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BULLETIN 197

CONTRIBUTIONS TO CANADIAN PALEONTOLOGY

(nine papers)

B. S. Norford, A. E. H. Pedder, Allen R. Ormiston, Jerome A. Eyer, W. M. Nassichuk, Claude Spinosa, Charles A. Ross, William S. Hopkins, Jr.

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CONTRIBUTIONS TO
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Preface

From time to time it is appropriate to issue several short papers of paleontological topics as a single Bulletin under the general title of Contributions to Canadian Paleontology. The nine papers that form this Bulletin describe different groups of fossils that are important to correlation in the sedimentary basins of northern and western Canada, and thus are relevant to petroleum exploration which is so dependent on accurate paleontological and stratigraphic interpretation.

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

OTTAWA, May 5, 1970

BULLETIN 197 — BEITRAEGE ZUR KANADISCHEN PALAEONTOLOGIE

Die oberordovizischen Korallen *Chaetetipora* und *Sibiriolites* aus dem nördlichen Ellesmereland (Franklindistrikt)
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Von A. E. H. Pedder

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Charazeen-Vorkommen im Devon des südöstlichen Britisch-Kolumbien
Von J. A. Eyer

Dohmophyllum und eine neue verwandte Korallengattung aus dem Mitteldevon Nordwestkanadas
Von A. E. H. Pedder

Eine oberpennsylvanische Ammonoidee aus dem Ogilvie-Gebirge (Yukonterritorium)
Von W. W. Nassichuk

Die auf Ellesmereland in der kanadischen Arktis gefundene permische Ammonoidee *Stacheoceras*
Von C. Spinosa und W. W. Nassichuk

Neue *Schwagerina*- und *Yabeina*-Arten (Fusulinacea) der Word-Zeit (Perm) im nordwestlichen Britisch-Kolumbien
Von C. A. Ross

Palynologie der Isachsen-Formation (Unterkreide) auf der Melville-Insel (Franklindistrikt)
Von W. S. Hopkins Jr.

БЮЛЛЕТЕНЬ 197 — МАТЕРИАЛЫ ПО ПАЛЕОНТОЛОГИИ КАНАДЫ

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Палинология нижнемеловой исаксенской формации о-ва Мельвиль, район Франклин
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UPPER ORDOVICIAN CORALS *CHAETETIPORA* AND *SIBIRIOLITES* FROM NORTHERN ELLESMERE ISLAND, DISTRICT OF FRANKLIN

by B. S. Norford

Abstract

Chaetetipora ellesmerensis new species and *Sibiriolites sibiricus* Sokolov are described from Judge Daly Promontory and M'Clintock Inlet. Both species are from rocks of Richmond (Ashgill) age.

Résumé

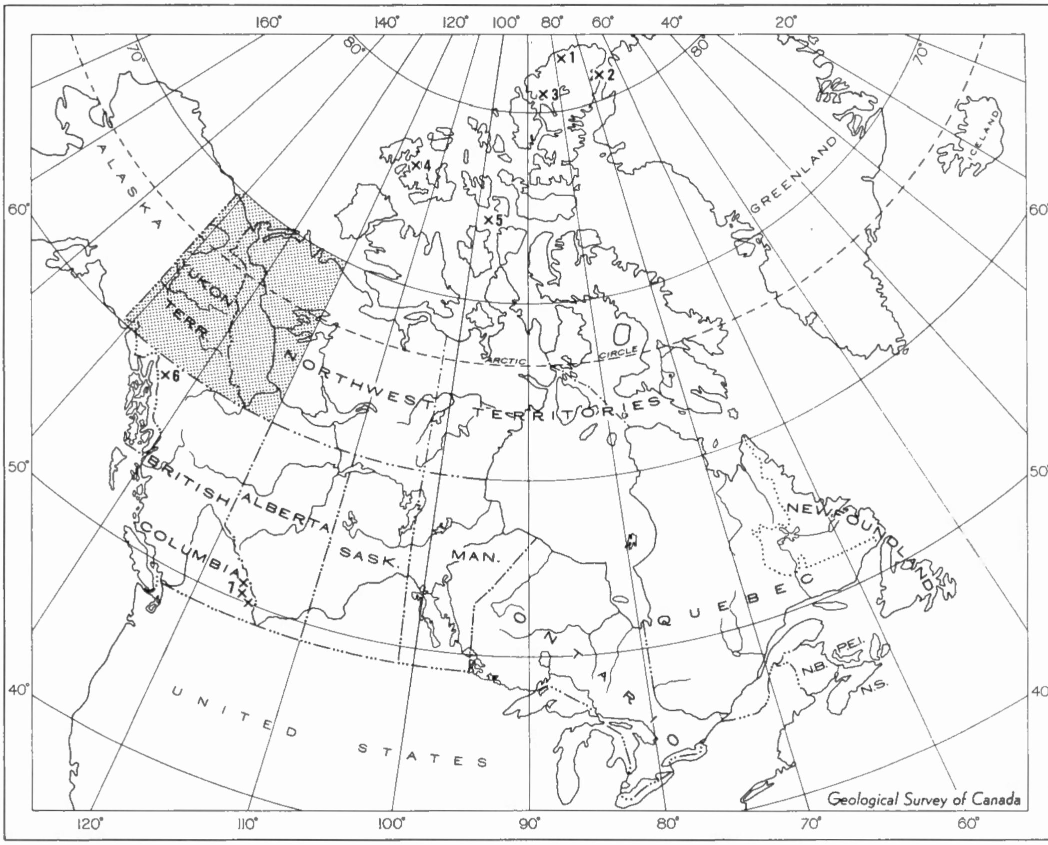
Description de deux espèces: *Sibiriolites sibiricus* Sokolov et la nouvelle espèce *Chaetetipora ellesmerensis*. Ces espèces ont été recueillies dans la promontoire Judge Daly et l'entrée M'Clintock. Les corails sont l'indication d'âge Richmond (Ashgill).

INTRODUCTION AND BIOSTRATIGRAPHY

Some well-preserved Upper Ordovician corals were collected during recent reconnaissance studies by the Geological Survey of Canada in northern Ellesmere Island. This paper describes two rare and unusual species, one of which is conspecific with a form described from Siberia. The species are from two localities.

Judge Daly Promontory

A reconnaissance stratigraphic section (Textfig. 1, loc. 2) east of the delta of Daly River was measured by R. L. Christie in 1966 and shows several thousand feet of Ordovician limestones underlying Silurian beds of the Cape Rawson Group. These limestones probably correspond to the informal Formation B of Norford (1967, p. 1) that in part may be equivalent to the Thumb Mountain and Irene Bay Formations of the upper part of the Cornwallis Group of central Ellesmere Island (Kerr, 1968). Norford (1967, p. 12; *see also* 1970) has reviewed knowledge of the sequence of faunas within the Cornwallis Group of the Arctic Islands and pointed out that faunules of Richmond age are known from Judge Daly Promontory and that these faunules are younger than the Eden–Maysville faunules reported from the upper beds of the Cornwallis Group elsewhere in the Arctic Islands. Collections



1. GSC locs. 69202, C-10, Zebra Cliffs Formation, Ellesmere Island (Norford)
2. GSC loc. 82042, unnamed Ordovician rocks, Ellesmere Island (Norford)
3. GSC loc. C-4320, Hare Fiord Formation, Ellesmere Island (Spinosa and Nassichuk)
4. GSC locs. C-4159 - C-4175, Isachsen Formation, Melville Island (Hopkins)
5. GSC loc. C-2682, unnamed Devonian rocks, Lowther Island (Ormiston)
6. GSC loc. 79412, Cache Creek Group, northwestern British Columbia (Ross)
7. GSC locs. 57565, 60092, 60098, 65065-6, 65093, 65150, 65152-4, 65158-9, 65162, C-476, Cedared, Mount Forster, "Burnais" and unassigned Devonian rocks, southeastern British Columbia (Eyer)

Locality data for Pedder and Nassichuk papers see Textfigure 15........................ [shaded]

TEXTFIGURE 1. Locality map for Norford, Ormiston, Eyer, Spinosa and Nassichuk, Ross, and Hopkins papers.

made by Christie from the upper part of Formation B at various localities in Judge Daly Promontory (Christie, 1964, pp. 19, 20 gives some of the faunal lists) include the following forms:

Bighornia sp.	*Lobocorallium* cf. *L. trilobatum* (Whiteaves)
Streptelasma sp.	*Calapoecia* sp.
Catenipora sp.	*Favosites* sp.
Labyrinthites sp.	*Parafavosites* sp.
Austinella sp.	*Lepidocyclus* sp.
Rhynchotrema sp.	*Receptaculites* sp.
? *Maclurites* sp.	? *Calyptaulax* sp.

Two of the faunules from Christie's measured section near the delta of Daly River are similarly of Richmond age; important fossils include:

GSC loc. 82041, about 800 feet below base of Cape Rawson Group	*Streptelasma* sp. *Protrochiscolithus kiaeri* Troedsson
GSC loc. 82042, about 1,000 feet below base of Cape Rawson Group	*Lobocorallium* sp. ? *Streptelasma* sp. *Calapoecia* sp. *Catenipora rubra* Sinclair and Bolton *Sarcinula* sp. favositid coral *Chaetetipora ellesmerensis* new species *Calyptaulax* sp.

M'Clintock Inlet

Several thousand feet of sediments of the Challenger Group is exposed at M'Clintock Inlet (Textfig. 1, loc. 1; Trettin, 1966, 1970), and all three constituent formations (Ayles, Taconite River, and Zebra Cliffs) are of Richmond age. Faunas from members A and B of the Zebra Cliffs Formation include:

Calapoecia sp.	*Receptaculites* sp.
Catenipora spp.	? *Austinella* sp.
Favosites sp.	? *Hesperorthis* sp.
Palaeofavosites sp.	*Rafinesquina* sp.
Troedssonites conspiratus (Troedsson)	*Rhynchotrema* sp.
Sibiriolites sibiricus Sokolov	*Rostricellula* sp.

Troedssonites conspiratus was described from the Cape Calhoun Formation at Cape Calhoun and thought to be of Richmond age by Troedsson (1929, p. 149). *Sibiriolites* is considered to be an index of the Upper Ordovician of Siberia (Sokolov, 1955, p. 88). The overlying member C of the Zebra Cliffs Formation contains *Climacograptus latus* Elles and Wood and *Orthograptus* spp. indicating Ashgill and Richmond age.

Acknowledgments

The manuscript has benefited from critical reading by B. S. Sokolov and Y. I. Tesakov of the Institute of Geology and Geophysics of the Siberian Branch of the U.S.S.R. Academy of Sciences, and by A. E. H. Pedder of the Geological Survey of Canada. Dr. C. L. Forbes

(Sedgwick Museum, Cambridge University) kindly loaned type material of *Chaetetipora akpatokensis* (Oakley). Mrs. N. C. Tschuikow-Roux, Mrs. V. Bamber, and J. T. Maximovitch translated certain parts of Russian works consulted during the study; H. J. Hamnet made the photographs.

SYSTEMATIC PALEONTOLOGY

Prefix GSC refers to specimens in the type collection of the Geological Survey of Canada, Ottawa.

Family CHAETETIDAE Milne Edwards and Haime 1850, emend. Sokolov 1939

Subfamily CHAETETIPORINAE Sokolov 1955

Genus *Chaetetipora* Struve 1898

Chaetetipora Struve 1898, p. 93.

Type species. *Chaetetipora confluens* Struve, Viséan of U.S.S.R.; selected by Sokolov, 1950.

Chaetetipora ellesmerensis new species

Plate 1, figures 1, 2

Material. A single corallum, holotype GSC 25522, collected by R. L. Christie, 1966, from Upper Ordovician limestones (GSC loc. 82042) about 1,000 feet below the base of the Cape Rawson Group in a measured section (81°14′N, 65°41′W) east of the delta of Daly River, northeastern Ellesmere Island, District of Franklin.

Description. Fragment (about 80 by 70 by 50 mm) of a massive corallum growing on top of a *Sarcinula* corallum. Corallites parallel in longitudinal section; meandroid (Pl. 1, fig. 1) in transverse section, subpolygonal in some parts of corallum, shorter diameter 0.3 to 0.4 mm, longer diameter variable 0.4 to 1.3 mm. Wall thick (about 0.1 mm) apparently homogeneous, but under high magnification some linear alternation of lighter and darker areas discernible in transverse section. No septal spines seen. Tabulae thin, flat, entire, mostly developed at same levels in adjacent corallites giving layered appearance to corallum, commonly very widely spaced (3 to 6 in 10 mm) but locally closely spaced (7 in 3 mm).

Discussion. The species has some resemblance to *Multisolenia* in transverse section, but the meandroid appearance is irregularly developed and seems to be caused by walls locally failing to develop between corallites. Commonly the whole wall is missing between corallites, more rarely just part is missing leaving a blunt end (pseudoseptal protuberance) projecting into the enlarged corallite or a pair of such ends separated by a semblance of a mural pore. Neither mural pores nor solenia are shown by longitudinal sections, which instead show some walls abruptly terminated and others irregularly interrupted.

Two described species of Canadian Ordovician tabulate corals resemble *C. ellesmerensis*. Transverse sections of the holotype of *Chaetetes akpatokensis* Oakley (1936, pp. 441–443; Upper Ordovician, Richmond, of Akpatok Island, Quebec) show sparse submeandroid corallites and the walls of the corallites show some alternation of light and dark areas. Discontinuous walls are locally present in longitudinal section, but these are rare. The tabulae are irregularly spaced and occur at similar levels in adjacent corallites, giving a layered appearance to the corallum, as in *ellesmerensis*. Transverse sections of the holotype of *Chaetetes perantiquus* Whiteaves (1897, pp. 238, 239; Upper Ordovician, Red River Formation of southern Manitoba) show common submeandroid corallites and the walls locally show some alternation of light and dark areas. In longitudinal section, discontinuous walls are very rare but present, and the tabulae are similarly spaced in adjacent corallites giving a layered appearance to the corallum.

Difference in size of the corallites is the prime means of distinguishing these three taxa. Those of *ellesmerensis* (transverse diameter 0.3 to 0.4 mm) are much larger than those of *perantiquus* (about 0.25 mm), which are slightly larger than those of *akpatokensis* (about 0.17 mm). All three can be referred to *Chaetetipora*. In this genus, some of the corallites are incompletely divided during axial increase leading to corallites of irregular and meandrine outlines (Sokolov, 1955, pp. 100, 102). Most of the species of *Chaetetipora* are Carboniferous and Devonian; the three Canadian species are the earliest known occurrences of the genus.

Subclass HELIOLITOIDEA

Family Proheliolitidae Kiaer 1899

Genus *Sibiriolites* Sokolov 1955

Sibiriolites Sokolov, 1955, pp. 87, 88.
Sibiriolites Sokolov, Dzyubo, *in* Khalfin, 1960, p. 386.
Sibiriolites Sokolov, Sokolov, 1962, p. 281.
Sibiriolites Sokolov, Sokolov and Tesakov, 1963, p. 105.
Sibiriolites Sokolov, Preobrazhensky, 1968, pp. 26–27.

Type species. *Sibiriolites sibiricus* Sokolov from the Upper Ordovician Dolborsky unit near Chunya River, Podkamennaya Tunguska River Basin, western part of the Siberian platform.

Diagnosis (translated from Sokolov, 1955). "Polyparies commonly small, varied in form: wafer-like, branching, nodular. Formed from tightly packed corallites which are rounded or angular-rounded in transverse section and which are traversed by horizontal or weakly concave tabulae. Corallites are separated by a narrow zone of coenenchyme composed of small cysts which lie vertically on each other. In the peripheral part of the polypary the vesicular coenenchyme is entirely or zonally replaced by uniform stereoplasm in which there are sharply separated vertical trabeculae accompanied by vertical rows of cysts. The septal apparatus can be observed at the edges of the calyxes and is weakly developed in the zone of peripheral stereoplasm; it is represented by twelve granular crests.

This genus is closest to *Proheliolites*, the branching forms of which also show an analogous change of the coenenchyme in the outer zone with the formation of continuous stereoplasm".

Discussion. The two species of *Sibiriolites* originally proposed by Sokolov, *reticulatus* and *sibiricus*, were both described from Upper Ordovician rocks and Sokolov (1955, p. 88) considered *Sibiriolites* to be an index of the Upper Ordovician of Siberia. *Sibiriolites koldorakensis* Dzyubo (*in* Khalfin, 1960, pp. 386, 387) was described from Upper Ordovician rocks of the Gorny Altai region and *S. septentrionalis* Preobrazhensky (1968, p. 27) is an Upper Ordovician species from the Yasach River Basin, both also of Siberia. *Sibiriolites elegans* Sokolov and Tesakov (1963, pp. 106, 107) is based on Upper Ordovician material also from the Dolborsky beds of Siberia, both *S. sibiricus* and *S. reticulatus* are present in this rock unit (Sokolov and Tesakov, 1963, pp. 105–108). The material now described from northern Ellesmere Island is also Upper Ordovician, Richmond.

Sibiriolites sibiricus Sokolov 1955

Plate 1, figures 3, 4; Plate 2, figures 1–5

Sibiriolites sibiricus Sokolov, 1955, p. 88, Pl. 79, figs. 1–3, Pl. 80, fig. 1.
Sibiriolites sibiricus Sokolov, Sokolov, 1962, p. 281, Pl. 6, figs. 1a–1c.
Sibiriolites sibiricus Sokolov, Sokolov and Tesakov, 1963, pp. 107, 108, Pl. 25, figs. 3, 4.
?*Sibiriolites* sp., Trettin, 1970, pp. 32, 33.

Material and occurrence. Two coralla (GSC 25524, 25525) collected by W. W. Nassichuk, 1966, from faulted outcrops (GSC loc. C-10, 82°32′N, 75°34′W; Trettin, 1970, p. 33) of the Zebra Cliffs Formation (probably member B), 2.3 miles due east of M'Clintock Inlet, District of Franklin. One corallum (GSC 25526, not illustrated) collected by H. P. Trettin, 1965, from member B of the Zebra Cliffs Formation (GSC loc. 69202, 82°45′N, 76°54′W; Trettin, 1970, p. 32) or just possibly from the underlying Taconite River Formation, 1.5 miles due west of M'Clintock Inlet and 1.3 miles south of Egingwah Bay.

Description. Corallum massive, cylindrical to nodular (largest incomplete corallum 90 by 50 by 55 mm), coenenchymal. In axial region of corallum, tabularia parallel axis before swinging abruptly (Pl. 2, figs. 1, 5) into outer region to be directed orthogonally to surface in peripheral region of corallum. Mature tabularia 1.2 to 1.4 mm in transverse diameter, long, closely packed, mostly 5 or 6 sided in transverse section but rounded by variation in width of coenenchyme. About 12 short septa rarely can be discerned in calicular regions (Pl. 1, fig. 3), formed by projection of trabeculae beyond the coenenchyme. Tabulae mostly entire, flat or slightly bowed upward axially, spacing variable at different levels within corallites, 11 to 23 tabulae in 5 mm; rarely bearing small cystose tabellae (Pl. 2, fig. 5). Coenenchyme in transverse section about 0.2 mm wide at midlength of side of tabularia, thicker at angles and more strongly raised above calyxes. Coenenchyme basically composed of a single row of small, blister-like dissepiments (similar to those of *Cystihalysites*), intervals of trabecular thickening common in axial region and even more prevalent in outer and peripheral (calicular) regions, the dissepiments are interrupted by the thickening, producing an apparently solid, wall-like coenenchyme. Mode of increase unknown.

Discussion. Described species of *Sibiriolites* have been discriminated primarily on the character of size of tabularia. Measurements of the diameter should be restricted to tabularia of mature corallites in the outer or peripheral regions of coralla. Precisely orientated transverse sections allow the most reliable measurements but the wider traverses shown by longitudinal sections can be useful.

The diameter of the tabularia of *S. sibiricus* was originally given as about 1.5 mm (Sokolov, 1955, p. 88) but was later refined as 1.2 to 1.5 mm (Sokolov and Tesakov, 1963, p. 107). Most of the other described species (*reticulatus*, *koldorakensis*, *elegans*) have smaller tabularia. For *S. septentrionalis*, Preobrazhensky (1968, p. 27) gives a range of diameter of 1.3 to 2.0 mm, but from his illustrations it seems possible that the smaller measurements may have been derived from immature corallites and that the tabularia of *septentrionalis* are larger than those of *sibiricus*.

The Ellesmere Island specimens appear to be similar to those described as *S. sibiricus* by Sokolov and by Sokolov and Tesakov but the trabecular thickening is not as completely developed as that shown by Plate 25, figures 3 and 4 of Sokolov and Tesakov. However such thickening is very variable within the suite of specimens from Ellesmere and that shown by a slender cylindrical specimen (Pl. 2, fig. 2) is more common than that shown by more robust specimens (Pl. 2, fig. 3) and seems to be very close to that illustrated by Sokolov (1955, Pl. 79, fig. 1) for the holotype.

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PLATE 1

Chaetetipora ellesmerensis new species (PAGE 4)

Figures 1, 2. Transverse (GSC 25522a) and longitudinal (GSC 25522b) sections from the holotype corallum from GSC loc. 82042; x4. Fig. 2 shows well the variation in spacing of the tabulae.

Sibiriolites sibiricus Sokolov (PAGE 6)

Figure 3. Enlarged transverse section (GSC 25525c) from peripheral region of corallum shown by Pl. 2, fig. 3; x8. Short septa locally detectable, walls solid in most of photograph but, in top part, dissepiments developed within walls of some corallites for which section is positioned below calyxes and at a structurally lower level than elsewhere within photograph.

Figure 4. Enlarged view (x6) of part of transverse section (GSC 25525a) of axial region of specimen shown by Pl. 2, fig. 3; no septa developed, transections of walls show both those formed by dissepiments and by solid trabecular thickening.

PLATE 1

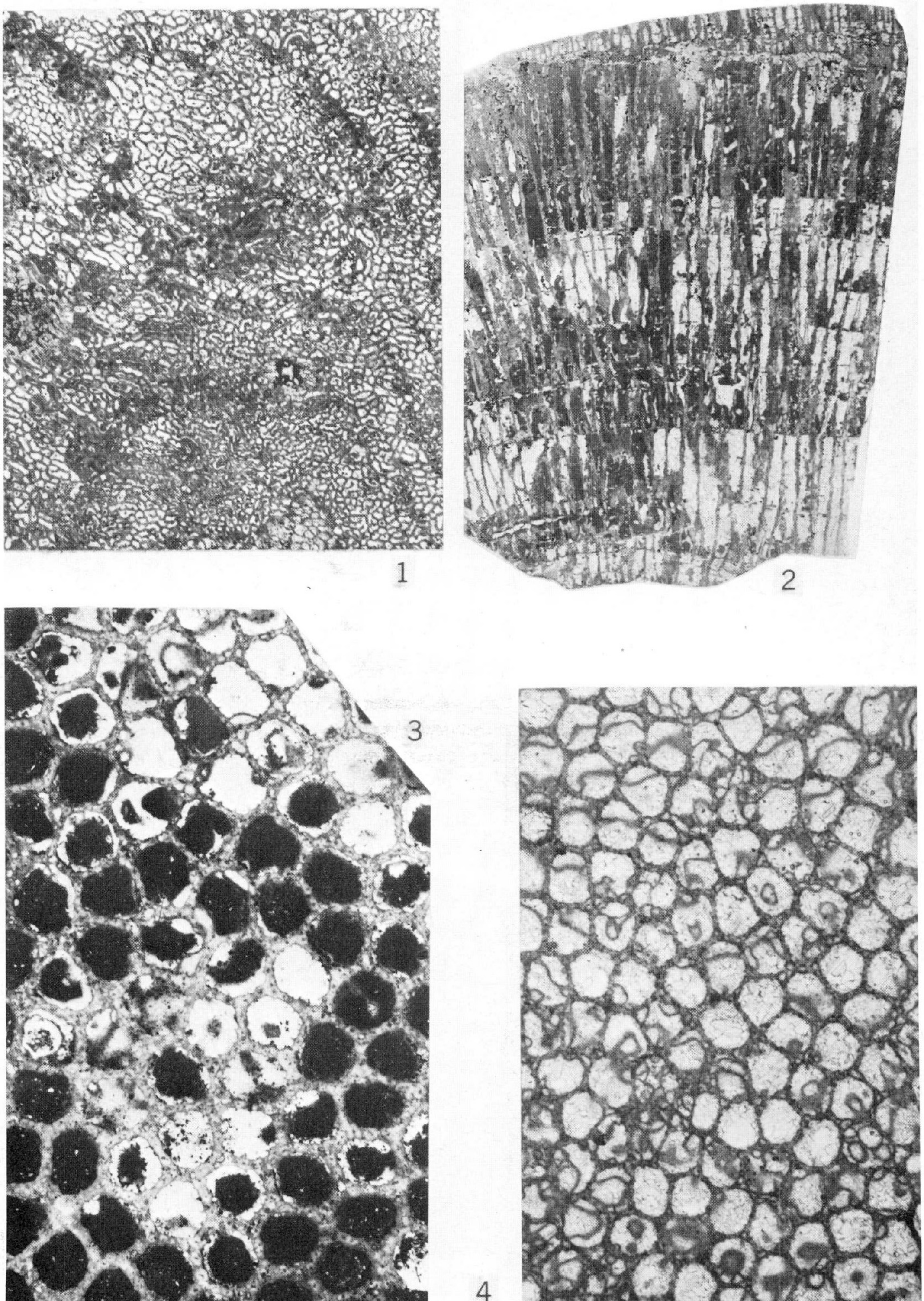


PLATE 2

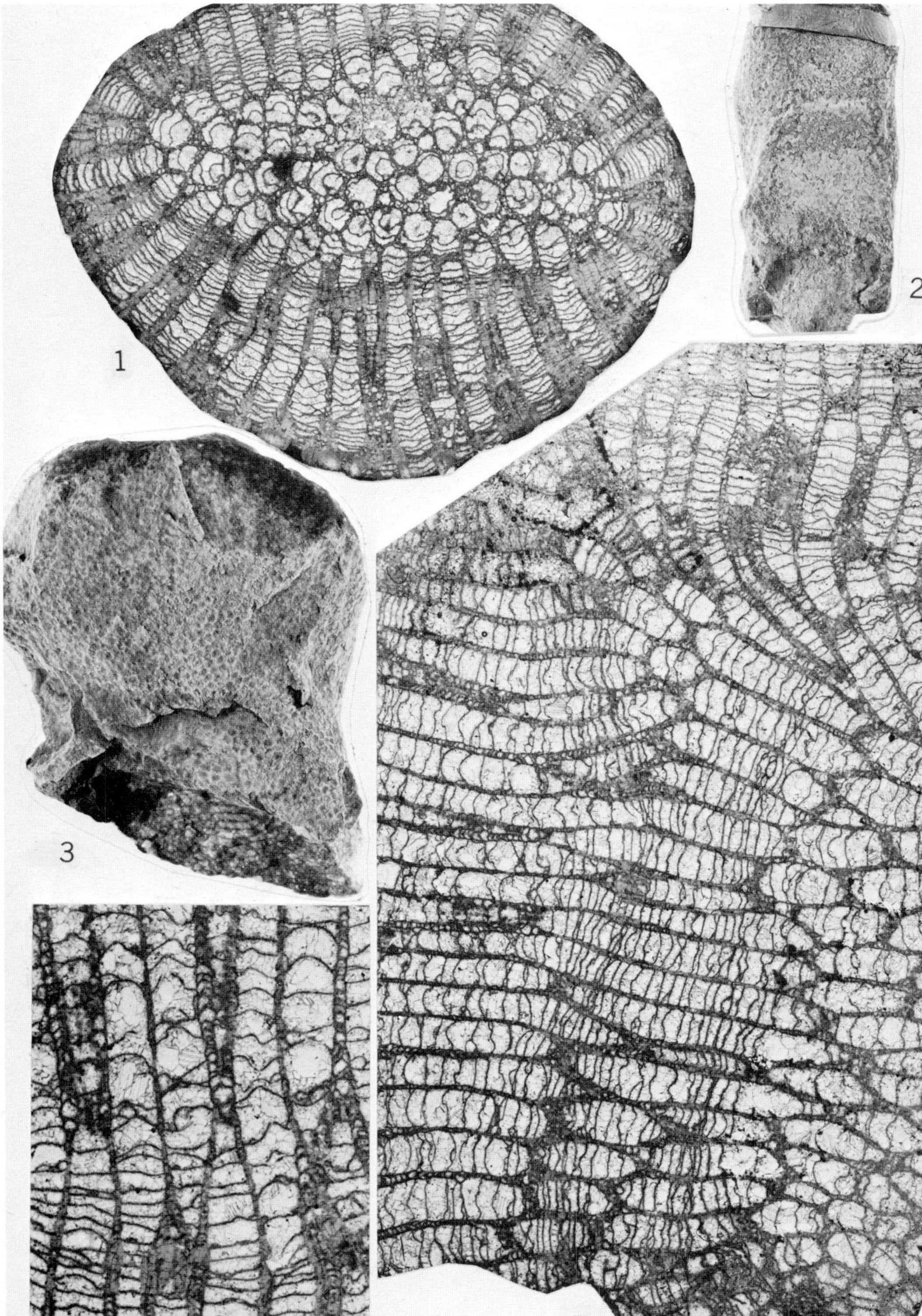
Sibiriolites sibiricus Sokolov (PAGE 6)

Figure 1. Transverse section (GSC 25524a) through corallum shown by fig. 2; x4. Central part is a transverse section through axial region of corallum, outer parts are longitudinal sections through outer and peripheral regions (matrix visible in many calyxes), corallites turn abruptly at junction of axial and outer regions. Within outer region, walls variably solid or formed by dissepiments, lower centre show a section along a wall formed by a row of dissepiments in addition to sections across such walls; within peripheral (or calicular) region, all walls are solid.

Figures 2, 3. Natural size views of two coralla (hypotypes GSC 25524, 25525) from GSC loc. C-10.

Figure 4. Enlarged view (x7) of part of axial region of longitudinal section shown by fig. 5; solid walls and those formed by dissepiments about equally developed; rare small cystose tabellae locally developed on tabulae.

Figure 5. Longitudinal section (GSC 25525b) through axial (centre) and outer (top and bottom) regions of corallum shown by fig. 3; x4; note abrupt turning of corallites at junction of axial and outer regions.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AN UPPER SILURIAN (PRIDOLIAN) CORAL FAUNULE FROM NORTHERN YUKON TERRITORY

by A. E. H. Pedder

Abstract

A coral faunule, consisting of a kodonophyllid, *Migmatophyllum lenzi* n. gen. and sp., and a spongophyllid, *Xystriphyllum pridolicum* n. sp., is described from the Prongs Creek Formation on Prongs Creek, northern Yukon Territory. The fauna is dated as Pridolian by means of associated graptolites.

Résumé

L'auteur décrit une faune corallienne comprenant un kodonophillidé, *Migmatophyllum lenzi*, genre et espèce nouveau, et un spongophillidé, *Xystriphyllum pridolicum*, espèce nouvelle, provenant de la formation de Prongs Creek, sur les bords du ruisseau Prongs, dans le nord du Yukon. Cette faune est attribuée au Pridolien grâce aux graptolites associés.

INTRODUCTION

Post-Ludlovian Silurian corals are undoubtedly present in several regions of the North American continent, including the Arctic Islands, Cordilleran and Appalachian regions, but because they usually occur with shelly faunas their precise age is often conjectural. The small fauna described here is exceptional in this respect, as it can be dated convincingly by means of associated graptolites.

Occurrence and Age

The coral faunule was collected 565 feet above a massive Ordovician limestone on Prongs Creek in the Wernecke Mountains of northern Yukon Territory (Textfig. 15, loc. 17; approximately 65°18'N, 135°40'W). This section was measured by B. S. Norford on Operation Porcupine in 1962. In preliminary reports on the work of Operation Porcupine (Norford, 1964, section 7; Norris, 1967, section 10) the Silurian part of the sequence above Ordovician massive limestone is referred to the Road River Formation and the Devonian part to the Prongs Creek Formation. On this basis the stratigraphic occurrence of the corals would be cited as 565 feet above the base of the Road River Formation. But revisions stemming from A. C. Lenz's 1968 work in the area have lowered the Road River–Prongs Creek formational contact to 510 feet above the massive Ordovician limestone (Lenz and Jackson, 1971); in terms of this more recent classification, the corals are from 55 feet above the base of the Prongs Creek Formation. Although the upper contact of the formation is not exposed in this section, at least 1,500 feet of the formation overlies the coral-bearing horizon.

The matrix of the specimens is a medium grey, rusty flecked, fine- to medium-grained biosparitic limestone.

An early Pridolian graptolite assemblage including *Monograptus bugensius* Teller, *M.* cf. *M. paraformosus* Jackson and Lenz, *M.* aff. *M. kosoviensis* Bouček and *Linograptus posthumus tenuis* Jaeger is identified by Lenz and Jackson (*op. cit.*) from 121 feet below the corals, and another, consisting of *Monograptus* ex gr. *M. transgrediens* Perner and *Linograptus* ex gr. *L. posthumus* Richter, occurs 103 feet below the corals. The lower of these is certainly early Pridolian (Zone of *M. chelmiensis* according to Lenz and Jackson); the other is less diagnostic but is probably also early Pridolian. The same authors report the typical Pridolian brachiopods *Atrypella* sp. and *Gracianella* cf. *G. umbra* (Barrande) from 60 feet above the corals and the late Pridolian graptolite *Monograptus transgrediens praecipuus* (Přibyl) from 135 feet above the corals. Lenz and Jackson consider this subspecies to be an index of the Zone of *M. transgrediens*. From this evidence the coral faunule seems certain to be Pridolian and most likely (Lenz, pers. com., October 1969) to be middle Pridolian. The evidence afforded by the corals is in accord with this. The new species of *Xystriphyllum* most resembles an early Gedinnian form and corals nearest to the new kodonophyllid are all of late Silurian age (Kopaninian and Pridolian).

Acknowledgments

A. C. Lenz provided the material and biostratigraphic information. My concept of the genus *Entelophylloides* is based on a specimen of the type species, *E. inequalis* (Hall) from the Cobleskill Formation of New York, given to me by W. A. Oliver. The typescript has been critically read and improved by B. S. Norford.

SYSTEMATIC PALEONTOLOGY

The prefix GSC refers to specimens catalogued in the type collection of the Geological Survey of Canada, Ottawa.

Class ANTHOZOA
Order RUGOSA
Family Kodonophyllidae Wedekind, 1927?
Genus ***Migmatophyllum*** new

Type species. *Migmatophyllum lenzi* new species.

Diagnosis. Corallum fasciculate, corallites subcylindrical; budding peripheral and possibly lateral. Outer wall of variable thickness. Septa radially arranged in two orders, generally smooth and only slightly dilated, except at the periphery where they may be considerably dilated and carinate. Major septa long, commonly slightly thickened and contiguous at the axis. Trabeculae probably coarsely monacanthate in the prominently dilated parts of the septa. Dissepiments small but increasing in size towards the axis, steeply inclined in several series and at certain levels thinly invested by sclerenchyme. Tabulae incomplete, moderately spaced. Tabularial surfaces elevated at the axis, sigmoidally descending from it.

Discussion. Although preservation in the type specimen leaves doubt as to the exact nature of the minute skeletal structure, traces of characteristic kodonophyllid septal granulation appear here and there. This and the peripheral thickening of some of the septa suggest that the new genus is a kodonophyllid rather than an arachnophyllid (= entelophyllid).

Scyphophyllum Strel'nikov, 1964 (p. 56), based on *S. clavum* from the "early Ludlovian" (Strel'nikov, 1968, p. 71) of the Bol'shaya Tundra and Subpolar Urals, which is probably the most closely related genus, differs in being solitary and having more uniformly dilated septa. *Carinophyllum* Strel'nikov, 1964 (p. 59) differs in having shorter, more uniformly dilated septa and a biseriate tabularium. *Kodonophyllum* Wedekind, 1927 (= *Patrophontes* Lang and Smith, 1927, and *Codonophyllum* Lang, Smith, and Thomas, 1940), *Schlotheimophyllum* Smith, 1945 and *Symphyphyllum* Spasskiy, 1968 have similar tabularia and axial structures, but are distinguished from *Migmatophyllum* by the absence of dissepiments and the presence of a perfectly formed stereozone. *Stereoxylodes* Wang, 1944 has strong zigzag carinae and shorter major septa. *Nanshanophyllum* Yü, 1956 is solitary with consistently carinate septa. In *Petrozium* Smith, 1930 the septa are attenuate both peripherally and axially.

The name, which is neuter, comes from the Greek *migma* = mixture and *phyllon* = leaf.

Migmatophyllum lenzi new genus and species

Plate 3, figures 2, 3, 5, 6; Textfigures 2, 3

Holotype. GSC 25867 from GSC locality C-3226, collected by A. C. Lenz 55 feet above the base of the Prongs Creek Formation (Pridolian part) on Prongs Creek, northern Yukon. No other specimen is known.

