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**BULLETIN 114**

**FAUNA OF THE  
DEVONIAN HORN PLATEAU FORMATION,  
DISTRICT OF MACKENZIE**

**D. J. McLaren and A. W. Norris**



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FAUNA OF THE DEVONIAN  
HORN PLATEAU FORMATION,  
DISTRICT OF MACKENZIE

By  
D. J. McLaren and A. W. Norris

DEPARTMENT OF  
MINES AND TECHNICAL SURVEYS  
CANADA

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## PREFACE

This report describes the faunas and stratigraphy of the Devonian Horn Plateau Formation. It is based on field observations and collections made by officers of the Geological Survey, and also makes use of fossil collections made by various oil company geologists. Detailed information is presented on a hitherto undescribed fauna that has considerable bearing on the regional correlation of Devonian rocks.

J. M. HARRISON,  
*Director, Geological Survey of Canada*

OTTAWA, February 26, 1963

Bulletin 114—Die Fauna der devonischen Hornplateau-  
Formation im Mackenzie-Distrikt.  
Von D. J. McLaren und A. W. Norris

Ein kleines Kalksteinriff, das im südlichen Teile des Mackenzie-Distrikts aufgeschlossen ist, enthält eine reiche Korallen-und Brachiopodenfauna. Diese Fauna ist insofern ungewöhnlich, als sie sonst noch nirgendwo im Nordwestlichen Kanada angetroffen ist. Sie wird beschrieben und in das jüngere Givet gestellt.

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БЮЛЛЕТЕНЬ 114—Д. Дж. МакЛарен и А. У.  
Норрис. Фауна девонской  
формации Горн Плато  
района Макензи.

Небольшой известняковый риф, обнажающийся в южном районе Макензи, содержит богатую фауну брахиопод и кораллов. Эта фауна замечательна тем, что ей подобной нигде не было открыто на северо-западе Канады. Фауна описана, и условно отнесена к позднему живетскому веку.

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# FAUNA OF THE DEVONIAN HORN PLATEAU FORMATION, DISTRICT OF MACKENZIE

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## *Abstract*

The Horn Plateau Formation is a small, circular, reef-like, richly fossiliferous limestone body outcropping on the east flank of Horn Plateau 53 miles north of Fort Providence. The reef is developed within either the upper part of the Middle Devonian Horn River Formation or strata mapped as the lower part of the Upper Devonian Fort Simpson Formation, both of which consist largely of shales. The fauna is unusual in that most of it has not been observed elsewhere in the Devonian of the Mackenzie region. The Horn Plateau fauna occurs above *Leiorhynchus castanea* (Meek) and associated fossils characteristic of the upper half of the Pine Point Formation and equivalent beds of the Great Slave Lake region. The Horn Plateau Formation is presumed to be equivalent to or younger than the Sulphur Point, Presqu'île, and Kee Scarp Formations.

In Part II one species of tabulate and thirteen species of rugose corals are described, nine of them new. The genera include *Favosites*, *Siphonophrentis*?, *Disphyllum*, *Cylindrophyllum*, *Grypophyllum*, *Neostriphophyllum*, *Australophyllum*?, *Heliophyllum*, *Cyathophyllum* (*Peripaedium*), *Sinospongophyllum*, *Stringophyllum* (*Sociophyllum*), *Lekanophyllum*, *Cystiphyllodes*, *Atelophyllum*. As the coral fauna is as yet unknown elsewhere in the region, suggestions as to its age depend on consideration of generic ranges. The corals are of Middle Devonian type, probably of Givetian age, possibly late but not latest. Difficulties in determination of the Givetian-Frasnian boundary based on shelly faunas, however, are aggravated by the uncertainty of trans-Atlantic correlation, and the fact that the base of the *Manticoceras* Zone in Rhenish facies is not as yet firmly correlated with the Ardennes shelly facies sequence.

In Part III of this report twenty-five species comprising one pelecypod, twenty-three brachiopods of which ten are new, and one trilobite are described. Although most of these fossils are Middle Devonian forms, three elements comprising species of *Schizophoria*, *Spinatrypa*, and *Eleutherokomma*, show close affinity but not identity with forms present in the basal Waterways Formation of northeastern Alberta. It is concluded that the Horn Plateau Formation is of late Middle Devonian (Givetian) age and slightly older than the basal Waterways Formation, the age of which is still an unsettled problem.

## *Résumé*

La formation Horn Plateau est une petite masse circulaire de calcaire hautement fossilifère, qui ressemble à un récif corallien, et affleure sur le versant oriental du Horn Plateau, à 53 milles au nord de Fort-Providence. Le récif se trouve soit dans la partie supérieure de la formation Horn River du Dévonien moyen, soit au sein de strates assignées à la partie inférieure de la formation Fort Simpson, qui date du Dévonien supérieur. Les deux formations se composent principalement de schistes argileux. La faune a ceci de particulier que, dans une très grande mesure, elle n'a pas été observée ailleurs au sein des roches dévoniennes de la région du Mackenzie. La faune de la formation Horn Plateau se situe au-dessus des *Leiorhynchus castanea* (Meek) et des fossiles associés qui sont particuliers à la moitié supérieure de la formation Pine Point et aux couches équivalentes de la région du Grand lac des Esclaves. La formation Horn Plateau serait équivalente, aux formations Sulphur Point, Presqu'île et Kee Scarp ou plus jeune que celles-ci.



La Partie II contient la description d'une espèce de Tabulés et de treize espèces de Rugueux, dont neuf sont nouvelles. Les genres comprennent *Favosites*, *Siphonophrentis?*, *Disphyllum*, *Cylindrophyllum*, *Grypophyllum*, *Neostrophophyllum*, *Australophyllum?*, *Heliophyllum*, *Cyathophyllum* (*Peripaedium*), *Sinospongophyllum*, *Strophophyllum* (*Sociophyllum*), *Lekanophyllum*, *Cystiphyllodes*, *Atelophyllum*. Étant donné que la faune corallienne est encore inconnue ailleurs dans la région, on doit tenir compte des classes génériques pour établir son âge. Les coraux sont du type dévonien moyen; ils appartiennent probablement aux couches supérieures, mais non aux couches les plus récentes du Givétien. La détermination de la limite entre le Givétien et le Frasnien fondée sur les faunes coquilleuses, est rendue plus difficile du fait de l'incertitude de la corrélation transatlantique et de l'absence de corrélation bien définie entre la base de la zone à *Manticoceras* du facies Rhenish et la succession du facies coquilleux d'Ardenne.

La Partie III du présent rapport contient la description de vingt-cinq espèces réparties comme suit: une espèce de pélécy-pèdes, vingt-trois espèces brachiopodes, dont dix nouvelles et une espèce de trilobites. Bien que la plupart de ces fossiles soient des formes du Dévonien moyen, trois espèces de *Schizophoria*, *Spinatrypa* et *Eleutherokomma* comportent des signes d'affinité, mais non pas d'identité, avec des formes présentes au sein des niveaux les plus bas de la formation Waterways du Nord-Est de l'Alberta. On en conclut que la formation Horn Plateau remonte à la fin du Dévonien moyen (Givétien) et qu'elle est un peu plus ancienne que les niveaux les plus bas de la formation Waterways, dont l'âge exact est encore indéterminé.

# STRATIGRAPHY OF THE DEVONIAN HORN PLATEAU FORMATION

by A. W. Norris

## Introduction

These papers review the stratigraphy (Part I), and describe the unique coral (Part II) and brachiopod faunas (Part III) of the Devonian Horn Plateau Formation, which is a small reef-like carbonate body outcropping on the east flank of Horn Plateau. The correlation and faunal affinities are discussed in Parts II and III, and from the available evidence an attempt is made to date this unusual fauna.

The reef-like body was mapped by members of Operation Mackenzie in 1957 and designated Map-unit 15 in a preliminary report by Douglas and Norris (1960, pp. 19-20)<sup>1</sup>. Later, this rock-unit was more fully described and named the Horn Plateau Formation by Norris (*in press*). Outcrops of the formation are confined to a small circular hill (*see* Pl. I) about three tenths of a mile in diameter and located 2.9 miles west of the southwest tip of Fawn Lake, 62°08.2'N, 117°39'W, District of Mackenzie. The hill rises 45 to 50 feet above the surrounding terrain, the elevation of which is between 700 and 800 feet above mean sea-level according to the Army Survey Establishment Provisional Map 85K (1958). The outcrops may be reached from Fort Providence on a bearing of almost due north and distance of 53 miles, or from Hay River on a bearing of 324 degrees and distance of 100 miles.

## Stratigraphy

The Horn Plateau Formation is represented by an incomplete section of close to 40 feet of strata. The lower part of the section outcrops around the periphery of the hill and consists of light to medium brown, coarse-grained, loosely cemented, bioclastic limestone, which on weathering breaks down into layers from one inch to three inches thick. It contains an exceedingly rich fauna consisting mainly of brachiopods. The lower unit grades upwards into more resistant, thick-bedded to massive, pale brown, fine- to very coarse-grained reefal limestone containing numerous corals. This upper unit stands out as erosional stacks and pillars capping the hill.

Neither the lower nor the upper contact of the Horn Plateau Formation is exposed. The beds around the periphery of the hill dip gently outwards suggesting a circular reef or dome structure. On the basis of the regional mapping and unique fauna, it is presumed (Norris, *in press*) that the Horn Plateau Formation overlies the Middle Devonian Horn River Formation and is overlain by the upper Devonian Fort Simpson Formation. The nearest bedrock exposures to the hill are shale and

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<sup>1</sup>Names and dates in parentheses refer to publications listed in Bibliography.

limestone beds of the Horn River Formation outcropping discontinuously along Horn River, from 12 to 19 miles to the northwest. The nearest bore-hole is the Imperial Triad Davidson Creek P-2 well ( $62^{\circ}11'45''\text{N}$ ,  $118^{\circ}15'05''\text{W}$ ) some 19 miles to the west-northwest. This well penetrated strata ranging in age from Cretaceous to Precambrian and did not encounter the reefal beds characteristic of the Horn Plateau Formation. The exposures of the Horn River Formation along Horn River are probably 50 to 100 feet lower in elevation than the base of the exposures of the Horn Plateau Formation. The regional dip of the Devonian strata in the area is a few feet per mile in a southwesterly direction, so that the projected top of the highest exposures of the Horn River Formation would presumably be well below the base of the Horn Plateau Formation exposures. The exposures along the Horn River represent strata high in the Horn River Formation but probably not the uppermost part. As mentioned above, the Horn Plateau Formation is a carbonate body of only local development. In the subsurface, away from the hill, it presumably interfingers with, and pinches out within either the upper part of the Horn River Formation or shales mapped as the lower part of the Fort Simpson Formation. Bore-holes in the immediate vicinity of the outcrop area of the Horn Plateau Formation are needed to establish its precise stratigraphic position and relationship to adjacent rock-units.

### Acknowledgments

These faunal studies are based mainly on fossils collected by B. G. Craig and A. W. Norris. Additional fossil material was kindly supplied by Pan American Oil Company Limited, and Shell Oil Company Limited, and is gratefully acknowledged by both authors.

## CORALS OF THE DEVONIAN HORN PLATEAU FORMATION

by D. J. McLaren

### Introduction

These corals are well preserved in detail, but all the specimens among the collections proved to be fragmented and difficult to section. In addition to those described, there are some badly broken pieces of *Thamnopora* and some fragments of cyathophylloid solitary corals that appear to be different from any described here. The fauna includes the following:

- Favosites* sp.
- Siphonophrentis?* sp.
- Disphyllum salicis* n. sp.
- Cylindrophyllum gruensis* n. sp.
- Grypophyllum cornus* n. sp.
- Neostriphyllum craigi* n. sp.
- Australophyllum?* cf. *A.?* *thomasa*e (Hill and Jones)
- Heliophyllum borealis* n. sp.
- Cyathophyllum* (*Peripaedium*) *greteneri* n. sp.
- Sinospongophyllum* cf. *S. planotabulatum* Yoh
- Stringophyllum* (*Sociophyllum*) *redactum* n. sp.
- Lekanophyllum* cf. *L. punctatum* Wedekind
- Cystiphyllodes spinosum* n. sp.
- Atelophyllum nebracis* n. sp.

### Discussion of the Fauna

As most of the species are new, there is an inherent difficulty in correlating with other faunas and in arriving at an age in terms of standard stages. This must necessarily be done by consideration of generic ranges as far as they are known, and each genus used in this report is considered in turn, except those whose assignment is in doubt.

The genus *Favosites* ranges from Upper Ordovician to the end of Middle Devonian, although a closely related genus, *Thamnopora* Steininger, is common in the Upper Devonian and ranges into the Permian. The presence of *Favosites* sens. str. is widely accepted as a reliable indicator that the rocks in which it occurs are not younger than latest Middle Devonian (but see p. 5).

*Siphonophrentis* is known only from Lower and Middle Devonian rocks. The specimens in the Horn Plateau fauna doubtfully referred to this genus are, nevertheless, probably correctly assigned to the family Streptelasmatidae, which is not known to range beyond the Middle Devonian.

Corals assigned to *Disphyllum* (= *Megaphyllum* Soshkina) are common from early Middle Devonian to the close of the Frasnian Stage. *Disphyllum salicis* closely

resembles *Megaphyllum paschiense* Soshkina, a form which occurs in the Upper Givetian and Lower Frasnian in the Urals and Armenia (Spasskij, 1960).

*Cylindrophyllum* ranges in North America from the Onondaga of New York to the Thunder Bay Limestone of the Traverse Group of Michigan. In Germany (as *Spinophyllum*) it is common in the Upper Givetian. The species from the Horn Plateau, *C. gruensis* n. sp., is closest to *C. grabau* Ehlers and Stumm from the late Middle Devonian Thunder Bay Formation.

*Grypophyllum* first appears in the Eifelian of Europe and ranges throughout the Givetian. The earlier forms belong to the *G. vermiculare* (Goldfuss) group and differ in certain respects (see p. 11) from the *G. denckmanni* Wedekind group which is typically Givetian. *G. cornus* n. sp. from the Horn Plateau Formation resembles the former. In western Canada the genus ranges from the Nahanni Formation to the top of the Ramparts (=Kee Scarp) Formation.

*Neostriophyllum* is exclusively a Middle Devonian genus, and is known in Europe only from the Givetian, with the exception of *N. concavum* (Walther) which ranges from the late Eifelian into the Givetian (Birenheide, 1961, p. 128). Species assigned to *Neostriophyllum* from the Frasnian of the Urals and Armenia (Soshkina, 1952) are probably more correctly to be placed in the genus *Mictrophyllum* Lang and Smith.

*Heliophyllum* ranges from the Onondaga Limestone into beds of Upper Devonian age in New York, and high in the Traverse Group of Michigan (Potter Farm Formation). It has been reported from the Givetian in Germany and throughout much of the Middle Devonian in the Urals.

In Germany, the genus *Cyathophyllum* (*Peripaedium*), now recognized as a senior synonym of *Keriophyllum* (see p. 18), is reported exclusively from the Eifelian Stage (Birenheide, 1962b). The generic assignment of *C. (P.) greteneri* from the Horn Plateau may be considered somewhat in doubt (see p. 17). It is certainly congeneric with late Middle Devonian forms found elsewhere in the District of Mackenzie, and reliably dated as Givetian. These species may prove to be generically (or sub-generically) distinct from *Cyathophyllum* (*Peripaedium*) sens. str.

The type species of *Stringophyllum* (*Sociophyllum*) — *Str. (Soc.) elongatum* Schlüter, occurs in the Lower Givetian of Germany, and the range of the subgenus is Upper Eifelian to Lower Givetian (Birenheide, 1962a, p. 53). The Horn Plateau species differs from the species described in Germany in the greater development of lamellar tissue on the septa in fully grown corallites. It is possible that this represents a later evolutionary development in the group. Partly grown corallites of *Str. (Soc.) redactum* resemble *Str. (Soc.) semiseptatum* (Schlüter).

*Cystiphylloides* ranges from the Onondaga to the Tully in New York and as high as the Lower Petoskey Formation in Michigan. Although the exact interpretation of the genus may remain in doubt, nevertheless cystiphylloid corals of this general type are unknown in rocks younger than the Middle Devonian Series. The genus appears to be well represented in the Givetian Stage in Europe.

Species of *Atelophyllum* occur in the Bell Shale and Four Mile Dam Limestone of the Traverse Group of Michigan and another form has been recorded in the Hume Formation in the Mackenzie River area. In Germany the genus appears to occur in rocks of mid-Givetian age.

The problem of the Middle-Upper Devonian boundary based on corals is complicated by the fact that the break in shelly faunas in Belgium is not reliably correlated with the base of the *Pharciceras lunulicosta* Goniatite Zone of Germany. This Zone, which has not been located in Belgium, is commonly taken to be the base of the Frasnian — the Major Zone of *Manticoceras*. House (1962) figures and describes *Pharciceras amplexum* (Hall) from the Tully Formation of New York and, therefore correlates this formation with the *P. lunulicosta* Zone of Germany. He points out (*ibid.*, p. 256) that this correlation cannot necessarily be asserted as proof of the Frasnian age of the Tully.

The Tully contains the following coral genera that are otherwise unknown in the Upper Devonian: *Favosites*, *Stereolasma*, *Amplexiphyllum*, *Heterophrentis*, *Siphonophrentis*, *Bethanyphyllum*, *Eridophyllum*, *Cystiphyllodes*. Should the Tully be shown to be of Frasnian age, then the final disappearance of several lines of earlier Devonian corals must be considered to have occurred during the early Frasnian in European terms. The important change in coral faunas in North America that has hitherto been considered to occur at the Givetian-Frasnian boundary must be extended into the Frasnian. Alternatively, it may be that the change in shelly faunas between the Givetian and Frasnian in Belgium is coeval with the comparable change in North America and that the base of the *Manticoceras* Zone in Germany is of late Givetian age.

The corals of the Horn Plateau Formation suggest a mid-to-late, but not latest, Givetian age. One or two elements in the fauna, e.g., *Cyathophyllum* (*Peripaedium*) and a *Grypophyllum* allied to the *G. vermiculare* group suggests earlier affinities, but the presence of *Neostriphophyllum* and *Atelophyllum* leaves little doubt that the fauna is late Middle Devonian, and the latter genus would seem to preclude latest Givetian.

### Wandblasen

Engel and Schouppé (1958, p. 69, etc.) have proposed the term “die Wandblasen” (literally “wall-blisters”) for skeletal elements that are developed, in certain coral genera, between the septa and the coral wall. These structures are secreted predominantly tangentially to the body of the polyp, and in development they precede the formation of septa. They differ from dissepiments which developmentally follow the formation of septa and are secreted by the basal part of the polyp. Structures that precede the formation of all septa are “first order Wandblasen”, and those that follow the major septa but precede the minor septa are “second order Wandblasen”.

“Wandblasen” are analogous to some of the structures referred to by Wedekind (1922) as “Randblasen” but, as pointed out by Engel and Schouppé (*op. cit.*), he included true dissepimental elements in his definition. The English term “lonsdaleoid

dissepiments" refers to analogous structural elements, but is rejected in being both clumsy and in confusing the developmentally post-septal term dissepiment with a distinct structure formed before the septa. The term Wandblasen is accepted and further discussed by Birenheide (1962a, pp. 46-48).

It is here proposed that the word be adopted unchanged as a useful descriptive term in English. It may be written uncapitalized as wandblase in the singular, wandblasen in plural. Genera mentioned in this report that show such structures include: *Grypophyllum* (rare in *G. cornus* n. sp.), *Australophyllum*, *Sinospongophyllum*, and *Stringophyllum* (*Sociophyllum*).

## Systematic Descriptions

### Order TABULATA Milne-Edwards and Haime

#### Family FAVOSITIDAE

#### Genus *Favosites* Lamarck 1816

Type species: by subsequent designation (Milne-Edwards and Haime, 1850, p. 60) *Favosites gothlandicus* Lamarck 1816.

*Favosites* sp.

Plate II, figures 4a-c

*Material.* Specimen GSC No. 16498, fragment of corallum with three thin sections, Nos. 16498a, b, and c, GSC loc. 31002; collected by A. W. Norris, 1957.

*Description.* The described specimen is a large fragment measuring 120 by 90 mm with a depth of about 50 mm. Other smaller fragments occur in the collection. The corallum was probably massive and large; no surfaces are preserved. The corallites are sub-polygonal to rounded and parallel; their adult diameter varies between 1.7 and 2.0 mm. Calices were probably perpendicular to surface. Walls are nearly straight to straight, generally thickened, sometimes thin, varying between 0.16 to 0.5 mm.

Tabulae horizontal or nearly horizontal, mainly complete, a few incomplete, very thin. There are five to nine in 5 mm; the closeness of the spacing tends to alternate in zones. Squamulae variably developed, short, thin, horizontal or slightly inclined upwards, up to about six visible in a single corallite in transverse section. Mural pores uniserial or biserial, spacing 0.7 to 1.3 mm, diameter about 0.3 mm, pore plates present but not common.

