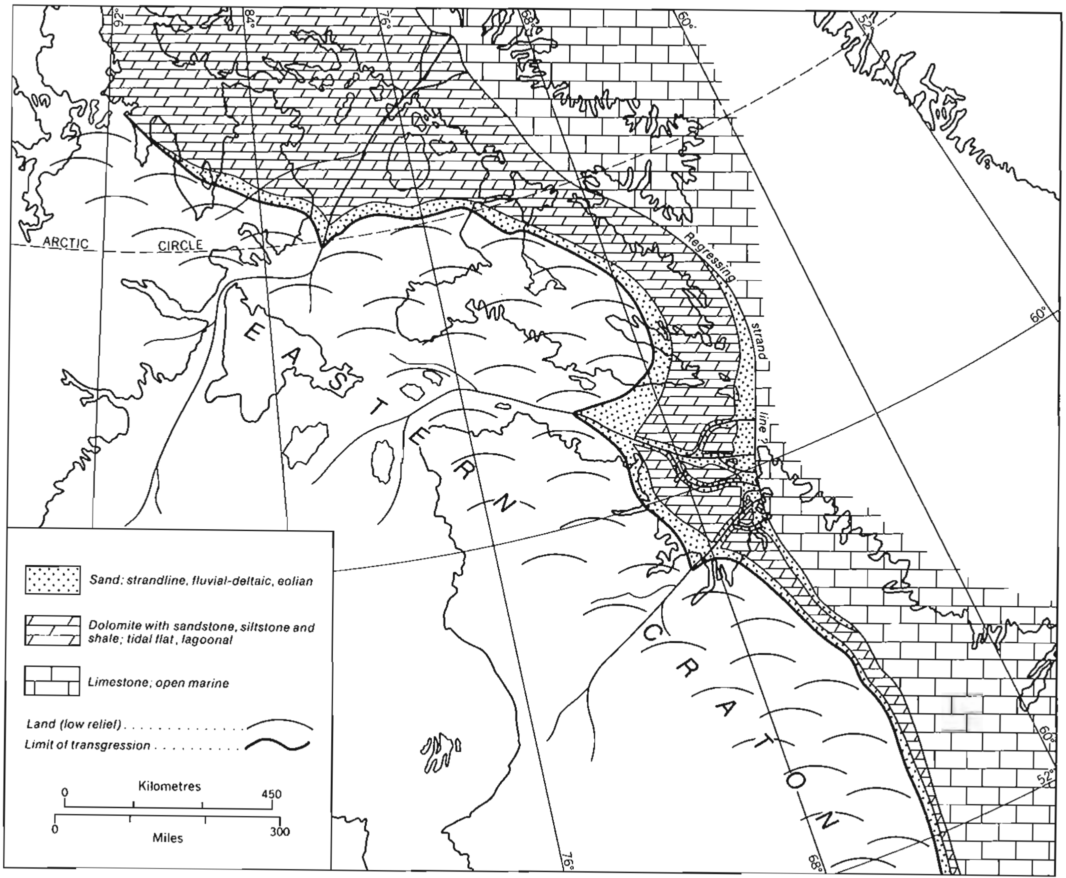


Figure 6. Early Middle Ordovician (Whiterock-Marmor-Ashby-Porterfield) paleogeography and facies.

Late Middle and early Late Ordovician (Wilderness-Barneveld-Eden) transgression-regression

A third and considerably more widespread Ordovician transgression was initiated in the Wilderness Stage and continued uninterrupted into the succeeding Barneveld, terminating during the Eden Stage. Initially (Wilderness), the central core of the craton was emergent and sedimentation was confined to Foxe Plain, Ungava Bay and eastern Labrador(?), southern Canadian Shield and adjacent St. Lawrence Platform (Fig. 7). In Foxe Plain the Wilderness Stage is represented by the lower few feet of dolomitic limestone and limestone of the Bad Cache Rapids Formation, and in southern Baffin Island and Ungava Bay by interbedded limestone and shale (unnamed beds). Rocks of Wilderness age have now been completely eroded from the eastern margin of the craton (Labrador and northern Quebec) but are preserved as outliers at widely separated areas on the southern Canadian Shield and on the St. Lawrence Platform, where they are variously referred to Long Point Formation (eastern Anticosti Basin) and elsewhere to Black River and Trenton groups.

During the Wilderness Stage the Canadian Shield had become vastly reduced in area and topographic relief; this was significantly reflected in the character and volume of clastic sediments deposited in the rapidly encroaching sea. Limestone of open-marine origin is everywhere the dominant rock type and is commonly underlain by a veneer of basal sandstone, siltstone and shale where older Paleozoic strata have been overlapped and Wilderness age rocks rest directly on the Precambrian Shield. Exceptions to this dominant limestone lithology occur in Ungava Bay and southern Baffin Island, where much of the Wilderness Stage is represented by shale interbedded with limestone, presumably a product of deposition near the outlets of mature river systems.

In the succeeding Barneveld-Eden stages (Fig. 8), continued closing of the proto-Atlantic Ocean and the accelerated emergence of tectonic highlands along the continental margins of eastern North America appear to have had a twofold effect on sedimentation processes on the craton: (*i*) the sea deepened and gradually covered most of the Canadian Shield with marine sediments and (*ii*) it brought about the dispersal of fine and coarse clastics onto the craton instead of away from it as in earlier Ordovician events.

In Barneveld-Eden time, thick, fine, black terrigenous euxinic sediments were deposited in elongated troughs along the continental margins of southeastern North America; these intertongued with upper Trenton limestone on the St. Lawrence Platform and ultimately succeeded the limestone to spread far across the eastern craton. The limestone that was deposited in

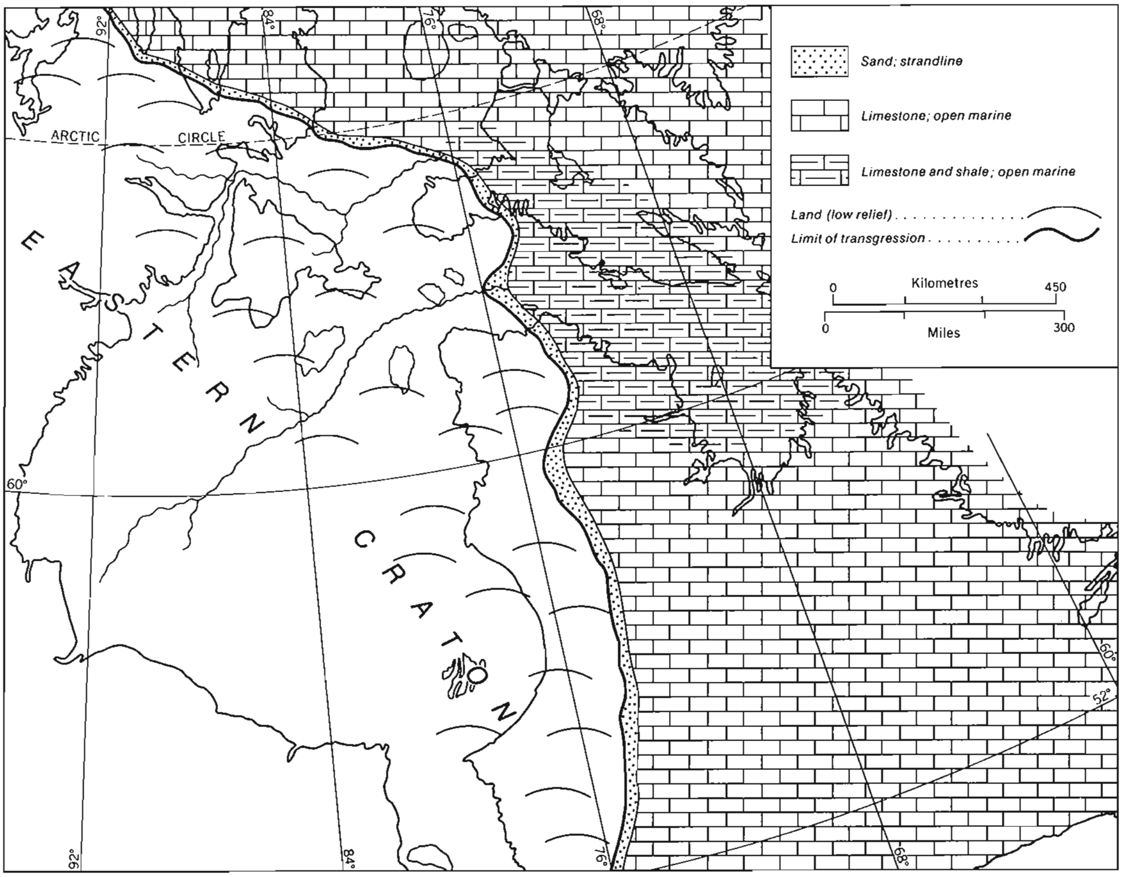


Figure 7. Late Middle Ordovician (Wilderness) paleogeography and facies.

the Barneveld–Eden transgression is referred to Bad Cache Rapids Formation in Hudson Platform and Foxe Plain. Here this formation is a relatively uniform sequence of fossiliferous, medium to dark brown micritic limestone of open-marine origin commonly with a thin sandy and shaly unit at the base, in areas where the strata have overlapped older Ordovician (Canadian Wilderness) rocks to rest directly on the Precambrian (Fig. 8). Limestone of Barneveldian and early Edenian age is present throughout the Hudson Platform and Foxe Basin and in the numerous Paleozoic remnants beneath Foxe Channel, Hudson Strait and Ungava Bay (Sanford *et al.*, *in press*). It also occurs as outliers in widely separated parts of the Canadian Shield, including Lake Timiskaming (Farr Formation), Clearwater Lake and elsewhere.

The black shale facies that was transported far to the northwest across the Eastern Craton during the Eden Stage is now preserved only as erosional remnants at such widely separated localities as Lake Timiskaming outlier (Dawson Point Formation), Southampton Island (Boas River shale) and on Akpatok Island in Ungava Bay. In Foxe Plain fossiliferous black, calcareous shale boulders bearing Edenian trilobites have been reported from glacial drift (Wilson, *in* Soper, 1928, p. 128). However, its absence on a broad regional scale in this and other stable interior basins of the Hudson Bay region may be due to intensive subaerial erosion that followed regression of the sea in late Edenian time.

Following this widespread late Middle to early Late Ordovician inundation, the sea again withdrew from the central and northern portions of the craton, initiating a period of widespread subaerial erosion that may have extended from the late Eden through Maysville(?) to early Richmond.

Late Ordovician (Maysville?–Richmond) transgression-regression

In latest Ordovician time, river systems flowing northward from the Appalachian highlands were dispersing coarse and fine clastics (delta complexes) onto the craton where they intertongued with carbonate and evaporite facies to the northwest (Fig. 9). As in the preceding Barneveld–Eden transgression, the Richmond sea probably covered much of the Canadian Shield, although remnants of these strata are now preserved only in St. Lawrence and Hudson platforms, Foxe Plain and in grabens beneath Hudson Strait and Ungava Bay (Sanford *et al.*, *in press*). In Hudson Bay Basin the Richmond Stage is represented by two major units. A lower, Churchill River Group is composed of fossiliferous limestone. This is succeeded by relatively unfossiliferous laminated dolomite of the Red Head Rapids Formation locally containing bioherms along the basin margins (Southampton Island) and evaporites (halite and gypsum) in the central basin. The latter were produced by increased salinity, possibly from the progressive lowering of sea level and local restriction of the Late Ordovician Richmond sea.

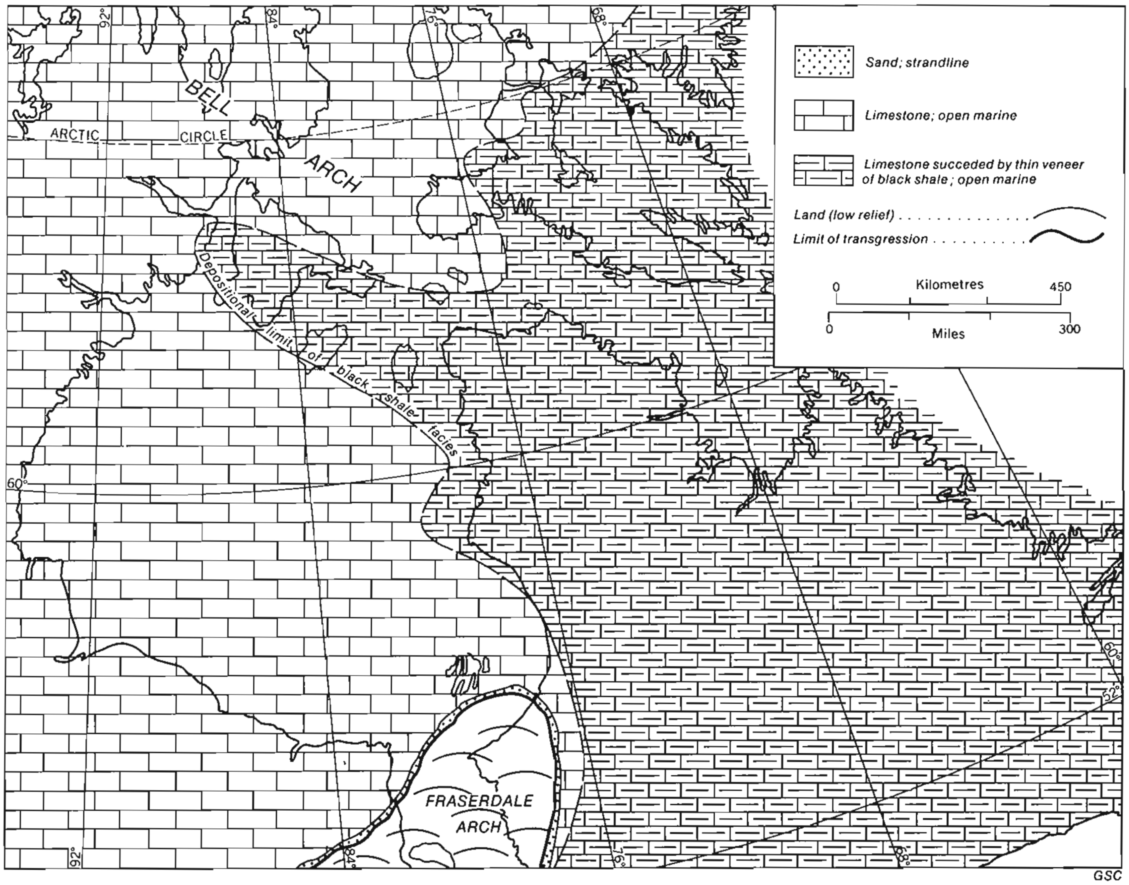


Figure 8. Late Middle Ordovician and early Late Ordovician (Barneveld-Eden) paleogeography and facies.

The writer did not recognize fossiliferous limestone typical of the Churchill River Group anywhere on eastern Melville Peninsula. The Upper Ordovician rocks of this region consist mostly of thin, evenly bedded bituminous dolomite similar to the Red Head Rapids Formation of nearby Southampton Island. The dolomite, tentatively referred to as 'unnamed reefal unit,' rests disconformably on the Bad Cache Rapids Formation and is probably coeval with the combined Churchill River Group and Red Head Rapids Formation of Hudson Bay Basin. In contrast, however, to the algal framework of the Red Head Rapids reefs, those on Melville Peninsula contain corals and other marine fossils (in association with algal and stromatolitic framework) and are believed to have been deposited on a subsiding platform bordering an open seaway on the northeast.

At the close of Ordovician time, the sea regressed from the central and northern craton, initiating a period of subaerial erosion that extended through Early Silurian (early Llandoverian) time. Seven succeeding Silurian and Devonian marine transgressions are assumed to have inundated the southern and central portions of the Canadian Shield, until the end of the Late Devonian period.

Stratigraphy

Ordovician rocks of eastern Melville Peninsula are about 520 ft (160 m) thick and are divisible into three major rock stratigraphic units: Ship Point Formation, Bad Cache Rapids Formation, and unnamed reefal unit (Fig. 10). The geological sketch map of eastern Melville Peninsula (Fig. 11) is based largely on work by H.P. Trettin with some changes and additions by the writer.

Ship Point Formation

The oldest Paleozoic rocks of Melville Peninsula are of late Early and early Middle Ordovician age and are 300 or more feet (90 m) thick. The formation rests unconformably on Helikian gneiss and is succeeded disconformably by dolomitic limestone and limestone of the Middle Ordovician Bad Cache Rapids Formation.

The Ship Point Formation forms the bedrock surface over some 100 mi (160 km) along the Paleozoic-Precambrian boundary between Hooper Inlet and Parry Bay and is exposed to good advantage at numerous localities throughout this area (Fig. 11). The most complete sections are at Roche Bay, Igloolik Island and Quilliam Bay. Quilliam Bay displays a nearly complete section exposed in a succession of benches. Its distribution south of Parry Bay is unknown but the formation presumably extends in subsurface south of the outcrop belt and is eventually disconformably overlapped by Bad Cache Rapids limestone along the southern margins of Foxe Basin.

The writer examined Ship Point sections at 18 localities between Igloolik Island and Roche Bay; over this distance the

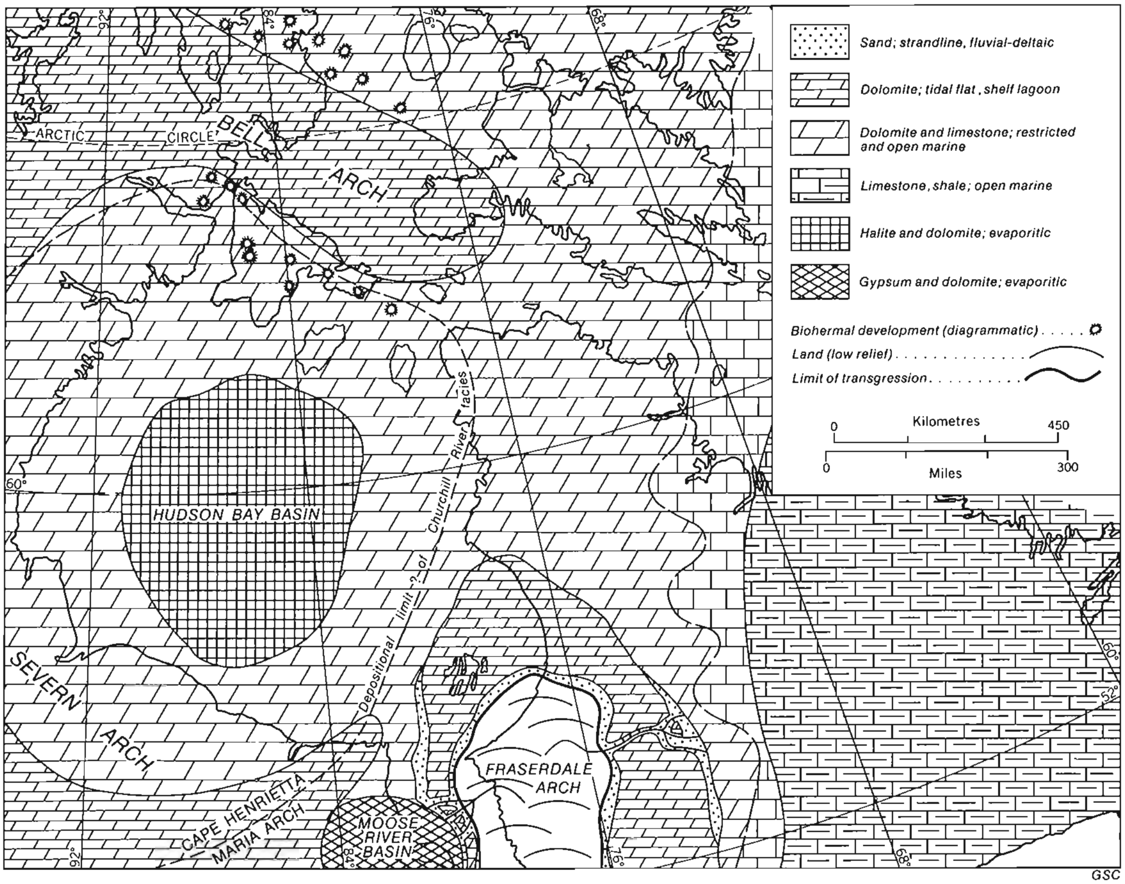


Figure 9. Late Ordovician (Maysville?–Richmond) paleogeography and facies.

formation maintained a relatively uniform lithological character. Four distinctive units or members of informal status were identified. They are described in ascending order.

Unit 1 is white, light grey and salmon-pink, medium- and coarse-grained, friable orthoquartzitic sandstone commonly containing a thin basal arkosic conglomerate resting directly and unconformably on Precambrian rocks. The sand grains are well rounded, commonly frosted and faceted, and were probably originally cemented by calcium carbonate, which has been removed by interstitial solution leaving the framework in its present unconsolidated state. Concentric structures are abundant on the weathered surface of the sandstone (Fig. 12). The origin of these structures is unknown but they may have once been pseudocarbonate concretions that were slightly more resistant to processes of erosion than the normal sandstone beds in which they are enclosed. The basal sandstone strata are about 40 ft (12 m) thick in the Quilliam Bay area, and appear to thicken slightly to the southwest, the probable source area of the detritus.

Gradationally succeeding the basal sand is *unit 2*, consisting of tan, medium grey and locally red, fine to medium crystalline and argillaceous dolomite in massive, resistant beds up to 2 or 3 ft (0.6 or 0.9 m) thick that weather yellowish orange and grey mottled. Many beds are laminated and contain an algal framework that locally swells into reeflike lenses or biohermal mounds (Fig. 13). The beds generally are sandy at the base with infrequent sandy intervals throughout, contain sporadic flat pebble conglomerate and are highly fucoidal at random horizons. Unit 2 varies in thickness from 25 ft(?) (7.5 m(?)) to 55 ft (16.5 m). A prominent stratigraphic break at the top of the unit may represent an erosional disconformity.

The dominant lithology of the Ship Point Formation is characterized by *unit 3*, which is composed of some 200 ft (60 m) of light grey-tan and locally red microsucrosic dolomites that weather yellowish grey in beds ½ to 4 in. (1.25 to 10 cm) and locally up to 7 in. (18 cm) thick (Fig. 14). The beds are uniformly platy, laminated, evenly bedded and commonly contain stromatolites, fucoidal zones, well developed ripple markings, intraformational breccia and flat pebble conglomerate at random intervals throughout the unit. Unit 3 often contains sandstone, sandy dolomite and red and grey-green shale interbeds, confined mainly to the lower part of the unit.

The uppermost beds of the Ship Point Formation are those characterized by *unit 4*. They consist of light grey-tan and orange mottled algal and vuggy dolomite that weathers yellowish orange and grey mottled. The beds, 3 to 6 in. (7.5 to 15 cm) thick, are hard, more resistant and more massive weathering than the underlying strata of unit 2 and therefore tend to form low escarpments. The thickness is highly variable ranging from barely a veneer to 25 ft (7.5 m) or more.

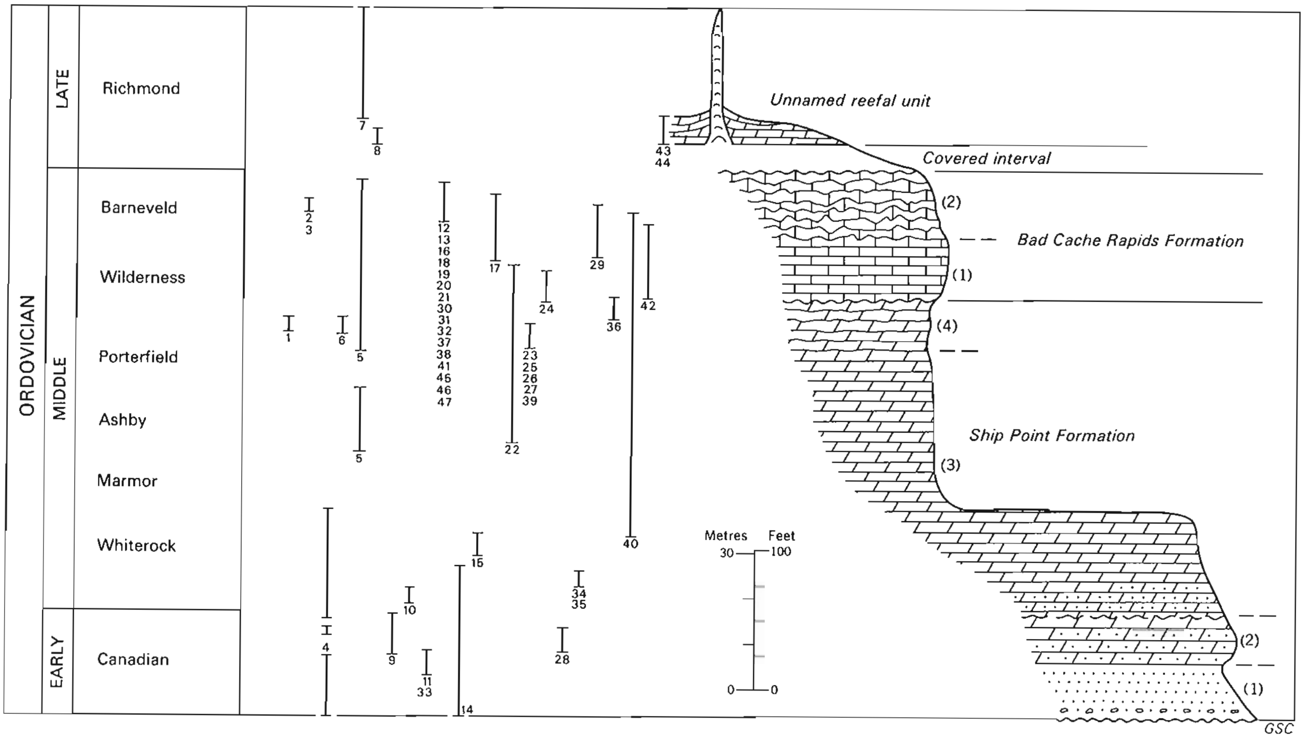


Figure 10. Generalized Ordovician succession of Melville Peninsula.

The age of units 1 and 2 of the Ship Point Formation is uncertain but is considered Early Ordovician, primarily because they underlie known early Middle Ordovician rocks. On the basis of conodonts, Barnes (this bulletin) has placed the bulk of the Ship Point (units 3 and 4) in the early Middle Ordovician Whiterock to Porterfield Stage; this designation fits very well with the paleogeological reconstruction of that period described previously. No diagnostic megafossils were found in the sections examined.

Bad Cache Rapids Formation

Middle Ordovician (and younger?) limestone that overlies the Ship Point dolomite in the eastern Arctic Platform has been traditionally assigned to the Baillarge Formation but because the upper limit of that formation is generally ill defined and may include Middle Silurian strata, the term is not considered applicable in the Foxe Basin region. Instead, the term Bad Cache Rapids Formation, originally proposed by Nelson (1964) for late Middle Ordovician limestone in Hudson Bay Lowlands and later adopted for mapping purposes on Southampton and Coats islands in northern Hudson Bay (Heywood and Sanford, 1976), is further extended to include strata in eastern Melville Peninsula. There, the formation includes resistant limestone and minor dolomite that disconformably overlie Ship Point dolomite and disconformably underlie the unnamed reefal unit of Late Ordovician age.

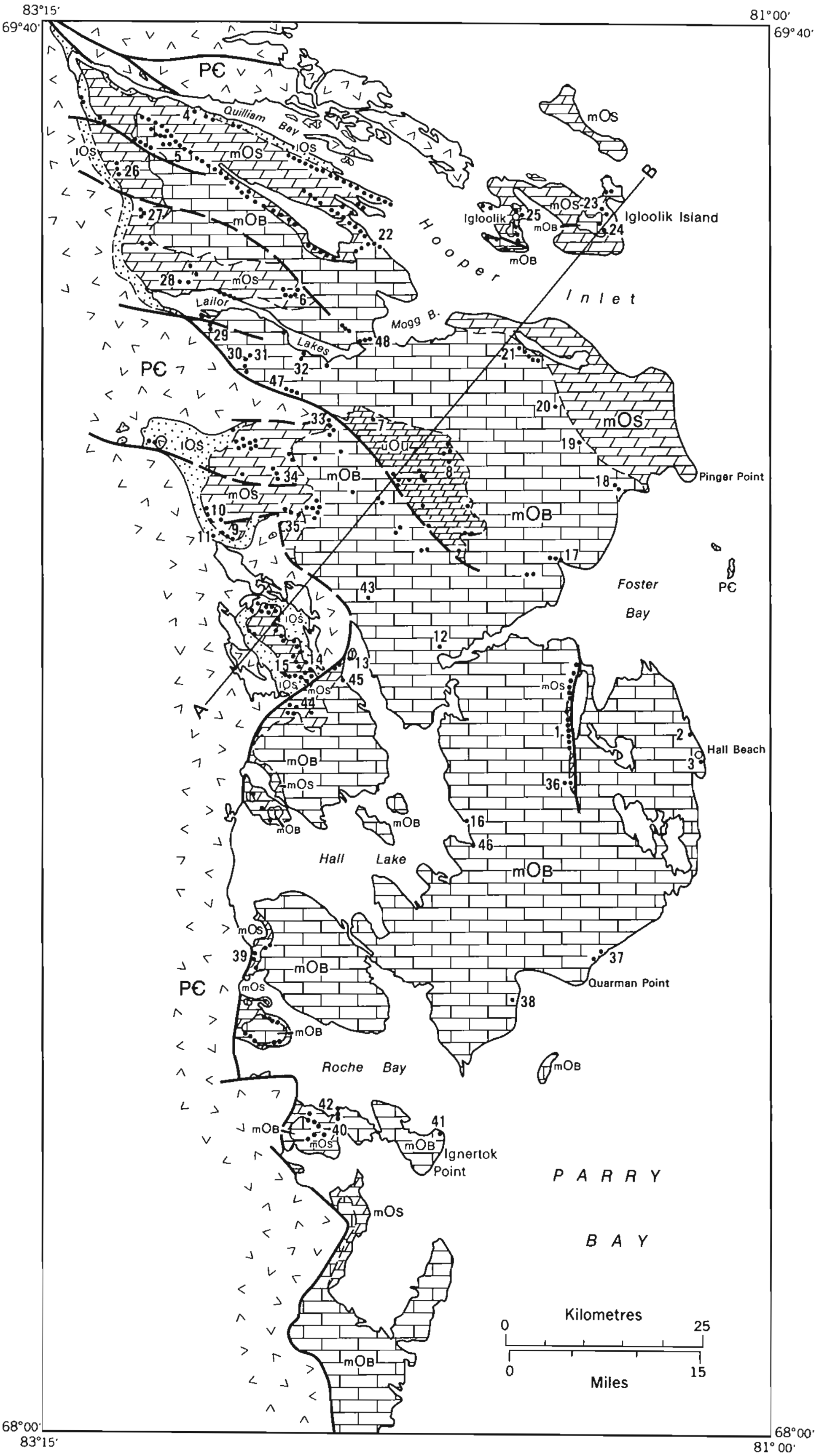
The Bad Cache Rapids Formation forms the bedrock surface over much of eastern Melville Peninsula and is well exposed at several localities between Igloolik Island and Roche Bay, about 100 mi (160 km), with the most complete sections near Quilliam Bay and at Roche Bay (Fig. 11). The thickness of the formation is not precisely known but slightly more than 100 ft (30 m) of strata is exposed south of Quilliam Bay; this seems to represent nearly the complete sequence.

The writer examined 26 sections of Bad Cache Rapids Formation in widely separated parts of Melville Peninsula and noted two lithological units of informal status:

Unit 1, up to 50 ft (15 m) thick, rests disconformably on the Ship Point Formation and consists of light brown, microcrystalline dolomitic limestone grading upward to limestone that weathers light grey with minor yellowish orange mottling (Figs. 15, 16). Although usually 2 to 4 in. (5 to 10 cm) thick, the relatively uniform beds are massive and resist weathering. Thus, where these rocks overlie the somewhat less resistant dolomite of the Ship Point Formation, they generally form a conspicuous escarpment along the erosional boundary. Beyond the erosional edge of the Bad Cache Rapids Formation, remnants of the formation rise abruptly above the lowland to form conspicuous buttes up to 100 ft (30 m) high.

Unit 2 of the Bad Cache Rapids Formation, up to 50 ft (15 m) thick, gradationally succeeds and resembles unit 1 in gross lithology except that the beds are thinner; they are also highly irregular (½ to 2 in. [1.25 to 5 cm] thick), presumably from greatly increased algal content (Fig. 17). In addition, unit 2 weathers grey and rusty orange mottled, a characteristic common to Bad Cache Rapids strata observed on Southampton and Coats islands, in Hudson Bay Lowlands and as outliers on the Canadian Shield.

The age of the Bad Cache Rapids Formation on Melville Peninsula is described elsewhere in this paper but in general the megafauna is similar to that of the Bad Cache Rapids strata of Barneveldian age in Hudson Bay Lowlands and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Hooper Inlet
Igloolik
Igloolik Island
Pinger Point
Foster Bay
Hall Beach
Hall Lake
Quarman Point
Roche Bay
Ignertok Point
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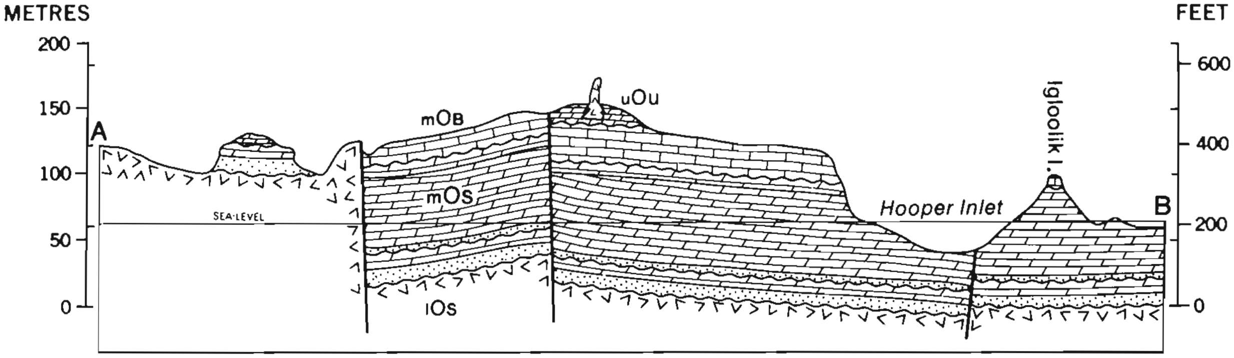

GENERALIZED STRUCTURE SECTION A - B

LEGEND

UPPER ORDOVICIAN

uOu *Unnamed reefal unit: dolomite, brown, sucrosic and bituminous, thin bedded, containing biohermal structures*

MIDDLE ORDOVICIAN

mOB *BAD CACHE RAPIDS FORMATION: limestone, dark brown, micritic, uniform to nodular bedded, massive weathering*

mOs *SHIP POINT FORMATION (units 3 and 4): dolomite, grey and tan, microsucrosic, thin uniformly bedded*

LOWER (?) ORDOVICIAN

lOs *SHIP POINT FORMATION (units 1 and 2): sandstone, red and grey, medium grained, and dolomite, tan, sucrosic, massive weathering, containing small algal mounds*

PRECAMBRIAN

Gneissic rocks undivided

Observed outcrop . . . . •

Field station number . . . . 40•

Fault: position defined, approximate . . ——— ——

Contact: defined, approximate . . . . . ～ – –

Geology by: H.P. Trettin, 1968, 1973 and B.V. Sanford, 1973

Compiled by B.V. Sanford, 1975

GSC

Figure 11. Geological sketch map of eastern Melville Peninsula *(above and opposite).*

Southampton Island and the units are considered coeval. The main distinction is the colonial coral *Labyrinthites* (*Labyrinthites*) *chidlensis* Lambe and the cephalopod *Gonioceras* sp. in the lowermost strata of the Bad Cache Rapids Formation. These fossils are herein considered diagnostic of the Wilderness Stage and we therefore conclude that sedimentation in Foxe Basin, Ungava Bay and Labrador may have been initiated earlier in the late Middle Ordovician, with Barneveldian sediments progressively overlapping Wildernessian sediments as the sea progressively transgressed the central portion of the Canadian Shield.

Unnamed reefal unit

Disconformably(?) succeeding the Bad Cache Rapids limestone are about 30 ft (9 m) or more of dolomite and associated bioherms, here informally referred to as the 'unnamed reefal unit,' which represent the youngest Paleozoic strata on eastern Melville Peninsula. The unit underlies a small isolated belt between Mogg Bay and Foster Bay, where it is preserved along the downthrown side of a tilted fault block (Fig. 11). These rocks undoubtedly are present throughout Foxe Plain, but have not been previously recognized as a separate rock unit.

The unnamed unit is composed principally of interreefal strata of flat-lying, medium to dark brown, bituminous sucrosic dolomite in thin, uniform platy beds ½ to 4 in. (1.25 to 10 cm) thick. At several localities these flat-lying strata grade into light brown and tan sucrosic dolomite in beds 6 in. (15 cm) or more thick with random dips of 5 to 10 degrees. These strata were nowhere observed in contact with a reef, but are interpreted as flanking off-reef beds deposited as carbonate detritus from a nearby bioherm.

Contained within the interreefal facies is a profusion of pinnacle reefs, ½ mi (0.8 km) or more in diameter, which rise as klintar up to 100 ft (30 m) above the floor of the lowland (Fig. 18). The reef cores consist primarily of light to medium brown algal and stromatolitic limestone framework. They are very similar to Red Head Rapids reefs mapped by the writer on Southampton Island (Heywood and Sanford, 1976), except that in eastern Melville Peninsula marine conditions in the latest Ordovician must have been somewhat more open-sea environment, and more conducive to the proliferation of corals and other marine organisms.

The paleofavositid corals and other fossils of the reef (Bolton, this bulletin) and conodonts from the interreefal beds (Barnes, this bulletin) are Late Ordovician and this agrees with the dating by means of conodonts of the lithologically similar Red Head Rapids reef-bearing strata of Southampton Island (Barnes, 1974, p. 235). On Melville Peninsula, however, these strata lie disconformably on late Middle Ordovician Bad Cache Rapids Formation, whereas on Southampton Island, Red Head Rapids strata lie gradationally on the Late Ordovician Churchill River Group. To explain this discrepancy, we must assume either that the eastern Arctic Platform (Foxe Basin) was initially emergent in the Late Ordovician while Churchill River limestone was accumulating in adjacent Hudson Bay Basin, or that the Churchill River limestone and Red Head Rapids Formation are time equivalent, the latter facies dominating sedimentation in the Late Ordovician on the stable basin-margin platforms.

The writer favours the second alternative. On the northern margin of Hudson Bay Basin, Churchill River strata thin

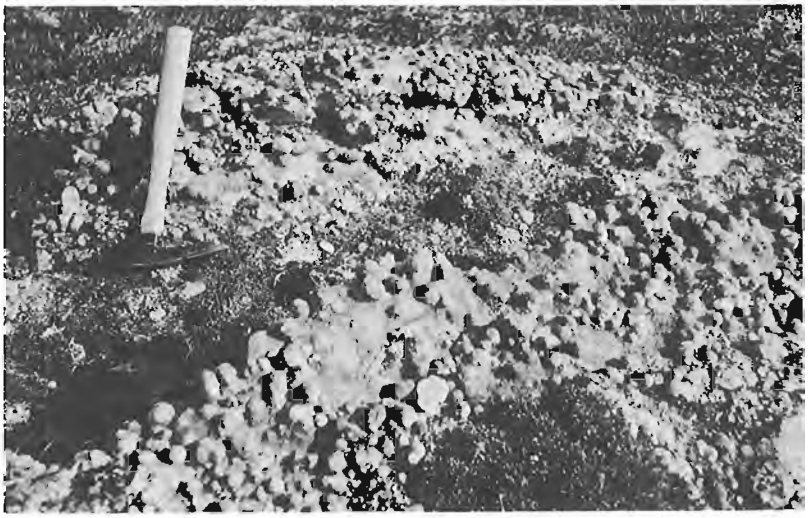

Figure 12. Weathered surface of basal Ship Point sandstone, west of Hall Lake, section 14, GSC loc. 89842.

Figure 13. Algal mounds in lower carbonate beds of Ship Point Formation, west of Hall Lake, section 15, GSC loc. 89843.

Figure 14. Thin laminated beds of Ship Point Formation, near Roche Bay, section 40, GSC loc. 89868.

Figure 15. Bad Cache Rapids dolomitic limestones resting disconformably on Ship Point dolomites, near Quilliam Bay, section 5, GSC loc. 89833.

Figure 16. Lower uniformly bedded limestones of the Bad Cache Rapids Formation, south of Lailor Lakes, section 29, GSC loc. 89857.

Figure 17. Upper irregularly bedded limestones of the Bad Cache Rapids Formation, island north end of Hall Lake, section 13, GSC loc. 89841.

Figure 18. Core of a bioherm, composed mostly of algal framework, section 7, GSC loc. 89835.

appreciably towards Bell Arch and the succeeding Red Head Rapids Formation correspondingly thickens. The two rock units are therefore partly equivalent lateral facies and the Red Head Rapids Formation (or unnamed reefal unit) is a product of the shallow marine or tidal flat environment, that dominated sedimentation on the stable Hudson Bay Basin margins and on the Arctic Platform (Foxe Plain).

Structural geology

Precambrian terrane bordering the Paleozoic strata of Melville Peninsula and in subsurface as basement rocks is principally gneiss, parasediments and paravolcanics of Helikian age. These rocks display numerous prominent lineaments, some of which continue east as fault systems into the lowlands of eastern Melville Peninsula, where they can be observed to intersect Ordovician rocks with displacements of a few feet to 300 or more ft (90 m). Thus the Paleozoic rocks of eastern Melville Peninsula, which initially appear to dip uniformly eastward beneath Foxe Basin, are in fact structurally disoriented and strike at all angles because of this basement block faulting.

The Paleozoic rocks presently preserved in Foxe Basin are erosional remnants of a much broader cratonic cover that once mantled most or all of the Canadian Shield. These strata have disappeared from the Shield because of local and wide regional basement uplift that occurred during several epeirogenic events throughout the Phanerozoic.

In the early Paleozoic, the eastern Arctic Platform (Foxe Basin) was bounded on the south by Precambrian rocks that presently form Bell Arch (Fig. 3). Although the arch apparently was positive from Early Ordovician time onward, actual vertical tectonic movement along its axis may not have occurred until the Late Silurian–Early Devonian, when the entire craton was subjected to both local and broad regional uplift accompanied by faulting and subaerial erosion. Whether the extensive faulting that intersects the Ordovician rocks of Melville Peninsula are of that age or are related to the dislocation and separation of Greenland in the Mesozoic-Tertiary is open to speculation. However, the most extensive uplift evidently occurred in southwestern Foxe Basin south of Hall Lake in proximity to Bell Arch, where Precambrian rocks rise abruptly along a series of fault line scarps above Paleozoic terrane (Fig. 11). Immediately south, beneath Foxe Channel, interpretative contouring of bathymetric charts demonstrates a widespread succession of horst and graben structures that are believed related to tectonic activity of the Bell Arch, whereas farther north on Melville Peninsula (north of Hall Lake) faults originating in Precambrian terrane radiate southeast across the Paleozoic plain with progressively decreasing vertical displacements (Figs. 2, 11). The writer believes, therefore, that many of the faults presently observed to cut Ordovician rocks on eastern Melville Peninsula are of mid-Paleozoic age (principally Early Devonian) and related to a major epeirogenic event that activated Bell Arch and its northern equivalent Boothia Arch during that period.

Economic geology

The Ordovician strata of eastern Melville Peninsula contain suitable potential reservoir and source rocks and trapping mechanisms for the generation and accumulation of hydrocarbon deposits, providing these could be found buried under ideal conditions in the deeper part of Foxe Basin. Basal sandstone deposits of the Ship Point Formation and pinnacle reefs in the unnamed reefal unit would provide excellent reservoir and trapping mechanisms. The pinch-out of basal sandstone in the southern part of Foxe Basin would normally provide an ideal trap where it is unconformably overlapped by Bad Cache Rapids limestone. In addition, there are undoubtedly pinnacle reefs in central Foxe Basin covered by varying thicknesses of Middle Silurian limestone. From outward appearance alone the best source rocks are the interreefal facies of the unnamed reefal unit and the lower carbonate beds (unit 2) of the Ship Point Formation, both of which contain varying amounts of bituminous material. Unfortunately the total Paleozoic succession (Ordovician and Silurian) in the deeper part of Foxe Basin may be no thicker than 2000 ft (600 m) and thus the region cannot be considered a significant future petroleum province. Only one well has been drilled in Foxe Basin in exploration for oil and gas and it proved unsuccessful. This was completed on Rowley Island (Aquitaine et al Rowley M-04) in 1971 to 1745 ft, terminating 67 ft into Precambrian basement rocks.

Geological conditions might be favourable for the concentration of base metal deposits in carbonate rocks (dolomite) along the Paleozoic-Precambrian boundary of Melville Peninsula. Unit 2 of the Ship Point Formation locally consists of massive carbonate containing pseudoalgal reefs that might warrant more thorough examination and analysis. The writer saw no indication of base metals in the sections examined but because the survey was of a reconnaissance nature, there was little opportunity to assess this aspect of the geology.

The Ship Point and Bad Cache Rapids formations provide abundant building stone of excellent quality for future construction in eastern Melville Peninsula.

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Ordovician Megafauna, Melville Peninsula, Southeastern District of Franklin

Thomas E. Bolton

Abstract

Paleozoic rocks of Melville Peninsula are principally Middle Ordovician. The Ship Point Formation (sandstone and dolomite) contains conodont faunas ranging from late Lower (Canadian) to early Middle (Whiterock–Porterfield) Ordovician age. The limited megafauna is not diagnostic. The Bad Cache Rapids Formation (limestone and argillaceous limestone) contains an abundant 'Arctic Ordovician' fauna. This highly diverse coralline-brachiopod-cephalopod-trilobite megafauna assemblage is assigned a late Middle (late Wilderness–Barneveld) Ordovician age; the associated ostracode and conodont faunas are typical of these stages. The formation is correlated with the limestone and shale of the Foxe Plain, southeastern Baffin Island, a part of Member *B* of the Baillarge Formation of Brodeur Peninsula, northwestern Baffin Island, Gonioceras Bay and the lower part of the Cape Calhoun formations of northwestern Greenland, and the Portage Chute Formation at the base of the Bad Cache Rapids Group of northern Hudson Bay Lowland.

Inland, in the northern half of the peninsula, there is an unnamed sequence of thin-bedded dolomite overlain by reefal-interreefal dolomitic limestones. Some reefs are composed of large stromatolites and numerous small colonies of *Paleofavosites okulitchi* Stearn associated with poorly preserved brachiopods and cephalopods. Conodonts from the interreefal beds indicate a late Ordovician age for this complex.

New species of the coral *Protrochiscolithus* (Upper Ordovician) and the cephalopods *Digenuoceras*, *Rasmussenoceras* and *Teichertoceras* (Middle Ordovician) are described.

Résumé

Les roches paléozoïques de la presqu'île Melville datent principalement de l'Ordovicien moyen. La formation de Ship Point (grès et dolomies) contient des faunes de conodontes dont l'âge va de la fin de l'Ordovicien inférieur (Canadien) jusqu'au début de l'Ordovicien moyen (Whiterock à Porterfield). Cette faune limitée n'est pas caractéristique. La formation de Bad Cache Rapids (calcaires et calcaires argileux) contient une faune abondante de 'l'Ordovicien arctique'. Cette faune très diversifiée de coraux, de brachiopodes, de céphalopodes et de trilobites est attribuée à la fin de l'Ordovicien moyen (fin du Wilderness–Barneveld); les faunes d'ostracodes et de conodontes qui lui sont associées sont typiques de ces étages. Il existe une corrélation de la formation avec les schistes et les calcaires de la plaine de Foxe, dans le sud-est de l'île Baffin, avec une partie du membre *B* de la formation de Baillarge de la presqu'île Brodeur, nord-ouest de l'île Baffin, avec la formation de Gonioceras Bay et de la partie inférieure de la formation de Cape Calhoun du nord-ouest du Groënland, et aussi avec la formation de Portage Chute à la base du groupe de Bad Cache Rapids des basses-terres du nord de la baie d'Hudson.

A l'intérieur des terres, dans la moitié nord de la péninsule, il y a une succession (non nommée) de lits minces de dolomies recouverte de calcaires dolomitiques récifaux et interrécifaux. Certains récifs sont composés de stromatolites de grandes dimensions et de nombreuses petites colonies de *Paleofavosites okulitchi* Stearn associées avec des brachiopodes et des céphalopodes mal conservés. Les conodontes des lits interrécifaux indiquent que ce complexe date de l'Ordovicien inférieur.

L'auteur décrit des nouvelles espèces de coraux *Protrochiscolithus* (Ordovicien supérieur) et des céphalopodes *Digenuoceras*, *Rasmussenoceras* et *Teichertoceras* (Ordovicien moyen).

Introduction

Prior to the 1968–73 field work by Trettin, Sanford and Bolton the Ordovician fauna of eastern Melville Peninsula was known principally through specimens gathered from coastal beach deposits rather than from bedrock (Teichert, 1937*a*). Foerste (1928; 1933) described some of the early collected cephalopod specimens; the most complete descriptions to date of the Ordovician fossils from the Foxe Basin region were by Teichert (1937*a*,*b*). Recently Blackadar (1963, p. 16) reported on typical 'Arctic Ordovician' fauna collected from the Mogg Bay section (GSC loc. 28688) as identified by G.W. Sinclair, and Trettin provided fossils from a few inland exposures between Igloolik Island on the north and Roche Bay on the south.

Ship Point Formation

No distinctive megafauna is present in this 300-ft-thick formation. A series of stromatolite mounds up to 10 ft high and more than 100 ft in individual diameter is at least 135 ft above the base of the Ship Point Formation west of the northern end of Hall Lake (GSC loc. 89843) but no invertebrate fossils were identified. From a dolomite ledge unit 12 to 23 ft below the upper contact southwest of Igloolik settlement, Igloolik Island (GSC locs. C-2806, C-2807), Trettin collected poorly preserved orthid and strophomenid brachiopods associated with echinoderm columnals and cryptostome bryozoans, and from the lower 45 ft of the Ship Point Formation upper exposures 4 mi south of Quilliam Bay, a few undeterminable gastropods. The writer collected similar gastropod steinkerns from this same ridge exposure (GSC loc. 89833) 85 ft below the upper contact.

Geol. Surv. Can., Bull. 269, 1977.