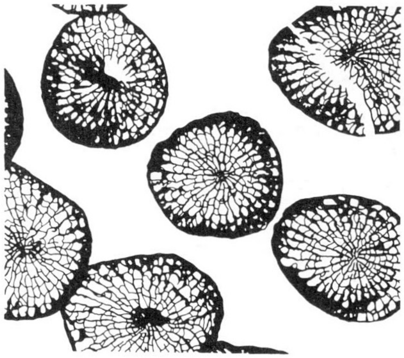
Diagnosis. Species of *Migmatophyllum* with corallites of diameter 6 to 8 mm and 19x2 to 21x2 septa in adult stages.

Description. The holotype is an incomplete phaceloid corallum approximately 10 cm high and 7 cm across its greatest width. Corallites enlarge slowly to a maximum mean diameter of between 6 and 8 mm. Generally they are cylindrical, but may be flattened or concave where they adhere to other corallites, and in places the dissepimentarium reaches out to an adjacent corallite to form a rather crude connecting process. Rejuvenescences are infrequent; the resultant change in diameter is slight. As far as it has been ascertained the mode of budding is peripheral and parricidal, although some corallites may be interpreted as having originated as lateral buds; up to three buds appear at each gemmation.

The thickness of the outer wall in youthful stages is 0.07 to 1.0 mm; subsequently the wall thickens only slightly, although in places it is indistinguishable from enlarged and contiguous septal bases. The fine structure is not well preserved and locally is completely obscured by silicification, nevertheless traces of granulation, possibly owing to coarse kodonophyllid type of trabecular structure, are visible in the peripheral parts of some septa. Septa are smooth to weakly carinate, except at the periphery where they may be strongly carinate to retiform. Although the arrangement is radial in most of the corallite the axial extremities of the major septa may be pinnate. The major septa, which extend to the axis or thereabouts, do not thin and may be slightly dilated towards the axis; some are axially contiguous. Minor septa usually extend to within two and three fifths of the distance to the axis. They are commonly perforate and in places acanthine. In the following table of septal counts corallite diameters are expressed in millimetres.

TEXTFIGURES 2, 3
Migmatophyllum lenzi new genus and species. Based on longitudinal and transverse thin sections of the holotype, GSC 25867; both x3.

2



3

Mean diameter	No. of septa	Mean diameter	No. of septa
2.5	14x2	5.0	18x2
2.8	15x2	5.8	19x2
3.3	14x2	6.1	19x2
4.0	16x2	6.9	20x2
4.6	18x2	8.0	21x2

In adult stages there are two to five, typically three or four series of steeply inclined dissepiments, those of the inner series being distinctly larger and relatively more elongate than those of the outer series. Some are thinly invested by sclerenchyme. The width of the tabularium is one quarter to one third of the total width of the corallite. Tabulae are incomplete and spaced approximately 13 per 5 mm. Tabularial surfaces slope sigmoidally down from the axis.

Remarks. Stereoxylodes argutus Strel'nikov, from the late Ludlovian (possibly Pridolian) of the northern Urals, has a wider dissepimentarium, shorter, more carinate septa and a biseriate tabularium. In *Scyphophyllum clavum* Strel'nikov, which is from the early Ludlovian of the northern Urals, the corallum is solitary, the corallite is larger and has many more septa (up to 30x2) than those of *Migmatophyllum lenzi*, the tabularium is biseriate, and the septa are uniformly dilated.

The species name is a patronym in honour of Professor A. C. Lenz.

Family SPONGOPHYLLIDAE Dybowski, 1873
Genus *Xystriphyllum* Hill, 1939

Xystriphyllum Hill, 1939, p. 62.
?*Pseudospongophyllum* Zhmaev *in* Khalfin, 1955, p. 213.

Type species. *Cyathophyllum dunstani* Etheridge, 1911, from the Douglas Creek Limestone (Emsian), Clermont, Queensland.

Remarks. Xystriphyllum is part of a large plexus of cerioid spongophyllids occurring in strata of Wenlockian to Givetian age in various regions of North America, Eurasia, North Africa, and Australia. Taxonomic treatment of this plexus is complicated and is far from settled. First, because the three earliest described genera, *Spongophyllum* Milne Edwards and Haime, 1851, *Entelophylloides* Rukhin, 1938, and *Kozlowiaphyllum* Rukhin, 1938, are founded on poorly known species that are atypical of the plexus as a whole, and secondly, because almost all workers have overlooked Rukhin's 1938 publication.

For the purposes of the present work *Xystriphyllum* is distinguished from *Spongophyllum* by its prominent minor septa, from *Entelophylloides* by its thickened septal bases and from *Kozlowiaphyllum* (tentatively regarded as a senior synonym of *Australophyllum* Stumm, 1949) by the absence from most corallites of lonsdaleoid dissepiments.

Xystriphyllum pridolicum new species
Plate 3, figures 1, 4; Textfigures 4, 5

Holotype. GSC 25868 from GSC locality C-3226, collected by A. C. Lenz 55 feet above the base of the Prongs Creek Formation (Pridolian part) on Prongs Creek, northern Yukon. No other specimen is known.

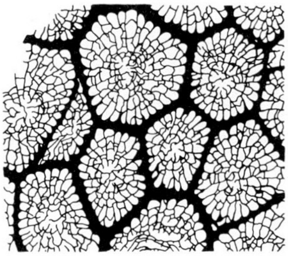
Diagnosis. Species of *Xystriphyllum* with corallite diameter of 4 to 6 mm and septal count of 15x2 or 16x2 in adult corallites. Minor septa well developed. Dissepiments relatively large, in two or three series. Tabularial surfaces shallowly concave, generally spaced about 12 per 5 mm.

Description. Before sectioning, the fragmentary cerioid corallum was approximately 7.5 cm high and 3.5 cm across its greatest diameter. Mean diameters of fully grown corallites range from 4 to 6 mm. Longitudinal sections show the calice to be bell-shaped. Budding is non-parricidal and, although the material has not been prepared to show the earliest stages, appears to be lateral. Offsets occur singly within one of the acute angles formed by the intercorallite wall.

A thin dark axial plate is clearly visible within the intercorallite wall, which is 0.15 to 0.4 mm thick; no other detail of the microstructure is well preserved. The inner part of the wall appears to merge with the septa and is not so well developed in places where the septa are withdrawn. Septa are in two series, smooth to crenulate and wedge-shaped at the periphery. One or several of the major septa may extend to or beyond the axis, the remainder are shorter and may extend only three quarters of the distance to the axis. Minor septa are about one half as long as the major septa. In most corallites there is no septal reduction, in a few however, the septa are perforate and some of the minor cycle are entirely suppressed. Normally there are 15x2 or 16x2 septa in each adult corallite.

TEXTFIGURES 4, 5
Xystriphyllum pridolicum new species. Based on longitudinal and transverse thin sections of the holotype, GSC 25868; both x3.

4



5

There are two or three series of relatively large dissepiments, a few of which are lonsdaleoid. Characteristically the upper surface of the dissepiment is arched, whereas the inner surface is steeply inclined. The tabularium is narrow, normally 1.0 to 1.2 mm in diameter, and mostly consists of shallowly concave, complete and incomplete tabulae. These are typically spaced 12 per 5 mm.

Remarks. The coral illustrated by Zheltonogova (*in* Khalfin, 1961, Pl. S-19, figs. 2a, b) as *Spongophyllum shearsbii* from the early Gedinnian (Rzhonsnitskaya, 1968, table 14) Tom'chumish Beds of the Kuznetsk Basin is close to this species, differing only in having a slightly wider tabularium and possibly more closely spaced tubulae. *S. shearsbii* (Chapman) *sensu stricto* from the late Wenlockian or Kopaninian of southern New South Wales is also similar, but in some specimens (Hill, 1940, Pl. 13, figs. 1, 2) major septa are commonly withdrawn or perforate and the minor septa are poorly developed. *Xystriphyllum praeschlueteri* (Pavlova, 1963, pp. 39, 40, Pl. 5, figs. la–3) from the Gedinnian of southern Fergana is another similar species; by comparison its septa are more numerous (18x2 to 21x2) 2nd more dilated, and its tabulae are more depressed and more closely spaced.

The name *pridolicus, a, um,* refers to the age of the beds in which the species was first found.

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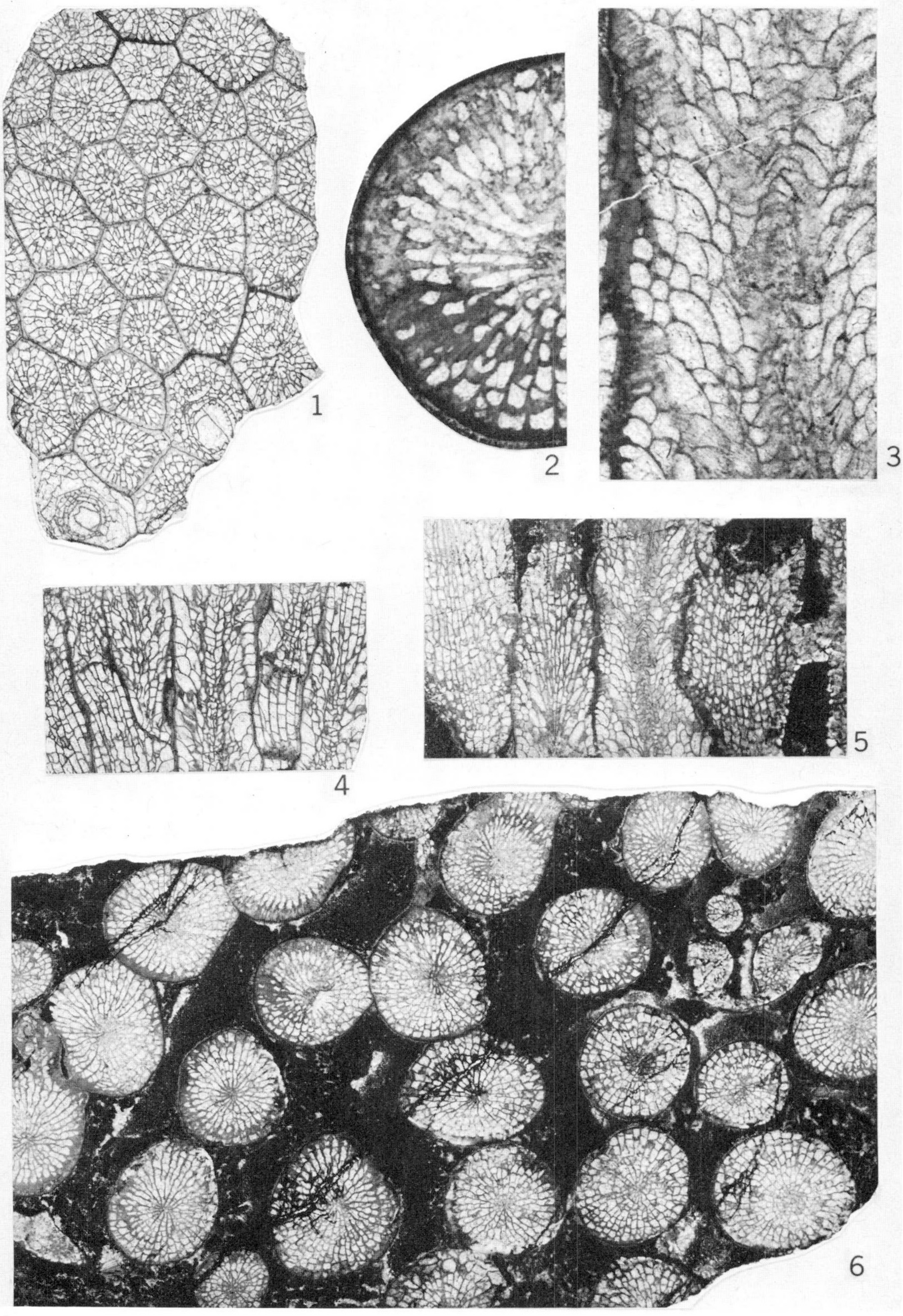
PLATE 3

Xystriphyllum pridolicum new species (PAGE 17)

Figures 1, 4. Transverse and longitudinal thin sections of the holotype, GSC 25868. Pridolian part of the Prongs Creek Formation, Prongs Creek, northern Yukon; both x3.

Migmatophyllum lenzi new genus and species (PAGE 15)

Figures 2, 3, 5, 6. Transverse and longitudinal thin sections of the holotype, GSC 25867. Pridolian part of the Prongs Creek Formation, Prongs Creek, northern Yukon; figs. 2 and 3 are x10, figs. 5 and 6 are x3.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A NEW DEVONIAN HARPID TRILOBITE SPECIES FROM LOWTHER ISLAND, DISTRICT OF FRANKLIN

by Allen R. Ormiston[1]

Abstract

A new species of harpid trilobite, *Kielania triabsidata* is described from Lower Devonian strata on Lowther Island that are probably of late Emsian age.

Résumé

L'auteur décrit une nouvelle espèce de trilobite de type Harpes, *Kielania triabsidata*, provenant de couches du Dévonien inférieur de l'île Lowther, qui datent probablement de la fin de l'Emsien.

INTRODUCTION

In North America harpid trilobites of Devonian age are known only from northern localities (Alaska, Yukon, and Arctic Islands; Ormiston, 1967, 1970), a distribution clearly reflecting ancient animal geography. Until the discovery of *Kielania*, only the genus *Harpes* was known from the Arctic Islands (Ormiston, 1967), but the Devonian record of the family in this region may prove to be more complete. Trilobite evidence (Ormiston, 1967, p. 19) for Old World provincial alliance in Devonian time is supported by the presence of the new species of *Kielania*, for all other known species of the genus are Old World forms.

The Devonian sequence on Lowther Island (Textfig. 1, loc. 5) has been studied and collected by Thorsteinsson but not yet described. Brachiopods from the same collection (GSC loc. C-2682) as *Kielania triabsidata* have been studied by J. G. Johnson and A. J. Boucot, who consider the collection to be of late Late Emsian age. An aseptate smooth species of *Gypidula* is common in the collection and the same species is confined to the *Elythyna* beds at the top of the Upper Emsian in Nevada.

Brachiopods from a stratigraphically lower collection (C-2681) on Lowther Island are dated by Johnson and Boucot as Emsian, probably Late Emsian, and of similar age to some part of the *Eurekaspirifer pinyonensis* Zone of Nevada. A stratigraphically higher collection (C-3217) on Lowther Island contains Eifelian brachiopods according to Johnson and Boucot.

Contrary to the correlation proposed by Ormiston (1969, p. 1110), these Lowther Island beds (especially collections C-2681 and C-2682) appear to be significantly younger than the Drake Bay beds of Prince of Wales Island.

In Europe, *Kielania* is known only from beds of Devonian age, and a Bohemian species of Pragian age most closely resembles the Arctic *Kielania*.

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Acknowledgments

The specimens described in this paper were collected in 1968 by R. Thorsteinsson of the Geological Survey of Canada, who kindly made them available for study. The manuscript has been critically read by W. T. Dean, also of the Survey.

SYSTEMATIC PALEONTOLOGY

The descriptive terminology employed is that of Whittington (1950, Textfig. 1). Prefix GSC refers to specimens in the type collection of the Geological Survey of Canada, Ottawa; MCZ to those in the Museum of Comparative Zoology, Harvard University.

Class TRILOBITA
Family HARPIDAE Hawle and Corda 1847
Genus ***Kielania*** Vaněk 1963

Type species. *Harpes waageni* Prantl and Přibyl, 1954, from the Pragian of Bohemia.

Diagnosis. As Vaněk (1963, p. 229) has emphasized, the most characteristic feature of *Kielania* is the inflated or steeply inclined brim. The fineness of the brim perforations and the tendency to steep genal prolongations are other important unifying characters. There seems to be much variety in glabellar shape and lobation within the genus.

Kielania triabsidata new species

Plate 4, figures 1–6, 9

Diagnosis. A *Kielania* with a pyriform cephalon, stout glabellar outline, pronounced glabellar lobation, deep alae, broad cheek roll, eyes touching inner margin of fringe, strongly convex cheek roll and brim, and genal prolongations nearly vertical posterior to intersection of girder with internal rim.

Material and occurrence. Holotype (GSC 25527), a cephalon lacking only the anterior part of the brim; and one paratype (GSC 25528), a partial cephalon with well-preserved upper lamella; both from a reefoid horizon within an unnamed Lower Devonian unit, GSC loc. C-2682 (Textfig. 1, loc. 5, UTM Zone 14; 544300 m. E; 8279500 m. N.), northwest coast of Lowther Island; collected by R. Thorsteinsson, 1968.

Description. Cephalon of pyriform outline, maximum width in line with eye lobes and equalling three quarters of length (restored) including genal prolongations; estimated length (*sag.*) equal to that of prolongations; height more than one third maximum width. Glabella broad in relation to length, flaring at base, evenly rounded anteriorly. Ratio of glabellar length to width at midlength 1.4:1 as compared with 1.9:1 in *Kielania dorbignyana* (Barrande) (Pl. 4, fig. 8). Glabellar lobation pronounced with distinct 1p, 2p, and 3p furrows; 1p furrow runs initially inward and backward but proximal portion turns to run forward and then forward and outward, 1p lobes trapezoidal in outline, 2p lobe oval not inflated, 3p furrow situated at one third of glabellar length behind anterior margin, 3p lobes small, subquadrate and distinctly inflated (Pl. 4, figs. 1, 2). Axial furrow deep opposite lateral glabellar lobes, but rapidly shallowing anterior to 3p lobe.

Cheek roll broad with inner margin nearly in contact with anterior margin of glabella so that there is almost no preglabellar field. Inner margin of fringe marked by double row of transversely aligned pits. Cheek lobe and brim are strongly convex in cross-section (Pl. 4, fig. 3) and together with the glabella produce a cephalic cross-section of three independent arches (whence the name *triabsidata*). Alae subtrigonal, depressed beneath genal level, more than one third as long (*exsag.*) as glabella and merging anteriorly with deepened axial furrow. Eye lobe situated far forward and in contact with inner margin of fringe, eye ridge indistinct.

Girder marked by smooth band bounded above and below by a row of oversize pits. Girder turns inward and upward to intersect internal rim just behind posterior border. Genal prolongations almost entirely formed by brim, steepen to essentially vertical (Pl. 4, figs. 1, 9) a short distance behind posterior border. In lateral view lower edge of prolongation (Pl. 4, figs. 4 and 5) rapidly rising beyond posterior border. Entire cheek lobe pitted. Pitting of equal size on cheek roll and brim; average diameter of pits about 0.25 mm which is about three times as large as those in *K. dorbignyana* (Pl. 4, fig. 8). A row of larger pits is present inside internal and external rims. Anterior part of the brim is not preserved. Internal and external rims prominent and apparently smooth. Occipital furrow is broad (*sag.*) but not exceptionally deep. Posterior margin of occipital ring convex backwards. Central part of ring is eroded but both specimens show a low node on internal mould suggesting presence of median occipital node. Glabella mostly eroded in both specimens, but anterior part on holotype (Pl. 4, fig. 2) has pustules.

Dimensions (mm)	GSC 25527 Holotype	GSC 25528 Paratype
maximum cephalic height	20.0	17.0
cephalic length (exclusive of prolongation)	(35)	—
cephalic length (inclusive)	(65)	—
maximum cephalic width	47.0	42.0
glabellar width (at midlength)	10.8	9.0
glabellar length	14.6	—

Discussion. Kielania can be divided into two species groups on the basis of brim shape: those exhibiting a strongly convex brim including *K. convexa* (Hawle and Corda), *K. dorbignyana* (Barrande), *K. novaki* (Prantl and Přibyl), and *K. triabsidata* new species; and those with a steeply inclined brim including *K. praecedens* (Prantl and Přibyl), *K. dvorcensis* (Prantl and Přibyl), *K. waageni* (Prantl and Přibyl), *K. kayseri* (Novák) and *K. socialis* (Holzapfel).

Compared with other members of its species group, *K. triabsidata* is readily recognizable by its stout, lobate glabella. The long known Bohemian species *K. dorbignyana* (Barrande, 1846) (Pl. 4, figs. 7, 8) has little beyond generic similarities in common with *triabsidata*. The species most closely resembling *K. triabsidata* is *K. novaki* (Prantl and Přibyl) (1954, p. 151, Pl. 9, fig. 1) originally ascribed to the Middle Devonian Chotéč Limestone of Bohemia, but now known (Chlupáč, 1969, pers. com.) to come from beds of Pragian age. The two species have comparable brim shape, eye position, and genal prolongations. *Kielania triabsidata* has a stouter glabella, more laterally flaring cephalic outline, larger pits in the fringe with these of equal size on brim and cheek roll, and deeper alae than does *K. novaki*.

The presence of *Kielania* in the Devonian of the Soviet Union is suggested by a specimen assigned by Maximova (1960, Pl. 6, figs. 5a and b) to *Harpes reticulatus* (Hawle and Corda). This specimen shows the fine pitting and convex brim typical of *Kielania* and was considered by Lütke (1965, p. 194) to possibly belong to *Harpes convexus* (=*Kielania convexa*). Maximova's specimen differs from *triabsidata* in having a narrow (*trans.*) elongate glabella.

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PLATE 4

Kielania triabsidata new species (PAGE 24)

Figures 1, 3, 4. Dorsal, anterior, and left lateral views of holotype (GSC 25527) from GSC loc. C-2682, showing outline and convexity; x1½.

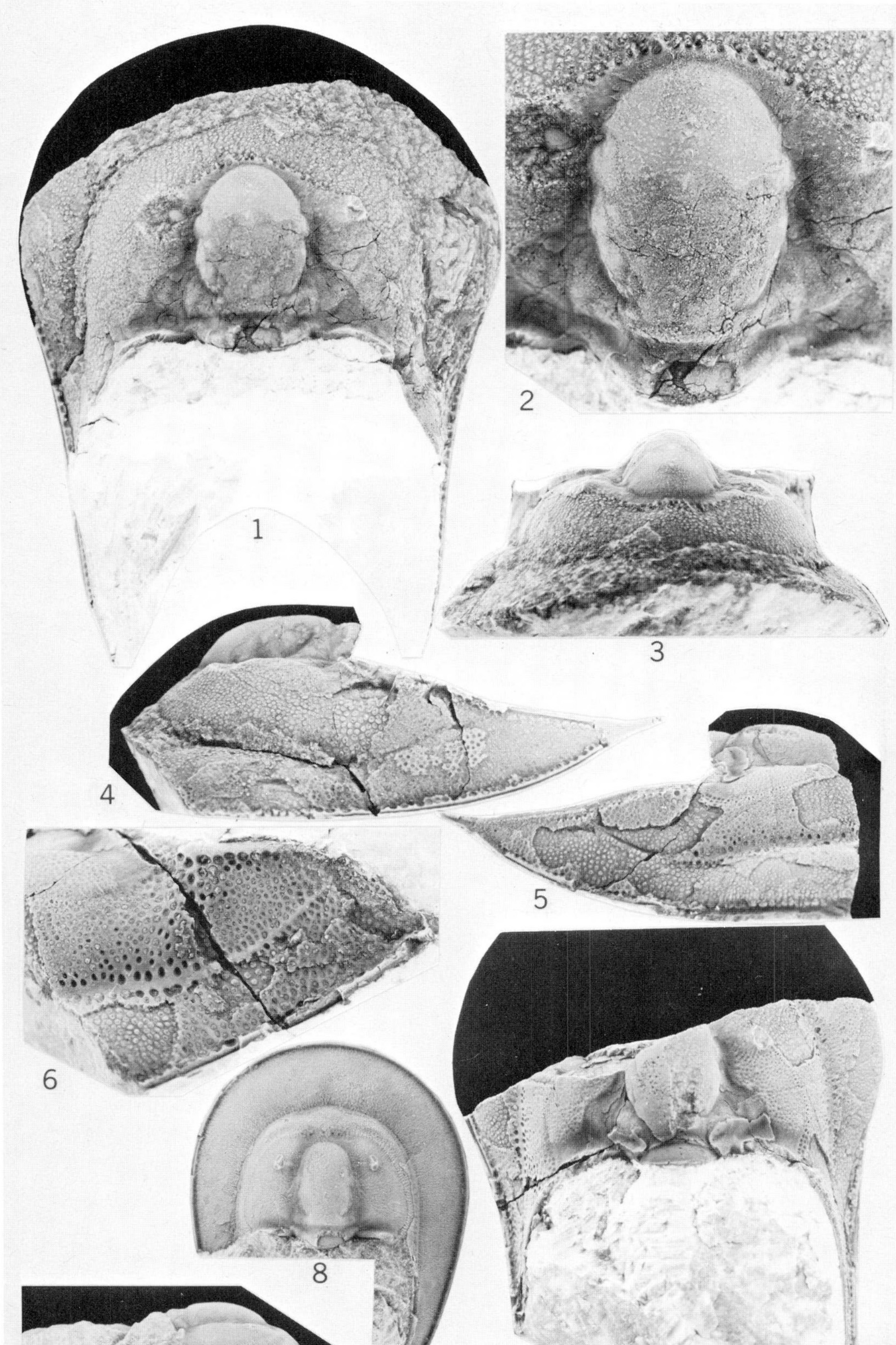
Figure 2. Oblique view of glabellar area of holotype to show pronounced glabellar lobes, wide alae, and fine glabellar ornament; x3.2.

Figures 5, 9. Right lateral and dorsal views of paratype cephalon (GSC 25528) from GSC loc. C-2682, to show convexity of brim and nature of pitting (equal on brim and cheek roll); x1½.

Figure 6. Enlarged view of left side of paratype to show course of girder, internal and external rims, and nature of pitting; x3.2.

Kielania dorbignyana (Barrande, 1846) (PAGE 25)

Figures 7, 8. Right lateral and dorsal views of a cephalon (MCZ 2094) from Branik Limestones, Bohemia, showing slender glabella, fine pitting of cheek roll and brim and convexity of cephalon for comparison with *K. triabsidata;* x2.5.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OCCURRENCES OF CHAROPHYTES IN THE DEVONIAN OF SOUTHEASTERN BRITISH COLUMBIA

by Jerome A. Eyer[1]

Abstract

Eochara wickendeni and *Chovanella burgessi* are reported from the Cedared and Mount Forster Formations and indicate Middle Devonian age for these units.

Résumé

Les espèces *Eochara wickendeni* et *Chovanella burgessi*, signalées dans les formations de Cedared et de Mount Forster, indiquent que ces unités datent du Dévonien moyen.

INTRODUCTION

Several collections of charophytes from the Devonian of Canada have been examined by the writer during the past ten years. Most of the collections are from carbonate rocks. Because the Charophyta secrete calcium carbonate, their fossil remains are composed of calcium carbonate and are thus impossible to separate from a carbonate matrix. Therefore thin sectioning is required for study of the specimens. In some instances, the preserved part of the charophyte, the gyrogonite, has been replaced by silica and can be easily extracted from the carbonate matrix by etching with acids. However, the process of replacement by silica frequently destroys some of the characters that are needed for specific identification and detailed description. Nearly all the characters necessary for specific identification of free specimens can also be determined from thin sections.

Acknowledgments

The manuscript has been critically read by the late H. M. A. Rice of the Geological Survey of Canada. Raymond E. Peck of the University of Missouri, Columbia, aided the writer by reviewing some of his collections from both the United States and Canada. B. S. Norford of the Geological Survey of Canada was very helpful in organizing the paper for publication within this volume.

[1]Continental Oil Company, Ponca City, Oklahoma

DEVONIAN CHAROPHYTA OF WESTERN CANADA

Choquette (1956) first described *Eochara wickendeni* from the Middle Devonian Elk Point Group of the subsurface of Alberta. Peck and Eyer (1963) and Peck and Morales (1966) reported the association of *Eochara wickendeni* Choquette with *Chovanella burgessi* Peck and Eyer in the Middle Devonian Slave Point and Watt Mountain Formations of western Canada.

Recent studies by the Geological Survey of Canada in the mountains of southeastern British Columbia have included the stratigraphy of Devonian units largely equivalent to the Elk Point Group. Belyea and Norford (1967, pp. 38–39) have summarized the stratigraphic relations of the Cedared, Burnais, Mount Forster, and Yahatinda (Aitken, 1966) Formations and the Elk Point Group. Charophytes are virtually the only fossils known from many of these formations.

Both *Eochara wickendeni* Choquette and *Chovanella burgessi* Peck and Eyer have been found in the Cedared, Slave Point, and Watt Mountain Formations. *Chovanella burgessi* is also known from the Mount Forster Formation. Examination of the one collection of charophytes from the Mount Forster Formation shows that other species may be present, but no firm generic identification can be made.

Thorough descriptions and systematic paleontology of both *Eochara* and *Chovanella* species have previously been published by Choquette (1956), Peck and Eyer (1963), and Peck and Morales (1966). Most of the charophytes available to the writer from the Mount Forster and Cedared Formations are contained in carbonates, but the specimens have the same general characters as those previously described. Identifications were made mostly on characters seen and measured in thin sections.

Briefly, *Chovanella* Reitlinger and Yartseva belongs to the family Sycidaceae. Species of *Chovanella* are characterized by gyrogonites having vertical ridges which usually bifurcate near the equator (mid-height) of the specimens. At the apex, the vertical ridges terminate and form a collar around the apical opening (Pl. 5, fig. 3). *Chovanella* is easily distinguished from *Eochara* Choquette in that gyrogonites of *Eochara* are sinistrally spiralled (Pl. 5, fig. 2). *Eochara* is the oldest known genus belonging to the Family Palaeocharaceae. The differences in the orientations of the spiral ridges is the quickest way to differentiate *Chovanella* from *Eochara* when examining free specimens or parts of specimens on weathered carbonate surfaces. When such material is not available one must resort to identification from thin sections of rocks and the enclosed charophytes.

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1963: Representatives of *Chovanella*, a Devonian charophyte in North America; *Micropaleontology*, vol. 9, pp. 97–100.

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OCCURRENCES OF CHAROPHYTES

(Textfig. 1, loc. 7)

GSC loc. No.	Collector	Locality	Coordinates	Formation	Species occurrence
60092	Norford	Hatch Creek Section (Belyea and Norford, 1967, p. 56)	51°00′N 116°23′W	Cedared 420–421 ft. above base of type section	*Chovanella burgessi*
60098	Norford	Pinnacle Creek Section	50°53′N 116°14′W	Cedared 6 inches of beds within about 300–400 ft. below top	*Eochara wickendeni*
57565	Leech	Lussier River	50°04′N 115°31′W	Cedared	*Eochara wickendeni* *Chovanella burgessi*
65065	Leech	Stanford Range	50°25′N 115°50′W	Cedared	*Eochara wickendeni* *Chovanella burgessi*
65066	Leech	Stanford Range	50°27′N 115°46′W	Cedared	*Chovanella burgessi*
65150	Leech	Stanford Range	50°27′N 115°46′W	Cedared	*Eochara wickendeni*
65152	Leech	Stanford Range	50°28′N 115°47′W	Cedared	*Tentaculites* and poorly preserved charophytes
65153	Leech	Stanford Range	50°29′N 115°48′W	Cedared	*Tentaculites* and poorly preserved charophytes
65154	Leech	Stanford Range	50°32′N 115°52′W	Cedared	*Eochara wickendeni* *Chovanella burgessi*
65158	Leech	Stanford Range	50°31′N 115°50′W	Cedared	*Eochara wickendeni* *Chovanella burgessi*
65159	Leech	Stanford Range	50°31′N 115°50′W	Cedared	*Eochara wickendeni* *Chovanella burgessi*
65162	Leech	Stanford Range	50°31′N 115°50′W	Cedared	Vegetative material? or *Tentaculites*?
65093	Leech	Stanford Range	50°30′N 115°54.3′W	Cedared	*Eochara wickendeni* *Chovanella burgessi*
C-476	Norford	Mount Forster	50°36′N 116°17′W	Mount Forster 826–827 ft. above base of type section	*Chovanella burgessi* undetermined charophytes

Plate 5

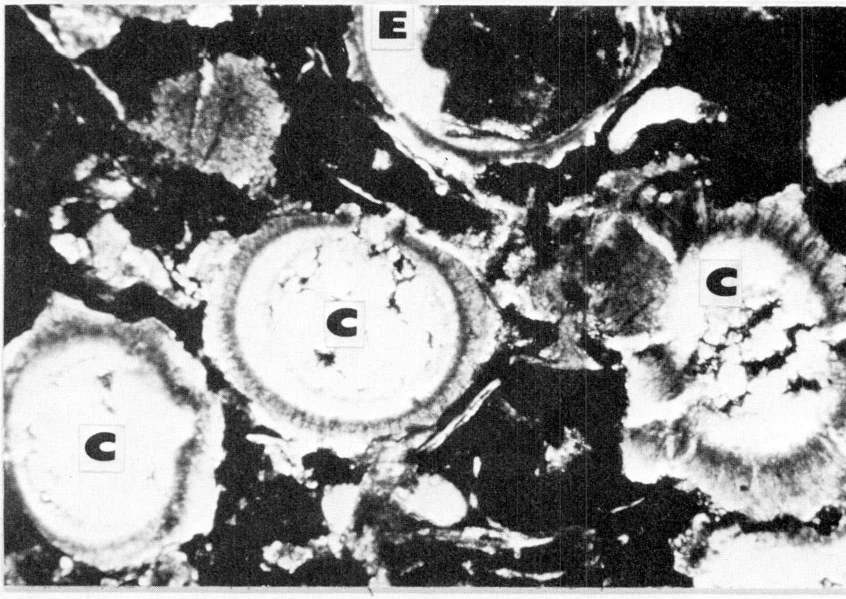
Eochara wickendeni Choquette and *Chovanella burgessi* Peck and Eyer (Page 30)

Figures 1, 4. Random sections of *Chovanella burgessi* (C) and *Eochara wickendeni* (E) from GSC loc. 65066, Cedared Formation, Stanford Range and from GSC loc. 57565, Cedared Formation, Lussier River. *E. wickendeni* has a thinner shell and in lateral section the spiral ridges and furrows are easily seen. Apical and basal pore shapes are very important characters for identification of species; other features can be easily measured. Fig. 1, (GSC 25601), x60; fig. 4 (GSC 25602), x40.

Figure 2. Lateral view of *Eochara wickendeni* (drawing similar to that of Pl. 3, fig. 6 of Peck and Morales, 1966); x55.

Figure 3. Lateral view of *Chovanella burgessi* (drawing similar to that of Pl. 1, fig. 7 of Peck and Eyer, 1963); x70.

Figure 5. Random thin section (GSC 25603) of *Chovanella burgessi*, GSC loc. 57565, Cedared Formation, Lussier River. Apical pore clearly shown; the species possesses vertical cells and thus lateral sections do not show furrows and ridges; x85.