*Discussion.* The coral described is a squamulate *Favosites* which bears a general morphological resemblance to forms described by Swann (1947) in the *Favosites alpenensis* lineage from the Traverse Group of Michigan. It differs, however, in habit; the complete corallum cannot have had the globose form with small area of attachment of the Traverse forms. Most authors are agreed that the genus *Emmonsia* Milne-Edwards and Haime is a polyphyletic grouping of favositids in

which squamulae are markedly developed. Many would merge the genus in synonymy with *Favosites* (see discussion in Swann, 1947, and Philip, 1960).

Order RUGOSA Milne-Edwards and Haime

Family STREPTELASMATIDAE

Genus *Siphonophrentis* O'Connell 1914

Type species: by original designation *Caryophyllia gigantea* Lesueur 1821.

*Siphonophrentis?* sp.

Plate II, figures 3a, b

*Material.* Specimen GSC No. 16499, fragment of corallum with two thin sections, Nos. 16499a and b, GSC loc. 31002; collected by A. W. Norris, 1957.

*Description.* The coral is strongly crushed and consists of a fragment about 110 mm long that was apparently cylindrical before crushing. The long diameter of the deformed specimen is about 35 mm and the short diameter some 10 to 15 mm. Fragments of other coralla occur in the same rock. A maximum of 43 major septa were counted in cross-sections; they are short (3-4 mm), thickened, and sigmoidally curved. They alternate with very short minor septa that are little more than spines on the coral wall. The coral fragments lay horizontally in the rock, and it is difficult to orient a longitudinal section. Figure 3b on Plate II may be upside down. The section shows thin sinuous tabulae most of which may have been complete. Their attitude cannot be determined, owing to crushing. There are no dissepiments.

*Discussion.* The coral is referred to *Siphonophrentis* with some doubt. Its slightly dilated major septa, very short minor septa, strong tabulae, and lack of dissepiments suggest that it is correctly assigned to the Streptelasmataidae (as used by Hill in the *Treatise*, 1956, p. F268). It may differ from *Heterophrentis* Billings in its cylindrical habit. No fossula was observed.

Family PHILLIPSASTRAEIDAE

Genus *Disphyllum* de Fromental 1861

Type species: by subsequent designation (Lang and Smith, 1934, p. 80) *Cyathophyllum caespitosum* Goldfuss 1826 (*partim*).

*Disphyllum salicis* n. sp.

Plate II, figures 1a-2b

*Material.* Holotype, GSC No. 16469, incomplete corallum with one transverse and one longitudinal section, Nos. 16469a and b, GSC loc. 31000; collected by A. W. Norris, 1957.

Paratype GSC No. 16470, incomplete corallum with one transverse and two longitudinal sections, Nos. 16470 a, b, and c, from same locality as holotype.



Phacelloid *Disphyllum* species are common in the Middle Devonian rocks of the Mackenzie River region and the Arctic Islands but *D. salicis* has not been recognized.

*Description.* The corallum is probably compound, and is known only from fragments. The corallites are cylindrical, the largest is the holotype with a diameter of 17 to 18 mm and an unbroken length of 50 mm. Other fragments have a diameter of from 11 to 16 mm. The surface of the epitheca is irregular with coarse growth rings and strongly marked interseptal ridges. The mode of increase is unknown. No calices are preserved.

There are 50 to 52 septa of two orders. They are nearly all smooth and almost straight or slightly sinuous. Major septa extend about two thirds of the radius towards the centre, but none reaches the axis. Minor septa vary in length from about half the length of the major to subequal. They stop at the edge of the dissepimentarium. Minor septa show a slight tendency to break up, being replaced, in transverse section by herring bone dissepiments. The septa are slightly dilated peripherally and merge with a stout coral wall; they thin axially. The parts of the major septa that extend into the tabularium are very thin, become wavy and show a tendency to break up.

The tabularium is half the diameter of a large corallite, less in a smaller. The tabulae are complete or incomplete, horizontal, slightly convex or sagging, axially. They may be supported by steeply plunging elongate tabellae of very variable size, or they may bend distally at the periphery of the tabularium. There are about 10 or 12 tabulae in 10 mm in a large corallite.

The dissepimentarium is a half to two thirds the radius of the corallite in width. It is composed of five to seven rows of globose dissepiments of unequal size; most are small, some are elongate and extend across two or three rows. They merge inwards with the lateral tabellae of the tabularium.

Under magnification the septa appear practically structureless except for a dark band visible peripherally in the axis of each, which ends in the thickened coral wall. Some longitudinal sections of septa show a very slight banding directed obliquely inward and distally at about 45 degrees to the coral wall. This banding may correspond to trabeculae in the septum.

*Discussion.* *Disphyllum salicis* differs from the lectotype of the genus *D. goldfussi* (Geinitz) (Lang and Smith, 1935, p. 569) in having a wider dissepimentarium relative to the diameter of the corallite, and in its shorter septa. The species is close to *Megaphyllum paschiense* Soshkina, differing primarily in the habit, the larger maximum size of the corallites, and slightly fewer septa.

The short septa of *D. salicis* suggest comparison with forms that have been referred to the genus "*Campophyllum*". For instance the species '*C. recessum*' Hill from the lower Middle Devonian of New South Wales, although apparently solitary, has many of the characters of this coral (Hill, 1940, p. 254). *Campophyllum boreale* Soshkina from the upper Frasnian of the Urals clearly belongs to this group and has a compound growth habit described as parricidal (Soshkina,

1952, p. 88). Hill (1950, p. 141), in discussing her new species *Disphyllum angulare* notes that it has minor septa that are withdrawn in the adult stage, leaving the dissepiments arranged in a herring bone pattern. This character is weakly developed in *D. salicis*. Finally it should be noted that the lectotype of the genus, *D. goldfussi*, consists of a corallite which grows by parricidal increase. The genus *Campophyllum* is no longer considered a Devonian genus (Lang, Smith, and Thomas, 1940, p. 30; and Hill, 1956, p. F290). All of the species considered above, however, are clearly related and may be considered congeneric. The genus *Disphyllum* may therefore be extended to include solitary or weakly compound corals.

*Disphyllum dyeri* Cranswick and Fritz differs from *D. salicis* in being larger, with a greater number of septa for equivalent diameter. *D. compactum* Ehlers and Stumm is smaller with fewer dissepiments.

The species is named from the Latin *salix*, a willow, for nearby Willow Lake.

#### Genus *Cylindrophyllum* Simpson 1900

Type species: by monotypy, *Cylindrophyllum elongatum* Simpson 1900.

#### *Cylindrophyllum gruensis* n. sp.

Plate III, figures 1a-2b

*Material.* Holotype, GSC No. 16495, corallum fragment 80 mm wide by 50 mm deep, with one longitudinal and one transverse section, Nos. 16495a and b; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

Paratype GSC No. 16496, corallum fragment 150 mm long, with one transverse and one longitudinal section, Nos. 16496a and b, from same horizon and locality as holotype.

*Description.* Phaceloid corallum, probably large, with peripheral and lateral increase. Mature corallites are 12 to 14 mm in diameter. Epitheca marked with strong horizontal wrinkles and weaker interseptal ridges. The calice is steep-walled, moderately deep, and flat-bottomed.

There are 48 to 56 septa of two orders. Minor septa extend only to the margin of the dissepimentarium; the major septa may protrude a little into the tabularium or up to about half its radius. The septa are dilated and carinate in the dissepimentarium, both features being highly variable. Dilation may be only peripheral or may extend most of the way across the dissepimentarium; some septa may be without dilation, being thin and wavy up to the periphery. Septa commonly carry cross-bar carinae at a spacing of about 2 per mm. Peripherally they may become irregular and offset or zigzag. Septa in some sections are without carinae. The coral wall in section may be thickened up to about 0.4 mm.

The tabularium is one third to half the diameter of the corallite and consists of closely spaced, incomplete, axially sagging tabulae with one to three rows of elongate, plunging, peripheral tabellae. The dissepimentarium is 2 to 4 mm wide

and is made up of steeply plunging to vertical rows of small globose dissepiments. The carinae, in longitudinal section, are directed inwards and upwards at 30 degrees from the horizontal at the periphery and flatten to nearly horizontal at the inner margin of the dissepimentarium.

During lateral increase, offsets contain very short septa, scarcely differentiated into two orders. They are non-carinate and slightly dilated. During peripheral increase the neo-tissue develops similar septa while those from the outside wall of the parent corallite remain carinate. Dimensions and number of septa of a few offsets are shown on the following table:

Corallite diameter (mm)	Number of septa	Length of septa (mm)
2.3	24?	peripheral ridges
4.5	26	up to 1.2
4.5	34	0.6 - 1.5
6	28	1.5 - 3.0

*Discussion.* *Cylindrophyllum gruensis* appears closest to *C. grabau* Ehlers and Stumm of any described American species. It differs in its shorter septa, less numerous and thinner carinae, and incomplete sagging tabulae. Wedekind's (1922) genus *Spinophyllum*, with *Campophyllum spongiosum* Schlüter as type species, is commonly considered congeneric with *Cylindrophyllum* (Stumm, 1949; Hill in Moore, 1956). It differs from *C. gruensis* in having more abundant and longer septa that are carinate peripherally only.

The species is named from the Latin *grus*, a crane.

Family CYATHOPHYLLIDAE

Genus *Grypophyllum* Wedekind 1922

Type species: by original designation *Grypophyllum denckmanni* Wedekind 1922.

*Grypophyllum cornus* n. sp.

Plate III, figures 3a-c

*Material.* Holotype, GSC No. 16482, fragment of a corallum, with two transverse sections and one longitudinal, Nos. 16482a, b, and c.

*Description.* Simple ceratoid coral with a diameter of about 30 mm. The holotype was over 40 mm long before sectioning. The epitheca is worn but carries a weak development of interseptal ridges and transverse rugae. Calice is not preserved but was probably leptoinophylloid, with steeply sloping walls and no peripheral platform, as indicated by the form of the dissepiments in longitudinal section.

The two transverse sections have diameters of 19 and 29.5 mm and possess 56 and 64 (estimated) septa of two orders. They are thin and irregular with very slight peripheral dilation. Major septa extend three quarters of the way to the centre or more; minor septa are about half the length of the major and show a slight tendency to become discontinuous and replaced by herring bone dissepiments.

The dissepimentarium extends across about one third of the radius and consists of five or six rows of small and medium-sized, plunging, globose, dissepiments; each row forms a steep downward angle from the periphery. The tabularium occupies about two thirds of the diameter of the coral. Tabulae are incomplete, variably spaced, and sag axially; they are supported by a few elongate, large, peripheral tabellae. Longitudinal sections through septa show parallel trabeculae axially and distally inclined at a low angle from horizontal. The coral wall is worn but was probably stout with secondary thickening.

*Discussion.* Stumm (1949), Taylor (1950), and Birenheide (1961) separate *Leptoinophyllum* from *Acanthophyllum* on the basis, among other characters, of calicular shape. Birenheide (1961 and 1962b), however, merges *Leptoinophyllum* in *Grypophyllum*. He chooses a lectotype for *L. multiseptatum* Wedekind, the type species of *Leptoinophyllum*, which he claims is conspecific with *Acanthophyllum* (*Grypophyllum*) *vermiculare* (Goldfuss) (idem, 1962a, p. 111). Wang (1950) also considered *Leptoinophyllum* synonymous with *Grypophyllum*, while Hill (1956, p. F303) merges both genera with *Acanthophyllum*, although with doubt in the case of *Grypophyllum*.

For the present I am disposed to follow Birenheide in his assignment of *Leptoinophyllum* to synonymy with *Grypophyllum*, and hence to the family Cyathophyllidae (=Acanthophyllidae, Ptenophyllidae of authors). The differences between *Grypophyllum* and *Acanthophyllum*, however, seem great enough to warrant distinction as separate genera rather than subgenera.

The *Grypophyllum vermiculare* group, to which *G. cornus* appears related, does seem, however, to differ in some respects from the type of the genus — *G. denckmanni* Wedekind (see Engel and Schouppé, 1958). The former displays less development of lonsdaleoid septa, fewer wandblasen, thinner coral wall, and commonly larger size and more irregular growth habit.

*G. cornus* differs from the type species of *Leptoinophyllum* and other species described by Wedekind (1925) in possessing septa that do not extend to the axis of the coral. *Mictophyllum richardsoni* (Meek) bears some resemblance to *G. cornus* but the septal dilation and strongly developed minor septa suggest that Meek's species may be classified with *Acanthophyllum* (*Neostriingophyllum*).

The species is named from the Latin *cornu*, horn.

#### Genus *Neostriingophyllum* Wedekind 1922

Type species: by original designation, *Neostriingophyllum ultimum* Wedekind 1922.

*Neostriingophyllum craigi* n. sp.

Plate IV, figures 1a-2c

*Material.* Holotype, GSC No. 16477a, b, and c, two transverse sections and one longitudinal of corallum fragment, GSC loc. 31000; collected by A. W. Norris, 1957.

Paratype GSC No. 16478, fragment of a corallum, with two transverse sections and one longitudinal, Nos. 16478a, b, and c; collected by P. E. Gretener, Shell Oil Company, 1947 (loc. PG-416-N57).

*Description.* Simple, ceratoid to cylindrical coral with a maximum diameter of about 19 mm (paratype). The length is unknown; the holotype, apparently a nearly complete specimen before sectioning, was 27 mm long. The epitheca is nearly smooth, with a weak development of interseptal ridges and transverse growth lines. No rejuvenescence was observed on the two specimens described. Calices probably funnel-shaped, with sloping walls, and no peripheral platform.

There are 58 septa of two orders on both sections of the holotype and 50 and 56 on the paratype. They are irregularly dilated: strongly peripherally, where they thicken into the marginarium, weakly to strongly in the off-peripheral zone (Taylor, 1950, p. 163), and they may be moderately dilated axially. Trabeculate carinae are sporadically developed; they may be zigzag or symmetrical along the septum. In the proximal section of the paratype, carinae are common in the off-peripheral and axial zones, where their development corresponds to septal dilation. In the proximal section of the holotype they are developed axially only, and in the distal section they are scarcely developed and the septa are strongly dilated only at the periphery. The major septa extend almost to the axis and are irregularly but slightly bent. Two opposite major septa are slightly shorter than the others, giving slight bilateral symmetry to the cross-sections. Minor septa extend up to three quarters of the radius towards the axis, but scarcely protrude into the tabularium and are not dilated axially.

The dissepimentarium occupies two thirds or more of the radius of the corallum and consists of eight to ten rows of small- to medium-sized plunging globose interseptal dissepiments, each row plunging inwards and downwards at a steep angle from the periphery. Occasional large dissepiments extend across two or more rows. The tabularium is narrow, being about one third of the diameter of the corallum. Tabulae are incomplete, closely set and axially sagging. Peripherally they are supported by globose tabellae, that resemble dissepiments. The tabulae themselves may break up into small elongate tabellae that plunge axially. The trabecular carinae are visible in the longitudinal section of the paratype, rising axially at an angle of about 30 degrees from the horizontal. The coral wall consists of a thin dense epitheca thickened internally by the enlarged peripheral ends of the septa.

*Discussion.* Birenheide (1961) discusses the genus *Acanthophyllum* and includes within it the subgenera *Acanthophyllum*, *Grypophyllum*, and *Neostringophyllum*. They differ primarily in the form of the calice and presence or absence of wandblasen. These differences are here considered of generic rank. *Neostringophyllum*

may be distinguished by possessing a funnel-shaped calice (also expressed in the structure of the dissepimentarium), as opposed to *Acanthophyllum* which has a calice with peripheral platform and axial pit (and dissepimentarium to match). *Grypophyllum* has a funnel-shaped calice, but develops second order wandblasen. Stumm (1949) considers the difference in form of the calice of familial importance taxonomically (Acanthophyllidae and Leptoinophyllidae) thus separating *Acanthophyllum* from *Neostriingophyllum*. Whether considered as a genus or subgenus, *Neostriingophyllum* appears to be a useful taxon to distinguish a distinctive and possibly inter-related group of coral species.

*Neostriingophyllum craigi* differs from most described species of the subgenus in being relatively small and with a strong development of trabecular carinae. In addition to the type species, the specimens of *Neostriingophyllum* figured by Wedekind (1925, pp. 44, 45) are larger with a greater number of septa. Of the species described by Walther (1928, pp. 106-117), *N. planum* appears closest, although it is figured in longitudinal section only; the main difference appears to be its larger size. Birenheide (1961, p. 124) suggests that *Ptenophyllum* sp. indet. of Stumm (1940, pp. 60, 61) from the upper part of the Nevada Limestone of Nevada might belong to *Neostriingophyllum*, thus extending the range of the genus and subgenus into the Upper Devonian. The broad, flat or gently arched tabulae (Stumm, 1940, Pl. 8, fig. 6b) of this coral are, however, sufficient to indicate that it is not an acanthophylloid coral, whatever its affinities might be. The genus is known only from the Middle Devonian.

The species is named for B. G. Craig, who made collections from the Horn Plateau Formation.

#### Genus *Australophyllum* Stumm 1949

Type species: *Spongophyllum cyathophylloides* Etheridge 1911.

*Australophyllum?* cf. *A.?* *thomasae* (Hill and Jones)

Plate IV, figures 3a-c

1940. [cf.] *Spongophylloides* (?) *thomasae* Hill and Jones, pp. 181-182, Pl. IV, figs. 1a, b.

*Material.* Specimen GSC No. 16497, fragment of corallum with one transverse and two longitudinal sections, Nos. 16497a, b, and c.

*Description.* There was only a single fragment in the collections, measuring 60 mm across by 30 mm deep, broken from a presumably much larger fragment. The coral is cerioid with very strong coral walls. In the transverse section there are parts of six corallites, none of them complete, their diameters may be estimated at between 14 and 30 mm, some may possibly be larger. The number of septa can only be estimated, but appears to range up to over 60 in the largest corallite fragment. Septa

are of two orders; the major extend from the periphery to, or almost to, the axis or may be withdrawn peripherally and separated from the coral wall by large and abundant wandblasen. Discontinuous septal crests appear on some of the peripheral wandblasen. The minor septa do not extend into the tabularium. The septa are slender except for axial thickening of the major septa which appear rhopaloid and slightly carinate in one corallite, and with a tendency to twist. The coral wall is strong and thin with heavy secondary thickening up to 1 mm thick that reinforces the zigzag junction between corallites.

In longitudinal section the marginarium is wide — up to 12 mm — and consists of abundant globose to elongate wandblasen and dissepiments that plunge from the periphery to the axis. The calice was therefore presumably funnel-shaped. The tabularium is 7-8 mm wide, it contains very closely set incomplete tabulae, horizontal to slightly convex, with peripheral depression in one section (the distal part of section figure 3c, Plate IV). Trabecular rods are visible in longitudinal section of the coral wall; they are directed inwards and upwards at a small angle (about 10 degrees) to the horizontal.

*Discussion.* The coral is imperfectly known and cannot be assigned to a genus with any certainty. The septal structure, marginarium, and tabularium suggest affinities with *Acanthophyllum*, although the calice was presumably funnel-shaped and not horizontal peripherally. It might be assigned to *Australophyllum* Stumm which is included in the Ptenophyllidae by Hill (*in* Moore, 1956, p. F306). Birenheide (1962a, p. 72), however, has recently suggested that Stumm's genus is a subjective synonym of *Spongophyllum* Edwards and Haime. He maintains (*op cit.*, p. 50) that *Australophyllum* does not possess true carinae, as described by Stumm (1949, p. 34), but septal protruberances ("Septalhöcker"). A similar septal structure is also found in the Cyathophyllidae (=Acanthophyllidae, Ptenophyllidae, *see* Birenheide, 1962b, p. 102), and *Australophyllum* may instead belong here.

The type species of *Endophyllum* Milne-Edwards and Haime 1851, *E. bowerbanki* M-E. & H. (subsequent designation Schlüter, 1889), is an aphroid form presumably generically distinct from *S. (?) thomasaе*. *Taimyrophyllum* Chernyshev 1941 and *Aphroidophyllum* Lenz 1961 are probably junior synonyms of this genus. Jones (1929) and Hill (*in* Moore, 1956, p. F300) follow Milne-Edwards and Haime in including *E. abditum* M-E. & H. in *Endophyllum*, although this species is subphaceloid to cerioid with a strong coral wall. It may be congeneric with *S. (?) thomasaе* and the Horn Plateau form discussed here. In summary, the specimen described is probably an acanthophyllid with a cerioid habit and might be an *Australophyllum* if that genus is correctly included in the Cyathophyllidae.