Middle Ordovician fauna, Bad Cache Rapids Formation, Melville Peninsula

Principal collecting localities Megafauna * Species illustrated	2	3	5	12	13	16	17 1	32	36	37	40	41	42 2	45	46	47	48
ALGAE																	
Cyclocrinites sp. aff. *C. globosus* (Billings)				X		X											
Receptaculites sp. aff. *R. biconstrictus* Bassler							X										
* *Receptaculites* sp.	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
PORIFERA (*see* Rigby, this Bulletin)																	
Astraeospongid undet.		X						X	X								
ANTHOZOA																	
* *Streptelasma oppletum* Teichert				X				X									
* *Grewingkia robusta* (Whiteaves)				X	X			X		X							X
Grewingkia sp. indet.				X									X		X		
Bighornia (?) sp. indet.				X													
cup corals indet.	X				X	X	X					X					
Favistina (?) sp. indet.								X									
* *Billingsaria parvituba* (Troedsson)		X								X							
* *Nyctopora* sp.					X												
* *Calapoecia arctica* Troedsson																	X
* *Esthonia* (?) sp.		X															
* *Coccoseris astomata* Flower								X		X							
* *Protrochiscolithus magnus* (Whiteaves)										X							
* *Cyrtophyllum pattersoni* (Roy)							X	X	X	X							X
* *Cyrtophyllum* sp.																	X
* *Catenipora aequabilis* (Teichert)								X								X	
* *Catenipora* spp.	X			X		X		X		X			X	X		X	X
* *Labyrinthites (Labyrinthites) chidlensis* Lambe													X				
ECHINODERMATA																	
columnal debris	X	X	X				X	X	X		X	X	X				
* echinoderm plates									X			X					
BRYOZOA																	
* *Amplexopora arctica* Teichert		X							X	X	X		X				
* *Diplotrypa bassleri* (Troedsson)				X													
Helopora sp.	X	X	X						X		X						
Rhinidictya sp.									X								
cryptostome indet.	X										X	X	X				
BRACHIOPODA																	
lingulid fragments													X				
Hesperorthis interplicata Roy												X					
Hesperorthis sp. indet.	X																
Plaesiomys (Dinorthis) sp. cf. *D. iphigenia* (Billings)		X				X				X							
Plaesiomys (Dinorthis) sp.				X					X								
orthid fragments indet.							X										
* *Isophragma* (?) sp.											X						
Sowerbyites (?) sp.													X				
* *Sowerbyella* sp. cf. *S. thraivensis* (Reed)							X										
* *Sowerbyella* sp.		X	X								X		X				
Strophomena sp. cf. *S. lenta* Troedsson		X								X							
* *Strophomena undulosa* Roy		X					X	X		X			X				
* *Strophomena* sp.		X									X	X					
strophomenid indet.				X		X						X	X				
Rafinesquina sp. aff. *R. deltoidea* (Conrad)		X									X						
* *Rafinesquina pronis* Roy		X															
* *Rafinesquina* sp.		X						X				X	X				
* *Oepikina* sp.												X	X				
leptaenid indet.							X										
* *Rhynchotrema arcticum* Roy						X											
* *Rhynchotrema* sp.										X	X						
* *Zygospira* sp.									X		X						
brachiopod fragments indet.			X														X
GASTROPODA																	
* *Hormotoma rotundivolvis* Roy			X														
Hormotoma sp.				X		X	X										
Liospira sp.				X						X		X					
* *Lophospira* sp.		X															
Maclurites manitobensis (Whiteaves)					X			X									
* *Maclurites manitobensis* var. *ovalis* Wilson			X				X									X	
Maclurites ungava Wilson								X									
Maclurites sp.	X	X		X		X			X		X		X	X			X
* *Subulites (Fusispira)* sp.			X	X			X	X							X		X
Subulites (Subulites) sp.		X															
Trochonema sp. cf. *T. umbilicatum* (Hall)																	X
Trochonema sp. cf. *T.* coxi Wilson											X						
Trochonema sp.						X	X	X									
gastropods indet.	X												X		X		X

Megafauna * Species illustrated / Principal collecting localities	2	3	5	12	13	16	17 1	32	36	37	40	41	42 2	45	46	47	48
CEPHALOPODA - NAUTILOIDEA																	
* *Cyrtocerina* sp.															X		
Endoceras sp.	X	X							X								X
* *Cyclendoceras kindlei* Foerste			X														
* *Cyclendoceras* sp.								X			X		X				
* *Narthecoceras sinclairi* Flower																	X
* *Actinoceras ruedemanni* var. *clarkei* (Troedsson)									X				X		X		X
Kochoceras sp. cf. *K. cuneiforme* Troedsson		X					X										
* *Kochoceras foordi* Foerste		X															X
Kochoceras sp. cf. *K. mantelli* Foerste		X															
* *Paractinoceras* (?) sp.			X														
* *Gonioceras groenlandicum* Troedsson			X														
* *Gonioceras* sp. cf. *G. wulffi* Troedsson	X		X														
Lambeoceras sp. cf. *L. arcticum* Teichert			X														
* *Lambeoceras baffinense* Miller, Youngquist and Collinson								X								X	
* *Lambeoceras* sp. cf. *L. magnum* Troedsson															X		
Lambeoceras sp. indet.							X				X						
* *Whitfieldoceras* sp.		X															
* *Ephippiorthoceras compressum* Foerste							X	X					X				
* *Gorbyoceras baffinense* (Schuchert)		X			X						X		X		X		
Billingsites sp. aff. *B. borealis* (Parks)						X											
Probillingsites sp. cf. *P. belli* Miller, Youngquist and Collinson				X													
* *Probillingsites* (?) sp.	X																
Oncoceras (?) sp. indet.							X										
* *Digenuoceras heywoodi* n. sp.																	X
* *Neumatoceras* (?) *contractum* (Foerste and Savage)	X																
* *Neumatoceras churchillense* Nelson	X																
Oonoceras (?) sp.					X												
* *Richardsonoceras* sp. cf. *R. beloitense* Foerste				X													
* *Richardsonoceras* (?) sp. indet.		X															
* *Rasmussenoceras* sp.							X										
* *Diestoceras* sp. cf. *D. schucherti* Foerste								X							X		
* *Diestoceras* sp.								X									
* *Cyrtogomphoceras alcocki* Nelson							X										
Cyrtogomphoceras (?) sp. indet.								X									
Westonoceras (?) sp.		X															
* *Winnipegoceras* sp.							X	X									X
Charactoceras sp.											X						
TRILOBITA																	
* asaphid, n. gen. (?)						X											
Isotelid indet.		X			X		X		X								X
* *Illaenus baffinlandicus* Roy			X														
Illaenus groenlandicus Troedsson												X					
Illaenus sp. cf. *I. groenlandicus* Troedsson													X				
* *Illaenus lacertus* Whittington			X									X					
Illaenus sp. indet.									X		X						
* *Nanillaenus punctatus* (Roy)		X															
Bumastus (Bumastoides) sp. aff. *B. tenuirugosus* Troedsson		X															
* *Bumastus (Bumastoides)* sp. indet.		X				X			X	X		X					
Otarion sp.								X									
Ceraurus sp.		X															
Remipyga sp.											X						
* *Sphaerocoryphe* sp. indet.															X		
cheirurid indet.							X										
Calyptaulax goodridgii (Schuchert)	X																
Calyptaulax sp.											X						
* *Calliops* sp.												X					
OSTRACODA (*see* Copeland, this Bulletin)																	
* *Eoleperditia* sp.	X	X	X				X	X	X		X		X				
SCOLECODONTS	X	X										X					

1) Upper 20 feet
2) 11 - 30 feet

GSC

Diagnostic conodont microfaunas, however, have been identified from various beds within this formation (Barnes, 1974; and this bulletin).

Barnes (1974, p. 228, 230) recognized that the Ship Point dolomites within Foxe Plain contain two distinct faunas, the lower of late Canadian age and the upper of early Middle Ordovician (late Whiterock to Marmor at least) age. The eastern Melville Peninsula strata essentially correlate with the upper part of the type Ship Point Formation of Brodeur Peninsula (Trettin, 1969), northern Baffin Island and the lower part of the Bay Fiord Formation of Devon Island to the north, and with the lower 231 ft of the 500-ft-thick sandstone unit at the base of the Paleozoic section within the Premium Homestead Akpatok Island well to the southeast in Ungava Bay (Workum *et al.*, 1976).

Bad Cache Rapids Formation

Fossils are fairly abundant in the Bad Cache Rapids sequence of limestones and argillaceous limestones, particularly in the latter. The most common forms in almost every exposure are the alga *Receptaculites* and the large gastropod *Maclurites*. These forms combined with several coral and cephalopod genera relate these beds to the 'Arctic Ordovician' Red River fauna. The genera and species of this fauna identified during the present study are listed in the table on pages 24 and 25.

At least two megafaunal assemblages are in this formation. The lower fauna in the lithographic limestone unit forming the lowest 10 to 15 ft of the formation exposed 4 mi south of Quilliam Bay (GSC loc. 89833) consists of large orthoconic cephalopods *Cyclendoceras* sp. and *Gonioceras* (*G. groenlandicum* Troedsson, *G.* sp. cf. *G. wulffi* Troedsson) associated with *Receptaculites* sp. and *Maclurites* sp.

Within the upper faunal assemblage, the dominant invertebrate fossils are corals and cephalopods. *Grewingkia* (*G. robusta* [Whiteaves]) and *Streptelasma* (*S. oppletum* Teichert) are the most common solitary corals. Neither the more trilobate forms of *Lobocorallium* nor the angulate *Deiracorallium* are found in this assemblage. Tabulate corals, however, are the most abundant fossils; representatives of *Calapoecia* (*C. arctica* Troedsson), *Plasmoporella* (*P. lambei* [Schuchert]), *Cyrtophyllum* (*C. pattersoni* [Roy]) and *Catenipora* (*C. aequabilis* [Teichert]) characterize this colonial coral fauna. *Billingsaria parvituba* (Troedsson), *Coccoseris astomata* Flower, *Protrochiscolithus magnus* (Whiteaves) and *Labyrinthites* (*Labyrinthites*) *chidlensis* Lambe are more restricted.

The Bad Cache Rapids cephalopod assemblage is characterized by the orthocones *Cyclendoceras* (*C. kindlei* Foerste), *Kochoceras* (*K. foordi* Foerste, *K. mantelli* Foerste, *K. borealis* Teichert, *K. breve* Teichert), *Metaspyroceras* (*M. melvillense* Teichert), *Lambeoceras* (*L. baffinense* Miller, Youngquist and Collinson, *L. arcticum* Teichert) and *Gorbyoceras* (*G. baffinense* [Schuchert]), and the brevicone *Neumatoceras* (*N.*(?) *contractum* [Foerste and Savage], *N. churchillense* Nelson). Additional typical 'Arctic Ordovician' genera include *Narthecoceras* (*N. sinclairi* Flower), *Westonoceras* (*W. ornatum* [Troedsson]), *Ephippiorthoceras* (*E. compressum* Foerste), *Diestoceras* (*D. schucherti* Foerste), *Cyrtogomphoceras* (*C. alcocki* Nelson) and *Winnipegoceras*.

The trilobite combination *Illaenus-Isotelus-Sphaerocorphe-Anataphrus-Bumastus-Calyptaulax-Calliops* in the 'Arctic Ordovician' fauna of Foxe Plain is common to sediments deposited during the Middle Ordovician throughout the prevailing fairly stable open marine environment.

An 'Arctic Ordovician' megafauna has long been recognized in eastern and central North America from New Mexico to Greenland. The paleogeographic-paleoequatorial-paleoclimatic inferences from this widespread relatively constant fauna have been outlined by Flower (1946), Nelson (1959), Cumming (1971) and Copeland (1974). Most of these reviewers agree that Melville Peninsula during the late Middle–Upper Ordovician lay well within the equatorial tropical zone; the tabulate corals of this megafauna are characteristic of both the Middle Ordovician Siberian-American and Late Ordovician Canadian-Arctic-Siberian paleozoogeographical provinces (Leleshus, 1970, 1972).

The age assigned to this fauna, however, has varied over the years, depending upon the specific age assigned to the Red River fauna of Manitoba, the Cape Calhoun fauna of northwestern Greenland, or the intervening Ordovician fauna of the 'Mt. Silliman beds' (Flower and Teichert, 1957, p. 31), southern Baffin Island. It is now evident that the total assemblage is composed of at least two ages of faunas. Teichert (1937*a,b*) recognized the strong Red River affinities of the fauna collected from the Paleozoic rocks of western Foxe Basin; a Trenton age "comparable to Upper Cobourg of Ontario" (Teichert, 1937*a*, p. 35) was assigned to these fossiliferous strata and "the absence of *Gonioceras* from Melville Peninsula and Iglulik [Igloolik] Island which suggests that the strata are mostly younger than the Middle Trenton Hull formation which contains *Gonioceras kayi*, the youngest known species of this genus" (*ibid.*, p. 35). He concluded that strata and fauna of both lower and upper Trenton age probably are represented on Melville Peninsula and that it might be possible to distinguish both horizons when the country had been reinvestigated geologically (*ibid.*, p. 41). Such separation still is difficult, but the combined fauna herein described of ostracodes (Copeland, this bulletin), conodonts (Barnes, this bulletin) and the megafossils *Billingsaria*, *Labyrinthites* (*Labyrinthites*), *Gonioceras*, *Probillingsites* and *Teichertoceras* do confirm the presence of late Middle Ordovician strata ranging from late Wilderness to Barneveld. As applied by Sinclair (1965, p. 3–5), the late Wilderness includes the Bucke Formation, Liskeard Group, of the Lake Timiskaming outlier, and the Rockland beds, Ottawa Formation of Ottawa Lowland, Ontario; whereas the late Barneveld includes the Farr Formation, Liskeard Group, of the Lake Timiskaming outlier, and the Cobourg beds of Ottawa Lowland.

Outliers of lower Paleozoic sedimentary rocks have been discovered at widely separated localities on the Central Stable Region of the Canadian Arctic Islands; the known Paleozoic rocks of the Interior Platform are but remnants of a former more continuous cover (Christie, 1972, p. 51). Ordovician faunas similar to the Melville Peninsula assemblage are found not only at the extreme northwestern (i.e., Aquitaine et al Rowley M-04 well) and southeastern extremities of Foxe Basin, but also in numerous outliers across the Melville Arch (Hoppner Inlet, Repulse Bay), in the southern halves of Prince Rupert (Committee Bay) and M'Clintock (Sherman Basin) basins and on the intervening Boothia Uplift.

The regional distribution and correlation of the Melville

Peninsula fauna have been detailed by Teichert (1937*a*, Table I, p. 360; 1937*b*, p. 13) and the equivalent Red River fauna-bearing Arctic strata by Flower (1957, p. 9; 1961, p. 8–10), Flower and Teichert (1957, p. 29–33) and Sinclair (1956; *in* Krank and Sinclair, 1963, p. 18; *in* Blackadar, 1967, p. 19–30). From these reviews a late Middle Ordovician age (similar to that determined from the present collections) was postulated for these boreal faunas rather than the predominantly Late Ordovician Richmond age advocated by Foerste (1929; 1933), Troedsson (1929*a,b*), Roy (1941) and Miller *et al.* (1954).

Megafossils common to the Ordovician of Melville Peninsula and Foxe Lowland (Putnam Highland–Silliman's Fossil Mount; localities *D* and *T*, Copeland, this bulletin, Fig. 1), southeastern Baffin Island include *Receptaculites* spp., *Grewingkia robusta*, *Plasmoporella lambei*, *Cyrtophyllum pattersoni*, *Hesperorthis interplicata*, *Strophomena undulosa*, *Rafinesquina pronis*, *Rhynchotrema arcticum*, *Hormotoma rotundivolvis*, *Maclurites* spp., *Subulites* (*Fusispira*) sp., *Cyclendoceras kindlei*, *Actinoceras ruedemanni* var. *clarkei*, *Lambeoceras baffinense*, *Ephippiorthoceras compressum*, *Gorbyoceras baffinense*, *Neumatoceras*(?) *contractum*, *Illaenus baffinlandicus*, *I. lacertus*, *Nanillaenus punctatus* and *Calyptaulax goodridgii*. The slightly older forms *Labyrinthites* (*Labyrinthites*) *chidlensis* and *Gonioceras* sp. cf. *G. wulffi* are also found in the basal beds of both regions.

Melville Peninsula Ordovician fossils are also recognized northward within the Franklin Strait Formation of Boothia Peninsula (Christie, 1973, p. 27), and Member *B* of the Baillarge Formation, Brodeur Peninsula and its equivalents in the Mary River area, northwestern Baffin Island. Still farther north in the Arctic Archipelago, similar assemblages are present within the Bay Fiord (*Gonioceras* sp.) and Thumb Mountain formations of Cornwallis (Sweet and Miller, 1958, p. 7), Bathurst (Kerr, 1974), Devon and Ellesmere (*Labyrinthites* (*Labyrinthites*) *chidlensis*, *Gonioceras* sp. [Bolton, 1965, p. 21; Norford, 1966, p. 12; Kerr, 1968, p. 47]) islands. In common with the basal Cape Calhoun beds or upper Gonioceras Bay Formation (*see* Troelson, 1950, p. 57, 58) of northwestern Greenland are *Receptaculites* spp., *Streptelasma oppletum*, *Billingsaria parvituba*, *Calapoecia arctica*, *Plasmoporella lambei*, *Cyrtophyllum pattersoni*, *Labyrinthites* (*Labyrinthites*) *chidlensis*, *Diplotrypa bassleri*, *Maclurites* spp., *Subulites* (*Fusispira*) sp., *Actinoceras ruedemanni* var. *clarkei*, *Gonioceras groenlandicum*, *G.* sp. cf. *G. wulffi*, *Westonoceras ornatum*, *Illaenus groenlandicus* and *Goldillaenus peculiaris*. The Ordovician corals described by Scrutton (1975) from the Centrum Limestone of northeastern Greenland are a younger fauna.

Southward, the Bad Cache Rapids Group of northeastern Manitoba includes the Melville Peninsula forms *Grewingkia robusta*, *Calapoecia arctica*, *Cyrtophyllum pattersoni*, *Catenipora aequabilis*, *Maclurites* spp., *Cyclendoceras kindlei*, *Neumatoceras churchillense* and *Cyrtogomphoceras alcocki*. In common with the Red River Formation of southern Manitoba (Caramanica, 1973) are the corals *Grewingkia robusta*, *Calapoecia arctica*, *Coccoseris astomata* and *Protrochiscolithus magnus* and the Mollusca *Maclurites* spp. and *Narthecoceras sinclairi*. In addition to *Maclurites* spp., the Farr Formation, Liskeard Group, of Lake Timiskaming, Ontario has the corals *Plasmoporella lambei* and *Cyrtophyllum pattersoni* in common with the Melville Peninsula Ordovician megafauna.

All these strata bearing fossils common to the early Paleozoic fossil assemblage of Melville Peninsula are regarded as late Middle Ordovician Barneveld in age. Strata of slightly older Wildernessian age forming the base of the Bad Cache Rapids Formation also are distributed throughout Foxe Plain and are correlative with the Gonioceras Bay Formation of Greenland.

Unnamed limestone (Upper Ordovician)

This unnamed reefal unit completing the early Paleozoic sequence south of Mogg Bay, Melville Peninsula is essentially a reefal-interreefal complex that contains few diagnostic megafossils. Locally within the upper parts of some reefs small colonies of *Paleofavosites okulitchi* Stearn are abundant. The fauna associated with this coral in the two northernmost reefs (GSC loc. 89835) include algae, cup corals indet., *Palaeophyllum* sp., *Hesperorthis* sp., *Camerella* sp., *Cyclospira*(?) sp., strophomenid indet. (small specimens), *Zygospira* sp. and orthocone cephalopods indet. (two sizes).

P. okulitchi is characteristic of the Gunton Member, Stony Mountain Formation and overlying Stonewall Formation (Stearn, 1956) of southern Manitoba, and the Chasm Creek Formation, Churchill River Group of northeastern Manitoba (Nelson, 1963). The species recently has been reported from farther north in the upper part of the Lang River Formation of Somerset Island (Dixon, 1975). A late Ordovician age for the associated interreefal beds (GSC loc. 89836) is further defined by the conodonts (Barnes, *pers. comm.*).

Paleontology

Algae

Representatives of cyclocrinitids and receptaculitids have been identified in most exposures of the Bad Cache Rapids limestone. Receptaculitids are the more abundant throughout the formation. Globular thalli of *Cyclocrinites* sp. aff. *C. globosus* (Billings) are present only in younger beds of the formation (GSC locs. 89840, 89844). *Receptaculites* sp. (Pl. 1, fig. 2) is preserved as sheets 3 mm thick (of *R. arcticus* Etheridge–*R. occidentalis* Salter type, GSC locs. 89845, C-2847, 91955), flattened expansions (GSC loc. 89831) and impressions at least 14 in. across (GSC locs. 90544, 90545). Laterals in the best preserved sheets (GSC loc. 89831) are simple, as in *R. occidentalis* Salter (Wilson, 1932, Pl. 1, fig. 4). A distinct, relatively complete large globular form 80 mm in diameter and 20 mm thick collected at GSC loc. 89845 has been identified by M.H. Nitecki (*pers. comm.*, 1974) as superficially like *R. biconstrictus* Bassler, a species described from the Porterfield–Wilderness beds of Tennessee.

Anthozoa, Rugosa

Rugose genera, though never too abundant, include solitary forms of *Streptelasma*, *Grewingkia* and *Bighornia*(?). The more trilobate forms of *Lobocorallium* and the angulate *Deiracorallium* did not develop until later in the Ordovician.

Streptelasma oppletum Teichert
Plate 1, figs. 3–5

1937 *Streptelasma*? *oppletum* Teichert, p. 51, Pl. 2, figs. 5–8; Pl. 3, figs. 1–4

Solitary cylindrical to weakly trochoid coralla, moderately curved, medium size; primary septa increase from 43 in a diameter of 22 mm to 62 in a diameter of 28 mm, long, a few uniting to form a loose, coarse, narrow (5 to 7 mm) axial structure; secondary septa short (3 to 4 mm), barely extending beyond the peripheral stereozone.

Discussion. Teichert (1937*a*) assigned to this species material from three localities on Melville Peninsula and one locality at Cape Calhoun, Greenland. The closest form *S. poulseni* Cox, although possessing a narrower stereozone, may be conspecific. Duncan (1957, p. 611) suggested that the species might belong to the genus *Bighornia*; the specimens, however, are not calceolid in form, nor do they have a shortened cardinal septum or develop a lathlike terminally rounded columella, features typical of that genus.

Type. Hypotypes, GSC 42906, 42907, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89860, 89840.

Grewingkia robusta (Whiteaves)
Plate 1, figs. 1, 8–10

1896 *Streptelasma robustum* Whiteaves, p. 391
1897 *Streptelasma robustum* Whiteaves. Whiteaves, p. 153, Pl. 18, figs. 1,*a*
1956 *Grewingkia robusta* (Whiteaves). Duncan, Pl. 21, figs. 4*a*,*b*
1963 *Grewingkia robusta* (Whiteaves). Nelson, p. 33, Pl. 8, figs. 1*a*,*b*, 2, 3*a*-*f*

Solitary ceratoid to trochoid coralla, latter form with a distinct cardinal ridge (hypotype, GSC 43050); primary septa increase from 78 in a diameter of 30 mm (Pl. 1, fig. 8) to 88 in a diameter of 45 mm (Pl. 1, fig. 9), extend toward the centre with some twisting to form a finely vermiform axial complex up to half the diameter of a corallum; secondary septa very short, restricted to the periphery; tabulae slightly arched, incomplete in septal stereozone.

Discussion. The form and internal structures of the specimens from Melville Peninsula here assigned to *G. robusta* are identical with the type specimen from the Red River Formation of southern Manitoba. They also are very close to those from the Portage Chute Formation, Bad Cache Rapids Group of northern Manitoba (Nelson, 1963); the axial complex is slightly larger and the tabulae spacing varies more in the Melville Peninsula coralla but both are features that vary with maturity. In the width and nature of the axial complex the specimens are similar to moderate-size *G. arctica* (Wilson) from the younger Ordovician of Akpatok Island as figured by Cox (1937); in the type specimens described by Wilson (1932) from the Ordovician of Baffin Island the axial complex is the same width but less vermiform, derived from fewer septa. *G. arctica* also is characterized by a more dominant cardinal septum and a moderately distinct fossula.

Types. Hypotypes, GSC 42901–42904, 43050, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89865, 89841, 28688, 89844.

Anthozoa, Tabulata

Tabulate corals dominate the Bad Cache Rapids faunal assemblage. Genera recognized include *Billingsaria*, *Nyctopora*, *Calapoecia*, *Esthonia*(?), *Coccoseris*, *Protrochiscolithus*, *Plasmoporella*, *Cyrtophyllum*, *Catenipora* and *Labyrinthites*. Many of the colonies display both horizontal and vertical burrows. The dominant element of the Late Ordovician reefs is small and medium-size colonies of *Paleofavosites*.

Billingsaria parvituba (Troedsson)
Plate 2, figs. 1–3, 7, 9–11

1929 *Columnaria parvituba* Troedsson, p. 114, Pl. 28, fig. 6; Pl. 29, fig. 4
1950 *Nyctopora* (?*Billingsaria*) *parvituba* (Troedsson). Bassler, p. 263, Pl. 14, fig. 7
1961 *Billingsaria parvituba* (Troedsson). Flower, p. 18

Coralla massive expansions up to 60 mm thick, laminar, cerioid; in transverse section, corallites 4- to 6-sided, 1 to 1.5 mm in diameter, walls thick, trabeculate; 8 thick straight primary septa extend nearly to the centre of a corallite, their tips frequently rounded or bulbous; short secondary 'spine' septa alternate on common corallite walls; in longitudinal section, central cylindrical columella continuous in some corallites (Pl. 2, figs. 3, 7, 11), in others constructed of individual rods extending between tabulae; tabulae close, complete, 3 to 4 per corallite diameter; septa linear extensions; no 'mural pores' preserved.

Discussion. The development of a columella distinguishes *Billingsaria* (*B. parva*, Pl. 2, figs. 4, 6) from *Nyctopora* as established by Hill (1961, p. 6) and Flower (1961, p. 63). According to Flower (1961, p. 30) the columella in both the type species *B. parva* (Billings) and topotypic *B parvituba* (Troedsson) from the Gonioceras Bay Formation of Greenland is formed by piles of spheres of poikiloplasm confined to the centres of anterior faces of the tabulae. Spheres are abundant in all the Melville Peninsula specimens and in some parts of the colony they form the columella; in other parts, however, the columella appears to be a continuous, even hollow rod (Pl. 2, fig. 11). Locally within a colony the trabeculate walls and septa are combined with columella poikiloblasts so that the corallites exhibit a *Protrochiscolithus* outline.

Types. Hypotypes, GSC 42915, *a*–*h*, 42916, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89831.

Nyctopora sp.
Plate 2, figs. 5, 8

Small laminar corallum, maximum length of 60 mm and thickness of 25 mm; in transverse section, corallites irregular shape, thick walled, 1.5 mm average diameter; septal ridges short, very broad with rounded tips; in longitudinal section, tabulae flat, 0.4–0.7 mm apart.

Discussion. In preservation the species resembles *N. mutabilis* Flower (1961, Pl. 2, fig. 1) from the Second Value Formation, Montoya Group, of western Texas, U.S.A.

Type. Hypotype, GSC 42918, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89841.

Calapoecia arctica Troedsson
Plate 3, figs. 8, 9

1941 *Calapoecia canadensis* var. *anticostiensis* Billings. Roy, p. 74, figs. 38*a*–*d*
1950 *Calapoecia arctica* Troedsson. Bassler, p. 276, Pl. 20, figs. 7, 8
1963 *Calapoecia arctica* Troedsson(?). Nelson, p. 49

Corallum massive, 20.3 cm wide and 6.4 cm high; in transverse section, corallites 15 mm below corallum surface, round, 2.5

to 2.7 mm in diameter (surface measurement 3 to 3.5 mm), centres 4 to 5 mm apart; 24 septal spines and radiating costae, latter uniting in the coenenchyme; in longitudinal section, corallite tabulae complete to incomplete, anastomosing, 9 to 11 per 5 mm, coenenchyme pores 7 to 9 per 5 mm.

Discussion. The specimen is similar to *C. arctica* Troedsson except that the Cape Calhoun species has corallites 4 to 6 mm in diameter. Specimens from Melville Peninsula with corallites averaging 3.5 mm in diameter, however, also were assigned to this species by Bassler (1950). The Middle Ordovician representative *C. canadensis* Billings is characterized by polygonal corallites in contact, 3 to 3.4 mm in diameter, centres 4 mm apart and tabulae consistently sparse, 4 to 5 per 5 mm. Foxe Basin forms with small corallites are very similar to the widely recognized late Upper Ordovician *C. anticostiensis* Billings.

Type. Hypotype, GSC 42923, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 28688.

Esthonia(?) sp.
Plate 3, figs. 6, 7

Corallum massive, 5.5 cm in diameter and 2 cm thick, laminar with individual layers varying from 0.6 to 3.4 mm in thickness; in transverse section, corallites cylindrical, averaging 0.7 mm in diameter, centres 1.2 to 1.5 mm apart, septa indistinct; coenenchymal tubes between 0.15 and 0.2 mm in diameter; in longitudinal section, tabulae and diaphragms not distinguishable.

Discussion. This specimen originally was believed to be a stromatoporoid of the *Dermatostroma* type. However, because of its hollow corallites and tubercles this specimen must be assigned to the coral family Heliolitidae; the abundant coenenchymal tubes and clearly defined corallites suggest the genus *Esthonia* (type species *E. schmidti* Sokolov, 1955, p. 77) more than *Protaraea* with compact, trabeculate coenenchyme and indistinct corallites.

Type. Hypotype, GSC 42922, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89831.

Coccoseris astomata Flower
Plate 3, figs. 1–5

1961 *Coccoseris astomata* Flower, p. 56, Pl. 16, figs. 17, 18
1975 *Coccoseris astomata* Flower. Dixon, p. 176
1975 *Coccoseris astomata* Flower. Norford and Macqueen, Pl. 9, fig. 7

Coralla 7 to 13 mm thick, at least 60 by 110 mm; in transverse section, no distinct corallites recognizable within the closely packed polygonal bacula; in longitudinal section, U-shaped fibres preserved in some corallites; locally at the base bacula rise from thin concentrations of cyst plates (Pl. 3, figs. 3, 5), again suggesting a stromatoporoid affinity for the species; colony much burrowed.

Discussion. The species occurs in the Second Value and Burnham formations of western and central Texas, U.S.A. and the Ordovician of Southampton and Akpatok islands as well as southern Manitoba (Caramanica, 1973), Mount Kindle, District of Mackenzie (Norford and Macqueen, 1975) and Somerset Island, District of Franklin (Dixon, 1975).

Types. Hypotypes, GSC 42919–42921, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89860, 89865.

Protrochiscolithus magnus (Whiteaves)
Plate 4, figs. 1–4

1897 *Protarea* (*vetusta*? var.) *magna* Whiteaves, p. 155, Pl. 18, figs. 2, 3
1952 *Protrochiscolithus kiaeri* Troedsson. Leith, p. 792, Pl. 114, figs. 1–4; Pl. 115, figs. 1–6
1961 *Protrochiscolithus magnus* (Whiteaves). Flower, p. 55, Pl. 13, figs. 1–9; Pl. 14, figs. 2–5; Pl. 15, fig. 14

Corallum elongate, 120 mm long, 60 mm wide and 40 mm thick; in transverse section, corallites stellate, 1.9 to 2.2 mm in diameter, centres 1.8 to 2.8 mm apart; columella 0.6 to 0.8 mm in diameter, composed of closely packed prismatic bacula; 12 septa and interseptal spaces of equal thickness; walls indistinct, coenenchyme composed of thick, closely packed bacula; in longitudinal sections, a single row of dissepiments, 6 to 8 per 2 mm; no distinct perforations (pores).

Discussion. The Melville Peninsula specimen varies from the lectotype of *P. magnus* (Pl. 4, figs. 1, 2) only in possessing slightly larger corallites.

Type. Hypotype, GSC 42924, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89865.

Protrochiscolithus cummingi n. sp.
Plate 4, figs. 5–8; Plate 5, figs. 1–3

1963 *Protrochiscolithus kiaeri* Troedsson. Nelson, p. 50, Pl. 7, figs 7, 8
1975 *Protrochiscolithus kiaeri* Troedsson. Dixon, p. 176

Coralla vary from encrusting 20 mm thick to an irregular ball 30 mm thick; in transverse section, corallites stellate, 1.6 (holotype) to 2 mm in diameter, centres similarly spaced; columella 0.5 (holotype) to 0.7 mm in diameter, composed of 4 to 6 subpolygonal bacula; 12 narrow septa and wide interseptal spaces, walls thin to locally thick; in longitudinal section, single series to rarely anastomosing dissepiments, 8 to 10 per 2 mm length; scattered circular 'mural pores' pierce the septa.

Discussion. Flower (1961, p. 54) recognized two groupings within *Protrochiscolithus*: (*i*) *P. kiaeri* Troedsson and *P. alemanensis* Flower with a columella composed of vesicular, twisted strands, thin common walls, narrow septa and interspaces wider than septa; (*ii*) *P. magnus* (Whiteaves) and *P. hembrilloense* Flower with a larger columella of solid, closely packed vertical bacula, thicker common walls, equally broad septa and interspaces. The new species has features characteristic of each group—thin common walls and narrow septa similar to *P. kiaeri* and a solid columella as in *P. magnus*.

Types. Holotype, GSC 42925, Churchill River Group, Upper Ordovician, south bank of Churchill River at head of Chasm Creek (GSC loc. 81851); paratypes, GSC 10853, 10859, Chasm Creek Formation, Churchill River Group, Upper Ordovician, right and left banks of Churchill River, approximately 4.5 and 9.25 to 10 mi above Red Head Rapids, Manitoba; paratype, GSC 42926, Upper Ordovician associated with *Calapoecia* sp. cf. *C. ungava* Cox, stream about 20 mi north of Aberdeen Lake, approximate lat. 64°55′N, long. 98°45′W, central Thelon Plain, District of Keewatin, GSC loc. 57572 (*see* Donaldson, 1969); paratypes, GSC 32062, 32063, Churchill River Group, Upper Ordovician, north bank of South Knife River, lat. 58°32′30″N, long. 95°54′W (GSC loc. 81760) and north bank of Herriot Creek, lat. 58°33′N, long. 94°47′W (GSC loc. 81904) Manitoba.

Plasmoporella lambei (Schuchert)

Plate 5, figs. 4–7; Plate 6, figs. 1–4

1900 *Plasmopora lambii* Schuchert, p. 154
1925 non *Plasmopora lambii* Schuchert. Hume, Pl. 5, figs. 1*a*,*b*
1941 *Plasmopora lambei* Schuchert. Roy, p. 70, figs. 36*a–f*
1963 non *Plasmopora lambei* Schuchert. Nelson, p. 50 (=*Cyrtophyllum pattersoni* [Roy])
1975 *Propora lambei* (Schuchert). Flower and Duncan, p. 185, Pl. 3, figs. 1–7 (lectotype)

Coralla large, from 150 to 250 mm long and 35 to 50 mm thick; in transverse section, corallites cylindrical, 1.5 to 1.8 (rarely 2) mm in diameter, centres 2.5 to 3+ mm apart, walls thin and indistinct, defined by vesicular coenenchyme tissue generally although locally up to 20 short costae ('trabeculae' of Flower and Duncan, 1975) disrupt the walls into cyst plates, costae only scarcely uniting; in longitudinal section, corallites vary in width, coenenchyme very cystose, tabulae vary from complete to incomplete, 6 or 7 to rarely 10 per 2 mm.

Discussion. Indistinct corallite walls are characteristic of *Plasmoporella* rather than *Propora*; because of the vesicular coenenchyme and few costae these corals cannot be assigned to either *Cyrtophyllum* (Sokolov, 1955) or *Plasmopora*. The disc-shaped (165 mm across and 20 mm thick) Hoppner Inlet specimens (Pl. 6, figs. 3, 4) have some corallites up to 2 mm in diameter with centres 2.5 to 3 mm apart and more incomplete tabulae but are here considered a variation only of *P. lambei* (*see* Flower and Duncan, 1975, Pl. 3, figs. 1, 2, 7).

Types. Hypotype, GSC 42929, Farr Formation, Liskeard Group, Middle Ordovician, lot 6, cons. V–VI, Bucke tp., Ontario, GSC loc. 37135; hypotypes, GSC 42927, 42928, Middle Ordovician, 'Pope Canyon', Putnam Highland, lat. 65°22′N, long. approx. 73°W, Baffin Island (Soper collection); hypotype, GSC 42930, Middle Ordovician, associated with *Receptaculites* sp., *Catenipora* sp., *Strophomena*(?) sp. and *Trochonema* sp., most northern exposure west side of Hoppner Inlet, Melville Peninsula, District of Franklin, GSC loc. 91955.

Cyrtophyllum pattersoni (Roy)

Plate 6, figs. 5, 8–11; Plate 7, figs. 1–6

1925 *Plasmopora lambii* Schuchert. Hume, Pl. 5, figs. 1*a*,*b*
1928 *Plasmopora lambi* Schuchert. Troedsson, p. 118, Pl. 31, figs. 1*a*,*b*; Pl. 33, figs. 1*a*,*b*
1937 *Plasmopora lambei* Schuchert. Teichert, p. 53, Pl. 4, fig. 13; Pl. 5, figs. 1, 2
1941 *Plasmopora pattersoni* Roy, p. 72, figs. 37*a–e*
1963 *Plasmopora lambei* Schuchert. Nelson, p. 50

Coralla large, up to 210 mm wide and 40 to 70 mm thick; in transverse section, corallites circular, thin 'walled', 1.9 to 2.2 mm in diameter, centres 2.5 to 3 mm apart; minute septal spines form the base of costae, 24 per corallite, that frequently unite in the coenenchyme; in longitudinal section, tabulae are complete to incomplete, concave to flat to convex, 5 to 7 per 2 mm, although in thinner small colonies and in parts of the large colonies spacing of 9 to 10 tabulae per 2 mm occurs; coenenchyme varies from highly cystose (Group *B* of Fomin, 1971) to strongly partitioned by costae, cysts frequently delimiting those corallites with no definite walls.

Discussion. Two small colonies (Pl. 6, figs. 5, 8) display the close tabulation found in the type material from Silliman's Fossil Mount, Baffin Island ("thirty in 6 mm"– Roy, 1941, p. 72). In most of the larger coralla examined during the present investigation, however, the tabulae are spaced farther apart and accordingly are few (up to 21 per 6 mm); most colonies locally exhibit tabulae spacing closer to the type, particularly at the edges of colonies (Pl. 6, fig. 10).

Troedsson's Cape Calhoun *Plasmopora lambi* form with corallites 1.2 to 1.4 mm in diameter recently has been designated the type species of *Cyrtophyllum troedssoni* Flower and Duncan (1975, p. 184).

In the same study (p. 188) Flower and Duncan erected the genus *Mcleodea* for heliolitids with "true walls from which tabulae and cyst plates of the coenenchyme are distinct, in contrast to the condition of *Cyrtophyllum*, in which there is no true corallite wall." They suggest that Teichert's (1937*a*) Igloolik Island form with a narrow coenenchyme is more like *Sibiriolites* or *Mcleodea*. Some of the Melville Peninsula forms figured herein (Pl. 6, figs. 9, 11; Pl. 7, figs. 1, 2) do display a continuous 'wall' structure, particularly where the bordering coenenchyme cysts are very fine, but even in these coralla the forward extension of tabulae into coenenchyme cysts as in *Cyrtophyllum* can be seen.

Within the Farr Formation, Liskeard Group, of the Lake Timiskaming area, Hume's (1925) *Plasmopora lambii* Schuchert is a *Cyrtophyllum pattersoni* (hypotype, GSC 9090: incomplete corallum 49 cm wide and 58 cm thick, corallites circular, 1.5 to 1.7 mm in diameter, centres 2 to 2.5 mm apart, 24 strong costae that all unite, short septal spines at base of each). This species is the dominant form in these rocks (Pl. 7, figs. 3, 6) but *Plasmoporella lambei* (Pl. 6, figs. 1, 2) has been found in association.

Types. Hypotypes, GSC 42931–42934, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89845, 89860; hypotype, GSC 42935, Franklin Strait Formation, Middle Ordovician, approximately 10 mi east of Pasley Bay, lat. 70°37′N, long. 95°34′W, Boothia Peninsula, GSC loc. 51769 (*see* Christie, 1973); hypotype, GSC 42936, Middle Ordovician, associated with *Maclurites* sp. and *Lambeoceras* sp., approximately 6 mi north of Inuktorfik Lake, lat. 71°21′N, long. 79°46′W, Mary River area, Baffin Island, GSC loc. 77291; hypotype, GSC 42937, Farr Formation, Liskeard Group, Middle Ordovician, Farr quarry ½ mi west of Haileybury, Ontario, GSC loc. 37134.

Cyrtophyllum sp.

Plate 6, figs. 6, 7

Corallum large mass, 170 mm long and 55 mm thick; in transverse section, corallites circular, thin but distinctly walled, 1.3 to 1.5 mm in diameter, centres 2 to 2.5 mm apart, rarely 1.5 mm; no trace of septal spines although corallite walls rarely thicken to develop up to 12 septal trabeculae (Dixon, 1974); up to 18 straight to hooked costae (exothecal septal development of Dixon, 1974) of varying length, rarely uniting; in longitudinal section, corallites vary in width; coenenchyme of domed plates or cysts, 10 to 12 per 2 mm; tabulae complete with incomplete zones only, 7 to 8 per 2 mm.

Discussion. The smaller and closer corallites and the fewer tabulae distinguish this form from *Cyrtophyllum pattersoni* (Roy). With its dominantly vesicular coenenchyme it approaches *Propora*.

Type. Hypotype, GSC 42938, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 28688.

Catenipora aequabilis (Teichert)
Plate 7, figs. 7–9, 11

1932 *Halysites* cf. *feildeni* Etheridge. Wilson, p. 297, Pl. 3, figs. 6, 7
1937 *Halysites aequabilis* Teichert, p. 57, Pl. 8, fig. 2; Pl. 9, fig. 4
1963 *Catenipora aequabilis* (Teichert). Nelson, p. 57, Pl. 14, figs. 8, 9
1975 *Catenipora aequabilis* (Teichert). Dixon, p. 176 (pars.)

Coralla massive, 150 mm wide and 25 mm thick; in transverse section, corallites small, subrectangular to subelliptical, transverse length 1.2 to 1.4 mm, midwidth 0.8 to 1 mm, arranged in monoserial ranks with 1 to 3 corallites per rank, occasionally longer ranks, lacunae accordingly small; thin to thick (0.2 mm) walled; septal spines very short, not always preserved; balken present in some species of *Catenipora* (Flower, 1961, p. 47, 48) not evident; in longitudinal section, tabulae complete, 3 to 4 per 2 mm.

Discussion. The preservation of septal spines in *C. aequabilis* removes it from the genus *Quepora*. The species is monomorphic and therefore not a representative of the genus *Falsicatenipora* to which it was assigned tentatively by Hamada (1958, p. 98) and Klaamann (1966, p. 34).

Types. Hypotypes, GSC 42939, 42940, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 90545, 89860.

Catenipora spp. 1–3
Plate 7, fig. 10; Plate 8, figs. 1, 5, 6

Among the numerous colonies of *Catenipora* collected from the Bad Cache Rapids Formation of Melville Peninsula are at least three different recognizable forms that appear different from previously described North American species.

Catenipora sp. 1. Plate 7, fig. 10. Corallum at least 170 mm wide and 45 mm thick; in transverse section, long monoserial ranks composed of a variable number of thick-walled (two-layered) corallites, 2 to 2.2 mm long (rarely 1.5 mm) and 1.4 mm at midwidth; in longitudinal section, horizontal to slightly convex tabulae, 2½ per 2 mm. Hypotype, GSC 42941, GSC loc. 89865.

Catenipora sp. 2. Plate 8, figs. 1, 5, 6. Coralla 100 mm wide and 50 mm thick; in transverse section, long monoserial ranks composed of thick-walled oval corallites, 2 to 2.2 mm long and 1.5 to 1.8 mm at midwidth; spines short; in longitudinal section, tabulae complete, 2 per 2 mm; differs from *Catenipora robusta* (Wilson) in its thicker walls and more rounded corallites. Hypotypes, GSC 42942, 42943, GSC loc. 89860.

Catenipora sp. 3. Corallum large, 300 mm wide and 50 mm thick; in transverse section, long monoserial ranks composed of very thick walled corallites, 3 to 4 mm in length and 1.8 mm at midwidth; in longitudinal section, tabulae complete, 2½ to 3 per 2 mm; differs from *Catenipora rubra* Sinclair and Bolton in its thick walls and larger corallites. Hypotype, GSC 42944, GSC loc. 89840.

Labyrinthites (*Labyrinthites*) *chidlensis* Lambe
Plate 8, figs. 2–4, 7–9, 11

1952 *Labyrinthites*? *monticuliporoides minor* Troedsson. Wilson, *in* Burns, p. 10
1965 *Labyrinthites* (*Labyrinthites*) *chidlensis* Lambe. Bolton, p. 18, Pl. 4, figs. 1–3, 7; Pl. 5, figs. 1–3; Pl. 6, figs. 1, 4, 5; Pl. 7, figs. 1, 6
1967 *Labyrinthites* sp. Sinclair, *in* Blackadar, 1967, p. 25

Low-domed colonies up to 250 mm wide and 50 mm thick; in transverse section, corallites phaceloid, oval to polygonal, four- to six-sided, 0.2 to 0.4 mm in diameter; individuals connected at corners by short hollow tubes to form chainlike networks; in longitudinal section, tabulae complete, horizontal to shallow concave, 0.6 to 1.5 mm apart; cut ends of tubules form vertical rows of 'mural pores' in interspaces, latter up to 0.3 mm thick.

Discussion. The age and distribution of *Labyrinthites* within North America as then known was discussed by Bolton (1965, p. 20). Again both this coral and the cephalopod *Gonioceras* form part of the Bad Cache Rapids faunas of Melville Peninsula and the Foxe Lowland of Baffin Island (*see* Sinclair, *in* Blackadar, 1967, p. 21, 25). All rocks displaying this association, including the Lourdes limestone, Long Point Group of western Newfoundland (Bergström *et al.*, 1974), are assigned to the Wilderness Stage.

Types. Hypotype, GSC 42945, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89870 (loose); hypotypes, GSC 42946, 42947, Middle Ordovician, Anderson Bluff, northeast corner of Foley Island, Foxe Basin, GSC locs. 18752, 18769; hypotype, GSC 42948, 6 to 10 ft above Precambrian contact, Middle Ordovician, south of Amadjuak Lake, lat. 64°32′N, long. 70°28′W, Baffin Island, District of Franklin, GSC loc. 69514.

Paleofavosites okulitchi Stearn
Plate 8, figs. 10, 12; Plate 9, figs. 1–4

1943 *Favosites intermedius* Okulitch, p. 70, Pl. 1, fig. 16
1956 *Paleofavosites okulitchi* Stearn, p. 61, Pl. 3, figs. 4, 6; Pl. 8, fig. 3
1963 *Palaeofavosites okulitchi* Stearn. Nelson, p. 53, Pl. 7, fig. 6
1975 *Paleofavosites okulitchi* Stearn. Dixon, p. 176

Coralla hemispherical, 120 mm wide and 60 mm high, corallites radiating from corallum origin; in transverse section, corallites subpolygonal with some rounded corners and slightly crenulated curved to straight walls, unequal in size with mature corallites 3 to 4.3 mm in diameter; pores predominantly in corners producing crenulated walls, some located in corallite walls usually near the corners but in double rows one pore in centre of walls as well; septal spines generally not preserved; in longitudinal section, tabulae complete varying from horizontal to concave to convex at margins, 1 to 3 per 2 mm.

Discussion. One thinner colony (Pl. 8, figs. 10, 12) has mature corallites 2.5 to 3 mm in diameter and 12 to 16 septa preserved, with tabulae more abundant, 5 to 6 per 2 mm, as found in the specimens from the Upper Ordovician Chasm Creek Formation of the northern Hudson Bay Lowland (Nelson, 1963). The presence and predominance of mural pores located in the corners over those in the corallite walls proper, rounded corallite corners and curved corallite walls are features characteristic of a *Paleofavosites* intermediate in development and suggestive of *Mesofavosites* Sokolov.

Types. Hypotypes, GSC 42949–42952, Upper Ordovician unnamed reef limestone, northwestern mound, GSC loc. 89835.

Bryozoa

Bryozoa are not abundant in the Ordovician rocks of Melville Peninsula. Teichert (1937*a*) identified a fragmentary cryptostome specimen as *Rhinidictya* cf. *R. neglecta* Ulrich, and the trepostome *Amplexopora arctica* Teichert. Within the present collections, fragments of cryptostome bryozoans are in a few sections; *Helopora* sp. is the most abundant form in association with unidentifiable rhinidictyids and pachydictyids. Trepostome bryozoans include ramose forms of *Amplexopora arctica* Teichert and *Diplotrypa bassleri* (Troedsson).

Amplexopora arctica Teichert

Plate 9, figs. 6, 8–10

1937 *Amplexopora arctica* Teichert, p. 58, Pl. 10, fig. 5; Pl. 11, figs. 1–3

Zoarium ramose, maximum diameter of 9 mm; in tangential section, zooecia rectangular to rounded, thin walled, 0.4 to 0.6 mm in diameter; in longitudinal section, diaphragms complete, widely spaced in endozone, crowded and complete to incomplete in exozone, 0.2 to 0.25 mm apart, rare mesopore, and crenulation to endozone, acanthopores few, long.

Discussion. As noted by Teichert, this species is related to *A. pulchra* Troedsson from the Cape Calhoun beds of Greenland. In a longitudinal section of hypotype, GSC 42956, the diaphragms are fewer and more like *A. pulchra* but the acanthopores are longer.

Types. Hypotypes, GSC 42955–42958, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89831, 66716, 89870.

Diplotrypa bassleri (Troedsson)

Plate 9, figs. 5, 7, 11

1929 *Batostoma bassleri* Troedsson, p. 103, Pl. 55; Pl. 56, fig. 1

Zoarium ramose, at least 40 mm long and 13 mm wide; in tangential section, zooecia hexagonal to rounded depending on the abundance of mesopores, 0.4 to 0.6 mm in diameter, 3 to 4 zooecia in 2 mm, walls thin and integrate, mesopores at corners either single or smaller pairs, angular to triangular, never very abundant, no acanthopores; in longitudinal section, zooecial walls uniformly thin, diaphragms complete, 2 to 3 per 2 mm, on an average 1 mm apart, beaded mesopores producing crenulated zooecial walls.

Discussion. The lack of acanthopores removes this species from *Batostoma* as originally proposed. Finer elements define *Diplotrypa schucherti* Fritz found in the equivalent *Gonioceras*- and *Labyrinthites*-bearing Lourdes Formation, Long Point Group, of western Newfoundland. Specimens from Akpatok Island assigned to this species by Bolton (Workum *et al.*, 1976) have larger zooecia and relatively fewer mesopores.

Types. Hypotypes, GSC 42953, 42954, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89840.

Brachiopoda

The Strophomenida are the most abundant brachiopods in the Bad Cache Rapids Formation of Melville Peninsula. Strophomenidae are the most common, particularly within the basal 15 to 20 ft of the formation. This assemblage consists of *Strophomena* sp. (Pl. 10, fig. 8; Pl. 16, figs. 5, 11), one form (Pl. 17, fig. 9) similar to *Rafinesquina* cf. *R. lata* illustrated by Teichert (1937*a*, Pl. 12, fig. 15) but not *R. lata* Whiteaves, *Rafinesquina* sp. (Pl. 10, figs. 5, 10), the Baffin Island form *R. pronis* Roy (Pl. 15, fig. 4), *R. deltoidea* as illustrated by Teichert (1937*a*, Pl. 12, figs. 3, 4) and *Oepikina* sp. (Pl. 10, figs. 1, 12; Pl. 16, fig. 6).

In addition, *Isophragma*(?) sp. (Pl. 11, fig. 10) was identified only in the lower 30 ft, whereas the Baffin Island form *Strophomena undulosa* Roy (Pl. 10, figs. 6, 13; *Strophomena fluctuosa* of Troedsson 1929*a*, Pl. 22, fig. 13) and the Greenland form *Strophomena* sp. cf. *S. lenta* Troedsson apparently occur only in stratigraphically higher beds. *Sowerbyella* sp. (Pl. 13, figs. 4–6, 8; Pl. 14, figs. 1, 5) and the rare *Sowerbyites medioseptata* Teichert range throughout the section.

Orthid representatives include *Hesperorthis interplicata* Roy, *Glyptorthis* sp. (Pl. 11, figs. 4, 5) and *Plaesiomys* (*Dinorthis*) sp. cf. *D. iphigenia* of Troedsson (1929*a*, Pl. 21, figs. 1*a–d*) from low in the formation. *Austinella cooperi* Roy (Pl. 11, fig. 9; Pl. 13, figs. 2, 7) and *A.*(?) *subcircularis* Roy, so common in the equivalent rocks of Silliman's Fossil Mount located at the eastern end of Foxe Plain, have not been identified in the Melville Peninsula fauna.

One small *Rhynchotrema arcticum* Roy (Pl. 15, figs. 8–10) much like *R. subtrigonale* from the Cape Calhoun Formation of Greenland (Troedsson, 1929*a*, Pl. 23, figs. 6–8) and a large obese *Rhynchotrema* sp. (Pl. 14, figs. 2, 6; Pl. 15, figs. 6, 7) that compares favourably with *R. capax* illustrated by Troedsson (1929*a*, Pl. 21, figs. 1*a–d*) were the only rhynchonellid brachiopods found in the more argillaceous upper 30 ft of the Bad Cache Rapids Formation. The only atrypid discovered, *Zygospira* sp. (Pl. 14, fig. 3), was from the lower 30 ft; it is too triangular to be *Z. recurvirostris* as reported by Teichert (1937*a*, Pl. 13, figs. 1–4).

Gastropoda

Gastropods are found throughout the Bad Cache Rapids Formation. Large and small internal moulds of *Maclurites* were found in practically every exposure. Teichert (1937*a*) recorded *M. crassus* Ulrich and Scofield, *M. borealis* Wilson, *M. manitobensis* (Whiteaves), *M. manitobensis* var. *ovalis* Wilson and *Lesueurilla mathiasseni* Teichert from Melville Peninsula, mainly from Igloolik Island. Within the recent collections, forms similar to *M. manitobensis* and *M. manitobensis* var. *ovalis* (Pl. 10, figs. 14, 15; see also *M. acutus* var. *major* Troedsson, 1929*b*, Pl. 8, fig. 2), as well as *M. ungava* Wilson, have been identified. *Subulites* (*Fusispira*) sp. (Pl. 1, figs. 14, 15; cf. *F. inflata* Meek and Worthen [Troedsson, 1929*b*, Pl. 10, figs. 4, 5]), *Trochonema* sp. cf. *T. umbilicatum* as illustrated by Teichert (1937*a*, Pl. 13, figs. 5, 6), *Hormotoma rotundivolvis* Roy (Pl. 1, fig. 12), *Lophospira* sp. (Pl. 1, fig. 11) and *Liospira* sp. are also in several exposures.