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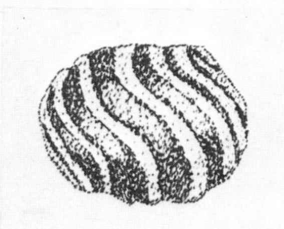

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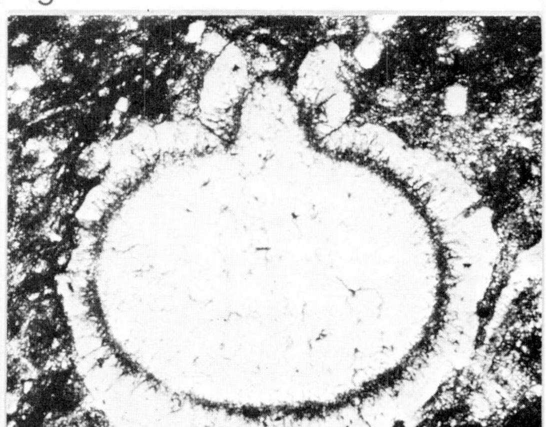


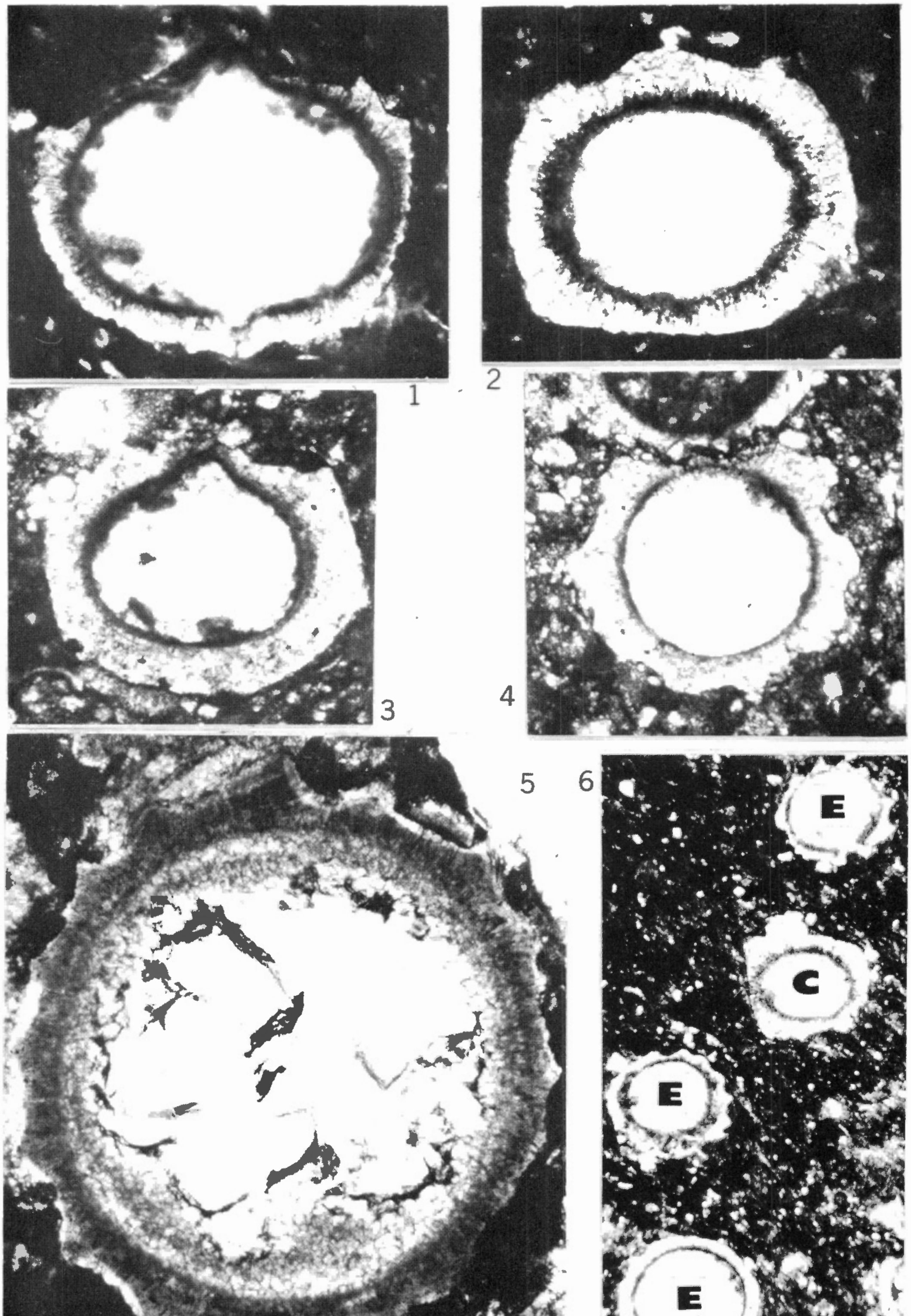
PLATE 6

Eochara wickendeni Choquette and *Chovanella burgessi* Peck and Eyer (PAGE 30)

Figures 1–4. Random cuts of *Chovanella burgessi* in thin sections of limestones; figs. 1 (GSC 25604) and 2 (GSC 25605) from GSC loc. 57565, Cedared Formation, Lussier River; figs. 3 (GSC 25606) and 4 (GSC 25607) from GSC loc. 65093, Cedared Formation, Stanford Range; all x85. The thick shell and absence of furrows and ridges in lateral section is an indication of *C. burgessi* which possesses vertical cells. Figs. 1 and 3 show the apical pore, fig. 1 also shows the basal pore, figs. 2 and 4 show neither the apical nor the basal pore. Fig. 4 is a section cut through the equator and the ridges and furrows of the vertical cells are apparent and can be easily counted, their number is a specific character of *C. burgessi.*

Figure 5. Oblique lateral section (GSC 25608) of *Eochara wickendeni* from GSC loc. 65066, Cedared Formation, Stanford Range; x250.

Figure 6. Random section (GSC 25609) of *Chovanella burgessi* (C) and *Eochara wickendeni* (E) from GSC loc. 57565, Cedared Formation, Lussier River; x40. *E. wickendeni* has a thinner shell and its spiral ridges and furrows are easily seen in sections that are near lateral in orientation.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DOHMOPHYLLUM AND A NEW RELATED GENUS OF CORALS FROM THE MIDDLE DEVONIAN OF NORTHWESTERN CANADA

by A. E. H. Pedder

Abstract

The genus *Dohmophyllum* is reviewed. Three new species are described, viz.: *D. grandicalyx* from the Nahanni, Hume, and possibly the Headless and Ogilvie Formations, *D. muratum* from the Nahanni Formation, and *D. mutabile* from the Hume Formation. A new genus and species, related to *Dohmophyllum* and named *Psydracophyllum lonsdaleiaforme*, is described from the Nahanni and Headless Formations.

The stratigraphy of the formations containing these corals and the difficulties encountered in attempting to correlate them are briefly discussed. No more precise age determination than late Eifelian to early Givetian is possible with the data available.

Résumé

L'auteur passe en revue le genre *Dohmophyllum*. Il décrit trois espèces nouvelles: *D. grandicalyx*, provenant des formations de Nahanni, de Hume, et peut-être aussi de Headless et d'Ogilvie; *D. muratum*, provenant de la formation de Nahanni; et *D. mutabile*, provenant de la formation de Hume. Il décrit un genre et une espèce nouveaux, apparentés à *Dohmophyllum* et auxquels il a donné le nom de *Psydracophyllum lonsdaleiaforme*, provenant des formations de Nahanni et de Headless.

L'auteur expose brièvement la stratigraphie des formations contenant ces coraux et les difficultés rencontrées lors de l'essai de corrélations. Les données disponibles actuellement ne permettent une détermination d'âge plus précise qu'entre l'Eifélien supérieur au Givétien inférieur.

INTRODUCTION

Until now records of the presence of *Dohmophyllum* in North America have been confined to two figures of an undetermined species from the Middle Devonian of the Hart River area of the Yukon (McLaren, Norris and McGregor, 1962), a brief description and figures of two specimens from the Hume Formation, identified as *D. helianthoides* by Lenz (1961) with the comment that the species is more abundant in the Nahanni Formation, and a report of the presence of *D. involutum* in the Middle Devonian of central Oregon (Kleweno and Jeffords, 1962).

Studies currently in hand of the coral faunas of the Hume, Nahanni and Headless Formations reveal the presence of at least three species. They have led also to the recognition of a closely related and hitherto unnamed genus. One of the species of *Dohmophyllum* and the new genus are sufficiently abundant to be considered characteristic of the formations in which they occur.

Acknowledgments

Specimens collected by the author at Sam MacRae Lake and Powell Creek are from sections measured by W. S. MacKenzie. A. W. Norris has discussed the stratigraphy of the Hart River area of the Yukon. The Management of Triad Oil Co. Ltd. has donated to the Geological Survey of Canada their company's specimens mentioned in this work and has made available for publication all the known collecting data of these specimens. The 73 thin sections used were prepared with the considerable assistance of R. Siegenthaler and S. Carbone. The photography is the work of H. J. Hamnet. The manuscript has benefited from the critical reading of D. J. McLaren.

STRATIGRAPHY

The material described is from the Hume, Nahanni and Headless Formations of the western regions of the District of Mackenzie.

The Hume Formation is a richly fossiliferous, commonly argillaceous limestone and shale unit extending from the Anderson River area, westward to just beyond longitude 132°W (between Arctic Red and Cranswick Rivers), where it passes into beds assigned to the Ogilvie Formation, and southward to between latitudes 63° and 63½°N (Dahadinni River area), where it is replaced laterally by the Nahanni and underlying Headless Formations. Southward from Anderson River it thickens from 200 feet to about 250 feet along Hare Indian River and 325 feet in the Norman Range. Westward the thickening is more rapid; in the front ranges of the Mackenzie Mountains the Hume is generally 400 to 600 feet thick and farther west, locally attains thicknesses of more than 800 feet.

The dark, massive limestones of the Nahanni Formation and dark, recessive, argillaceous limestones and shales of the underlying Headless Formation occur over a large area in southwestern District of Mackenzie. They also extend into the southeastern tip of the Yukon and northeastern British Columbia, where they pass into the Dunedin Formation. The combined thickness of the Nahanni and Headless Formations increases from 600 to 800 feet in the plains and front ranges to almost 2,000 feet in some of the more western mountain outcrops, but eventually diminishes to zero as the formations pass into lighter and much less calcareous shales constituting the upper part of the Funeral Formation. The contact between the Nahanni and Headless Formations is markedly diachronous (being later in the west than in the east), and cuts across the two faunal zones recognized in the Hume Formation.

Despite the richness of the shelly faunas of the Hume, Nahanni and Headless Formations, their precise correlation with the Devonian standard is by no means certain. The faunas include a few corals similar to or identical with European species that suggest an early Givetian age (Pedder, 1964), and a distinctive brachiopod, *Carinatina dysmorphostrota* (Crickmay), that closely resembles "*Spinatrypa*" *sinuata* (Cleland) (*see* Griesemer, 1965) from the Lake Church Formation of Wisconsin. Unfortunately the Lake Church itself can be dated only hesitantly as a correlative of the Dundee and Rogers City Limestones of Michigan (Cooper *and others*, 1942), that is with beds that appear to straddle the Eifelian–Givetian boundary (Sanford, 1968).

At certain localities in the Mackenzie Valley the Hume Formation is separated by a stratigraphic interval of less than 10 feet from diagnostic Givetian goniatites (House and

Pedder, 1963); elsewhere the base of the Headless Formation lies 469 feet above a diagnostic Eifelian ammonoid (op. cit.). The Hume fauna also overlies occurrences in the Gossage Formation of the giant ostracod *Moelleritia canadensis*, which is thought to indicate an Eifelian age (Copeland, 1962), and cephalopods in the Landry Formation that suggest an Eifelian or even younger age (Collins, 1969).

Of the new species here described *Dohmophyllum mutabile* and probably *D. grandicalyx* occur in both faunal zones (indexed by *Schuchertella adoceta* and *Carinatina dysmorphostrota*) corresponding to the Hume interval, while *Dohmophyllum muratum* and *Psydracophyllum lonsdaleiaforme* are probably known only from the upper or *dysmorphostrota* Zone. All the species described are possibly of early Givetian age, but may, especially those of the *adoceta* Zone, be late Eifelian. Clearly all come from close to the Eifelian–Givetian boundary.

SYSTEMATIC PALEONTOLOGY

The prefix GSC refers to specimens in the type collection of the Geological Survey of Canada, Ottawa. Details of the localities cited, including faunal lists, are given in a locality index at the end of the work; these localities are also plotted on Textfigure 15.

Class ANTHOZOA

Order RUGOSA

Family Spongophyllidae Dybowski, 1873

Genus ***Dohmophyllum*** Wedekind, 1923

Astrodiscus Ludwig, 1866, pp. 184, 187, 212.
Trematophyllum Wedekind, 1923, pp. 27, 35 (*nomen nudum*).
Dohmophyllum Wedekind, 1923, pp. 28, 35.
Trematophyllum Wedekind, 1924, p. 72.
Sparganophyllum Wedekind, 1925, p. 13.
Pseudoptenophyllum Wedekind, 1925, pp. 60, 78.

Type species. *Dohmophyllum involutum* Wedekind, 1923 (Textfig. 7 on p. 30), lower Middle Devonian, Auburg near Gerolstein, Germany.

Taxa assigned. Cyathophyllum helianthoides Goldfuss, 1826 (type of *Astrodiscus*); ?*Monticularia areolata* Steininger, 1831 (figured 1834); *Cyathophyllum helianthoides* mut. *philocrina* Frech, 1886 (type of *Pseudoptenophyllum*); *Cyathophyllum* (?) *clermontense* Etheridge, 1911; *Cyathophyllum tynocystis* var. *carnica* Vinassa de Regny, 1918; *Dohmophyllum involutum* Wedekind, 1923; ?*Trematophyllum simplex* Wedekind, 1924; *Trematophyllum schulzi* Wedekind, 1924 (type of *Trematophyllum*); *Trematophyllum abbreviatum* Wedekind, 1924; *Dohmophyllum goldfussi* Wedekind, 1924; *Stenophyllum intermedium* Wedekind, 1925; *Stenophyllum implicatum* Wedekind, 1925; *Stenophyllum maximum* Wedekind, 1925; *Sparganophyllum simplex* Wedekind, 1925; *Sparganophyllum gracile* Wedekind, 1925; *Sparganophyllum difficile* Wedekind, 1925 (type of *Sparganophyllum*); *Trematophyllum paradoxum* Kettnerová, 1932; *Cyathophyllum heraklei* Charles, 1933; *Dohmophyllum clarkei* Hill, 1942a, *Astrophyllum irgislense* Soshkina, 1949; *Trematophyllum sutherlandi* Taylor, 1951; *Dohmophyllum pamiri* Ünsalaner, 1951; *Acanthophyllum tenuiseptatum* Bulvanker, 1958; *Ptenophyllum bulvankerae* Spasskiy, 1960a; *Acanthophyllum daedaleum* Spasskiy *in* Dubatolov and Spasskiy, 1964; *Acanthophyllum nikolaievi* Bulvanker, 1965; *Acanthophyllum carinatum* Goryanov *in* Bulvanker and others, 1968; *Acanthophyllum mirable* Cherepnina, 1970; *Dohmophyllum grandicalyx* n. sp.; *Dohmophyllum muratum* n. sp.; *Dohmophyllum mutabile* n. sp.

As Birenheide (1963) has pointed out, many of Wedekind's species are subjective synonyms.

Definition. Solitary to weakly compound tetracorals with subcylindrical to patellate corallites and conical to everted calices. Exterior wall thin, or developed as an enclosure of contiguous wedges formed of trabeculae grouped at, or in positions corresponding to, the septal bases. Septa long, carinate, well differentiated into two, rarely three, orders; peripherally they may be slightly retiform, or replaced by lonsdaleoid, or more commonly naotic dissepiments. Major septa are typically rotated and bear strong flange carinae in the axial region. The dissepimentarium is narrow in early stages, but subsequently widens more rapidly than the tabularium, so that eventually the ratio of the diameter of the tabularium to the diameter of the calice (Dt/Dc) does not exceed 0.31. Individual dissepiments are relatively small, especially adaxially. Tabulae are closely spaced and much disrupted by the rotated ends and carinae of the major septa. Although the tabularial surfaces are highly irregular and variable, they are commonly inwardly inclined near their margin. The boundary between tabularium and dissepimentarium is characteristically sharp and straight.

Discussion. Wedekind used a number of features such as calicular shape, extent to which the major septa are rotated at the axis, colonial or solitary form, to distinguish *Dohmophyllum* from other closely related genera. For good reasons Wedekind's genera have been largely rejected by subsequent workers, who for the most part have preferred to recognize only two genera: *Dohmophyllum,* to include the genera given in the above synonymy, and *Acanthophyllum* Dybowski, 1873, to include *Ptenophyllum* Wedekind, 1923, *Rhopalophyllum* Wedekind, 1924 and *Astrophyllum* Wedekind, 1924. The basis for distinction between these two genera has been either the morphology of the tabularial surface (Hill, 1942a; Ünsalaner, 1951) or the calicular morphology and tabularial diameter of the adult stage (Birenheide, 1963). However, as the shape of the tabularial and calicular surfaces may vary enormously even within one specimen (e.g., holotype of *D. bulvankerae* and some paratypes of *D. mutabile*), and as some species are both solitary and colonial, the most satisfactory distinction that can be made between *Dohmophyllum* and *Acanthophyllum* lies in the ratio of the width of the tabularium to that of the entire corallite (Dt/Dc). In *D. involutum,* the type species of *Dohmophyllum,* and in *A. heterophyllum,* the type species of *Acanthophyllum,* Dt/Dc indices are approximately 0.26 and 0.36 respectively. It is suggested that the arbitrary division between these genera be set at the Dt/Dc ratio in mature stages of 0.31. This is midway between the values pertaining in the two type species, and if accepted would leave all the species revised by Birenheide in his important papers of 1961 and 1963 in the generic categories to which he assigned them. Of the known species that might be referred to these genera, only *D. bulvankerae* with Dt/Dc values in the figured paratypes of 0.26 and 0.27 and in the holotype of 0.3 or more, depending on how much of the coral has been eroded, is assigned with any difficulty.

Some species of *Dohmophyllum* approach *Pseudochonophyllum* Sherzer 1896 (*see* Strusz, 1966 for fresh figures and a reappraisal of the genus). Indeed for many years Soviet workers placed most of their specimens of *Dohmophyllum* in *Pseudochonophyllum* (Soshkina, 1937-1952; Spasskiy, 1955; Cherepnina and Dzyubo, 1962). But in *Pseudochonophyllum,* septal trabeculae are so profusely developed as to displace some of the interseptal loculi in the central region of the dissepimentarium. Other species of *Dohmophyllum* resembled *Taimyrophyllum* Chernychev, 1942 (= *Eddastraea* Hill, 1942) or *Aphroidophyllum* Lenz, 1961, although *Taimyrophyllum* and *Aphroidophyllum* are both genuinely plocoid genera.

Finally it must be pointed out that should Scrutton's (1969) application for the suppression of Ludwig's 1866 work for the purposes of zoological nomenclature be turned down, the appropriate name for *Dohmophyllum* would become *Astrodiscus.*

Distribution. Eifelian, Plymouth, England (Taylor, 1951); undifferentiated Devonian, Torquay, England (Milne Edwards and Haime, 1853); *cultrijugatus* beds, Sarthe, France (Milne Edwards and Haime, 1851); Givetian, Vosges Mountains, France (Firtion, 1957); early Eifelian (including *cultrijugatus* beds) to Givetian, Cabrières, southern France (Frech, 1887); Givetian, central Morocco (Termier and Termier, 1950); late Eifelian to early Givetian, Belgium (Tsien, 1968); early Eifelian to early Givetian, Eifel region of Germany (Salée, 1910; Birenheide, 1963); late Givetian, central Czechoslovakia (Quenstedt, 1879, 1881; Kettnerovā, 1932); Givetian, near Graz, Austria (Penecke, 1894); undifferentiated Devonian and Givetian, Carnic Alps of southern Austria (Frech, 1888; Charlesworth, 1914); Middle Devonian, Carnic Alps of northern Italy (Penecke, 1887; Vinassa de Regny, 1918; Assereto, 1962); undifferentiated Devonian, Heraclea, Turkey (Charles, 1933); "Upper Devonian", Adana region, Turkey (Ünsalaner, 1951); late Eifelian, Armenia (Soshkina, 1952; Spasskiy, 1960a) Givetian, Yugorskiy Shar coast (Dubatolov and Spasskiy, 1964); Emsian and Eifelian, northern Urals (Soshkina, 1937, 1949; Soshkina ? *in* Sokolov, 1962); early Givetian, central Urals (Soshkina, 1949); Eifelian, southern Urals (Soshkina, 1949; Spasskiy, 1955); late Siegenian or Emsian, Zeravshan Range (Goryanov *in* Bulvanker *and others*, 1968); Eifelian, Rudny Altai (Spasskiy, 1960a); Emsian, Kuzbass Basin (Soshkina ? *in* Sokolov, 1962); Emsian and Eifelian, Salair region of the Kuznetsk Basin (Bulvanker, 1958; Zheltonogova *in* Khalfin, 1961); Siegenian or early Emsian, Kireevskie region of the Gorny Altai (Cherepnina, 1970); Emsian, Peschanaya River, Gorny Altai (Cherepnina and Dzyubo, 1962); Eifelian, Bukhtarma River, Gorny Altai (Spasskiy, 1960b); Eifelian, Mongolian Altai (Spasskiy, 1960b); Emsian ? and Eifelian, Omulevsk Mountains (Bulvanker, 1965); Givetian, northern Queensland (Hill, 1942a; Hill, Playford, and Woods, 1967); Emsian, east-central Queensland (Hill, 1939); late Emsian and Eifelian, Tamworth area, New South Wales (Hill, 1942b); Givetian, Isis Valley, New South Wales (Pedder, 1968; Pedder, Jackson, and Ellenor, 1970); Emsian ?, Murrumbidgee River, New South Wales (Hill, 1940); Emsian, Buchan, Victoria (Hill, 1949); Middle Devonian, Hart River Yukon (McLaren, Norris, and McGregor, 1962); late Eifelian or early Givetian, western District of Mackenzie (Lenz, 1961; this contribution); ? Middle Devonian, central Oregon (Kleweno and Jeffords, 1962).

The corals figured as *Cyathophyllum helianthoides* from the Middle Devonian of Padaukpin, Burma (Reed, 1908) and Poshi, Yunnan (Mansuy, 1912) are a probable cyathophyllid and *Sinospongophyllum conicum* respectively (*see* Fontaine, 1966). There is no evidence at present of any occurrence of *Dohmophyllum* in southeast Asia. Other corals ascribed to *Dohmophyllum* from the Lower Devonian of Victoria by Philip (1962) and Talent (1963) are species of *Sterictophyllum* (*see* Pedder, 1965) and *Paradisphyllum.*

Dohmophyllum grandicalyx new species

Plate 7, figures 1–4; Plate 8, figures 3, 5; ? Plate 15, figures 1, 4

?*Dohmophyllum* sp. A, McLaren and Norris *in* McLaren, Norris and McGregor, 1962, Pl. 1, figs. 1, 2.

Material. Holotype: GSC 25816, Nahanni Formation at locality 15c. Four paratypes: GSC 25817, 25818, Nahanni Formation at locality 15c; GSC 25819, Nahanni Formation at locality 16c; GSC 25820, Hume Formation at locality 8.

GSC 25821 from the Headless Formation at locality 12a may belong here, but is expressly excluded from the type series.

Diagnosis. Corallum solitary, turbinate to trochoid with approximate maximum height 8 cm and diameter 8.5 cm. Calice conical. Dt/Dc in fully or nearly fully grown specimens

0.16 to 0.26 (mean of 3 measurements 0.23). Outer wall delicate in mature stages (0.15 to 0.5 mm thick). Adult septa 38x2 to 41x2 in number, axially rotated, peripherally withdrawn. Outermost dissepiments lonsdaleoid in late stages.

Description. Corallum simple, turbinate to trochoid with a maximum known height of approximately 8 cm and diameter 8.5 cm. The calice, which in the primary material is seen only in longitudinal sections, is large and conical with no marked calicular platform.

Sclerenchyme reinforces the outer wall in early stages, but in late stages the wall is thin (0.15 to 0.5 mm thick) and commonly eroded. The septa have radial arrangement and, apart from sporadic traces of tertiary septa, are in two series. They extend across the entire dissepimentarium in youthful stages; later they retreat leaving only a few scattered trabeculae in the peripheral region. The septa are carinate and thin to slightly dilated in the dissepimentarium; in the tabularium they are more strongly carinate and rotated, and may be moderately dilated. There are from 38x2 to 41x2 septa in adult stages. Minor septa differ from the major septa only by being excluded from all except the outermost part of the tabularium.

Initially the dissepimentarium is narrow with just a few series of dissepiments; subsequently it becomes relatively much more developed, normally consisting of 15 to 25 series of dissepiments. Dissepiments bridge the interseptal loculi in the normal manner and are steeply inclined in early stages; in adult stages some fail to completely cross the interseptal loculi and they may also be less inflated and less steeply inclined. The outermost dissepiments in adult stages are lonsdaleoid, but generally are not particularly large. The transition from dissepimentarium to tabularium is abrupt and straight as viewed in longitudinal section. Tabulae are closely spaced and repeatedly disrupted by the rotated axial parts of the major septa; some are distinctly vesicular. The tabularial surfaces are generally flat or inwardly sloping around the periphery of the tabularium, but become extremely irregularly inclined towards the axis. In the following table measurements are in mm, Dt is the diameter of the tabularium and Dc of the calice or corallite.

Specimen	Mean or measurable Dt	Mean or measurable Dc	Dt/Dc	No. of Septa	Preparation
25820	7	14	0.50	—	longitudinal section
25816	13	23	.57	29x2	transverse section
25819	13.5	84	.16	40x2	transverse section
25820	14	36	.39	—	longitudinal section
25820	16	62	.26	38x2	transverse section
25816	16.5	34	.49	—	longitudinal section
25820	17	44	.39	37x2	transverse section
25816	17	64	.27	—	longitudinal section
25816	17.5	83	.21	41x2	transverse section

Remarks. In the shape of the calice this species resembles *Dohmophyllum difficile* (Wedekind) from the late Eifelian and early Givetian of Germany and *D. clarkei* Hill from the Givetian of Queensland. These species, however, invariably have fully developed septa and no lonsdaleoid dissepiments.

The specimen figured by McLaren and Norris as *Dohmophyllum* sp. A, which is probably from the Ogilvie Formation of northern Yukon Territory, may belong to *D. grandicalyx* although its septa are more dilated than is usual for the species and it has a bell- rather than a cone-shaped calice. Further study of the Ogilvie coral fauna is desirable before a more definite identification of the specimen is attempted.

Another specimen tentatively associated with this species is GSC 25821 from the Headless Formation. It is poorly preserved and is probably not fully grown. Its tabularium is wide and distinctly arched periaxially, and its dissepimentarium is coarser than that of typical specimens of *D. grandicalyx:*

The species name is from the Latin *grandis* = large and *calyx* = cup.

Distribution. Nahanni and possibly Headless Formations of southwest District of Mackenzie; Hume Formation (probably *Carinatina dysmorphostrota* Zone) of northwest District of Mackenzie; possibly from the Ogilvie Formation of the Hart River area of northern Yukon Territory.

Dohmophyllum muratum new species

Plate 8, figures 1, 2, 4; Plate 9, figure 1

Material. Holotype: GSC 25822, Nahanni Formation at locality 16c. Two paratypes: GSC 25823, 25824, Nahanni Formation at locality 16c.

Diagnosis. Corallum weakly fasciculate; corallites trochoid to turbinate with maximum known height of between 4 and 5 cm and diameter 5.5 cm. Budding peripheral and usually parricidal. Calices bell- to saucer-shaped. Dt/Dc in adult stages 0.18 to 0.29. Outer wall normally strongly reinforced by trabeculae and sclerenchyme, typically so arranged that the inner surface of the wall is undulating; thickest parts of the wall commonly 0.5 to 1.0 mm. Septa 35x2 to 37x2 at maturity, moderately to strongly carinate, mostly withdrawn leaving a lonsdaleoid, locally tending towards a naotic dissepimentarium.

Description. One specimen (GSC 25823) is an incomplete, apparently solitary corallite of trochoid form; the other two specimens available are weakly colonial, each consisting of a small cluster of trochoid to turbinate corallites, having a maximum height of between 4 and 5 cm and diameter of 5.5 cm. Budding is peripheral, involving two or more offsets, and may be either parricidal or non-parricidal. In mature corallites the calice is saucer- to bell-shaped; in all the offsets examined it is bell-shaped. Dt/Dc values obtained in young stages are 0.35 and 0.50, and in adult stages 0.18 and 0.29.

The species characteristically has a strong outer wall which, unlike that of many other species of *Dohmophyllum*, persists between closely contiguous corallites, so that colonies show no tendency to become plocoid. Locally the outer wall is only 1.3 mm thick, but owing to both sclerenchymal and trabecular buildup on the interior, especially at, or in positions corresponding to the septal bases, its thickness at these positions is commonly 0.5 to 1.0 mm and may be as much as 2.0 mm. In adult stages there are 35x2 to 37x2 radially arranged and moderately carinate septa. Major septa are long and strongly rotated in the axial region. Minor septa resemble the major septa with the exception that they terminate near the margin of the tabularium. Although some septal dilation occurs in the inner region of the dissepimentarium, it is not pronounced; in places sclerenchyme and trabeculae spread from the septa on to intervening dissepimental surfaces. Peripherally the septa may be continuous, perforate, or entirely withdrawn. Short, dissociated or grouped trabeculae and some sclerenchyme are usually present in the peripheral region where the septa are not continuous. These trabeculae mostly show a naotic arrangement; a few are aligned with withdrawn septa.

The dissepimentarium is at first narrow with only one or a few series of steeply inclined and well-inflated dissepiments. Further series are added quickly during development and eventually about 20 are present. In late stages the outer dissepiments may be flatter lying and less inflated, and are commonly larger than the early dissepiments; they may not entirely bridge the interseptal loculi and where the septa are withdrawn are lonsdaleoid, in places tending towards naotic. The tabulae are closely spaced and may be vesicular. Peripherally they tend to slope towards the axis, elsewhere their inclination is highly variable and they are repeatedly dissected by the rotated major septa. In the following table measurements are in mm, Dt is the diameter of the tabularium and Dc of the corallite or calice.

Specimen	Mean or measurable Dt	Mean or measurable Dc	Dt/Dc	No. of Septa	Preparation
25824	4	11.4	0.35	32	transverse section
25824	8.5	17	.50	23x2	oblique section
24823	10	54	.18	—	longitudinal section
25822	12	42	.29	35x2	transverse section

Remarks. Dohmophyllum paradoxum (Kettnerová), which derives from the Givetian of Czechoslovakia and has a similarly developed outer wall, is distinguished from *D. muratum* by its considerably thicker and peripherally complete septa and its prominently developed tertiary septa. The German Eifelian and Givetian species *D. involutum* (Wedekind), which also has a well-formed wall, differs from the new species in its narrower, invariably solitary form and septa, which are normally complete and locally slightly retiform in the peripheral region.

The species name comes from the Latin *muratus* meaning walled.

Distribution. Nahanni Formation of southwestern District of Mackenzie.

Dohmophyllum mutabile new species

Plate 9, figure 2; Plate 10, figures 1, 2; Plate 11, figures 1, 2;
Plate 12, figures 1–5; Plate 13, figures 1–6

Dohmophyllum helianthoides (Goldfuss), Lenz (in part?, *not* Goldfuss), pp. 507, 508, Pl. 1, figs. 17, 18.

Material. Holotype: GSC 25825, Hume Formation at locality 10a. Nineteen paratypes: GSC 25826, 25827, Hume Formation at locality 10a; GSC 25828, Hume Formation at locality 1; GSC 25829, Hume Formation at locality 2; GSC 25830, 25831, Hume Formation at locality 3; GSC 25832–25834, Hume Formation at locality 4; GSC 25835, Hume Formation at locality 5a; GSC 25836, Hume Formation at locality 5b; GSC 25837, Hume

Formation at locality 5c; GSC 25838, Hume Formation at locality 5d; GSC 25839–25842, Hume Formation at locality 7; GSC 25843, Hume Formation at locality 9; GSC 25844, Hume Formation at locality 10b.

Diagnosis. Corallum solitary to weakly plocoid. Corallites large with maximum height and diameter both approximately 10 cm. Peripheral platform strongly reflexed, at least in part, and broad (where Dt is greater than 10 mm, Dt/Dc is 0.21 to 0.30, with a mean of 0.26). Outer wall 0.1 to 0.2 mm thick. Septa 34x2 to 52x2 in number at maturity, axially rotated and peripherally withdrawn. Dissepimentarium markedly naotic in the marginal region.

Description. The corallum is solitary, subcylindrical to almost patellate, or colonial with offsets that are usually at first discrete, but later coalesce to form a weakly plocoid colony. Solitary forms are known to grow to a diameter and height of between 10 and 11 cm; the greatest height and diameter observed in colonial forms are 7 and 14 cm. Long subcylindrical corallites show signs of having been frequently rejuvenated. Calices of adult specimens have prominent, although somewhat variable peripheral platforms which are typically strongly reflexed, in some cases so much so that the superior face is draped vertically about the corallite. In some specimens part of the platform is poorly developed and may be inwardly inclined. Offsets occur in about 15 per cent of the specimens examined. They may be solitary, or as many as four are produced simultaneously. The offsets are mostly lateral and originate near the periphery of a parent having a broad calicular platform; they are non-parricidal. In GSC 25839 the offsets are peripheral and may have been parricidal. The thin outer wall investing the offsets is lost as soon as the offsets have enlarged sufficiently to become contiguous.

In most specimens the outer wall, which is only 0.1 to 0.2 mm thick, is severely eroded; in some it is almost entirely absent. The septa are radially arranged and number 37x2 to 52x2 in adult corallites. They are withdrawn from the periphery in mature stages and rotated in the axial region, where they are commonly dilated and invariably bear strong septal flanges. Septal dilation is also common in the central region of the dissepimentarium and usually spreads onto intervening dissepimental surfaces; it is caused by buildup of both sclerenchyme and trabeculae. Minor septa only just project into the tabularium and by comparison with the major septa are thinner and more perforate. Short trabeculae are profusely developed in the naotic region of the coral and also occur sporadically in the interseptal loculi of the more adaxial parts of the dissepimentarium.

In early stages the dissepimentarium is narrow and inwardly sloping; subsequently it increases relatively more than the tabularium and in late stages consists of 15 to 35 series of dissepiments. Peripheral dissepiments, underlying the reflexed part of the calicular platform, are normally naotic, much less commonly lonsdaleoid. Adaxially from the naotic region dissepiments are typically broad and rather feebly inflated and are commonly lateral to chevron-shaped when viewed in transverse sections. The innermost dissepiments are smaller, more fully inflated and distinctly inwardly inclined. Transition from dissepimentarium to tabularium is regular and abrupt. Tabulae are extremely numerous, closely spaced and sinuous to locally even vesicular; because of the axial rotation of the septa they are much disrupted. At the periphery tabularial surfaces typically slope towards the axis; periaxially they are highly variable and may be either depressed or elevated. In the following table measurements are in mm, Dt is the diameter of the tabularium and Dc of the corallite or calice.

Specimen	Mean or measurable Dt	Mean or measurable Dc	Dt/Dc	No. of Septa	Preparation
25830	4.2	11	0.38	—	longitudinal section
25831	5.3	13	.41	17x2	oblique section (offset)
25838	6	12	.50	24x2	transverse section
25835	7	10.5	.67	not countable	unprepared
25834	7	11.5	.61	—	longitudinal section
25838	8.5	25	.34	—	longitudinal section
25834	9	20	.44	—	longitudinal section
25829	9	23	.39	—	longitudinal section
25835	10	40	.25	42x2	unprepared
25831	11	39.5	.28	34x2	transverse section
25830	11	48	.23	—	longitudinal section
25838	11.5	41	.28	40x2	transverse section
25829	13	56	.23	—	longitudinal section
25834	13	60	.22	—	longitudinal section
25832	14	47	.30	—	longitudinal section
25838	14	50	.28	—	longitudinal section
25826	15	50	.30	—	longitudinal section
25839	15.5	52	.30	47x2	transverse section
25843	16	55	.29	43x2	polished transverse face
25833	16	60	.27	41x2	transverse section
25826	17	64	.27	—	longitudinal section
25825	17	71	.24	48x2	transverse section
25832	21	101	.21	47x2	transverse section
25827	25	103	.24	52x2	unprepared

Remarks. Dohmophyllum tenuiseptatum (Bulvanker) from late Eifelian strata of the Kuznetsk Basin is a similar species, but is described as being entirely solitary, furthermore it has less naotic structure, a less everted calicular platform and less densely spaced septa (39x2 at 75 mm diameter). The Eifelian and Givetian species *Dohmophyllum helianthoides* (Goldfuss) has recently been revised by Birenheide (1963). It is also similar to *D. mutabile*, but is apparently invariably solitary, lacks naotic dissepiments, and generally has a less everted calicular platform. The transverse section of the holotype of *Stenophyllum maximum* Wedekind from the Givetian of Germany suggests another similar species; according to Birenheide (1962), however, this specimen is merely a large example of *Dohmophyllum difficile* (Wedekind) and therefore should have a very different dissepimentarium. The Turkish species *Dohmophyllum pamiri* Ünsalaner resembles *D. mutabile* in being weakly plocoid; it differs in having septa that are much more uniform in thickness and carination, and does not have a naotic peripheral region.

The trivial name is from the Latin *mutabilis* meaning changeable, a reference to the highly variable form of the corallum.

Distribution. Hume Formation (*Schuchertella adoceta* and *Carinatina dysmorphostrota* Zones) of western District of Mackenzie.

Genus ***Psydracophyllum*** new

Type species. *Psydracophyllum lonsdaleiaforme* n. sp.

Diagnosis. Corallum weakly to moderately dendroid. Increase lateral. Dt/Dc in only species currently assigned 0.17 to 0.28 with a mean of 0.22. Septa radially to pinnately arranged, smooth to strongly carinate, mostly peripherally withdrawn at all stages and commonly reduced in both length and number in the latest stages of development. Dissepiments numerous, large, lonsdaleoid in the outer region of the dissepimentarium. Tabulae closely spaced, incomplete, variably inclined.

Remarks. Most species of *Dohmophyllum* are either solitary or plocoid and do not have a well-developed lonsdaleoid dissepimentarium. Those that are dendroid or possess lonsdaleoid dissepiments are distinguished from *Psydracophyllum* by the late appearance of the lonsdaleoid dissepiments and by the Dt/Dc ratios, which do not decrease during ontogeny. In *Psydracophyllum*, Dt/Dc values are similar throughout development and the lonsdaleoid dissepimentarium is evident from the very earliest stages. *Grypophyllum* Wedekind, 1922 is a solitary genus characterized by septa that are normally entirely smooth and clearly embedded in the outer wall to give the so-called "pseudosockel" of German authors. Furthermore in *Grypophyllum* lonsdaleoid dissepiments are either absent, or present on a modest scale in advanced stages only.