Similarities to and differences from *Spongophylloides (?) thomasaе* Hill and Jones may be summarized as follows:

Horn Plateau Specimen	<i>S. (?) thomasaе</i>
1. Cerioid with large corallites	Cerioid with large corallites
2. Over 60 septa	66 septa
3. Most septa withdrawn peripherally with septal crests on wandblasen	All septa withdrawn peripherally, with septal crests on wandblasen

Corals of the Devonian Horn Plateau Formation

<p>4. Major septa extend to, or almost to, the axis</p> <p>5. Major septa axially thickened with weak carinae (Septalhöcker)</p> <p>6. Coral wall secondarily thickened, zigzag</p> <p>7. Tabulae closely spaced, incomplete, with peripheral depression</p> <p>8. Wide marginarium with elongate plunging wandblasen</p> <p>9. Wandblasen sometimes geniculate in transverse section</p>	<p>Major septa extend to, or almost to, the axis</p> <p>Major septa weakly carinate (from the figure, presumably only axially)</p> <p>Coral wall thick, not zigzag (from figure)</p> <p>Tabulae closely spaced, incomplete, with axial depression</p> <p>Wide marginarium with elongate plunging wandblasen</p> <p>Wandblasen "frequently geniculate in transverse section"</p>
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*S. (?) thomasae* occurs in the Garra Beds of presumed Lower Devonian age in New South Wales. It is hard to believe that it can be closely related to the late Middle Devonian Horn Plateau specimen, yet the similarities are striking and it must be presumed that the two forms are congeneric at least.

Genus *Heliophyllum* Hall in Dana 1846

Type species: by monotypy *Strombodes helianthoides?* [sic] Goldfuss, Hall 1843 (= *Heliophyllum halli* Milne-Edwards and Haime, 1850).

*Heliophyllum borealis* n. sp.

Plate V, figures 1a-c; Plate VI, figures 1a, b

*Material.* Holotype, GSC No. 16483, large fragment of a corallum, with two transverse sections and one longitudinal, Nos. 16483a, b, and c.

Paratype GSC No. 16484, large fragment of a corallum, with one transverse and one longitudinal section, Nos. 16484a and b, GSC loc. 31001; collected by A. W. Norris, 1957.

*Description.* Simple, ceratoid to cylindrical coral with a diameter up to 50 mm or more. The longest fragment was over 100 mm long before sectioning. The epitheca is not preserved. The fragments are relatively smooth and regular, and slightly curved. Maximum diameter is along the axis of curvature, but this may be partly due to crushing. From the form of the dissepimentarium, the calice is probably acanthophylloid with peripheral platform and axial pit.

There are 90 to 100 septa of two orders. They are slender peripherally, tend to thicken in the inner part of the dissepimentarium and are slender to absent in the tabularium. The major septa do not quite reach the axis; in the dissepimentarium they become wavy and irregular and show a tendency to break. The minor septa are less than half the length of the major and may be discontinuous or even absent in some segments. Where absent there is a tendency for herringbone dissepiments to form between the major septa. There are well-marked cross-bar carinae on the peripheral half of the septa — up to about ten are developed in 10 mm along a septum, but they may be absent altogether in some segments. The cross-bars are



up to two thirds mm long, and are slender peripherally, but thicken axially. Few show the flanged ends common in the type species of the genus. The cardinal septum is short and discontinuous and the fossula long and narrow. There is a suggestion of quadrate arrangement in the ends of the major septa.

The dissepimentarium is wide, up to four fifths of the radius and consists of very many small globose dissepiments that are arranged in horizontal rows at the periphery and curve downwards steeply towards the axis. The tabularium is narrow, one tenth to one fifth of the diameter of the corallum. The tabulae are numerous, incomplete and approximately horizontal to axially sagging. Peripheral tabellae may be present. The carinae are steeply inclined upwards and inwards from the periphery and fan out at right angles to the rows of dissepiments axially. The coral wall is not preserved.

*Discussion.* Following Wang (1948) and Hill (1956), *Heliophyllum* is considered a genus distinct from *Keriophyllum* Wedekind (now shown to be a junior synonym of *Cyathophyllum* (*Peripaedium*) Ehrenberg; see Głinski, 1961, p. 277; and Birenheide, 1962b, p. 102). The matter is considered further in the discussion on *C. (P.) greteneri* n. sp.

*H. borealis* differs from the type species of *Heliophyllum*, *H. halli* (Milne-Edwards and Haime), in having more numerous septa, a narrower tabularium with more closely spaced incomplete tabulae, and in possessing minor septa that may become discontinuous. *Keriophyllum dahlemense* Haller may belong to *Heliophyllum*, and differs from *H. borealis* in possessing fewer septa, a wider tabularium, and complete minor septa.

Of the species of *Heliophyllum* described recently from the Traverse Group of Michigan by Stumm and Tyler (1962), *H. elongatum* from the Four Mile Dam Formation is closest to *H. borealis*. They differ in that the former is smaller, has fewer septa, more carinae, and a proportionately wider tabularium with flat to distally arched tabulae.

The species is named from the Latin *borealis*, northern.

#### Genus *Cyathophyllum* Goldfuss 1826

Type species: by subsequent designation (Dana, 1846, p. 183) *Cyathophyllum dianthus* Goldfuss 1826.

#### Subgenus *Cyathophyllum* (*Peripaedium*) Ehrenberg 1834

Type species: by subsequent designation (Lang, Smith, and Thomas, 1940, p. 97) *Cyathophyllum turbinatum* Goldfuss 1826.

#### *Cyathophyllum* (*Peripaedium*) *greteneri* n. sp.

Plate VI, figures 2a-3; Plate VII, figures 1a, b

*Material.* Holotype, GSC No. 16479, fragment of a corallum, with one transverse and one longitudinal section, Nos. 16479a and b, GSC loc. 31000; collected by A. W. Norris, 1957.

Paratype A, GSC No. 16480, fragment of a corallum, with one transverse and one longitudinal section, Nos. 16480a and b; paratype B, GSC No. 16481, fragment of a corallum, with one transverse section.

*Description.* Simple, ceratoid to cylindrical coral with a diameter of up to about 30 mm (the holotype). The length is unknown as all specimens in the collection are fragments; fragments were up to 40 mm long but the unbroken coral is probably much longer. The epitheca is worn off all specimens. The outside shape of the coral appears irregular, with considerable longitudinal variation in the diameter. The calice is probably acanthophylloid, with peripheral platform and axial pit, as indicated by the appearance of the dissepiments in longitudinal section.

There are 66 septa of two orders in the holotype, 72 in paratype A, and 64 in paratype B. They are thin, with zones of irregular trabecular thickening. In the sections of holotype and paratype B there is an off-peripheral zone, another about the middle of the dissepimentarium and a third at the inner margin of the dissepimentarium. In the section of paratype A there is only an off-peripheral zone of thickening. The minor septa extend two thirds to three quarters of the radius, to the margin of the tabularium. The major septa project well into the tabularium where they may be irregularly thickened; some reach the axis. The trabecular dilation of the septa may result in simple thickening, or in the development of trabecular carinae which may be irregular or may resemble cross-bar carinae. All modifications can be observed on one zone in a single section, e.g., the two outer zones on the holotype. There is some sign of quadrate arrangement of the septa. In paratype B apparently a short cardinal septum is opposite a long and axially dilated counter septum, and a similar arrangement is discernible in the holotype.

The dissepimentarium is wide, up to three quarters of the corallum radius, and consists of many (15 to 20) rows of small globose interseptal dissepiments that tend to alternate in growth zones with larger more elongate dissepiments. Peripherally these rows are nearly horizontal and curve down axially to become steep or almost vertical at the inner margin of the dissepimentarium. The tabularium is narrow, one third to one quarter the width of the corallum. Tabulae are incomplete, closely spaced and horizontal to gently domed. Small globose peripheral tabellae are probably present. Dense, irregular zones of septal dilation are visible on sectioned septa. The broadly fan-shaped trabecular carinae project upwards and inwards at a steep angle peripherally but are almost horizontal towards the centre. The coral wall is not preserved.

*Discussion.* This species is not easily assigned to an existing genus, but it appears closest to *Keriophyllum* Wedekind in its relatively slender septa with trabecular thickening that do not quite reach the axis, in its acanthophylloid dissepimentarium, and domed to flattened, but not plunging, tabulae. Lang, Smith, and Thomas (1940, p. 35) and Stumm (1949, p. 21) considered the genus a subjective synonym of *Heliophyllum* Hall. Wang (1948, p. 11; 1950, pp. 217 and 219), however, convincingly differentiates the two genera on the basis of septal structure; the septa of

*Heliophyllum* possess flanging plates (=cross-bar carinae) unlike the trabecular thickening of *Keriophyllum*.

The family affinities of the genus also are in dispute. Stumm (1949), Taylor (1950), and Middleton (1959) consider it related to *Acanthophyllum* on the grounds of septal structure, calices and dissepimentaria. Hill (1956, p. F278), however, classifies the genus in the Zaphrentidae because of its domed tabulae. The acanthophyllid corals are certainly typified by plunging funnel-shaped tabulae and in this respect *Keriophyllum* is different. But, there are so many similarities that it is difficult convincingly to separate them.

Glinski (1961, p. 277) claims that *Keriophyllum* is a subjective synonym of *Peripaedium* Ehrenberg (1834, p. 308), with a designated type species (by Lang, Smith and Thomas, 1940, p. 97): *Cyathophyllum turbinatum* Goldfuss (1826); he chose a lectotype for the species from Goldfuss' figures (Pl. 16, fig. 8c). Birenheide (1962b, pp. 102, 108) accepts the resurrection of *Peripaedium*, and claims that *Keriophyllum heiligensteini* is synonymous with *Cyathophyllum turbinatum*—the type species of Ehrenberg's genus. He classifies *Peripaedium* as a subgenus of *Cyathophyllum*<sup>1</sup>. Hence *Keriophyllum* is merged with *Cyathophyllum* (*Peripaedium*) in this paper.

*Cyathophyllum* (*Peripaedium*) *greteneri* differs from *Keriophyllum heiligensteini* in transverse section, primarily in having many fewer carinae on the septa. It is larger and has more septa than either of Wang's (1948) species — *K. conicum* and *K. temeniphyллоides*. (Wang followed Lang, Smith, and Thomas (1940) in spelling the genus "*Ceriophyllum*", but this change is not legally valid.) The species is larger than, but otherwise resembles fairly closely, the specimen figured as *Keriophyllum* sp. by Ma (1937, Pl. XII, figs. 2a, b).

The specimen figured by Lenz (1961, Pl. 1, figs. 13-16) as "*Cyathophyllum*" *kobehense* Stumm differs from *C. (P.) greteneri* in having more inflate septa, shorter minor septa, a wider tabularium, and smaller and more abundant dissepiments. Lenz's form may be conspecific with *Keriophyllum* sp. F of McLaren (*in* McLaren, Norris, and McGregor, 1962, Pl. IV, figs. 1-4)<sup>2</sup>, and are both found in late Middle Devonian rocks in the District of Mackenzie. The coral described by Stumm (1938, pp. 479-480) is a small trochoid form with smooth septa and no sign of trabecular carinae in the longitudinal section (Pl. 59, fig. 1b); it is probably distinct from the Mackenzie forms, and its generic assignment remains in doubt.

The species is named for P. E. Gretener who collected from the Horn Plateau Formation.

<sup>1</sup>The matter is further discussed by Birenheide in *Senckenbergiana lethaea*, vol. 44, pp. 363-458, 1963.

<sup>2</sup>This species should be referred to *Cyathophyllum*, and possibly to *C. (Peripaedium)*.

Family CHONOPHYLLIDAE

Genus *Sinospongophyllum* Yoh 1937

Type species: by original designation *Sinospongophyllum planotabulatum* Yoh 1937.

*Sinospongophyllum* cf. *S. planotabulatum* Yoh 1937

Plate VII, figures 2a-c

*Material.* Specimen GSC No. 16476, incomplete corallite with three thin sections, Nos. 16476a, b, and c, GSC loc. 31004; collected by A. W. Norris, 1957. Yoh's species occurs in the Middle Devonian of China.

*Description.* The specimen is about 40 mm long with a maximum diameter of 11 mm. It appears to be solitary but a compound mode of growth cannot be ruled out. The two transverse sections have diameters of 10.5 and 11 mm and both possess 50 septa of two orders. The main difference from *S. planotabulatum* in transverse section lies in the small diameter (11 mm against 18 to 35 mm), and the fewer septa (50 as opposed to 56 to 60). The major septa do not reach the axis and show a slight involution axially; the minor septa are very short and both orders of septa are separated from the periphery by large wandblasen. The septa are recrystallized and appear to be homogeneous lamellae without carinae or irregularities. There is no suggestion of monacanth or braided strands of lamellar tissue peripherally.

In longitudinal section the flat tabulae grow more closely together (ten to eleven in 5 mm; there are seven in 5 mm in *S. planotabulatum*). They are down-warped peripherally and separated from the inner wall by a flat series of peripheral tabellae which are possibly more distinctly developed than in *S. planotabulatum*. One rank of wandblasen appears to be developed in the specimen described.

*Discussion.* There seems little doubt that the specimen described here is specifically distinct from *Sinospongophyllum planotabulatum* Yoh, but there is inadequate material to establish this positively. For the present an informal designation seems advisable. Wang (1948, p. 31) described Yoh's species as an *Endophyllum*, together with two others. The specimen discussed here differs again primarily in its smaller size, fewer septa, and better developed peripheral tabellae.

Engel and Schouppé (1958, pp. 94, 95) point out that Yoh (1937, Pl. VI) figures more than one species under the original description. They choose the specimen figured on Plate VI, figures 2a, b, as lectotype of the species, with figure 5 as conspecific, and reject the remainder. They put the genus *Sinospongophyllum* in synonymy with *Neospongophyllum*, but the entirely different septal microstructure is sufficient to separate them. Stumm (1949, p. 27) merges the genus with *Tabulophyllum* but notes that it may be desirable to retain *Sinospongophyllum*. Hill

(1956, p. F300) accepts the genus and classifies it with the Subfamily Endophyllinae of the Family Chonophyllidae. Birenheide (1962a, p. 52) considers that the genus may be a synonym of *Tabulophyllum* which he refers, with doubt, to the Family Stringophyllidae.

It seems likely that Yoh's genus is indeed related to *Tabulophyllum*, but it is difficult to see relationship of either genus to the Stringophyllidae. Stout trabecular fibre bundles forming monacanthos are lacking, and the tabulae are horizontal to domed — unlike *Stringophyllum*. For the present, Hill's (1956) assignment of both genera to the Family Chonophyllidae is followed.

Family STRINGOPHYLLIDAE

Genus *Stringophyllum* Wedekind 1922

Type species: by subsequent designation (Wedekind, 1925, p. 64) *Stringophyllum normale* Wedekind 1922.

Subgenus *Stringophyllum* (*Sociophyllum*) Birenheide 1962a

Type species: by original designation *Spongophyllum elongatum* Schlüter 1881.

*Stringophyllum* (*Sociophyllum*) *redactum* n. sp.

Plate VII, figures 3a-5b; Plate VIII, figures 1a-2b

*Material.* Holotype, GSC No. 16471, incomplete corallum fragment, with two thin sections, Nos. 16471a and b; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

Paratypes: A, GSC No. 16472a and b, two thin sections of corallum fragment; B, GSC No. 16473, large fragment of a corallum and two thin sections, 16473a and b; C, GSC No. 16474, fragment of a corallum, with three thin sections, 16474a-c; D, GSC No. 16475, fragment of a large corallite, with two thin sections, 16475a and b.

*Description.* The compound corallum is phaceloid to sub-ceroid and is known only from large fragments; the largest, paratype B, measured 150 mm across and 70 mm deep, before sectioning. It is clear from the fragments in the collection that the complete corallum may have attained a much greater size. The corallites are cylindrical, slightly sinuous and subparallel; they are closely set and commonly in contact with one another along at least part of their length. The diameter of individual corallites varies between 9 and 17 mm for specimens with a full septal count. Increase is peripheral; the offsets increase in diameter slowly after separating from the parent corallite. No calices are preserved.

The septa vary in number from 0 to 32; their development in relation to corallite diameter is shown on the following table:

## Corals of the Devonian Horn Plateau Formation

Specimen	Corallite diameter in mm	Number of septa or septal spines
Holotype	2.1	0
"	2.3	0
"	2.4	0
"	3.0	11
"	3.3	0
"	3.9	5
"	4.8	12
Paratype C	5.0	23
Paratype B	7.8	14
Paratype C	8.0	28
Paratype A	8.5	31
Holotype	8.5	30
"	9.5	29
Paratype B	9.5	19
Paratype A	10.0	32
Holotype	10.5	31
"	13.0	32
Paratype D	17.0	31

The septa are composed of strong monacanths at a low angle of inclination, invested with strongly developed lamellar tissue. In some specimens, they break peripherally into loose strands of lamellar tissue, where they may join the coral wall or be separated from it by large wandblasen. Minor septa are commonly not present but may be sporadically developed as ridges on the inside of the coral wall. The septa do not reach the axis, but are very variable in length; they show a slight tendency to become bilaterally symmetrical axially and in some sections there is a shortened cardinal septum. Peripherally they may be strongly attached to the coral wall or they may be withdrawn and break into individual monacanths when the lamellar tissue is suppressed. The greatest variation is found in developing corallites (*see below*). The coral wall consists of a strong epitheca thickened by a stereozone of lamellar tissue internally.

In longitudinal section there is a strongly developed marginarium equal in width to about half the radius of the corallite and formed of large, globose, plunging, wandblasen, in one to three ranks. Large wandblasen occur in one rank in young, associated with lonsdaleoid septa, but more ranks are present in mature corallites with complete septa. Tabulae are complete or incomplete, close-set, horizontal or weakly concave distally to strongly depressed axially or periaxially. The vertically discontinuous ends of the septa are visible in the axial part of longitudinal sections, and the stout inclined monacanths in the dissepimentarium.

The greatest variation is displayed in developing corallites. Newly formed offsets are essentially empty tapering cylindrical tubes in which a few wavy but approximately horizontal tabulae develop. With increasing diameter short thorn-

shaped septa appear and a few very large irregularly shaped primary wandblasen. The septa may be attached to the coral wall, or to a wandblase, or they may be dissociated irregular monacanth which appear to be without root or regular direction. At this stage the corallites have a superficial resemblance to *Spongophyllum* except for the microstructure of their septa. Further growth leads to an increase of lamellar tissue along the septa, which roots them to the thickened coral wall; this tissue may develop a braided appearance by the intergrowth of separate strands peripherally. Some septa remain unconnected peripherally, i.e., lonsdaleoid, and consist of little more than the original monacanth.

*Discussion.* Hill (1956, p. F306) recognizes only one genus in the Family Stringophyllidae Wedekind 1921 [=1922], namely, *Stringophyllum*, and places *Neospongophyllum* Wedekind 1922, together with other genera, in subjective synonymy. The family is characterized by the highly individual septal structure, consisting of discrete monacanth invested with lamellar tissue, and by the weak development of minor septa; the septa may be complete or may be withdrawn from the periphery. Most authors have considered *Neospongophyllum* a valid genus, separated from *Stringophyllum* by the almost complete lack of minor septa and the withdrawal of the major septa from the periphery (e.g., Wang, 1948; Taylor, 1950; Stumm, 1949; Engel and Schouppé, 1958). Wang, Taylor, and Hill (but not Engel and Schouppé) include phaceloid species within the family.

Recently, Engel and Schouppé (1958) have included the genus *Grypophyllum* within the Family Stringophyllidae. The septal structure alone is sufficient to separate this genus from true stringophyllids; it is more properly classed with *Acanthophyllum* (Birenheide, 1961).

Birenheide (1962a) has erected a new subgenus, *Stringophyllum* (*Sociophyllum*), for phaceloid stringophyllids in which minor septa are lacking or represented only as remnants. Several species of Schlüter and Wedekind are referred to the subgenus, which is an important and distinct stringophyllid form. The Horn Plateau coral described here may be referred with confidence to Birenheide's subgenus.

*Stringophyllum* (*Sociophyllum*) *redactum* differs from most of the species of Schlüter (1881) and Wedekind (1925), redescribed by Birenheide (1962a), in having fewer septa that are withdrawn from the axis of the coral, and which may be invested with braided lamellar tissue peripherally. *Str. (Soc.) semiseptatum semiseptatum* (Schlüter) has greatly reduced primary septa and resembles young corallites of *Str. (Soc.) redactum* (Pl. VII, figs. 1a, b). *Str. (Soc.) semiseptatum aequale* Birenheide is smaller, with less secondary lamellar tissue on the septa, more widely spaced concave tabulae, and simpler marginarium.

The species figured by McLaren (*in* McLaren, Norris, and McGregor, 1962, Pl. I, figs. 7, 8) as *Stringophyllum* (*Neospongophyllum*?) sp. J belongs to Birenheide's subgenus *Str. (Sociophyllum)*. It is close to *Str. (Soc.) elongatum* Schlüter, differing primarily in its shorter septa and simpler dissepimentarium with

more globose wandblasen. It differs from *Str. (Soc.) redactum* in its simpler shorter septa and simpler marginarium.

The species is named from the Latin *redactus*, reduced.

Family DIGONOPHYLLIDAE

Genus *Lekanophyllum* Wedekind 1924

Type species: by subsequent designation (Lang, Smith, and Thomas, 1940, p. 75), *Lekanophyllum punctatum* Wedekind, 1924.