Cephalopoda

Orthoconic Cephalopoda are present throughout the Bad Cache Rapids Formation. Members of the Actinocerida are the most common and include typical 'Arctic Ordovician' genera *Actinoceras*, *Kochoceras*, *Paractinoceras*(?), *Gonioceras* and *Lambeoceras* in association with the Ellesmerocerida genus *Cyrtocerina*, Endocerida genera *Cyclendoceras* and *Narthecoceras*, and Orthocerida genera *Whitfieldoceras*, *Ephippiorthoceras* and *Gorbyoceras*. The Ascocerida is represented by *Probillingsites*(?), the Oncocerida by *Digenuoceras*, *Neumatoceras*, *Richardsonoceras*, *Rasmussenoceras* and *Diestoceras*, and the Discosorida by *Cyrtogomphoceras* and *Winnipegoceras*.

Cyrtocerina sp.

Plate 10, figs. 4, 9

Phragmocone with three camerae and living chamber, at least 70 mm long, diameter at base of living chamber 49 mm contracting to 33.2 mm at apical end and enlarging to at least 64.5 mm below flaring aperture; specimen compressed laterally, venter gently concave and dorsum gently convex; suture oblique, slight lateral lobe 4.5 mm apart, narrowing ventrally to 2.5 mm and expanding dorsally to 8.5 mm apart; circular siphuncle large, 17.3 mm diameter, endogastric located at ventral margin.

Discussion. The large size distinguishes this specimen from other described species of *Cyrtocerina.*

Type. Hypotype, GSC 42963, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 90544.

Cyclendoceras kindlei Foerste

Plate 11, figs. 1, 2, 7, 8

1892 *Endoceras annulatum* var. Whiteaves, p. 77, Pl. 3, figs. 1,*a*
1929 *Cyclendoceras kindlei* Foerste, p. 152, Pl. 12, fig. 2; Pl. 22, fig. 2
1937 *Cyclendoceras popoagiense* Miller. Teichert, p. 90, Pl. 20, fig. 2
1954 *Cyclendoceras* sp. Miller *et al.*, p. 51, Pl. 19, fig. 4

Straight specimens 120, 150, 170 and 450 mm long, enlarging only 10 mm in diameter in the longest specimen, depressed dorsoventrally; suture directly transverse in the most complete form, 7 camerae per diameter; annulations distinct, strongly oblique, 6 per diameter; oval siphuncle 14 mm in diameter at adapical end of specimen 170 mm long, located near venter, holochoanitic (Pl. 11, fig. 2).

Discussion. The genus *Cyclendoceras* is retained herein for highly annulated endocerids. Most specimens are similar in size to the holotype collected from the Ordovician of Nelson River, Manitoba (Portage Chute Formation, Bad Cache Rapids Group of Nelson, 1963, p. 68). The siphuncle is closer to the venter in some of the Melville Peninsula forms but this may be the result of differential weathering; one fragmentary specimen of 3-camera length (hypotype 42976) weathered like Teichert's illustrated form has the siphuncle farther away as in the holotype. The Melville Peninsula forms lack the nodes that characterize the Bad Cache Rapids Group species *C. belli* Nelson.

Types. Hypotypes 42972–42976, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89868, 89833.

Narthecoceras sinclairi Flower

Plate 12, figs. 2, 5

1968 *Narthecoceras sinclairi* Flower, p. 53, pls.

Siphuncle incomplete, at least 300 mm long, enlarging from a diameter of 22 mm to 32 mm; faint septal constrictions inclined; endosiphotube central, generally compressed, small (4 to 5 mm in diameter), thick walled.

Discussion. The slender gently enlarging siphuncle segments are characteristic of *N. sinclairi* rather than the more rapidly expanding *N. crassisiphonatum* (Whiteaves). It is quite different from the narthecocerid with long expanded segments described as *Calhounoceras freucheni* Teichert from Igloolik Island; Teichert included in this species a form from the Red River Formation of Manitoba that Flower (1968, p. 74) subsequently described as *Farroceras*(?) *winnipegense.*

Type. Hypotype, GSC 42984, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 28688.

Kochoceras foordi Foerste

Plate 12, fig. 1

1928 *Kochoceras foordi* Foerste, p. 70, Pl. 6, fig. 3

Incomplete depressed specimen, 35 mm long, enlarging from 25 to 35 mm diameter in that length, 3 camerae preserved; sutures sloping downward; large central circular siphuncle with well developed septal neck, maximum diameter of 12 mm.

Discussion. Foerste (1928, p. 69) described *K. foordi* Foerste and *K. mantelli* Foerste in material collected from "the Black River formation" of Igloolik Island. In other Melville Peninsula material, Teichert (1937*a*) recognized *K. boreale* Teichert, *K. breve* Teichert, *K.* cf. *K. cuneiforme* Troedsson, and *K.* cf. *K. tyrrelli* Foerste, the last specimen from Igloolik Island. Within the new collections, *K.* sp. cf. *K. mantelli* and *K.* sp. cf. *K. cuneiforme* were identified in addition to *K. foordi.*

Type. Hypotype, GSC 42983, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89831.

Gonioceras groenlandicum Troedsson

Plate 12, fig. 6

1912 *Gonioceras occidentale* Hall. Holtedahl, p. 9, Pl. 3, fig. 1
1926 *Gonioceras groenlandicum* Troedsson, p. 86, Pl. 48, fig. 3; Pl. 53, figs. 1, 2; Pl. 54, fig. 1; Pl. 65

Large straight incomplete cephalopod, impression at least 70 mm long with 12 camerae preserved, expanding in that length from 55 to 80 mm; median lobe 30 mm wide with septa 5 mm apart; wide high lateral saddles and long lateral lobes steeply dipping apically.

Discussion. In the height of the saddles and steepness of the lateral lobes this specimen resembles *G. holtedahli* Troedsson (in particular Pl. 49, fig. 1 specimen) but it differs in the greater width of the flange saddle and accordingly flatter lobes.

Type. Hypotype, GSC 42989, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89833.

Gonioceras sp. cf. *Gonioceras wulffi* Troedsson

Plate 12, fig. 7; Plate 13, figs. 1, 3

Straight incomplete impression 90 mm long with 21 camerae preserved, expanding from 40 to 80 mm in that length; median lobe 20 to 38 mm in diameter with septa 4 to 5 mm apart; wide low lateral saddles and gently sloping lateral lobes; siphuncle 9 mm in diameter.

Discussion. A more complete straight form collected from Baffin Island, 150 mm long with 42 camerae preserved, expanding from 40 to 100 mm in that length, median lobe 20 to 50 mm in diameter, is illustrated for comparison (Pl. 13, fig. 1). It is closer to *G. wulffi* than *G. groenlandicum*, which was reported by Wilson (*in* Miller *et al.*, 1954, p. 154) from the same region; it differs in its suture spacing of 3 mm and narrower median lobe.

Types. Hypotypes, GSC 42990, 42993, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89833, 89830 (loose); hypotype, GSC 42992, Middle Ordovician, 30 mi northwest of Nettilling Lake, lat. 65°40′N, long. 71°51′W, Baffin Island, District of Franklin, GSC loc. 69491.

Lambeoceras baffinense Miller, Youngquist and Collinson
Plate 13, fig. 9; Plate 14, figs. 4, 7, 8

1954 *Lambeoceras baffinense* Miller, Youngquist and Collinson, p. 79, Pl. 37, fig. 7; Pl. 38, figs. 1–3; Pl. 39, fig. 1; Pl. 40, fig. 1; Pl. 46, fig. 14
1963 *Lambeoceras baffinense* Miller, Youngquist and Collinson. Nelson, p. 75

The largest complete orthocone is 250 mm long, of which 180 mm is phragmocone with 26 camerae, expanding from 75 to 120 mm, sutures 7 mm apart in centre. Another incomplete phragmocone is 80 mm long and 95 mm wide, 13 camerae preserved, sutures 7 mm apart in centre.

Discussion. Both *Lambeoceras arcticum* Teichert and this species (as *Lambeoceras* cf. *L. nudum* Troedsson) have been reported from Igloolik Island by Troedsson. The camerae of *L. baffinense* are deeper than *L. nudum* but shallower than *L. princeps* Troedsson.

Types. Hypotypes, GSC 43000, 43006, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 90545, 89857; hypotypes, GSC 43004, 43005, Middle Ordovician, Schwatka Islands, Sherman Inlet, lat. 67°50′N, long. 97°51′W, District of Franklin, GSC loc. 42566.

Lambeoceras sp. cf. *Lambeoceras magnum* Troedsson
Plate 15, fig. 5

Incomplete phragmocone 100 mm long and at least 130 mm wide preserving 11 shallow camerae; sutures 10 mm apart; siphuncle up to 8 mm in diameter.

Discussion. Similar large shallow camerae are reported only in *L. magnum* Troedsson from the Cape Calhoun Formation of Greenland.

Type. Hypotype, GSC 43012, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 90544.

Whitfieldoceras sp.
Plate 10, fig. 2

Living chamber only preserved, 22.2 mm long, 13 mm across at base and contracting to 9.8 mm near aperture, which is 12 mm in diameter; cross-section circular, becoming depressed dorsoventrally as diameter contracts; siphuncle minute, slightly off centre.

Discussion. *Whitfieldoceras foerste* Teichert from Igloolik Island is distinguished from this specimen by a shorter and less contracting living chamber; *W. baffinense* Foerste has a shorter and narrower living chamber.

Type. Hypotype, GSC 42961, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89831.

Ephippiorthoceras compressum Foerste
Plate 16, fig. 8

1954 *Ephippiorthoceras compressum* Foerste. Miller, Youngquist and Collinson, p. 53, Pl. 45, fig. 12 (synonymy)

A weathered, slightly distorted phragmocone 78 mm long with 10 camerae preserved, maximum diameter 32 mm, expanding little; sutures oblique, 7.3 mm apart, broad deep lateral lobes and rounded saddles; cross-section subcircular to subelliptical; siphuncle not evident.

Discussion. The Melville Peninsula specimen is more compressed and distorted than both the primary types of *Ephippiorthoceras dowlingi* Foerste and Savage from the Shamattawa limestone of Gods River and the secondary type from Churchill River, northern Manitoba. In cross-section, however, it is closest to the broadly elliptical *E. compressum* from Baffin Island. About 4 camerae occupy a length equal to the dorsoventral diameter compared with 5 in the primary type of *E. compressum* and 7 in *E. dowlingi.*

Type. Hypotype, GSC 43022, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89860.

Gorbyoceras baffinense (Schuchert)
Plate 10, fig. 11; Plate 11, fig. 6; Plate 12, figs. 3, 4, 10, 11

1900 *Orthoceras olorus baffinense* Schuchert, p. 151, Pl. 12, figs. 19–22
1937 *Spyroceras* sp. 1 Teichert, p. 82, Pl. 17, fig. 2
1954 *Spyroceras baffinense* (Schuchert). Miller, Youngquist and Collinson, p. 59, pls.

Phragmocones ranging in lengths of: 110 mm with 24 annulations, enlarging from 15 to 30 mm; 85 mm long with 16 annulations, enlarging from 20 to 30 mm; 55 mm long with 11 annulations, enlarging from 18 to 28 mm; and 61 mm long with 14 annulations, enlarging from 15 to 22 mm; cross-section circular to semielliptical; annulations oblique to longitudinal axis, crests high and angular, sutures parallel in grooves between annulations, 4 to 6 mm apart; siphuncle slightly off centre, circular, 3 mm in diameter; no longitudinal or transverse lirae evident.

Discussion. This is the most abundant orthoconic cephalopod in the Bad Cache Rapids Formation of Melville Peninsula. In the parallel sharp-edged annulations and sutures, and the near-central position of the siphuncle, these specimens resemble *Gorbyoceras geronticum* (Foerste and Savage). One specimen (Pl. 10, fig. 11) in particular with sutures 7 mm apart resembles a small *G. geronticum* and compares well with some *Spyroceras baffinense* from Silliman's Fossil Mount (Miller *et al.*, 1954, Pl. 26, figs. 1–5; Pl. 27, figs. 1, 2). Because the sutures do not cross the annulations, the phragmocones are not referred to the genus *Metaspyroceras* (represented on Melville Peninsula by *M. melvillense* Teichert).

Types. Hypotypes, GSC 42969, 42980, 42985–42988, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 90544, 89868, 89831.

Probillingsites(?) sp.
(prepared by R.H. Flower)
Plate 16, figs. 2, 7

Shell exogastric, faintly breviconic, the figured specimen 46 mm long with an anterior complete living chamber 27 mm long ventrally and 11 mm dorsally. The base is somewhat crushed and a deep septum of truncation is not everywhere clearly distinct from a first camera; on the venter when presumably 6 mm represents the septum of truncation, then camerae measure 5, 5, 4 and 2 mm; on the dorsum the septum of truncation is estimated at 13 mm, with camerae 4, 2, 1.8 and

1 mm; at the dorsal anterior end of the septum of truncation the shell is 18 mm high and 24 mm wide; a maximum height just beyond the base of the living chamber is 20 mm; the maximum width a little farther forward is 26 mm. Normal to the dorsal margin of the aperture the width is 24 mm, the height normal to the shell curvature is 16 mm, but the true aperture, nearly vertical as the specimen is oriented in lateral view, is 18 mm.

The septum of truncation is crushed and the siphuncle is not evident. The aperture clearly slopes apically from venter to dorsum and clearly has no hyponomic sinus.

Discussion. This specimen is morphologically so close to the boundary between *Redpathoceras* and *Probillingsites*, that originally I was uncertain on which side to place it. The slight inflation and negligible forward extension of anterior septa on the dorsum suggest *Probillingsites* but the extension is not constant. The marked adoral contraction suggests *Probillingsites.* The final assignment to *Probillingsites* was influenced largely by the abrupt turning of the aperture toward the dorsum and the marked adoral contraction of the living chamber both vertically and horizontally.

Type. Hypotype, GSC 43016, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. C-2847.

Digenuoceras heywoodi n. sp.
Plate 15, figs. 1–3

Specimen slightly curved, 130 mm long with 19 camerae preserved in a length of 110 mm, very gradual enlargement dorsoventrally to 62 mm at base of living chamber; strongly compressed laterally, ventral convex margin angulate, dorsal concave margin subangulate to narrowly rounded adorally; sutures simple, forming shallow lateral lobes 6 mm apart and acute dorsal and ventral saddles; the first 6 camerae apically from the junction with the living chamber are smaller, sutures 3 mm apart; small siphuncle near ventral wall.

Discussion. The slight curvature distinguishes this new species from other forms included in the genus. In cross-section, both the ventral and dorsal margins of *Digenuoceras* are angular, although Nelson (1963, p. 83) noted that specimens of *D. latum* (Foerste) from the Portage Chute Formation, Bad Cache Rapids Formation of northern Manitoba, exhibited narrowly rounded margins adorally. The genus *Exomegoceras* comprises exogastrically curved strongly compressed nautiloids with narrowly to broadly rounded dorsal and acutely angular ventral sides. It is now included in the genus *Oonoceras*; no species of that genus, however, approaches *D. heywoodi* n. sp.

Type. Holotype, GSC 43009, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 28688.

Neumatoceras(?) *contractum* (Foerste and Savage)
Plate 16, fig. 1

1927 *Westonoceras*? *contractum* Foerste and Savage, p. 55, Pl. 16, figs. 2A,B
1954 *Westonoceras*? *cornulum* (Schuchert). Miller, Youngquist and Collinson, p. 87, Pl. 48, figs. 1–3

Specimen with living chamber and 3 camerae preserved, at least 43 mm long with a maximum dorsoventral diameter of 33 mm (21 mm laterally) and an oral diameter of 25 mm; strongly convex ventral margin and concave dorsal margin; cross-section narrowly elliptical; sutures gently curving, 3 mm apart reducing to 1 mm at dorsum and expanding to 4 mm at venter; anterior end camera very narrow; siphuncle ventral, elliptical, at least 2 mm in long diameter.

Discussion. The curvature of the sutures is less in the Melville Peninsula specimen but the phragmocones are similar, though longer than those of *N. medium* Flower and Teichert and *N. churchillense* Nelson with which it is associated.

Type. Hypotype, GSC 43015, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89830.

Neumatoceras churchillense Nelson
Plate 16, fig. 9

1963 *Neumatoceras churchillense* Nelson, p. 86, Pl. 36, figs. 2*a*,*b*

Gently curved, laterally compressed cephalopod, 42 mm long with 7 camerae preserved; ventral margin uniformly convex, dorsal margin nearly straight; dorsoventral diameter maximum of 30 mm near anterior end of phragmocone, reducing to 26 mm at apical end and 27 mm at top of the living chamber; sutures uniformly curved, 2.5 mm apart, reducing to 1.5 mm apart on dorsum and expanding to between 3.5 and 5 mm apart on venter; anterior end camera narrowest; cross-section elliptical; siphuncle not evident.

Discussion. The present specimen is less crushed than the holotype collected from the Portage Chute Formation, Bad Cache Rapids Group of northern Manitoba; the sutures are closer particularly on the dorsum of the better preserved phragmocone. There is a similarity between the Melville Peninsula specimen and that from Silliman's Fossil Mount assigned to *Westonoceras*? cf. *W.*? *breviposticum* (Miller) by Miller *et al.* (1954, p. 86, Pl. 48, figs. 4, 5) and subsequently described as *Neumatoceras medium* Flower and Teichert (1957, p. 140), but the concavity of its dorsal proper is more typical of *N. churchillense* Nelson. Flower (1975, *pers. comm.*) questions the generic assignment of this species, preferring *Oncoceras*.

Type. Hypotype, GSC 43023, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89830.

Richardsonoceras simplex (Billings)
Plate 16, fig. 3

1857 *Cyrtoceras simplex* Billings, p. 313
1933 *Richardsonoceras simplex* (Billings). Foerste, p. 91, Pl. 26, figs. 1A–5B
1961 *Richardsonoceras simplex* (Billings). Wilson, p. 91, Pl. 34, figs. 5, 6

Strongly curved phragmocone 77 mm long composed of 15 camerae and a living chamber 30 mm long, compressed laterally, dorsoventral diameter ranging from 15 mm at apex to 25.4 mm at base of living chamber; slightly flaring at aperture; sutures 3 mm apart laterally to 2.4 mm dorsally and 5 mm ventrally, shallow lateral lobes and rounded ventral saddles; cross-section ovate; siphuncle not evident.

Discussion. The Schwatka Islands specimen differs from the primary Black River types from Ottawa Valley only in its slightly more compressed cross-section. A small phragmocone derived from the apical region(?) that appears to be a *Richardsonoceras*(?) sp. indet. (Pl. 16, fig. 4) was collected from the Bad Cache Rapids Formation of Melville Peninsula. In both specimens, the camerae are longer than in the strongly curved

R. multicameratum Teichert from the Wright Bay Formation of northern Greenland.

Type. Hypotype, GSC 43017, Middle Ordovician, Schwatka Islands, Sherman Inlet, lat. 67°50′N, long. 97°51′W, District of Franklin, GSC loc. 42566.

Richardsonoceras sp. cf. *Richardsonoceras beloitense* Foerste
Plate 17, figs. 12, 15

Gently curved laterally compressed phragmocone 67 mm long with 14 camerae and living chamber 36 mm long; diameters range from 22.5 mm dorsoventrally and 17.6 mm laterally at apical end, to 32.3 mm and 25.2 mm at base of living chamber, to 29 mm and 21.4 mm at aperture; sutures nearly transverse, faint ventral saddles; siphuncle 4.5 mm in diameter, near venter; strong longitudinal striae similar to *Teichertoceras* and *Westonoceras*.

Discussion. A gently curved form with moderately curving camerae and laterally contracted aperture, the Melville Peninsula specimen could be included in the genus *Oonoceras* as defined by Flower (1946, p. 311, 319, 384). It is more curved and more robust than *Oonoceras humei* (Miller, Youngquist and Collinson) of Baffin Island, and not quite as compressed as the primary type of *R. beloitense* Foerste.

Types. Hypotype, GSC 43034, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 84840; hypotype, GSC 43035, Middle Ordovician, Schwatka Islands, Sherman Inlet, lat. 67°50′N, long. 97°51′W, District of Franklin, GSC loc. 42566.

Rasmussenoceras schwatkaense n. sp.
Plate 17, fig. 13

Phragmocone straight, strongly compressed dorsoventrally, 70 mm long with 25 camerae preserved, expanding from 29 to 35 mm diameter in that length; sutures 2.5 mm apart, broadly rounded lobes and subangular lateral saddles; cross-section lenticular; siphuncle small (2.2 mm in diameter), close to venter, suborthochoanitic, segments expanding only slightly within camerae.

Discussion: The closest forms to this Schwatka Islands specimen are the smaller *R. scofieldi* (Foerste) and *R. variabile* Flower, but both these species expand more rapidly. The narrow siphuncle and shallow sutures eliminate *Lambeoceras*, which it superficially resembles.

Type. Holotype, GSC 43036, Middle Ordovician, Schwatka Islands, Sherman Inlet, lat. 67°50′N, long. 97°51′W, District of Franklin, GSC loc. 42566.

Rasmussenoceras sp.
Plate 17, fig. 5

Living chamber only, strongly compressed dorsoventrally, 60 mm long, expanding from 15 to 24 mm; cross-section lenticular; no trace of siphuncle; deep, wide hyponomic sinus.

Discussion. Because no definite keel or ridge is evident on the living chamber and the cross-section is lenticular rather than depressed-triangular, the specimen is assigned to the genus *Rasmussenoceras* rather than *Tripteroceras*.

Type. Hypotype, GSC 43027, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89845.

Diestoceras sp. cf. *Diestoceras schucherti* Foerste
Plate 17, fig. 1

Living chamber and 1 camera, 32.2 mm long, with diameter contracting from 51.2 mm at base to 30 mm near aperture; cross-section subcircular resulting from slight compression; no trace of the siphuncle.

Discussion. The Melville Peninsula specimen is slightly larger than the primary type from Baffin Island, but smaller than *D. pyriforme* Troedsson from Greenland.

Type. Hypotype, GSC 43025, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 90544.

Diestoceras sp.
Plate 18, fig. 15

Mature specimen slightly compressed laterally, 97 mm long, consisting of phragmocone 61.3 mm long with at least 9 camerae preserved and living chamber 35.7 mm long; maximum diameter 76.4 mm at base of living chamber, contracting apically to 61.6 mm and to at least 52.5 mm at aperture; transverse sutures 5.7 mm apart; siphuncle round, near venter, 7 mm in diameter.

Discussion. The Melville Peninsula specimen proportionately is slightly wider and much longer, with a longer living chamber than *D. pyriforme* Troedsson; it is quite similar to *D. stensioei* (Troedsson) for the Lyckholm Formation of Estonia.

Type. Hypotype, GSC 43048, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89860.

Cyrtogomphoceras alcocki Nelson
Plate 18, fig. 10

1963 *Cyrtogomphoceras alcocki* Nelson, p. 96, Pl. 28, fig. 1*a,b*

Incomplete slightly distorted mature specimen, 55 mm long, consisting of a phragmocone 28 mm long with 4 camerae preserved and a living chamber 27 mm long; dorsoventral diameter maximum of 57.5 mm reducing to 56 mm at base of living chamber and 39.7 mm below flaring aperture; cross-section elliptical, height: width about 1:0.7; sutures rise dorsally, 7.7 mm apart on a strongly curved dorsum and 4 mm apart on straight to slightly curved venter; circular siphuncle located at margin, endogastric, 9.4 mm in diameter.

Discussion. The Melville Peninsula specimen differs only in being slightly smaller than the primary types. It is a little larger than *C. schucherti* Flower and Teichert (1957, p. 63) from Baffin Island.

Type. Hypotype, GSC 43045, Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89845.

Teichertoceras curti n. sp.
Plate 16, fig. 10; Plate 17, fig. 14

1937 *Teichertoceras* sp. Teichert, p. 88, Pl. 17, figs. 13–15

Holotype, medium-size phragmocone with 18 camerae preserved and a small part of the living chamber, totalling 65 mm in length; diameter a maximum of 34.4 by 20 mm reducing to 31 by 21.5 mm at living chamber junction and 11.4 by 11 mm at apex; dorsal outline straight, maximum ventral curvature 6 camerae from the anterior end of phragmocone, apical portion slightly curved endogastrically; sutures shallow lateral lobes 2.3 to 3 mm apart, subangular ventral saddles, low dorsal saddles; siphuncle close to ventral wall, 4 mm diameter at a phragmocone diameter of 14.3 mm, subquadrate segments. Paratype phragmocone composed of 19 camerae, 40 mm long, compressed cross-section, increasing from an apex dorsoventral diameter of 6.8 to 30.9 mm; venter curved endogastrically, narrowly rounded, dorsum broadly rounded and straight; sutures 1.9 mm apart; siphuncle near venter; strong longitudinal striae well preserved.

Discussion. This new species is smaller and more slender than *T. husseyi* Foerste. The paratype without the endogastric apex could easily be mistaken for the more common flattened forms of *Westonoceras ornatum* (Troedsson) from Baffin Island. The paratype and specimen described by Teichert from the Bad Cache Rapids Formation of Melville Peninsula are considered conspecific.

Types. Holotype, GSC 43037, Middle Ordovician, Schwatka Islands, Sherman Inlet, lat. 67°51′N, long. 97°51′W, GSC loc. 42566; paratype, GSC No. 43024, Middle Ordovician, Schwatka Islands, Sherman Inlet, lat. 67°52′N, long. 97°52′W, GSC loc. 42567, District of Franklin.

Winnipegoceras sp.
Plate 18, figs. 9, 16, 17

1963 *Winnipegoceras dowlingi* Foerste. Nelson, p. 89, Pl. 31, fig. 4

Laterally compressed curved specimen 260 mm long measured along venter of which 180 mm is phragmocone with 16 camerae preserved; dorsoventral diameter 31 mm at apex, 71 mm maximum 4 camerae down from living chamber, narrowing to 68 mm at base of living chamber and approximately 42 mm at end of specimen; dorsum rounded gently concave, venter strongly convex, narrowly rounded; sutures relatively transverse, 7.2 mm apart, curving upward adorally over venter into broad saddles 13 mm apart and gently downward to 6 mm dorsally, straight in apical portion; cross-section subelliptical; siphuncle small, segments narrow, located at ventral margin.

Discussion. In general outline this specimen is much like the Red River form *Winnipegoceras dowlingi* Foerste which Flower and Teichert (1957, p. 33) have reassigned to the more gibbous endogastric genus *Cyrtogomphoceras*. As the Melville Peninsula specimens and those from the lower Bad Cache Rapids Group of northern Manitoba assigned by Nelson (1963) to *W. dowlingi*, especially GSC hypotype 10887, are exogastric, they are best retained in the genus *Winnipegoceras* within the group composed of short living chambers (Flower and Teichert, 1957, p. 76). *W. royi* Miller, Youngquist and Collinson common to the Middle Ordovician of Baffin Island, even though based on a very incomplete specimen, is a much straighter form.

Type. Hypotypes, GSC 43044, 43049, Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89845, 89860.

Trilobita

Trilobitomorphs are never abundant in the Bad Cache Rapids Formation of Melville Peninsula. Forms that are common to these beds and the Middle Ordovician of Baffin Island include *Calyptaulax goodridgii* (Schuchert), *Illaenus lacertus* Whittington, *I. baffinlandicus* Roy, *Bumastus* (*Bumastoides*) sp. (Pl. 18, figs. 1, 2, 12) and *Nanillaenus punctatus* (Roy) (Pl. 17, fig. 6); no specimens of *Anataphrus borraeus* Whittington (Pl. 17, fig. 10) or *Brachyaspis*? *australe* Whittington. Additional forms recognized in the Melville Island limestones include *Bumastus* (*Bumastoides*) sp. aff. *B. tenuirugosus* Troedsson, *Calliops* sp. (Pl. 10, fig. 12; Pl. 17, fig. 8), *Ceraurus* sp. (non *Hapsiceraurus*), *Otarion* sp. and *Remipyga* sp.

Illaenus lacertus Whittington
Plate 17, fig. 11; Plate 18, figs. 3, 4, 6–8, 11, 13

1937 *Illaenus americanus* Billings. Teichert, p. 102, Pl. 20, figs. 3–5
1954 *Illaenus lacertus* Whittington, *in* Miller *et al.*, p. 136, Pl. 61, figs. 1–6

Most of the specimens from Melville Peninsula are smaller than the Baffin Island representatives (Pl. 17, fig. 11). The species is characterized by low convex glabella between axial furrows and of the axial part of the cephalon in both transverse and longitudinal profile, palpebral lobes with gentle longitudinal convexity, and grooved and pitted pygidia surfaces (*I. baffinlandicus* Roy pygidium surface is marked by fine, raised branching ridges [Pl. 18, fig. 5]).

Types. Hypotypes, GSC 43033, 43040–43042, Middle Ordovician, lat. 64°37′N, long. 70°49′W, northwestern end of Amadjuak Lake, Foxe Lowland, Baffin Island, GSC loc. 69516; Bad Cache Rapids Formation, Middle Ordovician, GSC locs. 89833, 66758, 89869.

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Plate 1
Bad Cache Rapids Formation, Middle Ordovician

Figures 1, 8–10. *Grewingkia robusta* (Whiteaves). All ×1. (1) Longitudinal section showing slightly arched tabulae; hypotype, GSC 42901; GSC loc. 89865. (8, 9) Transverse sections showing wide axial complex; hypotypes, GSC 42902, 42903; GSC loc. 89841. (10) Alar view; hypotype, GSC 42904; GSC loc. 28688.

Figure 2. *Receptaculites* sp. ×1; hypotype, GSC 42905; GSC loc. C-2847.

Figures 3–5. *Streptelasma oppletum* Teichert. All ×2. (3, 5) Transverse sections 30 and 20 mm from apex, showing loose, narrow axial structure and increase in primary septa; hypotype, GSC 42906; GSC loc. 89860. (4) Transverse section 15 mm from apex, showing loose axial structure; hypotype, GSC 42907; GSC loc. 89840.

Figures 6, 7, 13. Echinoderm plates, ×4 and ×3 (fig. 13); hypotypes, GSC 42908–42910; GSC locs. 89869, 91955, 89864.

Figure 11. *Lophospira* sp. Abapertural view, ×2; hypotype, GSC 42911; GSC loc. 89831.

Figure 12. *Hormotoma rotundivolvis* Roy. Apertural view, ×1; hypotype, GSC 42912; GSC loc. 89833.

Figures 14, 15. *Subulites* (*Fusispira*) sp. Apertural views, ×1; hypotypes, GSC 42913, 42914; GSC loc. 89845.


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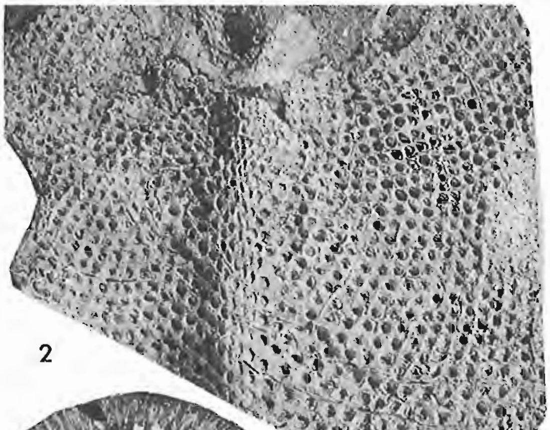
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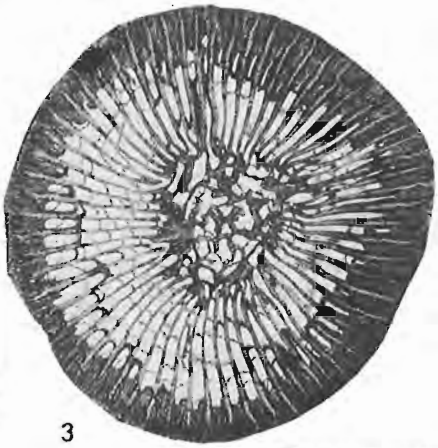
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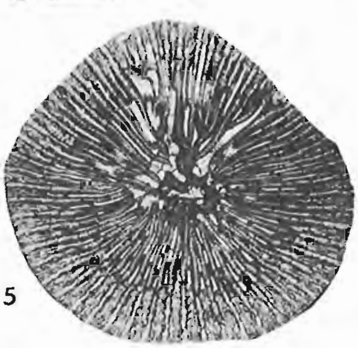
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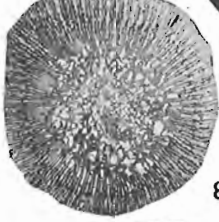
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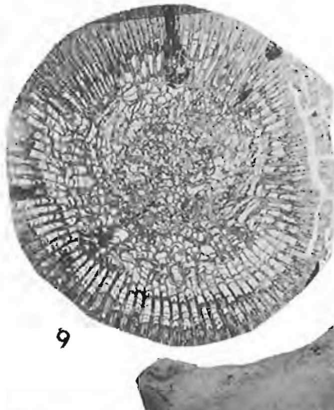
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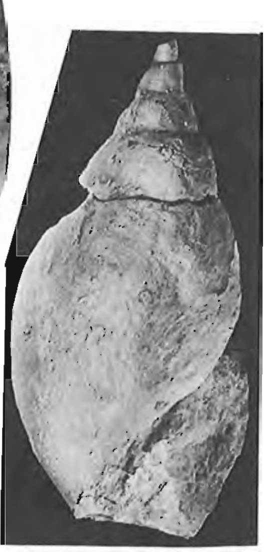
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Plate 2
Bad Cache Rapids Formation, Middle Ordovician

Figures 1–3, 7, 9–11. *Billingsaria parvituba* (Troedsson). GSC loc. 89831. (1, 2, 7, 9) Transverse and longitudinal sections, ×4, showing the variation in preservation of septa and columellae within different parts of one colony; hypotype, GSC 42915*a*, *b*, *d*, *e*. (3) Longitudinal section, ×4, tabulae more widely spaced as in *Nyctopora*; hypotype, GSC 42916. (10, 11) Transverse and longitudinal sections, ×10, showing variation from thin-walled *Nyctopora*-like corallites with short alternating spines to thicker walled corallites with longer septa and traces of the columella that in vertical section appears a continuous hollow rod; hypotype, GSC 42915*g*, *h*.

Figures 4, 6. *Billingsaria parva* (Billings). Transverse and longitudinal sections, ×10, showing thick walls, 8 major septa and columellae preserved; hypotype, GSC 42917, Valcour limestone, Chazyan, Middle Ordovician, Cooperstown, Vermont, U.S.A.

Figures 5, 8. *Nyctopora* sp. Longitudinal and transverse sections, ×4, considerably recrystallized, showing thick trabecular walls; hypotype, GSC 42918; GSC loc. 89841.

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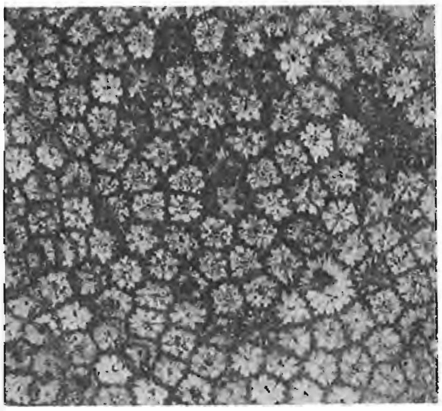
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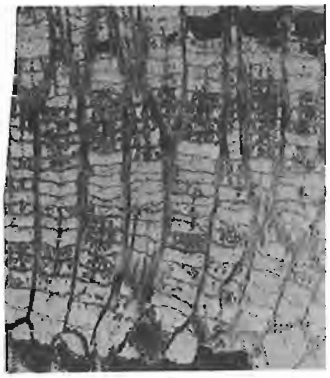
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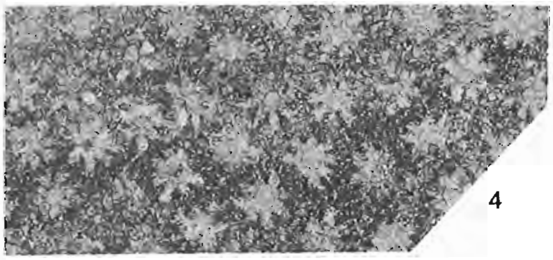
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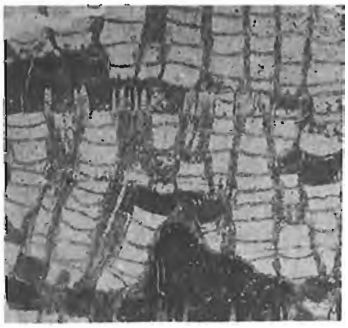
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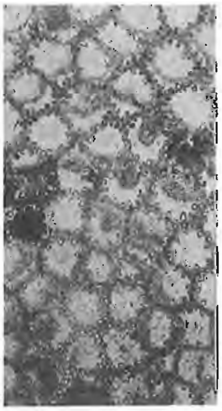
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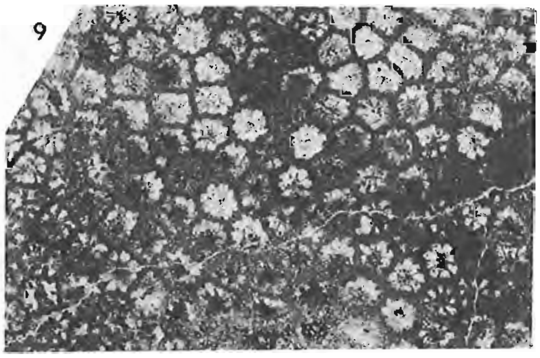
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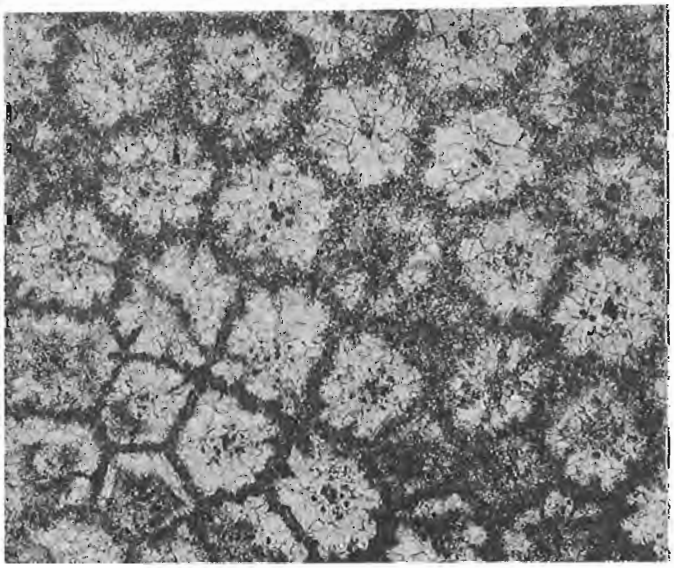
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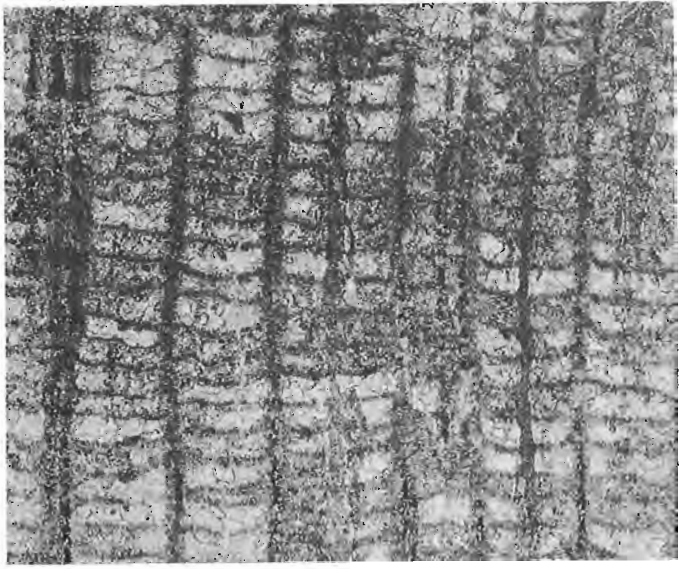
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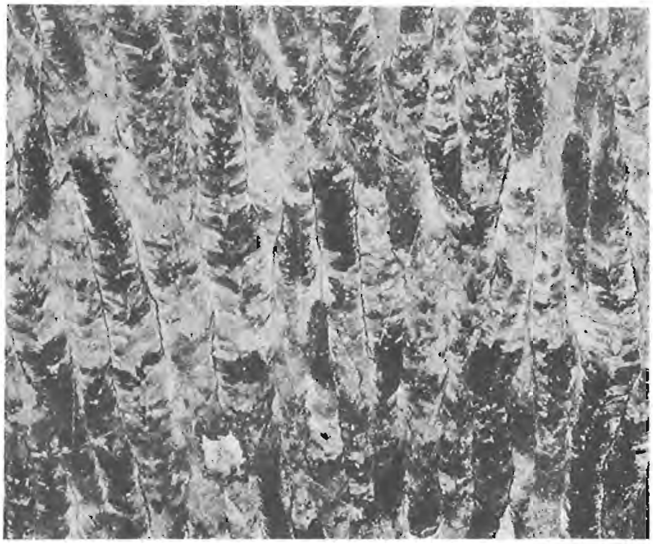
Plate 3
Bad Cache Rapids Formation, Middle Ordovician

Figures 1–5. *Coccoseris astomata* Flower. All ×10. (1, 4) Longitudinal and transverse sections showing U- to V-shaped fibres and the rare larger round corallite; hypotype, GSC 42919; GSC loc. 89860. (2, 3) Transverse and longitudinal sections showing cyst development at base of colony; hypotype, GSC 42920; GSC loc. 89865. (5) Longitudinal section showing cyst development at base of colony and V-shaped fibres; hypotype, GSC 42921; GSC loc. 89865.

Figures 6, 7. *Esthonia*(?) sp. Transverse and longitudinal sections, ×10, faintly showing larger round corallites; hypotype, GSC 42922; GSC loc. 89831.

Figures 8, 9. *Calapoecia arctica* Troedsson. Transverse and longitudinal sections, ×4, showing short septal spines and continuous radiating costae, abundant pores; hypotype, GSC 42923; GSC loc. 28688.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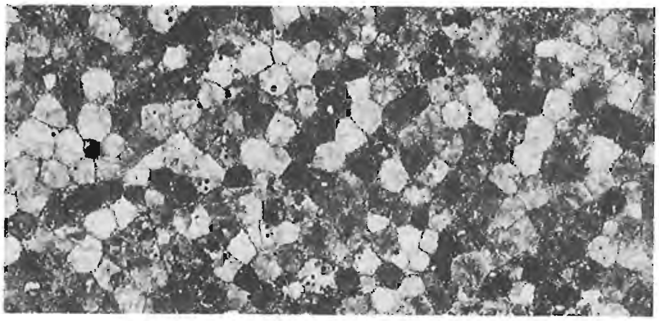
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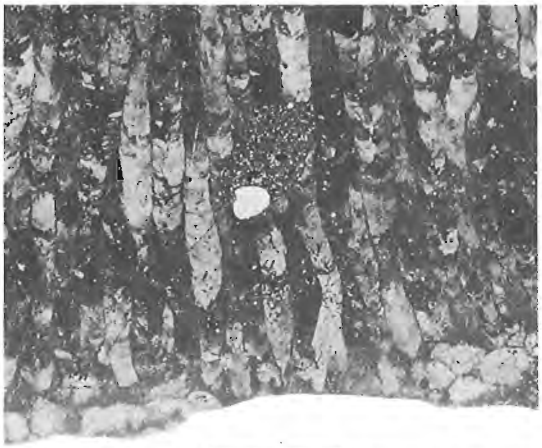
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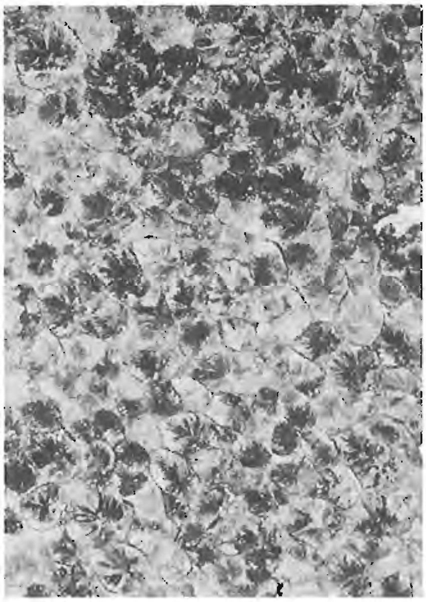
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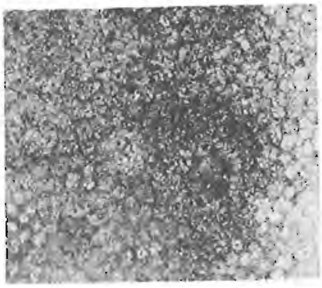
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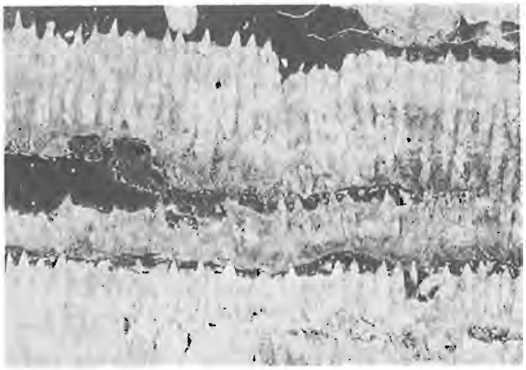
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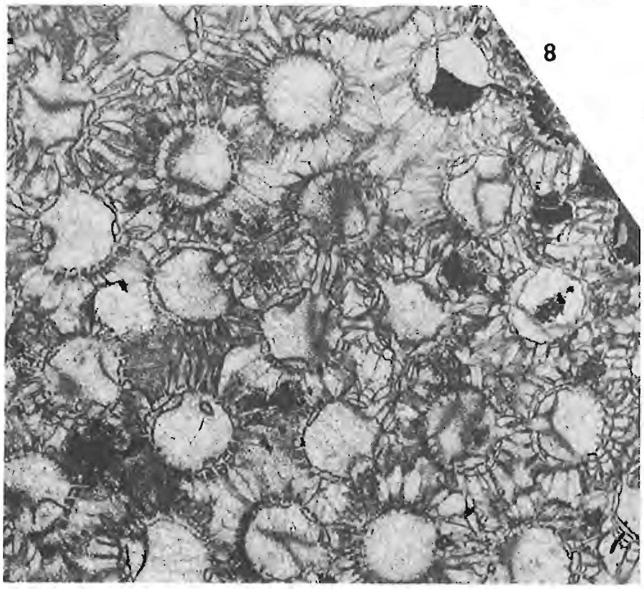
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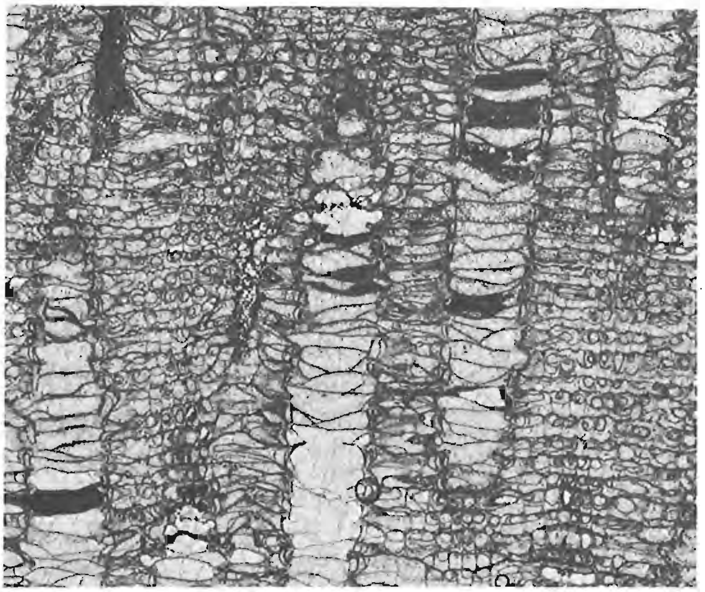
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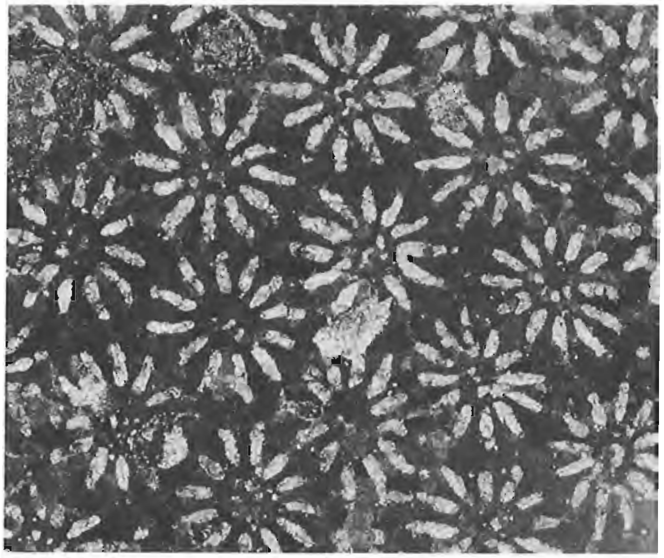
Plate 4

Figures 1–4. *Protrochiscolithus magnus* (Whiteaves). All ×10. (1, 2) Transverse and longitudinal (columella of vertical rods on left) sections; lectotype, GSC 6904*c*; Red River Formation, Middle Ordovician, Lower Fort Garry, Manitoba. (3, 4) Transverse and longitudinal (off centre) sections; hypotype, GSC 42924; Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89865.

Figures 5–8. *Protrochiscolithus cummingi* n. sp. Transverse and longitudinal sections, ×4 and ×10, showing bacular columella and septal pores; holotype, GSC 42925; Churchill River Group, Upper Ordovician, GSC loc. 81851.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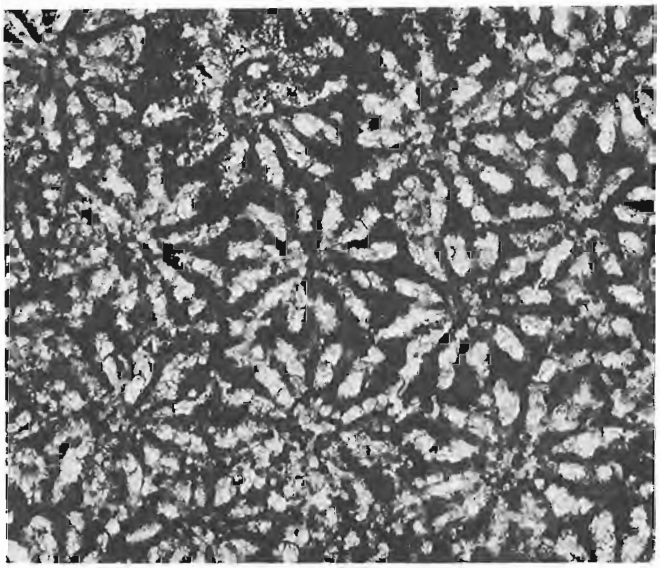
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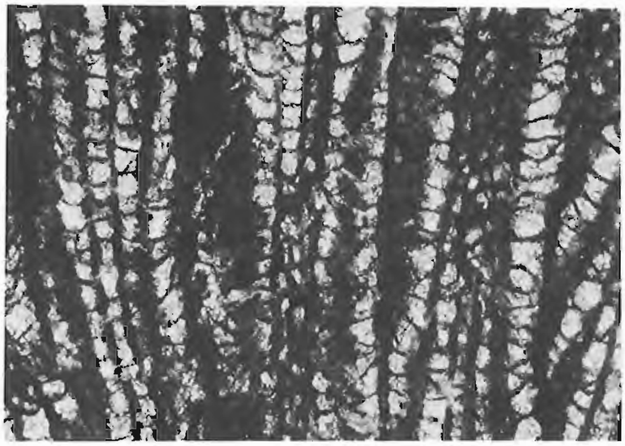
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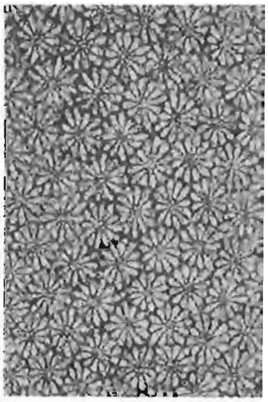
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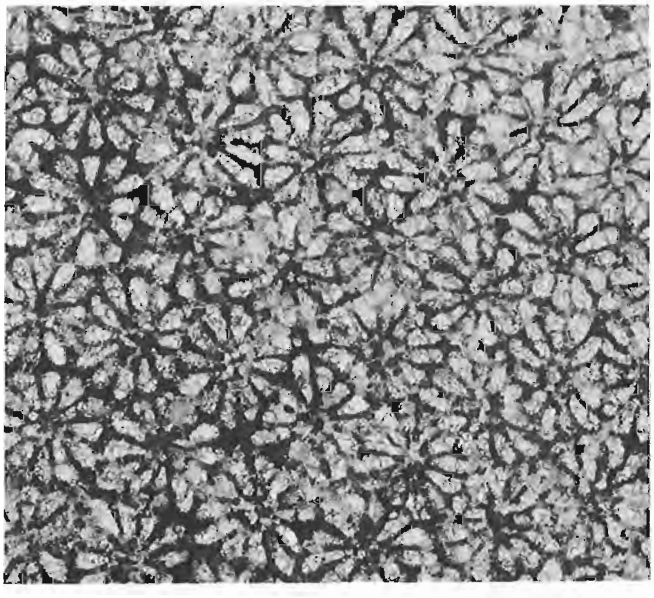
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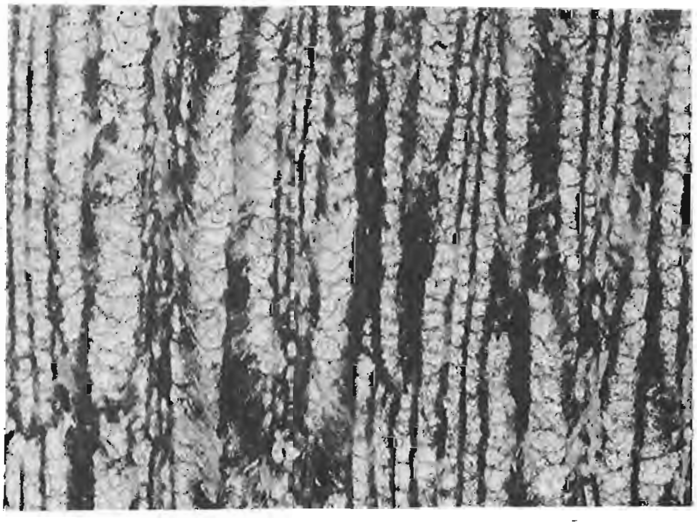
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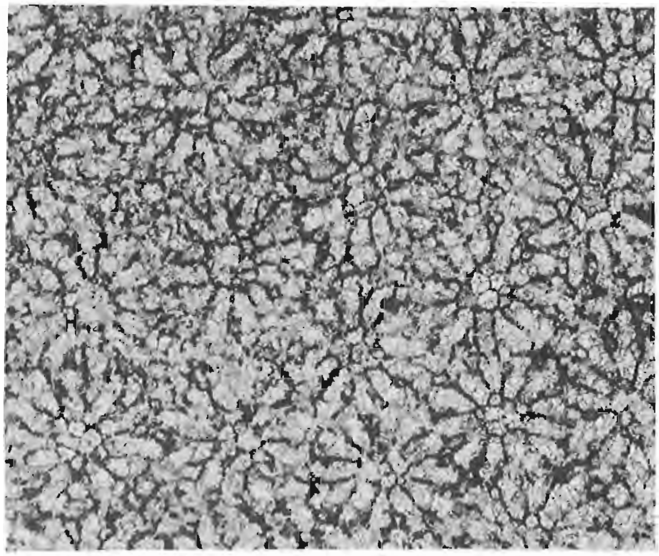
Plate 5

Figures 1–3. *Protrochiscolithus cummingi* n. sp. All ×10. (1, 2) Transverse and longitudinal sections; paratype, GSC 42926; Upper Ordovician, GSC loc. 57572. (3) Transverse section, columella preserved in several corallites; paratype, GSC 10853*b*; Chasm Creek Formation, Upper Ordovician, right bank Churchill River, approximately 4½ miles above Red Head Rapids, Manitoba (GSC loc. 25288).