Although unrelated, some specimens of the early Carboniferous genus *Vesiculophyllum* Easton, 1944 (= *Kakwiphyllum* Sutherland, 1958) resemble *Psydracophyllum.* There are, however, differences in microstructure (uniformly fibro-normal in *Vesiculophyllum*) and tabularium (tabulae more widely spaced in *Vesiculophyllum*).

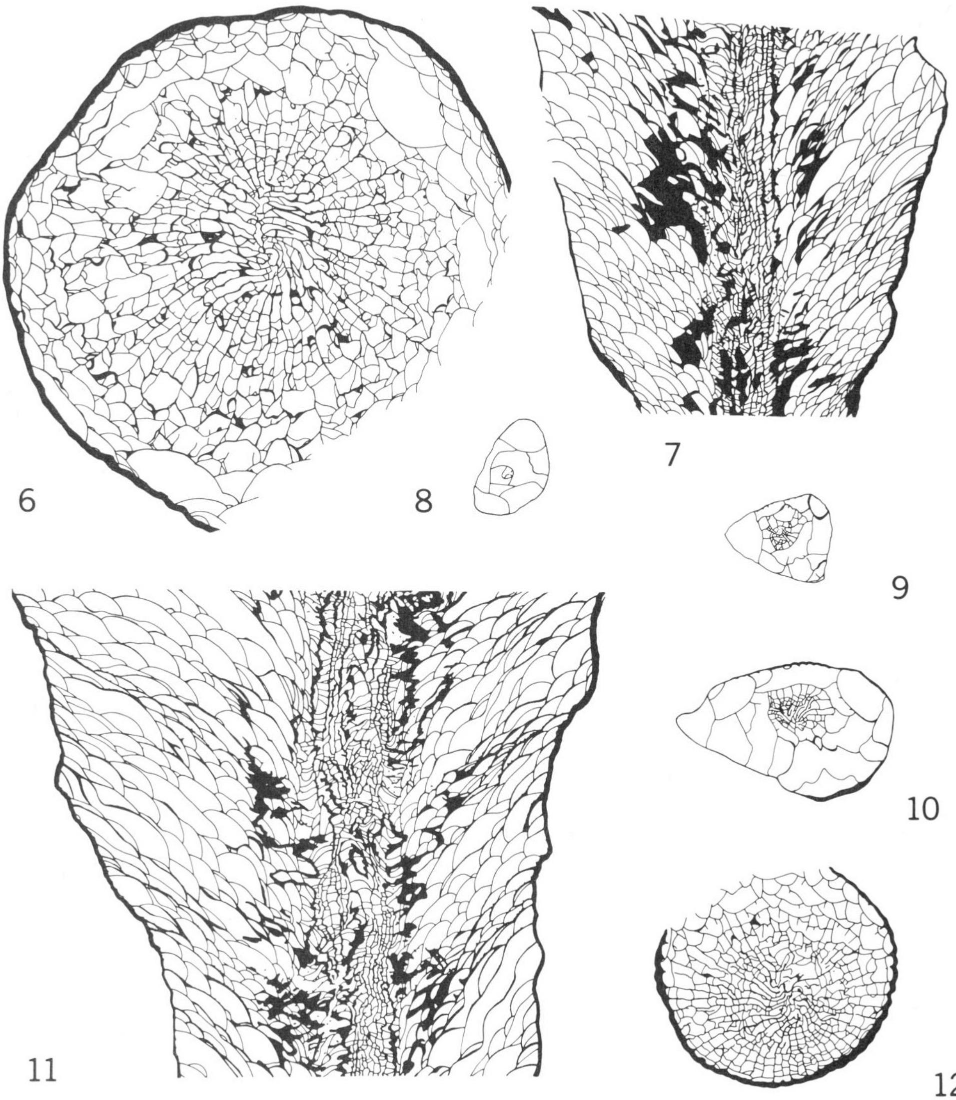
The name is taken from the Greek ψνδραε = blister, and øνʌʌον = leaf, and is neuter.

Psydracophyllum lonsdaleiaforme new species

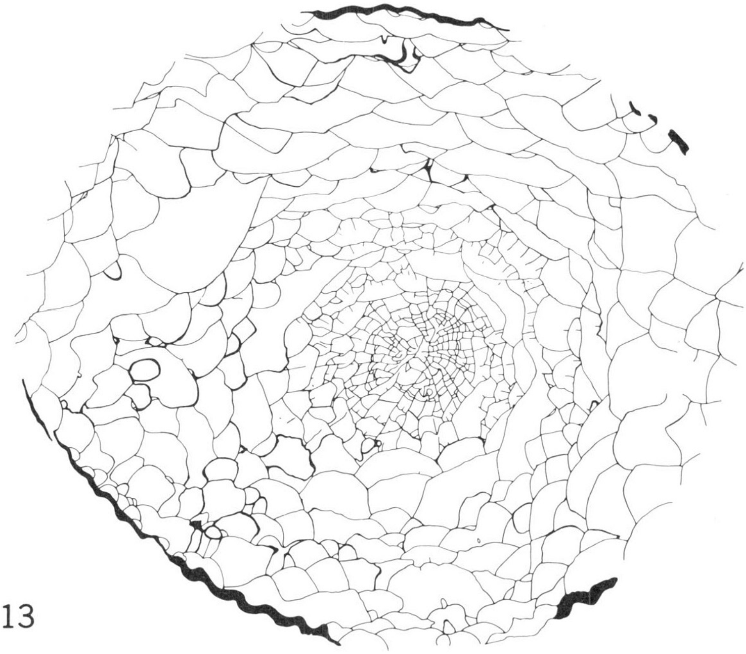
Plate 14, figure 1; Plate 15, figures 2, 3, 5, 6; Textfigures 6–14

Material. Holotype: GSC 25845, Nahanni Formation at locality 15c. Twenty-one paratypes: GSC 25846–25849, Nahanni Formation at locality 15c; GSC 25850, 25851, Nahanni Formation at locality 12b; GSC 25852, Nahanni Formation at locality 13; GSC 25853, Headless Formation at locality 11; GSC 25854, Headless Formation at locality 12a; GSC 25855–25860, Headless Formation at locality 14a; GSC 25861, Headless Formation at locality 14b; GSC 25862, 25863, Headless Formation at locality 15a; GSC 25864, Headless Formation at locality 15b; GSC 25865, Headless Formation at locality 16a; GSC 25866, Headless Formation at locality 16b.

Diagnosis. Corallum dendroid; corallites turbinate to subcylindrical with maximum known height and diameter of 8 cm. Calice conical to bell-shaped. Budding lateral, non-parricidal. Dt/Dc in adults 0.17 to 0.28, mean 0.22. Outer wall 0.1 to 0.7 mm thick. Septa typically thin, smooth or carinate; septal count 26x2 to 42x2 in adults, although in some, minor septa may be entirely suppressed in late stages. Most septa peripherally withdrawn leaving a prominent lonsdaleoid dissepimentarium in all stages. Dissepimentarium well developed from the earliest stages with up to 30 series of generally large dissepiments. Tabulae closely spaced, incomplete. Tabularial surfaces elevated or depressed.



TEXTFIGURES 6–12. *Psydracophyllum lonsdaleiaforme* new genus and species; all x2. 6. Paratype, GSC 25852, Nahanni Formation, South Ram River Canyon. 7. Paratype, GSC 25860, Headless Formation, Upper Prairie Creek. 8–10. Offsets from the holotype, GSC 25845, Nahanni Formation, northern Funeral Range. 11. Paratype, GSC 25856, Headless Formation, Upper Prairie Creek. 12. Paratype, GSC 25865, Headless Formation, Meilleur River Valley. All are from southwestern District of Mackenzie.



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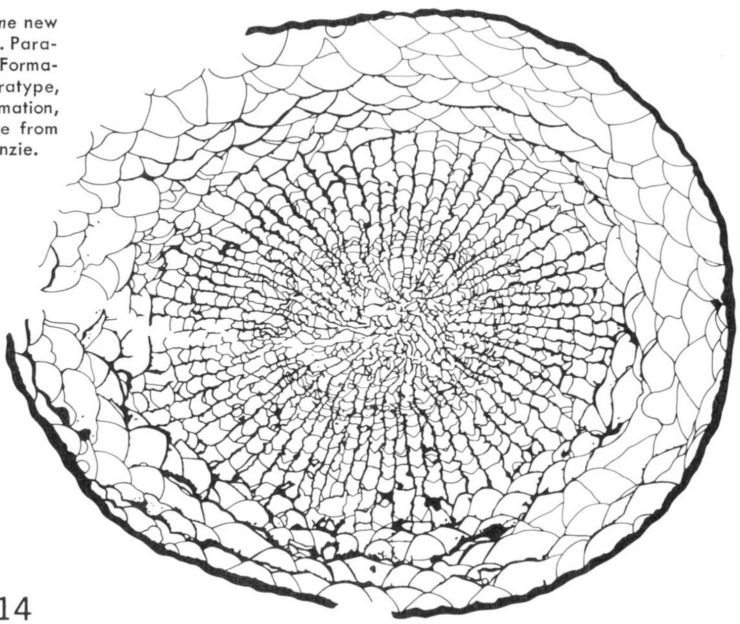
TEXTFIGURES 13, 14
Psydracophyllum lonsdaleiaforme new genus and species; both x2. 13. Paratype, GSC 25850, Nahanni Formation, Manetoe Range. 14. Paratype, GSC 25857, Headless Formation, Upper Prairie Creek. Both are from southwestern District of Mackenzie.



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Description. The corallum varies from weakly fasciculate forms composed of only a few corallites to markedly dendroid colonies of 20 or more corallites. The largest colony known is approximately 18 cm in diameter and more than 10 cm high. Corallites are turbinate to trochoid with irregular increases in diameter in early stages, subcylindrical to ceratoid and commonly rejuvenated in later stages. The largest seen to date has a mean diameter of 8 cm and was more than 8 cm high; the largest corallites of a colony are commonly from 4 to 6 cm in diameter and less than 8 cm long. Calices are deep, conical to bell-shaped and lack a platform. The exterior bears fine growth ridges and in places faint to well-marked corrugations which apparently correspond to interseptal ridges. Budding is lateral, nonparricidal. Offsets are produced one or two at a time and emerge from the periphery of the parental corallite. They quickly dissociate from the parent and may therefore appear to be intermural.

The exterior wall, which is usually between 0.1 and 0.3 mm thick but may be up to 0.7 mm thick, is complete; it embeds numerous trabeculae and in the rare instances where the septa reach it may embed them also. Septa are radially arranged or are weakly pinnate in the axial region. In specimens where there is marked septal reduction they are not everywhere clearly differentiated into major and minor septa. Where they are differentiated, the septal count is normally 31x2 to 42x2 in late stages. Some septa may extend to the outer wall in youthful stages; later all are invariably highly discontinuous in the peripheral region, or more commonly, are entirely withdrawn from it. Septa in the inner region of the dissepimentarium and tabularium vary from being thin and smooth to slightly dilated and highly carinate. The degree of development of the minor septa is also variable, usually they are much less continuous than the major septa and they never extend very far into the tabularium. Short, dissociated trabeculae may be present on the lonsdaleoid dissepiments.

From the earliest stages the dissepimentarium is prominent and at least partly lonsdaleoid. In large specimens there are commonly 12 to 20 series of dissepiments and rarely as many as 30 series. The innermost dissepiments tend to be only a little smaller, steeper and more inflated than the outermost, which are large to very large and moderately to weakly inflated. A characteristic feature of the species is that in transverse section many dissepiments appear to be somewhat pinched and angular. The transition from dissepimentarium to tabularium is abrupt and regular. The tabularium is narrow with abundant closely spaced, incomplete tabulae. Tabularial surfaces are commonly of extremely irregular inclination, although in some specimens (e.g., GSC 25845) they are distinctly depressed axially and in others (e.g., GSC 25856) are elevated. In the following table measurements are in mm, Dt is the diameter of the tabularium and Dc of the calice or corallite.

Specimen	Mean or measurable Dt	Mean or measurable Dc	Dt/Dc	No. of Septa	Preparation
25845	2	6.3	0.32	17	transverse section (offset)
25845	2.8	11.5	.24	19	transverse section (offset)
25859	3	17	.18	—	longitudinal section
25860	3.5	20.5	.12	—	longitudinal section
25860	3.8	25	.15	—	longitudinal section
25856	4.3	21.5	.20	—	longitudinal section
25850	5	45	.11	26 major?	transverse section
25856	5.2	40	.13	—	longitudinal section
25865	5.5	16	.34	26x2	transverse section
25865	5.5	28	.20	—	longitudinal section

Specimen	Mean or measurable Dt	Mean or measurable Dc	Dt/Dc	No. of Septa	Preparation
25851	6	40	0.15	—	longitudinal section
25859	6.5	35	.19	—	longitudinal section
25845	6.5	41.5	.16	—	longitudinal section
25845	7	49	.14	—	longitudinal section
25850	8	34	.24	31x2	transverse section
25857	8.4	50	.19	—	longitudinal section
25852	8.5	30	.28	—	longitudinal section
25852	8.5	32	.27	36x2	transverse section
25845	8.5	50	.17	31x2	transverse section
25850	9	24.2	.38	28x2	transverse section
25857	9	37	.24	—	longitudinal section
25853	10	28	.36	30x2	transverse section
25853	10.5	46	.23	—	longitudinal section
25857	11	42	.26	34x2	transverse section
25859	11.5	45	.26	34x2	transverse section
25862	12.5	67	.18	42x2	transverse section
25858	13	55	.24	40x2	transverse section
25858	14	53	.26	—	longitudinal section

Remarks. Psydracophyllum lonsdaleiaforme does not closely resemble any previously described species. *Dohmophyllum muratum* n. sp. is weakly fasciculate and shares some other features, but is easily distinguished by its ontogeny, smaller size, thicker wall, and dissepimentarium which locally in advanced stages tends to be somewhat naotic.

The name *lonsdaleiaformis, e* refers to the *Lonsdaleia*-like dissepiments.

Distribution. Hume and Nahanni Formations of southwestern District of Mackenzie.

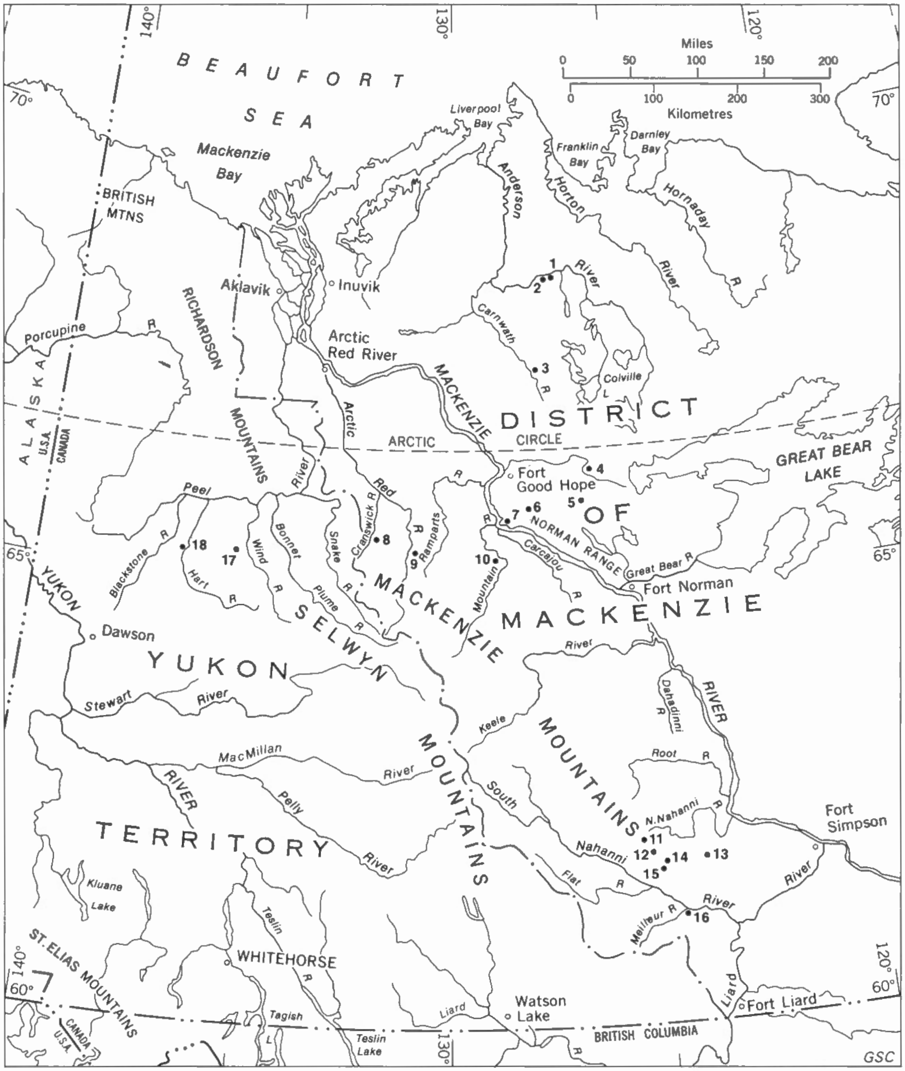
LOCALITY INDEX

The prefix C denotes GSC collections registered at the Institute of Sedimentary and Petroleum Geology, Calgary. Prefixes D and G refer to collections, now the property of the GSC, but made by geologists of Triad Oil Co. Ltd., Calgary. In these faunal lists the genera *Mesophyllum* and *Plasmophyllum* are interpreted after Birenheide (1964). Textfigure 15 shows the following localities.

1. Hume Formation, isolated outcrop. Left bank of Anderson River; 68°31¾′N, 127°12½′W. Collected by A. E. H. Pedder, July 1959 (D-15).

Sphaerospongia tessellata of Warren 1944 if not Phillips 1841, *Favosites* sp., *Disphyllum* sp., *Radiastraea nevadensis* (Stumm), *R. verrilli* (Meek), *Taimyrophyllum triadorum* Pedder, *Dohmophyllum mutabile* Pedder, "*Microcyclus*" *multiradiatus* (Meek), *Mesophyllum* sp., *Fistulipora* sp., *Schuchertella adoceta* Crickmay, "*Spinulicosta*" *stainbrooki* Crickmay, *Desquamatia arctica* (Warren), *Spinatrypa andersonensis* (Warren), *Undispirifer compactus* (Meek), *Dechenella* sp., etc.

2. Hume Formation, 78–198′ above base, 0–120′ below top. Left bank of Anderson River; 68° 31⅔ ′N, 127° 15′W. Collected by A. E. H. Pedder, July 1959 (D-18).



All localities except 17 and 18 are for Pedder, 2nd paper

1. Triad loc. D-15, Hume Formation, Anderson River
2. Triad loc. D-18, Hume Formation, Anderson River
3. GSC loc. C-2521, Hume Formation, Carnwath River
4. GSC loc. C-2538, Hume Formation, Hare Indian River
5. GSC locs. C-2533, -4, -6, -7, Hume Formation, Sam MacRae Lake
6. Lenz's (1961) *Dohmophyllum* locality, Hume Formation, Gibson Range
7. Triad loc. D-101, Hume Formation, East Mountain
8. GSC loc. C-164, Hume Formation, Flyaway Creek
9. GSC loc. C-3370, Hume Formation, near Arctic Red River
10. GSC locs. C-3867, C-3871, Hume Formation, Powell Creek Valley
11. Triad loc. G-7207, Headless Formation, central Manetoe Range
12. Triad locs. G-6787, G-6819, Headless and Nahanni Formations, Prairie Creek
13. Triad loc. G-5276, Nahanni Formation, South Ram River Canyon
14. Triad locs. G-7050, -1, Headless Formation, upper Prairie Creek
15. Triad locs. G-5021, G-5067, G-5071, Headless and Nahanni Formations, Funeral Range
16. Triad locs. G-3745, -6, G-3694, Headless and Nahanni Formations, Meilleur River Valley
17. GSC loc. C-3226, Prongs Creek Formation, Prongs Creek (Pedder 1st paper)
18. Ammonoid locality, unnamed black shales, eastern Ogilvie Mountains (Nassichuk paper)

TEXTFIGURE 15. Locality map for Pedder and Nassichuk papers.

Sphaerospongia tessellata of Warren 1944 if not Phillips 1841, *Alveolites* sp., *Chaetetes* sp., *Disphyllum* sp., *Radiastraea verrilli* (Meek), *Dohmophyllum mutabile* Pedder, *Mesophyllum rectum* (Meek), *Hederella* (*H.*) sp., *Fistulipora* sp., *Douvillina* sp., "*Spinulicosta*" *stainbrooki* Crickmay, *Pentamerella* sp., *Desquamatia aperanta* (Crickmay), *D. arctica* (Warren), *Spinatrypa andersonensis* (Warren), *Undispirifer compactus* (Meek), *Straparollus* (*Euomphalus*) sp., *Dechenella* sp., etc.

3. Hume Formation, isolated outcrop of approximately 40′ stratigraphic thickness. Right bank of Carnwath River; 67°23′N, 127°44′W. Collected by A. E. H. Pedder, June 1968 (C-2521).

Favosites sp., *Thamnopora* sp., *Alveolites* sp., *Syringopora* sp., *Aulopora* sp., *Disphyllum* sp., *Radiastraea verrilli* (Meek), *Utaratuia praeclara* (Crickmay), *Taimyrophyllum stirps* (Crickmay), *Aphroidophyllum howelli* Lenz, *A. meeki* Pedder, *Dohmophyllum mutabile* Pedder, *Redstonea* sp., *Plasmophyllum* sp., *Mesophyllum* spp., *Mackenziephyllum insolitum* Pedder, *Carinatina dysmorphostrota* (Crickmay), *Desquamatia aperanta* (Crickmay), *D. arctica* (Warren), *Spinatrypa andersonensis* (Warren), orthoconic nautiloid, trilobite to be described by A. R. Ormiston, etc.

4. Hume Formation, 12′ cliff at or very close to the top of the formation. Scarp north of Echo Bend on Hare Indian River; 66°20½′N, 127°17½′W. Collected by A. E. H. Pedder, July 1968 (C-2538).

Sphaerospongia tessellata of Warren 1944 if not Phillips 1841, *Favosites* sp., *Alveolites* sp., *Radiastraea verrilli* (Meek), *Dohmophyllum mutabile* Pedder, *Mesophyllum* sp., *Schizophoria* sp., "*Spinulicosta*" *stainbrooki* Crickmay, *Carinatina dysmorphostrota* (Crickmay), *Desquamatia aperanta* (Crickmay), *D. arctica* (Warren), *Spinatrypa andersonensis* (Warren), "*Atrypa*" *borealis* Warren, *Undispirifer compactus* (Meek).

5a. Hume Formation, 55–70′ above base, 180–195′ below exposed top which approximates to the actual top. Southwest side of Sam MacRae Lake; 65°57′N, 127°15′W. Collected by A. E. H. Pedder, July 1968 (C-2536).

Alveolites sp., *Radiastraea nevadensis* (Stumm) small form, *R. verrilli* (Meek), *Dohmophyllum mutabile* Pedder, "*Microcyclus*" *multiradiatus* (Meek), *Schuchertella adoceta* Crickmay, *Spinulicosta* sp., *Desquamatia aperanta* (Crickmay), *D. arctica* (Warren), *Undispirifer compactus* (Meek), *Straporollus* (*Euomphalus*) sp., etc.

5b. Hume Formation, 230–235′ above base, 15–20′ below exposed top which approximates to the actual top. Same section and collector as 5a (C-2534).

Favosites sp., *Alveolites* sp., *Radiastraea verrilli* (Meek), *Dohmophyllum mutabile* Pedder, *Desquamatia arctica* (Warren), etc.

5c. Hume Formation, 242–250′ above base, 0–8′ below exposed top which approximates to the actual top. Same section and collector as 5a (C-2533).

Alveolites sp., *Dohmophyllum mutabile* Pedder, *Sociophyllum glomerulatum* (Crickmay), *Carinatina dysmorphostrota* (Crickmay), etc.

5d. Hume Formation, talus derived from the upper 55′ of the formation. Same section and collector as 5a (C-2537).

Aphroidophyllum howelli Lenz, *Dohmophyllum mutabile* Pedder, *Mesophyllum* sp., etc.

6. Hume Formation, upper member. Gibson Range; 65°49′N, 128°02′W. Locality of Lenz's figured specimens of *Dohmophyllum* (information given in a letter to D. J. McLaren).

Hexagonaria sp., *Dohmophyllum mutabile* Pedder.

7. Hume Formation, upper beds, probably within 30′ of the top of the formation. East Mountain; 65°41′N, 128°42′W. Collected by A. E. H. Pedder, September 1959 (D-101).

Stromatoporoids, *Favosites* sp., *Alveolites* sp., *Syringopora* sp., *Disphyllum* sp., *Radiastraea verrilli* (Meek), *Aphroidophyllum howelli* Lenz, *Dohmophyllum mutabile* Pedder, *Sociophyllum glomerulatum* (Crickmay), *Mesophyllum* sp., "*Spinulicosta*" *stainbrooki* Crickmay, *Carinatina dysmorphostrota* (Crickmay), *Desquamatia arctica* (Warren), *Undispirifer* sp., *Straparollus* (*Euomphalus*) sp., *Dechenella* sp., etc.

8. Hume Formation, 200′ above base, 427′ below top. Flyaway Creek; 65°26′N, 132°04′W. Collected by W. S. MacKenzie, July 1967 (C-164).

Favosites sp., *Dohmophyllum grandicalyx* Pedder, *Taimyrophyllum stirps* (Crickmay), etc. This is approximately 160′ above an occurrence of *Schuchertella adoceta* Crickmay, thus despite its stratigraphic position the collection probably derives from the upper faunal zone of the Hume Formation.

9. Hume Formation, topmost beds below a south-dipping thrust. Mackenzie Mountain Front, right bank of a small tributary of Arctic Red River, 8½ miles east of Arctic Red River; 65°20½′N, 130°53′W. Collected by D. K. Norris, August 1968 (C-3370).

Alveolites sp., *Syringopora* sp., *Dendrostella trigemme* (Quenstedt), *Dohmophyllum mutabile* Pedder, *Sociophyllum glomerulatum* (Crickmay), *Schizophoria* sp., "*Spinulicosta*" *stainbrooki* Crickmay, *Carinatina dysmorphostrota* (Crickmay), *Desquamatia arctica* (Warren), *Undispirifer compactus* (Meek), etc.

10a. Hume Formation, 343–347′ above base, 91–95′ below top. Left side of Powell Creek Valley; 65°16½′N, 128°46′W. Collected by A. E. H. Pedder, July 1969 (C-3867).

Favosites sp., *Alveolites* sp., *Radiastraea verrilli* (Meek), *Taimyrophyllum stirps* (Crickmay), *Aphroidophyllum howelli* Lenz, *A. meeki* Pedder, *Dohmophyllum mutabile* Pedder, *Redstonea sperabilis* (Crickmay), *Mackenziephyllum* sp., *Undispirifer compactus* (Meek), etc.

10b. Hume Formation, talus 386–430′ above base, 8–52′ below top. Same section and collector as 10a (C-3871).

Favosites sp., *Radiastraea verrilli* (Meek), *Dohmophyllum mutabile* Pedder, *Stringophyllum* sp., *Mesophyllum rectum* (Meek), *Schizophoria* sp., *Douvillina* sp., *Carinatina dysmorphostrota* (Crickmay), *Desquamatia aperanta* (Crickmay), *D. arctica* (Warren), *Spinatrypa coriacea* Crickmay, "*Altrypa*" *borealis* Warren, *Nucleospira* sp., *Emanuella* sp., *Cyrtina* sp., *Undispirifer compactus* (Meek), etc.

11. Headless Formation, 386–396′ above base, 104–114′ below top and 1,125–1,135′ below the top of the Nahanni Formation, although this may include some repetition due to faulting. Central Manetoe Range; 62°01½′N, 125°06′W. Collected by L. F. Cote, August 1960 (G-7207).

Favosites sp., *Alveolites* sp., *Radiastraea verrilli* (Meek), *Psydracophyllum lonsdaleiaforme* Pedder, *Plasmophyllum* sp., *Desquamatia aperanta* (Crickmay), etc.

12a. Headless Formation, 605–615′ above base, 335–345′ below top and 820–830′ below the top of the Nahanni Formation. Prairie Creek Headwaters, Manetoe Range; 61°49½′N, 125°05′W. Collected by E. O'Bertos and A. E. H. Pedder, August 1960 (G-6819).

Alveolites sp., *Syringopora* sp., *Dohmophyllum grandicalyx* Pedder ?, *Psydracophyllum lonsdaleiaforme* Pedder, *Sociophyllum* sp., *Mesophyllum* spp., *Schizophoria* sp., *Desquamatia aperanta* (Crickmay), *Spinatrypa* sp., *Warrenella* sp., *Dechenella* sp., etc. The stratigraphic interval 0–10′ above this collection is the type occurrence of *Leiorhynchus manetoe* McLaren.

12b. Nahanni Formation, 4–14′ above base, 471–481′ below top. Same section and collectors as 12a (G-6787).

Hexagonaria sp., *Psydracophyllum lonsdaleiaforme* Pedder, etc.

13. Nahanni Formation, 172–182′ above base, 173–183′ below the top exposure which probably approximates to the actual top of the formation. South Ram River Canyon; 61°46′N, 123°58′W. Collected by L. F. Cote, August 1960 (G-5276).

Syringopora sp., *Aulopora* sp., *Dendrostella trigemme* (Quenstedt), *Disphyllum* sp., *Hexagonaria* sp., *Psydracophyllum lonsdaleiaforme* Pedder, *Sociophyllum* sp., *Plasmophyllum* sp., *Mesophyllum* sp., *Undispirifer* sp., etc.

14a. Headless Formation, 289–299′ above base, 50–60′ below top and 320–330′ below the top of the Nahanni Formation. Upper Prairie Creek; 61°42′N, 124°58′W. Collected by L. F. Cote, July 1960 (G-7051).

Favosites sp., *Radiastraea verrilli* (Meek), *Taimyrophyllum vescibalteatum* Pedder, *Psydracophyllum lonsdaleiaforme* Pedder, *Sociophyllum* sp., *Plasmophyllum* sp., *Mesophyllum* sp., etc.

14b. Headless Formation, 299–313′ above base, 36–50′ below top and 306–320′ below the top of the Nahanni Formation. Same section and collector as 14a (G-7050).

Favosites sp., *Syringopora* sp., *Radiastraea verrilli* (Meek), "*Endophyllum*" *barbatum* Crickmay, *Psydracophyllum lonsdaleiaforme* Pedder, *Sociophyllum* sp., *Mesophyllum* sp., *Desquamatia aperanta* (Crickmay), etc.

15a. Headless Formation, 780–790′ above base, 51–61′ below top and 267–277′ below the top of the Nahanni Formation. Northern Funeral Range, 61°41½′N, 125°05′W. Collected by A. E. H. Pedder, August 1960 (G-5071).

Favosites sp., *Alveolites* sp., *Psydracophyllum lonsdaleiaforme* Pedder, *Plasmophyllum* sp., *Schizophoria* sp., *Spinulicosta* sp., *Undispirifer* sp., *Paracyclas* sp., etc.

15b. Headless Formation, 819–829′ above base, 12–22′ below top and 228–238′ below the top of the Nahanni Formation. Same section and collector as 15a (G-5067).

Taimyrophyllum vescibalteatum Pedder, *Psydracophyllum lonsdaleiaforme* Pedder, etc.

15c. Nahanni Formation, 30–40′ above base, 176–186′ below top. Same section and collector as 15a (G-5021).

Receptaculitid, *Favosites* sp., *Alveolites* sp., *Syringopora* sp., *Taimyrophyllum vescibalteatum* Pedder, *Dohmophyllum grandicalyx* Pedder, *Psydracophyllum lonsdaleiaforme* Pedder, *Sociophyllum glomerulatum* (Crickmay), *Plasmophyllum* sp., *Mesophyllum* sp., *Spinatrypa* sp., etc.

16a. Headless Formation, 192–202′ above base, 7–17′ below top and 542–552′ below the top of the Nahanni Formation. Right side of the lower reaches of the Meilleur River Valley; 61°14′35″N, 124°38′25″W. Collected by A. E. H. Pedder, July 1960 (G-3746).

Favosites sp., "*Endophyllum*" *barbatum* Crickmay, *Psydracophyllum lonsdaleiaforme* Pedder, *Schizophoria* sp., camarotoechiid nov., *Desquamatia aperanta* (Crickmay), etc.

16b. Headless Formation, 202–209′ above base, 0–7′ below top and 535–542′ below the top of the Nahanni Formation. Same section and collector as 16a (G-3745).

Stromatoporoid, *Favosites* sp., *Radiastraea verrilli* (Meek), "*Endophyllum*" *barbatum* Crickmay, *Psydracophyllum lonsdaleiaforme* Pedder, *Plasmophyllum* sp., *Mesophyllum* sp., rhynchonelloid brachiopod, *Desquamatia aperanta* (Crickmay), etc.

16c. Nahanni Formation, 525–535′ above base, 0–10′ below top. Same section and collector as 16a (G-3694).

Favosites sp., *Alveolites* sp., *Syringopora* sp., *Taimyrophyllum vescibalteatum* Pedder, *Aphroidophyllum howelli* Lenz small form, *Dohmophyllum grandicalyx* Pedder, *D. muratum* Pedder, *Redstonea* sp., etc.

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PLATE 7

(all figures x1½)

Dohmophyllum grandicalyx new species (PAGE 41)

Figures 1, 3, 4. Holotype, GSC 25816. Nahanni Formation; northern Funeral Range, southwestern District of Mackenzie.

Figure 2. Paratype, GSC 25820. Hume Formation; Flyaway Creek, northwestern District of Mackenzie.

PLATE 7

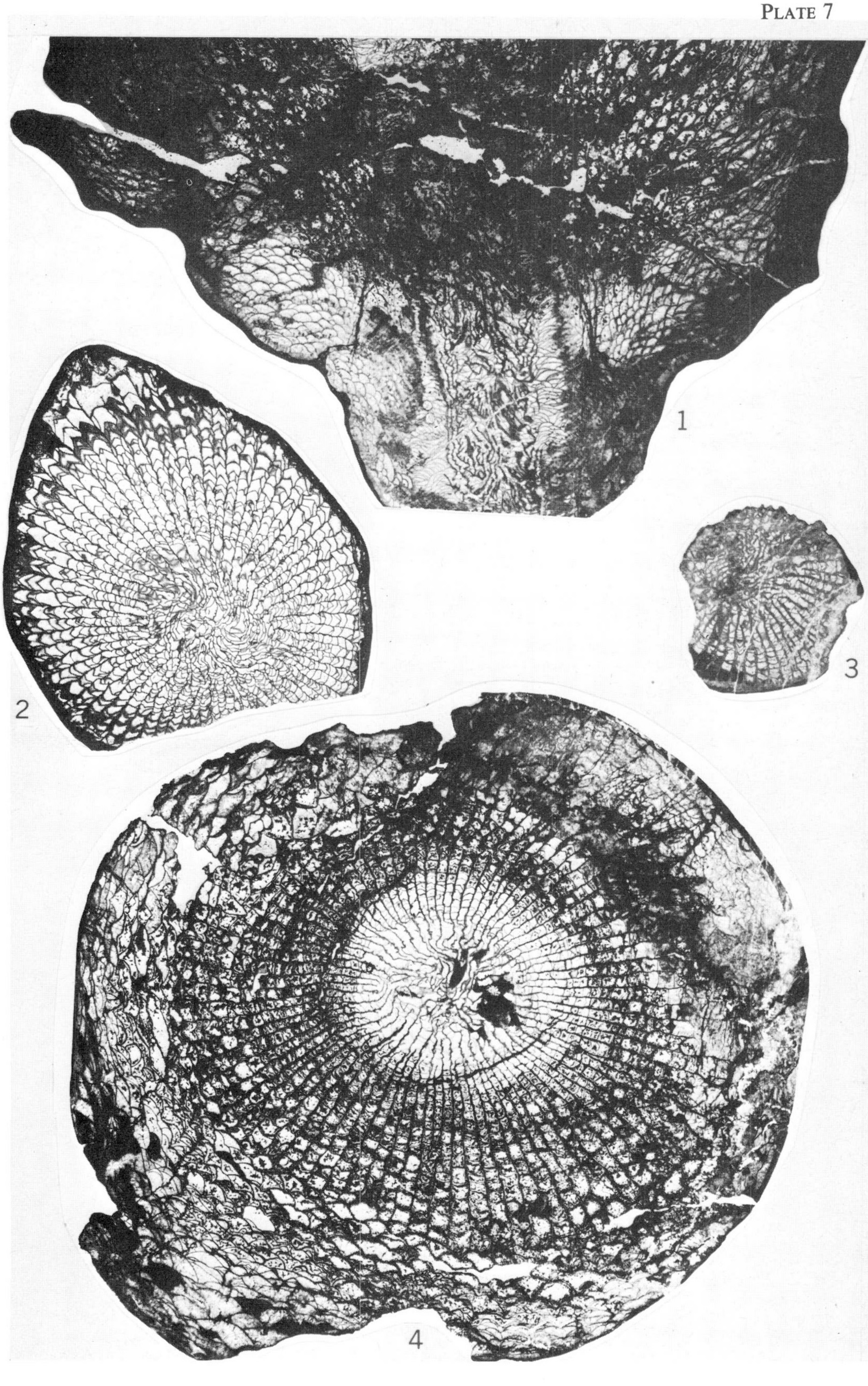


PLATE 8

(all figures x$1\frac{1}{2}$)

Dohmophyllum muratum new species (PAGE 43)

Figures 1, 4. Paratype, GSC 25824. Nahanni Formation; Meilleur River Valley, southwestern District of Mackenzie. The left corallite of fig. 1 shows in transverse section an early stage of budding; fig. 4 shows the development of peripheral buds in longitudinal section.