*Lekanophyllum* cf. *L. punctatum* Wedekind

Plate VIII, figures 3a-4b

*Material.* Specimen A, GSC No. 16493, fragment of corallum with one transverse and one longitudinal section, Nos. 16493a and b. Specimen B, GSC No. 16494, fragment of corallum with one transverse and one longitudinal section, Nos. 16494a and b. Wedekind's species occurs in beds of latest Eifelian age in Germany.

*Description.* The transverse section of specimen A is very close in appearance to the section figured by Wedekind (1924, fig. 38) of *Lekanophyllum punctatum*. The Horn Plateau specimen is trochoid to ceratoid and, in section, is slightly smaller (25 mm opposed to 30 mm diameter), but both possess about 74 septa that are characteristically 'beaded' in appearance and which are incomplete and extend neither to the periphery nor to the axis. The minor septa may be almost as long as the major, and tend to be more discontinuous. The axial zones of both are occupied by globose tabellae that may be thickened and carry denticulate fringes. Peripherally the discontinuous septal fragments tend to be rooted on dissepiments but some disconnected rods are present that, in section, are unsupported by other skeletal elements.

Specimen B has shorter septa which appear to be fewer in number than specimen A, although an accurate count is difficult. It represents a form morphologically intermediate between *Lekanophyllum* and *Cystiphyllodes*.

*L. punctatum* is unknown in longitudinal section. Specimens A and B both resemble *Cystiphyllodes* longitudinally. There is a wide dissepimentarium of steeply plunging globose to elongate dissepiments and a narrow tabularium of globose tabellae. Thorn-like septal spines rest on zones of weak thickening and a few penetrate two or more rows of dissepiments.

*Discussion.* The specimens described above are compared with the type species of *Lekanophyllum* on the basis of similarity in transverse section of an epehebic stage. Younger growth stages, as figured by Wedekind (1924, figs. 36 and 37), are unknown. With so little material it cannot be considered that even their generic affinities are certain.



Genus *Cystiphylloides* Chapman 1893

Type species: by monotypy, *Cystiphyllum aggregatum* Billings 1859.

*Cystiphylloides spinosum* n. sp.

Plate IX, figures 1a-4c

*Material.* Holotype, GSC No. 16489, medium-sized trochoid corallum with broken proximal end, with one transverse and one longitudinal section, Nos. 16489a and b, GSC loc. 31002; collected by A. W. Norris, 1957.

Paratypes: A, GSC No. 16490, trochoid corallum with one transverse and one longitudinal section, 16490a and b; B, GSC No. 16491, ceratoid corallum with two transverse sections and one longitudinal, 16491a-c; C, GSC No. 16492, trochoid corallum with two transverse sections and one longitudinal, 16492a-c.

*Description.* Simple, trochoid to ceratoid corals up to about 40 mm or more long and a maximum diameter of about 27 mm. The epitheca is heavy, with irregular horizontal concentric wrinkles. The calice is cone-shaped with rounded or angular base and slightly flaring sides.

There are numerous small, thorn-shaped septa developed in concentric rings in transverse section. For the most part they appear to be rooted to the globose dissepiments. But in some zones in the corallum the septal spines lengthen and penetrate two or more successive ranks of dissepiments, being directed inwards and upwards at an angle of 45 to 60 degrees to the vertical. In longitudinal section the spinose septa are seen to develop in zones on successive dissepimental ranks and pass axially into weak but continuous zones of stereoplasm marking successive calicular floors, and presumably representing septal cones. These cones are spaced some 3 to 8 mm apart and are visible on all longitudinal sections. It is impossible to determine the trabecular structure of the septal spines, which appear of similar tissue to other parts of the coral skeleton.

The dissepimentarium is wide and composed of many steeply inclined rows of small globose dissepiments. The boundary with the tabularium is indefinite and irregular. The tabularium is narrow and composed of large and medium-sized strongly convex tabellae which plunge axially. Both dissepiments and tabellae may show an elongate oval outline in transverse section.

*Discussion.* Hill (1939, pp. 248-250) has described how Devonian "cystimorph" corals differ from Silurian forms in having monacanthine rather than holacanthine septa. Stumm (1949, p. 38) states that Devonian cystiphylloid corals may be distinguished from the Silurian genus *Cystiphyllum*, which has "septal crests developed from lateral acanthine septa, while Devonian forms possess septal cones derived from calycinal septal striae."

Sections of the type species of *Cystiphylloides*, *C. aggregatum* (Billings) have been figured recently for the first time (Stumm, 1961). Unlike the remainder of the species and subspecies of *Cystiphylloides* described by Stumm (1961 and 1962),

*C. aggregatum*, in both longitudinal and transverse sections plainly possesses spinose septa that penetrated two or more layers of horizontal skeletal elements, e.g., dissepiments. When the trabecular composition of the septal elements cannot be determined — and this is common — the distinction between Devonian cystimorphs of this type and *Cystiphyllum* itself may become difficult. The figures of *Cystiphyllum cylindricum* Lonsdale in Hill (1936, Pl. 30; and 1956, p. F313) show ranks of septal spines arranged in cones in longitudinal section, similar to *Cystiphyllodes aggregatum* or *C. spinosum*.

The differences between the two genera may be in the greater differentiation into dissepimentarium and tabularium, possibly the absence of spinose septal elements axially, and a greater tendency towards formation of septal cones in *Cystiphyllodes*.

*C. spinosum* differs from the type species, *C. aggregatum*, in its simple trochoid to ceratoid habit as opposed to the phacelloid form of the latter, its wider, better developed dissepimentarium, and more widely spaced septal cones. It differs from *C. septatum* (Wedekind) in possessing a narrower tabularium and fewer septal spines in transverse section.

Lenz (1961, p. 512) assigns *Cysteophyllum americanum* var. *arcticum* Meek to *Cystiphyllodes*? but does not figure it. The presence of septa allowing a septal count (Meek, 1867, p. 80) makes it unlikely that the form is related to *C. spinosum*.

*Cystiphyllodes kwangsiense* Yoh also develops long septal spines that cut several rows of dissepiments, but is larger, and possesses more abundant dissepiments and tabellae. The form figured under this name by Lenz (1961, Pl. 1, fig. 23) does not show septal spines of this type.

*C. spinosum* differs from other described species of *Cystiphyllodes* in the length of its septal spines.

The species is named from the Latin *spinosus*, thorny.

#### Genus *Atelophyllum* Wedekind 1925

Type species: by original designation, *Atelophyllum emsti* Wedekind (1925, pp. 37, 38) = *Mesophylloides Emsti* Wedekind (1922, p. 57).

#### *Atelophyllum nebracis* n. sp.

Plate X, figures 1a-2b; Plate XI, figures 1-2d; Plate XII, figures 1a-d

*Material.* Holotype, GSC No. 16485, large fragment of corallum, originally 140 mm long, with two transverse and two longitudinal sections, 16485a-d, GSC loc. 31004; collected by A. W. Norris, 1957.

Paratypes: A, GSC No. 16486, large fragment of corallum, originally 110 mm long, with one transverse and one longitudinal section, 16486a and b; B, GSC No. 16487, large fragment of corallum, originally 75 mm long, with three transverse sections and one longitudinal, 16487a-d; C, GSC No. 16488, large fragment of corallum, originally 140 mm long, with five transverse sections prepared with

approximately 7.5 mm intervals between them, 16488a-e; D, GSC No. 16500, fragment of corallum in lateral contact with paratype C, with similar sections.

*Description.* Long cylindrical corals with a diameter of up to about 35 mm. Individual coralla grew close together, and even in contact (paratypes C and D), and the coral could be weakly compound, although no branching was observed. The longest fragment was 140 mm before sectioning. Few proximal ends are preserved in the collection, and no calices. The epitheca is preserved on parts of some specimens; it is marked with fine annulations superimposed on a series of weak but regular constrictions corresponding to rhythmical rejuvenation of the septal structure internally. The constrictions are 15 to 20 mm apart. Judging by the form of the dissepimentarium in longitudinal section, the calice was bell-shaped.

Development of the septa is highly variable, but the variation appears to follow a definite pattern. In an adult corallite there are about 40 to 44 major septa, which may be developed only at the margins of the tabularium and are commonly thickened (Pl. X, fig. 1b); or the major septa may extend from the periphery nearly to the axis as slender and sometimes slightly discontinuous lamellae, thickened peripherally and axially (Pl. XII, fig. 1b); or there may be an intermediate stage between these extremes in which the septa are lonsdaleoid, but still present, although possibly discontinuous, in the dissepimentarium. The minor septa are equally variable and tend to be present, but discontinuous, when the major septa are complete, and absent, being replaced by herring bone dissepiments, when the major septa are only developed axially.

These changes are related to rejuvenation within the corallum. The cycle within an adult coral is illustrated by the series of transverse sections cut at 7.5 mm intervals of paratype C. In section c (Pl. XII, fig. 1b) there are 44 major septa which extend from the periphery nearly to the axis. They are thickened peripherally and axially and some are weakly lonsdaleoid or discontinuous. Minor septa are moderately well developed but are irregularly discontinuous, being replaced by herring bone dissepiments. Those that reach the tabularium are shorter than the major but weakly dilated. The diameter of the section is 30 mm.

In section d (Pl. XII, fig. 1c) the septa are long and slender lamellae withdrawn from the periphery with an off-peripheral and a weak axial zone of thickening. Minor septa are weak and discontinuous, being largely replaced by herring bone dissepiments. The diameter of the section is about 32 mm.

In section e (Pl. XII, fig. 1d) the major septa are shorter, weakly thickened and separated from the periphery by a zone of globose dissepiments. Minor septa are almost absent, being represented by herring bone dissepiments between the major septa.

Section a (Pl. XII, fig. 1a), although proximal to the other sections, presumably represents a late stage of the cycle. The septa are similar to those of section e, but are shorter peripherally and thicker axially. There is a wide dissepimental zone with sporadic septal crests and very short thickened major and minor septa attached to the coral wall over part of the circumference. The section is 35 mm in diameter.

The development of the septa in the growing coral is illustrated by sections of paratype B. Section a, 11.5 mm diameter (Pl. XI, fig. 2a) is cut as close to the proximal end as preservation allowed. Short thickened septa are developed on parts of the periphery and sporadic, isolated septa, within the dissepimentarium. The distinction between major and minor septa is obscure, probably both orders are present peripherally, but only majors are developed away from the periphery. Section b, 18 mm in diameter (Pl. XI, fig. 2b), was cut 10 mm from section a. Although incomplete it contains an estimated 34 major septa, which are slender, lonsdaleoid, and short axially; minor septa are virtually absent between them. Some thickened peripheral septa are present on one part of the circumference.

Each rhythm of rejuvenation appears to begin with a stage of long, more or less complete, slender septa which shorten inwards apically from the periphery and become increasingly thickened axially. There is a corresponding reduction in the minor septa. Each of these changes in the septa may be considered due to the development of partly overlapping "septal cones", which are sectioned at different levels and spaced some 15 to 20 mm apart.

The dissepimentarium is 10 to 14 mm wide — up to three quarters of the radius. It consists of many rows of small globose to elongate dissepiments that plunge proximally at a steep angle inwards. A fairly regular development every 15 to 20 mm of coral length of smaller close-set zones of dissepiments corresponds to the rhythmic rejuvenation discussed above. The tabularium is narrow and consists of small globose tabellae weakly depressed axially. A few larger tabellae occur and also zones of small globose tabellae that correspond to the similar zones of small dissepiments. One section (paratype A, Pl. X, fig. 2b) cuts a septum longitudinally that shows a weak but definite trabecular fan structure. The trabeculae make an angle of about 30 degrees inwards from vertical peripherally. Axially the angle increases to 45 degrees or more at the margins of the tabularium. Although rare, there may be some development of trabecular carinae near the periphery.

*Discussion.* Successive transverse sections of an *Atelophyllum* may be so different from one another that it is difficult to compare species whose full range of variation is not known. However, based on diameter, number of septa, and general morphology in longitudinal section, *Atelophyllum nebracis* differs from other described species of the genus. The type species, *A. emsti* Wedekind is larger, possesses a wider tabularium and larger, more inflate tabellae. *A. frankei* Wedekind is larger, has more major septa and a different gross morphology. *A. multiseptatum* Yoh is larger, has more complete minor septa and larger more irregular dissepiments. Yoh's other species (1937) bear no resemblance to *A. nebracis*.

*A. elongatum* Kettnerová has similar proportions and number of major septa but appears to differ in that there is no development of herring bone dissepiments between major septa when the minor septa are absent.

*A. fultum* (Hill) differs in having more septa and a wider tabularium, as does the species figured under this name by Lenz (1961) from the Hume Formation of the District of Mackenzie. Lenz's form is distinctive in possessing small lateral

dissepiments buttressing the major septa even where minor septa are developed.

Recently Stumm (1962) has described two species of *Atelophyllum* from the Traverse Group of Michigan. Together with Lenz's (1961) description of a form from the Mackenzie area, these constitute the only records of the genus on this continent. Stumm's *A. subcylindricum* differs in being smaller with fewer septa that appear to be always short and discontinuous, forming successive concentric zones in transverse section. His *A. magnum* is larger with more numerous and more strongly thickened septa, including well-developed minor septa.

The species is named from the Greek *nebrax*, a fawn or young deer, from nearby Fawn Lake.

## BRACHIOPODS AND OTHER FOSSILS OF THE DEVONIAN HORN PLATEAU FORMATION

by A. W. Norris

### Discussion of Faunas

Fossils from the Horn Plateau Formation other than corals described and illustrated in this paper include Pelecypoda — one species, Brachiopoda — twenty-three species, Trilobita — one species (*see* p. 31). Other forms poorly represented and not described or illustrated include *Styliolina* sp., a small planispiral gastropod, fenestellid-like bryozoa, a large pentamerid, and a finely costate *Spinatrypa*. Ten of the twenty-three brachiopods described are new species.

Dating and correlation are difficult because most of the fauna has not been observed in Devonian strata elsewhere. Only three species in the Horn Plateau Formation are identical or closely related to forms known from the Mackenzie region: *Leptagonia? rhomboidalis* (Wilckens), *Hypothyridina cameroni* Warren, and *Atrypa nasuta* n. sp. *Leptaena rhomboidalis* (Wilckens) has been reported by Williams (1922, p. 62) from Middle Devonian limestones outcropping near the site of Old Fort Wrigley on Mackenzie River; by Cairnes (1914, pp. 78, 80) from Middle Devonian limestone outcropping along the Yukon-Alaska boundary; and by Kindle (1908, pp. 327-329) from Devonian limestone outcropping opposite Old Rampart House, Porcupine River, Alaska. *Hypothyridina cameroni* Warren occurs in the Sulphur Point Formation, Presqu'île Point, south shore of Great Slave Lake; in the "Ramparts" Formation, west end of Carcajou anticline exposures, right bank of Mackenzie River; and in beds overlapping the west flank of the Presqu'île Formation, northwest of Sulphur Bay on the northwest side of Great Slave Lake. At the first two localities *H. cameroni* is closely associated with *Stringocephalus* sp., the guide fossil for the Givetian. At the last mentioned locality *H. cameroni* is associated with a fauna having strong affinities with the basal Waterways Formation of northeastern Alberta, and tentatively dated as early Upper Devonian (Frasnian). The third form, *Atrypa nasuta* n. sp., has commonly been identified with *Atrypa peshiensis* Grabau (1931, 1933), a Middle Devonian species from China, which *A. nasuta* n. sp. superficially resembles. Warren and Stelck (1950, p. 75) recorded "*Atrypa* cf. *pechiensis* Grabau" in the fauna of their *Rensselandia laevis* zone present in the lower part of the Ramparts limestone of the lower Mackenzie Valley; and two specimens were later illustrated by Warren and Stelck (1956, pl. 4, figs. 5-6; pl. 5, figs. 18-20) as part of the *Rensselandia laevis* fauna from "Ramparts limestone", Merganser Creek and Rond Lake respectively, District of Mackenzie.

Species of the Horn Plateau fauna with strong Middle Devonian affinities include *Pentamerella* sp., *?Sieberella newtonensis* Imbrie, *Cymostrophia* sp., *Pholidostrophia?* sp., *Longispina whittakeri* n. sp., *Atrypa nasuta* n. sp. (mentioned

above), *Ambocoelia* cf. *A. umbonata* (Conrad), *Athyris acqulionius* n. sp., *Trematospira* sp., and *Dechenella* (*Basidechenella*) sp. Both *Pentamerella* sp. and *?Sieberella newtonensis* Imbrie are similar to species in the Middle Devonian part of the Traverse Group of Michigan. The genus *Cymostrophia* in North America is known only from Middle Devonian rocks, and its presence in the Horn Plateau Formation is the first record of its occurrence in western Canada. *Pholidostrophia?* sp., *Longispina whittakeri* n. sp., and *Trematospira* sp. are representatives of genera that do not, as far as known, range into rocks younger than the Middle Devonian. *Ambocoelia* cf. *A. umbonata* (Conrad) appears to be similar to the type of this species which is typically confined to the Middle Devonian. *Athyris acqulionius* n. sp. is certainly more closely related to Middle Devonian species, particularly *Athyris spiriferoides* (Eaton), than to any known species from the Upper Devonian. *Dechenella* (*Basidechenella*) sp. compares closely with *Dechenella* (*Basidechenella*) *pulchra* Stumm (1953) present in the Middle Devonian Gravel Point Formation, Traverse Group, Michigan.

Species in the Horn Plateau Formation showing affinities to Upper Devonian forms include *Schizophoria fascicostella* n. sp., *Pentamerella sclavus* n. sp., *Hypothyridina cameroni* Warren (mentioned above), *Spinatrypa hornensis* n. sp., and *Eleutherokomma implana* n. sp. Of these, *S. fascicostella* n. sp., *S. hornensis* n. sp., and *E. implana* n. sp. seem to be more closely related to forms present in the basal Waterways Formation of northeastern Alberta than to known Middle Devonian forms of the Mackenzie region. The age of the Waterways Formation is tentatively dated as early Upper Devonian (see Norris, 1963). The first appearance of the genus *Eleutherokomma* in western Canada is in the basal Waterways and equivalent beds, but the new species of *Eleutherokomma* described here may be of slightly earlier age. *Pentamerella sclavus* n. sp. is similar to *Pentamerella aulax* Imbrie from the uppermost part of the Petoskey Formation, Michigan, dated as early Upper Devonian (Frasnian) age by Cooper, *et al.* (1942). From the known occurrences of *Hypothyridina cameroni* Warren this species appears to range from very late Middle Devonian (Givetian) to very early Upper Devonian (Frasnian) age.

In conclusion, the Horn Plateau Formation is a local reef development within either the uppermost part of the Horn River Formation or the lower part of the Fort Simpson Formation. The Horn Plateau fauna is clearly younger than *Leiorhynchus castanea* and associated fossils so characteristic of roughly the upper half of the Pine Point Formation in the Great Slave Lake region and which are completely lacking in the Horn Plateau Formation. Some of the Pine Point fauna including *Leiorhynchus castanea* (Meek) has been collected from the upper but not uppermost part of the Horn River Formation. Two species, *Hypothyridina cameroni* Warren and *Atrypa nasuta* n. sp. occur in beds (Sulphur Point and Kee Scarp Formations) elsewhere in the Mackenzie basin closely associated with *Stringocephalus* sp. and thus definitely dated as late Middle Devonian (Givetian) age. Three genera in the Horn Plateau Formation comprising *Pholidostrophia*, *Longispina*, and *Trematospira*, have not been recorded elsewhere in rocks younger

than the Middle Devonian. Three species comprising *Schizophoria fascicostella* n. sp., *Spinatrypa hornensis* n. sp., and *Eleutherokomma implana* n. sp. show affinity but not identity with forms present in the early Upper Devonian basal Waterways Formation of northeastern Alberta. The Horn Plateau Formation thus is presumed to be broadly equivalent to or more likely younger than the Sulphur Point, Presqu'île, and Kee Scarp Formations. Its relationship to the Slave Point Formation of the Great Slave Lake area is not known because the two formations are widely separated and are faunally and lithologically distinct. The presence of forms having affinity but not identity with basal Waterways species is taken to indicate that the Horn Plateau is slightly older than the basal Waterways Formation. On stratigraphic and faunal evidence the Horn Plateau Formation is therefore tentatively dated as very late Middle Devonian (Givetian) and slightly older than the basal Waterways Formation. The age of the Waterways Formation is still unsettled, but is commonly accepted as marking the base of the early Upper Devonian in western Canada.