Figures 4–7. *Plasmoporella lambei* (Schuchert). Middle Ordovician, 'Pope Canyon', Putnam Highland, Baffin Island. All ×4. (4, 5) Longitudinal and transverse sections showing costae in coenenchyme; hypotype, GSC 42927. (6, 7) Longitudinal and transverse sections showing wide cystose coenenchyme; hypotype, GSC 42928.

Plate 5



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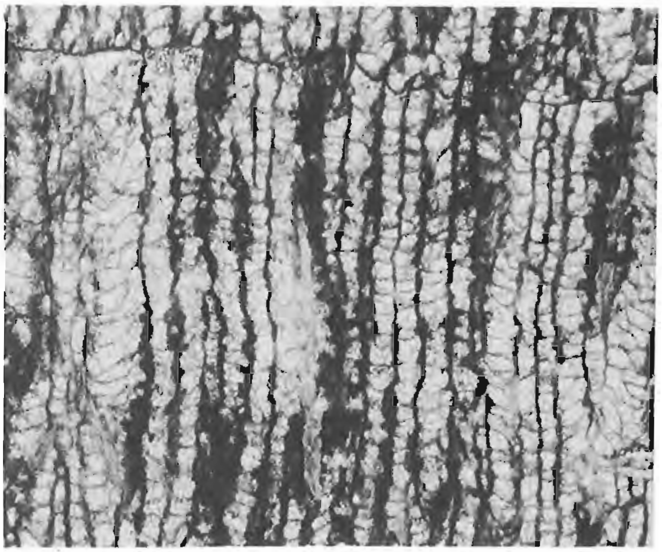

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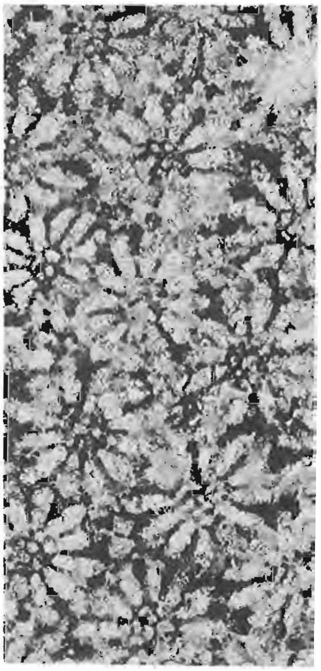

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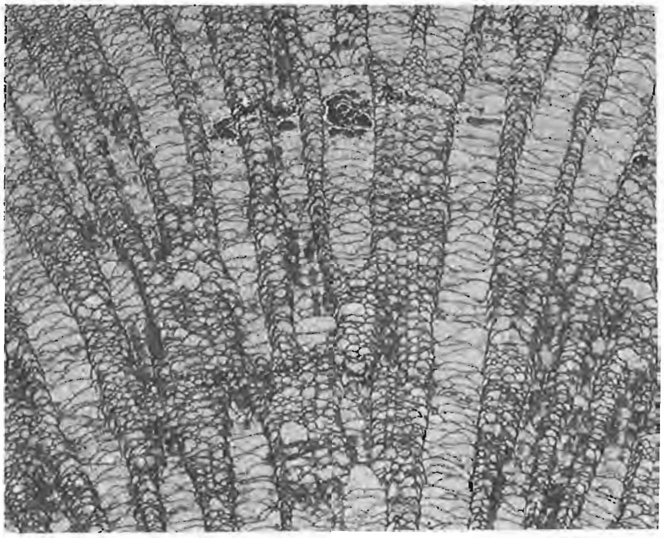

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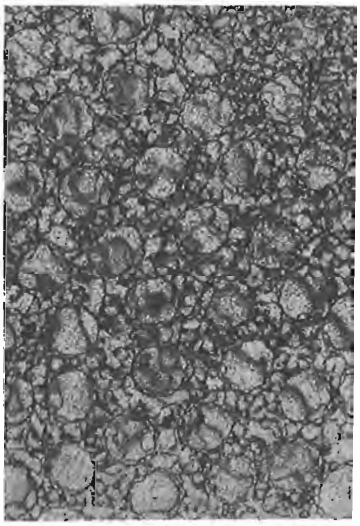

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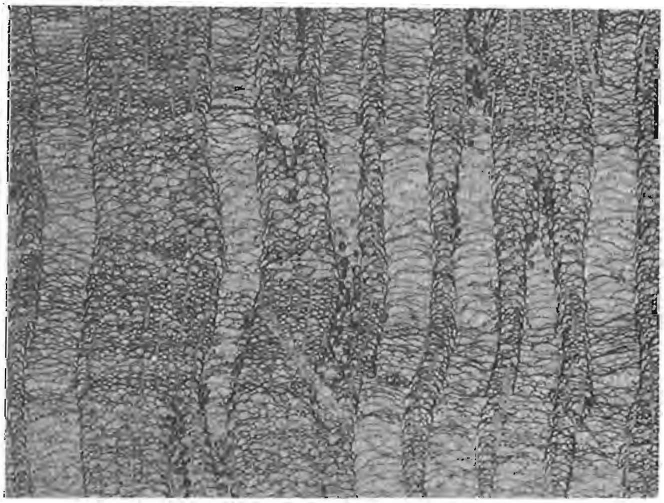

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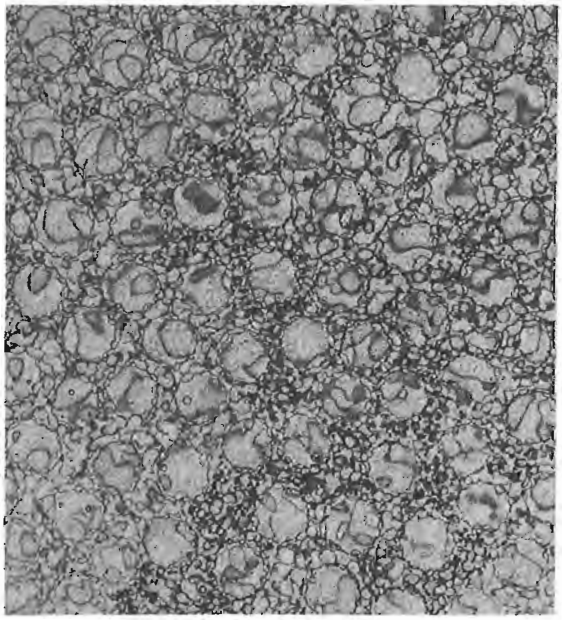

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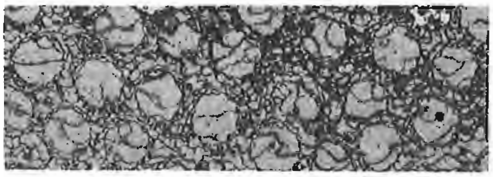
Plate 6
(all ×4)

Figures 1–4. *Plasmoporella lambei* (Schuchert). (1, 2) Transverse and longitudinal sections; hypotype, GSC 42929; Liskeard Group, Middle Ordovician, GSC loc. 37135. (3, 4) Longitudinal and transverse sections illustrating the larger and more stubby corallites and closer development of tabulae; hypotype, GSC 42930; Middle Ordovician, GSC loc. 91955.

Figures 5, 8–11. *Cyrtophyllum pattersoni* (Roy). Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89860. (5, 8) Longitudinal sections showing close tabulae development similar to type specimen; hypotype, GSC 42932; and hypotype 42936; Middle Ordovician, GSC loc. 77291. (9, 11) Longitudinal and transverse sections, tabulae farther apart; hypotype, GSC 42933. (10) Longitudinal section showing crowding at edge of corallite and variation in tabulae spacing; hypotype, GSC 42934.

Figures 6, 7. *Cyrtophyllum* sp. Transverse and longitudinal sections; hypotype, GSC 42938; Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 28688.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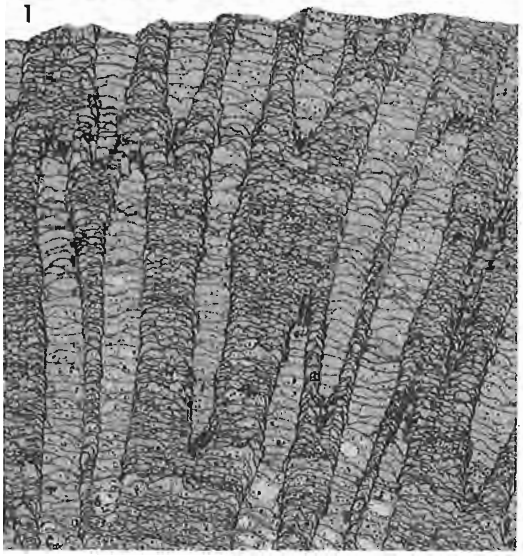
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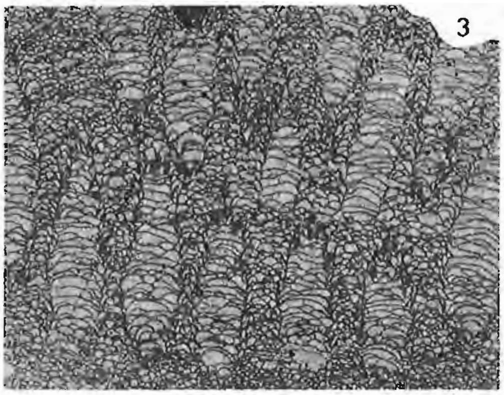
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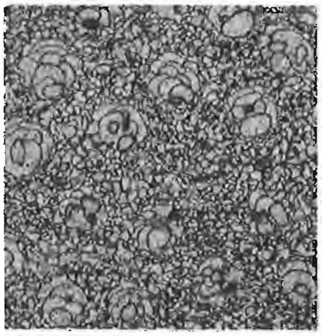
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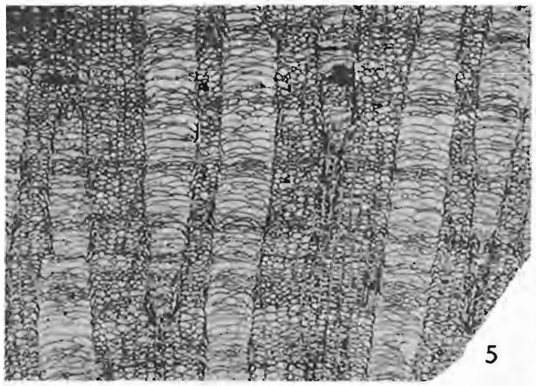
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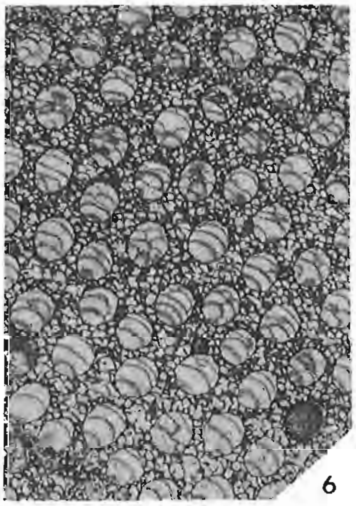
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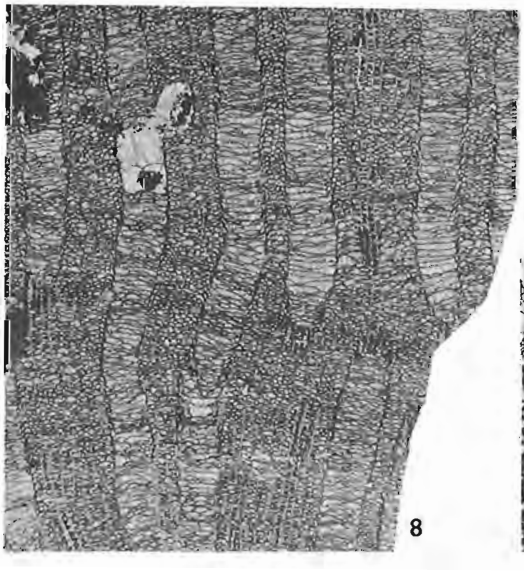
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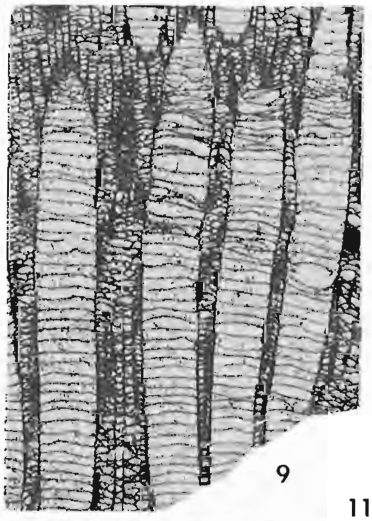
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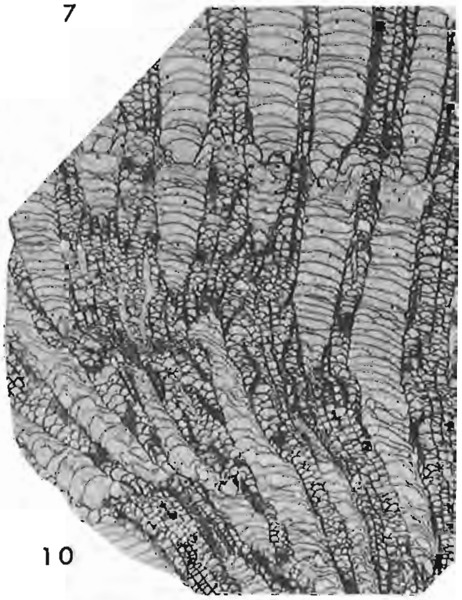
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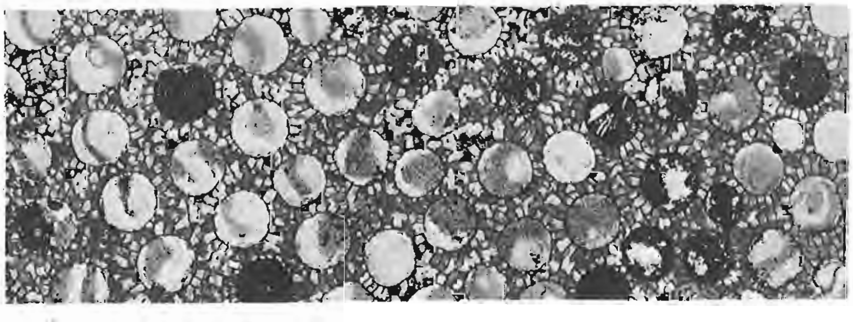
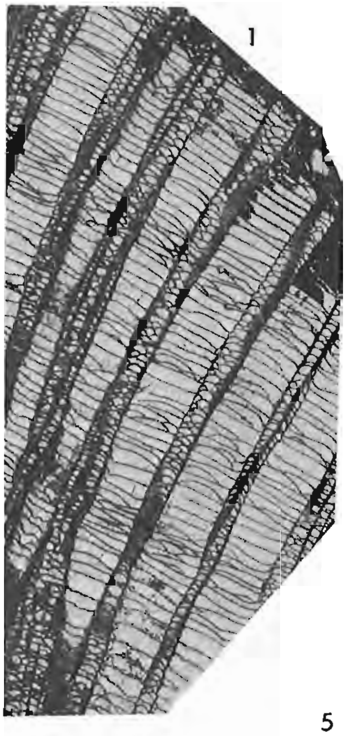


Plate 7

Figures 1–6. *Cyrtophyllum pattersoni* (Roy). All ×4. (1, 2) Longitudinal and transverse sections showing relatively uniform development of complete tabulae with zones of incomplete and distinct costae; hypotype, GSC 42931; Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89845. (3, 6) Transverse and longitudinal sections showing costae and associated curved corallite walls, and highly vesicular coenenchyme which frequently develop from a tabula end (lower left corner of vertical section); hypotype, GSC 42937; Farr Formation, Middle Ordovician, GSC loc. 37134. (4, 5) Transverse and longitudinal sections showing well developed costae dividing coenenchyme; hypotype, GSC 42935; Franklin Strait Formation, Middle Ordovician, GSC loc. 51769.

Figures 7–9, 11. *Catenipora aequabilis* (Teichert). Bad Cache Rapids Formation, Middle Ordovician. All ×4. (7, 9) Longitudinal and transverse sections showing slightly looser ranks and larger lacunae with smaller corallites; hypotype, GSC 42939; GSC loc. 90545. (8, 11) Longitudinal and transverse sections showing typical small lacunae and variation in wall thickness; hypotype, GSC 42940; GSC loc. 89860.

Figure 10. *Catenipora* sp. 1. Transverse section, ×10, showing thin outer holotheca and thicker inner layer; hypotype, GSC 42941; Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89865.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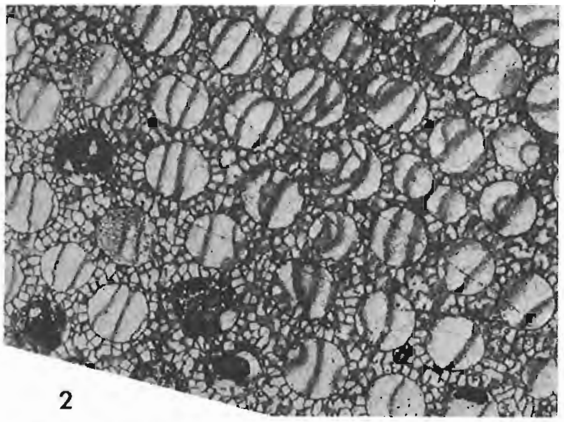
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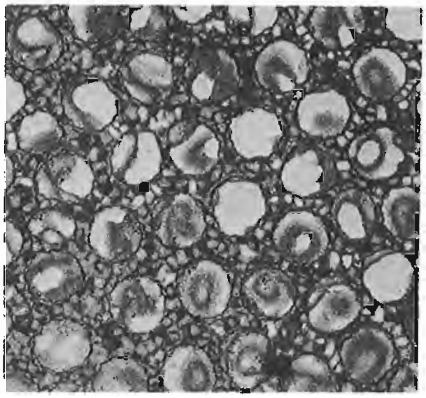
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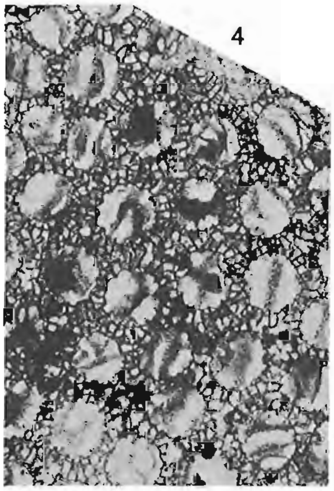
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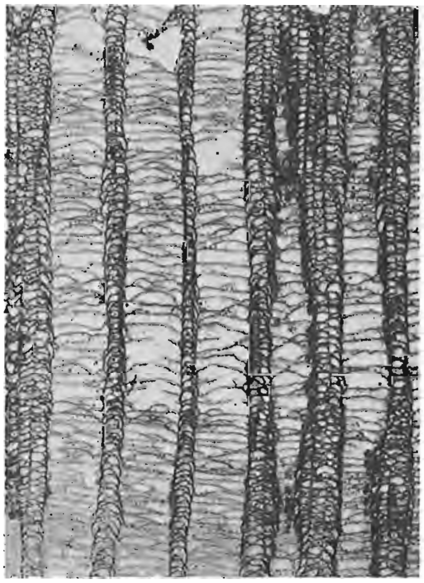
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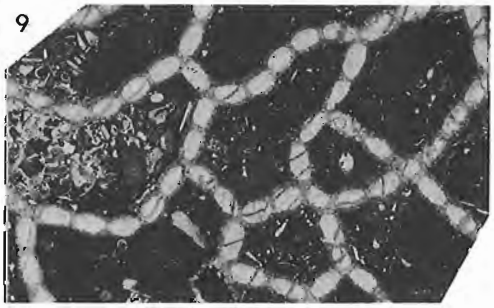
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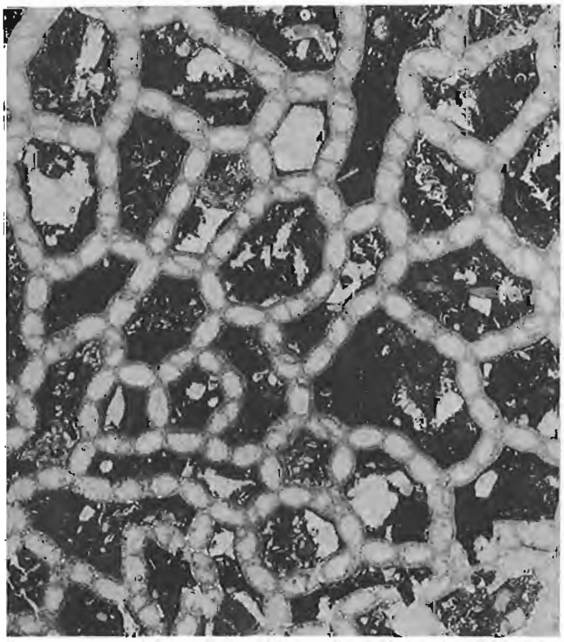
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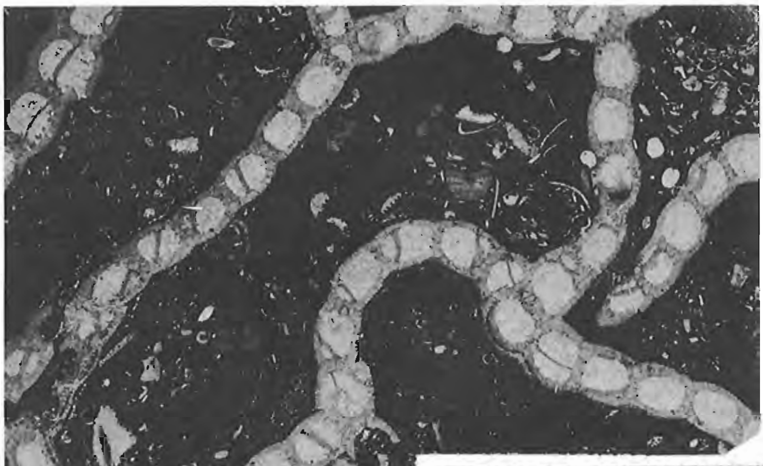
Plate 8

Figures 1, 5, 6. *Catenipora* sp. 2. Bad Cache Rapids Formation, Middle Ordovician, hypotypes, GSC 42942, 42943, GSC loc. 89860. All ×4. (1, 6) Transverse and longitudinal sections showing oval corallites and thick walls. (5) Transverse section showing cluster of corallites, *Tollina*-like in appearance.

Figures 2–4, 7–9, 11. *Labyrinthites* (*Labyrinthites*) *chidlensis* Lambe. All ×10. (2, 11) Longitudinal and transverse sections showing rounded corallites of equal diameter; hypotype, GSC 42948, Middle Ordovician, GSC loc. 69514. (3) Transverse section showing both isolated and connected angulate corallites; hypotype, GSC 42947; Middle Ordovician, GSC loc. 18769. (4, 7) Longitudinal and transverse sections showing many connecting tubes; hypotype, GSC 42945; Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89870 (loose). (8, 9) Transverse and longitudinal sections showing angulate corallites with many connecting tubes; hypotype, GSC 42946; Middle Ordovician, GSC loc. 18752.

Figures 10, 12. *Paleofavosites okulitchi* Stearn. Longitudinal and transverse sections, ×4, showing abundant tabulae and septa; hypotype, GSC 42949, Upper Ordovician unnamed reefal limestone, GSC loc. 89835.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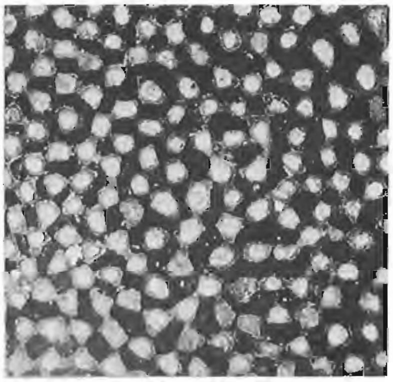
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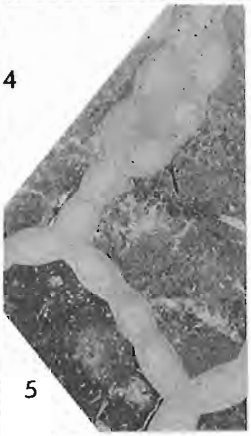
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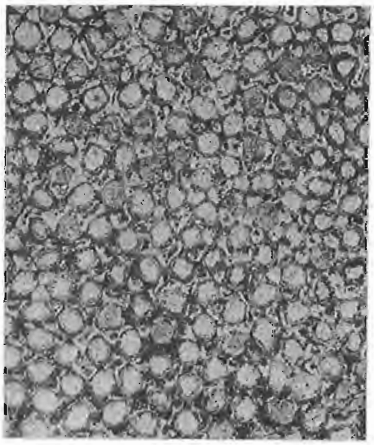
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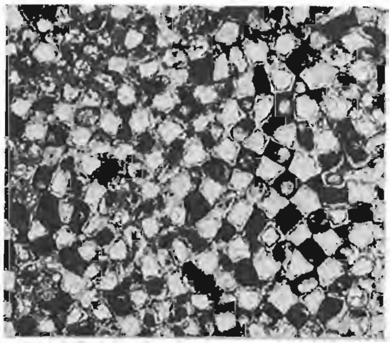
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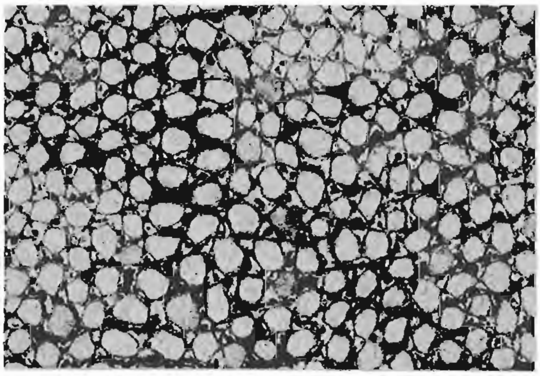
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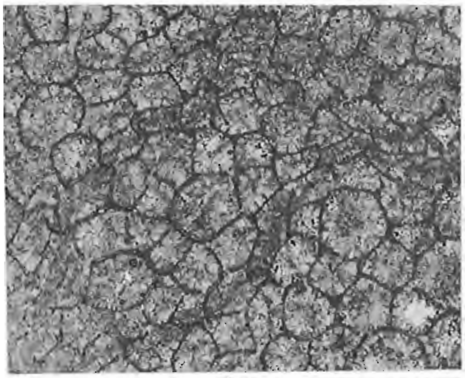
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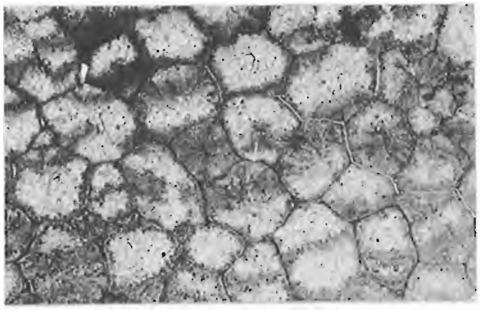
Plate 9

Figures 1–4. *Paleofavosites okulitchi* Stearn. Upper Ordovician reefal limestone, GSC loc. 89835. All ×4. (1) Transverse section showing variability in corallite shape and size; hypotype, GSC 42950. (2, 4) Transverse and longitudinal sections showing mural pores at or near corners and complete tabulae; hypotype, GSC 42951. (3) Longitudinal section showing crenulated walls around mural pores; hypotype, GSC 42952.

Figures 5, 7, 11. *Diplotrypa bassleri* (Troedsson). Bad Cache Rapids Formation, Middle Ordovician, GSC loc. 89840. All ×10. (5, 7) Tangential and longitudinal sections showing thin-walled subangular zooecia and small angular mesopores, and spacing of diaphragms and mesopore development in growing tip region of the zoarium; hypotype, GSC 42953. (11) Tangential section, lack of mesopores producing a *Monotrypa*-like zoarium; hypotype, GSC 42954.

Figures 6, 8–10. *Amplexopora arctica* Teichert. Bad Cache Rapids Formation, Middle Ordovician. (6) Tangential section, ×10, showing angular zooecia of two sizes; hypotype, GSC 42955; GSC loc. 89831. (8–10) Longitudinal sections, ×4 and ×10, showing variation in diaphragm spacing between endozone and exozone; hypotypes, GSC 42956–42958; GSC locs. 66716, 89831, 89870.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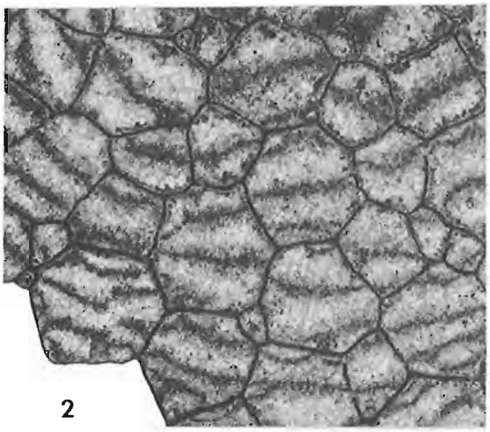
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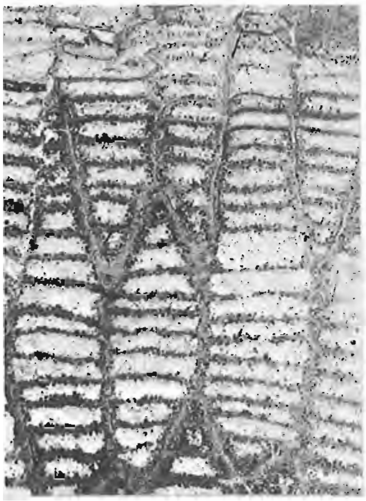
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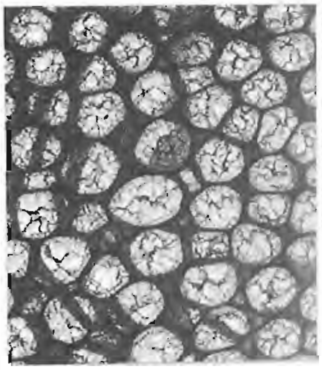
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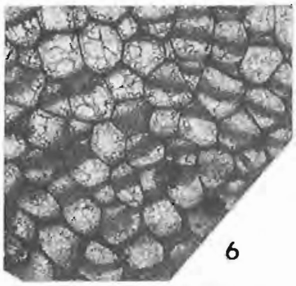
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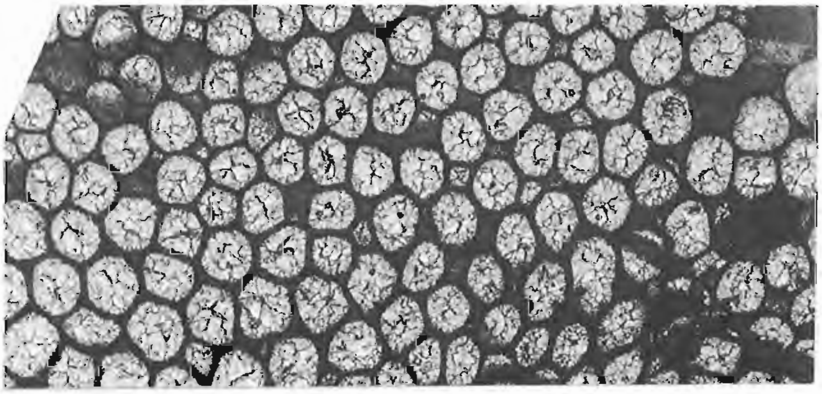
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Plate 10
Bad Cache Rapids Formation, Middle Ordovician
(all ×2 except figs. 3, 14, 15, ×1)

Figures 1, 12. *Oepikina* sp. Brachial interiors showing long septal ridge (fig. 12—*Calliops* sp.); hypotype, GSC 42959, 42960; GSC loc. 89869.

Figure 2. *Whitfieldoceras* sp. Living chamber, venter right; hypotype, GSC 42961; GSC loc. 89831.

Figure 3. *Actinoceras ruedemanni* var. *clarkei* (Troedsson). Ventral view; hypotype, GSC 42962; GSC loc. 89845.

Figures 4, 9. *Cyrtocerina* sp. Apical and dorsum views; hypotype, GSC 42963; GSC loc. 90544.

Figures 5, 10. *Rafinesquina* sp. Pedicle and posterior (pedicle below) views; hypotypes, GSC 42964, 42965; GSC locs. 89831, 89869.

Figures 6, 13. *Strophomena undulosa* Roy. Anterior and brachial exterior; hypotype, GSC 42966; GSC loc. 89845.

Figure 7. Strophomenid brachiopod, brachial interior showing short septal ridges; hypotype, GSC 42967; GSC loc. 91955.

Figure 8. *Strophomena* sp. Pedicle valve with *Zygospira* sp. (Plate 14, fig. 3); hypotype, GSC 42968; GSC loc. 89869.

Figure 11. *Gorbyoceras baffinense* (Schuchert). Phragmocone showing the strong annulae; hypotype, GSC 42969; GSC loc. 90544.

Figures 14, 15. *Maclurites manitobensis* var. *ovalis* Wilson. Apertural and apical views; hypotypes, GSC 42970, 42971; GSC locs. 89845, 89833.


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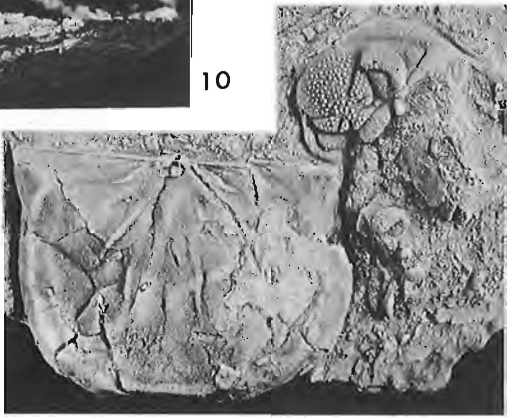
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Plate 11
Bad Cache Rapids Formation, Middle Ordovician

Figures 1, 2, 7, 8. *Cyclendoceras kindlei* Foerste. Ventral views of phragmocones, × ½ and × 1, and polished vertical section showing siphuncle, × 1; hypotypes, GSC 42972–42975; GSC locs. 89868, 89833.

Figure 3. *Paractinoceras*(?) sp. Living chamber and one camera, × 1; hypotype, GSC 42977; GSC loc. 89831.

Figures 4, 5. *Glyptorthis* sp. Brachial valves exterior with shallow sinuses, × 2; hypotypes, GSC 42978, 42979; GSC loc. C-2847.

Figure 6. *Gorbyoceras baffinense* (Schuchert). Ventral view, × 1; hypotype, GSC 42980; GSC loc. 89868.

Figure 9. *Austinella cooperi* Roy. Brachial valve exterior, × 2; hypotype, GSC 42981; Middle Ordovician, Silliman's Fossil Mount, head of Frobisher Bay, Baffin Island (GSC loc. 15862).

Figure 10. *Isophragma*(?) sp. Brachial valve exterior, × 2; hypotype, GSC 42982; GSC loc. 89868.


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Plate 12
Bad Cache Rapids Formation, Middle Ordovician
(all ×1 except fig. 2, ×2)

Figure 1. *Kochoceras foordi* Foerste. Phragmocone showing large siphuncle; hypotype, GSC 42983; GSC loc. 89831.

Figures 2, 5. *Narthecoceras sinclairi* Flower. Transverse thin-section and polished vertical section; hypotype, GSC 42984; GSC loc. 28688.

Figures 3, 4, 10, 11. *Gorbyoceras baffinense* (Schuchert). Phragmocones showing variation in slope of angular annulae and parallel sutures; hypotypes, GSC 42985–42988; GSC loc. 89831.

Figure 6. *Gonioceras groenlandicum* Troedsson. Hypotype, GSC 42989; GSC loc. 89833.

Figure 7. *Gonioceras* sp. cf. *Gonioceras wulffi* Troedsson. Hypotype, GSC 42990; GSC loc. 89833.

Figures 8, 9. *Deiroceras*(?) sp. Lateral and ventral views; hypotype, GSC 42991; GSC loc. C-2847.


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Plate 13
Bad Cache Rapids Formation, Middle Ordovician

Figures 1, 3. *Gonioceras* sp. cf. *Gonioceras wulffi* Troedsson. ×1 and ×2, natural weathered section exposing siphuncle; Middle Ordovician, hypotype, GSC 42992; GSC loc. 69491, Baffin Island; and hypotype, GSC 42993; GSC loc. 89830 (loose).

Figures 2, 7. *Austinella cooperi* Roy. Pedicle valves exteriors, ×1 and ×2; hypotypes, GSC 42994, 42995; Middle Ordovician, Silliman's Fossil Mount, head of Frobisher Bay, Baffin Island (GSC loc. 15862).

Figures 4–6, 8. *Sowerbyella* sp. (4) Pedicle valve interior, ×4, showing pseudopunctate nature and segregated costellae; hypotype, GSC 42996; GSC loc. 89831. (5, 6) Pedicle valves exteriors, ×4 and ×2, showing segregated costellae and pseudopunctate nature; hypotypes, GSC 42997, 42998; GSC loc. 89831. (8) Brachial valve interior showing strong pair of submedian septa, no median ridge and non-denticulate hinge, and pedicle valve exterior, ×4; hypotypes, GSC 42999,*a*; GSC loc. C-2847.

Figure 9. *Lambeoceras baffinense* Miller, Youngquist and Collinson. Natural section, ×1; hypotype, GSC 43000; GSC loc. 90545.


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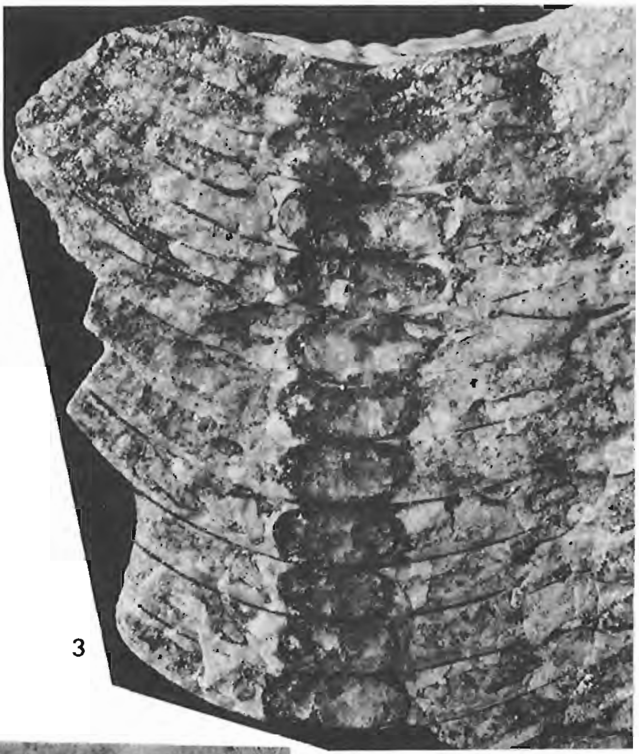
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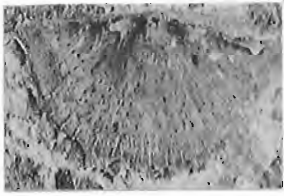
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Plate 14
Bad Cache Rapids Formation, Middle Ordovician

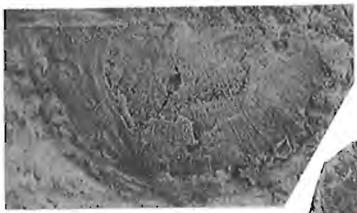
Figure 1. *Sowerbyella* sp. Pedicle valve exterior, ×4, showing pseudopunctate nature and segregated costellae; hypotype, GSC 43001; GSC loc. 89868.

Figures 2, 6. *Rhynchotrema* sp. Brachial valve exterior and posterior view, ×1; hypotype, GSC 43002; GSC loc. 89865.

Figure 3. *Zygospira* sp. Pedicle valve exterior, ×4; hypotype, GSC 43003; GSC loc. 89868.

Figures 4, 7, 8. *Lambeoceras baffinense* Miller, Youngquist and Collinson. (4, 8) Apical ends, ×1, natural weathered section, showing siphuncle traces; hypotypes, GSC 43004, 43005; Middle Ordovician, Schwatka Islands (GSC loc. 42566). (7) Largest specimen, ×1; hypotype, GSC 43006; GSC loc. 89857.

Figure 5. *Sowerbyella* sp. cf. *Sowerbyella thraivensis* (Reed). Pedicle valve exterior, ×4, showing broad sinus (with *Eoleperditia* sp.); hypotypes, GSC 43007, 43008; GSC loc. 89845.



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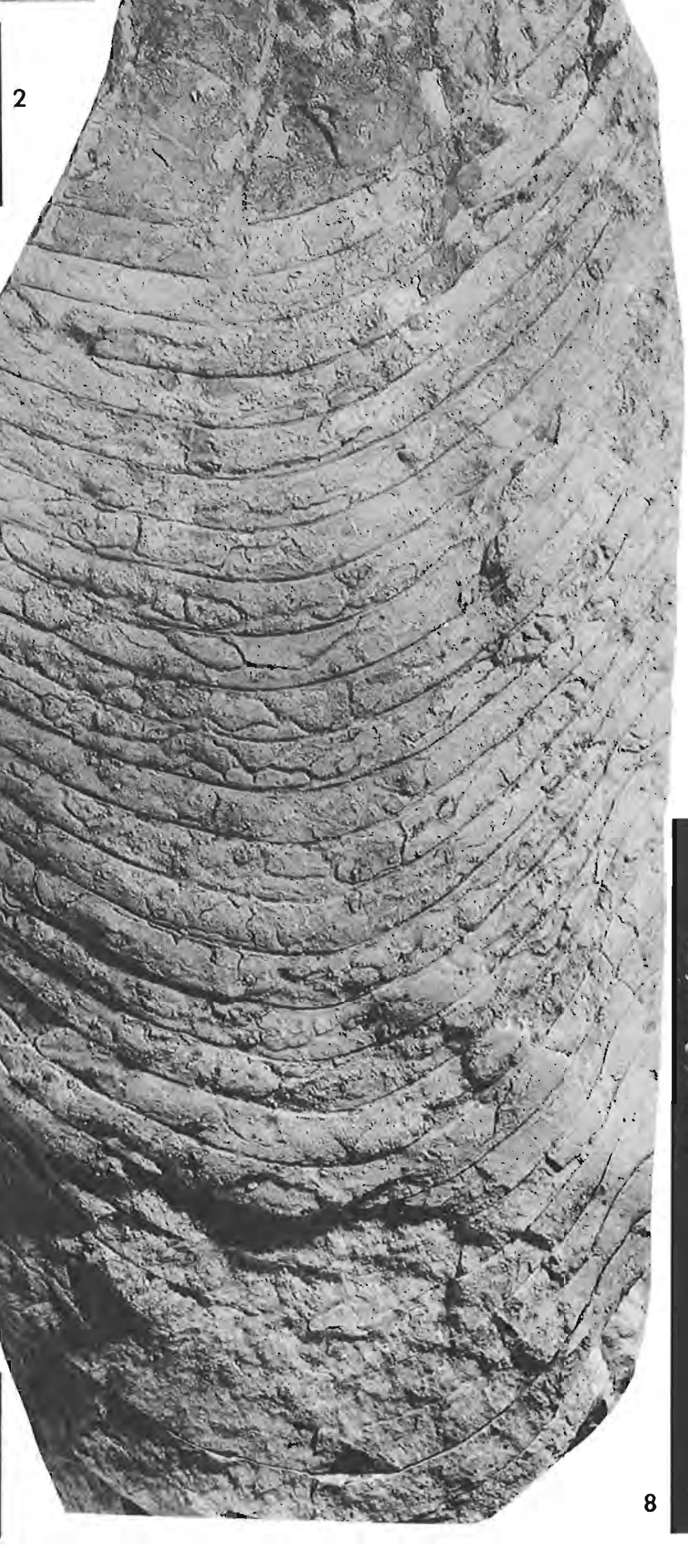

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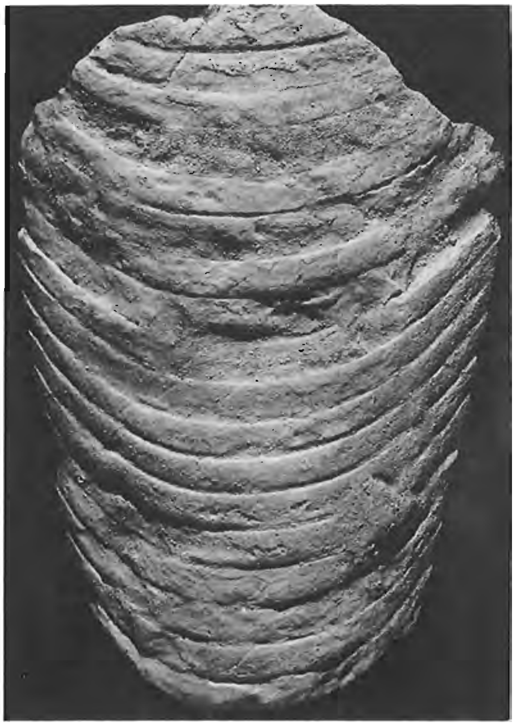

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Plate 15
Bad Cache Rapids Formation, Middle Ordovician
(all × 1 except figs. 8–10, × 2)

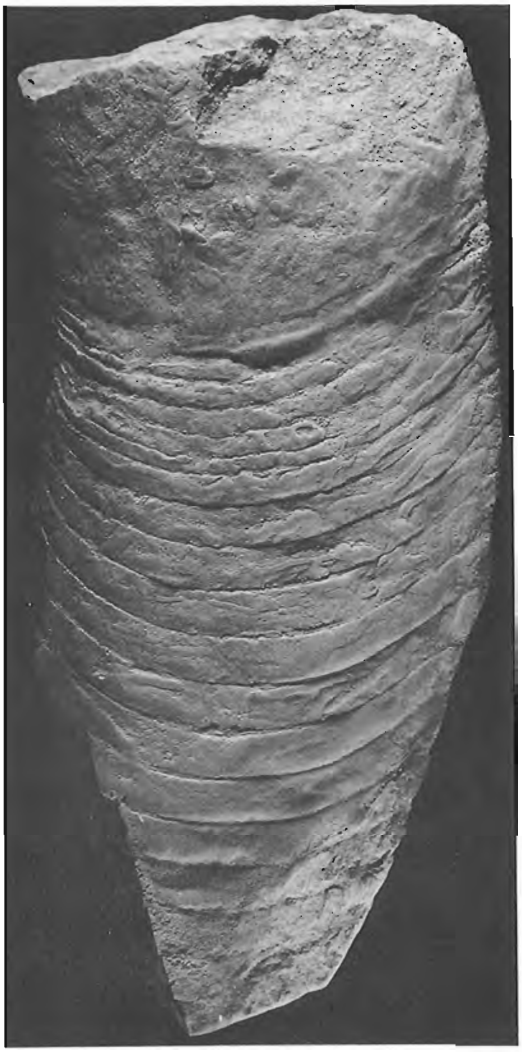
Figures 1–3. *Digenuoceras heywoodi* n. sp. Lateral and ventral views; holotype, GSC 43009; GSC loc. 28688.

Figure 4. *Rafinesquina pronis* Roy. Pedicle exterior view (upper brachiopod–pedicle exterior view of *Strophomena undulosa* Roy); hypotypes, GSC 43010, 43011; GSC loc. 89831.

Figure 5. *Lambeoceras* sp. cf. *Lambeoceras magnum* Troedsson. Natural longitudinal section showing trace of siphuncle; hypotype, GSC 43012; GSC loc. 90544.

Figures 6, 7. *Rhynchotrema* sp. Lateral view and brachial exterior; hypotype, GSC 43013; GSC loc. 89865.

Figures 8–10. *Rhynchotrema arcticum* Roy. Brachial valve, lateral and pedicle valve exteriors; hypotype, GSC 43014; GSC loc. 89844.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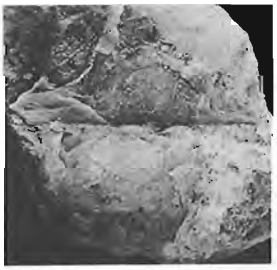
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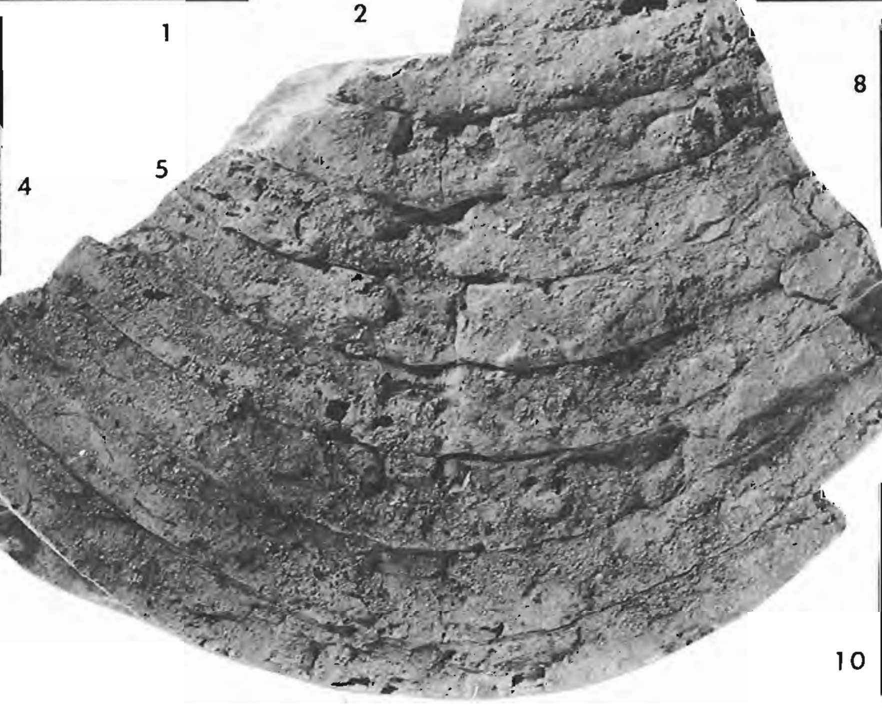
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Plate 16
Bad Cache Rapids Formation, Middle Ordovician

Figure 1. *Neumatoceras*(?) *contractum* (Foerste and Savage). Lateral view, ×2, venter left; hypotype, GSC 43015; GSC loc. 89830.