Figure 2. Paratype, GSC 25823. Nahanni Formation; Meilleur River Valley, southwestern District of Mackenzie.

Dohmophyllum grandicalyx new species (PAGE 41)

Figure 3. Paratype, GSC 25820. Hume Formation; Flyaway Creek, northwestern District of Mackenzie.

Figure 5. Paratype, GSC 25819. Nahanni Formation; Meilleur River Valley, southwestern District of Mackenzie.

PLATE 8

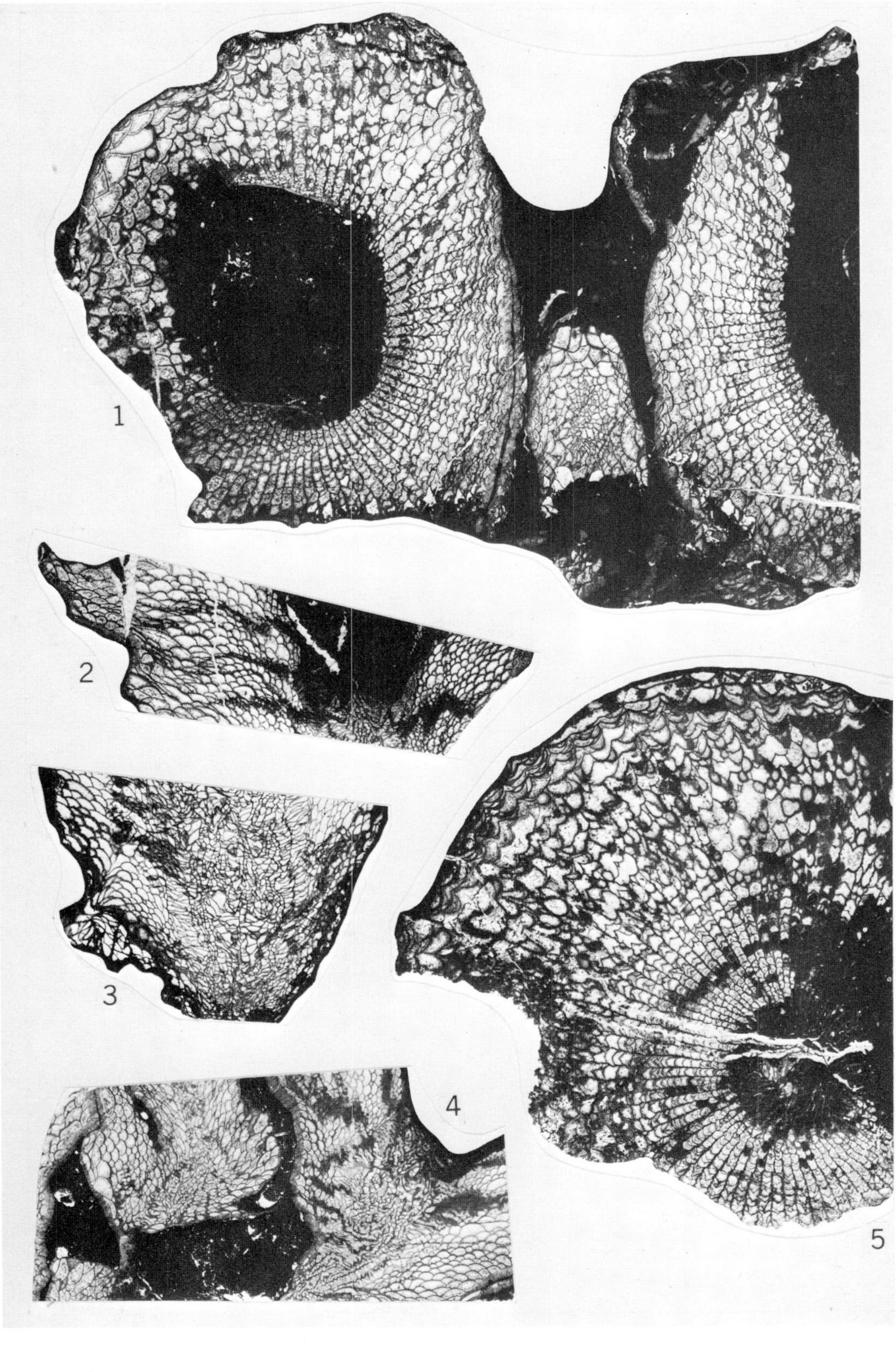


PLATE 9

(both figures x1½)

Dohmophyllum muratum new species (PAGE 43)

Figure 1. Holotype, GSC 25822. Nahanni Formation; Meilleur River Valley, southwestern District of Mackenzie.

Dohmophyllum mutabile new species (PAGE 44)

Figure 2. Paratype, GSC 25833. Hume Formation; Hare Indian River Valley, western District of Mackenzie. Where the intercorallite wall is lost in the lower part of the figure the corallum is plocoid.

PLATE 9

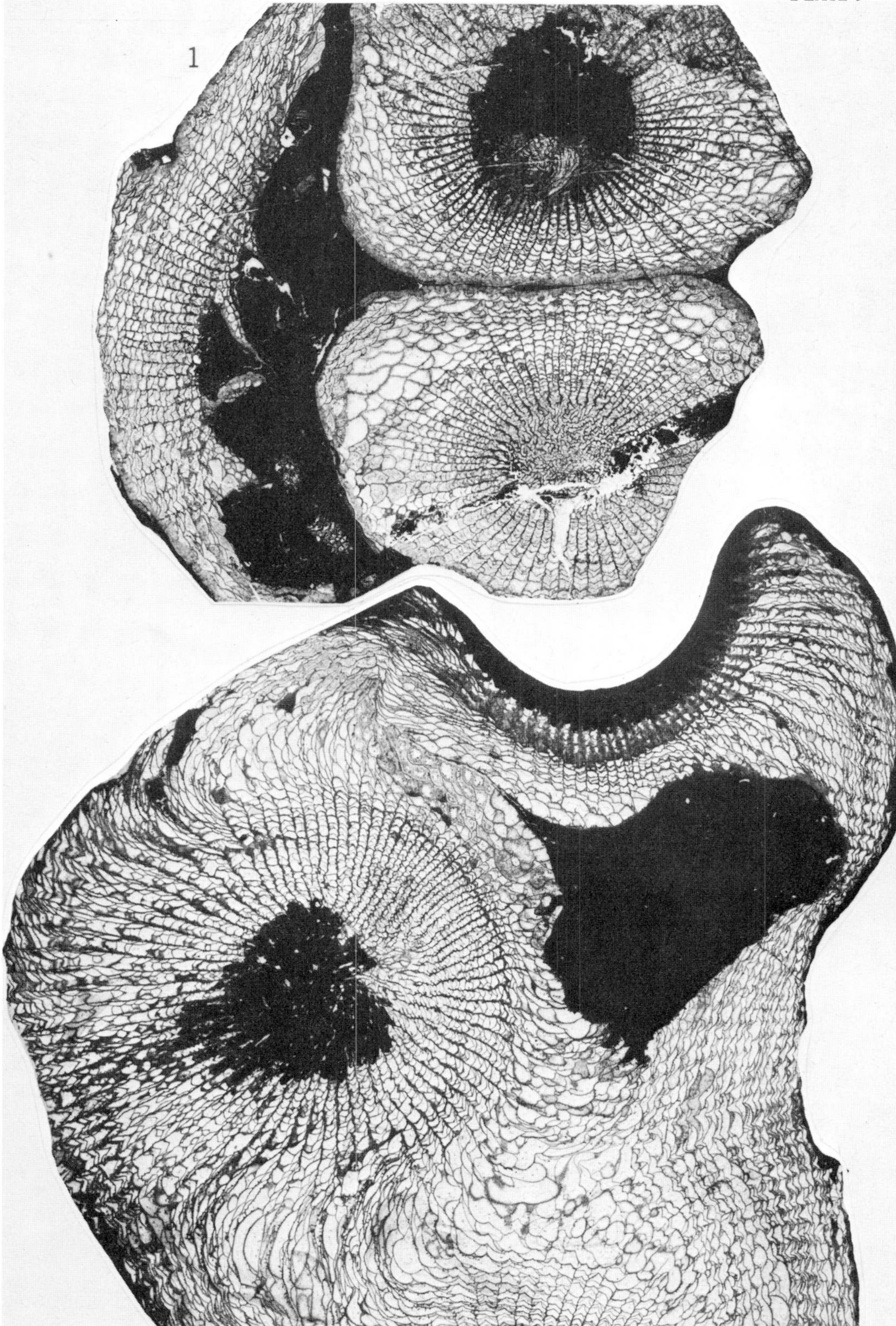
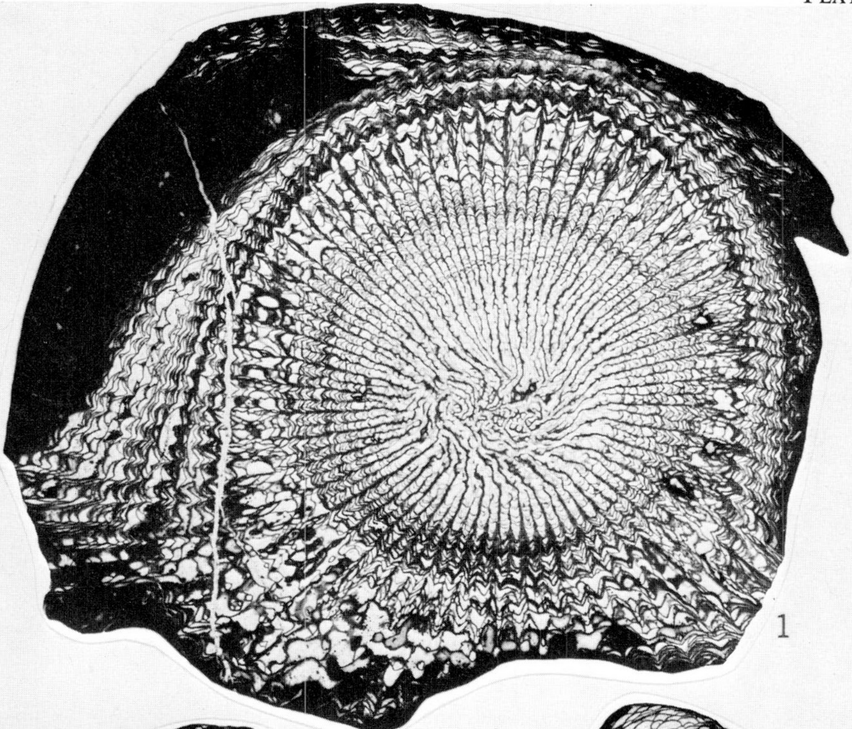


PLATE 10

(both figures x1½)

Dohmophyllum mutabile new species (PAGE 44)

Figures 1, 2. Holotype, GSC 25825. Hume Formation; Powell Creek Valley, western District of Mackenzie. This specimen is a large subcylindrical form with an eroded periphery.



1

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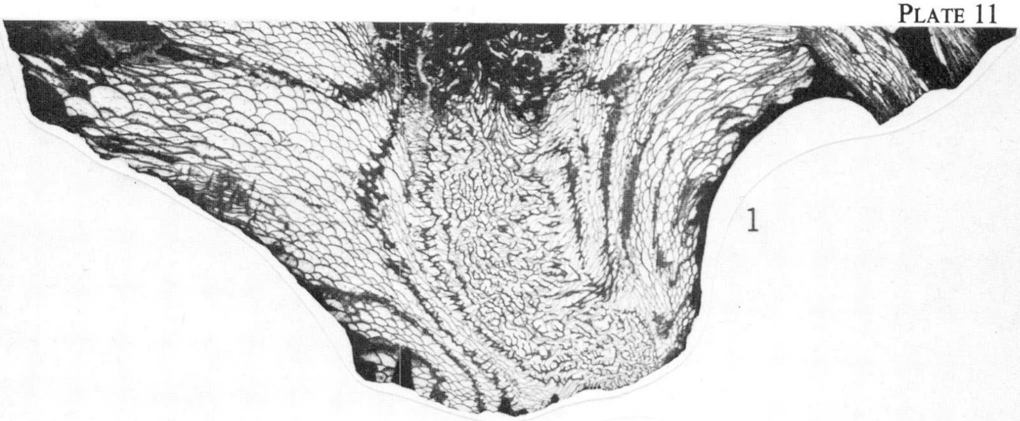
PLATE 11

(both figures x1½)

Dohmophyllum mutabile new species (PAGE 44)

Figures 1, 2. Paratype, GSC 25832. Hume Formation; Hare Indian River Valley, western District of Mackenzie. This is a large almost patellate form with a well-developed noatic structure.



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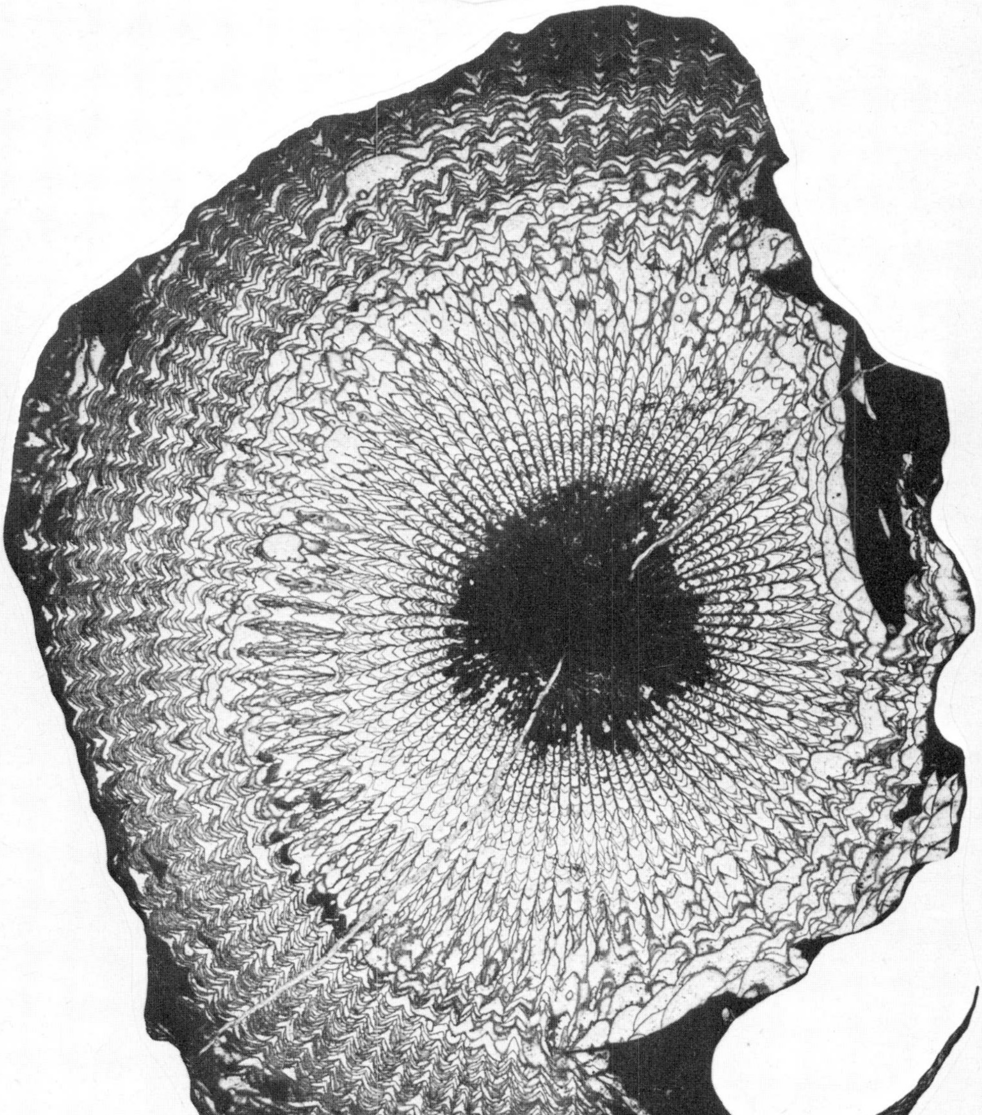

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PLATE 12

(all figures x1½)

Dohmophyllum mutabile new species (PAGE 44)

Figure 1. Paratype, GSC 25839. Hume Formation; East Mountain, western District of Mackenzie. *See* Pl. 13, figs. 1, 5, 6 for later stages of this specimen.

Figure 2. Paratype, GSC 25834. Hume Formation; Hare Indian River Valley, western District of Mackenzie. The superior face of the peripheral platform is vertical in the right side of the figure.

Figure 3. Paratype, GSC 25838. Hume Formation; Sam MacRae Lake, western District of Mackenzie.

Figure 4. Paratype, GSC 25826. Hume Formation; Powell Creek Valley, western District of Mackenzie. This specimen well displays the strong variation in the morphology of the peripheral platform that is characteristic of the species.

Figure 5. Paratype, GSC 25830. Hume Formation; Carnwath River, northwestern District of Mackenzie. The left corallite was peripherally budded from the right corallite to give a plocoid corallum.

Plate 12

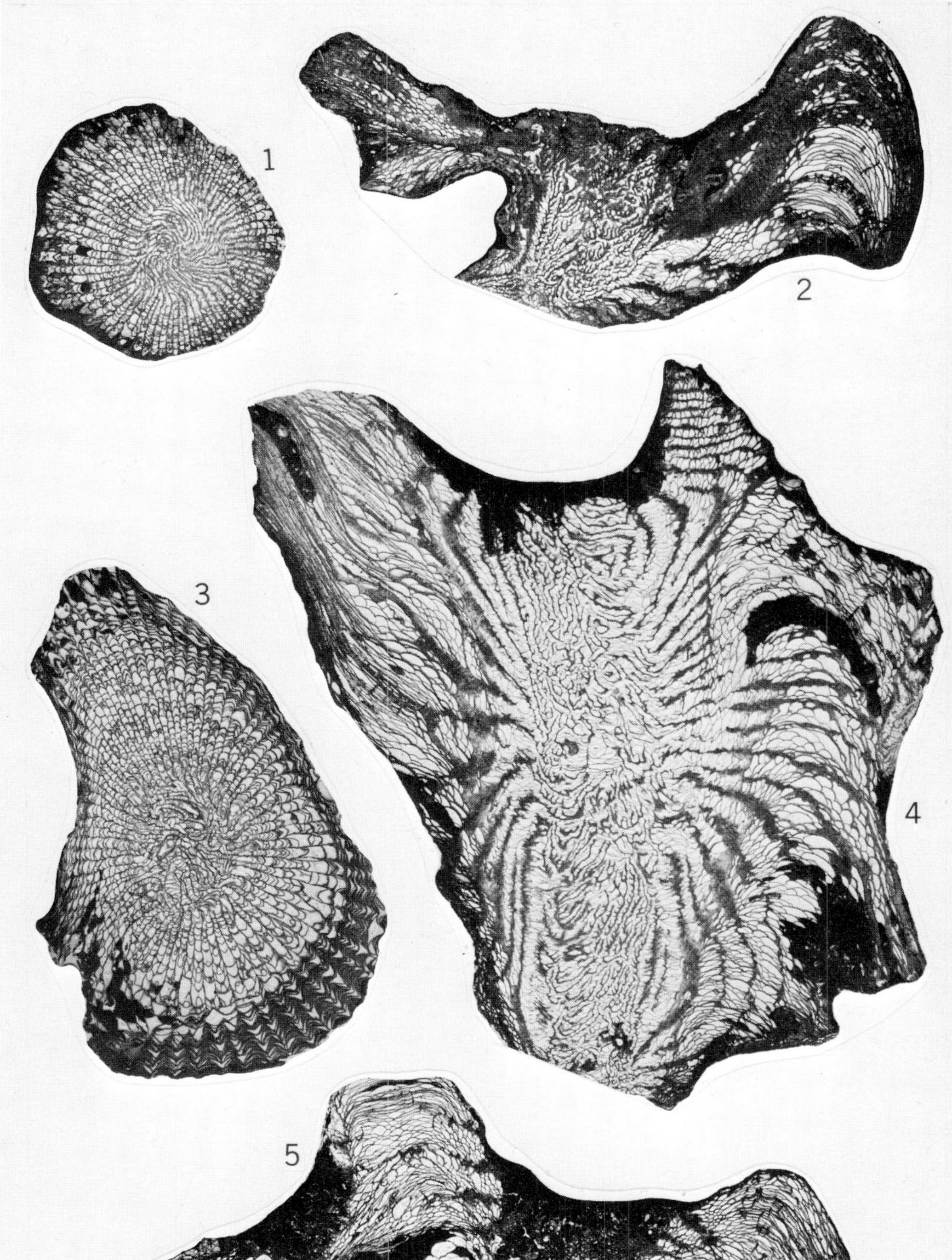


Plate 13

(all figures x1½)

Dohmophyllum mutabile new species (Page 44)

Figures 1, 5, 6. Paratype, GSC 25839. Hume Formation; East Mountain, western District of Mackenzie. These show the development of four peripheral offsets that may have been parricidal. *See* Pl. 12, fig. 1 for an earlier stage of this specimen.

Figure 2. Paratype, GSC 25831. Hume Formation; Carnwath River, northwestern District of Mackenzie. Shows four non-parricidal lateral buds that are at first discrete and later plocoid.

Figure 3. Paratype, GSC 25836. Hume Formation; Sam MacRae Lake, western District of Mackenzie. This specimen has an unusually narrow dissepimentarium.

Figure 4. Paratype, GSC 25838. Hume Formation; Sam MacRae Lake, western District of Mackenzie.

PLATE 13

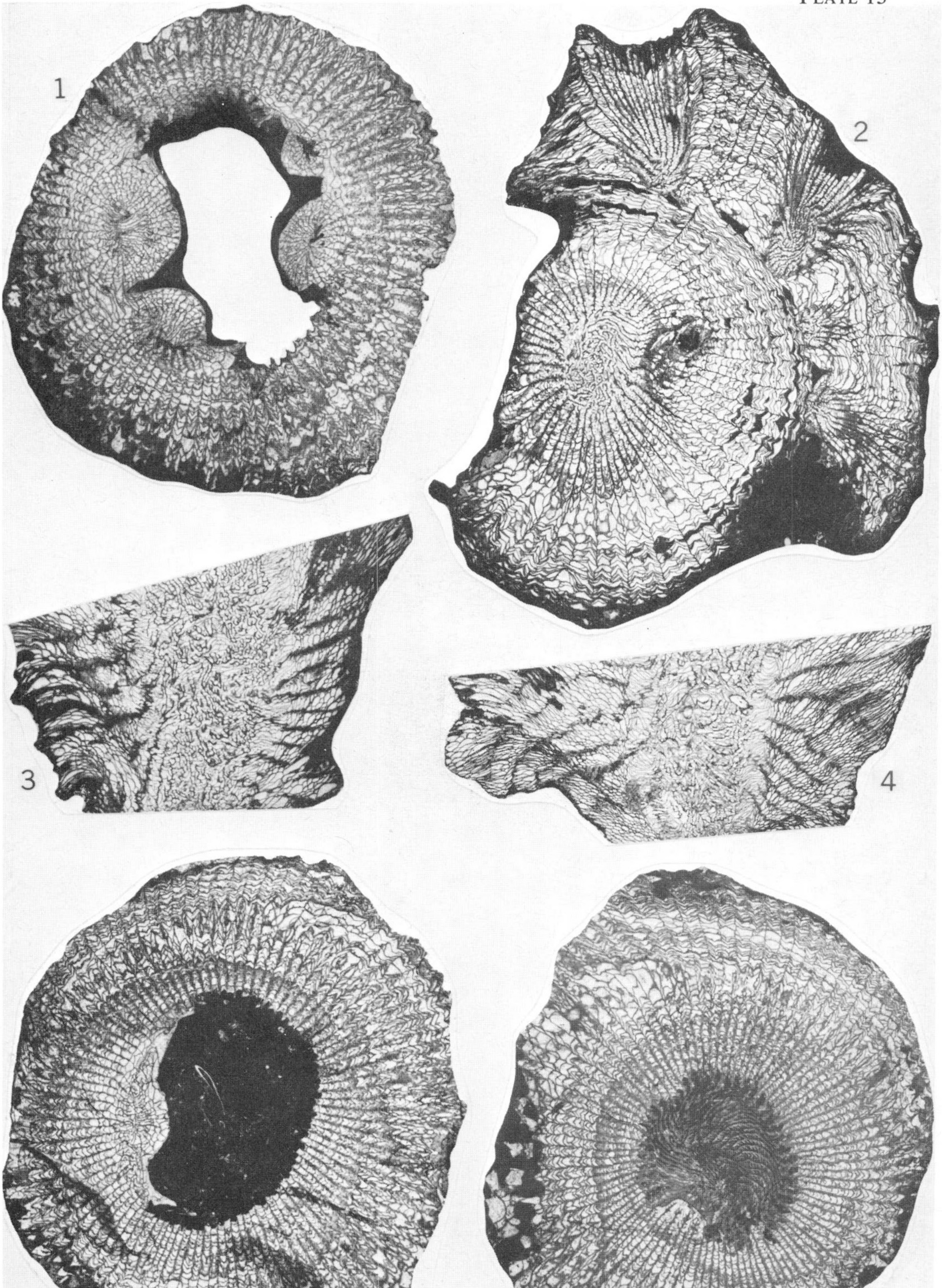


PLATE 14

Psydracophyllum lonsdaleiaforme new genus and species (PAGE 47)

Figure 1. Holotype, GSC 25845. Nahanni Formation; northern Funeral Range, southwestern District of Mackenzie. This is a smoothly septate form; x1½.

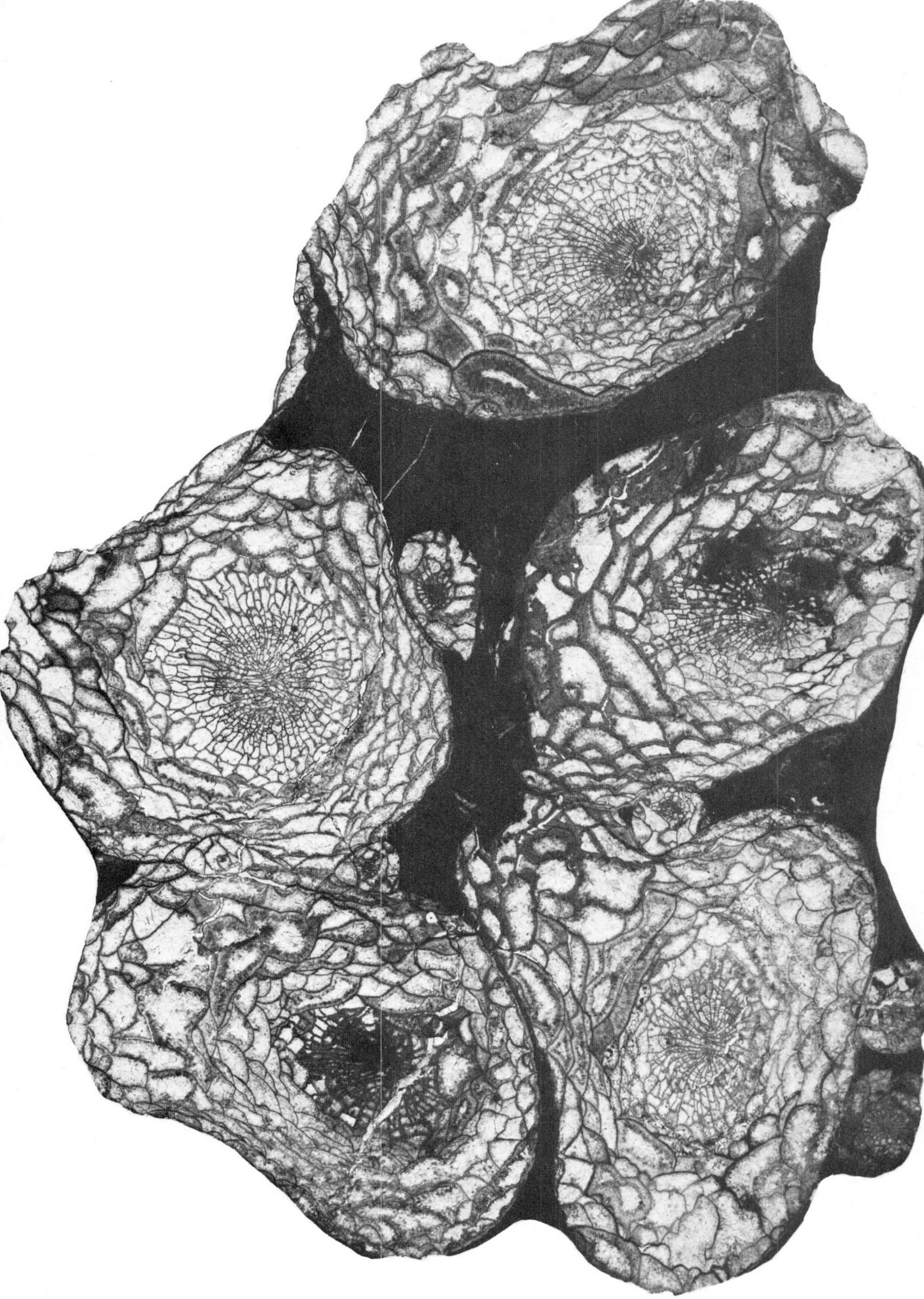


PLATE 15

(all figures x1½)

Dohmophyllum grandicalyx new species ? (PAGE 41)

Figures 1, 4. Hypotype, GSC 25821. Headless Formation; Manetoe Range, southwestern District of Mackenzie. Note the wide tabularium with arched surfaces and rather coarse dissepiments.

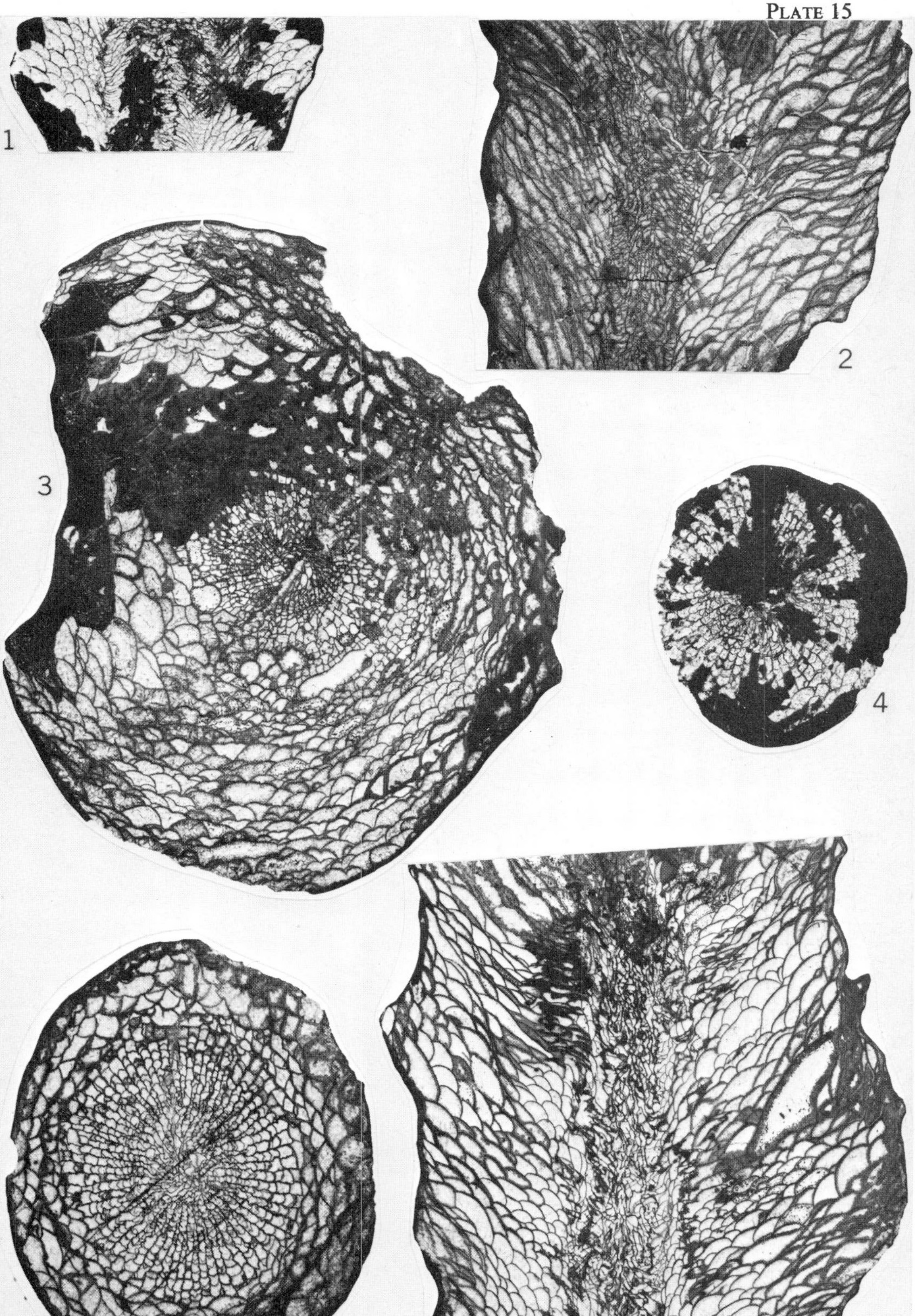
Psydracophyllum lonsdaleiaforme new genus and species (PAGE 47)

Figure 2. Holotype, GSC 25845. Nahanni Formation; northern Funeral Range, southwestern District of Mackenzie. The tabularial surfaces are mostly elevated.

Figure 3. Paratype, GSC 25862. Headless Formation; northern Funeral Range, southwestern District of Mackenzie. This is a large corallite with strongly reduced septa.

Figures 5, 6. Paratype, GSC 25857. Headless Formation; Prairie Creek, southwestern District of Mackenzie. In this specimen the septa are markedly carinate and the tabularial surfaces are mostly depressed.

PLATE 15



AN UPPER PENNSYLVANIAN AMMONOID FROM THE OGILVIE MOUNTAINS, YUKON TERRITORY

by W. W. Nassichuk

Abstract

Metapronorites stelcki n. sp. from an unnamed black shale formation in the eastern Ogilvie Mountains, northern Yukon Territory, has attained a stage of evolutionary development comparable with that of the Missourian species *M. pseudotimorensis* in west Texas and with that of the Zhigulevian species *M. cuneilobatus* in the Ural Mountains.

Résumé

Metapronorites stelcki, espèce nouvelle rencontrée dans une formation de schistes noirs, sans dénomination particulière, de la partie orientale des monts Ogilvie, dans le nord du Yukon, a atteint un stade d'évolution comparable à celui de l'espèce *M. pseudotimorensis*, du Missourien, de l'ouest du Texas, et à celui de l'espèce *M. cuneilobatus*, du Zhigulévien, des monts Oural.

INTRODUCTION

Pennsylvanian ammonoids are rare in the Yukon Territory and to date only two isolated occurrences are known. The Upper Pennsylvanian *Metapronorites stelcki* is described herein from the Ogilvie Mountains (Textfig. 15, loc. 18), north-central Yukon, and a few undescribed Middle Pennsylvanian, Atokan (Moscovian) species are known from the Taku Group, some 300 miles away, in south-central Yukon. Elsewhere in Canada, Middle and Upper Pennsylvanian ammonoids as yet have been reported only from the central region of Sverdrup Basin in the Arctic Archipelago. There, at least twenty Atokan (Moscovian) species and one Missourian species (*Parashumardites* sp.) are known from the Hare Fiord Formation (Nassichuk and Furnish, 1965; Nassichuk, 1967a, b, 1969).