Table of Horn Plateau Formation Fossils Other Than Corals  
Showing Distribution and Relative Abundance

	Lower thin-bedded unit	Upper thick-bedded unit
PELECYPODA		
1. <i>Conocardium</i> sp. ....	r	
BRACHIOPODA		
Dalmanellacea		
2. <i>Schizophoria fascicostella</i> n. sp. ....	r	r
Pentameracea		
3. <i>Gypidula?</i> spp. ....		r
4. <i>Pentamerella</i> sp. ....	r?	
5. <i>Pentamerella sclavus</i> n. sp. ....		r
6. <i>?Sieberella newtonensis</i> Imbrie ....	r?	
Strophomenacea		
7. <i>Cymostrophia</i> sp. ....		r
8. <i>Leptagonia? rhomboidalis</i> (Wilckens) ....	c	
9. <i>Pholidostrophia?</i> sp. ....	r	
Orthotetacea		
10. <i>Schuchertella</i> sp. ....	r	
Chonetacea		
11. <i>Longispina whittakeri</i> n. sp. ....	r	r
Productacea		
12. <i>Spinulicosta</i> sp. ....	r	
Rhynchonellacea		
13. <i>Leiorhynchus? matonabbee</i> n. sp. ....	r	
14. <i>Hypothyridina cameroni</i> Warren ....	r	
Atrypacea		
15. <i>Atrypa nasuta</i> n. sp. ....		a
16. <i>Atrypa nasuta hearnei</i> n. sp. n. subsp. ....		r
17. <i>Spinatrypa hornensis</i> n. sp. ....	a	r
Spiriferacea		
18. <i>Ambocoelia</i> cf. <i>A. umbonata</i> (Conrad) ....	e	
19. <i>Emanuelia?</i> sp. ....	c	
20. <i>Eleutherokomma implana</i> n. sp. ....	c	



	Lower thin-bedded unit	Upper thick-bedded unit
Rostrospiracea		
21. <i>Athyris aquilonius</i> n. sp. ....	a	
Punctospiracea		
22. <i>Trematospira</i> sp. ....	r?	
Terebratulacea		
23. <i>Cranaena?</i> sp. ....	r?	
24. <i>Cranaena? cryptonelloides</i> n. sp. ....	c	
TRILOBITA		
25. <i>Dechenella (Basidechenella)</i> sp. ....		r

? — stratigraphic position uncertain within Horn Plateau Formation exposures  
 r — rare  
 c — common  
 a — abundant

## Systematic Descriptions

### PELECYPODA

#### Genus *Conocardium* Bronn, 1834

Type species: *Cardium hibernicum* Sowerby, 1812.

#### *Conocardium* sp.

Plate XIII, figures 1a-c

*Material and occurrence.* GSC No. 16044, an incomplete specimen from the lower thin-bedded unit of the Horn Plateau Formation, GSC loc. 35251; collected by B. G. Craig, 1957.

*Dimensions* (in mm).

Length — incomplete .....	5
Width .....	4.7
Height .....	5.6

*Description.* Shell very small for the genus, subtrigonal in lateral outline, longer than wide with body of valves full and swollen. Anterior part of shell missing. Posterior margin obliquely truncated. Beaks presumably posterior. Posterior slopes concave, meeting in the middle to form a sharp ridge.

Body of shell marked by low, flat plicae radiating from the beak and separated by shallow furrows of slightly greater width. Anteriorly the plicae become coarser to the line where the anterior part of the shell passes from the body to the nasute anterior (part of which is missing). There the ornament abruptly changes to narrower plicae separated by still narrower angular furrows. On concave

posterior slope the plicae are more angular and simulate a stair-like pattern. Entire shell covered by closely spaced concentric growth lines which are most conspicuous over the posterior part of shell, presumably because of better preservation on concave surfaces.

*Discussion.* In lateral shape outline this form somewhat resembles *Conocardium cuneus* var. *nasutum* Hall (1885, p. 410, pl. 67, figs. 12-20) from the Schoharie Grit of New York, but appears to differ in having much coarser and relatively straighter plicae over the body of the shell, as well as being considerably smaller in size. From *Conocardium normale* Hall (1885, p. 411, pl. 68, figs. 17-19) from the Hamilton Group of Cumberland, Maryland, the Horn Plateau form differs in being considerably smaller, having a differently shaped ventral margin, and probably a much shorter nasute anterior, as well as other shape differences. It may be a new species but is not named formally here because of limited material.

### BRACHIOPODA

Genus *Schizophoria* King, 1850

Type species: *Conchylolithus Anomites resupinatus* Martin, 1809.

*Schizophoria fascicostella* n. sp.

Plate XIII, figures 2a-4e

*Material.* Holotype, GSC No. 16047, a complete adult individual; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

Paratypes: GSC No. 16123, a very young individual, not illustrated, from GSC loc. 31001; GSC No. 16045, a pedicle valve embedded in matrix along with *Cymostrophia* sp., from GSC loc. 31000; both the above paratypes collected by A. W. Norris, 1957; GSC No. 16046, pedicle valve of a young individual.

*Dimensions* (in mm).

GSC No. ....	16045	16046	16123	16047
Length of pv .....	9.1	10.2	5.3	18.7
Length of bv .....	—	—	4.8	18
Width .....	(11.7)	12	6.9	22
Depth of shell .....	—	—	2.6	12.5
Hinge line length .....	(8.6)	7.2	4.7	13.8
Depth of anterior plica .....	nil	nil	slightly curved	(2)

*Description.* Shell medium sized, subelliptical, wider than long, with greatest width about mid-length; lateral commissure gently inclined anteriorly in ventral direction; anterior commissure broadly rounded, varies from weakly sulcate to rectimarginate in young stages, to weakly uniplicate in adult stage.

Pedicle valve moderately convex, highest at about one-quarter length from tip of beak, its surface sloping rapidly from the umbo to the cardinal margins and

gently and evenly to the lateral margins; a broad indistinct sinus originates immediately anterior to mid-length and widens and deepens towards the front where it attains a width about half that of valve. Umbo low, broadly convex from side to side. Beak moderately large, pointed, a little incurving, elevated, and extended slightly beyond that of the opposite valve. Interarea high, broadly triangular, sharply defined at the sides, very gently concave for about three quarters of height, abruptly concave under beak, marked by irregularly spaced transverse ridges. Delthyrium about one half as wide as high.

Brachial valve more convex than pedicle valve, highest at about one third length from beak, umbo broadly convex, concave towards cardinal and posterolateral margins, flattened mesially, lateral slopes relatively steep and very gently convex; fold broad and indistinct. Beak broad and low, pointed, moderately curved, and inclined towards opposite beak. Interarea broad, very low, very sharply defined laterally, marked by transverse ridges. Notothyrium broadly triangular, wider than high.

Valves ornamented by fine numerous radiating costellae of two sizes, the larger costellae are separated by from two to six finer costellae at lateral and anterior margins. This fascicostellate ornament is more conspicuous on the posterior part of the pedicle valve and is much less distinct or even absent on the brachial valve. Concentric growth lines are weak, widely and irregularly spaced but more common towards front of shells.

*Discussion.* The main distinguishing features of *Schizophoria fascicostella* are its fascicostellate ornament, its transverse elliptical outline, and relatively high pedicle interarea. The same ornament has been noted on *Schizophoria* from the Peace Point Member of the Waterways Formation outcropping at Gypsum Cliffs, and from the Firebag Member of the Waterways Formation outcropping on the upper Clearwater and lower Athabasca Rivers of northeastern Alberta. These forms approximate the same shape outline as *Schizophoria fascicostella* but attain a much larger size. They differ also in generally having a lower pedicle interarea, as well as other shape differences which may or may not be of specific significance.

Some specimens in GSC collections labelled *Schizophoria iowensis?* Hall from the Snyder Creek Shale, Craghead Creek, Missouri, display the fasciculate ornament and resemble *Schizophoria lata* Stainbrook in shape. The latter form occurs in the *waterlooensis* zone of the Cedar Valley Limestone of Iowa.

The trivial name is from the Latin *fascis*, bundle, packet, sheaf; *costa*, rib; *ella*, little.

*Occurrence.* Holotype, GSC No. 16047, from lower part of Horn Plateau Formation exposures.

Paratypes: GSC No. 16123, from lower thin-bedded unit; GSC No. 16045, from basal beds of upper thick-bedded unit; GSC No. 16046, precise horizon not recorded.

*Schizophoria fascicostella* is rare in the Horn Plateau Formation but appears to be most abundant in the lower thin-bedded unit of the exposures.

Genus *Gypidula* Hall, 1867Type species: *Pentamerus occidentalis* Hall, 1858.*Gypidula?* spp.

Plate XIII, figures 5a-7

*Material.* GSC No. 16048, an incomplete adult specimen embedded in coral matrix, from GSC loc. 31000, collected by A. W. Norris, 1957; GSC No. 16049, an incomplete adult specimen; GSC No. 16050, a pedicle valve of a large individual; two latter specimens collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions* (in mm).

GSC No. ....	16048	16049	16050
Length of pv .....	—	20.5	24
Length of bv .....	—	19.1	—
Width .....	—	(18)	21.3
Depth .....	—	14.6	—
Hinge line length .....	(15.6)	—	(16)

*Description.* Shell of medium size, subheptagonal, longer than wide with greatest width three-quarters length from pedicle beak; lateral commissures nearly straight, sloping gently anteriorly towards pedicle valve; anterior commissure broadly and very weakly sulcate.

Pedicle valve moderately to strongly and fairly evenly convex, highest a little posterior to mid-length; umbo broadly convex; beak tapering to a rounded end, erect; interarea large, ill-defined laterally by rounded beak ridges, interarea bordering delthyrium narrow, fairly high, and concavely arched; delthyrium broadly triangular, presumably open. Fold broad, weak, confined to anterior median quarter or less of valve.

On partly abraded specimen (GSC No. 16050) a strong median septum is evident extending anteriorly from beak one third or more length of valve. Irregular rugose markings present on posterior interior part of same specimen. Fine irregular markings present on abraded anterior part of pedicle valve of GSC No. 16049.

Brachial valve moderately convex accounting for slightly less than half total depth of shell; greatest convexity in umbonal region. Beak moderately large, pointed, strongly inturned. Sulcus very weak, shallow, barely evident on anterior median part of valve.

Surface of both valves smooth except for weak irregularly spaced growth lines and very weak broad costae on anterior parts of valves.

*Discussion.* The above description is based on three incomplete individuals which are inadequate for comparison with forms occurring elsewhere. Assignment to the

genus *Gypidula* is questionable and is based mainly on external shape, especially on the presence of a pedicle fold and weak brachial sulcus. The relatively large interarea on specimen GSC No. 16048 is unusual as this feature is generally obsolete on most pentamerids. This incomplete specimen may actually belong with a form described below as *Pentamerella* sp. More than one species or even genus may be represented.

*Occurrence.* Specimen GSC No. 16048 is from the basal part of the upper thick-bedded unit of the Horn Plateau Formation exposures. Specimens GSC Nos. 16049 and 16050 are from the same general locality and presumably from the same stratigraphic interval.

Genus *Pentamerella* Hall, 1867

Type species: *Atrypa arata* Conrad, 1841.

*Pentamerella* sp.

Plate XIII, figures 8a-e

*Material.* GSC No. 16051, a nearly complete specimen; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions* (in mm).

GSC No. ....	16051
Length of pv .....	18.3
Length of bv .....	14.5
Width .....	15.4
Depth .....	10.6
Hinge line length .....	12.4
Hinge angle (in degrees) .....	124

*Description.* Size moderate for the genus, longer than wide with greatest width at about two-thirds length forward from beak, elongate subheptagonal, unequally biconvex in lateral profile, median part of front margin slightly protruding; anterior commissure weakly and broadly uniplicate.

Pedicle valve moderately convex, highest at one-third length forward from beak, strongly arched over umbo, concave near anterior median margin, strongly and smoothly arched transversely. Umbo very large, strongly arched; beak blunt, erect, slightly distorted to one side.

Interior unknown, except for median septum evident on abraded beak.

Brachial valve subelliptical, moderately convex but less so than pedicle valve, highest immediately anterior to umbo; beak small, pointed, nearly straight, in contact with opposite valve; a broad, slightly raised fold on anterior median part of valve.

On abraded posterior part of valve can be seen two converging plates of

spondylium nearly meeting along mid-line of floor of valve which extend for about one-half length of valve from beak.

Shell mainly smooth; weak, closely and irregularly spaced concentric growth lines evident on anterior half of valves; vague barely visible broadly rounded costae developed along lateral and anterior margins, numbering five on the lateral flanks and three on tongue of pedicle valve, and four on lateral flanks and three on fold of brachial valve.

*Discussion.* In general shape, especially the protruding anterior margin, the Horn Plateau form resembles *Pentamerella lingua* Imbrie (1959, p. 370, pl. 52, figs. 6-10) from the Middle Devonian Ferron Point Shale, Traverse Group, Michigan. The Horn Plateau form differs by having less well developed and finer costae, by a proportionately shorter brachial valve, as well as by other shape differences.

*Occurrence.* It is represented by a single specimen, presumably from the lower thin-bedded unit of the Horn Plateau Formation exposures.

*Pentamerella sclavus* n. sp.

Plate XIII, figures 9a-13

*Material.* Holotype, GSC No. 16053, a nearly complete specimen.

Paratypes: GSC No. 16052, a nearly complete specimen; GSC No. 16054, a nearly complete pedicle valve embedded in matrix; GSC No. 16055, a complete pedicle valve of a large broad individual with matrix filling interior; GSC No. 16056, plaster casts and anterior part of a serially sectioned brachial valve of a large broad individual partly embedded in matrix; GSC No. 16124, plaster casts and anterior part of serially sectioned pedicle valve of a small adult individual, not illustrated.

All types from GSC loc. 31000; collected by A. W. Norris, 1957.

*Dimensions* (in mm).

GSC No. ....	16052	16053	16054	16055	16056	16124
Length of pv .....	8.8	9.4	10.3	9.9	—	9.6
Length of bv .....	7.4	8.4	—	—	8.1	—
Width .....	8.5	9.9	10.6	11.5	10.7	(8)
Depth of shell .....	6.9	7.2	—	—	—	—
Hinge line length .....	4.7	6.5	7.6	6.8	—	—

*Description.* Shell small, width slightly greater than length of pedicle valve; hinge narrow, cardinal extremities rounded; lateral margins straight to slightly convex, sloping in direction of pedicle valve; anterior margin rounded, uniplicate.

Pedicle valve strongly convex in lateral profile, highest about mid-length, anterior flattened. Anterior profile strongly convex. Sulcus originates one-quarter

to one-third of length from beak, relatively broad, deepens anteriorly but never very deep. Sulcus contains two to three costae and is bounded on each side by costae stronger than those on remainder of flanks. Tongue is broad, angular, and extended beyond anterior margin of flanks. Flanks strongly convex, sloping steeply to extremities and containing five(?) to eight costae. Interarea small, more or less flat at and near hinge line, curved towards beak; delthyrium relatively large, about as wide as long; beak gently incurved.

Pedicle interior with strong median septum which extends some distance anteriorly.

Brachial valve in lateral profile moderately convex, with maximum curvature located over umbo; in anterior profile strongly convex, nearly 'inverted V-shaped'. Fold originates at beak, expanding slowly on posterior half and then rapidly on anterior half of valve. Fold with three relatively strong costae, sharply defined laterally by relatively deep grooves; flanks nearly flat to gently convex, containing from five to six costae. Interarea very short, broad, extending length of hinge line, nearly flat, forming a platform nearly at a right angle to the interarea of opposite valve. A broad, short notothyrium possibly present.

Brachial interior with irregular stout septal plates which posteriorly are relatively widely spaced and ventrally have thickened extremities. Anteriorly the plates become thinner and converge dorsally to join a low stout median septum.

Surface coarsely and sharply costate. Very faint closely spaced concentric ornamentation, as well as conspicuous coarse growth lamellae especially on anterior parts of some individuals. Shell material thick.

*Discussion.* The presence of a large pedicle interarea suggests a similarity to some spiriferids and the coarse sharp costae are similar to some platystrophids. However, a fold on the dorsal valve opposite a sulcus on the pedicle valve and septal plates that unite with a low septum to form a cruralium, are characters suggestive of the genus *Pentamerella*. *P. sclavus* differs from some species of *Pentamerella* by having a longer septum in the pedicle valve.

In sharp coarse costation and relatively large pedicle interarea *P. sclavus* is somewhat similar to *Gypidula osturalica* Bazonova, and others (1959, pp. 22-23, pl. 4, figs. 1-2) from beds of Middle Devonian (Eifelian) age, Ivdel area, Russia. *P. sclavus* differs in being relatively thicker, smaller at maturity, and by having a better defined fold and sulcus.

*Pentamerella aulax* Imbrie (1959, p. 373, pl. 51, figs. 11-17) from the uppermost Petoskey Formation of Michigan, is the most similar described species, differing in being larger, more finely costate, and lacking a brachial interarea.

Trivial name of the new species is from the Latin *sclavus*, slave, one taken in war, after Great Slave Lake.

*Occurrence.* *Pentamerella sclavus* is known only from the basal part of the upper thick-bedded unit of the Horn Plateau Formation exposures where it is relatively rare.

Genus *Sieberella* Oehlert, 1887

Type species: *Pentamerus sieberi* Von Buch in Barrande, 1847.

?*Sieberella newtonensis* Imbrie

Plate XIII, figures 14a-c

1959. [?] *Sieberella newtonensis* Imbrie; Bull. Amer. Mus. Nat. Hist., vol. 116, art. 4, pp. 369-370, pl. 51, figs. 1-5.

*Material.* Hypotype, GSC No. 16057, a gerontic specimen; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions* (in mm).

GSC No. ....	16057
Length of pv .....	9.8
Length of bv .....	9.5
Width .....	9.3
Depth .....	7.9
Hinge line length .....	(6.5)
Hinge angle (in degrees) .....	(115)

*Description.* Shell small, gibbose, subglobular or subheptagonal, slightly longer than wide, widest at about one-half length of shell, unequally biconvex in lateral profile; lateral commissure gently flexed dorsally; anterior commissure vaguely sulcate.

Pedicle valve strongly convex with greatest convexity over umbo; beak bluntly pointed, erect, projecting a little beyond brachial beak; anterior profile strongly convex, curvature greatest over mid-line; anterior fold faint or absent; interarea low, poorly defined.

Brachial valve moderately and fairly evenly convex; sulcus not developed, instead there is a suggestion of a faint fold; beak small, pointed, suberect; interarea presumably low.

Shell substance thick; surface smooth except for widely and irregularly spaced growth lines.

*Discussion.* This form is questionably referred to *Sieberella newtonensis* Imbrie (1959) solely on the basis of external shape. Both the holotype from the Middle Devonian of Michigan and the form from the Horn Plateau Formation are gerontic specimens. The latter form is smaller in size. Both appear to be weakly costate along the anterior margins.

*Occurrence.* This form is represented by a single specimen, from the Horn Plateau Formation exposures. It has not been noted previously in Devonian rocks of the Mackenzie region.

*Sieberella newtonensis* Imbrie (1959) occurs in the Middle Devonian Newton Creek Limestone, Traverse Group, Michigan.



Genus *Cymostrophia* Caster, 1939

Type species: *Leptaena stephani* Barrande, 1879.

*Cymostrophia* sp.

Plate XIII, figures 15a-16b

*Material.* GSC No. 16058, an impression showing part of the exterior of a brachial valve and part of the interarea of the opposite valve; GSC No. 16059, a fragment showing the partly abraded exterior and interior of part of the pedicle and brachial valves. Specimens from GSC loc. 31000; collected by A. W. Norris, 1957.

*Dimensions* (in mm).

GSC No. ....	16058
Length of pv .....	(5.7)
Length of bv .....	(5.2)
Width .....	(8.8)
Depth .....	—
Hinge line length .....	(8.8)

*Description.* Shell very small, concavo-convex, subquadrate outline, wider than long with greatest width along hinge line, slightly mucronate cardinal extremities.

Pedicle valve weakly convex, highest immediately anterior to umbo; interarea low, orthocone, delthyrium broad, with a tapering ridge along mid-line; part of hinge line shows fine denticulation.

Pedicle interior with what appears to be a short muscle field consisting of two spatula-shaped muscle scars radiating antero-laterally from rostral region and extending about one-third or less radius of valve, bounded medianly and laterally by slightly raised sharp ridges. A small indistinct semi-circular muscle field with a faint ridge along the mid-line separates the posterior ends of the muscle scars.

Brachial valve very weakly concave, a narrow ridge along mid-line over umbo, bounded by shallow linear depressions on each side; interarea low, broad, and nearly catacline.

Brachial interior with large megastrophid-like disjunct cardinal process with attachment faces directed ventro-posteriorly. Cardinal process is buttressed laterally by two broadly rounded crescent-shaped ridges which mark the posterior edges of the muscle area. Conspicuous also are two closely spaced subparallel roughened ridges straddling the mid-line which diverge slightly anteriorly for about one-third radius of valve. A weak median septum or myophragm is apparent between and slightly beyond the anterior ends of the two ridges.

Surface of the pedicle valve is marked by fine widely spaced radiating primary costae bordered on each side by trenches of less or equal width. Similar but finer secondary costae are present midway between the primaries. Exfoliated exterior

valve surface has a pitted appearance. Rugae on this valve absent or only weakly developed.

Surface of brachial valve marked by widely spaced primary, secondary and tertiary costae of similar character to those on pedicle valve. Costae increase anteriorly by implanation midway between adjacent costae. Also present on this valve are coarse, wavy, interrupted concentric rugae which abut the primary and secondary costae but do not cross them. Between adjacent costae, the rugae are roughly V-shaped with apex of each 'V' pointing roughly towards the beak. Exfoliated exterior parts of valve marked by closely spaced pits.