Figures 2, 7. *Probillingsites*(?) sp. Ventral and lateral views, ×2; hypotype, GSC 43016; GSC loc. C-2847.

Figure 3. *Richardsonoceras simplex* (Billings). Lateral view, ×1 (plaster cast); hypotype, GSC 43017; Middle Ordovician, Schwatka Islands (GSC loc. 42566).

Figure 4. *Richardsonoceras*(?) sp. indet. Lateral view, ×1; hypotype, GSC 43018; GSC loc. 89831.

Figures 5, 11. *Strophomena* sp. ×2 and ×1; hypotypes, GSC 43019, 43020; GSC locs. 89868, 89831.

Figure 6. *Oepikina* sp. Brachial interior, ×2, showing septal ridges; hypotype, GSC 43021; GSC loc. 89870.

Figure 8. *Ephippiorthoceras compressum* Foerste. Phragmocone, lateral view, ×1; hypotype, GSC 43022; GSC loc. 89860.

Figure 9. *Neumatoceras churchillense* Nelson. Lateral view, ×2, venter left; hypotype, GSC 43023; GSC loc. 89830.

Figure 10. *Teichertoceras curti* n. sp. Lateral view of apical portion of phragmocone, ×2, venter right (plaster cast); paratype, GSC 43024; Middle Ordovician, Schwatka Islands (GSC loc. 42567).


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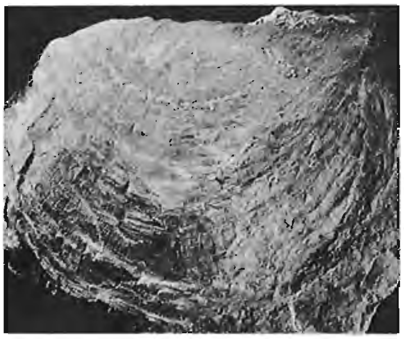
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Plate 17
Bad Cache Rapids Formation, Middle Ordovician

Figure 1. *Diestoceras* sp. cf. *Diestoceras schucherti* Foerste. Living chamber, ventral view, ×1; hypotype, GSC 43025; GSC loc. 90544.

Figures 2–4. Asaphid, n. gen.(?). Dorsal, anterior and lateral views of an incomplete specimen, ×1, showing a wider than long cephalon, large elevated eye lobes situated on posterior half of the cephalon and no distinct glabella or pygidial axis, but a wide low thoraxial axis; hypotype, GSC 43026; GSC loc. 89844.

Figure 5. *Rasmussenoceras* sp. Living chamber, ventral view, ×1; hypotype, GSC 43027; GSC loc. 89845.

Figure 6. *Nanillaenus punctatus* (Roy). Dorsal view of cranidium, ×2; hypotype, GSC 43028; GSC loc. 89831.

Figure 7. *Eoleperditia* sp. ×3; hypotype, GSC 43029; GSC loc. 89864.

Figure 8. *Calliops* sp. Dorsal view of an incomplete cephalon, ×4; hypotype, GSC 43030; GSC loc. 89869 (*see* Pl. 10, fig. 12).

Figure 9. *Strophomena* sp. (cf. *Rafinesquina* sp. *R. lata* of Teichert, 1937*a*, Pl. XII, fig. 15). Pedicle valve, ×1; hypotype, GSC 43031; GSC loc. 89831.

Figure 10. *Anataphrus borraeus* Whittington. Anterior view of enrolled specimen, ×2, showing smooth convex transverse profile; hypotype, GSC 43032; Middle Ordovician, lat. 65°25′N, long. 73°05′W, southeast of Bowman Bay, Foxe Lowland, Baffin Island, District of Franklin (GSC loc. 69529).

Figure 11. *Illaenus lacertus* Whittington. Anterior view of an incomplete cephalon, ×2, showing smooth outward slope from palpebral lobe and finely punctate nature; hypotype, GSC 43033; GSC loc. 69516.

Figures 12, 15. *Richardsonoceras* sp. cf. *Richardsonoceras beloitense* Foerste. Lateral views, venter left, ×1; hypotypes, GSC 43034, 43035; GSC locs. 89840, 42566.

Figure 13. *Rasmussenoceras schwatkaense* n. sp. Phragmocone (plaster cast), ventral view, ×1; holotype, GSC 43036; GSC loc. 42566.

Figure 14. *Teichertoceras curti* n. sp. Phragmocone and living chamber (plaster cast), venter left, ×1; holotype, GSC 43037; GSC loc. 42566.


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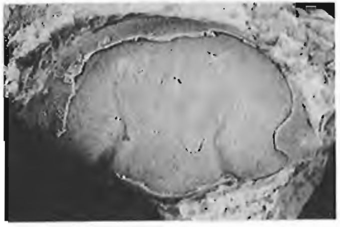
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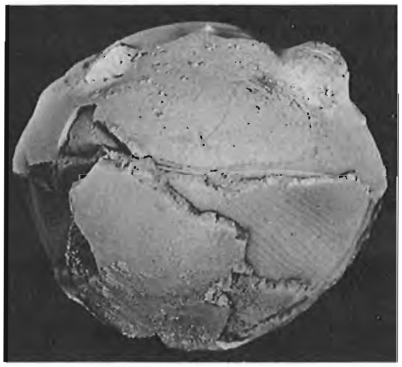
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Plate 18
Bad Cache Rapids Formation, Middle Ordovician

Figures 1, 2. *Bumastus* (*Bumastoides*) sp. Dorsal view of a cranidium, and of 10 thoraxial segments and pygidium, × 1 and × 2; hypotypes, GSC 43038, 43039; GSC loc. 89831.

Figures 3, 4, 6–8, 11, 13. *Illaenus lacertus* Whittington. (3, 8, 13) Lateral, posterior and anterior views of a cephalon, ×2, showing convexity and smooth outward slope from palpebral lobe; hypotype, GSC 43040; GSC loc. 89833. (4) Posterior view of a cephalon, × 1; hypotype, GSC 43041; northwest side of Hoppner Inlet, lat. 66°55′N, long. 83°55′W, District of Franklin (GSC loc. 66758). (6, 7, 11) Dorsal views of the thorax and cephalon, and lateral view of an incomplete enrolled specimen, × 1 (compare Teichert, 1937*a*, Pl. 20, figs. 3–5); hypotype, GSC 43042; GSC loc. 89869.

Figure 5. *Illaenus baffinlandicus* Roy. Dorsal view of a pygidium, ×2, showing raised branching ridges; hypotype, GSC 43043; GSC loc. 89833.

Figures 9, 17. *Winnipegoceras* sp. Phragmocone, × 1, ventral showing siphuncle and lateral, venter right, views; hypotype, GSC 43044; GSC loc. 89845.

Figure 10. *Cyrtogomphoceras alcocki* Nelson. Slightly distorted incomplete specimen, × 1, ventrolateral view; hypotype, GSC 43045; GSC loc. 89845.

Figure 12. *Bumastus* (*Bumastoides*) sp. Pygidium, × 1; hypotype, GSC 43046; GSC loc. 89865.

Figure 14. *Sphaerocoryphe* sp. indet. Dorsal view of an incomplete cranidium, ×4; hypotype, GSC 43047; GSC loc. 90544.

Figure 15. *Diestoceras* sp. Lateral view, × 1, venter left; hypotype, GSC 43048; GSC loc. 89860.

Figure 16. *Winnipegoceras* sp. Lateral view, × 1, venter right; hypotype, GSC 43049; GSC loc. 89860.


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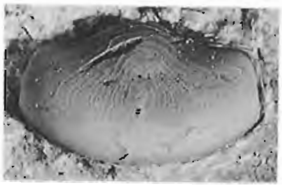
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Ordovician Ostracoda, Southeastern District of Franklin

M. J. Copeland

Abstract

Many Late Mohawkian ostracode species in southern Baffin Island and Melville Peninsula appear frequently elsewhere in North America. Some genera, however, are known only from areas on or adjacent to the Canadian Shield and may be considered as having a boreal aspect. Based on these genera, a biogeographic subdivision of the Late Mohawkian North American faunal province may be postulated.

Résumé

De nombreuses espèces d'ostracodes du Mohawkien supérieur, que l'on trouve dans le sud de l'île Baffin et dans la presqu'île Melville, apparaissent fréquemment aussi, ailleurs en Amérique du Nord. Certains genres sont toutefois connus seulement dans des régions du Bouclier canadien ou régions voisines de celui-ci et peuvent être considérés comme ayant un aspect boréal. En se fondant sur ces genres, une subdivision biogéographique de la province nord-américaine de la faune du Mohawkien supérieur peut être proposée.

Introduction

Ordovician ostracodes have been reported previously from Frobisher Bay, Baffin Island and Melville Peninsula. Those from Frobisher Bay, particularly Silliman's Fossil Mount at the western end of the bay, received considerable attention but have not been extensively documented. Emerson (*in* Nourse, 1879, p. 579–582) recorded five ostracode species of uncertain geographic location from Frobisher Bay collected by C.F. Hall during the First Arctic Expedition; Ulrich (*in* Schuchert, 1900, p. 173) listed four species attached to megafossils from Silliman's Fossil Mount collected during the Seventh Peary Arctic Expedition; Bassler (*in* Schuchert, 1914, p. 470) re-examined the specimens described by Emerson; and Roy (1941, p. 169–176), while with the Rawson-MacMillan Expedition of Field Museum, collected eleven species of ostracodes from talus (*ibid.*, p. 44) at the mount. Warthin (*in* Miller *et al.*, 1954, p. 19) listed 24 species of ostracodes from Silliman's Fossil Mount; the specimens, deposited with the United States Geological Survey, were collected from 8 intervals in the lowest, stratigraphic unit 175 ft thick. These are the only ostracode specimens from Frobisher Bay for which detailed stratigraphic information is available. From Foxe Plain, which extends more than 200 mi across Baffin Island northwest from Frobisher Bay, Hussey (1928, p. 74) described *Leperditia* sp., collected by the Putnam Baffin Island Expedition; Wilson (*in* Miller *et al.*, 1954, p. 154) recorded specimens of two leperditiid species collected by Fortier; and Sinclair (*in* Blackadar, 1967, Fig. 1 and p. 19–30) recorded *Eurychilina* sp., *Hallatia* sp., *Krausella* sp., *Laccochilina*? sp., and *Leperditia* sp. from 11 sections of unknown stratigraphic relationships.

Ordovician ostracodes from Melville Peninsula on the western side of Foxe Basin were described by Teichert (1937*a*) from three collections made during the Fifth Thule Expedition. Only general geographic localities for these collections are reported but their relative stratigraphic positions may be inferred from recent geological investigations (T.E. Bolton, *pers. comm.*). Of the 13 ostracode species reported, several appear similar to species recorded from northern Greenland (Troedsson, 1929; Teichert, 1937*b*) and Frobisher Bay.

The present study seeks to integrate information available from previous geological investigations and from more recently obtained Geological Survey of Canada collections from Foxe Plain and Melville Peninsula. In general, leperditicopid ostracodes are treated casually, none of those examined are *Leperditia* s.s., as previously reported, and their equivalence to *Eoleperditia* or *Anisochilina* is uncertain. The available leperditiids apparently have no particular stratigraphic value but, as usual, they occur more commonly in calcareous than in argillaceous strata.

The author acknowledges with thanks the loan of type specimens of Ostracoda from the United States National Museum collected by C.F. Hall, and from Chicago Natural History Museum collected by S.K. Roy. The comprehensive collection prepared by Warthin (*in* Miller *et al.*, 1954, p. 19) and obtained from the United States National Museum through the courtesy of J.M. Berdan is of major importance because of the diversity of ostracodes and associated stratigraphic information. Based on that collection it has been possible to relate ostracode occurrences from Baffin Island with those from Melville Peninsula and the central part of North America.

Stratigraphy

Ordovician strata from southern Baffin Island (Fig. 1) have not been precisely mapped. A maximum thickness of about 700 ft of beds may be in Putnam Highland to the west and a

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Geol. Surv. Can., Bull. 269, 1977.

thinner section is exposed eastward near Frobisher Bay. At Silliman's Fossil Mount (Fig. 1, loc. *T*), Miller *et al.* (1954, p. 6) recorded a thickness of 300 ft: "Throughout the Mount the top 50 feet of these beds consists of massive dolomitic limestone, the next 75 feet of thin-bedded limestone, and the lower 175 feet of calcareous shale with some interbedded limestone." About 20 mi northwest of the head of Frobisher Bay near Jordan River (Fig. 1, loc. *S*), Sinclair (*in* Blackadar, 1967, p. 26–29, section *S*) recorded fossils from a composite section of thin rubbly limestone 400 ft thick. Farther northwest, near Foxe Basin, Sinclair (*ibid.*, p. 21, 22, section *D*) reported on the paleontology of a section of similar lithology some 450 ft thick (Fig. 1, loc. *D*). This is approximately the same area of Putnam Highland from which Gould (1928, p. 22) recorded ". . . 700 feet, of which about 600 feet consists of shales. The strata are all flat-lying and throughout this great thickness there is no evidence of any angular unconformities. Limestone beds like the cap rock are found interbedded with the shales far below the mesa rim." It is difficult to determine the true thickness and lithology of the more argillaceous lower beds because they are obscured by talus composed of slumped limestone debris from the upper beds.

Ordovician rocks occur in a narrow belt on Melville Peninsula along the northwestern shore of Foxe Basin. Approximately 500 ft of strata is exposed, of which the lower 300 ft of sandstone and dolomite constitutes the early Ordovician Ship Point Formation and is disconformably overlain by about 100 ft of dolomitic limestone of the younger Bad Cache Rapids Formation, on which late Ordovician bioherms developed (Bolton, *pers. comm.*). Except for the upper reefal development, a similar sequence of rocks is encountered at depths of 450 to 1467.3 ft in Aquitaine et al, Rowley M-04 well drilled on Rowley Island 100 mi east (Trettin 1975, p. 94–116). This sandy dolomitic northwestern Foxe Basin facies is in distinct contrast to the shaly-calcareous facies of southeastern Foxe Plain (Fig. 2). Based on their ostracode fauna, however, the lower dolomitic limestone of the Bad Cache Rapids Formation may be correlated with the presently unnamed argillaceous sequence at Frobisher Bay, Baffin Island.

Ostracode fauna

Re-examination of ostracode specimens collected by Miller *et al.* (1954) from Silliman's Fossil Mount (Fig. 2, loc. 1) has resulted in the identifications contained in Table 1. Forty-three species are present, four are described for the first time and several, possibly new, are incompletely known. These collections, scattered throughout the upper 135 ft of the lower shale unit at the mount, contain a cosmopolitan late Wilderness–

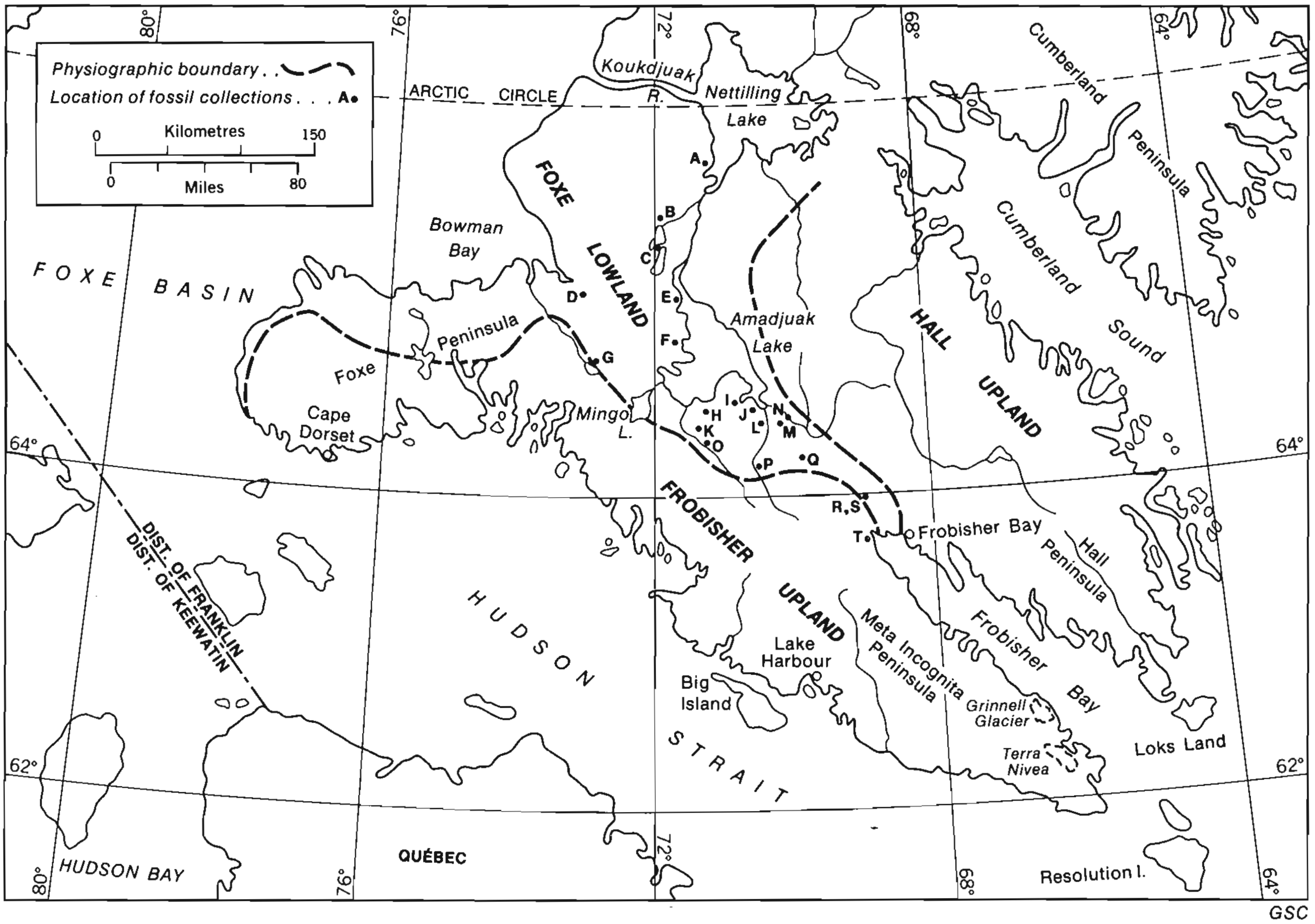
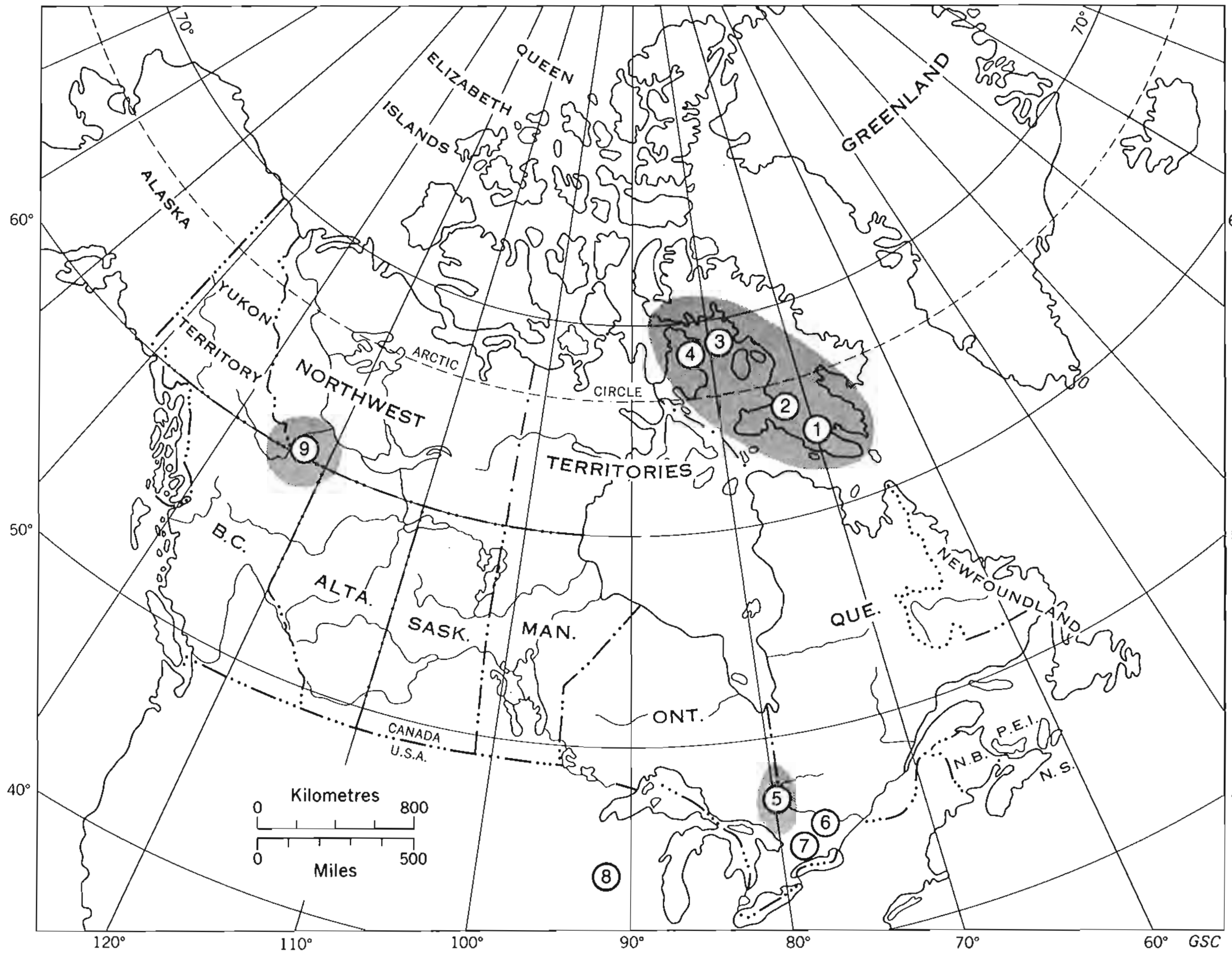


Figure 1. Physiographic divisions and locations *A*-*T* of fossil collections, southern Baffin Island, District of Franklin. *T* indicates Silliman's Fossil Mount. (From Blackadar, 1967, Fig. 1.)



INDEX TO LOCALITIES

1. Silliman's Fossil Mount
2. Foxe Lowland
3. Rowley Island, Foxe Basin
4. Melville Peninsula
5. Lake Timiskaming, Ontario
6. Braeside, Ontario
7. Healey Falls, Ontario
8. Decorah Formation, Iowa-Minnesota
9. Southwestern District of Mackenzie

Figure 2. Localities mentioned in text. Stippled areas indicate localities with boreal faunal aspects.

Barneveld ostracode fauna, typified by *Krausella*, *Eurychilina* and *Tetradella*, found in Mohawkian platformal deposits throughout North America. This (Decorah–Kirkfield–Bucke–Braeside) fauna has been previously documented (Kay, 1934, 1940; Swain *et al.*, 1961; Copeland, 1965; *in* Steele and Sinclair, 1971) and recently extended to southwestern District of Mackenzie (Copeland, 1974). Composition varies somewhat, so that a certain distinction between older and younger 'Trentonian' elements appears possible. Typical of the early part of this fauna is the common association of species of the genera *Winchellatia*, *Monoceratella*, *Macrocyproides*, *Euprimitia* and *Levisulculus*, whereas the later fauna is marked by a higher proportion of species of *Dicranella*, *Ceratopsis*, *Milleratia* and *Oepikium*.

Other non-leperditiid ostracode species reported from the vicinity of Silliman's Fossil Mount, but not in Miller's collections, are *Beyrichia symmetrica* Emerson (non Hall) and *Primitia frobisheri* Emerson. The type specimen of *B. symmetrica* and a cast of *P. frobisheri* were obtained through the courtesy of the United States National Museum. *B. symmetrica* is a drepanellid and examination confirms its assignment as *Scofieldia halli* (Teichert); also, *P. frobisheri* is a small ($l=1.2$ mm, $h=0.9$? mm), smooth eurychilinid, as reported by Bassler (*in* Schuchert, 1914), and despite the poor condition of the frill and the apparent immaturity of the specimen it may be assigned as *Eurychilina frobisheri* (Emerson).

Little additional information has come from re-examination of collections from Foxe Plain (Blackadar, 1967) northwest of Frobisher Bay. Specimens of *Krausella* sp. cf. *K. inaequalis* Ulrich, *Bairdiocypris cylindrica* (Hall), *Diplopsis socialis* Levinson, *Byrsolopsina centipunctata* (Kay), *Punctaparchites rugosus* (Jones), *Eurychilina* sp. cf. *E. subradiata*

Table 1. Ostracodes from Silliman's Fossil Mount, collected by Miller *et al.* (1954) (USNM Accession No. 26477)

	Stratigraphic Position										
Species	B-4	B-1	B-3	B-5	B-14	B-7	B-8	B-13	B-9	B-11	B-2
Aechmina sp.		X		X	X		X		X	X	X
"*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich)	X	X	X	X				X			X
"*Aparchites*" sp.			X								
Bairdiocypris cylindrica (Hall)	X	X	X	X	X	X	X	X	X	X	X
Bairdiocypris granti Ulrich	X			X		X	X	X	X	X	X
Bolbopisthia? sp.			X								
Byrsolopsina centipunctata (Kay)	X		X		X		X			X	
Ceratopsis quadrifida (Jones)									X	X	X
Chilobolbina? sp.					X						
Dicranella bicornis Ulrich											X
Diplopsis socialis Levinson	X	X	X	X	X	X	X	X	X		
Distobolbina warthini n. sp.	X	X		X	X						
Euprimitia sp. cf. *E. sanctipauli* (Ulrich)				X		X					
Eurychilina subradiata Ulrich				X	X	X		X	X	X	X
Eurychilina sp.		X				X					
Glymmatobolbina? *spinosa* n. sp.	X		X	X			X		X	X	
Hyperchilarina bella Copeland	X	X	X	X			X	X	X	X	
?*Krausella* sp. cf. ?*K. acuta* (Teichert)	X	X	X	X	X	X	X	X	X	X	X
Krausella sp. cf. *K. inaequalis* Ulrich					X			X			X
Krausella rawsoni Roy		X	X	X	X	X	X	X	X	X	X
Laccochilina (*Prochilina*) *irrasa* Copeland		X	X	X		X					
Levisulculus michiganensis Kesling					X						
Levisulculus planus Copeland			X			X			X		X
?*Longiscula emaciata* Copeland		X			X	X		X			
Macrocyproides trentonensis (Ulrich)	X	X	X	X							
Milleratia sp.								X			
Monoceratella baffinensis n. sp.		X			X				X		
Monoceratella decorata n. sp.		X	X				X	X	X	X	X
Monoceratella sp.	X								X		
Oepikella jaynesi (Roy)					X						
Oepikium sp.				X	X			X	X		X
ostracode indet. 1		X									
ostracode indet. 2	X										
Punctaparchites rugosus (Jones)		X	X	X	X	X	X	X	X	X	X
Saccelatia buckensis Copeland		X		X	X		X		X	X	
Schmidtella sp. cf. *S. affinis* Ulrich			X		X						
Steusloffina ulrichi Teichert					X						
Tetradella buckensis Guber		X	X		X						
Tetradella ellipsilira Kay	X	X		X				X			
Tetradella ulrichi Kay	X	X	X					X	X		
Tetradella sp.									X		X
Thomasatia falcicosta Kay			X		X					X	
Winchellatia longispina Kay		X									

B-1, north slope of small northwest conical segment of Silliman's Fossil Mount, about 100 ft above the base. B-2, southwest slope of large, central segment of mount about 175 ft above base. B-3, B-5, B-14, east slope of small northwest conical segment of mount, about 100 ft above base. B-4, west slope of central segment of mount, some 500 ft from southeast end of that segment, about 40 ft above base. B-7, B-8, north slope of large central segment of mount, about 120 ft above base. B-9, same as B-1, but 35 ft higher. B-11, same as B-2, but 10 ft lower. B-13, northeast slope of small northwest conical segment of mount, 125 ft above base.

Ulrich and undetermined leperditiids are present on limestone slabs containing megafossils. These are typical Mohawkian ostracode species that are not otherwise stratigraphically diagnostic, although no undoubted Edenian forms are present. Until more complete micropaleontological collections are available, similarity of lithological successions is the main basis of correlation within this thick sequence of beds lying between Frobisher Bay and Foxe Basin.

Only about 100 ft of limestone separates dolomite of the Ship Point Formation and bioherms overlying the youngest Bad Cache Rapids Formation on Melville Peninsula. Teichert (1937*a*) recognized 10 non-leperditiid ostracodes from these beds. The type specimens have not been re-examined but based on their photographs and descriptions the taxonomic changes in Table 2 are suggested.

The following ostracodes were identified from collections

Table 2. Suggested taxonomies of ostracode species reported by Teichert (1937*a*) from Melville Peninsula

Teichert (1937*a*)	Copeland (this report)
Drepanella halli melvillensis	*Scofieldia halli* (Teichert)
Bollia reticulata	*Eurychilina* sp. (non *E. reticulata* Ulrich)
Basslerites canadensis	*Krausella* sp. cf. *K. inaequalis* Ulrich
Monoceratella teres	*Monoceratella teres* Teichert
Basslerites acutus	?*Krausella acuta* (Teichert)
Steusloffina ulrichi	*Steusloffina ulrichi* Teichert
Primitia sp.	?
Aparchites whiteavesi	?leperditellid
Eurychilina tuberculata	*Eurychilina tuberculata* Teichert
Macronotella tenuis	?*Macronotella tenuis* Teichert

of the Bad Cache Rapids Formation made by Bolton in 1973 from the vicinities of Hall Beach (GSC loc. 89830) and Roche Bay (GSC loc. 89868), Melville Peninsula: leperditiid spp., *Eoleperditia* sp., *Punctaparchites rugosus* (Jones), *Steusloffina ulrichi* Teichert, *Eurychilina subradiata* Ulrich, *Eurychilina*? sp., *Euprimitia labiosa* (Ulrich), *Distobolbina teicherti* n. sp., *Krausella* sp. cf. *K. inaequalis* Ulrich, *Krausella* sp., *Leperditella*? sp., *Bairdiocypris* sp., *Bairdiocypris cylindrica* (Hall), *Tetradella ellipsilira* Kay, *Tetradella ulrichi* Kay, *Tetradella buckensis* Guber, *Saccelatia buckensis* Copeland, *Parapyxion melvillensis* n. sp., *Krausella rawsoni* Roy, *Eurychilina* sp., *Macrocyproides trentonensis* (Ulrich) and *Scofieldia halli* (Teichert). None of the distinctive later Barneveldian genera (*Dicranella*, *Ceratopsis*, *Milleratia*, *Oepikium*) are present, possibly indicating that these collections are from the lower part of the previously mentioned cosmopolitan Mohawkian ostracode fauna. Collections are insufficient, however, to verify this assumption.

More than half of the fauna listed in Table 1 occur in the Bucke Formation at Lake Timiskaming, Ontario (Copeland, 1965), 1200 mi south of Frobisher Bay. Common elements of that fauna are: "*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich), *Byrsolopsina centipunctata* (Kay), *Bairdiocypris cylindrica* (Hall), *Bairdiocypris granti* Ulrich, *Diplopsis socialis* Levinson, *Euprimitia labiosa* (Ulrich), *Eurychilina subradiata* Ulrich, *Hyperchilarina bella* Copeland, *Krausella* sp. cf. *K. inaequalis* Ulrich, *Levisulculus michiganensis* Kesling, ?*Longiscula spicata* Copeland, *Oepikella labrosa* Copeland, *Saccelatia buckensis* Copeland, *Tetradella buckensis* Guber, *Tetradella ulrichi* Kay, *Thomasatia falcicosta* Kay and *Winchellatia longispina* Kay. The Bucke Formation, with the typical lower 'Trentonian' ostracode fauna, is disconformably overlain by limestone of the Farr Formation with *Dicranella* and *Oepikium*, more commonly of later Barneveldian age. The overlying black shale of the Dawson Point Formation bears early Edenian brachiopods and trilobites (Sinclair, 1965). This is similar to the stratigraphic succession postulated for southern Baffin Island, where limestone overlies the older shale beds and blocks of black calcareous shale bearing Edenian trilobites occur in glacial drift (Wilson, *in* Soper, 1928, p. 128). Those younger unnamed Barneveldian and Edenian strata on Baffin Island have not been examined for a distinctive microfauna but, based on their megafauna, they may be stratigraphically equivalent to those from Lake Timiskaming.

Middle Ordovician ostracode faunas from the Braeside beds at Braeside, Ontario (Copeland, *in* Steele and Sinclair, 1971), Kirkfield Formation at Healey Falls, Ontario (Kay, 1934; Copeland, *in* Sinclair, 1964) and Decorah Formation of Iowa and Minnesota (Kay, 1940; Swain *et al.*, 1961) each contain about a third of the species reported here from Silliman's Fossil Mount. Variation among these three North American faunules is slight and many species common to all are typical of the late Wilderness–early Barneveld part of the assemblage. These are *Krausella* sp. cf. *K. inaequalis* Ulrich, *Macrocyproides trentonensis* (Ulrich), *Diplopsis socialis* Levinson, *Bairdiocypris cylindrica* (Hall), *Bairdiocypris granti* Ulrich, *Byrsolopsina centipunctata* (Kay), *Tetradella ulrichi* Kay, *Tetradella ellipsilira* Kay, *Punctaparchites rugosus* (Jones), *Winchellatia longispina* Kay, *Thomasatia falcicosta* Kay and *Eurychilina subradiata* Ulrich. This fauna is widespread throughout southern Ontario, occurring both east and west of the Precambrian Frontenac Axis in strata commonly considered of Chaumont-Kirkfield equivalence.

Three ostracode zones (*Eurychilina subradiata*, *Byrsolopsina planilateralis*, *Pseudulrichia simplex*) are recognized from the Decorah Formation of Minnesota (Swain *et al.*, 1961, p. 349). These correspond in general with the Spechts Ferry, Guttenberg and Ion members of that formation as developed in northern Iowa. Faunal lists of Decorah ostracodes presented by Swain *et al.* (*ibid.*) and Kay (1940, p. 236, 237) are difficult to compare but it appears that typically *Winchellatia* is of Guttenberg affinity and *Dicranella* and *Ceratopsis* are commonly in the overlying Ion member. Otherwise there appears to be relatively little variation in the occurrence of ostracodes in the two upper members of the formation.

In southwestern District of Mackenzie, R. Ludvigsen recently obtained a sequence of silicified Mohawkian ostracodes from strata of the upper Sunblood and lower Whittaker formations and an unnamed intervening stratigraphic interval (Copeland, 1974). Those ostracodes from the lower Whittaker Formation pertinent to the present discussion are: "*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich), *Krausella inaequalis* Ulrich, *Schmidtella affinis* Ulrich, *Leperditella* sp., *Oepikella labrosa* Copeland, *Diplopsis socialis* Levinson, ?*Krausella* sp. cf. ?*K. acuta* (Teichert), *Tetradella*? sp., *Ceratopsis quadrifida* (Jones), *Bairdiocypris* sp. cf. *B. cylindrica* (Hall), *Pteroleperditia* sp. cf. *P. armata* (Walcott), *Milleratia* sp., *Dicranella bicornis* Ulrich and *Oepikium* sp. The last two species occur only in the uppermost strata from which collections were obtained. Apparently there also the genera *Dicranella* and *Oepikium* mark the younger, later Barneveld aspect of this fauna; the older late Wilderness–early Barneveld fauna is represented by several generalized species, and *Pteroleperditia* sp. cf. *P. armata* (Walcott) may be considered more typical of an even older Wilderness fauna of Lowville aspect.

The widespread late Wilderness–Barneveld fauna (Fig. 2) appears to have developed in a transgressive, platformal lithofacies in which shale and limestone are dominant. Its North American aspect was derived from late Chazy–Porterfield ostracode faunas that evolved rapidly along the early Mohawkian continental margins. Such genera as *Tetradella*, *Eurychilina*, *Krausella*, "*Aparchites*" and *Diplopsis* developed then and subsequently became the most dominant forms in the later Mohawkian ostracode assemblage. Other genera of this assemblage such as *Distobolbina*, *Oepikella*, *Levisulculus*, *Steusloffina* and *Laccochilina* have a boreal aspect and are apparently restricted to the northern part of the continent. The younger later Barneveld part of the assemblage may be distinguished because species of such relatively bizarre genera as *Dicranella* and *Ceratopsis* of North American aspect and *Oepikium* of boreal aspect are more common.

Descriptions of new ostracode taxa

Family Sigmoopsidae Henningsmoen, 1953
Genus *Distobolbina* Sarv, 1959
Type species *Distobolbina nabalaensis* Sarv, 1959
Distobolbina teicherti n. sp.
Plate 1, figs. 1–7

Description. Carapace small, preplete, cardinal angles rounded. S2 pitlike, near midvalve, extending as shallow, bifurcating groove to dorsum and equally shallow, anteroventrally directed, geniculate groove to velar ridge. Surface randomly pustulose with dorsomedian pustule above S2 pit, small node anterior of S2 pit, small node near velar ridge anterior of ventral extension of S2 and large ovate pustule, obliquely oriented, near velar node posterior of ventral extension of S2. Dorsum generally with 3 or more equally distributed pustules, posterior pustule may form indistinct, lowly elevated node.

Nonstriate velar ridge extending from midanterior to midventral margins, narrow and parallel with marginal ridge on tecnomorphs, broad, slightly undulating and more distant from marginal ridge on heteromorphs. Posterior part of velar ridge on both dimorphs incurved at midventer with velar structure near margin continuing to posterodorsal area as a row of discrete tubercles.

Measurements. Tecnomorphic specimens: lengths 0.70–0.80 mm, height 0.50–0.55 mm; heteromorphic specimens: length 0.73–0.80 mm, height 0.55–0.60 mm.

Types. Holotype, GSC 41921, paratypes, GSC 41916–41920, 41922.

Occurrence. GSC loc. 89868, Bad Cache Rapids Formation, top of 15-ft cliff section, more than 100 ft above exposed Ship Point dolomite south of Roche Bay, Melville Peninsula, District of Franklin.

Remarks. This species agrees most closely with *Distobolbina nabalaensis* Sarv in shape and velar ornamentation. *D. nabalaensis*, however, is consistently larger, more pustulose, not reported as having a median pit on S2 and, as on *D. tuberculata* (Henningsmoen), the velum extends as a ridge to the posteroventral part of the valve. Possibly some distinction between Middle and Upper Ordovician species of this genus may be based on the extent and characteristics of their velar structures.

Distobolbina warthini n. sp.
Plate 6, figs. 9–12

Description. Small preplete carapace, cardinal angles rounded. S2 pitlike, near midvalve, extending as bifurcating groove to dorsum and as geniculate, anteroventrally directed groove to velar ridge. Surface randomly pustulose with two rows of 3 to 5 dorsal pustules, the median pustules of which lie above S2. Small node anterior of S2 pit, smaller node near velar ridge anterior of ventral extension of S2 and an ovate pustulose node posterior of ventral extension of S2. Posterior third of valve sparsely pustulose.

Nonstriate velar ridge extending from midanterior to midventral margins of heteromorphic specimens, continuing to posterior corner as a row of discrete tubercles. Velar structure of tecnomorphic specimens consisting only of a row of discrete tubercles. Marginal structure finely tuberculate.

Measurements. Tecnomorphic specimens: length 0.50–0.51 mm, height 0.39–0.40 mm; heteromorphic specimens: length 0.73–0.80 mm, height 0.52–0.55 mm.

Types. Holotype, USNM 216134, paratypes, USNM 216133, 216135, 216136.

Occurrence. Silliman's Fossil Mount, 40 to 100 ft above base.

Remarks. This species agrees closely with *Distobolbina teicherti* n. sp. in shape and surface ornamentation. *D. teicherti*, however, bears an anterior and anterovental velar ridge on both dimorphs, whereas tecnomorphic specimens of *D. warthini* have the entire velar structure reduced to discrete tubercles.

Family Leperditellidae Ulrich and Bassler, 1906
Genus *Parapyxion* Jaanusson, 1957
Type species *Primitia subovata* Thorslund, 1948
Parapyxion melvillensis n. sp.
Plate 2, figs. 5, 6

Description. Large postplete valve, cardinal angles obtuse. Valves sparsely punctate, rising from all margins, slightly flattened medially. S2 somewhat anterodorsal of midvalve, lacrimose, nearly extending to dorsal margin. Surface of valves antero- and posterodorsally of S2 faintly inflated. Muscle scar indicated by roughened area in deepest, ventral part of S2.

Measurements. Holotype, length 2.1 mm, height 1.4 mm; paratype, length 2.2 mm, height 1.5 mm.

Types. Holotype, GSC 41936, paratype, GSC 41935.

Occurrence. GSC loc. 89868, Bad Cache Rapids Formation, top of 15-ft cliff section, more than 100 ft above exposed Ship Point dolomite south of Roche Bay, Melville Peninsula, District of Franklin.

Remarks. Specimens of this species are larger than those taxa from Sweden described by Jaanusson (1957) and Thorslund (1948). *P. melvillensis* also differs from most other *Parapyxion* species in having a less elevated central valve surface and a relatively distinct S2 outline.

Family Kloedenellidae Ulrich and Bassler, 1908
Genus *Glymmatobolbina* Harris, 1957
Type species *Glymmatobolbina quadrata* Harris, 1957
Glymmatobolbina? *spinosa* n. sp.
Plate 3, fig. 8; Plate 6, figs. 7, 8

Description. Valves convex, subovate in lateral view; hinge straight, four fifths greatest length; cardinal angles abrupt, slightly projecting. Greatest length near median, greatest height posterior, greatest width near median in tecnomorphic valves, posterior in heteromorphic valves. Dorsal margin straight anteriorly, tecnomorphic valves with low dorsal hump extending to or slightly above hinge in posterior half, dorsal hump of heteromorphic valves with a pronounced spinose projection extending dorsally.

Surface smooth, S2 deep, slightly anterior of median, broadest in dorsal third above slightly projecting L2. L1 and S1 indistinct, but present. S2 extending about half the distance from dorsum to venter in tecnomorphic valves, about two thirds that distance in heteromorphic valves. Left valve slightly overlapping right along antero- and posteroventral margins.

Measurements. Several carapaces: tecnomorphs, length 2.6 mm, height 1.7 mm, width 1.2 mm; heteromorphs, length 2.6 mm, height 1.9 mm, width 1.35 mm.

Types. Holotype, USNM 216091, paratypes, USNM 216131, 216132.

Occurrence. Silliman's Fossil Mount, 40–165 ft above base.

Remarks. This species mostly resembles *G.*? *magna* Copeland from beds of the Bucke Formation, Lake Timiskaming, Ontario. Heteromorphic carapaces of *G.*? *magna*, however, lack the posterodorsal spinose projection of *G.*? *spinosa*, and both dimorphs have shorter S2 than *G.*? *spinosa*. Both species show kloedenellid posterior dimorphism and should possibly be removed from the genus *Glymmatobolbina*.

Family uncertain

Genus *Monoceratella* Teichert, 1937

Type species *Monoceratella teres* Teichert, 1937

Monoceratella decorata n. sp.

Plate 4, figs. 1, 6–9

Description. Valves small, somewhat preplete; cardinal angles abrupt, slightly more than 90 degrees. Finely reticulate surface rising evenly from all margins. S2 incised into anterodorsal surface of valve, not reaching dorsum, deepest ventrally. Presulcal node low or absent. Two prominent spines, one near anterodorsal corner of valve, the other near midheight of posterior margin. Margin of valves finely denticulate.

Measurements. Average of several specimens (excluding spines): length 1 mm, height 0.6 mm.

Types. Holotype, USNM 216092, paratypes, USNM 216093–216096.

Occurrence. Silliman's Fossil Mount, 100 to 175 ft above base.

Remarks. The position of the spines of *M. decorata* n. sp. is similar to those of *M. spicata* Copeland from the Bucke Formation at Lake Timiskaming, Ontario. Unlike *M. spicata*, however, *M. decorata* is reticulate and has a much more pronounced S2.

Monoceratella baffinensis n. sp.

Plate 4, figs. 2, 5, 10

Description. Valves small, preplete, cardinal angles abrupt, slightly more than 90 degrees. Coarsely reticulate surface with irregular, linear, fingerprintlike arrangement. S2 shallow, not reaching dorsum, with roughened area of adductorial scar in lower part. Presulcal node low, circular. Two prominent spines, one at anterodorsal corner projecting anterodorsally, the other near posteroventral margin. Margin of valves denticulate, denticles increasing in size anteriorly.

Measurements. Holotype: length 1.1 mm, height 0.7 mm; paratype, USNM 216097: length 0.9 mm, height 0.6 mm.

Types. Holotype, USNM 216098, paratypes, USNM 216097, 216099.

Occurrence. Silliman's Fossil Mount, 100 to 135 ft above base.

Remarks. This species is more preplete and coarsely and regularly reticulate than *M. decorata* n. sp. Also the posterior spine is lower on the posteroventral slope, the marginal denticles are larger and S2 is less distinct than on *M. decorata*.

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Plates 1 to 6

For Geological Survey of Canada localities from Melville Peninsula, District of Franklin, see Sanford (*this bulletin*). See Table 1 for stratigraphic positions of collections from Silliman's Fossil Mount, Baffin Island, District of Franklin. Illustrated specimens from those collections are deposited in the United States National Museum (USNM).

Plate 1
All GSC loc. 89868 except figs. 8, 9, 12, GSC loc. 89830.

Figures 1–7. *Distobolbina teicherti* n. sp. (1) Left lateral view of a tecnomorphic valve, ×50, paratype, GSC 41916. (2) Right lateral view of a heteromorphic valve, ×50, paratype, GSC 41917. (3) Right lateral view of a tecnomorphic valve, ×50, paratype, GSC 41918. (4) Right lateral view of a heteromorphic valve, ×50, paratype, GSC 41919. (5) Left lateral view of a heteromorphic valve, ×50, paratype, GSC 41920. (6) Ventral view of a heteromorphic carapace, ×40, holotype, GSC 41921. (7) Ventral view of a tecnomorphic left valve, ×40, paratype, GSC 41922.

Figures 8, 10, 13, 14. *Tetradella buckensis* Guber. (8) Right lateral view of a heteromorphic valve, ×40, hypotype, GSC 41923. (10) Right lateral view of a heteromorphic valve, × 40, hypotype, GSC 41924. (13) Right lateral view of a heteromorphic valve, ×50, hypotype, GSC 41925. (14) Left lateral view of a heteromorphic valve, ×50, hypotype, GSC 41926.

Figure 9. *Tetradella ulrichi* Kay. Left lateral view of a heteromorphic valve, ×40, hypotype, GSC 41927.

Figure 11. *Tetradella ellipsilira* Kay. Right lateral view of an immature valve, ×45, hypotype, GSC 41928.

Figure 12. *Eurychilina*? sp. Right lateral view of an incomplete valve, ×55, figured specimen, GSC 41929.

Figures 15–18. *Steusloffina ulrichi* Teichert. (15) Right lateral view of a carapace, ×45, hypotype, GSC 41930. (16) Left lateral view of a carapace, ×50, hypotype, GSC 41931. (17) Right lateral view of a carapace, ×50, hypotype, GSC 41932. (18) Interior view of a right valve, ×50, hypotype, GSC 41933.

Figure 19. *Macrocyproides trentonensis* (Ulrich). Left lateral view of a carapace, ×50, hypotype, GSC 41934.


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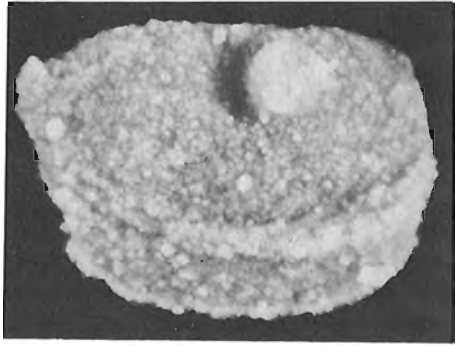
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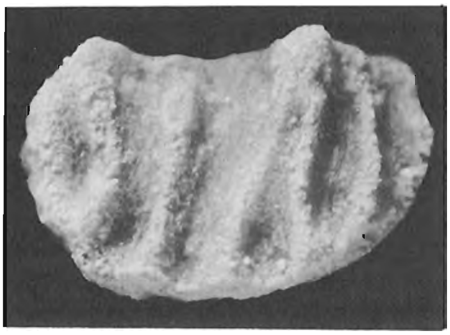
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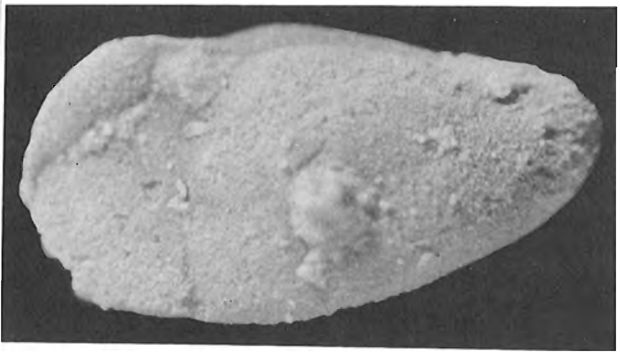
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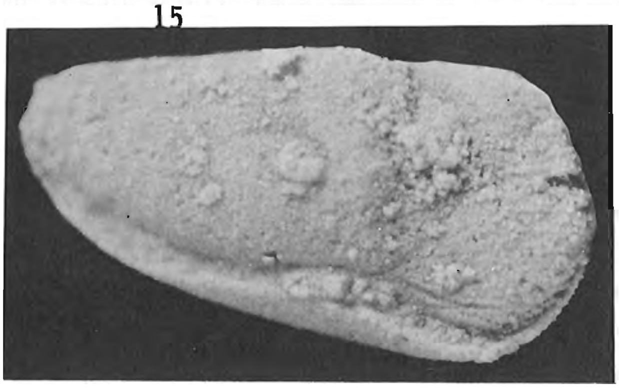
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Plate 2
All except figures 5, 6 and 10 from Silliman's Fossil Mount

Figure 1. *Thomasatia falcicosta* Kay. Left lateral view of a valve, ×37, loc. B-3; hypotype, USNM 216076.

Figures 2, 3. *Byrsolopsina centipunctata* (Kay). Right and left lateral views of two carapaces, ×37, loc. B-8; hypotypes, USNM 216077, 216078.

Figures 4, 9. *Eurychilina subradiata* Ulrich. Right lateral views of two valves, ×40, locs. B-7, B-9; hypotypes, USNM 216079, 216080.

Figures 5, 6. *Parapyxion melvillensis* n. sp. Left and right lateral views of two valves, ×40, loc. 89868; paratype, GSC 41935, holotype, GSC 41936.

Figure 7. "*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich). Left lateral view of a carapace, ×40, loc. B-1; hypotype, USNM 216081.

Figure 8. *Ceratopsis quadrifida* (Jones). Right lateral view of a valve, ×40, loc. B-2; hypotype, USNM 216082.

Figure 10. *Leperditella*? sp. Lateral view of a carapace, ×40, loc. 89868; figured specimen, GSC 41937.