Little information on the precise distribution and detailed stratigraphy of Pennsylvanian rocks in the northern Yukon is available in the literature; but general accounts have been provided by Martin (1959), Nelson (1961), Bamber and Barss (1969), and Zeigler (1969). Valuable stratigraphic data were collected by officers of the Geological Survey of Canada, particularly E. W. Bamber, during the course of "Operation Porcupine", a project under the leadership of D. K. Norris in which an area including the Yukon Territory north of 65°N latitude was mapped on a reconnaissance basis. On a preliminary map Norris, and others (1963) incorporated Pennsylvanian rocks, including the black shales that yielded *Metapronorites stelcki* into their map-unit "9", a variable and widespread unit that includes Carboniferous and Permian limestone, shale, sandstone, conglomerate, and chert. Bamber and Waterhouse (in press) have subdivided this unit into six formations in the northern Ogilvie Mountains – Peel River area. Green and Roddick (1962) mapped an area immediately south of 65°N latitude (Dawson, Larsen Creek, and Nash Creek map-areas) and included Pennsylvanian fusulinid-bearing rocks in their map-unit 15 (*see* Green and Roddick, 1962, p. 10).

According to Bamber and Barss (1969) and Bamber (*pers. com.*, 1969) a significant sub-Permian unconformity extends throughout the northern Yukon. Permian strata overlie rocks ranging in age from Devonian to Pennsylvanian, but the upper age limit of the Pennsylvanian rocks has not been established. Middle Pennsylvanian, Desmoinesian (Moscovian) fossils appear to be widespread below Permian rocks, and Ross (1967, 1969) has documented a number of fusulinacean occurrences. Upper Pennsylvanian fossils have not been described previously in the northern Yukon, but the literature contains some references to the possible presence of rocks of this age. Nelson (1961) presented a generalized section of Carboniferous and Permian strata for the northern Yukon and tentatively assigned his Lower Limestone Unit to the early Upper Pennsylvanian (Missourian) on the basis of resemblances of a certain unfigured brachiopod (*see* op. cit., p. 4). Nelson (1962) suggested that the unit may be older than Missourian, that is Moscovian, on the basis of the presence of the coral *Multithecopora penchiensis* Yoh. Nelson and Johnson (1968) indicated that the age of the Lower Limestone Unit is in doubt, but that both Middle and Upper Pennsylvanian faunas are present.

Age relationships of the Upper Pennsylvanian *Metapronorites stelcki* are presented in the following taxonomic discussion of the species. *M. stelcki* closely resembles the American Missourian species *M. pseudotimorensis* (Miller) and the Soviet Zhigulevian species *M. cuneilobatus* Ruzhencev, and in all probability all three species represent the same age. *Metapronorites* is apparently morphologically stable and evolutionary relationships between species are not yet resolved in more than a general way. Thus refined correlations within the Upper Pennsylvanian cannot be achieved at present.

Acknowledgments

The author is indebted to C. R. Stelck of the University of Alberta for providing for study the two specimens of *Metapronorites* described here. E. W. Bamber provided considerable information on regional geology in the Yukon, and W. M. Furnish and Diane R. Ryerson provided comparative materials from the University of Iowa and Yale Peabody Museum of Natural History collections, respectively. The manuscript has been critically read by W. M. Furnish of the University of Iowa, and by B. S. Norford of the Geological Survey of Canada. Photography was done by Claude Spinosa, Boise State College, Idaho.

SYSTEMATIC PALEONTOLOGY

The prefix UA refers to specimens that are in the type collections of the University of Alberta, Edmonton.

Suborder PROLECANITINA Miller and Furnish 1954

Superfamily MEDLICOTTIACEAE Karpinsky 1889

Family PRONORITIDAE Frech, 1901

Genus *Metapronorites* Librovitch 1938

Type species. *Pronorites timorensis* Haniel, 1915; from the early Lower Permian Somohole beds, Timor.

Diagnosis. Metapronorites includes discoidal, moderately involute ammonoids with flat or slightly convex flanks and venter and typically with a smooth shell. Some early representatives of the genus, however, may have weakly ribbed ventrolateral flanks. Details of the external suture best characterize the genus; at least six lateral lobes are present and the first lateral lobe is broad and symmetrically bifurcate. The saddle separating the two branches of this lobe is low, unconstricted and less than half the height of the first lateral saddle. Typically two pointed "teeth" are developed on the ventrad branch of the first lateral lobe; development of "teeth" is inconsistent and variable. Two lobes occur on the umbilical wall and internally four to six lateral lobes are present.

Distribution. Metapronorites maintains a remarkable morphologic stability between early Middle Pennsylvanian and late Early Permian time and species are distinguished on the basis of subtle differences in conch and sutural form. The oldest representatives of the genus are undescribed species in the Atokan (Moscovian) basal Hare Fiord Formation, Ellesmere Island, Arctic Canada (Nassichuk and Furnish, 1965) and in the Atokan "Winslow Formation" of Arkansas. A single specimen from the Winslow Formation is in the repository at the University of Iowa. *M. pseudotimorensis* (Miller, 1930) occurs in Missourian strata in the Gaptank Formation of west Texas and resembles *M. cuneilobatus* Ruzhencev, 1949, from Zhigulevian strata in the Ural Mountains. Immature representatives of an undescribed species in the University of Iowa collections were collected from probable Virgilian strata in the Upper Gaptank Formation, west Texas. The type species, *M. timorensis* is from the early Lower Permian Somohole beds of Timor; the species is also known from the Artinskian Bitauni beds in Timor.

Discussion. Metapronorites was erected principally to accommodate pronoritids with irregularly denticulate divisions of the first lateral lobe. Miller and Furnish (1940) recognized a considerable variation of this feature, even on single specimens and questioned the taxonomic value of irregular denticulation. They regarded *Metapronorites* as a synonym of *Neopronorites* Ruzhencev, 1936. Ruzhencev (1949) provided a study of the systematics and evolution of the Pronoritidae and indicated that *Metapronorites* represents an intermediate stage in a phylogenetic series between *Stenopronorites* Schindewolf and *Parapronorites* Gemmellaro. *Stenopronorites* is known to range from Namurian to Moscovian and *Parapronorites*, the youngest known pronoritid, ranges from Artinskian to early Guadalupian.

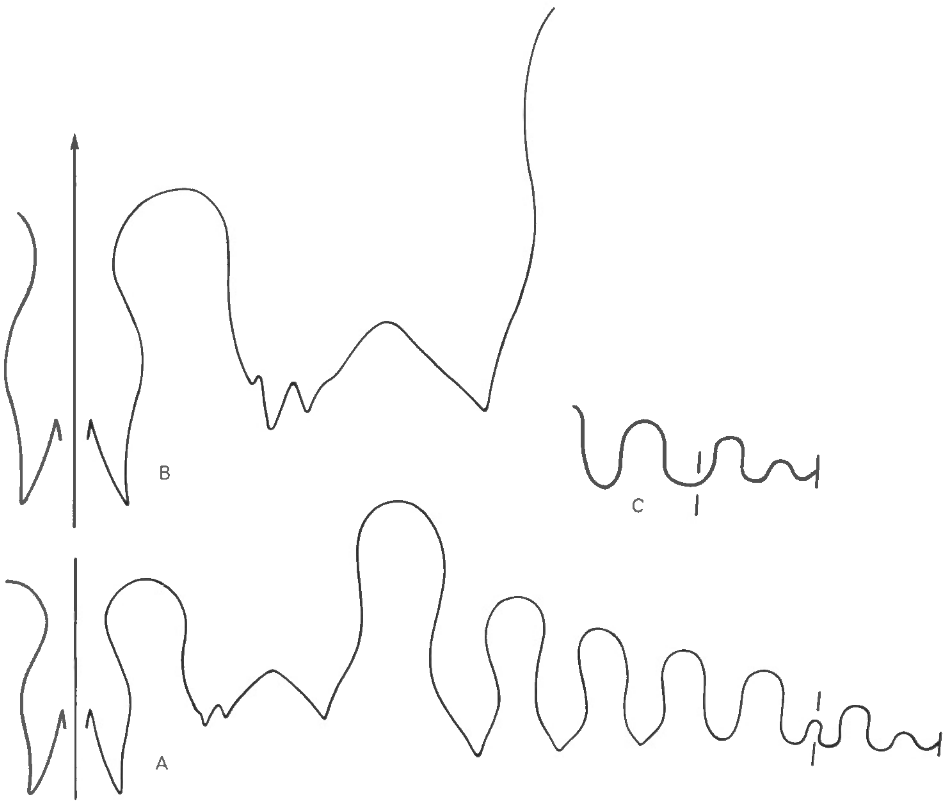
At least one of the species that Ruzhencev (1949) assigned to *Neopronorites* (*Neopronorites prior*, Ruzhencev, 1949) closely resembles *Metapronorites*. In fact, Ruzhencev (1949) indicated that the only difference between his Orenburgian species *N. prior* and the Zhigulevian *Metapronorites cuneilobatus* is that the former has a bidentate dorsal lobe; this feature appears hardly sufficient for generic distinction.

At the time of Ruzhencev's study, *Metapronorites* was unknown from Moscovian strata; it is now known in beds of this age in Arctic Canada where it is directly associated with *Stenopronorites* (Nassichuk and Furnish, 1965).

Metapronorites stelcki new species

Plate 16, figures 1–4; Textfigure 16

Material and occurrence. Holotype (UA 1015) and one paratype (UA 1016) were recovered from a series of black shales, at least 500 feet thick, overlying the Devonian "Imperial Formation", 44.7 miles south of the confluence of Blackstone and Peel Rivers, eastern Ogilvie



TEXTFIGURE 16. Diagrammatic representations of the external suture of *Metapronorites stelcki* new species from an unnamed black shale formation, Ogilvie Mountains, northern Yukon Territory. 16A, 16C. Based on holotype, UA 1015, at a diameter of 33 mm; A and C are part of the same suture but on opposite sides of the shell. 16B. Based on holotype, UA 1015, at a diameter of 48 mm.

Mountains, northern Yukon Territory. They were found in the axis of an east-west trending syncline about 3 miles west of Hart River, in the valley of a small tributary flowing eastward into Hart River (65°14′N, 137°13′W). The black shales are the youngest rocks in this particular valley.

Description. The two available specimens of *Metapronorites stelcki* are pyritized and entirely septate. The largest of the specimens (holotype UA 1015) has a conch diameter of 52 mm, a whorl height of 28.5 mm, a whorl width of 17 mm, and an umbilical diameter of 7 mm. The smaller specimen (paratype UA 1016) is damaged in the ventral area but by reconstruction has an approximate diameter of 40 mm, a maximum width of 13.2 mm, and an umbilical diameter of 6.3 mm. The venter and ventrolateral shoulders are broadly rounded but flanks are nearly flat. Shell ornament is absent.

The external suture is characterized by an elongate trifid ventral lobe, six lateral and two umbilical lobes. The first lateral lobe is broad and symmetrically divided; the ventrad subdivision of the first lateral lobe has three distinct "teeth". "Teeth" are uniformly developed on both sides of the shell. The most nearly ventrad of these three "teeth" is seen as an indentation on the ventral side of the lobe at a diameter of 33 mm (Textfig. 16A) and becomes fully isolated at a diameter of 45 mm. The sixth lateral lobe lies directly on the umbilical shoulder. On one side of the holotype the sixth lateral lobe on all visible sutures is subdivided by a low, slightly constricted saddle (Textfig. 16A), but this feature is absent on the opposite side of the shell (Textfig. 16B) and also is absent on the one exposed side of the paratype.

Comparison. Metapronorites stelcki differs from all other described species of the genus in possessing a tri-dentate ventral subdivision of the first lateral lobe; this feature although unique may be of limited taxonomic significance. *M. stelcki* differs from the Permian type species *M. timorensis* in that it has six rather than seven external lateral lobes and the saddle separating the two branches of the first lateral lobe is relatively higher and narrower in *M. timorensis*. Additionally, the flanks and venter of *M. timorensis* are more prominently rounded. *M. stelcki* resembles *M. pseudotimorensis* and *M. cuneilobatus* in general conch form but the three species are separated on the basis of minor sutural differences. All three species exhibit considerable sutural variation, but only in *M. stelcki* is a trifid division of the ventrad branch of the first lateral lobe observed. Ruzhencev (1949) distinguished *M. cuneilobatus* from *M. pseudotimorensis* because the Soviet species has five rather than four internal lateral lobes and has relatively more pointed external second lateral and dorsal lobes. The internal suture of *M. stelcki* was not observed, but examination of the ultimate septum of the holotype indicates the presence of four internal lateral lobes. An undescribed Moscovian species associated with *Christioceras* Nassichuk and Furnish and *Winslowoceras* Miller and Downs in the Canadian Arctic differs from *M. stelcki* in that it has a relatively flatter venter and flanks and all lateral sutural elements are devoid of serration. In addition, the Arctic species has subdued ribs on the ventrolateral flanks but the shell of *M. stelcki* is smooth.

Age relationships. Although *Metapronorites* was relatively stable morphologically between Moscovian and Artinskian time, *M. stelcki* more closely resembles the Missourian species *M. pseudotimorensis* and the Soviet *M. cuneilobatus* than either Moscovian or Permian species. It is conceivable that the above three species may ultimately be shown to be conspecific when the range of sutural variation within each is more thoroughly known.

M. cuneilobatus was based on 22 specimens taken from the right bank of Sakmara River, southern Urals. According to Ruzhencev (1949, 1950) the specimens were recovered from the upper part of the Zhigulevian Stage (Zianchurin horizon). A discussion of relationships of the Missourian equivalent Zhigulevian Stage is provided in Ruzhencev (1950).

Metapronorites pseudotimorensis is known from the Gaptank Formation in the Marathon Basin, 4.5 miles S15°E of Lenox, Brewster County, Texas, where it is associated with several other ammonoids, including *Prouddenites*. A detailed description of the locality was provided by P. B. King (*in* Miller, 1930, p. 386). Miller (1930) and Miller and Furnish (1940) indicated that the fauna was older than the *Uddenites* fauna near Wolf Camp; the *Uddenites* Zone was shown to be Virgilian by Keyte, Blanchard, and Baldwin (1927). Plummer (*in* King, 1937) considered that the *Prouddenites* fauna described by Miller (1930) was the same as that in the Palo Pinto Limestone (Missourian) in the Canyon Group, north-central Texas. Additional information concerning stratigraphy and age relationships of the Gaptank Formation is available in King (1931, 1937) and Ross (1963).

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Plate 16

(all figures x2)

Metapronorites stelcki new species (Page 81)

Figure 1. Lateral view of paratype (UA 1016) from an unnamed black shale formation, Ogilvie Mountains, northern Yukon Territory.

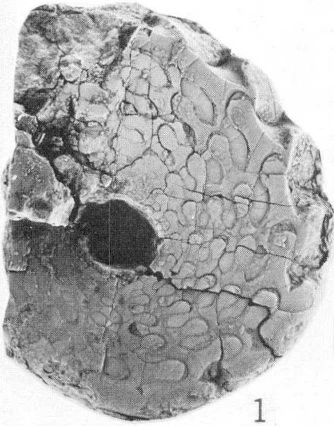
Figures 2–4. Lateral and apertural views of holotype (UA 1015) from an unnamed black shale formation, Ogilvie Mountains, northern Yukon Territory.

Stacheoceras new species (Page 91)

Figure 5. Lateral view of hypotype (GSC 25508) from the Hare Fiord Formation, northern Ellesmere Island.

Paragastrioceras new species Nassichuk, Furnish and Glenister, 1965 (Page 89)

Figure 6. Lateral view of hypotype (GSC 25509) from the Hare Fiord Formation, northern Ellesmere Island.



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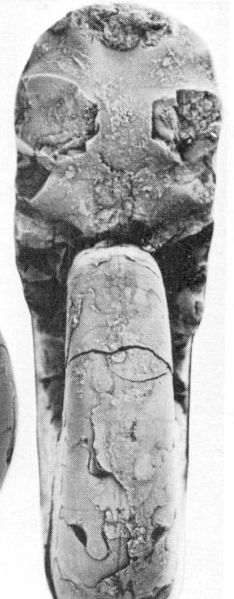

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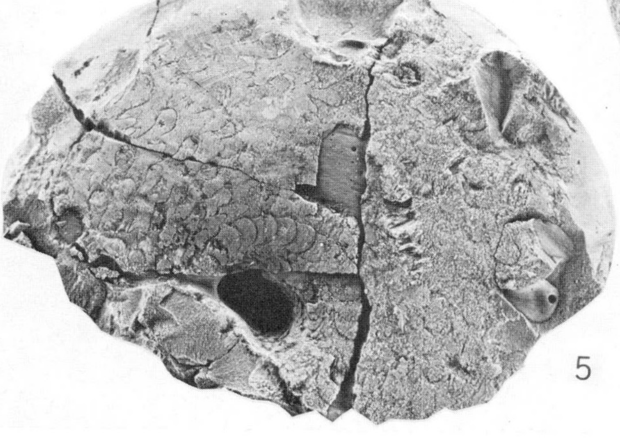

5

THE PERMIAN AMMONOID *STACHEOCERAS* DISCOVERED ON ELLESMERE ISLAND, CANADIAN ARCTIC

by Claude Spinosa[1] and W. W. Nassichuk

Abstract

Stacheoceras n. sp., from the upper part of the Hare Fiord Formation, in the central part of Sverdrup Basin, northern Ellesmere Island, is closely related to *Stacheoceras arthaberi* Smith from the Bitauni beds in Timor; an Early Permian, Artinskian age is indicated.

Résumé

La nouvelle espèce *Stacheoceras*, provenant de la partie supérieure de la formation du fjord Hare, au centre du bassin Sverdrup, dans le nord de l'île Ellesmere, est étroitement apparentée au *Stacheoceras arthaberi* Smith des couches Bitauni dans le Timor et date de l'Artinskien, du début du Permien.

INTRODUCTION

Lower Permian ammonoids are moderately abundant at several localities along the southern and southeastern margins of the Sverdrup Basin (Nassichuk, Furnish, and Glenister, 1965; Nassichuk, 1970) but they are rare elsewhere in the basin. During the summer of 1969 the authors discovered representatives of *Daubichites* Popow in the upper Lower Permian Assistance Formation and *Uraloceras* Ruzhencev in an older unnamed formation along the northeastern margin of the basin in the vicinity of the Sawtooth Mountains. *Stacheoceras* n. sp. was found in black, concretionary shales in the upper part of the Hare Fiord Formation, on the west side of the Blue Mountains, northern Ellesmere Island (Textfig. 1, loc. 3). The Hare Fiord Formation is confined to central regions of Sverdrup Basin, and has yielded fossils ranging from Middle Pennsylvanian to Early Permian. The only other fossils found associated with *Stacheoceras* n. sp. were a few representatives of the ammonoid *Paragastrioceras* Tchernow. Nassichuk, Furnish, and Glenister (1965, p. 18) described the latter as *Paragastrioceras* n. sp. from black shales in the same stratigraphic position, less than half a mile northeast of and along strike from the *Stacheoceras* n. sp. locality.

A restricted age within the Lower Permian cannot be designated on the basis of *Paragastrioceras* n. sp., and the genus ranges throughout the Lower Permian, from Asselian to Artinskian. *Stacheoceras*, on the other hand, is unknown from pre-Artinskian rocks and the evolutionary development of the Arctic species, *S.* n. sp. indicates a late Artinskian age.

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Fossils were not found in Permian rocks above the *Stacheoceras* n. sp. horizon, but fusulinaceans collected from limestones some 500 feet below *Stacheoceras* n. sp. probably indicate an early Permian (Asselian) age (Thorsteinsson, *pers. com.*, 1969).

Acknowledgments

The authors are indebted to Panarctic Oils Limited and particularly to G. Alexander for providing logistic support for field work on northern Ellesmere Island. W. M. Furnish and W. Bruce Saunders of the University of Iowa loaned comparative materials for study and also provided critical discussion concerning taxonomy. B. S. Norford of the Geological Survey of Canada critically reviewed the manuscript.

SYSTEMATIC PALEONTOLOGY

GSC 25508 is the specimen number of the described hypotype of *Stacheoceras* n. sp. in the type collections of the Geological Survey of Canada, Ottawa.

Genus ***Stacheoceras*** Gemmellaro 1887

Type species. *Stacheoceras mediterraneum* Gemmellaro, 1887, pp. 29, 30, Pl. 4, figs. 2–6, S.D.; from the Upper Permian Sosio beds in Sicily.

Diagnosis. The conch of *Stacheoceras* is ellipsoidal to subglobular; at maturity the apertural margin bears a prominent constriction. Shell ornament is characterized by growth lines that form lateral and ventral sinuses. The suture has six to twelve pairs of external lateral lobes that are mainly trifid or bifid. The first lateral lobe may be bifid, trifid, or quadrifid.

Distribution. Representatives of *Stacheoceras* have a wide geographic distribution and occur in both Lower and Upper Permian rocks (Artinskian–Dzhulfian Stages); they are particularly abundant and well preserved in rocks of Guadalupian age. *Stacheoceras* has been reported from Sicily, Timor, Soviet Armenia, the Crimea, the Salt Range, the Himalayas, Madagascar, East Greenland, Coahuila, California, Wyoming, and Texas. Other possible occurrences are in the Pamirs, Croatia, and Japan. Two undescribed species are known from limestones in the upper part of the Cache Creek Group near Atlin, northern British Columbia. These were found in association with representatives of *Waagenoceras* Gemmellaro, *Hyattoceras* Gemmellaro, and *Agathiceras* Gemmellaro and are considered to be of early Guadalupian (Wordian) age. *Stacheoceras* n. sp. described in this report represents the first occurrence of the genus in Arctic North America.

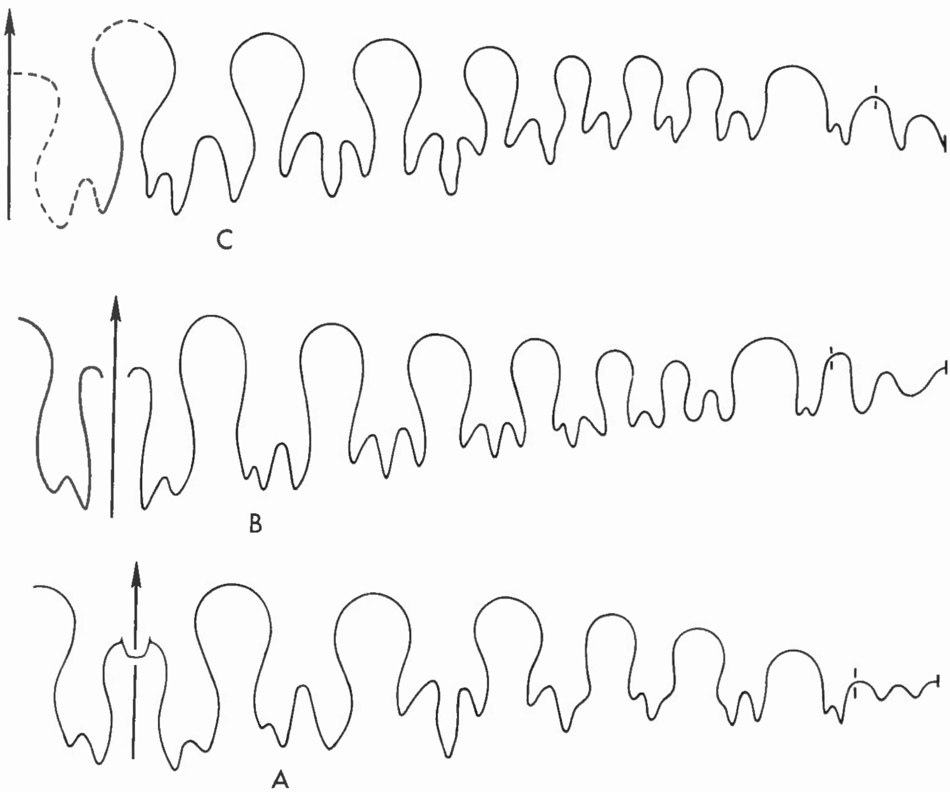
Discussion. Considerable discussion concerning the taxonomy of *Stacheoceras* and related genera is in the literature. Of particular importance are accounts presented by Miller and Furnish (1940, pp. 129–133), Miller (1944, pp. 104–109), Ruzhencev (1956, pp. 209–212; 1962, pp. 395–396), and Furnish (1966, pp. 280–281). Furnish has included *Stacheoceras* in the Marathonitidae and Ruzhencev includes it in the Vidrioceratidae. No attempt is made in this report to review the higher taxonomy of *Stacheoceras;* despite the uncertainties concerning phylogenetic relationships of the genus, the single available Arctic specimen can be compared with established species and in a general way can be used to date the stratum in the Hare Fiord Formation from which it came.

Ruzhencev placed *Stacheoceras* as the most advanced genus in a lineage that includes *Waagenina* Krotow, *Prostacheoceras* Ruzhencev, and *Vidrioceras* Böse. This lineage is based on a single sutural feature, the number of lobes derived from the primary lateral lobe; *Vidrioceras* has three such lobes, *Prostacheoceras* four, *Waagenina* five, and *Stacheoceras* at least six. Phylogenetic consideration of more detailed aspects of sutural configuration in this group is complicated by extremes of sutural variation in single populations. A striking variation in the sutural form of *Stacheoceras* has been observed (by C.S.) in large collections from Mexico and Timor at the University of Iowa.

Stacheoceras new species

Plate 16, figure 5; Textfigure 17C

Material and occurrence. A single phragmocone of *Stacheoceras* n. sp. (hypotype GSC 25508) was found in the Hare Fiord Formation, on the west side of the Blue Mountains, northern Ellesmere Island (Textfig. 1, loc. 3). The locality (GSC loc. C-4320) is 7.28 miles southeast of the eastern shore of Hare Fiord (80°43′30″N, 85°40′W). Near this locality and along strike for 4 miles to the northeast and 3 miles to the southwest, the basal part of the Hare



TEXTFIGURE 17. Diagrammatic representation of the external suture of *Waagenina subinterrupta* (Krotow), *Stacheoceras arthaberi* Smith, and *Stacheoceras* new species.
17A. *Waagenina subinterrupta* (Krotow); taken from Ruzhencev (1956, p. 216, fig. 76d); x4.5.
17B. *Stacheoceras arthaberi* Smith; taken from Haniel (1915, p. 98, fig. 28); magnification unknown. Haniel referred this form to *Popanoceras* (*Stacheoceras*) *timorense* form *delta*.
17C. *Stacheoceras* new species; composite suture at a diameter of 38 mm; x5.

Fiord Formation consists of a massive light grey biohermal limestone with a maximum thickness of 1,500 feet. Several Middle Pennsylvanian (Atokan) ammonoids were recovered from the upper 20 feet of this biohermal limestone, at the same section that yielded *Stacheoceras* n. sp. *Stacheoceras* n. sp. was found in concretionary black shales in association with *Paragastrioceras* n. sp. Nassichuk, Furnish, and Glenister (1965), about 1,550 feet above the Middle Pennsylvanian ammonoid horizon.

Description. The specimen described in this report is entirely septate and has a diameter of 40 mm. It is preserved as a pyritized internal mould in a siltstone concretion; external ornament is absent. Ventrolateral and lateral sutural elements are well preserved but much of the ventral portion of the specimen has been destroyed; internal elements were not observed. The first lateral lobe is distinctly bifid and the ventrad portion has been secondarily subdivided, giving the lobe an asymmetrically trifid appearance. The second and third lateral lobes are distinctly trifid and are followed by four bifid elements; the fourth of these latter bifid elements is relatively wide and is subdivided by a broad and relatively high secondary saddle. A large saddle separates these lateral elements from a bifid, narrow lobe located just outside the umbilical shoulder. A narrow, deep element is located between the shoulder and the seam.

Comparisons. Distinction between *Waagenina* Krotow and *Stacheoceras* Gemmellaro as at present understood is simply based on the relative numbers of lateral lobes derived from the primary lateral lobe; *Waagenina* characteristically has five such lobes and *Stacheoceras* at least six. Affinities between typical *Waagenina, W. subinterrupta* (Krotow), and *Stacheoceras* are demonstrated in Textfigure 17. *Stacheoceras arthaberi* Smith (= *Popanoceras* (*Stacheoceras*) *timorense*, form *delta* of Haniel, 1915) from the Artinskian Bitauni beds of Timor has the same basic sutural plan as does the Artinskian *Waagenina subinterrupta* but has one additional lateral element. Similarly the Arctic *Stacheoceras* n. sp. has a comparable sutural plan but has two more lateral elements than *W. subinterrupta*. Thus, *S.* n. sp. is more closely related to *S. arthaberi* than to any other representative of the genus. The Arctic species has fewer lobes that the type species, *S. mediterraneum*.

Comparison of the Arctic species with other representatives of *Stacheoceras* is less informative, but there is some general similarity between *S.* n. sp. and *S. rothi* Miller and Furnish from the Leonard of Texas, the two species are separated on the basis of sutural detail.

Furnish (1966) indicated that isolated specimens of *Stacheoceras* cannot be placed chronologically in more than a general way; the number of sutural elements on *S.* n. sp. and association in the Hare Fiord Formation with representatives of *Paragastrioceras* indicate an Artinskian, probably late Artinskian age.

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NEW SPECIES OF *SCHWAGERINA* AND *YABEINA* (FUSULINACEA) OF WORDIAN AGE (PERMIAN) FROM NORTHWESTERN BRITISH COLUMBIA

by Charles A. Ross[1]

Abstract

Three new species of fusulinacean Foraminiferida from the Cache Creek Group in the Atlin map-area of northern British Columbia are *Schwagerina atlinensis*, *Yabeina cordillerensis*, and *Y. nakinensis*. All three are associated with the ammonoids *Waagenoceras*, *Stacheoceras*, *Agathiceras*, and *Hyattoceras*, which are indicative of a Wordian age (early Late Permian). The juvenarium and axial and transverse septula in the two species of *Yabeina* have primitive morphological features that are typical for species of *Yabeina* from the lower part of the stratigraphic range of the genus. In the Akasaka Limestone of Japan, such species are found in the upper part of the Zone of *Neoschwagerina*.

Résumé

Trois espèces nouvelles de l'ordre des foraminifères présentant des caractères de fusuline et provenant du groupe de Cache Creek, dans la région cartographique d'Atlin, dans le nord de la Colombie-Britannique sont: *Schwagerina atlinensis*, *Yabeina cordillerensis*, et *Y. nakinensis*. Les trois espèces sont associées aux ammonites *Waagenoceras*, *Stacheoceras*, *Agathiceras*, et *Hyattoceras*, qui sont caractéristiques du Wordien (début du Permien supérieur). La loge initiale, ainsi que les cloisons axiale et transversales de ces deux espèces de *Yabeina* présentant des particularités morphologiques primitives, typiques de l'espèce de *Yabeina* de la partie inférieure du phylum stratigraphique de ce genre. Dans le calcaire d'Akasaka, au Japon, on trouve des espèces semblables dans la partie supérieure de la zone à *Neoschwagerina*.

INTRODUCTION

During field studies in the Atlin map-area of northern British Columbia, J. W. H. Monger collected a sample containing ammonoids and fusulinaceans from the Cache Creek Group near the summit of a 4,000-foot mountain just south of Nakina River (Text fig. 1, loc. 6, 59°06'N, 132°57'W, GSC loc. 79412). The collection is from less than 20 feet of strata near the top of a thick limestone unit within the upper Cache Creek (horizons L.P. of stratigraphic section Aa of Monger, 1969, p. 24). After preliminary identification of the cephalopods by W. W. Nassichuk, he and Monger returned to the locality and collected extensive

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additional material. The cephalopods from this locality include *Waagenoceras* Gemmellaro, *Stacheoceras* Gemmellaro, and *Agathiceras* Gemmellaro that form an ammonoid zonal assemblage which characterizes the Wordian Stage (lower part of the Guadalupian Series, Upper Permian) of the North American standard section. R. Thorsteinsson and I independently examined randomly oriented thin sections of the fusulinaceans from the same pieces of rock that contained the cephalopods and identified the genus *Yabeina* Deprat, which has long been considered a guide fossil to the Tethyan equivalents of the Capitanian Stage (upper part of the Guadalupian Series) of the North American standard sections.

The anomaly in the apparent ages of the two groups of fossils from the same piece of limestone suggests that the lower part of the Range Zone of *Yabeina* of the Tethyan faunal realm is older than usually believed and is equivalent to most of the Wordian Stage of the Midcontinent–South American faunal realm (Ross and Nassichuk, 1970). A review of morphological features in different species of *Yabeina* and of their stratigraphic occurrence (Kanmera, 1954, 1957; Minato and Honjo, 1959, 1965) indicates that the Range Zone of *Yabeina* may be subdivided broadly into two parts. The lower part contains primitive species of *Yabeina*, such as *Y. ozawai* Honjo (which occurs low in the Zone of *Neoschwagerina margaritae* Deprat) and the two species described in this report. The upper part has more advanced species of *Yabeina* with thin, dense septula and consistently more than one secondary transverse septulum between primary transverse septula, such as *Y. gubleri* Kanmera, which occurs in the Assemblage Zone of *Yabeina* and *Lepidolina*. A probable corollary from this review is that only the upper part of the Zone of *Neoschwagerina* of the Tethyan faunal realm is correlative with the Wordian Stage of the Guadalupian Series and most of the lower part of the Zone of *Neoschwagerina* is correlative with the upper part of the Leonardian Series in the Midcontinent–South American faunal realm. Further discussion of the significance of these fossils to the correlation between Tethyan and non-Tethyan faunal realms is presented by Ross and Nassichuk (1970).

Most previously described species of *Yabeina* from southern British Columbia, Washington, and Oregon (Dawson, 1879; Dunbar, 1932; Anderson, 1941; Thompson and Wheeler, 1942; Thompson, Wheeler, and Danner, 1950; and Skinner and Wilde, 1966) are sufficiently advanced morphologically to suggest that they are from the Assemblage Zone of *Yabeina* and *Lepidolina*. The following descriptions of the new fusulinacean species from the northern British Columbia locality help in defining a part of the faunal assemblage from the lower part of the Range Zone of *Yabeina* that appears to lie within the Zone of *Neoschwagerina margaritae*. Nassichuk is preparing a paper describing the ammonoids from this locality.

Acknowledgments

It is a pleasure to acknowledge and thank J. W. H. Monger and W. W. Nassichuk for collecting this material and for their discussion of the stratigraphic and paleontological significance of the interesting fauna, and also B. S. Norford for critically reading the manuscript.

SYSTEMATIC PALEONTOLOGY

Prefix GSC refers to specimens in the type collection of the Geological Survey of Canada, Ottawa.

Order FORAMINIFERIDA

Family Schwagerinidae

Genus *Schwagerina* von Möller 1877

Type species. *Borelis princeps* Ehrenberg, 1842, from the Lower Permian of the USSR.

Schwagerina atlinensis new species

Plate 17, figures 1–5

Material and occurrence. Four illustrated specimens (holotype GSC 24698, paratypes GSC 24695–24697) and twelve fragmentary specimens from GSC locality 79412. *Schwagerina atlinensis* is rare to common in hand specimens from the locality and in these occurs with *Yabeina cordillerensis* new species, *Y. nakinensis* new species, *Waagenoceras*, and other cephalopods.

Description. Shells have spindle-shaped outlines and reach 6 to 7 mm in length and 2.5 to 3.5 mm in diameter in 7 to 8½ volutions. In specimens measured, the proloculi are 0.09 to 0.12 mm outside diameter and spherical to slightly irregular in shape (Pl. 17, fig. 5). The first two to four volutions are low and elongated along the axis of coiling. Succeeding volutions increase gradually in height and become spindle-shaped. In the fifth or sixth volution the poles become narrow and pointed (Pl. 17, figs. 3, 4), and the lateral slopes become concave. The spiral wall is composed of a thin tectum and a coarsely alveolar keriotheca (Pl. 17, fig. 5). Wall thickness increases gradually in early volutions, from 0.008 to 0.012 mm in the proloculi and first volution, to 0.020 to 0.025 mm in the third volution. In the third to fifth volution the thickness of the wall increases markedly (Pl. 17, fig. 5) and reaches 0.10 to 0.12 mm by the sixth volution. In the sixth volution there are 5 to 5.5 alveoli in the wall per 0.1 mm. Rugosity of the spiral wall surface is a persistent feature (Pl. 17, figs. 3–5) of these shells.

Septa are intensely folded and septal folds reach to the top of the chambers and have a variable outline when seen in thin sections (Pl. 17, figs. 3–5). Tunnel path is regular to slightly irregular and rudimentary chomata and pseudochomata are inconspicuous or lacking. Secondary deposits heavily coat and infill portions of the axial region of the shell (Pl. 17, figs. 3, 4). Septal folds are commonly coated even in parts of the shell where the roof or floor of the chambers are not coated.

Remarks. Schwagerina atlinensis is similar in general construction and shape to *S. royandersoni* Thompson, Wheeler, and Danner from Snohomish County, Washington. *S. atlinensis* differs in having considerably denser and more widely distributed secondary axial deposits, a smaller shell per volution, smaller mature size, and a subcylindrical midregion (Pl. 17, figs. 3, 4). *S. atlinensis* can be contrasted with most other species of *Schwagerina* by a number of features including the coarseness of the alveoli and the persistent rugosity of the spiral wall. Rugosity of the spiral wall is also known in the genus *Pseudofusulina* Dunbar and Skinner, and study of additional species of the *S. atlinensis* and *S. royandersoni* group perhaps may indicate a reassignment to that genus.