*Discussion.* The genus *Cymostrophia* was erected by Caster (1939, pp. 39-40) to include megastrophid-like forms with a surface ornamentation of fine parvicostellae and widely spaced and strong primary costae, and with a strong development of concentric interrupted rugae. Williams (1953, pp. 39-40) has pointed out that the few known interiors of species assigned to this genus differ so widely that it is impossible to generalize on cymostrophid internal characters. The internal features of the ventral valve of the Horn Plateau form certainly agree in general outline with those of *Cymostrophia stephani* (Barrande) the type species of the genus as illustrated by Williams (1953, pl. 9, fig. 5). Dorsal interiors of the genotype are unknown (op. cit. p. 39).

Of the three species of *Cymostrophia* from South America described by Caster (1939), the Horn Plateau form is closest to *C. schucherti* but certainly specifically distinct.

A much larger undescribed species of *Cymostrophia* occurs in the Devonian of the Canadian Arctic Archipelago but none of the specimens in Survey collections from this area shows interiors for comparison.

Two specimens of *Cymostrophia* sp. recently illustrated by Fagerstrom (1961, p. 20, pl. 8, figs. 7, 8) from the Middle Devonian Formosa reef of southwestern Ontario, differ from the Horn Plateau form by having an extended, mucronate hinge line.

The *Cymostrophia* sp. from Horn Plateau is probably new, but the material is inadequate for a complete description or formal naming.

*Occurrence.* This is a rare form known only from the basal part of the upper thick-bedded unit of the Horn Plateau Formation exposures. This is the first record of the occurrence of the genus *Cymostrophia* in Devonian rocks of western Canada.

#### Genus *Leptagonia* McCoy, 1844

Type species: *Producta analoga* Phillips, 1836.

#### *Leptagonia? rhomboidalis* (Wilckens)

Plate XIII, figures 17a-c; Plate XIV, figures 1a-4b

*Material.* Hypotypes: GSC Nos. 16060 and 16061, incomplete adult specimens; 16062, a nearly complete young adult specimen; 16063, a complete young specimen;

16064, a nearly complete pedicle valve of an adult individual; 16065, a large adult individual embedded in matrix, not illustrated. All from GSC loc. 31001; collected by A. W. Norris, 1957.

Nine other incomplete specimens collected by A. W. Norris, 1957; and four incomplete specimens collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57); all from the same locality.

*Dimensions* (in mm).

GSC No. ....	16060	16061	16062	16063	16064	16065
Length of pv .....	(20.2)	—	(20.3)	18.4	22.3	(23)
Length of bv .....	20.2	—	(20.3)	17.4	—	—
Width .....	31.6	(31.5)	26.8	19.8	26.5	(34)
Depth of shell .....	7.5	(8)	3.9	3	—	—
Hinge line length .....	—	—	(17.6)	(12.4)	(17.8)	(35.2)
Hinge angle (in degrees) .....	—	—	174	177	—	179

*Description.* Shell attains moderate size; roughly semicircular, plano-convex in lateral profile. Hinge line about equal to or less than maximum width of shell; cardinal extremities probably only slightly auriculate in adult growth stages.

Pedicle valve gently to strongly convex over umbo, flattening laterally and anteriorly and reversing curvature to become concave, in mature individuals abruptly geniculate near lateral and anterior margins; beak straight, beak ridges sharp; foramen epithyrid, oval shaped, filled by a calcite plug; interarea wide and low, highest immediately beneath the beak, striated parallel to hinge line; delthyrium relatively large, about four-fifths covered by a pseudodeltidium which is longitudinally rounded and rises above the relatively flat interarea.

Brachial valve nearly flat or slightly concave in lateral profile, with a broad very gentle depression along mid-line over posterior part of valve. Interarea broad but low, about one-half as high as that of opposite valve.

Posterior region of both valves of shell up to line of geniculation covered with medium to fine concentric rugae which are absent beyond this line. Rugae slope steeply posteriorly, less steeply anteriorly. Both valves covered with fine closely spaced radiating costae which become less conspicuous on margin of shell beyond line of geniculation. Both valves coarsely pitted (pseudopunctate) with pits arranged more or less in radial rows; they appear to be coarser towards lateral and anterior margins of shell.

Interior of pedicle valve: Dental lamellae in line with the diverging sides of the delthyrium, sloping slightly inward towards one another, extending a short distance posteriorly of the hinge line, and forming margin of muscle field. Muscle field slightly depressed, roughly oval shaped, extending from one-quarter to one-third length of shell and bounded on lateral and anterior sides by a slightly raised relatively large area of shell material dotted with pseudopunctae. A narrow depression is present along and near lateral and anterior edges of shell serving as a receptor for geniculation of dorsal valve.

Interior of brachial valve: Part of the brachial interior can be seen on an

abraded immature specimen (hypotype 16063) illustrated by Plate XIV, figure 3b, which shows part of the cardinal process and some of the adjacent structures.

*Discussion.* Campbell (1957, pp. 40-41) has suggested that the genus *Leptagonia* McCoy be applied to those species that are similar in form and outline to *Leptaena* Dalman, but which differ from that genus in their larger size, the presence of a high marginal ridge on the interior of the brachial valve, and the presence of a well-developed spondylium and adductor platform in the pedicle valve. According to Campbell, the genus *Leptagonia* ranges from Lower Devonian to Lower Carboniferous. The leptaenids from the Horn Plateau Formation seem to agree in most features considered diagnostic by Campbell with *Leptagonia* but differ in having a shallow rather than deep cuspidate muscle attachment in the pedicle valve. For this reason and the lack of material showing more internal structures for a better comparison, the name *Leptagonia* is applied with reservation to the Horn Plateau form. Citations of *Leptaena* in faunal lists for the Devonian of western Canada and elsewhere could actually refer to either genus.

The Horn Plateau form compares rather closely with *Leptaena* "*rhomboidalis*" illustrated by Cooper and Williams (1935, pl. 57, fig. 22) from the Tully Formation of New York.

*Occurrence.* *Leptagonia? rhomboidalis* is relatively abundant in the lower thin-bedded unit of the Horn Plateau Formation exposures.

In the New York standard Devonian section the genus *Leptaena* or *Leptagonia?* is common in the Onondaga Limestone, absent from the Hamilton, rare in the Tully, and abundant in the Ostselic Member of the Ithaca Formation (Cooper and Williams, 1935, p. 823). *Leptaena* "*rhomboidalis*" is one of four exotic species listed by Cooper and Williams occurring in the Tully Formation of New York.

The genus *Leptaena* or *Leptagonia?* is certainly not abundant in the Devonian of western Canada. From the Mackenzie region, Williams (1922, p. 62) reported "*Leptaena rhomboidalis* (Wilckens)" along with other fossils from Middle Devonian limestones outcropping on the islands and banks of Mackenzie River near the site of Old Fort Wrigley. It has been recorded also by Cairnes (1914, pp. 78, 80) from Middle Devonian limestone beds outcropping along the Yukon-Alaska boundary; and by Kindle (1908, pp. 327-329) from the Devonian Salmontrout Limestone outcropping opposite Old Rampart House, Porcupine River, Alaska. The genus has not been found in the Devonian of the Canadian Arctic Archipelago.

#### Genus *Pholidostrophia* Hall and Clarke, 1892

Type species: *Strophomena (Strophodonta) nacrea* Hall, 1857.

*Pholidostrophia?* sp.

Plate XIV, figures 12a, b

*Material.* GSC No. 16073, impression of part of brachial valve and interarea of pedicle valve with shell fragments of both valves adhering to impression, from GSC loc. 31001; collected by A. W. Norris, 1957.

Dimensions (in mm).

GSC No. ....	16073
Length of pv .....	9.5
Width at mid-length .....	(13.4)
Hinge line length .....	(13.4)

*Description.* Shell small, subelliptical, considerably wider than long with greatest width presumably along hinge line, lateral margins tapering continuously forward from the cardinal extremities. Lateral profile gently and evenly concavo-convex.

Pedicle valve highest immediately posterior to the umbo; interarea low and broad. Brachial valve concave, with approximately same lateral profile as opposite convex valve; slightly swollen over umbo.

Shell material very thin, finely pseudopunctate; smooth except for low irregular, interrupted concentric wrinkles presenting a scale-like appearance.

*Discussion.* Assignment to the genus *Pholidostrophia* is based solely on exterior characters. In some features it resembles *Pholidostrophia gracilis gracilis* Imbrie (1959, pl. 61, figs. 1-10) but differs in lateral profile and smaller size. The material is insufficient for formal designation.

*Occurrence.* The genus *Pholidostrophia* is represented by a single incomplete specimen from the lower thin-bedded unit of the Horn Plateau Formation exposures. This genus is certainly not common in the Devonian of the Mackenzie region. Kindle (1908, pp. 328-329) reported "*Pholidostrophia* cf. *iowensis* (Owen)" from Devonian limestones outcropping opposite the site of Old Rampart House, on Porcupine River, Alaska.

Genus *Schuchertella* Girty, 1904

Type species: *Streptorhynchus lens* White, 1862.

*Schuchertella* sp.

Plate XIV, figures 5a-6d

*Material.* GSC No. 16066, an incomplete pedicle valve of a large adult individual; GSC No. 16067, an incomplete specimen of a young adult individual; both from GSC loc. 31001; collected by A. W. Norris, 1957.

Material includes four other incomplete, poorly preserved specimens from the same locality.

Dimensions (in mm).

GSC No. ....	16066	16067
Length of pv .....	(25.6)	(12.5+)
Length of bv .....	—	(12.5+)
Width .....	(35.6)	—
Depth .....	—	4.3

*Description.* Shell of medium size for the genus, variable in shape, plano-convex to unequally biconvex, roughly semi-elliptical, with hinge line a little less than breadth; anterior commissure slightly and irregularly sinuous.

Pedicle valve weakly to moderately convex, highest in umbonal region, gently arched transversely; surface of more mature individuals deformed by irregular concentric wrinkles and depressions. Umbo strong, may or may not protrude beyond hinge line, distorted in some individuals. Beak pointed or bluntly rounded, projecting, generally twisted. Interarea of moderate height, decreasing rapidly towards extremities, nearly flat, variable orientation to plane of valve. Deltidium high, moderately broad at base, strongly convex, transversely striated, irregular median depression dividing deltidium into two halves.

Brachial valve thin, flat or slightly to moderately convex and irregular. Umbonal region slightly to moderately convex; beak minute.

Exterior of both valves marked by numerous fine but relatively widely spaced radial costae. Some specimens show costae of unequal strength. Costae increase by intercalation, are angular to rounded, and separated by flat spaces considerably wider than the costae. Intercalated costae are generally finer than those originating on posterior part of shell. Where shell is well preserved numerous closely spaced concentric striae can be seen crossing the costae.

*Discussion.* In exterior shape and ornament this form bears some resemblance to *Schuchertella arctostriata* (Hall) of the New York Middle Devonian.

It differs from *Schuchertella adoceta* Crickmay (1960, p. 18, pl. 10, figs. 10-17; pl. 11, fig. 1), an early Middle Devonian species from the lower Mackenzie Basin, by attaining a much larger size and having finer more closely spaced costae.

*Occurrence.* This form is relatively rare in the lower thin-bedded unit of the Horn Plateau Formation exposures.

#### Genus *Longispina* Cooper, 1942

Type species: *Chonetes emmetensis* Winchell, 1866.

#### *Longispina whittakeri* n. sp.

Plate XIV, figures 7a-9

*Material.* Holotype, GSC No. 16069, an incomplete specimen of a large individual embedded in matrix, from GSC loc. 31001.

Paratypes: GSC No. 16068, an incomplete specimen of a young adult individual, from GSC loc. 31001; GSC No. 16070, a nearly complete pedicle valve of a young individual embedded in matrix, from GSC loc. 31000.

All specimens collected by A. W. Norris, 1957.

*Dimensions* (in mm).

GSC No. ....	16068	16069	16070
Length of pv .....	8.2	9.8	(7.2)
Length of bv .....	7.4	—	—
Width at mid-length .....	—	(11.8)	8.5
Depth .....	(1)	—	—
Hinge line length .....	—	(12.6)	(6)

*Description.* Shell small to medium sized, subquadrate to subsemicircular, wider than long with greatest width at hinge line; cardinal extremities acute, sides sloping more or less strongly towards the middle and gently convex; anterior margin broadly rounded, rectimarginate.

Pedicle valve moderately convex in lateral profile with maximum convexity located in posterior third; anterior profile with maximum convexity along mid-line, lateral slopes moderately steep, flatten towards lateral margins. Umbonal region narrowly inflated and expanding rapidly anteriorly into a moderately swollen median area having a moderately steep flattened anterior slope. Posterior lateral slopes steep and concave in profile. Beak incurved. Interarea low but considerably higher than that of brachial valve, orthocline, with irregularly spaced transverse markings. Delthyrium relatively large, open. Eight (?) or nine (?) small posterolaterally directed spines along posterior margin; and a large laterally directed spine near cardinal angle on each side of beak.

Brachial valve deeply concave in the median area and in the umbonal region, concavity lessening in the anterolateral areas and becoming shallow to flattened in the posterolateral areas and cardinal extremities. Interarea very low.

Brachial interior with relatively large posteriorly directed cardinal process filling delthyrial cavity of opposite valve.

Surface coarsely costate, costae broadly rounded; three occurring in a space of 2 mm across mid-line at 5 mm from beak; they appear to increase mainly by bifurcation. Concentric growth lines closely spaced. Very fine radial filae can be seen in places. Shell substance pseudopunctate.

*Discussion.* Of known species of *Longispina* the Horn Plateau form most closely resembles *L. leionanus* Imbrie (1959, p. 398, pl. 64, figs. 6-10; pl. 65, figs. 5, 6) from the Lower Bell Shale, Traverse Group, Michigan. It differs in having coarser costae and more spines on each side of beak of pedicle valve.

Trivial name of the new species is after the late E. J. Whittaker of the Geological Survey of Canada, who traversed Horn River in 1921.

*Occurrence.* This form is rare in the Horn Plateau Formation being represented by only three specimens. Holotype GSC No. 16069 and paratype GSC No. 16068 are from the lower thin-bedded unit, and paratype GSC No. 16070 is from the base of the upper thick-bedded unit of the Horn Plateau Formation exposures.

According to Imbrie (1959, p. 397), this genus is restricted to Middle Devonian rocks. The genus has not been reported previously from the Devonian of western Canada.

Genus *Spinulicosta* Nalivkin, 1937

Type species: *Productella spinulicosta* Hall, 1867.

*Spinulicosta* sp.

Plate XIV, figures 10, 11

*Material.* GSC Nos. 16071 and 16072, parts of pedicle valves, from GSC loc. 31001; collected by A. W. Norris, 1957.

*Dimensions* (in mm).

GSC No. ....	16072
Length of pv .....	(15)
Width .....	(17)

*Description.* Shell of medium size, productiform, subovate, wider than long, with greatest width anterior to hinge line.

Pedicle valve moderately convex in lateral profile, highest about mid-length, posteriorly recurved beneath beak, surface curves rapidly and evenly to the antero-lateral and front margins and more strongly on either side of umbo to the posterolateral margins, flattened towards cardinal angles, umbo narrow, strongly raised, and extended beyond the hinge line, beak small and incurving; interarea high, straight, slightly convex in lateral profile, interrupted centrally by a broad triangular delthyrium.

Surface of valve marked by relatively large spine bases. Some but not all of the spine bases are situated at the anterior ends of broadly rounded radiating ridges, which give a pseudocostate appearance to the shell.

*Discussion.* In so far as the limited material from the Horn Plateau Formation permits comparison it appears to resemble closely an undescribed form called *Productella* sp. O in Survey reports, which is present in large numbers in the Horn River Formation northwest of Great Slave Lake (*see* Norris, *in press*).

The Horn Plateau form also closely resembles *Productella spinulicosta* Hall which is the type species of the genus *Spinulicosta* Nalivkin (1937, pp. 49, 140).

*Occurrence.* The illustrated specimens are from the lower thin-bedded unit of the Horn Plateau Formation exposures. The genus occurs in both the Middle and Upper Devonian.



Genus *Leiorhynchus* Hall, 1860Type species: *Orthis quadracostata* Vanuxem, 1842.*Leiorhynchus? matonabbee* n. sp.

Plate XIV, figures 13a-15c; Plate XV, figures 1a-2e

*Material.* Holotype, GSC No. 16078, a complete adult individual; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

Paratypes: GSC No. 16074, a complete young adult individual; GSC No. 16075, pedicle valve and part of brachial valve of a large individual; both above paratypes from GSC loc. 33503; GSC No. 16076, an incomplete young individual, from GSC loc. 35251; all above paratypes collected by B. G. Craig, 1957; GSC No. 16077, a nearly complete young individual; GSC No. 16125, plaster replicas and anterior part of an incomplete young specimen embedded in matrix which was serially sectioned; GSC No. 16126, plaster replicas and anterior part of an incomplete specimen of an adult individual embedded in matrix which was serially sectioned; last three paratypes from GSC loc. 31001; collected by A. W. Norris, 1957.

*Dimensions* (in mm).

GSC No. . . . .	16074	16075	16076	16077	16078	16125	16126
Length of pv . . . . .	17	18	(13.3)	12.1	19.9	—	(17)
Length of bv . . . . .	16.1	—	(12)	11.6	18.5	—	—
Width . . . . .	20.9	26.3	(12.4)	(14.4)	24.5	(13.2)	(22.6)
Depth . . . . .	12.6	—	9.8	7.1	14.6	(12)	(16.8)
Hinge line length . . . . .	17	(18.6)	—	6	(17.5)	—	—
Hinge angle (in degrees) . . . . .	127	156	131	126	114	—	—
Depth of sulcus . . . . .	5.3	—	—	2.8	11.5	—	—
Width of sulcus at anterior margin . . . . .	11	14.4	—	5.5	13	—	—

*Description.* Shell attains medium size, subovate to subpentagonal, unequally biconvex, width generally greater than length, broadest towards front, anterior commissure moderately to strongly uniplicate.

Pedicle valve weakly to moderately convex along mid-line, highest at about one-third length from beak. Sulcus originates at or posterior to mid-length, widens anteriorly to about one-half width of shell, shallowly concave, bottom moderately to very strongly upturned anteriorly as a rounded to subangular tongue. Umbo moderately to strongly convex. Beak erect, projecting slightly, pierced by a very small oval-shaped permesothyrud foramen in young growth stages and later closed; beak ridges rounded. Delthyrium covered by opposite valve.

Pedicle interior with stout dental plates which project a short distance anteriorly; posteriorly they are nearly vertically oriented, anteriorly they become detached from the floor of valve and are obliquely inclined towards mid-line of floor of valve.

Brachial valve moderately to strongly convex, highest at about mid-length of valve, most strongly arched over umbo; transverse profile almost semicircular; beak concealed by opposite valve. Anterior median half to third of valve very slightly to moderately flexed by a fold which is generally little differentiated from slopes. On holotype the weak fold starts over the umbo and abruptly widens at about two-thirds length forward from beak. On paratypes GSC Nos. 16076 and 16077 a weak sinus is present along the mid-line over the umbo which changes to a weak fold anteriorly.

Brachial interior with a thin median septum supporting a 'bridged' septalium. The septum extends anteriorly from beak for about one-half length of valve and is apparent on exteriors of holotype and paratype GSC No. 16074.

Costae over posterior third to half of shell are relatively weak, closely spaced, and increase gradually in strength anteriorly; over remaining anterior part of shell they abruptly increase in size to become rounded to sharply angular plications along posterolateral and anterior margins; their number is from four to five on fold of brachial valve, three to six on sulcus of tongue of pedicle valve, and from four to eight on the lateral slopes. Concentric growth lines closely and irregularly spaced, in places interrupted by very coarse growth rugosities.

*Discussion.* Externally this species seems to be most closely related to the genus *Leiorhynchus* as recently defined by Sartenaer (1961) but differs from it in certain internal characters. More material is needed for sectioning, however, to determine fully the internal structures of the Horn Plateau form.

Two species may be represented in the Horn Plateau material, one in which the costae are rather coarse and abruptly become almost angular along the lateral and anterior margins of the shell, the other in which the costae are somewhat finer and coarsen more gradually anteriorly. Paratypes GSC Nos. 16074, 16075, 16076, and 16126 are examples of the former form, and holotype GSC No. 16078, and paratypes GSC Nos. 16077 and 16125 are examples of the latter. The former form superficially resembles *Hadorrhynchia sandersoni* (Warren) but differs from this species by lack of a pedicle interarea and absence of internal grooving at anterior margin. The latter form somewhat resembles *Leiorhynchus awokanak* McLaren (1962) but differs in having a more strongly upturned tongue, a truncated or indented rather than a slightly protruding anterior margin, a longer, more nearly straight and more steeply sloping hinge line, and a less inflate pedicle valve.

The trivial name is after Matonabee the resourceful and unusually persistent Chipewyan Indian who was responsible for conducting Samuel Hearne on the successful journey from Churchill to the mouth of Coppermine River and return by Great Slave Lake.