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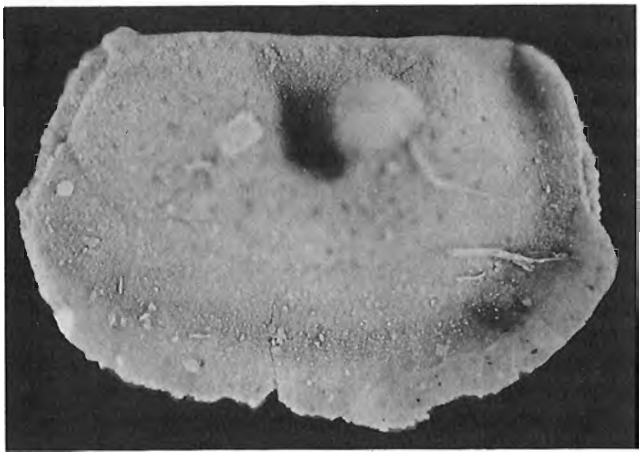

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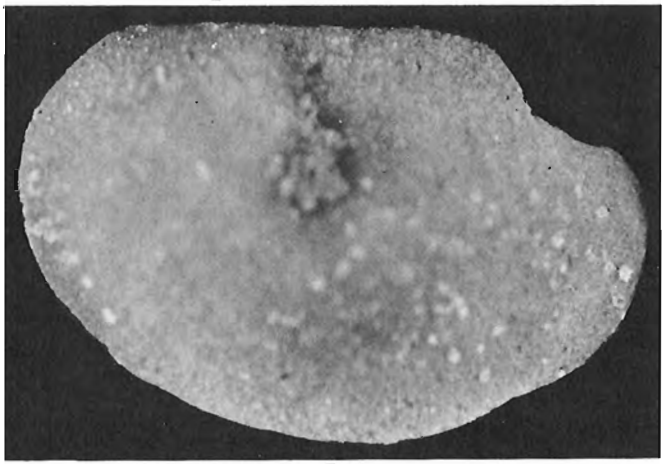

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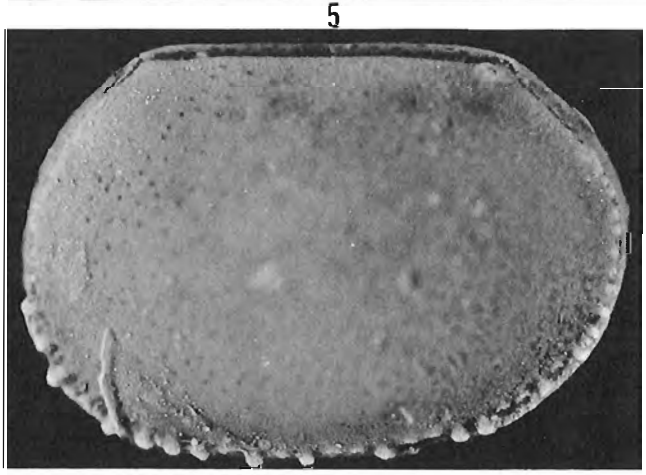

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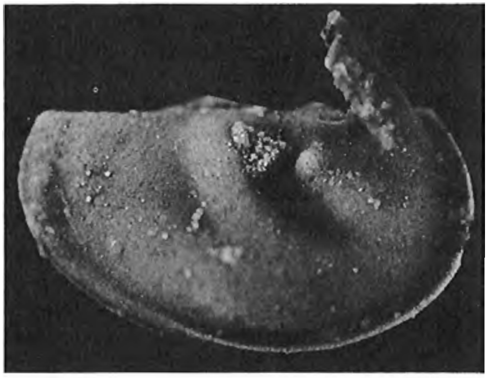

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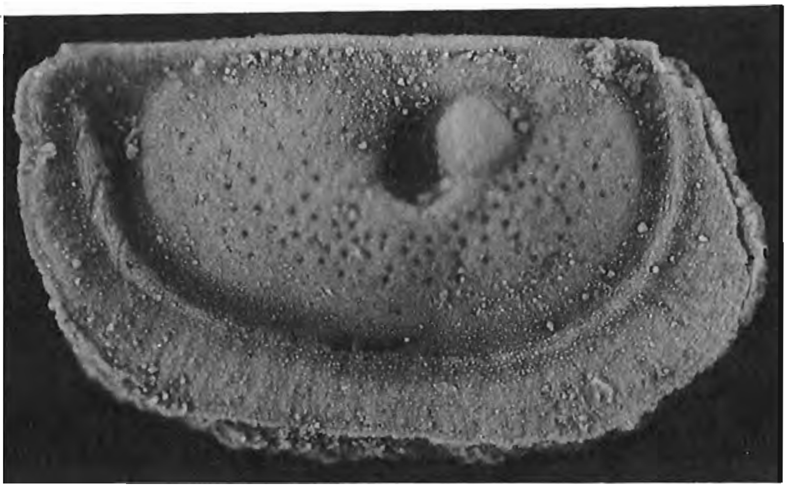

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Plate 3
Silliman's Fossil Mount

Figures 1–4. ?*Krausella* sp. cf. ?*K. acuta* (Teichert). (1, 2) Left and right lateral views of two carapaces, ×40, loc. B-1; hypotypes, USNM 216083, 216084. (3, 4) Dorsal and ventral views of two carapaces, ×40, loc. B-8; hypotypes, USNM 216085, 216086.

Figure 5. *Krausella rawsoni* Roy. Left lateral view of a carapace, ×37, loc. B-8; hypotype, USNM 216087.

Figure 6. *Eurychilina subradiata* Ulrich. Right lateral view of an incomplete valve, ×40, loc. B-7; hypotype, USNM 216088.

Figures 7, 9. *Bairdiocypris cylindrica* (Hall). Left and right lateral views of two carapaces, ×37, loc. B-5; hypotypes, USNM 216089, 216090.

Figure 8. *Glymmatobolbina*? *spinosa* n. sp. Left lateral view of a heteromorphic carapace, ×40, loc. B-8; holotype, USNM 216091.

Plate 3


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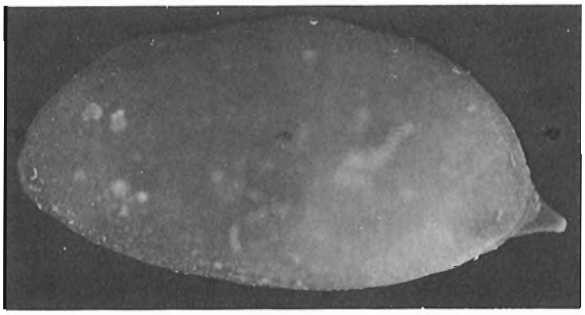
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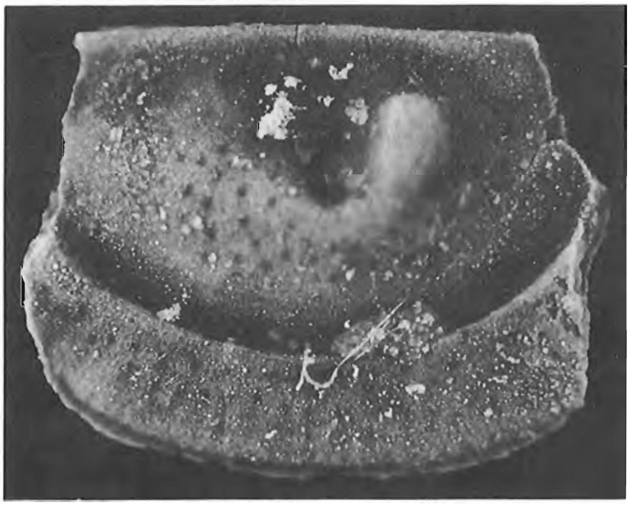
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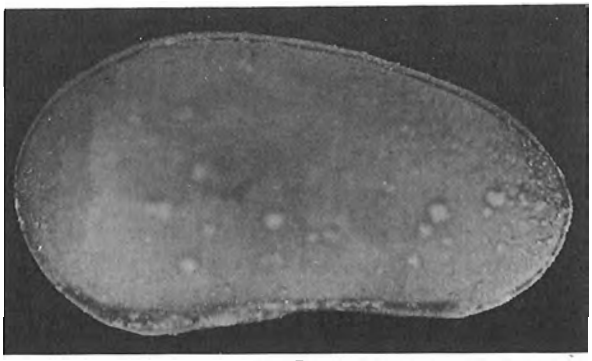
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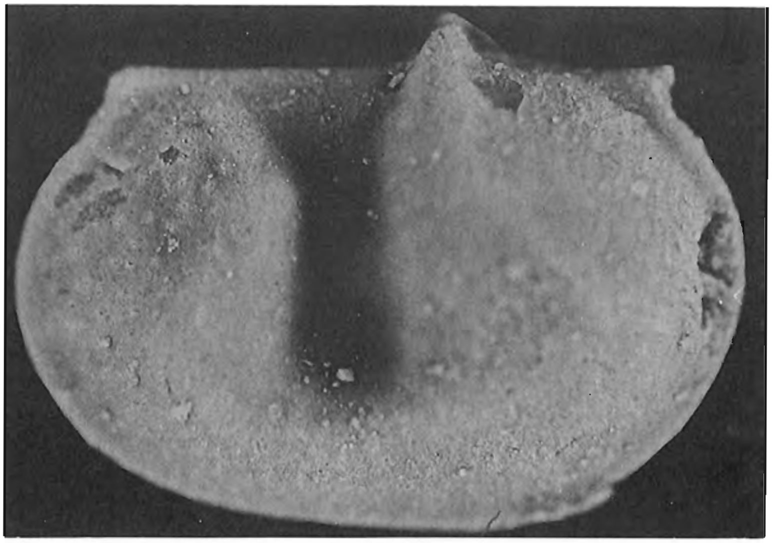

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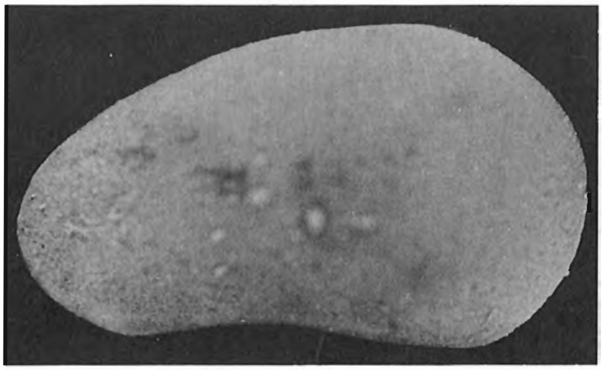

Plate 4
All except figure 18 from Silliman's Fossil Mount

Figures 1, 6–9. *Monoceratella decorata* n. sp. All ×37. (1) Right lateral view of a valve, loc. B-1; holotype, USNM 216092. (6) Left lateral view of a valve, loc. B-1; paratype, USNM 216093. (7, 8) Ventral and dorsal views of two left valves, loc. B-1; paratypes, USNM 216094, 216095. (9) Left lateral view of a valve, loc. B-1; paratype, USNM 216096.

Figures 2, 5, 10. *Monoceratella baffinensis* n. sp. (2) Left lateral view of a valve, ×60, loc. B-14; paratype, USNM 216097. (5) Right lateral view of a valve, ×60, loc. B-9; holotype, USNM 216098. (10) Right lateral view of a carapace, ×40, loc. B-1; paratype, USNM 216099.

Figure 3. Ostracode indet. 1. Right lateral view of a carapace, ×37, loc. B-1; figured specimen, USNM 216100.

Figure 4. *Saccelatia buckensis* Copeland. Left lateral view of a carapace, ×37, loc. B-1; hypotype, USNM 216101.

Figure 11. ?*Longiscula emaciata* Copeland. Right lateral view of a carapace, ×40, loc. B-1; hypotype, USNM 216102.

Figures 12, 20. *Diplopsis socialis* Levinson. Right and left lateral views of two carapaces, ×40, loc. B-13; hypotypes, USNM 216103, 216104.

Figure 13. *Punctaparchites rugosus* (Jones). Right lateral view of a valve, ×40, loc. B-2; hypotype, USNM 216105.

Figures 14, 15. *Byrsolopsina centipunctata* (Kay). Left and right lateral views of two carapaces, ×40, loc. B-8; hypotypes, USNM 216106, 216107.

Figure 16. *Tetradella buckensis* Guber. Right lateral view of a heteromorphic valve, ×40, loc. B-1; hypotype, USNM 216108.

Figure 17. *Tetradella ulrichi* Kay. Left lateral view of a heteromorphic valve, ×40, loc. B-13; hypotype, USNM 216109.

Figure 18. *Leperditella*? sp. Left? lateral view of a carapace, ×40, loc. 89868; figured specimen, GSC 41938.

Figure 19. "*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich). Left lateral view of a carapace, ×40, loc. B-1; hypotype, USNM 216110.

Figure 21. *Laccochilina* (*Prochilina*) *irrasa* Copeland. Left lateral view of a valve, ×40, loc. B-1; hypotype, USNM 216111.


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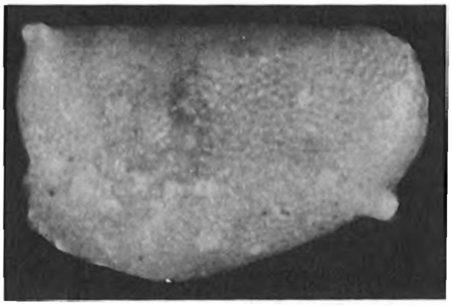
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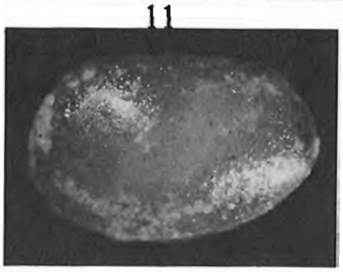
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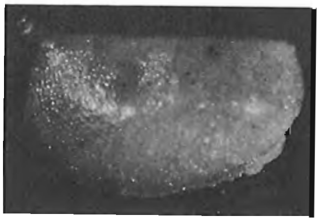
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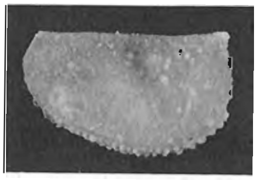
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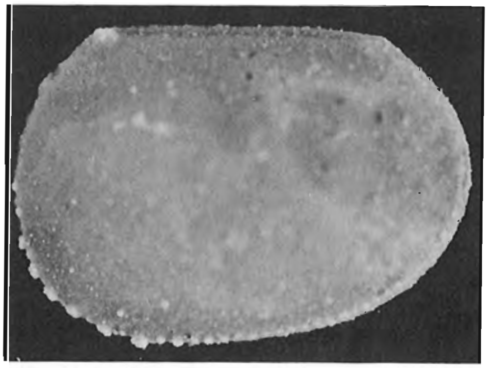
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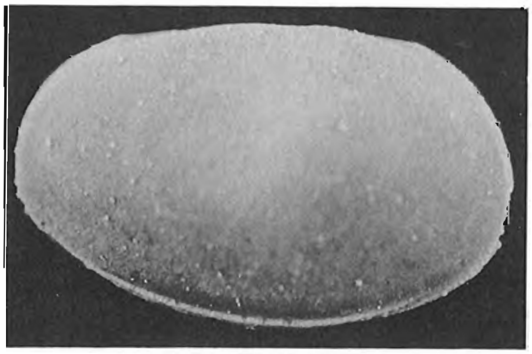
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Plate 5
Silliman's Fossil Mount
(all ×60 except figs. 3–7, ×20)

Figures 1, 2. *Euprimitia* sp. cf. *E. sanctipauli* (Ulrich). Right lateral views of two carapaces, locs. B-3 and B-14; hypotypes, USNM 216112, 216113.

Figure 3. *Levisulculus planus* Copeland. Left lateral view of a valve, loc. B-2; hypotype, USNM 216114.

Figure 4. ?*Krausella* sp. cf. ?*K. acuta* (Teichert). Ventral view of a carapace, loc. B-14; hypotype, USNM 216115.

Figure 5. *Ceratopsis quadrifida* (Jones). Left lateral view of a carapace, loc. B-9; hypotype, USNM 216116.

Figure 6. *Oepikium* sp. Right lateral view of a valve with incomplete velar frill, loc. B-2; figured specimen, USNM 216117.

Figure 7. *Oepikella jaynesi* (Roy). Right lateral view of a carapace, loc. B-14; hypotype, USNM 216118.

Figure 8. *Bolbopisthia*? sp. Left lateral view of a valve, loc. B-3; figured specimen, USNM 216119.

Figure 9. *Levisulculus michiganensis* Kesling. Right lateral view of a tecnomorphic carapace, loc. B-14; hypotype, USNM 216120.

Figure 10. *Winchellatia longispina* Kay. Right lateral view of a valve, loc. B-1; hypotype, USNM 216121.

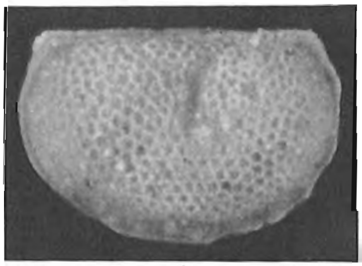
Figure 11. *Tetradella buckensis* Guber. Ventral view of a heteromorphic carapace, loc. B-14; hypotype, USNM 216122.

Figure 12. *Tetradella ulrichi* Kay. Left lateral view of a heteromorphic valve, loc. B-3; hypotype, USNM 216123.

Figure 13. Ostracode indet. 2. Left lateral view of an incomplete valve, loc. B-4; figured specimen, USNM 216124.

Figure 14. *Dicranella bicornis* Ulrich. Left lateral view of a heteromorphic valve, loc. B-2; hypotype, USNM 216125.

Figure 15. *Chilobolbina*? sp. Left lateral view of an incomplete valve, loc. B-14; figured specimen, USNM 216126.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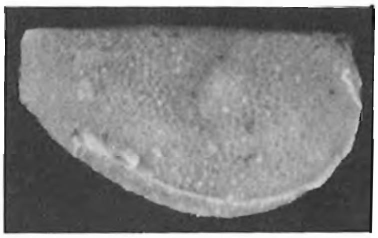
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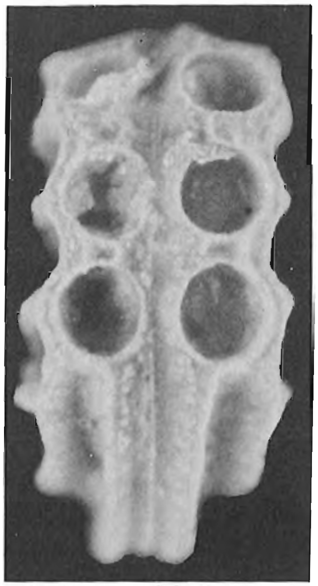
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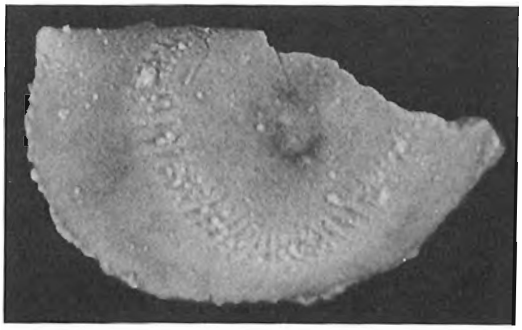
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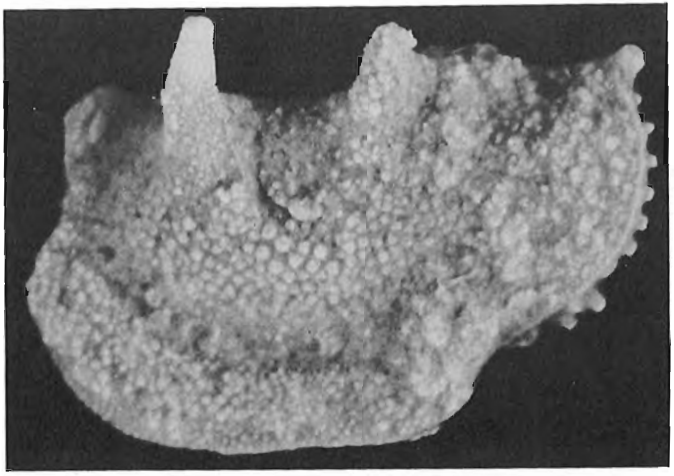
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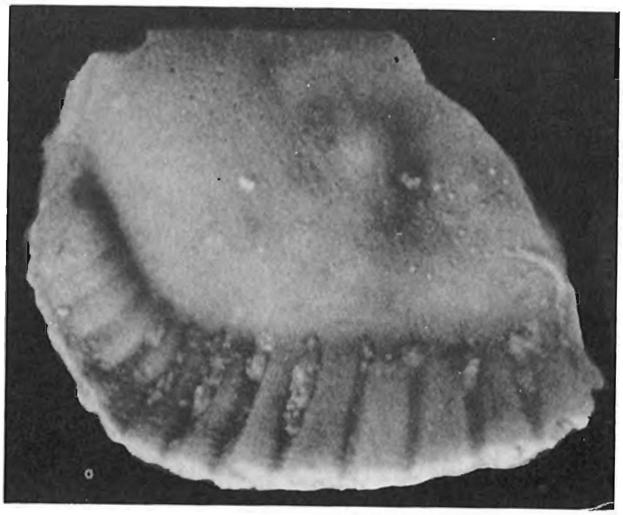
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Plate 6
All from Silliman's Fossil Mount except figs. 5, 6, 13, 15–17

Figure 1. "*Aparchites*" sp. cf. "*A.*" *fimbriatus* (Ulrich). Right lateral view of a carapace, ×20, loc. B-1; hypotype, USNM 216127.

Figure 2. *Steusloffina ulrichi* Teichert. Right lateral view of a carapace, ×20, loc. B-14; hypotype, USNM 216128.

Figure 3. *Krausella rawsoni* Roy. Right lateral view of a carapace, ×20, loc. B-14; hypotype, USNM 216129.

Figure 4. *Aechmina* sp. Left lateral view of a carapace, ×40, loc. B-8; figured specimen, USNM 216130.

Figure 5. *Krausella* sp. Right lateral view of a carapace, ×20, loc. 89868; figured specimen, GSC 41939.

Figure 6. *Bairdiocypris* sp. Right lateral view of a carapace, ×40, loc. 89868; figured specimen, GSC 41940.

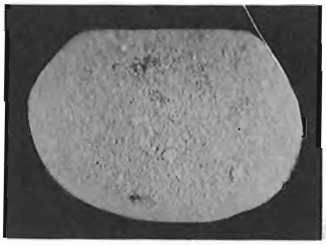
Figures 7–8. *Glymmatobolbina*? *spinosa* n. sp. Right lateral views of tecnomorphic and heteromorphic carapaces, ×20, loc. B-5; paratypes, USNM 216131, 216132.

Figures 9–12. *Distobolbina warthini* n. sp. All ×80. (9) Left lateral view of a heteromorphic valve, loc. B-1; paratype, USNM 216133. (10) Ventral view of a heteromorphic carapace, loc. B-4; holotype, USNM 216134. (11) Right lateral view of a tecnomorphic valve, loc. B-4; paratype, USNM 216135. (12) Ventral view of a tecnomorphic carapace, loc. B-4; paratype, USNM 216136.

Figure 13. *Eoleperditia* sp. Right lateral view of a valve, ×3, loc. 89864; figured specimen, GSC 41941 (pygidium of *Illaenus* sp. in lower left corner).

Figure 14. *Saccelatia buckensis* Copeland. Left lateral view of a valve, ×35, loc. B-8; hypotype, USNM 216137.

Figures 15–17. *Scofieldia halli* (Teichert). Two left and one right lateral views of three valves, ×15, loc. 89831; hypotypes, GSC 41942–41944.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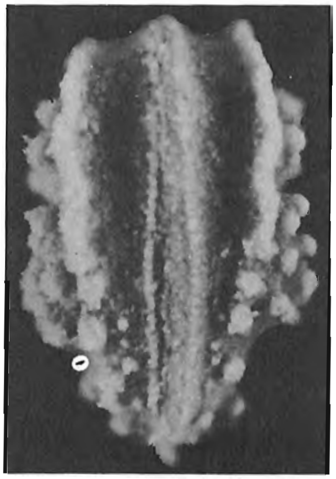
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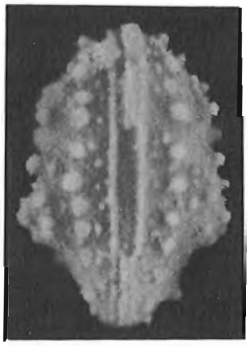
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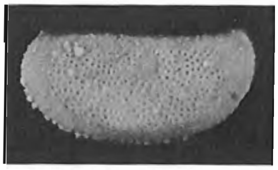
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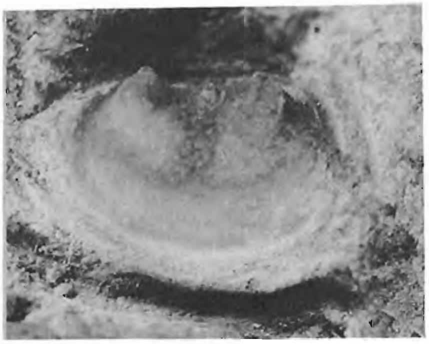
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Ordovician Conodonts from the Ship Point and Bad Cache Rapids Formations, Melville Peninsula, Southeastern District of Franklin

Christopher R. Barnes

Abstract

Fifty samples from Ordovician strata of Melville Peninsula were processed for conodonts; half of these yielded a total of 851 identifiable specimens. Conodonts from 7 samples from the Ship Point Formation indicated an age for the unit of mid-Whiterock to Marmor (latest Arenigian to Late Llandeilian). The conodont faunas in 17 samples from the overlying rocks range in age from Blackriveran–Kirkfieldian to Shermanian–Maysvillian. The faunas of both formations belong to the Midcontinent Province and several new taxa are described, of which one, a species of *Panderodus*, is named formally.

Résumé

Cinquante échantillons pris dans les couches de l'Ordovicien de la presqu'île Melville ont été traités pour y rechercher des conodontes; la moitié de ceux-ci ont donné un total de 851 spécimens identifiables. Les conodontes de sept échantillons de la formation de Ship Point indiquent pour cette unité un âge qui va du milieu du Whiterock au Marmor (de l'extrême fin du Arenigien au Llandeilien inférieur). La faune de conodontes de dix-sept échantillons des roches qui recouvrent les précédentes ont un âge qui va du Blackriverien–Kirkfieldien au Shermanien–Maysvillien. Les faunes des deux formations appartiennent à la Province médiocontinentale (Midcontinent Province) et l'auteur décrit plusieurs nouveaux taxons dont l'un, une espèce de *Panderodus*, reçoit une dénomination officielle.

Introduction

Fifty samples from Ordovician rocks of Melville Peninsula were processed for conodonts. The average sample weight was about 1 kg. Twenty-five samples yielded identifiable conodonts, with 306 conodonts from 7 Ship Point Formation samples and 545 conodonts from 17 Bad Cache Rapids Formation samples (Tables 1, 2).

Although these are relatively small collections, the conodonts are well preserved and include some diagnostic species that permit age assignments for the two stratigraphic units.

In describing the conodonts, multielement taxonomy is used where possible with residual form elements designated by the suffix s.f. (*sensu formo*), as adopted earlier (Barnes and Poplawski, 1973). All type material is deposited with the Geological Survey of Canada, Ottawa.

Ship Point Formation

The localities in which conodont specimens from the Ship Point Formation of Melville Peninsula were found are shown in Table 1. The fauna is characteristic of the Midcontinent Province (Barnes *et al.*, 1973) and may represent a long time. With one exception the Ship Point Formation samples produced low conodont yields (GSC loc. 89833: 270 specimens).

The conodont faunas largely accord with the stratigraphic positions of the sections indicated in Figure 10 (Sanford, this bulletin). One sample (GSC loc. 89861) of possible late Canadian age contains *Scolopodus gracilis* Ethington and Clark, a species that ranges from late Canadian to early Middle Ordovician.

One sample (GSC loc. 89833) contains several diagnostic species, including *Eoneoprioniodus bialatus* (Mound), *E. bilongatus* (Harris), *Oistodus multicorrugatus* Harris, *O. scalenocarinatus* Mound, *Ulrichodina prima* Furnish and New Genus

Table 1. Distribution of conodonts, Ship Point Formation, Melville Peninsula

Species		GSC locality (section)						
		89829(1)	89833(5)	89834(6)	89850(22)	89861(33)	89863(35)	89864(36)
Belodella erecta s.f.	3				3			
B. n. sp. s.f.	8			1	5			2
Drepanodus parallelus	74		68	3	aff. 3			
Drepanoistodus basiovalis	49	1	44		3		1	
Eoneoprioniodus bialatus	69		69					
E. bilongatus	47		47					
"*E.*" sp.	2						1	1
Erismodus horridus s.f.	1						1	
Oistodus multicorrugatus	15		15					
O. scalenocarinatus	13		13					
Phragmodus flexuosus	8	1		1	6			
Scolopodus gracilis	5		4			1		
Ulrichodina prima s.f.	4		4					
U. n. sp. s.f.	3		3					
New Genus B n. sp. s.f.	3		3					
New Genus C n. sp. s.f.	1			1				
Gen. et sp. indet.	1						1	
Total specimens	306							
Total per sample		2	270	6	20	1	4	3

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B. These taxa are indicative of conodont Faunas 2 and 3 of Sweet *et al.* (1971). Mound (1965 *a, b*) has described most of these taxa from the Joins Formation of Oklahoma. These two conodont faunas appear to represent a limited time interval that equates with latest Arenigian to early Llanvirnian (mid-Whiterock).

Other samples (GSC locs. 89829, 89834, 89850, 89864) generally lack the above-mentioned taxa but include *Belodella erecta* (Rhodes and Dineley) s.f., *B.* n. sp. s.f., and *Phragmodus flexuosus* Moskalenko. Barnes (1974, p. 230) reported these taxa earlier from Foxe Basin and referred them to conodont Fauna 4 of Sweet *et al.* (1971), with some taxa ranging into Faunas 3 and 5. Moskalenko (1972, 1973) reported *Phragmodus flexuosus* from the Volginsky beds (middle to late Llanvirnian) of the Siberian Platform. This age corresponds largely to the late Whiterock to Marmor stages as used by other authors in this bulletin. However, some of these taxa probably extend up into the lower Porterfield Stage (late Llandeilian).

Bad Cache Rapids Formation

The localities and conodont specimens found in samples from the Bad Cache Rapids Formation of Melville Peninsula are shown in Table 2. This fauna is typical of the Midcontinent Province with the exception of a few components of North Atlantic Province affinity: *Periodon grandis* (Ethington) is in four samples and *Protopanderodus insculptus* (Branson and Mehl) in three other samples. The main influx of North Atlantic Province forms is in the Boas River shale that lies between the Bad Cache Rapids and Churchill River groups, and also within the latter unit in northern Hudson Bay (Barnes, 1974, p. 235).

The conodont fauna from the Bad Cache Rapids Formation may be separated into two assemblages: one of Blackriveran to Kirkfieldian age and the other of Shermanian to Maysvillian age. Stadial terms used herein are those proposed by Sweet and Bergström (1971). Most of the taxa occur in both assemblages and are dominated by panderodans and belodinans, typical of the northern and western areas of the Midcontinent Province (Barnes *et al.*, 1973; Barnes and Fåhraeus, 1975).

Some elements (GSC locs. 89831, 89833, 89850, 89869) suggest a Blackriveran to Kirkfieldian age. One fragment of *Appalachignathus* sp. is present (GSC loc. 89833) and the known range of this recently established monospecific genus is upper Chazy to lower Black River (Bergström *et al.*, 1974). In terms of Midcontinent conodont biostratigraphy this is the range of conodont Faunas 6 and 7 of Sweet *et al.* (1971). One sample (GSC loc. 89831) contains *Polyplacognathus ramosus* Stauffer and this distinctive platform species ranges through conodont Faunas 6 (upper part) to 10 (lower part). It also occurs, with *Appalachignathus delicatulus* Bergström, Carnes, Ethington, Votaw and Wigley, in a sample from the base of Member *B*, Baillarge Formation, in Panarctic Deminex Garnier 0–21 well, east coast of Somerset Island, Canadian Arctic Archipelago. Three samples (GSC locs. 89830, 89850, 89869) contained elements that belong to *Plectodina aculeata* (Stauffer). This taxon ranges through conodont Faunas 7 and 8, Blackriveran to mid-Kirkfieldian.

The remaining samples contain some elements that suggest a Shermanian–Maysvillian age, probably Edenian. As used herein, and by Sweet and Bergström (1971), Edenian

Table 2. Distribution of conodonts, Bad Cache Rapids Formation, Melville Peninsula

		GSC locality (section)																
Species		89830(2)	89831(3)	89833(5)	89840(12)	89841(13)	89844(16)	89845(17)	89849(21)	89850(22)	89857(29)	89858(30)	89859(31)	89860(32)	89865(37)	89866(38)	89869(41)	89870(42)
Acodus mutatus	7	2		1						1		1					1	1
Appalachignathus sp.	1			1														
Belodina compressa	25	4		3		1	4	2		1		3	3				4	
B. dispansa	3												1			1	1	
B. leithi	5	2					1					1			1			
B. profunda	1														1			
B. n. sp. 1	2					1	1											
Drepanoistodus suberectus	67	11	2	6		1	5	1	2	6	1	3	2	1	2	2	22	
Eobelodina sp. s.f.	1									1								
Panderodus arcuatus	11						5	4				2						
P. breviusculus	10					1	5			1				1		1	1	
P. feulneri	19	2			2				4				4		2		5	
P. gracilis	310	46	1	24	15	1	46	14	10	9	1	10	20	4	18	6	85	
P. panderi	11						2						1		1		1	6
P. staufferi	29				3	1	11	2				1	2		1	1	7	
Periodon grandis	7	3		2													1	1
Phragmodus undatus	14			4													10	
Plectodina aculeata	4	2								1							1	
Polyplacognathus ramosus	2		2															
Protopanderodus insculptus	5							3			1	1						
Staufferella lindstroemi	9		1				2			1	3						2	
New Genus A n. sp. 1 s.f.	1						1											
New Genus A n. sp. 2 s.f.	1						1											
New Genus A n. sp. 3 s.f.	1						1											
Total specimens	546																	
Total per sample		72	6	41	20	6	85	26	16	21	6	22	33	6	26	11	141	8

equates mostly to late Barneveldian (includes the Coubourgian) as adopted by other authors in this volume. The belodinan elements (e.g., *Belodina leithi* Ethington and Furnish, *B.* n. sp. 1, New Genus A n. spp. 2, 3) are in the upper Thumb Mountain Formation of the Canadian Arctic Archipelago (Barnes, 1974, p. 232). This association is typical of conodont Fauna 11 of Sweet *et al.* (1971), that is, mid-Edenian to mid-Maysvillian. The range of some of these relatively poorly known belodinans may extend downward into conodont Fauna 10; the notable absence of species of *Plegagnathus* suggests that conodont Fauna 12 may not be represented in the Bad Cache Rapids Formation of Melville Peninsula. Fauna 12 is known from strata of the Churchill River Group on Southampton Island, northern Hudson Bay (Barnes, 1974). Some of the panderodans, e.g., *Panderodus panderi* (Stauffer) and *P. staufferi* (Branson, Mehl and Branson), also suggest a post-Edenian age for some samples but the precise stratigraphic range of these species is not yet clear.

Systematic paleontology

Ship Point Formation conodonts

Genus *Belodella* Ethington, 1959
Type species *Belodus devonicus* Stauffer, 1940

Barnes and Poplawski (1973, p. 769) noted that the apparatus of early forms of *Belodella* appeared to include both denticulate and adenticulate elements. Similar forms are found in the Melville Peninsula material, although specimens are too few to be formally revised here.

Belodella erecta (Rhodes and Dineley) s.f.
Plate 2, fig. 7

Belodus erectus Rhodes and Dineley, 1957, p. 359, Pl. 38, fig. 8
Belodella erecta (Rhodes and Dineley). Barnes and Poplawski, 1973, p. 769, Pl. 4, figs. 19, 20 (includes synonymy to 1973)
Bellodella n.sp. s.f. Barnes, 1974, Pl. 1, fig. 11

Remarks. A transition series exists within elements previously referred to *Belodella erecta*, i.e., cordylodiform, zygognathiform and trichonodelliform. Elements in the Melville Peninsula fauna are few and these appear to be intermediate in form between the equally sparce belodellans from the Arenigian illustrated by Serpagli (1974) and the early Middle Ordovician by Ethington and Schumacher (1969).

Type. Hypotype, GSC 45585, GSC loc. 89850.

Belodella n. sp. s.f.
Plate 2, figs. 5, 6

c.f. *Belodella* n. sp. s.f. Barnes and Poplawski, 1973, p. 769, 770, Pl. 4, figs. 5, 9, 10, 18, 18*a*, Text-fig. 2F

Remarks. A few adenticulate and weakly denticulate elements appear to belong to the same apparatus as *Belodella erecta* (Rhodes and Dineley). These forms have a smaller basal cavity than those illustrated by Barnes and Poplawski (1973) but have the same lateral outline and weakly developed lateral costa, and possess white matter throughout most of the cusp.

Types. Figured specimens, GSC 45586, 45587, GSC locs. 89864, 89850.

Genus *Drepanodus* Pander, 1856, emend.
Lindström, 1971
Type species *Drepanodus arcuatus* Pander, 1856
Drepanodus parallelus Branson and Mehl
Plate 1, figs. 1–3

Drepanodus parallelus Branson and Mehl, 1933, p. 59, Pl. 4, fig. 17; Barnes, *in* Workum *et al.*, 1976, p. 171, Pl. 4, fig. 3

Types. Hypotypes, GSC 45588–45590, GSC loc. 89833.

Genus *Drepanoistodus* Lindström, 1971
Type species *Oistodus forceps* Lindström, 1955
Drepanoistodus basiovalis (Sergeeva)
Plate 1, figs. 4–6

Oistodus basiovalis Sergeeva, 1963, p. 96, Pl. 7, figs. 6, 7
Drepanoistodus basiovalis (Sergeeva). Barnes and Poplawksi, 1973, Pl. 4, figs. 3, 4, 7 (includes synonymy to 1973); Barnes, *in* Workum *et al.*, 1976, p. 171, 173, Pl. 4, figs. 1, 2

Types. Hypotypes, GSC 45591–45593, GSC loc. 89833.

Genus *Eoneoprioniodus* Mound, 1965
Type species *Oistodus bilongatus* Harris, 1962

Within late Lower Ordovician and early Middle Ordovician strata of midcontinent North America, is a wide variety of distinctive conodonts that are predominately hyaline yet not as robust and massive as the true neurodonts (e.g., *Erismodus*). Many have already been described (e.g., Mound, 1965*a*, *b*) but multielement taxonomy has yet to be applied. Only minor revision can be attempted with the relatively small fauna available.

One of the dominant components of the Ship Point Formation fauna from Melville Peninsula is *Eoneoprioniodus*. Herein, the generic diagnosis by Mound (1965*a*) is emended: predominantly hyaline conodonts with a skeletal apparatus following the prioniodont plan. The cordylodiform, zygognathiform and trichonodelliform elements have long slender cusps and sharp margins or costae that extend down into short, laterally compressed processes that are adenticulate to weakly denticulate. Oistodiform and dichognathiform elements have shorter, broader cusps that are more sharply reclined. The basal cavity is large and deep, conical in lateral view, ramiform elements commonly have lobate lateral basal margins.

Whereas Mound (1965*a*) described the transition series of the ramiform elements, it is now evident that both dichognathiform (acodiform) and oistodiform elements are also present to basically produce the prioniodont plan (Sweet and Bergström, 1970). Two species of *Eoneoprioniodus* are distinguished in the Melville Peninsula fauna. The genus is characterized by distinct short denticulate to weakly denticulate processes together with long slender cusps of the ramiform elements. Oistodiform and acodiform (dichognathiform) elements similar but not conspecific to those in *Eoneoprioniodus* were described by Barnes (*in* Workum *et al.*, 1976, p. 173) as *Oistodus akpatokensis*. Other elements belonging to a symmetry transition series were described as *Scandodus ungavensis* (*ibid.*, p. 175). It is possible that these two groups belong to the same multielement species and are part of the ancestral lineage of *Eoneoprioniodus* but the material available from Akpatok Island was too limited to confirm such an association. Later evolutionary forms become highly denticulate and are herein referred to as "*Eoneoprioniodus*" sp. (Sweet *et al*., 1971, Pl. 1, figs. 26, 28, 30; Barnes, 1974, Pl. 1, fig. 14). Others have been referred to *Multioistodus*. The other important hyaline taxa in the Ship Point Formation are *Oistodus multicorrugatus* Harris and *O. scalenocarinatus* Mound.

Eoneoprioniodus bialatus (Mound)
Plate 2, figs. 20–29

Dichognathiform element: cf. *Acodus auritius* Harris and Harris. Mound, 1965, p. 8, Pl. 1, figs. 1–3
Trichonodelliform element: *Acontiodus bialatus* Mound, 1965, p. 11, Pl. 1, figs. 16–18, 24, Text-fig. 1C
cf. *Tetraprioniodus robustus*? Lindström. Mound, 1965, p. 35, Pl. 4, figs. 28, 33 only

Description. Oistodiform, dichognathiform, cordylodiform, zygognathiform and trichonodelliform elements are recognized in this multielement species.

The oistodiform element has a large wide cusp with a weak broad carina on the inner lateral face. The sharp anterior margin meets the base at an angle of 35 to 45 degrees. The small low base has a low posterior extension and a flat basal margin. The basal cavity is wide but relatively shallow.

The dichognathiform element has a large wide cusp that is relatively straight. The low short base has a small basal cavity. The costa on the inner lateral face is sharp and extends out and down in the basal area but is never as conspicuous as that within the dichognathiform element of *E. bilongatus*.

The cordylodiform, zygognathiform and trichonodelliform elements provide the symmetry transition series with many features in common. The cusps are of moderate length and have keeled margins and high sharp costae. The costae pass down to extend as distinct processes, relatively high and locally serrated on the upper edge. Relative to the posterior process, the cusps are proclined and the process merges into the cusp as a smooth curve, rather than forming an angle of about 90 degrees as in *E. bilongatus*. The trichonodelliform elements were illustrated and described by Mound (1965*b*) as *Acontiodus bialatus*. A few elements included herein within *E. bialatus* have a rather high posterior process similar to one illustrated as *Tetraprioniodus robustus*? Lindström (Mound, 1965*b*, Pl. 4, fig. 28). These may possibly be transferred later to a different species of *Eoneoprioniodus*.

White matter distribution in the elements is similar to that described for *E. bilongatus*.

Remarks. The different orientation of the cusp, the high sharp costae and keeled margins, and the well developed processes distinguish the ramiform elements of *E. bialatus* from those of *E. bilongatus*. The oistodiform and dichognathiform elements have relatively larger wider cusps and smaller bases than in *E. bilongatus*.

Types. Hypotypes, GSC 45594–45603, GSC loc. 89833.

Eoneoprioniodus bilongatus (Harris)
Plate 2, figs. 10–19

Oistodiform element: *Oistodus bilongatus* Harris, 1962, p. 201, 202, Pl. 1, figs. 8–10
Oistodus linguatus Lindström. Mound, 1965, p. 27, 28, Pl. 3, fig. 36
Dichognathiform element: *Acodus tripterolobus* Mound, 1965, Pl. 1, figs. 9, ?11, ?12, 13, Text-fig. 1B
Cordylodiform element: *Eoneoprioniodus cryptodens* Mound, 1965, p. 197, 198, fig. 1 only
Zygognathiform element: *Eoneoprioniodus cryptodens* Mound, 1965, p. 197, 198, fig. 2 only
Trichonodelliform element: *Tetraprioniodus robustus*? Lindström. Mound, 1965, p. 35, Pl. 4, fig. 29 only

Remarks. As indicated in the synonymy, the individual components of the apparatus have been previously described as separate form species by Mound (1965*a*,*b*) and Harris (1962).

The oistodiform is similar to the general lateral outline of the dichognathiform element, lacks the lateral costa or process, has a more extended posterior section of the base and a short, commonly rounded anterior section. The base is gently arched.

The morphology of the dichognathiform element is variable, especially in the development of the lateral costa or process. It is not clear from the material available whether two dichognathiform elements may be within the range of variation.

All the cordylodiform, zygognathiform and trichonodelliform elements have long slender, erect to suberect cusps bearing sharp margins or costae. The latter extend downward into laterally compressed short processes that are usually adenticulate but white matter is weakly developed on the upper edges and some specimens have weak denticulation or serration. Posterior and downward-directed anterior processes are conspicuous; lateral processes are weakly developed on the zygognathiform and trichonodelliform elements. In cordylodiform elements the basal cavity is flanked by lobate extensions of the sides.

All the elements are hyaline with white matter developed in cusp growth axes and process tips in the ramiform elements and as growth axes and partly in the cusp tip in the dichognathiform and oistodiform elements.

Types. Hypotypes, GSC 45604–45613, GSC loc. 89833.

"*Eoneoprioniodus*" sp.
Plate 2, figs. 1, 2

Remarks. The few predominantly hyaline specimens are similar to elements within *Eoneoprioniodus* but are distinctly denticulate. Similar but probably not conspecific elements have been illustrated previously by Sweet *et al*. (1971, Pl. 1, figs. 26, 28, 30) and Barnes (1974, Pl. 1, fig. 14).

Types. Figured specimens, GSC 45614, 45615, GSC locs. 89864, 89863.

Genus *Erismodus* Branson and Mehl, 1933

Type species *Erismodus typus* Branson and Mehl, 1933

Erismodus horridus Harris s.f.

Plate 2, fig. 8

Erismodus? *horridus* Harris, 1964, p. 174, 176, Pl. 1, figs. 2*a–d*

Remarks. This distinctive hyaline element bears two denticulate lateral processes and a short denticulate posterior process. Pending full revision of the neurodont conodonts, the single specimen is identified in open nomenclature.

Type. Hypotype, GSC 45616, GSC loc. 89863.

Genus *Oistodus* Pander, 1856

Type species *Oistodus lanceolatus* Pander, 1856

Oistodus multicorrugatus Harris

Plate 1, figs. 20–24

Oistodus multicorrugatus Harris, 1962, p. 204, Pl. 1, figs. 2*a–c*; Mound, 1965, p. 29, Pl. 3, figs. 31, 34, 35; Pl. 4, fig. 2; Uyeno and Barnes, 1970, p. 110, Pl. 21, fig. 3; Higgins, 1967, p. 387, Pl. 2, fig. 3; Sweet, Ethington and Barnes, 1971, Pl. 1, fig. 32

Oistodus pseudomulticorrugatus Mound, 1965, p. 29, Pl. 4, figs. 3–5, 8, 9

Remarks. Forms described previously as *Oistodus multicorrugatus* and *O. pseudomulticorrugatus* are interpreted as belonging to a single symmetry transition series. The noncostate forms represent the cordylodiform element whereas those with costae represent the cladognathiform-hibbardelliform elements. However, most of the latter group are cladognathiform. In the Melville Peninsula material there is an oistodiform element that strongly resembles *O. pseudomulticorrugatus* s.f. and is herein included within the apparatus. The hyaline oistodiform element has a long flat base that rises rapidly towards the anterior to produce a notch characteristic of other elements in *O. multicorrugatus*; the cusp is strongly recurved to become almost parallel to, and extend slightly beyond, the posterior portion of the base.

Types. Hypotypes, GSC 45617–45621, GSC loc. 89833.

Oistodus scalenocarinatus Mound

Plate 1, figs. 11–13

Oistodus scalenocarinatus Mound, 1965, p. 30, Pl. 4, figs. 6, 7, 10–12

Oistodus lanceolatus Pander. ?Bradshaw, 1969, p. 1156, Pl. 113, figs. 16–18 only; Uyeno and Barnes, 1970, p. 119, Pl. 24, figs. 23, 24; Bamber *et al.*, 1970, Pl. 5, fig. 23

Oistodus multicorrugatus Harris. Barnes, 1974, Pl. 1, fig. 7

Description. The symmetry transition series includes costate cordylodiform, cladognathiform and hibbardelliform elements. The base is generally flat to bowed downwards and elongate posteriorly. The cusp is relatively narrow, is commonly one and a half times to twice the length of the base, and is sharp pointed. The lateral costa is strongly developed in the cordylodiform and especially cladognathiform elements. Most elements are predominantly hyaline with partly developed white matter in the tip of the cusp and along the growth axis.

Remarks. This taxon is similar in many respects to *Oistodus lanceolatus* Pander described previously from many localities of Lower Ordovician strata. The essential difference lies in the pronounced recurvature of the slender cusp rather than its being broad and suberect as in *O. lanceolatus*. The symmetry transition series is the same as that illustrated for *O. lanceolatus* by Lindström (1964, figs. 26A–E). Although many authors have reported *O. lanceolatus*, from the descriptions and illustrations a broad range of forms has evidently been included within this taxon. Those possessing the strongly recurved cusps have been included in the synonymy and appear to be restricted to late Arenigian to Llanvirnian age.

Types. Hypotypes, GSC 45622–45624, GSC loc. 89833.

Genus *Phragmodus* Branson and Mehl, 1933

Type species *Phragmodus primus* Branson and Mehl, 1933

Phragmodus flexuosus Moskalenko

Plate 2, figs. 3, 4

Phragmodus flexuosus Moskalenko, 1973, p. 73, 74, Pl. 11, figs. 4–6

Subcordylodus sinuatus Stauffer. Moskalenko, 1973, p. 80, 81, Pl. 12, figs. 7–9*a,b*

Gothodus evenkiensis Moskalenko, 1973, p. 67, 68, Pl. 11, figs. 1–3*a,b*

Dichognathus decipiens Branson and Mehl. Moskalenko, 1973, p. 66, 67, Pl. 15, figs. 7*a,b*, 8–12*a,b*

Oistodus abundans Branson and Mehl. Moskalenko, 1973, p. 35, 36, Pl. 1, figs 8, 9

Phragmodus sp. *A* Sweet, Ethington and Barnes, 1971, Pl. 2, figs. 3–6

Phragmodus n.sp. Moskalenko, 1972, fig. 1 (1–12)

Phragmodus n.sp. *A* Barnes, 1974, Pl. 1, fig. 10

Remarks. A few specimens represent elements within *Phragmodus flexuosus* as described by Moskalenko (1973), who has also reconstructed the apparatus (Moskalenko, 1972, fig. 1). More abundant representatives have been reported elsewhere in the Canadian Arctic by Barnes (1974).

Types. Hypotypes, GSC 45625, 45626, GSC loc. 89850.

Genus *Scolopodus* Pander, 1856

Type species *Scolopodus sublaevis* Pander, 1856

Scolopodus gracilis Ethington and Clark

Plate 1, figs. 14, 15

?*Drepanodus striatus* Graves and Ellison, 1941, p. 11, Pl. 1, figs. 3, 12

Scolopodus gracilis Ethington and Clark, 1964, p. 699, Pl. 115, figs. 2–4, 8, 9; Barnes and Poplawski, 1973, Pl. 3, figs. 6, 6*a*, 7, 7*a*, 8, 8*a*, Text-figs. 2G, H (includes synonymy to 1973); Barnes, 1974, Pl. 1, fig. 2; Barnes and Slack, 1975, fig. 3A; Barnes, *in* Workum *et al.*, 1976, p. 176, Pl. 4, fig. 6

Types. Hypotypes, GSC 45627, 45628, GSC loc. 89833.

Genus *Ulrichodina* Furnish, 1938
Type species *Ulrichodina prima* Furnish, 1938
Ulrichodina prima Furnish s.f.
Plate 1, figs 9, 10

Ulrichodina prima Furnish, 1938, p. 335, Pl. 41, figs. 21, 22, Text-fig. 1A; ?Mound, 1968, p. 421, Pl. 6, figs. 67, 68, 72; Barnes and Tuke, 1970, p. 94, Pl. 20, figs. 5, 6, 12, fig. 6G; Barnes and Slack, 1975, figs. 6A, B

Types. Hypotypes, GSC 45629, 45630, GSC loc. 89833.

Ulrichodina n. sp. s.f.
Plate 1, figs. 7, 8

Diagnosis. A species of *Ulrichodina* without the characteristic constriction at the anterobasal juncture; the keeled anterior margin extends below the general level of the basal margin.

Description. The cusp is wide and of moderate length. Posterior and anterior margins are sharp, and the latter is developed into a minor keel. Low rounded carinae are symmetrically developed on each lateral face close to the anterior margin. The basal cavity is shallow. There is no constriction at the anterobasal juncture, as typically found in species of *Ulrichodina*. In specimens of this new taxon, the keeled anterior margin extends below the general plane of the basal margin as a pointed lip and the keel fades proximally.

Types. Figured specimens, GSC 45631, 45632, GSC loc. 89833.

New Genus B
New Genus B n. sp. s.f.
Plate 1, figs. 16–18

New Genus B Sweet, Ethington and Barnes, 1971, Pl. 1, fig. 34; Barnes, 1974, Pl. 1, fig. 9

Description. A robust blade element that has a shallowly excavated basal cavity with a distinctive constriction at the posterior end. The base of the element is flat or slightly arched. The basal cavity extends from the anterior end, gradually widening, to terminate abruptly below the first (posteriormost) well defined denticle. At this posterior end, the basal cavity exhibits a constriction on the inner lateral side. Farther back is a small twisted, adenticulate process with a flat base exhibiting a weakly developed inverted cavity. On the outer lateral face the central part of the basal margin flares out slightly. The high blade usually bears 8 to 10 confluent denticles, of which those to the anterior are erect, whereas those towards the posterior become slightly inclined in that direction. The posteriormost denticles are smaller and merge into a short low process that is deflected or twisted to the inner side. White matter is developed in the process and in most denticles; the contact between white matter and hyaline matter passes from the basal cavity tip to the tip of the anterior denticle.

Remarks. This distinctive element appears to be short ranging but is so rare that it cannot be formally identified. It may be the only form element within the apparatus.

Types. Figured specimens, GSC 45633–45635, GSC loc. 89833.

New Genus C
New Genus C n. sp. s.f.
Plate 1, fig. 19

Chosonodina? sp. *A* ?Sweet, Ethington and Barnes, 1971, Pl. 1, fig. 41; Barnes, 1974, Pl. 1, fig. 15

Description. A blade element that has a shallow basal cavity, well defined by lateral flaring of the walls, below the posterior two thirds of the element. The cavity terminates at, or extends as a minute groove under, the anterior third of the element. The high blade is gently bowed and includes about 8 denticles. Anterior denticles are erect to suberect; those to the posterior are increasingly proclined. The subequal denticles are confluent; the main denticle is posteriormost and about twice as wide as the other denticles. White matter is developed throughout most of the element.

Remarks. Although superficially similar to New Genus B, New Genus C is more compressed, laterally bowed and has a different basal cavity and a different form of denticulation. No other elements can be associated with it within the Melville Peninsula fauna. While it slightly resembles *Chosonodina* and *Histiodella*, it apparently represents an entirely new genus.