S. atlinensis takes its name from the town of Atlin and the nearby Atlin Horst, British Columbia.

Family VERBEEKINIDAE

Genus *Yabeina* Deprat 1914

Type species. *Yabeina inouyei* Deprat, 1914, from the Akasaka Limestone of Japan.

Yabeina cordillerensis new species

Plate 17, figures 6–12; Plate 18, figures 1–8

Material and occurrence. Twelve illustrated specimens (holotype GSC 24704, paratypes GSC 24699–24703, 24705–24708, 25058, 25059) and numerous poorly oriented specimens from GSC locality 79412. The species is abundant in a fusulinacean coquina in association with *Y. nakinensis* new species, *Schwagerina atlinensis* new species, *Waagenoceras*, and other ammonoids.

Description. Fusiform to subelliptical shells reach 8.5 to 11 mm length and 6 to 8 mm diameter in 16 to 19 volutions. In specimens examined, proloculi are small, 0.04 to 0.05 mm outside diameter, and the first 1 to 2½ volutions form a staffelloid juvenarium (Pl. 18, figs. 1, 7, 8). Succeeding volutions are coiled about a single axis of coiling and gradually and uniformly increase in height and length. The shells become progressively more elongate in succeeding volutions and the form ratio increases from 1.5 to 1.6 in the fourth to sixth volution to 2.0 to 2.2. in the thirteenth or fourteenth volution. Poles are broadly round to slightly indented and the lateral slopes are convex throughout (Pl. 17, figs. 6–11).

Spiral wall is composed of a thin tectum and a finely alveolar keriotheca having 8 to 11 alveoli per 0.1 mm. The thickness of the spiral wall is 0.02 to 0.03 mm in the tenth or eleventh volution and in most later volutions. Septa are essentially plane and widely spaced and their number gradually increases from 8 in the third or fourth volution to about 25 in the sixteenth to seventeenth. Axial septula are composed of thin prolongations of keriotheca with clearly visible alveoli and first appear in the third volution as a single septulum, as a single *s* or *l* septulum in the fourth and fifth volution, and as multiple *v*, *s*, and *l* septula in later volutions (terminology of Minato and Honjo, 1959). In the sixteenth or seventeenth volution three *l* and one *s* or one *v* septula are commonly present (Pl. 18, figs. 2, 7, 8). Major transverse septula, composed of thin prolongations of keriotheca having clearly visible alveoli (Pl. 17, fig. 12; Pl. 18, figs. 5 and 6) join with parachomata to subdivide the chambers into rectangular chamberlets that are interconnected through elliptical foramina. Minor transverse septula first appear in the eighth or ninth volution and occasionally two minor transverse septula appear between pairs of primary transverse septula in the eleventh or twelfth and later volutions (Pl. 17, fig. 11; Pl. 18, figs. 5, 6). The tips of some septula are plugged with dark organic-rich material; however, this is not a prominent feature. More prominent is the thick dark tectum in the septa (Pl. 18, fig. 8).

Remarks. In comparison with other species described from the Pacific northwest and British Columbia, *Yabeina cordillerensis* is of similar size to *Y. columbiana* (Dawson) but differs from that species in having thicker axial and transverse septula that are not infilled as extensively by secondary deposits. *Y. cordillerensis* is larger and less globose than *Y. parvula* Skinner and Wilde and *Y. minuta* Thompson and Wheeler (1942, emend. Skinner and Wilde, 1966) and is more elongate than *Y. nakinensis* new species, *Y. dunbari* Skinner and Wilde, and *Y. obesa* Skinner and Wilde. *Y. dawsoni* Skinner and Wilde is about the same size as *Y. cordillerensis*, but has thinner septula that are more densely infilled with secondary material. *Y. cylindrica* Skinner and Wilde and *Y. gracilis* Skinner and Wilde are considerably more elongate than *Y. cordillerensis*. In comparison with these species and other previously described species of the genus from western Canada, *Y. cordillerensis* is a well-developed species of the genus, but morphologically is not advanced in terms of the amount of thinning and infilling of the septula. In this one aspect, *Y. cordillerensis* shows some similarity to *Y. cascadensis* (Anderson) from Snohomish County, Washington, and this species also has consistently small proloculi and staffelloid juvenaria. *Y. cascadensis* is more globose than *Y. cordillerensis.*

Yabeina cordillerensis takes its name from the Cordilleran region of western Canada.

Yabeina nakinensis new species

Plate 19, figures 1–4

Material and occurrence. Two illustrated specimens (holotype GSC 25061, paratype GSC 25060) and five unillustrated specimens that are randomly oriented from GSC locality 79412 where *Yabeina nakinensis* is abundant in coquinal bands in association with *Y. cordillerensis* new species, *Schwagerina atlinensis* new species, *Waagenoceras,* and other ammonoids.

Description. Large, subglobose shells attain 10 mm length and 6.5 mm diameter in 16 to 19 volutions. In specimens examined, the proloculi are small and difficult to observe while making thin sections. The first 1 to 3 volutions are small and staffelloid and coiled at a high angle to the axis of later coiling. Succeeding volutions are coiled around a single axis, and height and length of volutions gradually increase. The form ratio changes very slightly from 1.6 in the third or fourth volution to 1.5 in the sixteenth to nineteenth volution. Poles are broadly rounded and the lateral slopes are convex throughout (Pl. 19, fig. 4).

The spiral wall is composed of a thin tectum and a finely alveolar keriotheca having 9 to 12 alveoli per 0.1 mm. The thickness of the spiral wall is 0.01 to 0.05 mm in the fifth or sixth volution and reaches 0.01 to 0.03 mm in the fifteenth or sixteenth volution and in most later volutions. Septa are essentially plane and widely spaced and their number gradually increases from 12 in the seventh or eighth volution to 26 to 30 in the eighteenth or nineteenth volution. Axial septula are composed of thin elongations of the keriotheca that have clearly visible alveoli and that first appear in the second or third volution as a single septulum, as a single *s* or *l* septulum in the fourth volution, as multiple *s* or *l* septula in the fifth volution, and reach a maximum of 5 $l+s$ and 6 *l* septula in the eighteenth or nineteenth volutions (Pl. 19, figs. 1, 2). Major transverse septula, composed of thin prolongations of the keriotheca having clear visible alveoli (Pl. 19, fig. 3) join with parachomata to subdivide the chambers into chamberlets that are interconnected through elliptical foramina. Minor transverse septula first appear in the ninth or tenth volution (Pl. 19, figs. 3, 4), and two minor axial septula between primary transverse septula are lacking or rare. The tips of some septula are infilled with dark secondary material, but infilling is not a prominent feature.

Remarks. Yabeina nakinensis is more globose and has less waxy axial septula than *Y. cordillerensis* new species that occurs with it. *Y. packardi* Thompson and Wheeler is larger and more globose. *Y. cascadensis* (Anderson) and *Y. columbiana* (Dawson) have more prominent secondary transverse septula that appear in earlier volutions than in *Y. nakinensis. Y. ampal* Skinner and Wilde and *Y. decora* Skinner and Wilde are longer and more elongate and have more highly developed secondary tranverse septula. *Y. dawsoni* Skinner and Wilde and *Y. obesa* Skinner and Wilde have secondary transverse septula that appear in earlier volutions and become multiple between primary transverse septula in contrast to *Y. nakinensis. Y. gracilis* Skinner and Wilde and *Y. cylindrica* Skinner and Wilde are markedly more elongate and more advanced in septula construction. *Y. dunbari* Skinner and Wilde is more globose than *Y. nakinensis.*

In comparison with the species of *Yabeina* from Japan, *Y. nakinensis* is similar in general shape, in construction and appearance of axial septula and in primary and secondary transverse septula to *Y. ozawai* Honjo from the lower part of the Zone of *Yabeina* at the Akasaka quarry. Most other described species of *Yabeina* have thinner, more strongly infilled secondary transverse septula and other features suggestive of more advanced evolutionary position than *Y. nakinensis*.

Yabeina nakinensis takes its name from Nakina River, which drains part of the Atlin Horst area.

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Plate 17

All specimens from GSC loc. 79412; all figures x10 except 5 and 12, x50

Schwagerina atlinensis new species (Page 97)

Figures 1, 2. Near sagittal sections of paratypes (GSC 24695, 24696).

Figures 3, 4. Axial sections of paratype (GSC 24697) and holotype (GSC 24698) showing dense secondary axial deposits.

Figure 5. Enlarged view of part of fig. 4, showing coarse alveoli in the rugose wall.

Yabeina cordillerensis new species (Page 98)

Figures 6, 7, 9. Axial sections of immature paratypes (GSC 24699–24701).

Figure 8. Deep tangential section of paratype (GSC 24702) showing pattern of primary and secondary transverse and axial septula.

Figures 10, 11. Axial sections (paratype GSC 24703, holotype GSC 24704) showing strongly developed secondary septula.

Figure 12. Enlarged view of part of fig. 11, showing microstructure of spiral wall.

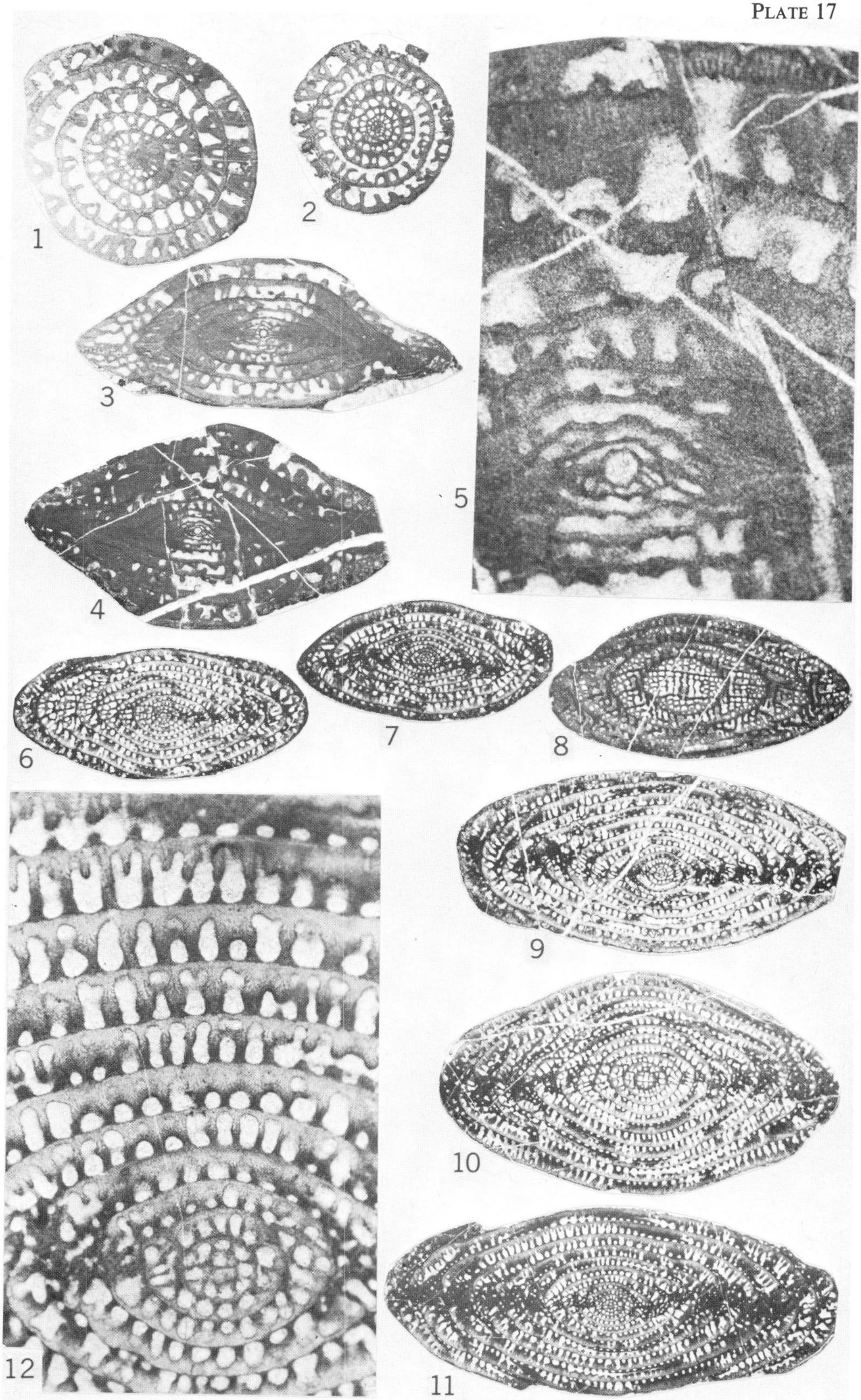
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PLATE 18

All specimens from GSC loc. 79412; all figures x10 except 6 and 8, x50

Yabeina cordillerensis new species (PAGE 98)

Figures 1, 3, 7. Sagittal sections of paratypes (GSC 24705–24707), showing development of primary and secondary axial septula.

Figures 2, 4, 5. Axial sections of paratypes (GSC 24708, 25058, 25059), showing development of primary and secondary transverse septula.

Figures 6, 8. Enlarged views of parts of figs. 5 and 7 showing microstructure of spiral wall.

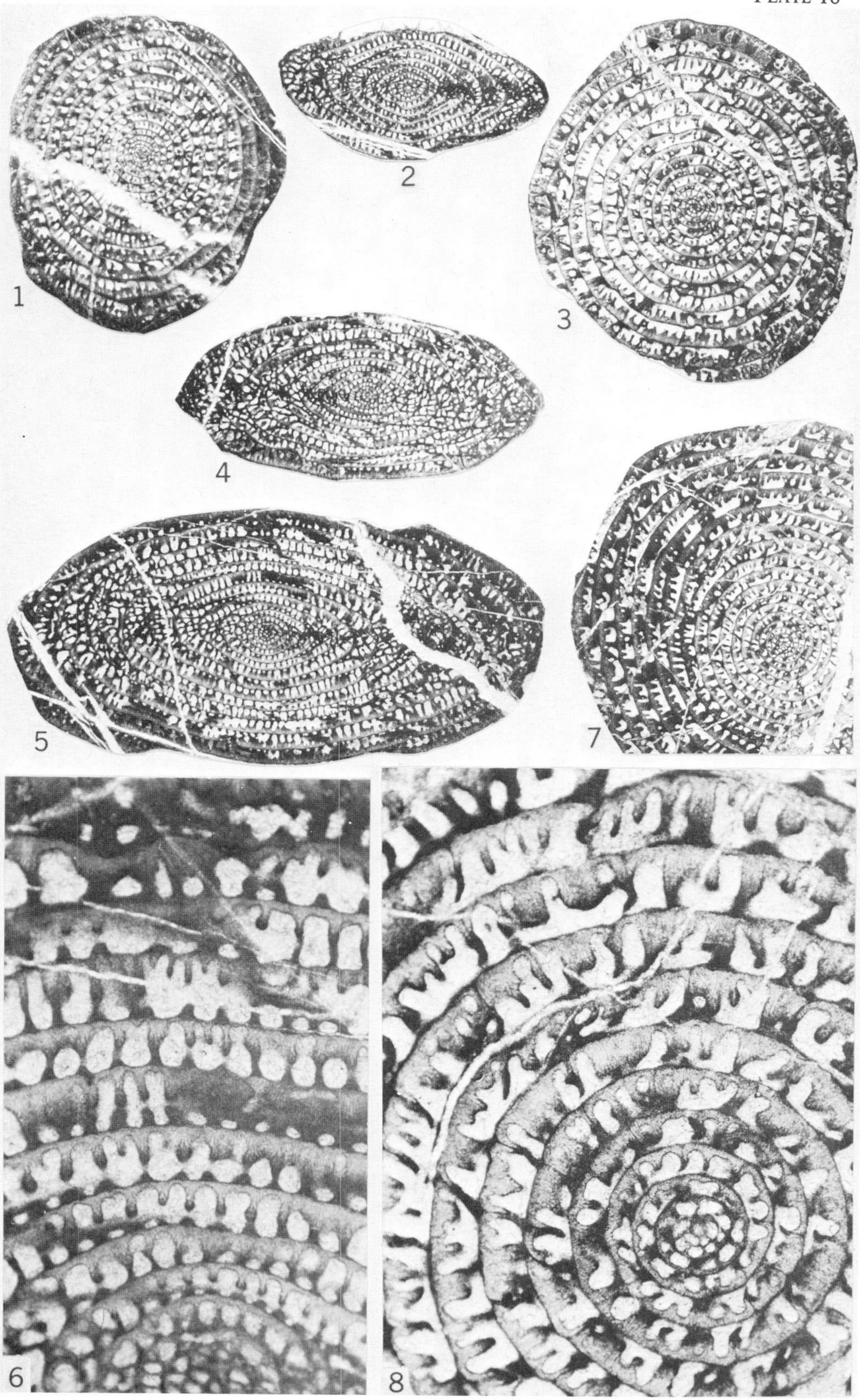
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Plate 19

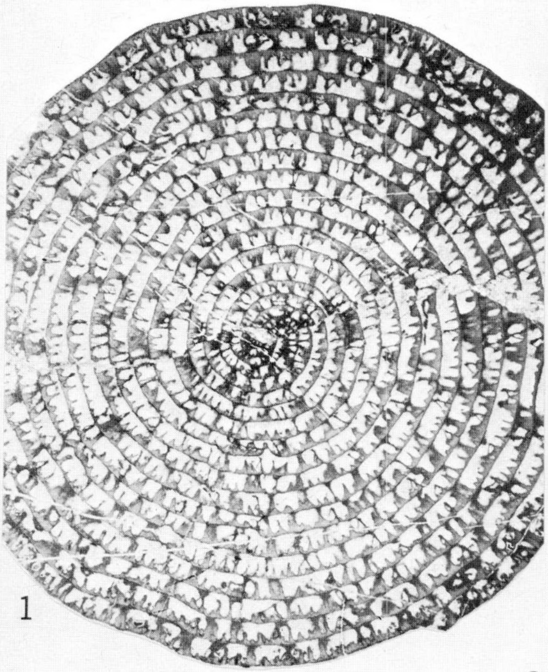
All specimens from GSC loc. 79412; all figures x10 except 2 and 3, x50

Yabeina nakinensis new species (Page 99)

Figure 1. Portion of sagittal section of paratype (GSC 25060) showing development of primary and secondary axial septula.

Figures 2, 4. Enlarged views of parts of figs. 1 and 3 showing microstructure of spiral wall.

Figure 3. Portion of axial section of holotype (GSC 25061) showing development of primary and secondary transverse septula.



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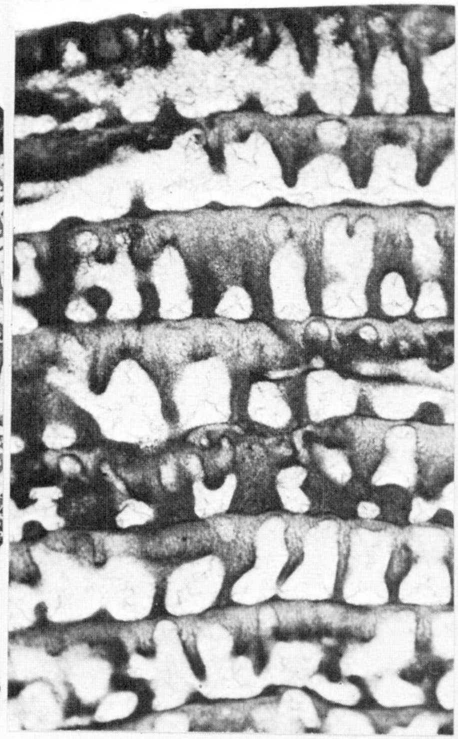

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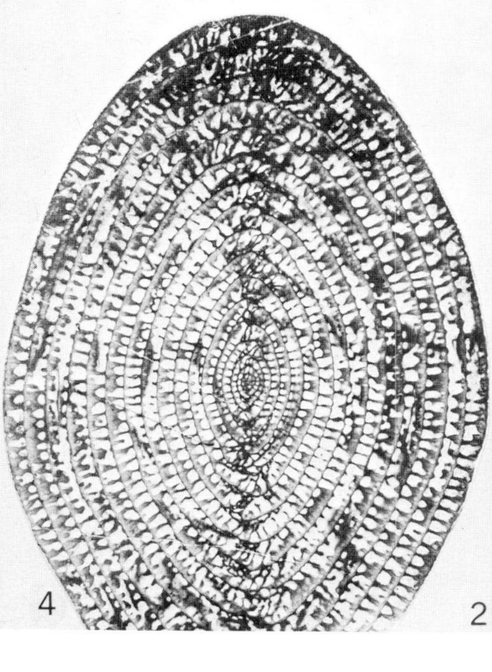

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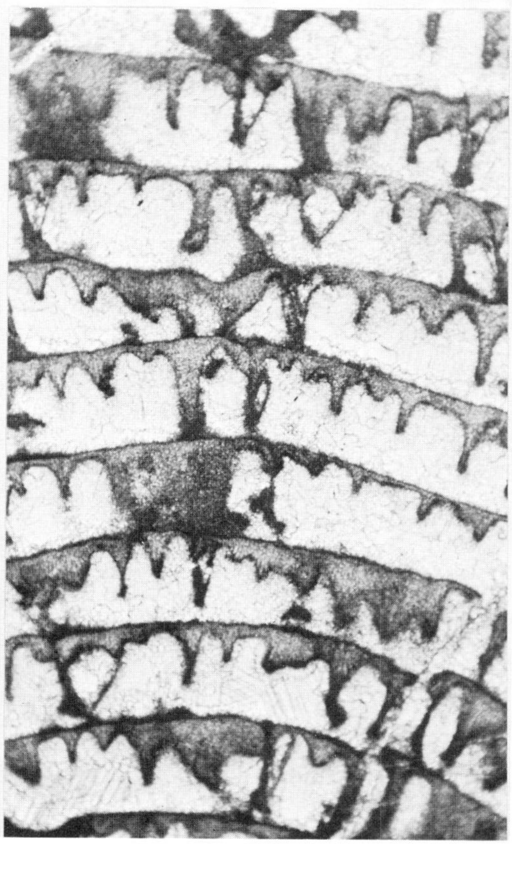

2

PALYNOLOGY OF THE LOWER CRETACEOUS ISACHSEN FORMATION ON MELVILLE ISLAND, DISTRICT OF FRANKLIN

by William S. Hopkins, Jr.

Abstract

Twenty rock samples from the Isachsen Formation on northwest Melville Island were examined for their palynomorph content. Forty-nine palynomorph species are illustrated, but these do not include the bisaccate conifer pollen grains. A warm temperate lowland during Isachsen time is indicated by the plant microfossils.

Résumé

L'auteur a étudié le contenu pollinique de 20 échantillons de roches provenant de la formation d'Isachsen, dans la partie nord-ouest de l'île Melville. Il décrit 49 espèces polliniques, mais celles-ci ne comprennent pas les grains de pollen de conifères à deux ballons. L'existence de ces fossiles végétaux microscopiques montre que pendant la période de l'Isachsen existait une plaine basse, sous un climat tempéré chaud.

INTRODUCTION AND ACKNOWLEDGMENTS

These illustrations of Lower Cretaceous palynomorphs form the first of a proposed series of preliminary reports dealing with the palynologic examination of Mesozoic formations in parts of the Sverdrup Basin, District of Franklin. This paper deals with the Isachsen Formation as exposed on northwest Melville Island in the area of 76°20'N latitude and 115°34'W longitude (Textfig. 1, loc. 4). Panarctic Oils Limited supplied the samples on which this work is based. The manuscript has been critically read by R. L. Cox.

STRATIGRAPHY AND AGE RELATIONS

The Isachsen Formation was originally named by Heywood (1957, p. 11) on Ellef Ringnes Island for a sequence of arenaceous strata. The beds are mainly light coloured clastic rocks composed of sandstone, quartzite, and conglomerate with interbedded shales and coals. Apparently the unit is essentially continental with possibly a few intercalated marine beds. The Isachsen Formation is widespread throughout Sverdrup Basin, ranging in thickness from 400 feet at the basin margins to 4,500 feet on western Axel Heiberg Island.

Although the Isachsen Formation largely lacks marine invertebrate fossils it can be dated approximately from ages of formations above and below. The Mould Bay Formation, which immediately underlies the Isachsen, contains Upper Valanginian marine invertebrates, as does the lower Isachsen at some localities. The Christopher Formation, also marine, overlying the Isachsen, is of Albian and possibly also Aptian age. The Isachsen Formation is therefore entirely Lower Cretaceous, ranging from Upper Valanginian, including probably Hauterivian and Barremian; possibly also Aptian (Tozer and Thorsteinsson, 1964, p. 147). On northwest Melville Island the formation is about 400 feet thick and dips gently northward into Sverdrup Basin.

For a more complete discussion of general geology and the Isachsen Formation specifically *see* Tozer and Thorsteinsson (1964) and Stott (1969). These publications both have extensive bibliographies pertaining to earlier geologic work.

SAMPLES

This study was based on twenty samples collected by Panarctic Oils Limited from the bottom of 50- to 75-foot-deep seismic shot holes. The shot holes utilized are from three separate lines and cross the formation at approximately right angles to strike. Maceration of samples followed essentially standard palynologic techniques, including breakdown of the rocks in hydrochloric and hydrofluoric acids, followed by oxidation and staining. The residues were permanently mounted in Canada balsam on glass slides.

DISCUSSION

There appears to be no significant variation in the flora from top to bottom of the Isachsen Formation suggesting that environmental conditions did not vary greatly during the time represented by Isachsen deposition, although minor and probably insignificant variations do occur. *Osmunda-sporites* occurs only in the upper part of the formation, and *Baculatisporites* is somewhat more abundant in the upper part. These two facts suggest a growing importance of Osmundaceous ferns with the passage of time. The pteridosperm *Vitreisporites* is rarely present, and only near the base of the formation. This genus is abundant in Jurassic rocks and rare by mid-Neocomian, so its occurrence may well prove to be a useful stratigraphic marker in this area. However, the paleoecological implications of the presence or absence of *Vitreisporites* are not known. Other than these minor variations, which may prove to be only local, the flora is remarkably uniform over a comparatively long period of time (about 10 million years).

The following genera and species of plant microfossils are illustrated in this report:

Sphagnum antiquasporites Wilson and Webster

Sphagnum bimammatus (Naumova ex Bolkhovitina) Elsik

Lycopodiumsporites austroclavatidites (Cookson) Potonié

Lycopodiumsporites cerniidites (Ross) Del. and Sprum.

Acanthotriletes varispinosus Pocock

Osmundacidites wellmanii Couper

Osmunda-sporites elongatus Rouse

Baculatisporites comaumensis (Cookson) Potonié

Cicatricosisporites australiensis (Cookson) Potonié

Cicatricosisporites hallei Del. and Sprum.

Cicatricosisporites ludbrooki Dettmann

Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann

Klukisporites cf. *pseudoreticulatus* Couper

Gleicheniidites senonicus Ross

Cyathidites australis Couper

Cyathidites minor Couper

Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann

Concavissimisporites parkinii (Pocock) Singh

Concavissimisporites punctatus (Del. and Sprum.) Singh
Concavissimisporites variverrucatus (Couper) Singh
Concavissimisporites cf. *C. verrucosus* Del. and Sprum.
Converrucosisporites saskatchewanensis Pocock
Leptolepidites cf. *L. verrucatus* Couper
Pilosisporites trichopapillosus (Thiergart) Del. and Sprum.
Trilobosporites apiverrucatus Couper
Trilobosporites bernissartensis (Del. and Sprum.) Potonié
Trilobosporites canadensis Pocock
Trilobosporites sp.
Deltoidospora junctum (Kara-Murza) Singh
Deltoidospora hallii Miner
Staplinisporites caminus (Balme) Pocock
Rugulatisporites sp.
Densoisporites cf. *D. crassus* Tralau
Foveosporites canalis Balme
Hymenozonotriletes cf. *H. pseudoalveolatus* (Couper) Singh
Trilete A
Vitreisporites pallidus (Reissinger) Nilsson
Monosulcites spp.
Araucariacites australis Cookson
Laricoidites gigantus Brenner
Laricoidites magnus (Potonié) Potonié, Thomson and Thiergart
Tsugaepollenites mesozoicus Couper
Tsugaepollenites cf. *T. dampieri* (Balme) Dettmann
Podocarpidites sp. A
Podocarpidites sp. B
Classopollis torosus (Reissinger) Couper
Eucommiidites troedssonii Erdtman
Inaperturopollenites sp.
Schizosporis reticulatus Cookson and Dettmann

The dominant microfloral elements are the coniferales, both those included in this report (*Tsugaepollenites*, *Araucariacites*, *Laricoidites*, *Podocarpidites*, *Classopollis*, and *Inaperturopollenites*) and a host of taxa represented by comparatively nondescript bisaccate forms that are not described. Also abundant are the ferns, especially representatives of the families Schizaeaceae and Gleichenaceae. Cycadophytes and Ginkgophytes appear to be minor, although in many parts of the world they form an important part of Mesozoic floras. The characteristic monocoplate pollen produced by these families is exceedingly rare in the Isachsen. According to present interpretation *Eucommiidites* is related to the Ginkgoales, Cycadales or Pteridosperms, or even possibly to a completely unknown plant group (Reymanowna, 1968). If it is related to the ginkgos or cycads, the occurrence of this genus, never abundant, but usually present, may suggest at least a small growth of one of these families during Isachsen time. The pollen record gives no evidence to indicate that angiosperms had made their appearance by Isachsen time.

The environmental picture that comes to mind is a broad and extensive lowland of deposition, probably a coastal plain dotted with lakes, swamps, and meandering rivers. The lowland was clothed in a luxuriant cover of gymnosperms of many types, the specific types in any given area controlled by edaphic, biologic, climatic, and other factors.

The source of the Isachsen sediments was the higher areas bordering the basin, and these were undoubtedly covered by conifers. In the drier areas grew the few cycads and/or ginkgo (if they were present). Ferns were present throughout this conifer forest, smaller forms composing a ground cover, others forming thickets and others were lianas. The gleichenaceous ferns and lycopods were probably restricted to the drier and better drained areas whereas the Sphagnaceae were restricted to ponds and swamps. Selaginellaceae occupied the damp and boggy sites.

This assemblage grew and prospered some 125 million years ago, so climatic interpretations must remain generalized and rather imprecise. The most satisfactory interpretations are achieved by comparing the climatic requirements of the most closely related modern forms and extrapolating backwards in time. However, there are serious complications in using this method. First, plants may change, slightly or considerably, their ecologic requirements with the passage of time. Secondly, our understanding of the relationship of the fossil palynomorphs with modern plants is often tenuous. The use of modern generic names for Mesozoic plants is probably not valid, because in almost all instances there are significant morphologic differences and it seems unlikely a genus would survive 100 million years. The best we can do is to make probable assignments to modern families. Thirdly, there can be, and usually is, considerable variation in the ecologic requirements of various species within a given genus; consequently the spread of ecologic requirements within a plant family may be tremendous. Because of these problems, it is vitally necessary to utilize entire floras for interpretations of past climates (or as large a flora as can be identified from the palynomorphs) rather than individual form species.

The contemporary conifers as a group have a highly variable distribution and a wide range of climatic requirements. Some genera grow in the tropics while others compose the northern boreal forests. Most of the fossil bisaccate pollen, therefore, gives little hint of climate, but there is one exception: the Podocarpaceae. At present this family is essentially restricted to warm temperate climates of the Southern Hemisphere. The climatic requirements of modern counterparts of families identified in the Isachsen Formation are tabulated below.

Family	Tropical	Subtropical	Temperate
Sphagnaceae			*
Lycopodiaceae		*	+
Selaginellaceae	*	*	*
Osmundaceae	*	*	*
Schizaeaceae	*	+	+
Gleicheniaceae	*	*	+
Cyatheaceae	*	*	+
Ginkgoaceae		*	+
Cycadaceae		*	+
Araucariaceae		*	*
Podocarpaceae		*	+
?Pinaceae		+	*

+Present, but not common. *Common occurrence.

The climatic evidence at a family level is ambiguous, but taken as a whole the data indicate that the climate was far warmer than the harsh arctic climate that prevails today. The table above would suggest a warm temperate to even subtropical climate at the time of Isachsen deposition. The evidence for this becomes stronger if we minimize the significance of the gymnosperms whose identification to a family level is more tenuous than is so with the ferns. The climate obviously was much more moderate than at present and supported a more diverse flora.

TAXONOMY

Wherever possible, palynomorphs were classified to higher levels of the botanical natural system as used by Scagel, *and others* (1965). Those of uncertain affiliation are classified under "Incertae Sedis". No attempt was made to classify the bisaccate pollen (with the few exceptions noted) because of its abundance in endless variation. Certain specimens could be assigned to one or another of the existing form genera but the overwhelming majority could not. As a result, it is my opinion that most of the bisaccate genera have no particular validity and little biostratigraphic use. The few that could be consistently used are described and illustrated.

The relative frequencies of occurrence are given by the terms "rare", "occasional", "common", or "abundant". Rare implies one or two grains (or less) in a preparation, "occasional" up to 3 per cent of the total, "common" 4 to 9 per cent, "abundant" that the palynomorphs occur in a frequency of 10 per cent or more. Wherever possible 200 or more specimens in each preparation were counted, excluding the non-classified bisaccate types. The latter would be considered abundant in nearly every preparation.

A total of 49 species in 33 genera are discussed and illustrated. The figured specimens are housed in the Type Collections of the Geological Survey of Canada, Ottawa. Locality (GSC loc. C-4175, etc.) details for the strata at the bottoms of the seismic shot holes from which the samples were collected are on file at the Geological Survey of Canada, Calgary.

Division BRYOPHYTA

Family SPHAGNACEAE

Genus ***Sphagnum*** Erhart

Sphagnum antiquasporites Wilson and Webster

Plate 20, figure 1

1946, Amer. J. Bot., vol. 33, p. 273.

Stratigraphic range. Abundant in Jurassic, Cretaceous, and Tertiary rocks throughout the world.

Frequency. Absent to common throughout the Isachsen Formation in certain samples.

Sphagnum bimammatus (Naumova ex Bolkhovitina) Elsik

Plate 20, figures 2, 3

1968, Pollen et Spores, vol. 10, p. 302.

Stratigraphic range. Jurassic and Cretaceous rocks in many parts of the world.

Frequency. Rare.

Division LYCOPODOPHYTA

Family LYCOPODIACEAE

Genus ***Lycopodiumsporites*** Thiergart ex Del. and Sprum.

Lycopodiumsporites austroclavatidites (Cookson) Potonié

Plate 20, figure 4

1956, Beih. zum Geol. Jahrb., Bd. 23, p. 46.

Stratigraphic range. Jurassic and Cretaceous rocks throughout the world.

Frequency. Rare to common in most samples.

Lycopodiumsporites cf. *L. cerniidites* (Ross) Del. and Sprum.

Plate 20, figure 5

1955, Mém. Soc. Géol. Belgique, new ser., vol. 4, p. 32.

Stratigraphic range. Jurassic and Cretaceous of Alberta (Pocock, 1962; Singh, 1964), Santonian of Sweden (Ross, 1949)

Frequency. Rare.

Family SELAGINELLACEAE

Genus ***Acanthotriletes*** (Naumova) Potonié and Kremp

Acanthotriletes varispinosus Pocock

Plate 20, figure 6

1962, Palaeontographica, Bd. 111, Abt. B., p. 36.

Stratigraphic range. Lower Cretaceous (Singh, 1964).

Frequency. Rare.

Division PTEROPHYTA

Family OSMUNDACEAE

Genus ***Osmundacidites*** Couper

Osmundacidites wellmanii Couper

Plate 20, figures 7, 8

1953, New Zealand Geol. Surv. Paleont., Bull. 22, p. 20.

Stratigraphic range. Abundant in Jurassic and Cretaceous rocks throughout the world.

Frequency. Rare to occasional, but present in every sample.

Genus ***Osmunda-sporites*** Wolff

Osmunda-sporites elongatus Rouse

Plate 20, figure 9

1957, Can. J. Bot., vol. 35, p. 362.

Stratigraphic range. Upper Cretaceous of Alberta (Rouse, 1957).

Frequency. Rare, occurring only in the upper part of the Isachsen Formation.

Genus ***Baculatisporites*** Thomson and Pflug

Baculatisporites comaumensis (Cookson) Potonié

Plate 20, figures 10, 11

1956, Beih. zum Geol. Jahrb., Bd. 23, p. 33.

Stratigraphic range. Jurassic and Cretaceous of Australia (Dettmann, 1963) and New Zealand (Norris, 1968). Albian-?Cenomanian of central Alberta (Norris, 1967), Upper Triassic of Europe (Klaus, 1960).