*Occurrence.* The species is known only from the lower thin-bedded unit of the Horn Plateau Formation exposures. The precise horizon in the Horn Plateau Formation of holotype GSC No. 16078 is not known but presumably it is also from the lower beds.

Genus *Hypothyridina* Buchman, 1906

Type species: *Atrypa cuboides* Sowerby, 1840.

*Hypothyridina cameroni* Warren

Plate XV, figures 3a-d

1944. *Hypothyridina cameroni* WARREN, Trans. Roy. Soc. Can., 3rd ser., vol. 38, sec. 4, pp. 114-115, pl. 2, figs. 11-12.

1956. *Hypothyridina cameroni* Warren, WARREN and STELCK, Geol. Assoc. Can., pl. 5, figs. 14-17.

*Material.* Hypotype, GSC No. 16079, an incomplete specimen of an adult individual, and fragments (not illustrated), from GSC loc. 31001; collected by A. W. Norris, 1957; part of tongue of a very large individual (not illustrated), from GSC loc. 35251; collected by B. G. Craig, 1957.

*Dimensions* (in mm).

GSC No. ....	16079
Length of pv .....	21.9
Length of bv .....	20.9
Width .....	(22)
Depth of shell .....	15.8
Hinge line length .....	(13)
Hinge angle (in degrees) .....	120

*Discussion.* Although fragmentarily represented this form appears to be conspecific with *Hypothyridina cameroni* Warren. The most complete specimen from the Horn Plateau Formation (GSC No. 16079) is about the same length as Warren's (1944, pl. 2, fig. 11) syntype Dv849 of *Hypothyridina cameroni* but is slightly thinner. Two specimens from the Horn Plateau Formation have seven costae on the sulcus of the tongue as have the three syntypes described by Warren.

A shorter, more globular, and more finely costate specimen of *Hypothyridina* with eleven costae on the tongue has been collected from the core of the upper part of the Slave Point Formation, Frobisher Hay River Test 5B well (60°42'N, 115°52'W) at 530 feet depth by A. E. Kliske of California Standard Company, 1952 (GSC loc. 41640).

*Hypothyridina cameroni* Warren from the Great Slave Lake area differs from *Hypothyridina venustula* (Hall) of the Tully Formation of New York State in the following features: by having a more strongly developed fold on pedicle valve, by having less steeply sloping sides on the tongue, by a straighter hinge line, by reaching a larger size at maturity, by tending to have a greater length to width ratio, as well as by other minor differences.

Warren's types of *Hypothyridina cameroni* bear a remarkably close resemblance to a form collected 150 feet above the base of the Devonian "Flume" Formation, Kakwa Lake, northeastern British Columbia, by D. J. McLaren in 1952 (GSC loc. 35510). The Kakwa Lake form is represented by two specimens, one partly crushed and the other incomplete, and which seems to bridge the gap between *H. cameroni* and *H. magister* Belanski. The latter form occurs in the *Lepidocentrus* zone, Mason City Substage, of the Shellrock Stage of Iowa (Belanski, 1928, pp. 198-200, pl. 15, figs. 1-6). Direct comparison was made with a plaster cast of USNM paratype No. 71044. Merriam (1940, pl. 9, figs. 13-14) illustrates paratype 1255 of *Hypothyridina magister* Belanski.

The Kakwa Lake specimens have eight costae on the tongue of the sulcus, have a relatively long fairly straight hinge line and like Warren's syntypes of *Hypothyridina cameroni* have a strongly developed transverse outline. Belanski's paratype USNM 71044 of *Hypothyridina magister* has a rough pentagonal outline and bears nine costae on the tongue of the sulcus. Its hinge line in contrast to *H. cameroni* slopes steeply away from the apex of the beaks.

An undescribed *Hypothyridina* sp. that occurs in the Christina and Moberly Members of the Waterways Formation of northeastern Alberta is a small highly inflate form with generally five costae on the tongue and distinct from *Hypothyridina cameroni* Warren.

*Occurrence.* In the Great Slave Lake area outside of the type locality, this species occurs sparingly in the lower thin-bedded unit of the Horn Plateau Formation, east flank of Horn Plateau, District of Mackenzie; and is rare also in beds overlying the west flank of the Presqu'île Formation, on the northwest side of Great Slave Lake, District of Mackenzie.

Two of Warren's syntypes of this species are from the Middle Devonian "Presqu'île dolomite", actually a limestone and dolomitic limestone and now called the Sulphur Point Formation (Norris, *in press*), Presqu'île Point, Great Slave Lake, District of Mackenzie; the remaining syntype is from drift, and presumably derived from the same beds.

The "*Rhynchonella cuboides*" reported by Cameron (1922, pp. 14, 24) from shaly limestones (his Slave Point Formation) overlying coarsely crystalline dolomite (Presqu'île Formation) north of Sulphur Bay on the northwest side of Great Slave Lake, is almost certainly conspecific with *Hypothyridina cameroni*. The writer collected half dozen or so incomplete specimens of *Hypothyridina cameroni* from this same rock-unit at the same general locality, in 1961. *H. cameroni* has been collected also by D. J. McLaren in 1961 from the "Ramparts Formation" associated with *Stringocephalus* sp. about 90 feet down from the top of the outcrop section, west end of Carcajou anticline exposures, right bank of Mackenzie River, District of Mackenzie.

Genus *Atrypa* Dalman, 1828

Type species: *Anomia reticularis* Linnaeus, 1753, subsequent designation Davidson, 1853.

*Atrypa nasuta* n. sp.

Plate XV, figures 5-9c; Plate XVI, figures 1-2b

1956. *Atrypa* cf. *pechiensis* Grabau, WARREN and STELCK, Geol. Assoc. Can., pl. IV, figs. 5-6; pl. V, figs. 18-20.

*Material.* Holotype, GSC No. 16084, a nearly complete specimen of a large individual.

Paratypes: GSC No. 16081, a specimen of a young individual, from GSC loc. 33504; collected by B. G. Craig, 1957; GSC Nos. 16082 and 16083, young individuals; GSC No. 16085, a gerontic individual; GSC No. 16086, a young adult individual; GSC No. 16087, a small rotund individual; GSC No. 16127, plaster replica and anterior part of a serially sectioned specimen of a thin adult individual.

Holotype, and paratypes GSC Nos. 16082, 16083, 16085, 16086, 16087, and 16127 are from GSC loc. 31000; collected by A. W. Norris, 1957.

Collection includes about thirty other nearly complete specimens of this species from the same locality.

*Dimensions* (in mm).

GSC No. ....	16081	16082	16083	16084
Length of pv .....	13.2	19	22.1	32.5
Length of bv .....	12.4	17.1	20.5	29.7
Width .....	13.7	20.8	24.4	33.2
Depth of shell .....	7.6	9.8	10.8	18.5
Hinge line length .....	10.5	12.4	15.8	21
Hinge angle (in degrees) .....	150	159	150	154
Depth of anterior plica .....	0	2	0.8	6.7

GSC No. ....	16085	16086	16087	16127
Length of pv .....	33.1	26.6	24.6	27.9
Length of bv .....	30.9	23.8	22.3	25.5
Width .....	(37.8)	29.4	24.1	30.3
Depth of shell .....	19.3	16.5	15.5	14.4
Hinge line length .....	29	19.4	17.4	22.4
Hinge angle (in degrees) .....	—	157	146	154
Depth of anterior plica .....	12	5.3	8.1	5

*Description.* Shell attains medium to moderately large size, subequally biconvex, both relatively thin and highly inflate forms at maturity, shape outline varying from roughly circular to oval, commonly wider than long, broadest at or posterior to mid-length, relatively long and nearly straight hinge line, posterolateral extremities rounded, anterior commissure rectimarginate in young stages, moderately to strongly uniplicate in later stages.

Pedicle valve moderately and irregularly arched from back to front along mid-line with greatest curvature immediately anterior to beak, gently arched transversely, commonly strongly elevated in umbonal region, flattened towards posterolateral extremities in young and adult stages but recurved in gerontic stage. Sulcus absent or only weakly developed in young stages, relatively broad and weakly to strongly upturned in later stages. Beak relatively large, pointed, nearly straight throughout all growth stages, beak ridges sharp, interarea narrow, deltidial plates relatively long and longitudinally striated. Large oval-shaped mesothyrid foramen present throughout young to adult growth stages.

Brachial valve moderately to strongly arched longitudinally, highest and most strongly arched near posterior margin, flattened along mid-line, sloping abruptly thence to lateral margins, flattened and slightly recurved towards posterolateral extremities. Beak hidden.

Exterior of both valves ornamented by moderately coarse rounded costae that increase in number by dichotomy and implanation. They gradually increase in strength anteriorly and are separated by U-shaped furrows of equal or slightly greater width. Two to four costae occur in a space of 2 mm at 5 mm from the beak along the mid-line. Growth lines on most individuals very weakly developed, fairly widely and irregularly spaced in young and adult stages, closely spaced in gerontic stage. No alate lamellae preserved.

*Discussion.* In character of beak and size of costae this species somewhat resembles *Atrypa peshiensis* Grabau (1931, 1933, pp. 181-183, pl. 15, fig. 7; pl. 18, figs. 1a-1e) but differs in other features. The nearly straight orientation of the beak is characteristic of all *Atrypa* in very young growth stages but in the Horn Plateau form this feature is retained throughout later stages of growth.

*Atrypa nasuta* appears to be conspecific with "*Atrypa* cf. *pechiensis* Grabau" recorded by Warren and Stelck (1950, 1956) as part of the *Rensselandia laevis* (Meek) fauna from the lower Mackenzie region. Comparison has been made only with the illustrations by Warren and Stelck, not actual specimens.

Another form which *Atrypa nasuta* superficially resembles is an unnamed coarsely costate *Atrypa* present in Middle Devonian beds exposed on Little Island, Peace River, located 50 to 60 miles west of the Peace River canyon, in the Halfway River map-area, northeastern British Columbia. *Atrypa nasuta* differs from this latter form in having finer costae, a large, and more conspicuous pedicle beak, as well as other shape differences.

The more diagnostic features of *Atrypa nasuta* are the nearly straight pointed beak, the fairly sharply rounded costae which flare out towards the margins of the shell, separated by equal or wider U-shaped troughs, and the rounded outline.

Trivial name of the new species is from the Latin *nasutus*, large-nosed.

*Occurrence.* *Atrypa nasuta* occurs in the upper thick-bedded unit of the Horn Plateau Formation exposures. It is especially common in the lower part of the unit.

It has been noted also in collections from the "basal Upper Ramparts Formation of the Beavertail anticline" (GSC loc. 37455), District of Mackenzie.

The recorded occurrences of "*Atrypa cf. pechiensis* Grabau" are from *Rensselandia laevis* zone, lower part of the Ramparts Limestone of the lower Mackenzie Valley (Warren and Stelck, 1950, p. 75); and from Ramparts Limestone (*Rensselandia laevis* fauna), Merganser Creek and Rond Lake respectively, District of Mackenzie (Warren and Stelck, 1956, pl. 4, figs. 5-6; pl. 5, figs. 18-20).

*Atrypa nasuta hearnei* n. sp., n. subsp.

Plate XV, figures 4a-e

*Material.* Holotype, GSC No. 16080, a nearly complete specimen, from GSC loc. 31000; collected by A. W. Norris, 1957.

*Dimensions* (in mm).

GSC No. ....	16080
Length of pv .....	25.7
Length of bv .....	23.3
Width .....	23
Depth of shell .....	15.7
Hinge line length .....	16.8
Hinge angle (in degrees) .....	159
Depth of anterior plica .....	7

*Description.* Shell of medium size, unequally biconvex, relatively thick, roughly oval outline, slightly longer than wide, anterior commissure uniplicate.

Pedicle valve gently convex, highest about mid-length, slopes flattened and recurved towards lateral margins, depressed anteriorly and mesially to form a broad shallow sulcus which is extended to form a U-shaped moderately upturned tongue. Umbo broadly convex. Beak stout, relatively long, nearly straight, pierced by a small oval-shaped permesothyrid foramen. Beak ridges rounded. Interarea broad and high. Delthyrium covered by large conspicuous deltidial plates with vague longitudinal ridges.

Brachial valve moderately convex; highest about mid-length. Indistinct fold over tongue of opposite valve at anterior mesial margin; lateral slopes steep, flattened and recurved toward posterolateral margins to form slightly extended hinge line. Umbo broadly convex; beak hidden by that opposite.

Both valves ornamented by relatively fine radiating costae which increase only slightly in size outward; four costae occur in a space of 2 mm straddling the mid-line at 5 mm from beak. Growth lines relatively weak, widely spaced; lamellae probably exceedingly thin and fragile.

*Discussion.* The most diagnostic feature of this form is its relatively fine closely spaced costae, which separates it from *Atrypa nasuta* with which it is associated. Other prominent features are its elongate appearance, and proportionately large thickness. The straight extended beak, in common with *Atrypa nasuta*, suggests that this form is an end member of the line of development of relatively fine closely spaced costation, although intermediate forms are lacking.

The trivial name of the subspecies is after Samuel Hearne.

*Occurrence.* *Atrypa nasuta hearnei* is known only from the upper, thick-bedded unit of the Horn Plateau Formation exposures. It is represented by a single specimen.

Genus *Spinatrypa* Stainbrook, 1951

Type species: *Atrypa aspera* var. *occidentalis* Hall, 1858.

*Spinatrypa hornensis* n. sp.

Plate XVI, figures 3-8

*Material.* Holotype, GSC No. 16090, an adult individual showing the common roughly circular outline.

Paratypes: GSC No. 16088, a very young individual showing extreme development of an elongate oval outline; GSC No. 16089, a young individual with elongate oval outline; GSC No. 16091, a large adult individual with broad oval outline; GSC No. 16092, a young adult individual with broad oval outline; GSC No. 16093, a nearly complete specimen of a young adult individual with subcircular outline; GSC No. 16094, a large individual left partly embedded in matrix to show attachment of coarse imbricating spines; GSC No. 16128, anterior part and plaster replicas of a serially sectioned adult individual with slightly elongate oval outline.

Paratypes GSC Nos. 16088, 16089, and 16128, from GSC loc. 31001; collected by A. W. Norris, 1957. Holotype GSC No. 16090, and paratypes GSC Nos. 16091 and 16092, from GSC loc. 33503; collected by B. G. Craig, 1957. Paratype GSC No. 16093, from GSC loc. 35251; collected by B. G. Craig, 1957. Paratype GSC No. 16094, from GSC loc. 31000; collected by A. W. Norris, 1957.

This species is represented by about 130 individuals from the Horn Plateau Formation, and is second in abundance to *Athyris aquilonius*.

*Dimensions* (in mm).

GSC No. ....	16088	16089	16090	16091
Length of pv .....	9.8	19.3	27.1	(26+)
Length of bv .....	8.9	18.1	26.4	26
Width .....	8.5	17.8	28.9	34.6
Depth .....	4	9.1	15	15
Hinge line length .....	6.2	12.3	19.8	—

GSC No. ....	16092	16093	16094	16128
Length of pv .....	23	25	31.3	24.1
Length of bv .....	22.1	24	30	23.6
Width .....	30.6	27.2	31	25.5
Depth .....	11.4	12.7	14.4	13.6
Hinge line length .....	23.7	22.7	20.4	(16)



*Description.* Shell small to medium sized, almost equally biconvex, relatively thin, oval outline when young, approaching circular or semicircular outline in adult growth stages, generally wider than long with greatest width immediately anterior to hinge line in adult forms, anterior commissure rectimarginate when young but very slightly uniplicate in later growth stages. Hinge line moderately to steeply inclined.

Pedicle valve gently convex, commonly highest at or immediately posterior to mid-length, surface flattened laterally and anteriorly. Sulcus and tongue absent or only weakly developed at mesial anterior margin. Beak of medium size, straight when young, variably incurved in later stages; foramen oval, its position varying from submesothyrid to mesothyrid.

Brachial valve generally slightly more convex than pedicle valve, highest posterior to mid-length, gently arched along mid-line with greatest curvature over umbo, moderately arched transversely, flattened towards posterior lateral extremities. Fold absent or only weakly developed at anterior mesial margin.

Shell material relatively thin. Valve ornamented by moderately coarse, rounded costae which increase by irregular dichotomy. Eight to eleven costae start at the posterior margin; at 10 mm from the beaks 3.5 to four costae occur in a space of 5 mm straddling the mid-line. Growth lamellae thin, moderately spaced, sharply tapering spines produced where the lamellae cross the costae.

*Discussion.* *Spinatrypa hornensis* most closely resembles an unnamed coarsely costate *Spinatrypa* present in the lower part of the Firebag Member of the Waterways Formation of northeastern Alberta. It differs in having slightly finer costae, a steeper and generally shorter hinge line, an oval or circular rather than semicircular outline, as well as by other shape differences.

The trivial name is after Horn River.

*Occurrence.* Holotype, GSC No. 16090, paratypes GSC Nos. 16088, 16089, 16091, 16092, 16093, and 16128 are from the lower thin-bedded unit of the Horn Plateau Formation exposures. Paratype GSC No. 16094 is from the lower part of the upper thick-bedded unit of the Horn Plateau Formation exposures and same locality.

Genus *Ambocoelia* Hall, 1860

Type species: *Orthis umbonata* Conrad, 1842.

*Ambocoelia* cf. *A. umbonata* (Conrad)

Plate XVI, figures 10a-14

*Material.* Hypotypes: GSC No. 16095, an adult specimen; GSC No. 16096, pedicle valve of a large individual; GSC Nos. 16097 and 16098, complete specimens of young individuals; all from GSC loc. 31001; collected by A. W. Norris, 1957. GSC No. 16099, nearly complete young individual, from GSC loc. 35251; collected by B. G. Craig, 1957. GSC No. 16130, plaster replicas and

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anterior part of a serially sectioned small adult specimen; also two specimens (not illustrated) of adult individuals with very high pedicle interareas; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions* (in mm).

GSC No. ....	16095	16096	16097	16098	16099	16130
Length of pv .....	8	8.8	6.3	5.1	5.8	6.3
Length of bv .....	6.9	—	5.4	4.9	5.2	5.5
Width .....	9.7	9.1	6.9	6.4	6.3	6.9
Depth .....	5.5	—	4.5	3.8	3.9	(4.4)
Hinge line length .....	7.5	7.9	5.7	5.1	(5.4)	6

*Description.* Shell of small size, plano-convex, roughly pentagonal and heptagonal in outline, wider than long; hinge line straight and slightly less than maximum width of shell, cardinal angles rounded.

Pedicle valve highly inflate; umbo high and slightly incurved; mesial sinus narrow, continuous from beak to front; interarea relatively large, moderately to strongly curved, beak ridges rounded to fairly sharp; delthyrium very narrow and high, as a rounded elevation tapering towards beak.

Pedicle interior of serially sectioned specimen hypotype GSC No. 16130 shows a low, fairly sharp, median septum or myophragm present at least in the posterior part of the valve which coincides with the narrow longitudinal median sinus on the exterior of the valve.

Brachial valve roughly semi-elliptical to hexagonal, weakly and broadly convex over posterior region, weakly concave near lateral margins, and nearly flat to slightly concave over anterior mesial region of valve, the latter feature suggestive of a broad faint sulcus; beak straight, scarcely elevated above the hinge line; inter-area scarcely perceptible, relatively wide and very low.

Brachial interior of hypotype GSC No. 16130 has crural plates which converge along the floor and median part of the valve. Faint traces of laterally directed spiralia are also evident.

Surface marked by very fine radiating striae and on abraded parts of shell by more conspicuous tear-shaped depressions suggestive of spine bases; present also are faint closely spaced concentric growth lines which show sporadic coarsening and interruption.

*Discussion.* On the basis of external features this form closely resembles *Ambo-coelia umbonata* (Conrad). Unfortunately none of the specimens from Horn Plateau shows features of the musculature for detailed comparison. Serial sections by Veevers (1959b) of a specimen from Conrad's type locality of this species indicate a thicker shell substance than is present on the form from Horn Plateau. Serial sections of the Horn Plateau specimen, because of coarse recrystallization, cannot be compared reliably with those by Veevers; they do, however, show general similarity.

An *Ambocoelia* sp. with a higher and more slender beak and lacking spine bases has been collected from Devonian beds at a depth of 7,468 to 7,470 feet in and Pure T.C.P. and O. High Prairie well (6-7-74-16W5; GSC loc. 37988).

Another undescribed *Ambocoelia* sp. has been collected from outcrops of the Christina and Moberly Members of the Waterways Formation of northeastern Alberta. It differs from the Horn Plateau form by being smaller at maturity, having a higher relatively thicker umbo, a relatively broader sinus on pedicle valve, and a clathrate (reticulate) ornamentation on exterior of the valves.

*Occurrence.* Hypotypes GSC Nos. 16095 to 16099 inclusive are from the lower thin-bedded unit of the Horn Plateau Formation exposures. Hypotype GSC No. 16130 is from the same locality and presumably also from the lower beds.