Type. Figured specimen, GSC 45636, GSC loc. 89834.

Genus and species indet.
Plate 2, fig. 9

Remarks. The Ship Point Formation has a single hyaline specimen that is distinctive morphologically but cannot be formally identified. The element is asymmetrical and somewhat palmate. A broad main cusp rises above a shallow basal cavity; the cusp is compressed and has sharp margins. To one side of the cusp, a short process is developed that bears three small confluent denticles.

Type. Figured specimen, GSC 45637, GSC loc. 89863.

Bad Cache Rapids Formation conodonts

Genus *Acodus* Pander, 1856
Type species *Acodus erectus* Pander, 1856
Acodus mutatus (Branson and Mehl)
Plate 3, figs. 4, 5

Belodus mutatus Branson and Mehl, 1933, p. 126, Pl. 10, fig. 17
Acodus mutatus (Branson and Mehl). Bergström and Sweet, 1966, p. 303-305, Pl. 35, figs. 7–9 (includes synonymy through 1966); Uyeno, 1974, p. 16, Pl. 1, fig. 23

Remarks. Small, delicate elements referrable to *Acodus mutatus* (Branson and Mehl) are rare in the Bad Cache Rapids Formation of Melville Peninsula. Acodiform and distacodiform elements were grouped into one multielement species by Bergström and Sweet (1966). Barnes and Poplawski (1973, p. 779) suggested that *Oistodus venustus* Stauffer s.f. may also belong in the apparatus that would thus be referred to the multielement genus *Paroistodus* Lindström. No oistodiform elements were found in the present material, but they do occur with *A. mutatus* in the Bad Cache Rapids Group and the Churchill River Group of Southampton Island, northern Hudson Bay (Barnes, 1974).

The elements referred to *A. mutatus* by Serpagli (1967, p. 41, Pl. 6, figs. 1*a*, *b*, 6*a*, *b*) and by Igo and Koike (1967,

p. 12, Pl. 1, figs. 21, 22, text-fig. 4C) have different basal cavity forms and outlines of the basal region. They are excluded from synonymy with those elements discussed herein.

Types. Hypotypes, GSC 45638, 45639, GSC locs. 89858, 89869.

Genus *Appalachignathus* Bergström, Carnes, Ethington, Votaw and Wigley, 1974

Type species *Appalachignathus delicatulus* Bergström, Carnes, Ethington, Votaw and Wigley, 1974

Appalachignathus sp.

Plate 4, fig. 1

Remarks. One sample contains a fragmentary specimen that is probably part of the ozarkodiniform element of *Appalachignathus.* The genus is monotypic and possesses very distinctive elements. The pattern of denticulation combined with the high blade form and narrow groovelike cavity are characteristic. No other known conodont elements from late Middle Ordovician rocks of the Midcontinent Province have such features. *A. delicatulus* has been recognized in the base of Member *B*, Baillarge Formation, in Panarctic Deminex Garnier 0-21 well, east coast of Somerset Island.

Type. Figured specimen, GSC 45640, GSC loc. 89833.

Genus *Belodina* Ethington, 1959

Type species *Belodus compressus* Branson and Mehl, 1933

Belodina compressa (Branson and Mehl)

Plate 4, figs. 16–18

Belodus compressus Branson and Mehl, 1933, p. 114, Pl. 9, figs. 15, 16
Belodina compressa (Branson and Mehl). Bergström and Sweet, 1966, p. 312 315, Pl. 31, figs. 12–19 (includes synonymy through 1966); Weyant, 1968, p. 36, 37, Pl. 2, fig. 6; Sweet, Ethington and Barnes, 1971, Pl. 2, figs. 27, 28; Sweet, Thompson and Satterfield, 1975, Pl. 1, figs. 4–6
Belodina grandis (Stauffer). Winder, 1966, Pl. 10, fig. 1; Weyant, 1968, p. 38, Pl. 2, fig. 1
Belodina inclinata (Branson and Mehl). Winder, 1966, Pl. 10, fig. 2
Eobelodina fornicala (Stauffer). Winder, 1966, Pl. 10, fig. 3; Weyant, 1968, p. 49, 50, Pl. 2, fig. 7

Types. Hypotypes, GSC 45641–45643, GSC locs. 89830, 89859, 89845.

Belodina dispansa (Glenister)

Plate 4, figs. 8–10

Belodus dispansus Glenister, 1957, p. 729, 730, Pl. 88, figs. 14, 15
Belodina dispansa (Glenister). Stone and Furnish, 1959, p. 220, Pl. 31, fig. 11; Ethington and Furnish, 1959, p. 542, Pl. 73, figs. 12, 13; Schopf, 1966, p. 43, Pl. 1, fig. 7; Winder, 1966, Pl. 10, fig. 4; Weyant, 1968, p. 37, Pl. 2, figs. 2, 3; Barnes, 1974, Pl. 1, fig. 24
Belodina aff. *B. dispansa* (Glenister). Ethington, 1959, p. 272, Pl. 40, fig. 15

Remarks. B. dispansa has been recorded from several late Middle and Upper Ordovician localities in North America. Bergström and Sweet (1966, p. 314) regarded this taxon as probably an early growth stage of *B. compressa.* In the author's own extensive collection, *B. dispansa* is a separate distinctive species, characterized by the slender form, poorly developed heel, prominent pointed cusp and especially by the distally inclined denticles. The multielement apparatus proposed herein contains two elements homologous to *B. grandis* (Stauffer) s.f. and *B. compressa* (Branson and Mehl) s.f. within *B. compressa.* One element is narrow and slender with only a minor heel developed; the other is more strongly recurved and wider, and has a slightly larger heel. Both were illustrated by Weyant (1968, figs. 2*a*, *b*, 3*a*, *b*). Most previous authors have illustrated only the more slender form in the apparatus.

Types. Hypotypes, GSC 45644, 44645, 45650, GSC locs. 89859, 89869, 89866.

Belodina leithi Ethington and Furnish

Plate 4, figs. 20–22

Belodina leithi Ethington and Furnish, 1960, p. 269, 270, Pl. 38, fig. 12

Description. The apparatus appears to consist of only two elements, with no eobelodiniform element. The two elements are strongly homologous to the form taxa *B. grandis* and *B. compressa* within *B. compressa* (Branson and Mehl). Those resembling *B. grandis* (Stauffer) s.f. are, however, strongly flexed or bowed inwards, a feature that is rarely developed in belodinans. The cusp is relatively long and, in some specimens, bulbous in outline. The basal cavity is bifid with a pronounced groove on the inner side that reaches the basal margin at a notch or indentation. The heel is high and narrow. These elements tend to have more denticles (commonly 8 to 12), which are significantly longer than *B. grandis* s.f. The element resembling *B. compressa* s.f. is more strongly curved, also bears a lateral groove on the inner face, has a relatively long, pointed cusp and is not inwardly bowed. The heel is wider and shorter than that of the other element and the indentation on the basal margin is weak.

Remarks. These elements of *B. leithi* are in other undescribed faunas from the eastern Arctic Islands. The bowed element, in particular, is usually large. The unbowed element was described from a single specimen as *B. leithi* by Ethington and Furnish (1960). Bergström and Sweet (1966) tentatively placed this taxon in synonymy with *B. compressa* but morphological differences are significant enough to warrant specific separation.

Types. Hypotypes, GSC 45646–45648, GSC locs. 89830, 89858.

Belodina profunda (Branson and Mehl)

Plate 4, fig. 11

Belodus profundus Branson and Mehl, 1933, p. 125, Pl. 10, fig. 25
Belodina profunda (Branson and Mehl). Stone and Furnish, 1959, p. 221, Pl. 31, figs. 16, 17; Ethington and Furnish, 1959, p. 542, Pl. 73, fig. 3; Ethington and Furnish, 1960, p. 270, Pl. 38, figs. 10, 11; Kohut and Sweet, 1968, p. 1467, 1468, Pl. 185, figs. 2, 3; Weyant, 1968, p. 38, Pl. 2, fig. 5; Sweet, Ethington and Barnes, 1971, Pl. 1, fig. 21; Barnes, 1974, Pl. 1, fig. 22

Type. Hypotype, GSC 45649, GSC loc. 89865.

Belodina n. sp. 1

Plate 4, fig. 12

?*Belodina inclinata* (Branson and Mehl). Ethington and Furnish, 1960, p. 269, Pl. 38, fig. 13
Belodina sp. 1 Weyant, 1968, p. 39, Pl. 2, fig. 4

Diagnosis. A *Belodina* species apparently consisting of a single form element. This slender element has a single basal cavity, low base, a few short, wide and blunt denticles and a prominent high cusp.

Description. The element is long and slender with a single conical cavity terminating beneath the anterior denticle. The relatively short base has a low wide heel. Anterior margin is rounded and gently and continuously recurved. Cusp is long, sharp pointed and relatively wide. Denticles are few, usually two to four, short, wide and blunt (almost chisellike in lateral view). White matter is developed in the denticles and in the main cusp to below the most anterior denticle. The outer lateral side is smooth or has a weak groove near the rounded anterior edge. The inner lateral face bears a distinct sharp, offset shoulder on the rounded anterior margin producing a broad shallow groove beneath the denticles that fades below the heel and near the cusp tip.

Remarks. The low base, long high cusp and denticulation pattern provide a distinctive morphology. The species is more slender, less recurved and has different denticulation than *B. profunda* (Branson and Mehl). It is also close to *B. inclinata* (Branson and Mehl) although the latter has a less well defined heel, more denticles that are also sharp pointed and a different outline so that the height of the cusp rarely exceeds the height of the base.

Type. Figured specimen, GSC 45651, GSC loc. 89841.

Genus *Drepanoistodus* Lindström, 1971
Type species *Oistodus forceps* Lindström, 1955
Drepanoistodus suberectus (Branson and Mehl)
Plate 3, figs. 18–20

Oistodus suberectus Branson and Mehl, 1933, p. 111, Pl. 9, fig. 7
Drepanodus suberectus (Branson and Mehl). Bergström and Sweet, 1966, p. 330–333, Pl. 35, figs. 22–27 (includes synonymy through 1966); Oberg, 1966, p. 137, 138, Pl. 16, fig. 1; Winder, 1966, Pl. 9, fig. 6, Text-fig. 3–6; Weyant, 1968, p. 47, Pl. 2, figs. 11, 12; Ethington and Schumacher, 1969, p. 461, 462; Globensky and Jauffred, 1971, p. 55, Pl. 4, figs. 3–6
Drepanodus homocurvatus Lindström. Oberg, 1966, p. 137, Pl. 16, fig. 13; Andrews, 1967, p. 889, Pl. 113, fig. 16, Pl. 114, figs. 8, 15; Winder, 1966, Pl. 9, fig. 11, Text-fig. 3–11; Weyant, 1968, p. 46, 47, Pl. 2, figs. 13, 14; Ethington and Schumacher, 1969, p. 461
Oistodus inclinatus Branson and Mehl. Oberg, 1966, p. 139, Pl. 15, fig. 3; Weyant, 1968, p. 53, Pl. 2, fig. 8; Ethington and Schumacher, 1969, p. 467, Pl. 68, fig. 7
Drepanodus arcuatus Pander. Winder, 1966, p. 56, Pl. 1, fig. 10, Text-fig. 3–18
Drepanodus concavus (Branson and Mehl). Winder, 1966, p. 56, Pl. 1, fig. 18, Text-figs. 3–18
Oistodus excelsus Stauffer. Winder, 1966, Pl. 1, fig. 13, Text-fig. 3–13

Remarks. In the Melville Peninsula specimens, white matter is a cloudy, partly developed material in the cusps of the three form elements.

Types. Hypotypes, GSC 45653–45655, GSC locs. 89869, 89830.

Genus *Eobelodina* Sweet, Turco, Warner and Wilkie, 1959
Type species *Oistodus fornicalus* Stauffer, 1935
Eobelodina sp. s.f.
Plate 4, fig. 13

Remarks. The single eobelodinan specimen differs from *Eobelodina fornicala* (Stauffer) s.f., which belongs within *Belodina compressa* (Branson and Mehl). The element has a long recurved cusp and a high wide heel. The bifid basal cavity is deep. A thin groove is above midheight on the inner lateral face. The wide heel and form of the cusp are similar to those possessed by *Belodina* n. sp. 1 and this eobelodinan element may belong within that apparatus.

Type. Figured specimen, GSC 45652, GSC loc. 89850.

Genus *Panderodus* Ethington, 1959
Type species *Paltodus unicostatus* Branson and Mehl, 1933
Panderodus arcuatus (Stauffer)
Plate 3, figs. 23–25

Paltodus arcuatus Stauffer, 1935, p. 612, Pl. 74, figs. 6, 8, 9
Panderodus arcuatus (Stauffer). Schopf, 1966, p. 65, Pl. 5, figs. 26, 28; Webers, 1966, p. 38, Pl. 2, figs. 8*a*, *b*, 9*a*, *b*; ?Winder, 1966, p. 58, Pl. 9, fig. 23, Text-fig. 3 23; Weyant, 1968, p. 55, Pl. 5, fig. 7

Remarks. Some panderodans that are not referrable to the other species recorded herein appear to belong in *P. arcuatus* (Stauffer). Most are relatively slender but have the distinctive cross-section form described by Stauffer (1935). It seems possible that both slender and wider, more recurved, variants of this form species represent the total apparatus; the two extremes in form were illustrated by Webers (1966).

Types. Hypotypes, GSC 45656 45658, GSC locs. 89845, 89844.

Panderodus breviusculus n. sp.
Plate 3, figs. 13–17

Diagnosis. A small, robust panderodont element with a wide base but a sharply recurved and rapidly terminated cusp tip. Ornamentation on the lateral faces is similar to *P. feulneri* (Glenister).

Description. The form element is short and robust and has a wide base that narrows gently to the point of recurvature. The distal tip of the cusp is sharply recurved and tapers rapidly; in some specimens it is slightly twisted inwards. The anterior margin is broadly rounded in contrast with the sharp posterior margin. The outer lateral face is generally flat and relatively smooth except for a weak shoulder where it meets the anterior margin. The inner lateral face is inclined to the posterior margin; a sharp shoulder, or carina, occurs at the anterior margin that is accentuated in the central region; a central furrow floored by a fine groove occurs slightly to the posterior of the central part of the face. White matter is developed as a small area in the extreme tip of the cusp, just above the apex of the deep basal cavity.

Remarks. This element is most similar to *P. feulneri* but is much shorter and the form and curvature of the cusp tip is different. This distinctive element is in several Upper Ordovician faunas in northern and western Canada and appears to undergo evolutionary changes in width and curvature. It may have originated from *P. feulneri* and is probably associated with *P. gracilis* s.f. in its apparatus. However, from the faunas at hand a clear association cannot be determined. The oldest representatives of this species in the Melville Peninsula fauna are fairly slender and less robust than younger forms; both forms are illustrated herein.

Types. Holotype, GSC 45662, GSC loc. 89844; paratypes, GSC 45659–45661, 45663, GSC locs. 89850, 89844.

Panderodus feulneri (Glenister)
Plate 3, figs. 11, 12

Paltodus feulneri Glenister, 1957, p. 728, Pl. 85, fig. 11
Panderodus feulneri (Glenister). Ethington, 1959, p. 284, 285, Pl. 39, fig. 2; Stone and Furnish, 1959, p. 225, Pl. 31, fig. 3; Schopf, 1966, p. 66, Pl. 5, fig. 30; Webers, 1966, p. 38, Pl. 3, figs. 1*a*, *b*, 2*a*, *b*; Weyant, 1968, p. 56, Pl. 5, fig. 4

Remarks. This distinctive form element has been well described by Glenister (1957). Bergström and Sweet (1966, p. 357) included this element within *P. gracilis*. However, in large collections from northern and western Canada, this element can be distinguished from *P. compressus* s.f. and apparently is not simply a robust gerontic variant. It seems to combine with elements of *P. gracilis* s.f. and is recognized herein as a separate multielement species.

Types. Hypotypes, GSC 45664, 45665, GSC locs. 89840, 89859.

Panderodus gracilis (Branson and Mehl)
Plate 3, figs. 6, 7

Paltodus gracilis Branson and Mehl, 1933, p. 108, Pl. 8, figs. 20, 21
Panderodus gracilis (Branson and Mehl). Uyeno, 1974, p. 15, Pl. 3, figs. 7–14 (includes synonymy to 1974); Sweet, Thompson and Satterfield, 1975, Pl. 1, figs. 7, 8

Remarks. Late Ordovician forms of the *P. gracilis* s.f. element are more slender, longer and more sharply recurved at a point farther toward the tip than forms from the Middle Ordovician.

Types. Hypotypes, GSC 45666, 45667, GSC loc. 89844.

Panderodus panderi (Stauffer)
Plate 3, figs. 21, 22

Paltodus panderi Stauffer, 1940, p. 427, Pl. 60, figs. 8, 9
Panderodus panderi (Stauffer). Sweet, Thompson and Satterfield, 1975, p. 33, 34, Pl. 1, fig. 12 (includes synonymy to 1975)

Remarks. Sweet *et al.* (1975, p. 34) noted that recent work has established the range of *Panderodus panderi*, in the form figured herein, as Maysvillian and Richmondian. A more slender form with both faces convex existed earlier, which they refer to as *P.* sp. aff. *P. panderi*.

Types. Hypotypes, GSC 45668, 45669, GSC locs. 89844, 89865.

Panderodus staufferi (Branson, Mehl and Branson)
Plate 3, figs. 8–10

Paltodus staufferi Branson, Mehl and Branson, 1951, p. 7, 8, Pl. 1, figs. 23–27
Panderodus staufferi (Branson, Mehl and Branson). Kohut and Sweet, 1968, p. 1470, Pl. 186, figs. 4, 5
Paltodus angularis Branson, Mehl and Branson, 1951, p. 8, Pl. 1, figs. 34–39
Panderodus angularis (Branson, Mehl and Branson). Kohut and Sweet, 1968, p. 1469, Pl. 185, figs. 20, 23, 27

Remarks. Branson *et al.* (1951) described two form species, *P. staufferi* and *P. angularis*, which are interpreted herein as belonging to the same multielement taxon. *P. angularis* is a narrower, more costate and more erect element whereas *P. staufferi* is more recurved, more laterally compressed and is ornamented with a prominent furrow on the outer lateral face. In general form these two elements are thus homologous to the form taxa *P. gracilis* and *P. compressa* within *P. gracilis*. A similar, more robust, element of *P. staufferi* was also described by Branson *et al.* (1951) as *P. robustus*. This may be a variant within the proposed multielement association.

Types. Hypotypes, GSC 45670–45672, GSC locs. 89840, 89844.

Genus *Periodon* Hadding, 1913
emend. Bergström and Sweet, 1966
Type species *Periodon aculeatus* Hadding, 1913

Periodon grandis (Ethington)
Plate 4, figs. 6, 7

Loxognathus grandis Ethington, 1959, p. 281, Pl. 40, fig. 6
Periodon grandis (Ethington). Bergström and Sweet, 1966, p. 363–365, Pl. 30, figs. 1–8 (includes synonymy through 1966); Sweet and Bergström, 1970, Pl. 5, figs. 5J–M
Periodon aculeatus Hadding. Winder, 1966, Pl. 10, fig. 25
Oistodus breviconus Branson and Mehl. Winder, 1966, Pl. 9, fig. 15 only

Types. Hypotypes, GSC 45673, 45674, GSC locs. 89833, 89869.

Genus *Phragmodus* Branson and Mehl, 1933
emend. Bergström and Sweet, 1966
Type species *Phragmodus primus* Branson and Mehl, 1933

Phragmodus undatus Branson and Mehl
Plate 4, figs. 2–5

Phragmodus undatus Branson and Mehl, 1933, p. 115, Pl. 8, figs. 22–26; Bergström and Sweet, 1966, p. 369–372, Pl. 28, figs. 13–20 (includes synonymy through 1966); Winder, 1966, Pl. 10, fig. 11; Sweet and Bergström, 1970, figs. 5A–D; Globensky and Jauffred, 1971, p. 57, Pl. 4, figs. 7–13; Sweet, Ethington and Barnes, 1971, Pl. 2, figs. 7–10; Uyeno, 1974, p. 15, 16, Pl. 1, figs. 26–30
Dichognathus attenuata Branson and Mehl. Winder, 1966, Pl. 10, fig. 21
Oistodus abundans Branson and Mehl. Winder, 1966, Pl. 9, fig. 16

Types. Hypotypes, GSC 45675–45678, GSC locs. 89869, 89833.

Genus *Plectodina* Stauffer, 1935
Type species *Plectodina aculeata* (Stauffer, 1930)

Plectodina aculeata (Stauffer)
Plate 4, figs. 19, 23

Prioniodus aculeatus Stauffer, 1930, p. 126, Pl. 10, fig. 12
Plectodina aculeata (Stauffer). Uyeno, 1974, p. 16, Pl. 2, figs 1–26 (part) (includes synonymy to 1974)

Remarks. The full morphological range of *Plectodina aculeata* (Stauffer) has yet to be determined. It appears to have evolved into *P. furcata* in early Barneveldian time (Bergström and Sweet, 1966, p. 381; Sweet *et al.*, 1971, fig. 2). However, in Kirkfieldian strata in which the transitional elements are to be anticipated, Uyeno (1974) has illustrated a wide range of component elements that may belong to three or four species or subspecies of *Plectodina*. The distinctive ozarkodiniform and prioniodiniform elements found in the Bad Cache Rapids Formation seem typical of *P. aculeata*.

Types. Hypotypes, GSC 45679, 45680, GSC locs. 89850, 89869.

Genus *Polyplacognathus* Stauffer, 1935
Type species *Polyplacognathus ramosus* Stauffer, 1935

Polyplacognathus ramosus Stauffer
Plate 4, figs. 14, 15

Polyplacognathus ramosus Stauffer, 1935, p. 615, Pl. 75, figs. 23, 28–31, 37; Uyeno, 1974, p. 14, Pl. 1, figs 1–4 (includes synonymy to 1974)

Types. Hypotypes, GSC 45681, 45682, GSC loc. 89831.

Genus *Protopanderodus* Lindström, 1971
Type species *Acontiodus rectus* Lindström, 1955

Protopanderodus insculptus (Branson and Mehl)
Plate 3, fig. 3

Phragmodus insculptus Branson and Mehl, 1933, p. 124, Pl. 10, figs. 32–34
Scolopodus insculptus (Branson and Mehl). Bergström and Sweet, 1966, p. 398–400, Pl. 34, figs. 26, 27, Text-fig. 13B (includes synonymy through 1966); Winder, 1966, p. 60, Pl. 9, fig. 21, Text-fig. 3–21; Serpagli, 1967, p. 97–99, Pl. 28, figs. 1*a*–6*b*; Barnes, 1974, Pl. 1, fig. 19
Protopanderodus insculptus (Branson and Mehl). Sweet, Thompson and Satterfield, 1975, Pl. 1, figs. 19, 20

Remarks. Bergström (1971, figs. 4, 5) showed that *P. insculptus* evolved from *P. varicostatus* (Sweet and Bergström) during the *Nemagraptis gracilis* Zone interval. Morphology varies considerably among previously figured material, notably in the development of lateral costae, the curvature of the posterior margin especially near the base, and the lower extensions, almost as processes, of the anterior and particularly the posterior margins. Sufficient specimens have not been found to establish the apparatus plan but it appears to correspond to *Paroistodus*, which contains two costate drepanodan elements and one costate oistodan element (Sweet and Bergström, 1972, fig. 1J).

Type. Hypotype, GSC 45683, GSC loc. 89858.

Genus *Staufferella* Sweet, Thompson and Satterfield, 1975
Type species *Distacodus falcatus* Stauffer, 1935

Sweet *et al.* (1975, p. 43) recently proposed the name *Staufferella* for three form elements that are not common in any of the Middle or Late Ordovician faunas in which they occur. These elements have, however, been described from several formations in which the rest of the fauna is now well known in terms of multielement taxonomy. The three form elements almost certainly belong in one apparatus. The generic diagnosis of Sweet *et al.* (*ibid.*) included conodonts "with a skeletal apparatus of deeply excavated, variously curved simple cones that are faintly striated longitudinally and include: basally depressed, bilaterally symmetrical types with bicarinate or unicostate posterior faces and basally alate lateral costae; slightly asymmetrical, posteriorly bicarinate forms with prominent lateral costae but no basal alae; and decidedly asymmetric forms with one smooth side, one costate side, and a costa along one side of the posterior face."

Staufferella lindstroemi (Ethington and Schumacher)
Plate 3, figs. 1, 2

Acontiodus falcatus Ethington, 1959, p. 268, Pl. 39, figs. 6, 7
Acontiodus falcatus? Ethington. Schopf, 1966, p. 35, Pl. 5, fig. 16
Acontiodus lindstroemi Ethington and Schumacher, 1969, p. 452
Staufferella lindstroemi (Ethington and Schumacher). Sweet, Thompson and Satterfield, 1975, p. 46

Description. The bilaterally symmetrical element has been well described earlier by Ethington (1959) and Schopf (1966). The posterior face bears a sharp posterior median costa in contrast with the pair of rounded costae separated by a midposterior groove in *S. falcata* (i.e., in the form element *Acontiodus alveolaris* Stauffer).

The slightly asymmetrical element is fairly erect with a basal cavity extending about one third the length of the element; white matter occurs distally of the cavity tip. The anterior and posterior margins are relatively sharp and one lateral costa is developed with slight asymmetry on each face, close to the posterior margin. A low short carina is near the base and centre of the outer lateral face.

The markedly asymmetrical element is shorter and more recurved than the slightly asymmetrical element. The anterior margin is rounded; the posterior margin is represented by a low sharp costa in the lower part, but this swings laterally to the inner lateral face. The outer and inner lateral faces are generally smooth and gently curved to produce a subquadrate cross-section.

Remarks. Since specimens of this species are rare, there is some question about the assignment of these three elements in one multielement species. The general form and curvature of the three elements is similar to those of *S. alveolaris* (Stauffer) illustrated by Bergström and Sweet (1966, Pl. 35, figs. 10–13, 16–19) and Sweet *et al.* (1975, Pl. 1, figs. 10, 11, 18).

Types. Hypotypes, GSC 45684, 45685, GSC locs. 89850, 89869.

New Genus A

New Genus A is proposed for conodont elements of generally triangular lateral outline, with a shallow basal cavity that is widest in the upper part and poorly developed denticulation on the posterior (upper) margin.

Remarks. Three new form species are described, two of which have been previously referred to *Belodina*. The elements probably originated from a belodinan ancestor but are sufficiently different in morphology to warrant assignment to a new genus.

Too few specimens are available to establish multielement taxa. From comparison with belodinan apparatuses, one-, two- or three-element groupings are possible. New Genus A n. spp. 1 and 2 s.f. have closely similar basal features, whereas New Genus A n. sp. 3 s.f. has a different outline, large cusp and lateral striations on part of the inner face. All elements may belong to one multielement species with New Genus A n.sp. 2 s.f. acting as an eobelodinan homologue. Until more material is available the elements are left in open nomenclature.

New Genus A n. sp. 1 s.f.
Plate 4, fig. 26

Belodina sp. A Sweet, Ethington and Barnes, 1971, Pl. 1, fig. 6; Barnes, 1974, Pl. 1, fig. 21

Diagnosis. Triangular element with straight basal margin, slightly sinuous anterior margin and slightly arched, serrated posterior (upper) margin. Small basal cavity, crimped near upper end. Lateral faces lack ornamentation.

Description. Element is triangular in outline. Basal margin is straight, with slight protrusion of upper part; a slightly raised rim is developed around the basal margin. Basal cavity is bifid and shallow; the upper part is widest and is divided from the lower expansion by a prominent constriction. The cavity below the constriction tapers rapidly toward the anterior edge. The anterior edge is gently sinuous and sharply rounded. No heel is developed but dentition does not occur immediately anterior of the base. The denticles, usually 6 to 10, on the gently arched (upper) posterior margin are small and may be only a weak serration or even be entirely lacking. At the anterior end, the denticulation ends before reaching the anterior margin, thus creating a wide blunt ledge that can be considered the cusp. The inner and outer lateral faces are usually smooth but a fine groove may occur on the outer lateral face starting from the basal constriction. Some elements are weakly bowed inward. White matter tends to be developed throughout the element except for the basal cavity region and the small denticles.

Remarks. Sweet *et al.* (1971, p. 183) record this taxon in the subsurface of Kansas, and the writer (Barnes, 1974), in the upper Thumb Mountain and Irene Bay formations of eastern Arctic Archipelago and from the thin black shale that lies between the Bad Cache Rapids and the Churchill River groups of Southampton Island, northern Hudson Bay.

Type. Figured specimen, GSC 46789, GSC loc. 89844.

New Genus A n. sp. 2 s.f.
Plate 4, fig. 25

Diagnosis. Small element with straight basal margin; shallow basal cavity; straight anterior margin at right angles to basal margin; small cusp with a single larger denticle and large rounded heel on the posterior margin.

Description. Small element with basal features similar to New Genus A n. sp. 1 s.f., straight basal margin, shallow cavity widest near upper part, base slightly constricted at different positions on inner and outer lateral faces. The straight sharply rounded anterior margin extends at right angle from the basal margin. Posterior to a small rounded cusp is a single wide denticle, slightly larger than the cusp. A broad rounded heel completes the posterior margin. The inner lateral face is smoothly rounded. The outer lateral face is flatter and has a shallow narrow groove extending from the constriction.

Type. Figured specimen, GSC 46790, GSC loc. 89844.

New Genus A n. sp. 3 s.f.
Plate 4, fig. 24

Belodina n.sp. B Barnes, 1974, Pl. 1, fig. 17

Diagnosis. Short wide basal cavity, weakly crimped near top. Posterior margin concave with small denticles proximal to broad cusp. Inner lateral face bears longitudinal striae near anterior margin.

Description. Basal margin straight with slight protrusion in upper part. Basal cavity is wide but shallow, with constrictions in inner and outer lateral faces at different heights. Anterior edge is uniformly recurved. Concave posterior edge has small denticles or serration developed on proximal half of the margin; distal half to third is a sharp edge to the broad cusp. Outer lateral face is smooth or may have a weak groove starting from basal constriction. Inner lateral face is broadly rounded below denticles but flattens towards anterior margin. On the anterior half to third of this face are low, rounded, relatively fine longitudinal striae that extend from the basal margin to near the cusp tip. White matter is developed in the cusp and along most of the anterior part of the element; small denticles are predominantly hyaline.

Remarks. The writer (Barnes, 1974) reported this taxon from uppermost strata of the Thumb Mountain Formation, Bathurst Island, Canadian Arctic Archipelago.

Type. Figured specimen, GSC 46791, GSC loc. 89844.

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Plate 1
All from GSC loc. 89833 except fig. 19
(all ×30, except figs. 7, 8, 14, 15 and 19, ×50)

Figures 1–3. *Drepanodus parallelus* Branson and Mehl. Lateral views, GSC 45588–45590.

Figures 4–6. *Drepanoistodus basiovalis* (Sergeeva). (4) Lateral view, oistodiform element, GSC 45591. (5, 6) Lateral views, drepanodiform elements, GSC 45592, 45593.

Figures 7, 8. *Ulrichodina* n. sp. s.f. Lateral views, GSC 45631, 45632.

Figures 9, 10. *Ulrichodina prima* Furnish s.f. Lateral and anterior views, GSC 45629, 45630.

Figures 11–13. *Oistodus scalenocarinatus* Mound. (11) Lateral view of cladognathiform element, GSC 45622. (12) Lateral view of cordylodiform element, GSC 45623. (13) Posterior view of hibbardelliform element, GSC 45624.

Figures 14, 15. *Scolopodus gracilis* Ethington and Clark. Posterolateral and posterior views, GSC 45627, 45628.

Figures 16–18. New Genus B n. sp. s.f. (16, 17) Lateral views, GSC 45633, 45634. (18) Lower view, GSC 45635.

Figure 19. New Genus C n. sp. s.f. Lateral view, GSC 45636; GSC loc. 89834.

Figures 20–24. *Oistodus multicorrugatus* Harris. (20) Lateral view of oistodiform element, GSC 45617. (21, 22) Lateral views of costate (cladognathiform) elements, GSC 45618, 45619. (23, 24) Lateral views of acostate (cordylodiform) elements, GSC 45620, 45621.

Plate 1

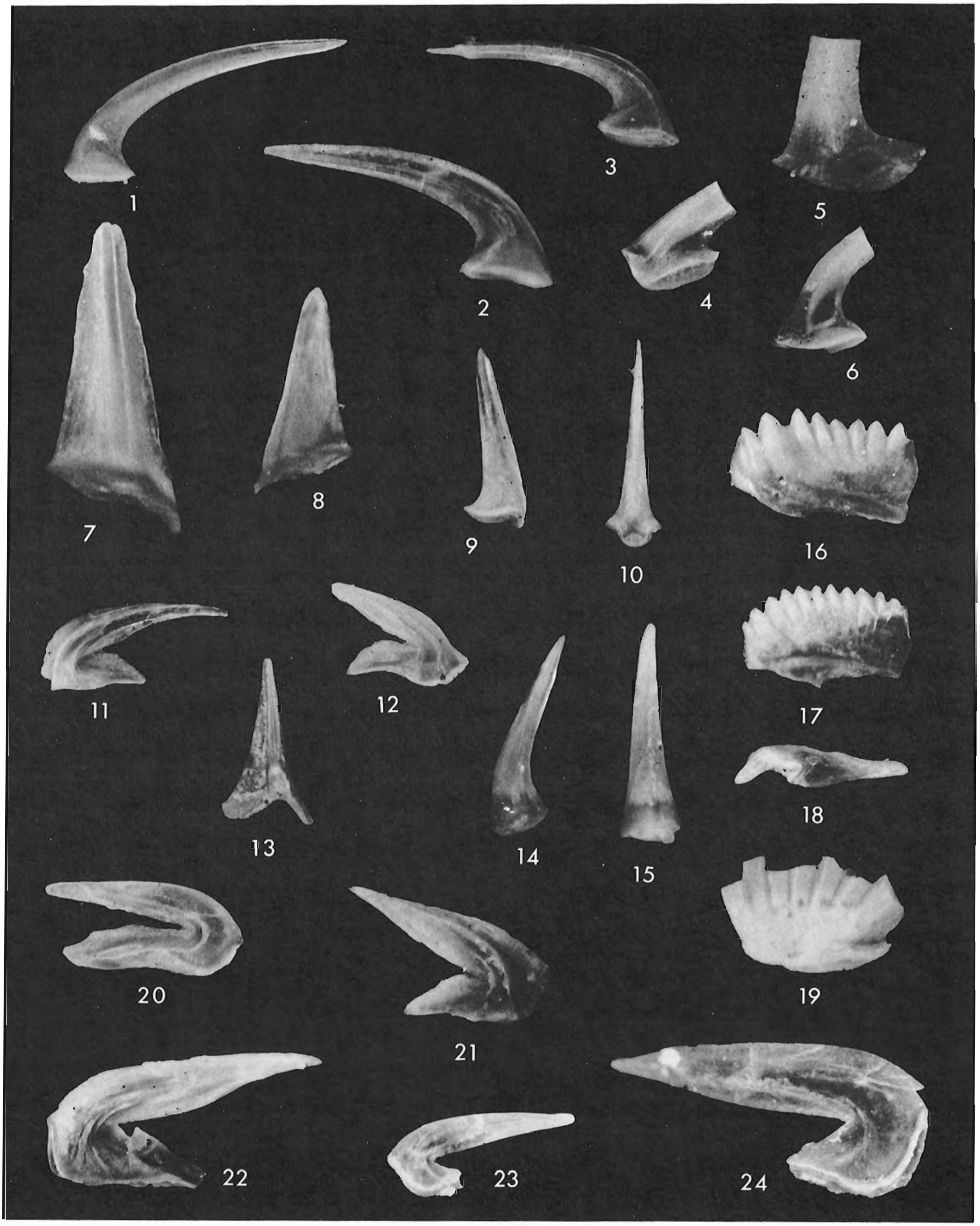

Plate 2
(all ×30 except figs. 3–7, ×50)

Figures 1, 2. "*Eoneoprioniodus*" sp. Lateral views, GSC 45614, 45615; GSC locs. 89864, 89863.

Figures 3, 4. *Phragmodus flexuosus* Moskalenko. GSC loc. 89850. (3) Lateral view of phragmodiform element, GSC 45625. (4) Inner lateral view of dichognathiform element, GSC 45626.

Figures 5, 6. *Belodella* n. sp. s.f. Lateral views, GSC 45586, 45587; GSC locs. 89864, 89850.

Figure 7. *Belodella erecta* (Rhodes and Dineley) s.f. Lateral view, GSC 45585; GSC loc. 89850.

Figure 8. *Erismodus horridus* Harris s.f. Anterior view, GSC 45616; GSC loc. 89863.

Figure 9. Genus and species indet. Inner lateral view, GSC 45637; GSC loc. 89863.

Figures 10–19. *Eoneoprioniodus bilongatus* (Harris). GSC loc. 89833. (10–12) Inner lateral views of oistodiform elements, GSC 45604–45606. (13, 14) Inner lateral views of dichognathiform elements, GSC 45607, 45608. (15, 16) Outer and inner lateral views, GSC 45609, 45610. (17, 19) Lateral views of trichonodelliform elements, GSC 45611, 45613. (18) Lateral view zygognathiform (cladognathiform) element, GSC 45612.

Figures 20–29. *Eoneoprioniodus bialatus* (Mound). GSC loc. 89833. (20, 21) Inner lateral views of oistodiform elements, GSC 45594, 45595. (22, 23) Inner lateral views of dichognathiform (acodiform) elements, GSC 45596, 45597. (24, 25) Inner lateral views of cordylodiform elements, GSC 45598, 45599. (26) Lateral view of zygognathiform element, GSC 45600. (27) Posterior view of trichonodelliform element, GSC 45601. (28, 29) Lateral views of trichonodelliform elements, GSC 45602, 45603.

Plate 2

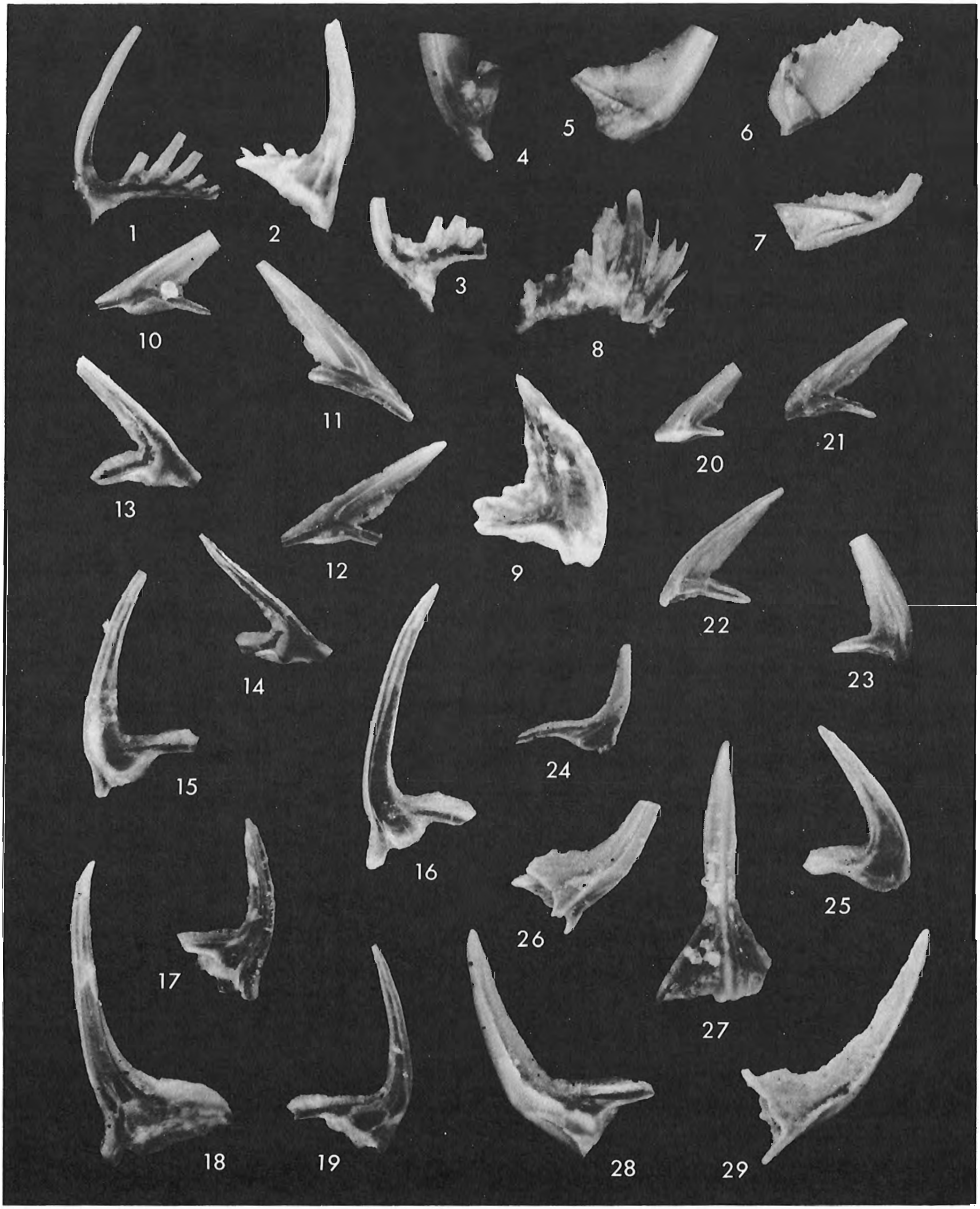

Plate 3
(all ×50 except figs. 20, 21, ×30)

Figures 1, 2. *Staufferella lindstroemi* (Ethington and Schumacher). (1) Posterior view of acontiodiform element, GSC 45684; GSC loc. 89850. (2) Lateral view of the slightly asymmetrical element, GSC 45685; GSC loc. 89869.

Figure 3. *Protopanderodus insculptus* (Branson and Mehl). Lateral view, GSC 45683; GSC loc. 89858.

Figures 4, 5. *Acodus mutatus* (Branson and Mehl). (4) Lateral view of distacodiform element, GSC 45638; GSC loc. 89858. (5) Lateral view of acodiform element, GSC 45639; GSC loc. 89869.

Figures 6, 7. *Panderodus gracilis* (Branson and Mehl). GSC loc. 89844. (6) Inner lateral view of narrow element, GSC 45666. (7) Inner lateral view of wide element, GSC 45667.

Figures 8–10. *Panderodus staufferi* (Branson, Mehl and Branson). Inner lateral views, GSC 45670–45672; GSC locs. 89840, 89844.

Figures 11, 12. *Panderodus feulneri* (Glenister). Inner lateral views of wide elements, GSC 45664, 45665; GSC locs. 89840, 89859.

Figures 13–17. *Panderodus breviusculus* n. sp. (13, 14) Inner lateral views of older, slender elements, paratypes, GSC 45659, 45660; GSC locs. 89850, 89844. (15, 17) Outer lateral views of younger, wide elements, paratypes, GSC 45661, 45663; both from GSC loc. 89844. (16) Inner lateral view of younger, wide element, holotype, GSC 45662; GSC loc. 89844.

Figures 18–20. *Drepanoistodus suberectus* (Branson and Mehl). (18, 19) Lateral views of drepanodiform elements, GSC 45653, 45654; GSC locs. 89869, 89830. (20) Inner lateral view of oistodiform element, GSC 45655; GSC loc. 89830.

Figures 21, 22. *Panderodus panderi* (Stauffer). Lateral views, GSC 45668, 45669; GSC locs. 89844, 89865.

Figures 23–25. *Panderodus arcuatus* (Stauffer). (23) Inner lateral view of narrow element, GSC 45656; GSC loc. 89845. (24, 25) Inner lateral views of wider, more recurved elements, GSC 45657, 45658; GSC locs. 89844, 89845.

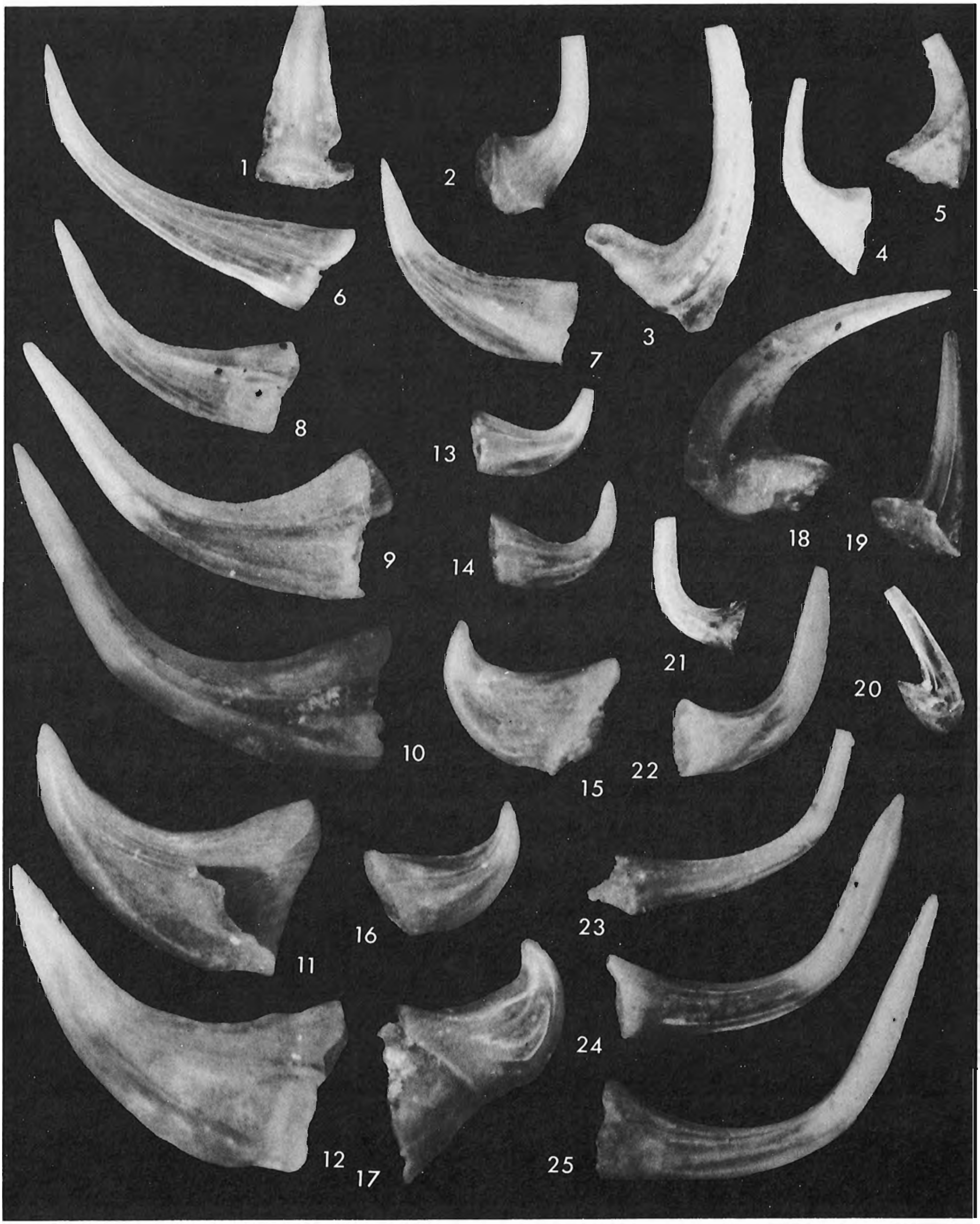
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Plate 4
(all ×50 except figs. 20, 22 and 23, ×30)

Figure 1. *Appalachignathus* sp. Inner lateral view, GSC 45640; GSC loc. 89833.

Figures 2–5. *Phragmodus undatus* Branson and Mehl. (2) Inner lateral view of oistodiform element, GSC 45675; GSC loc. 89869. (3) Lateral view of phragmodiform element, GSC 45676; GSC loc. 89833. (4, 5) Outer and inner lateral views of dichognathiform elements, GSC 45677, 45678; GSC loc. 89869.

Figures 6, 7. *Periodon grandis* (Ethington). (6) Lateral view of falodiform element, GSC 45673; GSC loc. 89833. (7) Inner lateral view of periodoniform element, GSC 45674; GSC loc. 89869.

Figures 8–10. *Belodina dispansa* (Glenister). (8, 9) Inner lateral views of narrow elements, GSC 45644, 45645; GSC locs. 89859, 89869. (10) Inner lateral view of wide element, GSC 45650; GSC loc. 89866.

Figure 11. *Belodina profunda* (Branson and Mehl). Inner lateral view, GSC 45649; GSC loc. 89865.

Figure 12. *Belodina* n. sp. 1. Inner lateral view, GSC 45651; GSC loc. 89841.

Figure 13. *Eobelodina* sp. s.f. Inner lateral view, GSC 45652; GSC loc. 89850.

Figures 14, 15. *Polyplacognathus ramosus* Stauffer. GSC loc. 89831. (14) Upper view of ambalodiform element, GSC 45681. (15) Upper view of amorphognathiform element, GSC 45682.

Figures 16–18. *Belodina compressa* (Branson and Mehl). (16, 17) Inner lateral views of belodiniform elements, GSC 45641, 45642; GSC locs. 89830, 89859. (18) Outer lateral view of eobelodiniform element, GSC 45643; GSC loc. 89845.

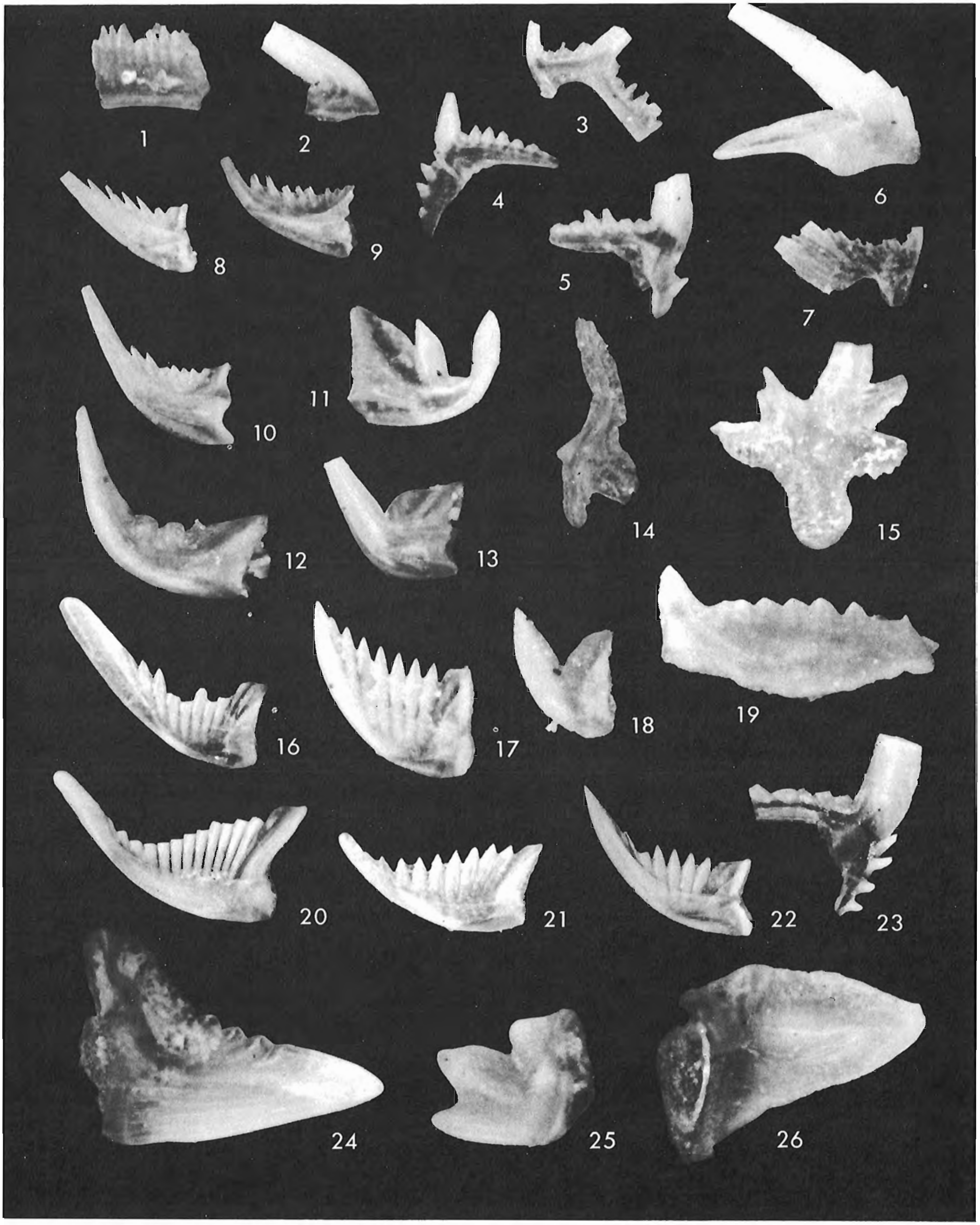
Figures 19, 23. *Plectodina aculeata* (Stauffer). (19) Lateral view of ozarkodiniform element, GSC 45679; GSC loc. 89850. (23) Inner lateral view of prioniodiniform element, GSC 45680; GSC loc. 89869.