Frequency. Rare throughout the formation but slightly more abundant near the top.

Remarks. Apparently there is a gradation of ornament type between that exhibited by *Baculatisporites* and *Osmundacidites*. However, the end products are distinctive and the separation of genera is maintained.

Family SCHIZAEACEAE

Genus ***Cicatricosisporites*** Potonié and Gelletich

Cicatricosisporites australiensis (Cookson) Potonié

Plate 20, figures 12, 13

1956, Beih. zum Geol. Jahrb., Bd. 23, p. 48.

Stratigraphic range. Lower and Upper Cretaceous of Australia, India, Canada (Norris, 1967), and Peru (Brenner, 1968).

Frequency. Rare to common throughout the Isachsen Formation.

Cicatricosisporites hallei Del. and Sprum.

Plate 20, figure 14

1955, Mém. Soc. Géol. Belgique, vol. 4, p. 17.

Stratigraphic range. Cretaceous of Alberta (Singh, 1964; Norris, 1967), Maryland (Brenner, 1963), England (Couper, 1958), and Belgium (Delcourt and Sprumount, 1955).

Frequency. Occasional.

Cicatricosisporites ludbrooki Dettmann

Plate 20, figures 15–17

1963, Proc. Roy. Soc. Victoria, new ser., vol. 77, p. 54.

Stratigraphic range. Lower Cretaceous of Australia (Dettmann, 1963), Wealden of Germany (Thiergart, 1949).

Frequency. Rare.

Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann

Plate 20, figure 18

1963, Proc. Roy. Soc. Victoria, new ser., vol. 77, p. 54.

Stratigraphic range. Cenomanian of the USSR and Albian of Australia (Dettmann, 1963). Albian of Oklahoma (Hedlund and Norris, 1968).

Frequency. Rare, present only in the upper part of the Isachsen Formation.

Genus *Klukisporites* Couper

Klukisporites cf. *K. pseudoreticulatus* Couper

Plate 20, figure 19

1958, Palaeontographica, Bd. 103, Abt. B, p. 138.

Stratigraphic range. Purbeck and Wealden of England (Couper, 1958), Potomac Group of Maryland (Brenner, 1963).

Frequency. Rare.

Family Gleicheniaceae

Genus *Gleicheniidites* (Ross ex Del. and Sprum.) Skarby

Gleicheniidites senonicus Ross

Plate 20, figures 20–22

1949, Bull. Geol. Inst. Upsala, vol. 34, p. 31.

Stratigraphic range. Upper Jurassic to Pliocene of Europe. Jurassic, Cretaceous and Tertiary in many other parts of the world, both Northern and Southern Hemispheres (Skarby, 1964). Gleichenaceous spores appear restricted to Mesozoic, Paleocene, and Eocene rocks in North America.

Frequency. Common to abundant. Varies greatly from sample to sample.

Remarks. Skarby (1964) in her exhaustive study of gleichenaceous spores, both fossil and modern, broadened the generic description to include a wide variation encountered in gleichenaceous spores. Pointing out that many of the characters utilized in the past for generic and specific differentiation are dubious at best, she has placed in synonymy the other described species of *Gleicheniidites* as well as other similar spores bearing varying generic names. The present writer concurs and has consequently placed all gleichenaceous spores in this genus and species. The several illustrated specimens indicate the range in morphology encountered in these rocks.

Family Cyatheaceae or Dicksoniaceae

Genus *Cyathidites* Couper

Cyathidites australis Couper

Plate 20, figure 23

1953, New Zealand Geol. Surv. Paleont., Bull. 22, p. 27.

Stratigraphic range. Jurassic through Upper Cretaceous of both Northern and Southern Hemispheres. Also reported in Danian rocks of southern California (Drugg, 1967).

Frequency. Rare.

Cyathidites minor Couper

Plate 20, figure 24

1953, New Zealand Geol. Surv. Paleont., Bull. 22, p. 28.

Stratigraphic range. Jurassic through Upper Cretaceous throughout the world.

Frequency. Rare.

SPORES—INCERTAE SEDIS

Genus *Aequitriradites* (Del. and Sprum.) Cookson and Dettmann

Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann

Plate 20, figure 25

1961, Paleontology, vol. 4, p. 426.

Stratigraphic range. Apparently a Cretaceous genus. Neocomian of Alberta (Pocock, 1962; Singh, 1964), Lower Cretaceous of Eastern Australia (Cookson and Dettmann, 1958), Lower and Upper Cretaceous of the USSR (Singh, 1964).

Frequency. Rare.

Genus *Concavissimisporites* (Del. and Sprum.) Delcourt, Dettmann and Hughes

Concavissimisporites parkinii (Pocock) Singh

Plate 20, figure 26

1964, Res. Council Alberta, Bull. 15, p. 78.

Stratigraphic range. Neocomian to Aptian of western Canada (Pocock, 1962; Singh, 1964).

Frequency. Rare to common.

Concavissimisporites punctatus (Del. and Sprum.) Singh

Plate 20, figure 27

1964, Res. Council Alberta, Bull. 15, p. 77.

Stratigraphic range. Neocomian to Aptian of Alberta (Pocock, 1962; Singh, 1964), Wealden and Aptian of England (Couper, 1958).

Frequency. Rare, somewhat more common in upper part of formation.

Concavissimisporites variverrucatus (Couper) Singh

Plate 21, figure 1

1964, Res. Council Alberta, Bull. 15, p. 78.

Stratigraphic range. Albian of Alberta (Singh, 1964), Upper Jurassic through Neocomian of western Canada (Pocock, 1962), Bajocian through Neocomian of England (Couper, 1958).

Frequency. Rare.

Concavissimisporites cf. *C. verrucosus* Del. and Sprum.

Plate 21, figure 2

1955, Mém. Soc. Géol. Belgique, new ser., vol. 4, p. 25.

Stratigraphic range. Wealden (Delcourt and Sprumont, 1955)

Frequency. One specimen only found.

Remarks. This form differs from *C. variverrucatus* Couper only in its larger size.

Genus *Converrucosisporites* Potonié and Kremp

Converrucosisporites saskatchewanensis Pocock

Plate 21, figures 3, 4

1962, Palaeontographica, Bd. 111, Abt. B, p. 47.

Stratigraphic range. Neocomian of Alberta (Pocock, 1962).

Frequency. Rare.

Genus *Leptolepidites* Couper

Leptolepidites cf. *L. verrucatus* Couper

Plate 21, figure 5

1953, New Zealand Geol. Surv. Paleont., Bull. 22, p. 28.

Stratigraphic range. Probably Upper Jurassic of New Zealand (Couper, 1953), Upper Mesozoic of Australia (Dettmann, 1963).

Frequency. Two specimens only found.

Genus *Pilosisporites* Del. and Sprum.

Pilosisporites trichopapillosus (Thiergart) Del. and Sprum.

Plate 21, figure 6

1955, Mém. Soc. Géol. Belgique, new ser., vol. 4, p. 34.

Stratigraphic range. Albian of Canada (Singh, 1964), Purbeck to Wealden of England (Couper, 1958), "Wealden" of Belgium (Delcourt and Sprumont, 1955), Potomac Group of Maryland (Brenner, 1963), Lower Cretaceous of Saskatchewan (Steeves and Wilkins, 1967).

Frequency. Rare, present in upper part of Isachsen Formation only.

Genus *Trilobosporites* Pant ex Potonié

Trilobosporites apiverrucatus Couper

Plate 21, figures 7, 8

1958, Palaeontographica, Bd. 103, Abt. B, p. 142.

Stratigraphic range. A typical palynomorph from the Lower Cretaceous in many parts of the world.

Frequency. Rare to common.

Remarks. Notice the range in ornamentation as illustrated by the two photographs.

Trilobosporites bernissartensis (Del. and Sprum.) Potonié

Plate 21, figure 9

1956, Beih. zum Geol. Jahrb., Bd. 23, p. 55.

Stratigraphic range. Purbeck and Wealden (Couper, 1958)

Frequency. One specimen only seen.

Trilobosporites canadensis Pocock

Plate 21, figure 10

1962, Palaeontographica, Bd. 111, Abt. B, p. 44.

Stratigraphic range. Barremian (?) to Middle Albian (Singh, 1964), Neocomian of Alberta (Pocock, 1962).

Frequency. Rare to common.

Trilobosporites sp.

Plate 21, figure 11

Frequency. One specimen only.

Remarks. A very large specimen, possibly assignable to *T. apiverrucatus* Couper except it is considerably larger. Size about 126 μ, while *T. apiverrucatus* ranges from 60 to 100 μ.

Genus *Deltoidospora* (Miner) Potonié

Deltoidospora junctum (Kara-Murza) Singh

Plate 21, figure 12

1964, Res. Council Alberta, Bull. 15, p. 81.

Stratigraphic range. Upper Jurassic to Lower Cretaceous of Alberta and USSR (Singh, 1964).

Frequency. Rare.

Remarks. Only several specimens were encountered and these were poorly preserved.

Deltoidospora hallii Miner

Plate 21, figure 13

1935, Amer. Midland Natur., vol. 16, p. 618.

Stratigraphic range. Widely distributed in Mesozoic rocks throughout the world.

Frequency. Rare.

Genus *Staplinisporites* Pocock

Staplinisporites caminus (Balme) Pocock

Plate 21, figure 14

1962, Palaeontographica, Bd. 111, Abt. B, p. 49.

Stratigraphic range. Upper Jurassic and Lower Cretaceous of Alberta (Pocock, 1962; Singh, 1964), Oxfordian to Aptian in western Australia (Balme, 1957).

Frequency. Rare.

Genus *Rugulatisporites* Pflug, in Thomson and Pflug

Rugulatisporites sp.

Plate 21, figure 15

Description. Trilete spore, triangular with rounded corners. Heavy rugulate ornamentation, laesurae extending to equator, well-developed margo. Average size 42 μ.

Frequency. Rare.

Genus *Densoisporites* (Weyland and Krieger) Dettmann

Densoisporites cf. *D. crassus* Tralau

Plate 21, figures 16, 17

1968, Sveriges Geologiska Undersokning, ser. C., No. 633, Arsbok 62, p. 35.

Stratigraphic range. Bajocian in France, Middle Jurassic of Sweden (Tralau, 1968).

Frequency. Rare.

Genus *Foveosporites* Balme

Foveosporites canalis Balme

Plate 21, figure 18

1957, Australia Sci. Indus. Res. Org., Div. Coal Res., Ref. T.C. 25, p. 17.

Stratigraphic range. Lower Cretaceous of western Australia (Balme, 1957) widely distributed in the Upper Mesozoic of Australia (Dettmann, 1963).

Frequency. Two specimens only found.

Genus *Hymenozonotriletes* Naymova ex Naumova

Hymenozonotriletes cf. *H. pseudoalveolatus* (Couper) Singh

Plate 21, figure 19

1964, Res. Council Alberta, Bull. 15, p. 83.

Stratigraphic range. Bajocian to Middle Albian (Singh, 1964), Bajocian to Aptian of England (Couper, 1958).

Frequency. Rare, two specimens found in the Isachsen.

Trilete A

Plate 21, figure 21

Description. Large (90 to 100 μ), circular, trilete spore. Exine scabrate to somewhat undulose. Laesurae comparatively short, distinct and bordered by weakly developed margo.

Frequency. Three specimens only found.

Remarks. Because of its size, circular shape and short distinct laesurae this is a distinctive spore. Probably Filicales.

Division PTERIDOSPERMOPHYTA

Family Caytoniaceae

Genus *Vitreisporites* (Leschik) Jansonius

Vitreisporites pallidus (Reissinger) Nilsson

Plate 21, figure 20; Plate 22, figure 1

1958, Lunds Univ. Arsskr., vol. 53, p. 78.

Stratigraphic range. Common in Mesozoic rocks throughout both the Northern and Southern Hemisphere.

Frequency. Rare, occurring only near base of Isachsen Formation.

Division GINKGOPHYTA–CYCADOPHYTA

Genus *Monosulcites* Cookson ex Couper

Monosulcites spp.

Plate 22, figures 2–4

Description. Elongated to circular monocolpate pollen grains, colpus usually gaping slightly or may be open at ends and closed in middle. Margo absent or only weakly developed, exine psilate to scabrate. Size range 18 to 67 μ.

Frequency. Rare.

Remarks. Pollen grains of this general morphology are widespread in Mesozoic rocks throughout the world. The Divisions Ginkgophyta and Cycadophyta have pollen very similar and it is exceptionally difficult to identify the family, even in modern material. Because diagnostic characters are so few it is virtually impossible to subdivide this genus into meaningful morphologic species. The extreme rarity of this palynomorph in the Isachsen Formation suggests that Ginkgo and /or Cycads and /or Bennettitales were a very subordinate component of the flora. Plate 22, figure 4 illustrates a form that is most probably a member of the Bennettitales.

Division CONIFEROPHYTA

Order coniferales

Family Araucariaceae

Genus *Araucariacites* Cookson ex Couper

Araucariacites australis Cookson

Plate 22, figure 5

1947, British, Australia, New Zealand Antarctic Res. Exped. (1929–1931), Rep. A2, p. 130.

Stratigraphic range. Widespread in Jurassic, Cretaceous, and Tertiary rocks throughout the world.

Frequency. Rare.

Family ?PINACEAE

Genus ***Laricoidites*** Potonié, Thomson, and Thiergart

Laricoidites gigantus Brenner

Plate 22, figure 6

1963, Maryland Dept. Geol. Mines and Water Res., Bull. 27, p. 88.

Stratigraphic range. Potomac Group of Maryland (Brenner, 1963).

Frequency. Rare.

Remarks. This is a very conspicuous palynomorph because of its very large size (average diameter about 130 μ). Except for the large size, this pollen grain is morphologically identical to modern *Larix*, but the relationship is far from certain.

The family Pinaceae is used here with some hesitation. In it are included those specimens which bear morphologic resemblance to modern members of the Pinaceae. Most of the undescribed bisaccate pollen can be included in this family.

Laricoidites magnus (Potonié) Potonié, Thomson and Thiergart

Plate 22, figure 7

1950, Geol. Jahrb., Bd. 65, p. 48.

Stratigraphic range. Oligocene–Miocene of Germany (Potonié, 1958), Potomac Group of Maryland (Brenner, 1963).

Frequency. Rare.

Remarks. This form, in both size and morphology, is indistinguishable from modern *Larix*.

Genus ***Tsugaepollenites*** Potonié and Venitz

Tsugaepollenites mesozoicus Couper

Plate 22, figures 8–10

1958, Palaeontographica, Bd. 103, Abt. B, p. 155.

Stratigraphic range. A rather common constituent of the Jurassic and Cretaceous in many parts of the world.

Frequency. Rare to common in most samples, but more abundant in upper portion of formation.

Tsugaepollenites cf. *T. dampieri* (Balme) Dettmann

Plate 22, figure 11

1963, Proc. Roy. Soc. Victoria, new ser., vol. 77, pt. 1, p. 100.

Stratigraphic range. Jurassic, Cretaceous, and Eocene of west Australia (Balme, 1957). Also present in Upper Mesozoic strata of India, Canada, and Europe (Dettmann, 1963).

Frequency. Rare.

Family PODOCARPACEAE

Genus *Podocarpidites* Cookson ex Couper

Podocarpidites sp. A

Plate 22, figure 12

Description. A typical, Mesozoic *Podocarpus*-type pollen grain with small distinct body and large bladders. Total breadth of grain 80 to 125 μ, breadth of central body 35 to 55 μ, length of central body 40 to 50 μ, with a length of bladder varying between 50 and 70 μ. Cap corrugate with distal leptoma usually well developed.

Frequency. Common throughout the Isachsen Formation.

Podocarpidites sp. B

Plate 22, figure 13

Description. A very large and very conspicuous *Podocarpus*-type pollen grain. Body very small in relation to size of bladders. The total breadth of grain ranges from 160 to 200 μ, breadth of central body 50 to 60 μ, length of bladders 105 to 125 μ, length of central body 60 to 65 μ.

Frequency. Very rare.

Remarks. A very distinctive species because of its large size.

CONIFERALES—INCERTAE SEDIS

Genus *Classopollis* (Pfluf) Couper

Classopollis torosus (Reissinger) Couper

Plate 22, figures 14–16

1958, Palaeontographica, Bd. 103, Abt. B., p. 156.

Stratigraphic range. A widespread palynomorph from rocks ranging from Late Triassic to Early Cretaceous throughout the world. It rapidly diminished in importance in Late Albian time and is rarely found in post-Cenomanian deposits (Brenner, 1968).

Frequency. Common to abundant.

Remarks. Barnard (1968) has recently described *Classopollis* pollen from the conifer cone *Masculostrobus* Seward. He further suggests that cones bearing pollen of this type all belong to a single family, the Cheirolepidaceae. Plate 22, figure 14 illustrates a tetrad of *Classopollis* pollen.

Genus *Eucommiidites* (Erdtman) Couper

Eucommiidites troedssonii Erdtman

Plate 22, figures 17–19

1948, Geol. Foren Forh., Bd. 70, p. 267.

Stratigraphic range. Jurassic and Cretaceous rocks from all over the world, and usually a common associate of *Classopollis* (Brenner, 1963). Its abundance declines after the Albian and in central Europe it has not been found above the Campanian (Krutzsch, 1957).

Frequency. Rare, but somewhat more abundant in the upper part of the Isachsen Formation.

Remarks. Eucommiidites is thought to be related to the Ginkgoales, Cycadales, or Pteridosperms, or even possibly to some totally unknown plant (Reymanowna, 1968).

Genus ***Inaperturopollenites*** (Pflug ex Thomson and Pflug) Potonié

Inaperturopollenites sp.

Plate 22, figures 20–22

Description. Inaperturate, scabrate, 20 to 40 μ in diameter. Exine frequently creased with folds, often split.

Frequency. Rare to common.

Remarks. These palynomorphs are morphologically similar to pollen of the modern gymnosperm families Cupressaceae and Taxodiaceae. In Plate 22, figure 20 resembles modern Juniper pollen, figure 21 suggests *Taxodium*, whereas figure 22 illustrates a form almost indistinguishable from extant *Glyptostrobus.*

Genus ***Schizosporis*** Cookson and Dettmann

Schizosporis reticulatus Cookson and Dettmann

Plate 22, figure 23

1959, Micropaleontology, vol. 5, p. 213.

Stratigraphic range. Upper Neocomian of Alberta (Pocock, 1962), Neocomian to Aptian and Cenomanian (?) of Alberta (Singh, 1964), Neocomian-Aptian to Cenomanian (?) of eastern Australia (Cookson and Dettmann, 1959), Potomac Group of Maryland (Brenner, 1963).

Frequency. Rare.

Remarks. This particular form may have algal affinities, perhaps related to the Chlorophyceae (Brenner, 1963). Preservation of this form is invariably poor.

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PLATE 20

Palynomorphs from the Isachsen Formation, Melville Island; all figures x500. (PAGES 113-117)

Figure 1.	*Sphagnum antiquasporites* Wilson and Webster (GSC 23787), GSC loc. C-4172.
Figures 2, 3.	*Sphagnum bimammatus* (Naumova ex Bolkhovitina) Elsik (GSC 23788, 23789), GSC locs. C-4165, C-4161.
Figure 4.	*Lycopodiumsporites austroclavatidites* (Cookson) Potonié (GSC 23790), GSC loc. C-4168.
Figure 5.	*Lycopodiumsporites cerniidites* (Ross) Del. and Sprum. (GSC 23791), GSC loc. C-4168.
Figure 6.	*Acanthotriletes varispinosus* Pocock (GSC 23792), GSC loc. C-4164.
Figures 7, 8.	*Osmundacidites wellmanii* Couper (GSC 23793, 23794), GSC locs. C-4168, C-4166.
Figure 9.	*Osmunda-sporites elongatus* Rouse (GSC 23795), GSC loc. C-4170.
Figures 10, 11.	*Baculatisporites comaumensis* (Cookson) Potonié (GSC 23796), GSC loc. C-4166.
Figures 12, 13.	*Cicatricosisporites australiensis* (Cookson) Potonié (GSC 23797, 25519), GSC locs. C-4166, C-4164.
Figure 14.	*Cicatricosisporites hallei* Del. and Sprum. (GSC 23798), GSC loc. C-4173.
Figures 15–17.	*Cicatricosisporites ludbrooki* Dettmann (figs. 15, 16, GSC 23799), GSC loc. C-4168, (fig. 17, GSC 23800), GSC loc. C-4159.
Figure 18.	*Cicatricosisporites pseudotripartitus* (Bolkhovitina) Dettmann (GSC 23801), GSC loc. C-4169.
Figure 19.	*Klukisporites* cf. *K. pseudoreticulatus* Couper (GSC 23802), GSC loc. C-4165.
Figures 20–22.	*Gleicheniidites senonicus* Ross (GSC 25065, 25066, 25067), GSC locs. C-4165, C-4164, C-4159.
Figure 23.	*Cyathidites australis* Couper (GSC 25068), GSC loc. C-4163.
Figure 24.	*Cyathidites minor* Couper (GSC 25069), GSC loc. C-4162.
Figure 25.	*Aequitriradites spinulosus* (Cookson and Dettmann) Cookson and Dettmann (GSC 25070), GSC loc. C-4166.
Figure 26.	*Concavissimisporites parkinii* (Pocock) Singh (GSC 25071), GSC loc. C-4168.
Figure 27.	*Concavissimisporites punctatus* (Del. and Sprum.) Singh (GSC 25072), GSC loc. C-4173.

PLATE 20

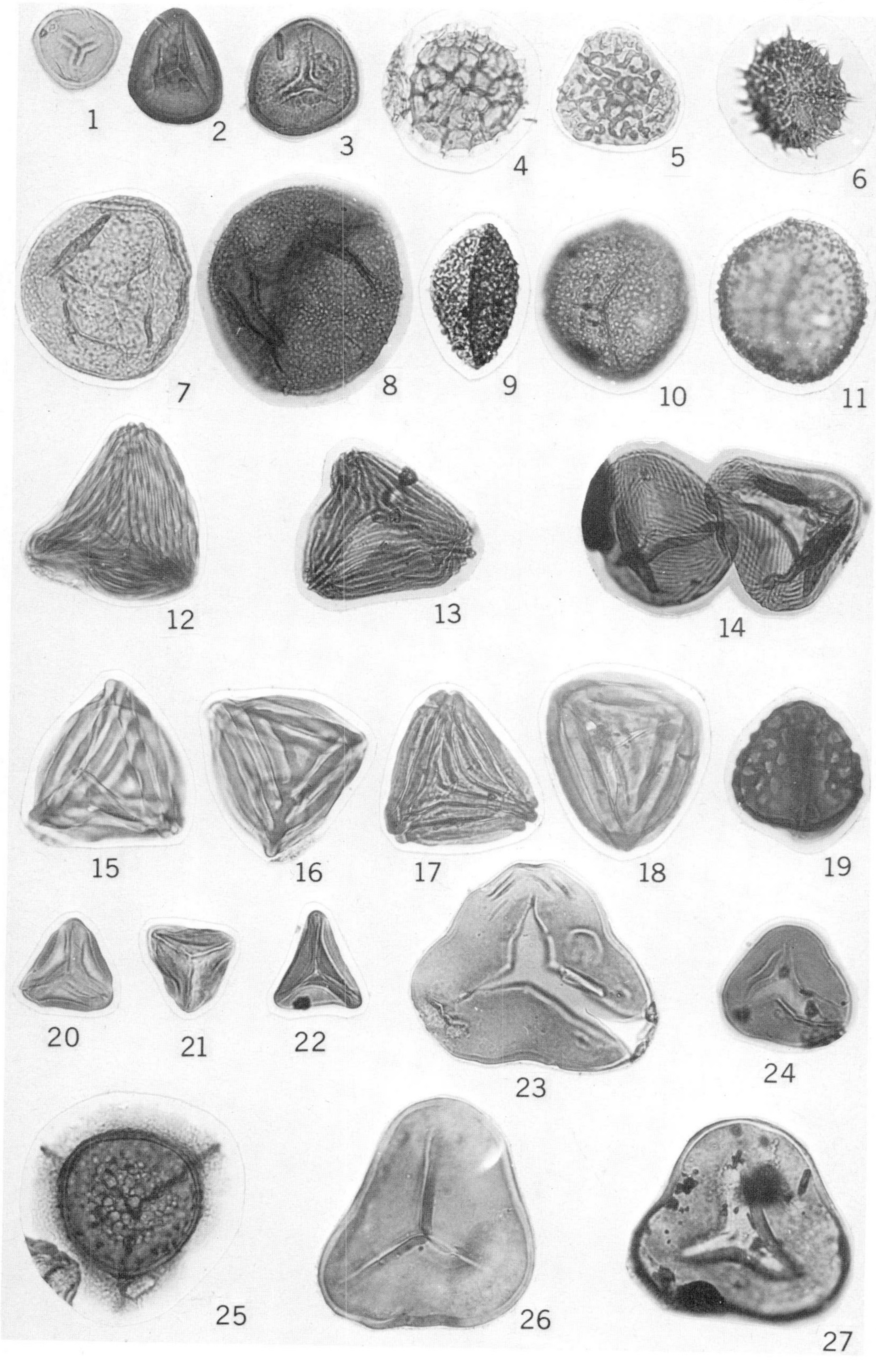

Plate 21

Palynomorphs from the Isachsen Formation, Melville Island;
all figures x500 unless otherwise indicated. (Pages 117-121)

Figure 1. *Concavissimisporites variverrucatus* (Couper) Singh (GSC 25073), GSC loc. C-4175.

Figure 2. *Concavissimisporites* cf. *C. verrucosus* Del. and Sprum. (GSC 25074), GSC loc. C-4159.

Figures 3–4. *Converrucosisporites saskatchewanensis* Pocock (GSC 25075, 25076), GSC loc. C-1644.

Figure 5. *Leptolepidites* cf. *L. verrucatus* Couper (GSC 25077), GSC loc. C-4169.

Figure 6. *Pilosisporites trichopapillosus* (Thiergart) Del. and Sprum. (GSC 25078), GSC loc. C-4167.

Figures 7, 8. *Trilobosporites apiverrucatus* Couper (GSC 25079, 25080), GSC locs. C-4167, C-4164.

Figure 9. *Trilobosporites bernissartensis* (Del. and Sprum.) Potonié (GSC 25081), GSC loc. C-4166.

Figure 10. *Trilobosporites canadensis* Pocock (GSC 25082), GSC loc. C-4163.

Figure 11. *Trilobosporites* sp. (GSC 25083), GSC loc. C-4164.

Figure 12. *Deltoidospora junctum* (Kara-Murza) Singh (GSC 25084), GSC loc. C-4161.

Figure 13. *Deltoidospora hallii* Miner (GSC 25085), GSC loc. C-4166.

Figure 14. *Staplinisporites caminus* (Balme) Pocock (GSC 25086), GSC loc. C-4164.

Figure 15. *Rugulatisporites* sp. (GSC 25087), GSC loc. C-4169.

Figures 16, 17. *Densoisporites* cf. *D. crassus* Tralau (GSC 25088, 25089), GSC locs. C-4163, C-4164.

Figure 18. *Foveosporites canalis* Balme (GSC 25090), GSC loc. C-4169.

Figure 19. *Hymenozonotriletes* cf. *H. pseudoalveolatus* (Couper) Singh (GSC 25091), GSC loc. C-4164.

Figure 20. *Vitreisporites pallidus* (Reissinger) Nilsson (GSC 25093), GSC loc. C-4160; x1250.

Figure 21. Trilete A (GSC 25092), GSC loc. C-4164.

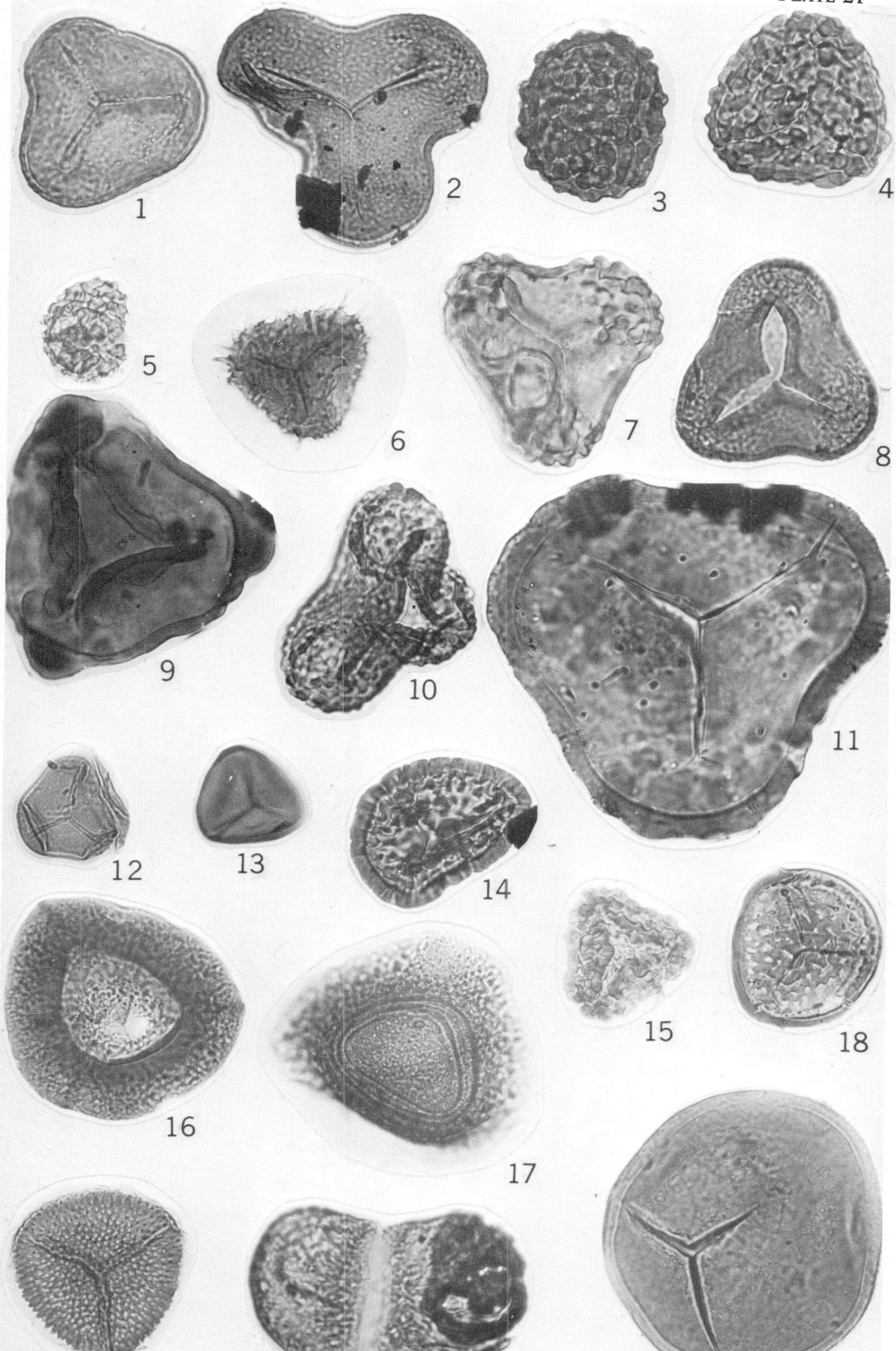
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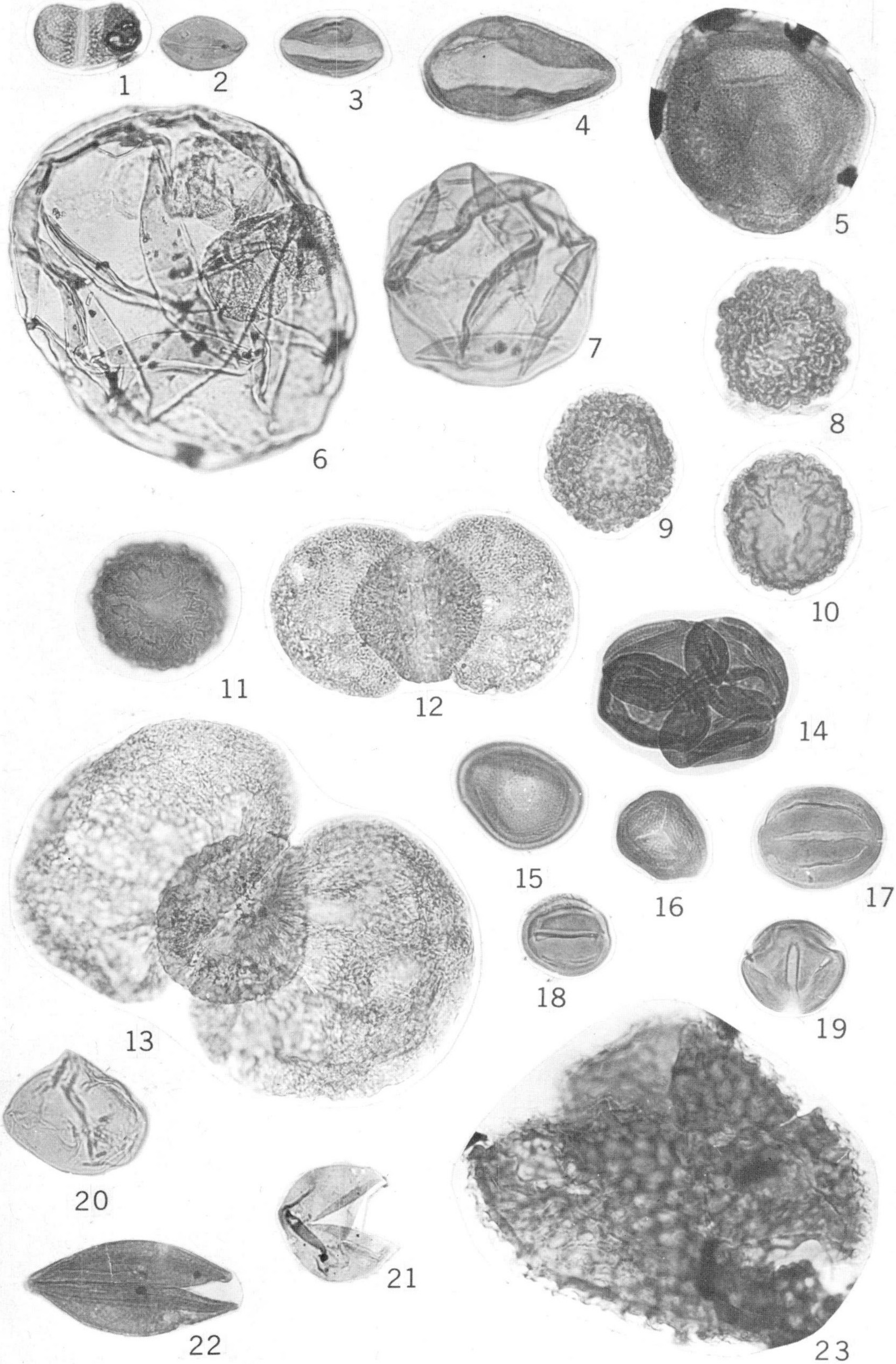
PLATE 22

Palynomorphs from the Isachsen Formation, Melville Island;
all figures x500. (PAGES 121-124)

Figure 1.	*Vitreisporites pallidus* (Reissinger) Nilsson (GSC 25093), GSC loc. C-4160.
Figures 2–4.	*Monosulcites* spp. (GSC 25094, 25095, 25520), GSC locs. C-4173, C-4161, C-4165.
Figure 5.	*Araucariacites australis* Cookson (GSC 25096), GSC loc. C-4166.
Figure 6.	*Laricoidites gigantus* Brenner (GSC 25097), GSC loc. C-4174.
Figure 7.	*Laricoidites magnus* (Potonié) Potonié, Thomson and Thiergart (GSC 25098), GSC loc. C-4172.
Figures 8–10.	*Tsugaepollenites mesozoicus* Couper (GSC 25099, 25100, 25101), GSC locs. C-4159, C-4167, C-4165.
Figure 11.	*Tsugaepollenites* cf. *T. dampieri* (Balme) Dettmann (GSC 25102), GSC loc. C-4175.
Figure 12.	*Podocarpidites* sp. A (GSC 25103), GSC loc. C-4169.
Figure 13.	*Podocarpidites* sp. B (GSC 25104), GSC loc. C-4167.
Figures 14–16.	*Classopollis torosus* (Reissinger) Couper (GSC 25105, 25106, 25107), GSC locs. C-4164, C-4165.
Figures 17–19.	*Eucommiidites troedssonii* Erdtman (GSC 25500, 25501, 25502), GSC locs. C-4161, C-4166, C-4169.
Figures 20–22.	*Inaperturopollenites* sp. (GSC 25503, 25504, 25505), GSC locs. C-4175, C-4171, C-4165.
Figure 23.	*Schizosporis reticulatus* Cookson and Dettmann (GSC 25506), GSC loc. C-4166.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