Figures 20–22. *Belodina leithi* Ethington and Furnish. (20, 21) Inner lateral views of bowed elements, GSC 45646, 45647; GSC loc. 89830. (22) Inner lateral view of unbowed element, GSC 45648; GSC loc. 89858.

Figure 24. New Genus A n. sp. 3 s.f. Inner lateral view, GSC 46791; GSC loc. 89844.

Figure 25. New Genus A n. sp. 2 s.f. Inner lateral view, GSC 46790; GSC loc. 89844.

Figure 26. New Genus A n. sp. 1 s.f. Inner lateral view, GSC 46789; GSC loc. 89844.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Two New Middle Ordovician Sponges from Foxe Plain, Southeastern District of Franklin

J. Keith Rigby

Abstract

Two new sponges have been collected from Middle Ordovician (Wilderness–Barneveld) beds from Foxe Plain, southeastern District of Franklin. Six specimens of a new heteractinid astraeosponge, *Asteriospongia anatrope*, were collected from Melville Peninusla in the northwestern part of the area and one specimen from near Amadjuak Lake on Baffin Island in the eastern part. *Asteriospongia anatrope* is a convex-upward, bowl-shaped form that has large excurrent canals in the rounded summit area and series of additional intermediate and smaller canals that occupy much of the peripheral region. Spicules are small octactines and derivatives of octactines in a felted irregular arrangement. Outer parts of the sponge are calcified with overgrowths on the spicule net.

Sixteen specimens of a new lithistid anthaspidellid, *Incrassospongia rhipidos*, collected together with the single specimen of *Asteriospongia* from near Amadjuak Lake on Baffin Island are characterized by upward-radiating skeletal structure composed of dendroclones that form secondarily thickened horizontal and vertical elements. *Incrassospongia* varies from irregular subcylindrical to fan-shaped forms, and lacks a spongocoel and differentiated canals, other than uniform openings that parallel the skeletal fibres.

Résumé

Deux nouvelles éponges ont été recueillies dans les couches de l'Ordovicien moyen (Wilderness–Barneveld) du bassin Foxe, dans le sud-est du district de Franklin. Six spécimens d'une nouvelle astraeospongia hétéractinide, *Asteriospongia anatrope*, ont été recueillis dans la presqu'île Melville dans la partie nord-ouest de la région et un spécimen a été recueilli dans un endroit situé près du lac Amadjuak dans l'île Baffin, dans la partie est du bassin. *Asteriospongia anatrope* a la forme d'un bol dont la convexité est tournée vers le haut, avec de grands canaux exhalants sur le dessus arondi, et une série supplémentaire de canaux, de taille intermédiaire et plus petits, qui occupe la plus grande partie de la région périphérique. Les spicules sont des petites octactines et des dérivés d'octactines qui sont feutrés de manière irrégulière. Les parties les plus extérieures de l'éponge sont calcifiées avec des excroissances sur le réseau de spicules.

Seize spécimens d'une nouvelle anthaspidellide lithistide, *Incrassospongia rhipidos*, recueillis en même temps que le spécimen unique d'*Asteriospongia* près du lac Amadjuak (dans l'île Baffin), sont caractérisés par un réseau squelettique qui rayonne vers le haut et est composé de desmes qui ont formé subséquemment des éléments verticaux et horizontaux épaissis. *Incrassospongia* passe de formes irrégulières quasi-cylindriques à des formes en éventail; il lui manque une cavité pseudo-gastrique, et des canaux différenciés autres que les ouvertures uniformes qui sont parallèles aux fibres du squelette.

Introduction

Seven nearly complete, three-dimensional heteractinid sponges have been recovered from limestone of Middle Ordovician age. Six came from exposures along the eastern side of Melville Peninsula, on the gently dipping western margin of Foxe Plain (locs. 3, 32, 36 of Bolton, this bulletin) and one from near Amadjuak Lake, Baffin Island in the southeastern part of Foxe Plain (Fig. 1, loc. *C* of Copeland, this bulletin). Sixteen three-dimensional specimens of a new anthaspidellid also were collected from the Baffin Island locality. Rocks bearing the sponges are equated with the northern extension of the Bad Cache Rapids Group of Hudson Bay Basin (Nelson, 1963, p. 7–14; 1964, p. 5–20; Nelson and Johnson, 1966, p. 541–547) or with the southern extension of Member *B* of the Baillarge Formation from northwestern Baffin Island (Trettin, 1965, 1971).

The fauna associated with the sponges is considered of Wilderness–Barneveld age, equivalent to that described from Silliman's Fossil Mount (loc. *T* of Copeland, this bulletin) in southern Baffin Island near Frobisher Bay. Sinclair (*in* Blackadar, 1967) noted *Gonioceras* sp. from the locality where the three-dimensional anthaspidellids were collected.

The Melville Peninsula sponges described here are new forms collected in 1973 by Thomas E. Bolton. The new astraeosponge genus is obviously related to some of the other thick-walled heteractinid astraeosponges of the Middle Paleozoic (Rigby and Nitecki, 1975) and appears to be transitional, to some degree, into large spiculed forms like *Astraeospongium* Roemer, 1860. Those sponges from Baffin Island were collected in 1965 by R. McNeely.

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Systematic paleontology

Class Demospongea Sollas, 1875
Order Lithistida Schmidt, 1870
Suborder Tetracladina Zittel, 1878
Family Anthaspidellidae Miller, 1889
Incrassospongia n. gen.

Types species *Incrassospongia rhipidos* n. sp.

Diagnosis. Subcylindrical, club-shaped to distinctly fan-shaped sponges, lacking spongocoel and composed of upward-fanning skeletal fibres cross-connected by less continuous horizontal fibres. Only openings are those parallel to skeletal structures. Spicules are dendroclones in ladderlike series, whose tips unite to form the upward-fanning fibres. Skeletal structures secondarily enlarged in older parts of the sponge, so that horizontal fibres cored by spicule shafts, and vertical fibres composed of united spicule tips are of nearly equal diameter.

Discussion. Because the dendroclone base of the skeletal net is most similar to the general structure of sponges in the Anthaspidellidae, the Baffin Island sponge is included there. In genera of the family described to date, however, I am aware of none that exhibits the enlargement of elements of the spicule net in older parts of the sponge like that seen in the Baffin Island material. In addition, most of the sponges of the family show distinct canals, which are clearly different from the normal skeletal openings.

At first glance *Incrassospongia* appears quite similar to various small species of the Upper Paleozoic sponge *Haplistion* (Young and Young, 1877; Finks, 1960, p. 87–98, Pls. 25–28) but the spicule patterns of the two genera are distinctly different. *Haplistion* has tracts composed principally of warty rhizoclones (Finks, 1960, p. 87; Rigby and Terrell, 1973, p. 1432–1437), rather than the dendroclones of the Baffin Island sponge. Similarly the Ordovician *Dystactospongia* (Miller, 1882) may appear superficially similar but it has a distinct canal system, tracts composed of numerous irregular ophioraphid (?) spicules (Rigby, 1966) and is less regularly organized on a larger scale.

Heliospongia (Girty, 1908; Finks, 1960) may also look superficially similar because of the gridlike skeletal pattern but it has distinctly different spicules and a well defined canal pattern.

Sinclair (*in* Blackadar, 1967, p. 20) listed these fossils as *Heterospongia* sp. However, because of the poor material upon which *Heterospongia* was based it is difficult to be certain that these Baffin Island sponges are congeneric with those described by Ulrich (1890).

Incrassospongia rhipidos n. sp.

Plate 2, figs. 1–7

Heterospongia sp. Sinclair, *in* Blackadar, 1967, p. 20

Description. Sponges are subcylindrical, club shaped, steeply conical or distinctly fan shaped and all vary considerably in vertical diameter and irregularities of growth. Specimens in the collection are up to 14 cm high and enlarge upward from pointed or subrounded bases to rounded or fan-shaped upper parts which may be 6 to 8 cm in diameter. Some specimens distinctly change growth direction and are somewhat contorted. No specimen available has a spongocoel and most have a rounded upper summit without any coarser skeletal texture than that visible along the sides.

Except for annulations produced by variation in growth, the exterior of the sponge is smooth, with no marked ornamentation. The exterior on some specimens also appears as weakly spinose because the upward-fanning and radiating skeletal fibres terminate at a high angle to the exterior. Regular nodes or distinct vertical or horizontal wrinkles or ribs are not evident.

The skeletal structure is relatively open and uniform, composed of upward-diverging or outward-fanning tracts, which are cross-connected with more or less horizontal tracts to produce a nearly rectangular framework.

Individual fibres range from single-spicule elements 0.05 to 0.08 mm in diameter, up to thickened fibres or tracts approximately 1 mm. Most of the vertical and horizontal fibres in the interior and lower part of the sponge are 0.25 to 0.50 mm in diameter, with considerable variation both in adjacent fibres and along a single fibre. Most fibres are relatively straight with only gentle outward curves in the vertical series and curves arched gently upward in the horizontal series, subparallel to the arched tip of the sponge. Tracts swell toward junctions with other tracts so that the diameter might be as much as doubled from the middistant diameter to the diameter near the tract junctions. The method of diameter increase is not evident because of the coarsely crystallized calcareous preservation. In any given region vertical fibres show somewhat larger diameters than horizontal ones, which appear to radiate out crudely from the central part of the sponge or to form roughly concentric bands approximately parallel to the outer margin of the sponge body.

Packing of the fibres is moderately regular, with vertical ones spaced approximately 1 mm apart, from centre to centre, although spacing is narrower in areas where vertical fibres bifurcate. In some areas wider spacing up to 1.5 to 2 mm apart produces relatively open areas in the net, although distinct canals larger than the regular skeletal mesh openings are not developed.

From the side, skeletal mesh openings are distinctly arranged in rectangles because of the regular fibre spacing and orientation of the vertical and horizontal series. From the top, however, the openings are somewhat rounder because radiating and concentric horizontal fibres are not rectangularly spaced or oriented. Openings on the summit are generally of the same size as those seen in vertical sections of the interior.

Horizontal fibres are spaced approximately 0.7 to 1 mm apart throughout most of the sponges. They maintain approximately uniform spacing from one side to the other in vertical sections out through the centre. Horizontal fibres are less obviously continuous than vertical ones and apparently depend, at least initially, on single spicules bridging from one vertical tract to another. In some areas, as seen in thin section, horizontal fibres occur at approximately the same level across the sponge to form a more or less continuous bar connecting several vertical fibres but horizontal ones are still more discontinuous than vertical ones.

Details of the spicule net are obscured by the coarse calcareous preservation of the sponges. In most specimens the skeleton is completely replaced by crystalline calcite, which shows only the gross outline of the various skeletal fibres and none of the spicule detail. In one specimen, however, some of the last-formed spicules are outlined by dark matrix near the top of the sponge. Though obscure, the basic pattern is evident here, but all details are lost. The basic spicule appears to be a smooth-shafted dendroclone, long enough to cross-connect between the vertical fibres or tracts which apparently are made of the interfingering tips of adjacent spicules, much as in other members of the Anthaspidellidae. Spicules, where measurable, are 0.5 to 0.8 mm long with a shaft diameter of 0.05 to 0.08 mm at midlength where smallest. Individual shafts double their diameter toward their distal preserved tips. The shaft is bifurcated in some but whether this represents the clads of a typical dendroclone is problematical because of the poor preservation.

One of the distinctive features of the sponge is that individual elements or fibres of the earliest-formed parts of the net have the thickest diameter and those formed last show single spicule elements. Openings between cross-connected parts of the net become slightly larger from the bottom to the top of the sponge and from the interior to the exterior, although the latter variation is less pronounced.

Pulses of secondary enlargement are apparent in one sectioned paratype (GSC 43574) in which thick and thin skeletal elements alternate in vertical sections. Levels of thin spicule elements appear to coincide with restrictions or annulations in sponge diameter. Thickened element distribution seems to correspond with expansion of the sponge diameter, as though marking a time of less rapid upgrowth.

Types. Holotype, GSC 43570, paratypes, GSC 43571–43585, northwest of Amadjuak Lake, Baffin Island, Fig. 1, loc. *C* of Copeland (this bulletin) (GSC loc. 69491), from unnamed Middle Ordovician strata.

Class Calcarea Bowerbank, 1864
Order Heteractinida Hinde, 1887
Family Astraeospongiidae Miller, 1889
Asteriospongia n. gen.

Type species *Asteriospongia anatrope* n. sp.

Diagnosis. Thick-walled, inverted bowl-shaped sponge in which large, nearly vertical excurrent canals empty onto a rounded summit that lacks a spongocoel. Skeletal net is of moderately regularly spaced but irregularly arranged small octactines or octactine-based derivatives such as sexiradiates in a felted mass. Outer fifth of wall is dense, produced by calcareous overgrowths on spicules.

Discussion. The new genus *Asteriospongia* is closely related to *Astraeospongium* (Roemer, 1860; Richardson, 1950) in the thick wall development and in the octactine-based skeletal net. *Asteriospongia* differs from that genus very clearly, however, in spicule size and distinctive canal pattern. *Asteriospongia* has an inverted convex-upward shape, rather than a concave-upward saucer shape as presently visualized for *Astraeospongium* (Pl. 1, fig. 1). Spicules in *Asteriospongia* are distinctly smaller than in *Astraeospongium* (Richardson, 1950) although generally they are arranged and placed similarly in both genera. The outer thickened, secondarily calcified, part of the sponge wall is not present in *Astraeospongium* (Roemer, 1860; Hall and Fritz-Gaertner, 1878; Lowenstam, 1948; Richardson, 1950) and would clearly differentiate *Asteriospongia* from almost any other Paleozoic sponge with which it might be confused.

Astraeoconus (Rietschel, 1968) is a deep conical sponge and differs from *Asteriospongia* in that significant respect. Internal skeletal and canal structure of *Astraeoconus* is not known but because of the shape differences between the two genera the canal patterns must be significantly different.

Ensiferites (Reimann, 1945) is also placed in the Astraeospongiidae and is characterized by radiating, long swordlike spicules; spicules are lacking in *Asteriospongia*.

Tholiasterella (Hinde, 1887, 1888) is an open-textured sponge composed of multiple ranks of different sizes of irregularly arranged octactine-based spicules and also shows some secondary calcification in some species. In the latter respect it may appear somewhat similar to *Asteriospongia*. Because *Tholiasterella* is based upon fragmentary material its canal pattern is not known, but even fragments of the genus would be easily separable from *Asteriospongia* because of fundamental differences in the skeletal net.

Asteractinella (Hinde, 1887, 1888; Vandercammen, 1950), *Wewokella* (Girty, 1911, 1915; King, 1943; Croneis and Toomey, 1965; Hoare and Sturgeon, 1968) and *Talpaspongia* (King, 1943; Lokke, 1964) all have some secondary calcification of the spicule net but different spicule patterns, including polyactinal and triactinal spicules, from that in *Asteriospongia*. Canal patterns of these various genera are also fundamentally different from that typical of *Asteriospongia*.

Asteriospongia anatrope n. sp.

Plate 1, figs. 2–6

Description. Thick-walled astraeosponges with low rounded, inverted bowl shape, in which the lower surface is concave upward and the upper arched surface is a rounded spongocoel-free summit. Specimens in the collection range from approximately 12 cm in diameter and 5 cm high to 8 or 9 cm in diameter and 3 cm high. All of the specimens exhibit a lower, broadly flaring half of the sponge capped by a distinctly rounded summit on the upper half, which combine to give an impression of an inverted bowl on an overturned dinner plate. Slopes of the outer margin are round to vertical to overturned at the lower distal edge but rise at about 30 degrees in the middle part of the sponge and then round to the summit that occupies the interior third of the diameter of the sponge.

Exterior of the sponge appears to be generally smooth except for some weak annulation about where the slope changes from the lower flared part to the upper rounded summit part of the body (Pl. 1, figs. 2, 3).

The lower surface is only gently concave, so that on the largest specimen the depression is only approximately 1 cm deep and shallower on the smaller specimens. Maximum depth of the depression is near the centre of the sponge. On all specimens there is a pronounced downward flexing of the margin so that a small rim is developed around the depression, much like a gently sloping rim of an inverted bowl.

The sponge body is as much as 4 or 5 cm thick in the centre of the large specimen but only 1.5 to 2 cm thick in the small forms. The sponge body thins to the rounded lateral margin which is generally less than 1 cm thick at the rounded edge. On one specimen where the margin has a distinct flare, the downward flaring portion of the wall is only 5 or 6 mm thick at the edge of the lower concave depression, making the sponge more saucer shaped with a distinct rim.

Four series of canals are evident in the sponge. Large excurrent canals show well on the mound in the centre of the holotype (Pl. 1, fig. 3). Largest openings range from 1.7 to approximately 2.3 mm in diameter but most of the canals are approximately 1.9 mm across. Large canals occur mainly in the central part of the sponge summit. A series of slightly smaller ones is on the exterior and has a modal diameter of approximately 1.5 mm. These canals occur on the outer slopes of the rounded summit of the sponge and around the canal-bearing central apex. In addition to these two sets there are numerous smaller canals 1 to 1.1 mm in diameter, which occur at irregular intervals over the exterior of the sponge.

There seems to be no regular spacing or pattern for the canals. In one area there are 6 or 7 of the large and intermediate-size canals in 1 sq cm, whereas elsewhere in the summit area or along the slopes there may be only 2 or 3 canals per sq cm. Canal separation varies from 1 to 2 mm to 4 or 5 mm, depending on where in the canal cluster the various canals occur.

On the exterior of a paratype (GSC 43202) of approximately equal size, the canals have a modal diameter of approximately 1.6 mm but range from 1.3 to 1.8 mm in the same vicinity. In the interior, on a horizontal section cut at mid-height (Pl. 1, fig. 4) most of the large canals are 1.2 to 1.3 mm in diameter. This suggests that the large canals are slightly bigger at the exterior than in the interior of the sponge. This seems to be the general pattern of the few canals which are cut longitudinally in a vertical section through the sponge.

In addition to these large canals there is an intermediate series in the interior of the sectioned paratype that has a modal diameter of 0.8 mm to 0.9 mm, probably equivalent to the 1 to 1.1 mm canals in the other paratype. These canals, in general, are vertically rising canals that converge slightly or incline inward toward the centre of the sponge. They appear to be cross-connected in the interior with a series of smaller canals that are 0.3 to 0.4 mm in diameter. The intermediate canals are distinctly circular openings now filled by fine dark argillaceous matrix. In the horizontal prepared section, they are 1 to 2 mm apart and feed into the larger vertical excurrent canals. The small canals feed from a fourth series of even smaller canals that perforate the outer dense layer.

The smallest canals are nearly circular and range from 0.06 to 0.14 mm in diameter but most in the outer part of the sponge appear to be approximately 0.10 mm. In cross-section the diameter varies along their course. In some places the same canal may be only half that size but elsewhere nearly twice that size. The smallest canals are somewhat branching or complexly anastomosing (Pl. 1, fig. 5) as they sweep around calcareous spicule rays and are dark matrix-filled openings in the specimens at hand. These canals are generally oriented not quite at right angles to the exterior surface but slope inward and downward toward the concave lower side, slightly less steeply than normal to the exterior. They branch inward and connect with the distinctly larger sets of canals evident in the cross-section.

The smallest canals appear to be openings between rays of spicules. Lateral fusion or secondary calcification on some of the spicules produces the small circular openings. The intermediate-size canals, 0.3 to 0.4 mm in diameter, appear to be placed between rays of spicules. The larger canals, 1.5 mm and larger, are produced by interruptions in the spicule net so that spicules with some rays terminated are occasionally developed at the canal margins. In some spicules nearly half of the normal structure has been aborted to leave room for a major vertical canal.

Secondary calcification and enlargement of spicules in the outer part has produced a relatively dense skeleton (Pl. 1, figs. 4, 5), compared with the interior of the sponge where individual rays of adjacent spicules are clearly differentiated. In the outer 4 to 5 mm of the sponge wall there is generally less than 20 per cent open space, occupied by the relatively small canals. The interior of the sponge has more open space because of the greater number of larger canals and considerably more interray space as well.

The spicule net is relatively well preserved but is clearest in the interior of the sponge (Pl. 1, fig. 6) where most spicules are outlined by a fine-grained dark grey 'dust'. In the thickened outer rim or crust the net is obscured. In the interior the octactine spicule pattern is clear in thin section; individual spicules are composed of a central button and 8 radiating rays. Six of these rays are in a single plane, typical of the basic spicule of the family, and are spaced relatively uniformly approximately 60 degrees apart. The other 2 rays are at right angles to the plane and are evident in the thin section only as circular spines or circular cross-sections of rays. In horizontal thin section many of the spicules appear oriented with the major plane roughly horizontal or parallel to the thin section, with the proximal and distal rays vertical.

Most spicules in the interior of the sponge have ray diameters at their base of 0.10 to 0.15 mm and ray lengths of approximately 1 mm. Rays appear smooth and taper uniformly to sharp points. Most rays are straight, although some are gently curved through 10 to 15 degrees, but there is no sharp flexing as in some related genera. The rays appear solid, at least in their present rather heavily calcified preservation.

Spicules are irregularly oriented to unoriented and their placement is also somewhat irregular, as in a tossed, loosely felted mass. However, spicules in the interior of the sponge appear to be 1 to 2 mm apart but do not occur in any geometric pattern. Orientation of the tangential rays from spicule to spicule is irregular.

Individual spicules in the inner part of the heavily calcified outer third of the sponge wall have basal ray diameters of up to 0.25 mm. Ray lengths are up to 2 mm and are longer than in the interior part of the sponge. Individual spicules are apparently somewhat enlarged, with overgrowths of calcium carbonate, in the outermost part of the sponge wall, so that rays 0.20 to 0.25 mm in diameter are relatively common and some range up to 0.30 mm in diameter. Rays of outer spicules are slightly more curved than on smaller interior spicules and in some outermost areas are laterally fused with rays of adjacent spicules to produce a somewhat wewokellid-appearing skeleton. The basic octactine nature of these outer spicules is obscured by the irregular overgrowths and bending of spicule rays.

In a vertical section through a paratype (GSC 43202) only a few spicules are clear and most of these are in the interior of the sponge. The skeletal pattern shows much more clearly in a horizontal section than in a vertical section of the same specimen. In the lowermost part of the sponge wall, lining the concave depression at the base of the sponge, coarsely overgrown spicules are evident between the rather small matrix-filled canals. The skeleton is much like that in *Wewokella*, with gross rounded, tuberose skeletal elements. In the lower part of specimens, spicules have been heavily calcified so that the initial centres of spicule development are not well preserved.

Types. Holotype, GSC 43201, paratypes, GSC 43202–43205, Hall Beach, loc. 3 of Bolton (this bulletin) (GSC loc. 89831); paratype, GSC 43206, escarpment 10.5 mi west-southwest of Hall Beach, loc. 36 (*ibid.*) (GSC loc. 89864); paratype, GSC 43207, top of mesa near Amadjuak Lake, 65°40'N, 71°51'W, Baffin Island (GSC loc. 69491). Specimens are from the Bad Cache Rapids Formation, Melville Peninsula, and equivalent strata, Baffin Island, Middle Ordovician.

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Plate 1

Figure 1. *Astraeospongium meniscus* Roemer, 1848. Silurian, western Tennessee, showing coarse spicules and smaller spicule ranks, lack of major canals, and generally coarse texture in contrast to *Asteriospongia anatrope* from Melville Peninsula, ×1; hypotype, Brigham Young University BYU 919.

Figures 2–6. *Asteriospongia anatrope* n. gen. and n. sp. Middle Ordovician, GSC loc. 89831, Hall Beach, Melville Peninsula, District of Franklin. (2) Paratype, GSC 43204, ×1, showing growth form and dense skeletal development. (3) Holotype, GSC 43201, ×1, showing growth form and development of distinctive large canals on the upper spongocoel-free convex surface. (4) Paratype, GSC 43202*a*, ×1, with horizontal section cut at midheight showing dense outer skeletal layer perforated by small radiating canals and less dense inner layer with large canals that are nearly normal to the cut surface. (5) Paratype, GSC 43202*c*, ×5, vertical section showing dark matrix-filled small and large canals in the outer dense part of the sponge. (6) Paratype, GSC 43202*e*, ×10, horizontal section showing small octactine-based spicules and dark matrix-filled large vertical canals to the left and similar spicules partially modified and secondarily enlarged to the right.

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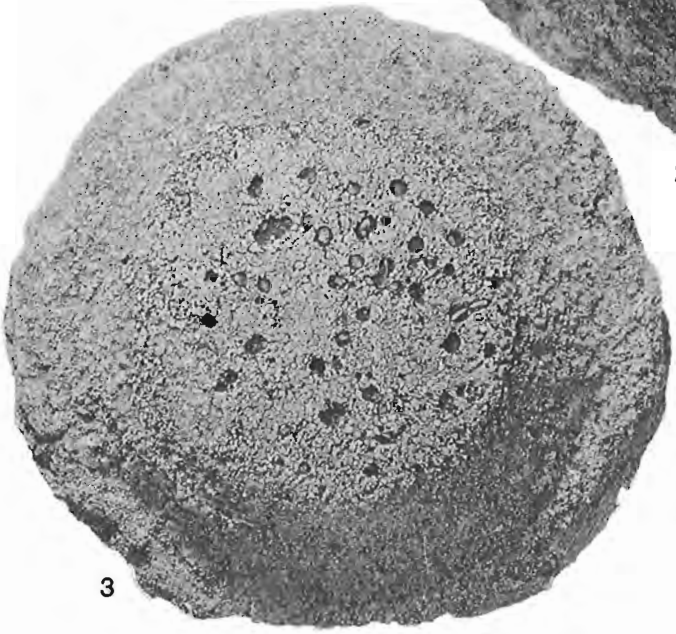

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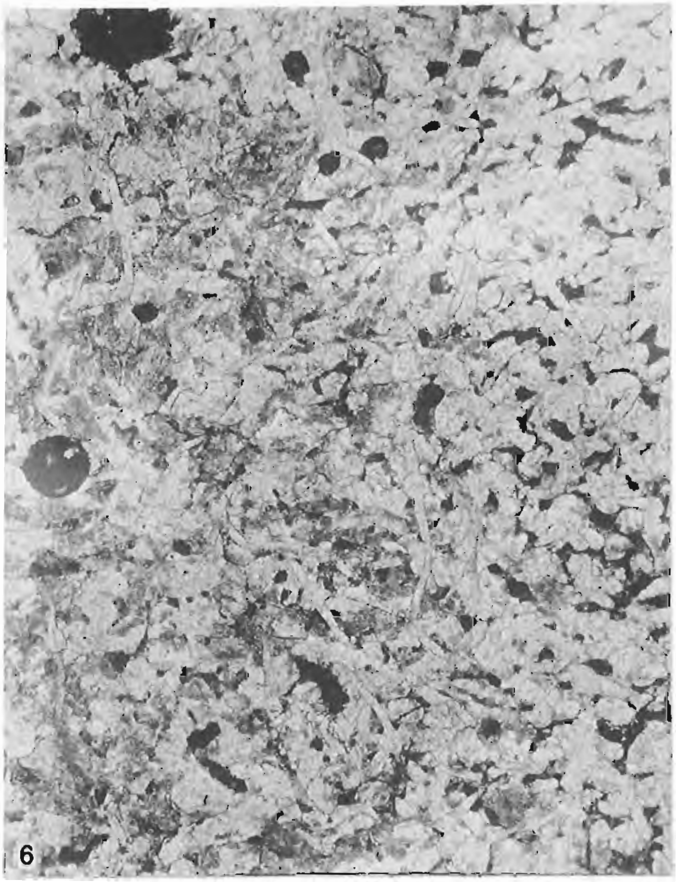

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Plate 2

Incrassospongia rhipidos n. gen. and n. sp.
Unnamed Middle Ordovician strata northwest of Amadjuak
Lake, Baffin Island, GSC loc. 69491 (*not* 69591).
(all ×1 except fig. 6, ×10)

Figure 1. Paratype, GSC 43571, showing flattened fan shape of some specimens, as well as radiating thickened skeletal fibres. Base is broken, but upper margin is complete.

Figure 2. Paratype, GSC 43572, showing steeply conical form typical of small specimens.

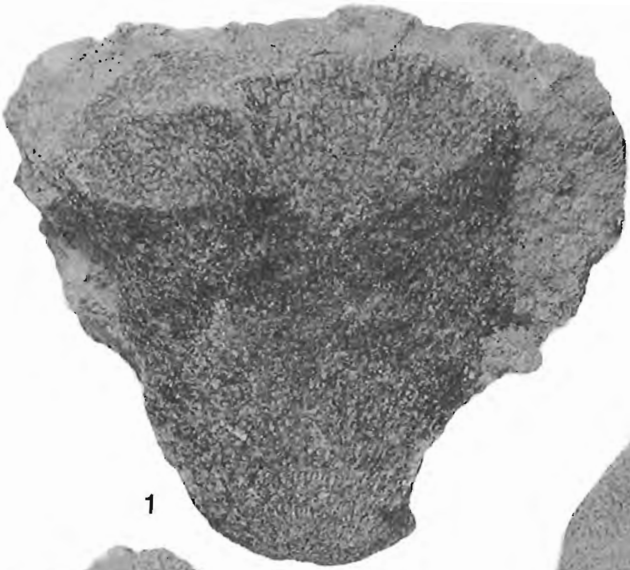
Figure 3. Paratype, GSC 43573, showing curved nearly complete base of thin subcylindrical specimen which also shows lack of large differentiated canals at the exterior.

Figure 4. Paratype, GSC 43574, polished vertical section showing internal structure and arrangement of skeletal fibres as an upward-radiating series, and a gently arched nearly horizontal series. Variation in thickness of skeletal fibres shows well near weak annulation in upper part of the sponge where fibres are thin.

Figure 5. Paratype, GSC 43575, large nearly complete conicocylindrical form of the species showing weak annulations and irregular appearance of the skeletal net at the exterior in spite of general internal regularity.

Figure 6. Paratype, GSC 43576*b*, photomicrograph of the upper part of a sponge showing general increase of skeletal fibre diameter into the older part of the sponge from the simple dendroclone ladderlike series shown at the top.

Figure 7. Holotype, GSC 43570, showing steeply conical form in lower part and flattened fan shape in the upper part. Vertical and horizontal series of skeletal fibres show in the upper part, and a cross-section showing the roughly concentric pattern of horizontal elements is shown in the broken base.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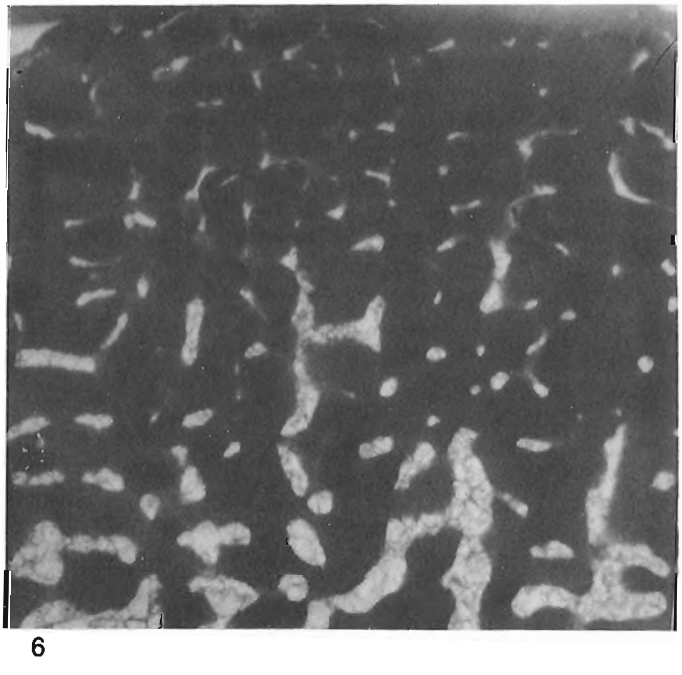
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Constellatospongia, a New Heteractinid Astraeosponge from the Upper Ordovician Churchill River Group, Manitoba

J. Keith Rigby

Abstract

The new thick-walled heteractinid sponge *Constellatospongia pervia* is distinguished by extensive parietal gaps in a skeletal net composed of matted, relatively fine octactines that are irregularly oriented. The sponge is broad and saucer shaped with a slightly arched or invaginated base and a broad shallow spongocoel. The fossil was collected from rocks of the Churchill River Group recently discovered along Herriot Creek, approximately 38 mi southwest of Churchill, Manitoba, in the northern part of the Hudson Bay Lowland.

Résumé

Une nouvelle éponge hétéractinellide aux parois épaisses *Constellatospongia pervia* se distingue par l'existence d'importants vides dans les parois d'un réseau squelettique composé d'octactines mattées relativement fines qui ont une orientation irrégulière. L'éponge est large et en forme de soucoupe avec une base en forme d'arc peu accentué ou repliée vers l'intérieur, ainsi qu'une cavité pseudo-gastrique large et peu profonde. Le fossile a été recueilli dans des roches du groupe de Churchill River qui ont été récemment découvertes le long du ruisseau Herriot, à environ 38 milles au sud-ouest de Churchill (Manitoba) dans la partie nord des basses-terres de la baie d'Hudson.

Introduction

Outcrops of the Churchill River Group along Herriot Creek (lat. 58°33′N, long. 94°18′W) in the northern part of the Hudson Bay Lowland of northern Manitoba were discovered during Operation Winisk by officers of the Geological Survey of Canada in 1967 (Cumming, 1975, p. 25, 26). The single well preserved fossil sponge described here was collected from these late Ordovician rocks at Station 239CE, the position of which is shown by Cumming (*ibid.*, fig. 3). It is approximately 38 mi southwest of the village of Churchill, in the middle part of the outcrop belt of the Churchill River Group. Cumming (*ibid.*, p. 26) described the rocks at this locality as 7.8 ft of light greyish brown, aphanitic, dolomitic limestone containing skeletal debris. Fossils are abundant here but this is the first sponge described from the region.

Systematic paleontology

Class Calcarea Bowerbank, 1864
Order Heteractinida Hinde, 1887
Family Astraeospongiidae Miller, 1889
Constellatospongia n. gen.
Type species *Constellatospongia pervia* n. sp.

Description. Thick-walled, saucer-shaped sponge, the lateral slopes of which are pierced by large irregular parietal gaps that rise approximately normally from the outer slopes and empty into the broad shallow spongocoel. Intermediate and smaller canals radiate approximately normally to the parietal gaps into the dense spicular sponge wall. Basal part of the sponge is slightly invaginated and essentially lacks parietal gaps. Spicules are relatively fine octactines in which the 6 horizontal rays are at least locally arranged roughly concentric to the surface of the sponge and appear to represent former positions of exterior sexiradiates or of octactines in which the distal rays are aborted. Proximal and distal rays are essentially the same diameter and length as the 6 horizontal rays in the interior of the sponge body. Some exterior spicules have small nodes or irregularities on the basic octactine spicule, probably the result of minor secondary calcification.

Discussion. The Ordovician genus *Constellatospongia* differs from all other presently known members of the Astraeospongiidae in possessing large parietal gaps. *Stellarispongia* (Rigby, 1976) from the Devonian of Ellesmere Island, may be superficially similar but has a fundamentally different canal pattern. *Stellarispongia* has relatively large radiating canals but not the large parietal gaps that pierce the lateral walls of the Ordovician form. The exterior of *Constellatospongia* is also dimpled by broad pits that mark positions of the parietal gaps. *Stellarispongia*, however, is sculptured by small anastomosing canals that are more or less impressed into the sponge surface.

The Ordovician genus has 6 tangential rays uniformly on all spicules observed, rather than the 4 or 5 tangential rays that are common in *Stellarispongia*, particularly on surface spicules. In addition, the robust spicules in *Stellarispongia* are consistently coarser and more heavily calcified than in the Ordovician form. Most of the body spicules on the exterior of the Devonian genus have rays that range from 0.5 to 1 mm in diameter and taper very abruptly, sometimes being wider than long. This spicule form is significantly different from that of the relatively delicate octactines observed in the Ordovician genus.

Constellatospongia differs from *Astraeospongium* (Roemer,

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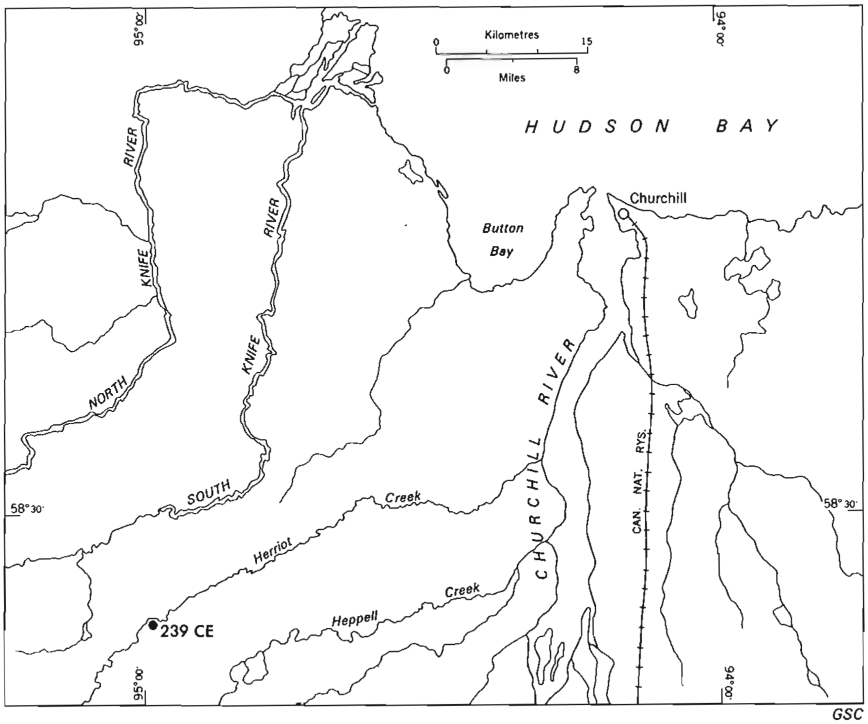

Figure 1. Index map to the occurrence of *Constellatospongia pervia* n. sp.

1860; Hall and Fritz-Gaertner, 1878; Lowenstam, 1948; Richardson, 1950) in possessing parietal gaps and a prominent canal system and distinctly smaller body spicules. The similarity of spicule form, however, allies this new genus closely to *Astraeospongium* and other members of the family.

Asteriospongia (Rigby, 1977) from Middle Ordovician of Foxe Basin northeast of Hudson Bay, is also a thick-walled heteractinid sponge but this genus has an inverted bowl shape in which the major canals appear as nearly vertical excurrent canals that empty onto the rounded summit of the sponge. In both these Ordovician genera the outer part of the lower wall appears dense, particularly in *Asteriospongia* because of calcareous overgrowth on the octactine-based spicules. The spicule pattern and tangential rays show better in horizontal sections than in vertical sections of both genera. This suggests that both have the same fundamental arrangement of felted spicules in the body wall. The lack of parietal gaps, the inverted convex-upward shape and the vertical excurrent canals that empty onto the rounded summit, however, clearly separate *Asteriospongia* from *Constellatospongia*.

Constellatospongia lacks the strongly radiate pattern and the elongate swordlike spicules characteristic of *Ensiferites* (Reimann, 1945); it has a different shape and presumably different wall structure and canal pattern from that described for *Astraeoconus* (Rietschel, 1968).

Constellatospongia appears similar to the basal part of *Malumispongium* (Rigby, 1967) but the latter genus is a hexactinellid and the differences in spicule structure would clearly differentiate them. In gross pattern, however, and in the extensive parietal gaps piercing densely and irregularly matted spicular walls, the two genera appear similar.

Scaphiomanon (Gutschick and Perry, 1959), from the Sappington Formation (Kinderhookian) of Montana, also has major parietal gaps but in general is a deep vase-shaped to almost goblet-shaped form and appears similar to *Malumispongium*. Fragments of *Scaphiomanon* could appear similar to *Constellatospongia*. Gutschick and Perry (1959) originally described *Scaphiomanon* as a calcareous sponge on the basis of its calcareous preservation. Calcified hexactines have been discovered in the genus, however, and its calcareous original nature is in doubt. Thus *Schaphiomanon* would be only superficially similar to the Ordovician Manitoba sponge.

Constellatospongia pervia n. sp.
Plate 1, figs. 1–6

Description. The genus is monotypic and specific characteristics are thus not clearly differentiated but canal sizes, spicule sizes and shapes of irregularities might be considered.

The single known specimen, the holotype, is a low saucer-shaped form, approximately 14 cm in diameter and slightly over 3 cm high. Maximum height of the sponge is about midway between the inner margin of the spongocoel and the outer margin of the wall. The sponge is thick walled, with a slightly invaginated base that rises at the centre, approximately 8 mm above the base of the outer lower rim (Fig. 2*A*). The upper part of the sponge is excavated by a broad shallow spongocoel that is approximately 7 cm wide and 2 cm deep at its deepest in the centre of the sponge. The invaginated basal area is approximately 8 cm across and has a smooth gently arched surface that meets the outward sloping upper flanks of the sponge at a rounded lower rim. The upper slope of the sponge is nearly straight and rises from the basal rounded rim to the maximum diameter just below the upper rounded summit of the sponge wall.

The sponge wall is approximately 1 cm thick at the base of the spongocoel, at the crest of the upward-arched invaginated base. The walls thicken peripherally to approximately 3 cm thick toward the outer basal rim and then thicken upward to a maximum of approximately 4 cm measured horizontally at the

Figure 2. Vertical and horizontal sections of *Constellatospongia pervia* n. sp. Distribution was prepared on photographs of acetate peels of the holotype, GSC 45686. *A*. Vertical section through the centre of the holotype. Matrix-filled parietal gaps (*P*) and matrix in the bottom of the spongocoel (*S*) are shown in black. *B*. Horizontal section, at approximately midheight, through the holotype showing parietal gaps (*P*) and smaller canals (*C*) in the interior of the sponge. Some matrix (*M*) adheres to the exterior of the specimen.

greatest diameter of the sponge, which is at the upper rim of the osculum (Fig. 2*A*).

Upper edges of the sponge wall are gently rounded to flat and are faintly marked by radiating large canals. The wall is pierced by a series of radiating and ascending parietal gaps that rise almost perpendicular to the exterior of the lower parts of the sponge wall (Figs. 2*A*, *B*) but are almost horizontal near the upper edge of the sponge. These large parietal gaps are common over the entire outer lateral walls of the sponge but are not in the invaginated base.

Parietal gaps range from 1 mm or so in diameter on the exterior to large openings 7 to 8 mm in diameter; most of the openings are 3 or 4 mm. In general the parietal gaps are separated by 5 to 8 mm of densely spiculed skeletal tracts over the entire outer wall of the sponge, from the basal rim at the outer edge of the basal invagination up to the upper margin on the oscular rim. Gaps are irregularly placed, however, and there is no pattern to their distribution other than a somewhat uniform spacing (Fig. 2*B*). In general the gaps occupy approximately one third of the volume of the sponge wall.

The gaps are irregular in outline and in diameter as they are traced through the sponge wall. Usually they are subround but are made uneven by junctions of many smaller canals with the gap margins. Parietal gaps decrease in diameter from the exterior of the sponge toward the interior, but raggedly. In a horizontal section cut at midheight (Fig. 2*B*; Pl. 1, figs. 1, 5, 6) gaps show as nearly equally spaced openings 3 to 5 mm across, with openings 1 to 1.5 mm in diameter in some of the broad areas between larger openings. The smaller openings may be tips of irregularities of parietal gaps, or cross-sections of smaller canals that radiate out from the gaps.

Parietal gaps appear to have nearly straight courses through the wall. Those that produce large openings in the base of the spongocoel feed vertically into the spongocoel but do not penetrate the basal part of the wall.

A network of canals 0.5 to 0.8 mm in diameter radiates out approximately normally from the margins of the parietal gaps into the dense spicular tracts of the sponge. These canals appear to occupy one to two tenths of the sponge wall volume. Courses of these canals are somewhat irregular because they swing around rays of the large spicules. In horizontal section the canals radiate uniformly from the gaps and are spaced approximately 1 mm apart around the gap periphery. Individual canals are traceable up to 2 or 3 mm into the spicule tract. Some canals seem nearly straight but most are gently curved.

A series of smaller canals 0.1 to 0.2 mm in diameter interconnects the larger ones. These are the smallest openings visible in sections of the sponge. They anastomose completely through the spicular areas in a very complex fashion.

The small canals appear to be separated from one another by single spicules or narrow clusters of skeletal material. Intermediate-size canals are separated approximately 1 mm apart around the periphery of the parietal gaps, where the pattern is best shown, and are arranged at a high angle to the margins of the gaps. In general the entire canal system appears irregular. Vertical sections show that parietal gaps locally merge and elsewhere diverge from one another.

The skeleton is composed of solid calcareous octactine spicules (Pl. 1, fig. 5) that are arranged in a felted mass sufficiently irregular that virtually all spicule rays appear as ellipses in either horizontal or vertical sections. Some of the spicules, however, are arranged so that 4 or 5, or in a few instances all 6, of the tangential rays are evident where the thin section happened to cut ray intersections in the felted mass (Pl. 1, fig. 5), but such occurrences appear to be irregular. In the lower, presumably older, part of the sponge, individual spicule rays are sometimes obscured in the dense mosaic of organic-rich calcium carbonate and some secondary calcification of spicules is evident. In the upper part of the sponge, however, individual circular or elliptical cross-sections of rays are moderately well defined by surrounding matrix.

In horizontal sections the longest rays extend approximately 1.5 mm from the ray junction and have a maximum basal ray diameter of 0.3 mm, with most rays slightly smaller. Rays appear to swell slightly distally and, from the swelling, taper relatively evenly to a sharp point; in some instances they have a slightly subcylindrical inner third beyond which they taper to a point. Knobby, almost spinose, overgrowths protrude into canals from some rays (Pl. 1, fig. 2).

A series of slightly smaller spicules are interleaved with the larger ones in the interior of the sponge. Smaller spicules have ray diameters of 0.12 to 0.15 mm and approximately the same length as the larger ones, but taper from the ray base evenly and smoothly to a sharp tip.

Some spicules on the exterior have rays up to 0.4 mm in diameter and up to 1.7 mm long. These are the largest spicules observed on the sponge. They are oriented with the 6 horizontal rays more or less tangential to the sponge surface and with the proximal ray directed into the interior. Distal rays on surficial spicules are poorly developed to totally aborted. Surface spicules are not arranged in a pattern, other than being spaced approximately 1 to 2 mm apart. Moderately coarse spicules are interspersed irregularly with slightly finer textured ones, although there is some mutual accommodation of ray tips into interray areas of adjacent spicules. Surface spicules show the same secondary irregular overgrowths as those seen in sections, such as weak knobs and spines up to 0.1 mm long and 0.1 mm in diameter. Differences in spicule colour from the matrix help outline the irregularities (Pl. 1, figs. 2, 3).

Because of a distinct difference in number of spicules showing ray junctions in horizontal versus vertical sections through the sponge, it appears that the skeleton is composed roughly of vertically oriented felted octactines. There is considerable range in orientation, however, and less than 10 per cent of the spicules are oriented with the 6 horizontal rays in the plane of the thin section. Even such a crude orientation, however, produces a fabric to the horizontal section that is distinctly different from the one in vertical section.

Type. Holotype, GSC 45686, Station 239CE (Cumming, 1975, Fig. 3), GSC loc. 81902, south bank Herriot Creek, 94°58′50″ W., approximately 58°24′N., northern Manitoba, Churchill River Group, Upper Ordovician.

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Plate 1

Plate 1

Constellatospongia pervia n. gen. and n. sp.
Holotype, GSC 45686, Churchill River Group, Upper Ordovician, GSC loc. 81902, northern Manitoba.

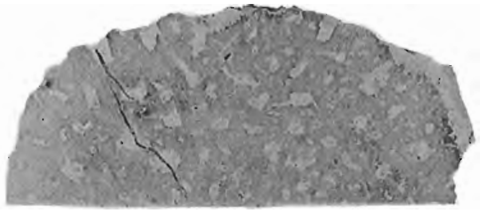
Figure 1. Polished section cut horizontally through midheight showing light matrix filling in parietal gaps and their distribution throughout the sponge, ×0.5.

Figures 2, 4. Exterior of the base of the sponge showing six tangential rays on several of the spicules and knobby or spinose overgrowths on some. At least two sizes of spicules are shown surrounded by the light matrix, ×5.

Figure 3. Vertical view into the upward-arched base of the sponge, showing dimples on the lateral slopes produced by openings of parietal gaps, ×0.5.

Figure 5. Acetate peel of the horizontal surface shown in fig. 1. Several interior spicules show at least part of the six horizontal rays of the octactines of the skeleton in the tracts between parietal gaps, here filled with dark-appearing matrix. Smaller canals radiate out from the gaps, ×5.

Figure 6. Photomicrograph produced using acetate peel as negative, of the central part of the horizontal surface shown in fig. 1, in which canals radiate out from parietal gaps. Spacing is characteristic of the sponge, ×2.



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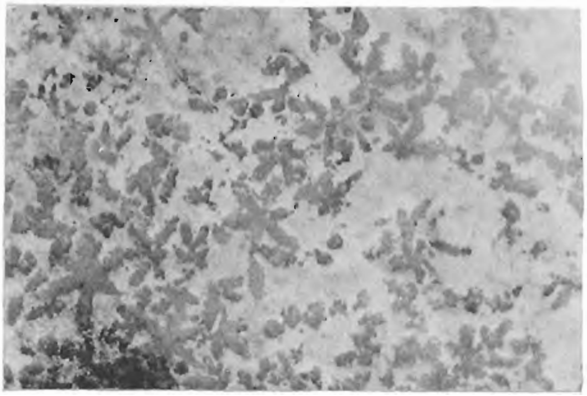

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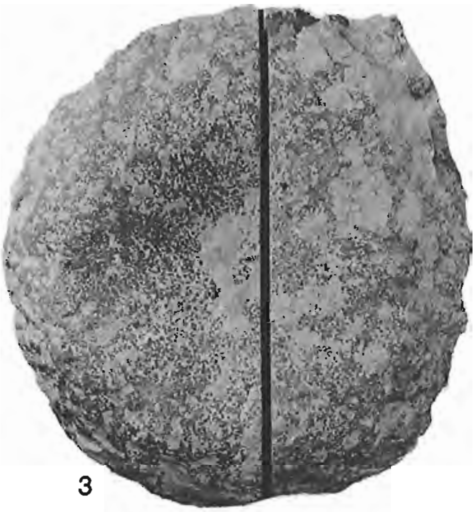

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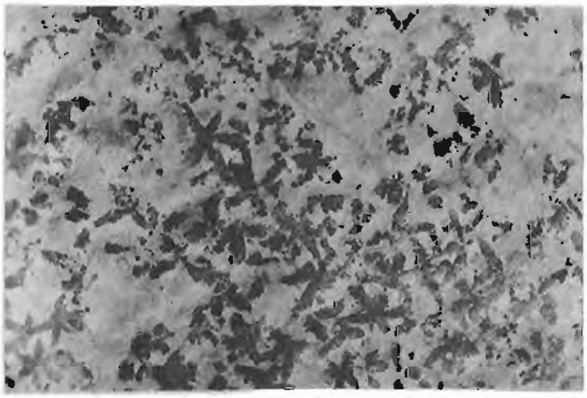

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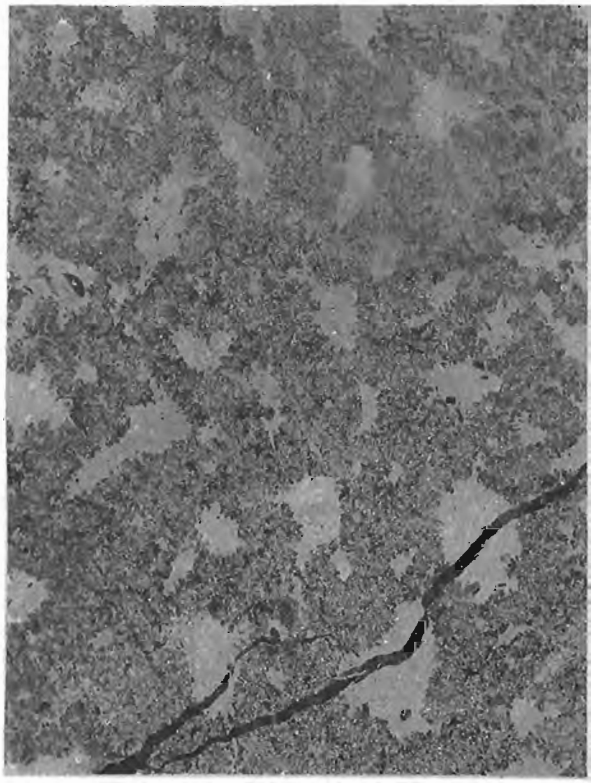

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