Genus *Emanuella* Grabau, 1925

Type species: *Spirifer undiferus* var. *takwanensis* Kayser in Richtofen, 1883.

*Emanuella?* sp.

Plate XVI, figures 9a-d; 15a-16d

*Material.* GSC No. 16100, a small adult individual; GSC No. 16101, a young elongate highly inflate individual; GSC No. 16102, a broad adult individual; GSC No. 16129, plaster replicas and anterior part of a serially sectioned specimen of a relatively large individual. GSC Nos. 16100, 16101, and 16129, from GSC loc. 31001; collected by A. W. Norris, 1957. GSC No. 16102; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions* (in mm).

GSC No. ....	16100	16101	16102	16129
Length of pv .....	8	4.8	7.4	10.9
Length of bv .....	7.2	4.1	6.6	9.3
Width .....	8.4	4.5	9.4	10.9
Depth .....	5	3.1	4.9	7.2
Hinge line length .....	(5.4)	3.2	5.5	(8.3)

*Description.* Shell of small size, biconvex with pedicle valve considerably more inflate than brachial valve especially in adult stages, roughly elliptical outline when young, becoming heptagonal in later stages, longer than wide when young but wider than long in adult stages; hinge line straight, roughly three-fifths to five-eighths total width of shell, cardinal angles rounded, lateral and anterior margins nearly straight.

Pedicle valve moderately to strongly convex, highest about mid-length, in transverse outline nearly flat along top and on flanks; a weak narrow median sinus originates over umbo and gradually widens anteriorly; interarea relatively small, moderately arched, bounded on the sides by moderately rounded beak ridges, and

divided by relatively large, tapering, raised and rounded delthyrium. Dental plates absent.

Brachial valve very gently convex, with the beak slightly projecting beyond the hinge line, in transverse profile nearly regularly convex, an exceedingly weak ill-defined depression along mid-line on anterior part of valve; interarea very small.

Brachial interior with thin crural plates which converge and nearly meet along the mid-line of the floor of valve.

Shell material thin; surface ornamented with weak very fine closely spaced striations, and tiny closely spaced tear-shaped depressions arranged more or less concentrically, suggestive of spine bases and best seen on abraded parts of shell; growth lines very faint.

*Discussion.* It is doubtful whether the Horn Plateau form agrees in micro-ornament with the type species of *Emanuella*, *E. takwanensis* (Kayser), recently described in detail by Veevers (1959b). The latter species is characterized by regular concentric growth lines and indented growth laminae simulating spines.

*Emanuella?* sp. is separated from *Ambocoelia* cf. *A. umbonata* with which it was found associated, on the basis of external shape. No transitional forms were found. Both forms appear to have similar micro-ornament.

Details of internal structures were unfortunately very poorly preserved because of coarse recrystallization in specimen serially sectioned.

*Occurrence.* GSC Nos. 16100, 16101 and 16129 are from the lower thin-bedded unit of the Horn Plateau Formation exposures. GSC No. 16102 is from the same locality and presumably from the same stratigraphic interval.

#### Genus *Eleutherokomma* Crickmay, 1950

Type species: *Eleutherokomma hamiltoni* Crickmay, 1950.

#### *Eleutherokomma implana* n. sp.

Plate XVI, figures 17a-19; Plate XVII, figures 1a-3e

*Material.* Holotype, GSC No. 16107, a complete specimen of an adult individual; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

Paratypes: GSC No. 16103, an incomplete young individual; GSC No. 16104, an incomplete pedicle valve of a young individual; GSC No. 16105, an exfoliated specimen of an adult individual; GSC No. 16106, a nearly complete specimen of a broad adult individual. GSC Nos. 16103 and 16105, from GSC loc. 31001; collected by A. W. Norris, 1957. GSC No. 16104, from GSC loc. 35251; collected by B. G. Craig, 1957. GSC No. 16106; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions (in mm).*

GSC No. ....	16103	16104	16105	16106	16107
Length of pv .....	—	9.5	17.2	(14+)	13.6
Length of bv .....	—	—	13.7	13.1	11
Width .....	—	(10)	20.6	24.7	(19.3+)
Depth of shell .....	3.6	—	12.9	12.3	10.5
Hinge line length .....	—	(10)	(19.6)	22.4	(18.2)
Depth of anterior plica .....	0.7	—	2.7	4	2.5
Width of fold and sulcus at anterior margin .....	2.2	—	8.5	8.4	6.6

*Description.* Shell of medium size, almost equally biconvex, subelliptical, moderately mucronate to briefly extended angles, angular to broadly rounded anterolateral margins, relatively narrow slightly rounded front, considerably wider than long with greatest width at or immediately anterior to the hinge line, anterior commissure uniplicate and dentate.

Pedicle valve moderately to strongly convex, strongly arched along the midline from beak to front, strongly arched transversely in the middle, highest at about one-third distance from tip of beak. Sinus originating at the beak, moderately shallow, broadly V-shaped, bordered by coarse costae, some individuals showing weakly developed irregular fairly broad costae in sulcus, sulcus continued at front to form a short tongue. Flanks strongly convex from back to front, sloping steeply and gently convex from sulcus to lateral margins, gently concave towards hinge line. Umbo convex and elevated. Beak moderately sharp, strongly inturned near tip, and extending beyond the hinge line. Interarea of moderate height, beak ridges slightly raised, sloping gradually from the beak to extremities, but in some individuals may be high near the extremities; interarea adjacent to hinge line is gently concave, catacline, area beneath beak more strongly concave, orthocline to anacline. Delthyrium high and narrow. Dental plates evident and also a suggestion of a median septum.

Brachial valve strongly convex, highest from one-quarter to one-third distance from beak, moderately arched from back to front, lateral slopes gently convex, slightly to moderately concave towards posterolateral extremities, roughly semi-elliptical. Fold strong but little elevated, beginning at the beak and gradually widening anteriorly, generally with strong costae posteriorly which increase in number but decrease in strength anteriorly to become obsolete in some individuals near anterior margins. Umbo slightly convex to nearly flat. Beak slightly extended and incurving. Interarea very low, orthocline.

Flanks ornamented with fairly coarse rounded costae which increase in strength anteriorly, generally increasing in number by dichotomy so that from nine to eleven occur along anterolateral margin of each flank. Costae on fold and sulcus where present are weakly to strongly and irregularly developed, and vary in number from zero to three. Growth laminae fairly coarse, closely and irregularly spaced. Each growth lamina is ornamented by very fine concentric lines and slightly coarser

closely spaced radial lines which are best preserved in troughs separating the costae. Interareas of both valves marked with closely spaced transverse and longitudinal markings, the former being more conspicuous.

*Discussion.* This form appears to be more readily assigned to *Eleutherokomma* Crickmay (1950) than to any other spiriferid genus described from western Canada. A feature that is common to *E. implana* and some other species of *Eleutherokomma* is the incipient development of costae on the fold and sulcus. This feature is particularly apparent on some but not on all specimens of *E. impennis* and *E. hamiltoni* as seen in GSC collections. These two species occur in the Firebag and Peace Point, and Moberly Members respectively, of the Waterways Formation of northeastern Alberta. Even the micro-ornament on the Horn Plateau form is closely similar to that said to characterize this genus, and differs only in being slightly less conspicuous.

*Eleutherokomma implana* differs from *E. impennis* Crickmay by having coarser and more irregular costae, by a shallow broadly V-shaped rather than a deep U-shaped sulcus, by a weakly elevated more evenly tapered fold rather than a strongly elevated 'trumpet'-shaped fold, by a lower more strongly arched pedicle interarea, and by being proportionately broader.

*E. implana* in general shape outline is somewhat similar to *E. jasperensis* (Warren) as diagnosed by Crickmay (1953, pp. 3-4, pl. 2, figs. 9-13). It differs by being less mucronate, by having coarser more irregular and fewer costae on the flanks.

From most species of *Mucrospirifer* Grabau, *E. implana* differs by having a much higher pedicle interarea, by having generally faint irregular costae on the sulcus and fold rather than an unmodified sulcus and fold or with a single costa on the sulcus. Growth lamellae and micro-ornament appear to be closely similar on the two genera but are coarser and more conspicuous on *Mucrospirifer*.

*E. implana* has many superficial resemblances in common with some of the species of *Tylothyris* North described by Stainbrook (1943) from the Cedar Valley Limestone of Iowa, particularly *T. subattenuata* (Hall) from the *Atrypa independensis* zone.

Two species, proportionately narrow and broad almost alate forms, may be represented in the material at hand. The narrow form is represented by holotype GSC No. 16107, and paratypes GSC Nos. 16104 and 16105; the broad form by paratypes GSC Nos. 16103 and 16106.

Trivial name of the new species is from the Latin *implanus*, uneven, referring to the uneven costae.

*Occurrence.* Paratypes GSC Nos. 16103, 16104 and 16105 are from the lower thin-bedded unit of the Horn Plateau Formation exposures. Holotype GSC No. 16107 and paratype GSC No. 16106 are from the same locality and presumably from the same stratigraphic interval.

Genus *Athyris* McCoy, 1844

Type species: *Terebratula concentrica* Von Buch, 1833.

*Athyris aquilonius* n. sp.

Plate XVII, figures 4a-10

*Material.* Holotype, GSC No. 16108, an adult specimen, from GSC loc. 31002; collected loose by A. W. Norris, 1957.

Paratypes: GSC Nos. 16109 and 16110, specimens of very young individuals; GSC No. 16111, a thick elongate individual; GSC No. 16112, an alate adult individual; GSC No. 16113, a large alate individual; GSC No. 16114, a very large broad individual; GSC No. 16131, plaster replicas and anterior part of serially sectioned specimen of a medium-sized individual. All paratypes from GSC loc. 31001; collected by A. W. Norris, 1957.

This form is represented by about 150 individuals and is by far the most common fossil in the Horn Plateau Formation.

*Dimensions* (in mm).

GSC No. ....	16108	16109	16110	16111	16112	16113	16114	16131
Length of pv .....	23.2	9	15.1	21.9	22.4	24.6	24	20.3
Length of bv .....	21	8.3	13.8	19.5	20.6	22.1	21.9	18.5
Width .....	24.5	9.7	15.3	23.7	26.8	29.5	30.2	21.5
Depth of shell .....	14.7	4.8	8.8	14.7	15	17.3	14.4	13.8
Hinge angle (in degrees) .....	129	128	124	127	136	136	136	128
Depth of anterior plica .....	5	0	1.3	7.8	5.3	8	(6.2)	5.3

*Description.* Shell moderately large for the genus, pentagonal to heptagonal in outline; posterior margins nearly straight, forming a hinge angle varying between 124 to 136 degrees; lateral margins narrowly rounded in adult specimens, more broadly rounded when young; anterolateral margins sloping more or less strongly inward and ventrally; anterior margin generally truncated, variably uniplicate in adult stages. Wider than long; position of greatest width variable but near mid-length.

Pedicle valve moderately convex in lateral profile with greatest convexity over umbonal region; anterior profile broadly convex with median region flattened in young individuals and depressed in older individuals, flanks moderately to gently sloping. Sulcus narrow, shallow, occupying roughly one-third to one-fourth the width of shell. Sulcus originates over or near umbonal region and in some individuals is bordered by weakly developed folds. Tongue varies from short and broadly rounded to greatly extended, tapering, and sharply rounded. Umbonal region inflated, median region depressed, flanks convex with steep to moderate slopes. Beak extended beyond brachial umbo and commonly closely overhanging it. Foramen presumably mainly closed.

Pedicle valve with stout teeth, supported by short thin parallel dental plates. Musculature similar to that of *Athyris spiriferoides* (Eaton).

Brachial valve in lateral profile most convex in umbonal region, highest at one-quarter to one-third length from beak; anterior profile broadly convex with the flanks gently convex, or nearly flat, or in broad individuals gently concave. Fold variably developed, generally narrow, gently convex, evident in some individuals throughout length, in others for only part of the length of valve. Umbonal region moderately swollen, somewhat narrow.

Brachial valve interior with hinge plate posteriorly perforated, supported anteriorly by short stout crural plates. The dental sockets are bounded by part of the valve wall and lateral plates of the hinge plate. Spiralia have up to twelve turns in adult specimens, and are directed laterally.

*Discussion.* Young individuals of this species are closely similar to a form present in the Upper Devonian, Point Wilkins Member of the Souris River Formation of Manitoba (see McCammon, 1960, pp. 62-63, pl. 11, figs. 1a-1c and 3 of hypotypes GSC Nos. 14679 and 14860; not pl. 11, 2a-2c of hypotypes GSC Nos. 14861, a). McCammon assigned all these forms to *Athyris vittata* Hall and they are closely similar to some of the athyrids in the middle part of the Waterways Formation of northeastern Alberta. *Athyris aquilonius* differs from these Manitoba forms by attaining a much larger size at maturity, by having a less steeply sloping hinge line, a less overhanging beak, a more pronounced uniplicate anterior margin, along with a more strongly developed fold and sulcus.

*Athyris aquilonius* closely resembles *A. spiriferoides* (Eaton) from the Middle Devonian of New York and adjacent States. It differs by being generally smaller, proportionately thicker, having a more steeply sloping hinge line, a less alate appearance, a more pronounced fold and sulcus, and having finer growth lamellae.

Trivial name of the new species is from the Latin *aquilonius*, north, northern, northerly.

*Occurrence.* *Athyris aquilonius* is exceedingly abundant in the lower thin-bedded unit of the Horn Plateau Formation exposures.

Genus *Trematospira* Hall, 1859

Type species: *Spirifer multistriatus* Hall, 1857.

*Trematospira* sp.

Plate XVII, figures 11a-d

*Material.* GSC No. 16115, an abraded specimen; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions* (in mm).

GSC No. ....	16115
Length of pv .....	9.7
Length of bv .....	8.5
Width .....	(11)
Depth of shell .....	4.6



*Description.* Shell small, unequally biconvex, relatively thin, subtriangular, with greatest width at about two-thirds the length of shell from the beak; front margin broadly rounded; anterior commissure very gently uniplicate and strongly dentate, hinge line relatively long, steeply sloping.

Pedicle valve weakly convex, slightly deeper than brachial valve, highest at about two-thirds length from beak, sulcus very shallow, beginning over umbo and rapidly widening anteriorly; beak relatively large and long, wedge-shaped; interarea relatively small, high and narrow, sides poorly defined by rounded ridges; delthyrium large, high and narrow.

Brachial valve very weakly convex, highest at about one-quarter length from beak along mid-line, very weak fold on anterior third of valve; beak small and straight, closely appressed against opposite valve.

Brachial interior with short median septum apparent on abraded beak. Suggestion of a laterally directed cone of spirillum with five turns.

Shell substance punctate, preserved only in small patches. Shell very strongly costate, ten simple costae are present around the anterior and lateral margins of each valve, four costae are present on each flank of each valve. On pedicle valve two costae in sulcus are slightly smaller than those bordering the sulcus. On pedicle valve the costae start at the beak and rapidly increase in size in anterior third of valve. On brachial valve costae are weak or absent over median posterior third and very strongly developed towards lateral and anterior margins; two costae on weak anterior median fold are shorter and less conspicuous than those bordering the fold.

*Discussion.* This form superficially resembles *Derbyina smithi* (Derby) and *Paranaia margarida* (Derby) as described and illustrated by Cloud (1942, pp. 120-121, pl. 21, figs. 1-6, cf. 7, 8; pp. 122-123, pl. 21, figs. 9-14) but differs in having concavely arched rather than slightly convexly arched beak ridges, as well as other shape differences.

From *Trematospira costata* Hall (1867, pp. 275-276, text-figs. 5-6) occurring in the "Lower Helderberg group" of New York, the Horn Plateau form differs in being proportionately more elongate, by having a less conspicuous fold and sulcus, and by having two rather than three costae on the fold and sulcus.

In general shape outline the Horn Plateau form somewhat resembles *Trematospira gibbosa* (Hall) (Shimer and Shrock, 1948, p. 361, pl. 141, figs. 21-24) present in the Middle Devonian of eastern North America. The latter form is proportionately thicker, and is characterized by a fold and sulcus with three and two costae, respectively.

*Occurrence.* Represented by a single specimen presumably from the lower thin-bedded unit of the Horn Plateau Formation exposures.

Genus *Cranaena* Hall and Clarke, 1893

Type species: *Terebratula romingeri* Hall, 1863; subsequent designation Hall and Clarke, 1884.

*Cranaena?* sp.

Plate XVII, figures 12a-c

*Material.* GSC No. 16116, an incomplete adult specimen; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions* (in mm).

GSC No. ....	16116
Length of pv .....	17.2
Length of bv .....	15.4
Width .....	(10.5+)
Depth of shell .....	8.3
Hinge angle (in degrees) .....	85

*Description.* Shell of moderate size, almost equally biconvex, gibbous, and subglobose. Elongate subpentagonal, with length about 1.6 times greater than width; sublenticular to subelliptical in lateral and end profiles. Greatest width a little anterior to mid-length. Anterior margin rectimarginate. Lateral margins straight for about two-thirds of its length, gently curving towards brachial valve posteriorly.

Pedicle valve nearly evenly convex from back to front along mid-line, highest at about mid-length, cardinal margin terebratulid; beak prominent, moderately long, suberect; foramen permesothyrid?, subovate?, moderately large, margin moderately thickened. Deltoidal plates not well preserved, appear to have been mainly covered by beak of opposite valve. Interarea relatively conspicuous, about a third as long as valve, defined laterally by rounded steeply sloping beak ridges.

Short dental plates that diverge slightly anteriorly are evident on each side of partly abraded beak of pedicle valve.

Brachial valve nearly uniformly convex, not marked by a fold but slightly flattened towards median anterior margin. Beak small, pointed, closely appressed against opposite valve.

Shell smooth except for weak irregularly spaced concentric growth lines; punctae very fine and closely spaced. Shell substance thin.

*Discussion.* On the basis of external shape this form more closely resembles *Cranaena* than it does *Cryptonella* as diagnosed by Cloud (1942).

This form is distinguishable from *Cranaena? cryptonelloides* n. sp. by being proportionately longer, thicker, having an incurved rather than nearly straight pedicle beak, and having a straight anterior margin.

It closely resembles *Cranaena sublingulata* Stainbrook (1941, pp. 47, 50, pl. 7, figs. 11-13, 30; text-fig. 2) from the *Cranaena iowensis* zone of the Cedar Valley

Limestone of Iowa, but is proportionately more slender and smaller than the Iowa species.

It differs from all known forms of *Cryptonella* and *Cranaena* occurring sparingly in the Waterways Formation and more abundantly in the shale of the Hay River Formation.

*Occurrence.* Exceedingly rare; presumably from the lower thin-bedded unit of the Horn Plateau Formation exposures.

The genus *Cranaena* is rare in the Middle Devonian of western Canada. It has been reported by Warren and Stelck (1950, p. 75) associated with *Rensselandia laevis* (Meek) from the lower part of the "Ramparts limestone" of the lower Mackenzie Valley.

*Cranaena? cryptonelloides* n. sp.

Plate XVII, figures 13a-15c

*Material.* Holotype, GSC No. 16117, a relatively large specimen. Paratypes: GSC No. 16118, an intermediate-sized specimen; GSC No. 16119, a small adult specimen; GSC No. 16132, plaster replicas and anterior part of a serially sectioned specimen. Holotype GSC No. 16117, and paratypes GSC Nos. 16118 and 16119, from GSC loc. 31002; collected by A. W. Norris, 1957. Paratype GSC No. 16132, and ten other more or less complete specimens and some fragments; collected by P. E. Gretener, Shell Oil Company, 1957 (loc. PG-416-N57).

*Dimensions* (in mm).

GSC No. ....	16117	16118	16119	16132
Length of pv .....	12.7	11.2	10.3	11.3
Length of bv .....	11	9.6	8.8	9.9
Width .....	11.5	9.8	9.5	10.8
Depth .....	6.2	6	5.9	5.9
Hinge line length .....	6.2	6.6	6	6.8
Hinge angle (in degrees) .....	152	136	148	140

*Description.* Shell small, almost equally biconvex, subpentagonal to subelliptical, longer than wide with greatest width at about mid-length; posterolateral margins slightly concave, lateral margins strongly rounded, anterior margin rounded to slightly truncate. Anterior commissure gently to moderately uniplicate.

Pedicle valve weakly to moderately and nearly evenly convex in lateral profile with maximum convexity located at or slightly posterior to mid-length. Anterior profile moderately and narrowly convex with the sides sloping fairly steeply. A very narrow and shallow V-shaped sulcus originates in posterior fifth of valve which becomes stronger anteriorly. Beak slender, wedge-shaped, suberect, revealing a large deltidial area, forming an apical angle varying from about 88 to 96 degrees. Foramen permesothyrid; a pedicle collar suggested in worn specimens.

Pedicle interior with relatively strong teeth projecting obliquely towards one another; supported posteriorly by moderately thick plates. A very weak myophragm present in rostral part of shell.

Brachial valve smoothly convex in lateral profile with highest point immediately posterior to mid-length, depth slightly greater than pedicle valve. Anterior profile strongly and narrowly convex with the sides sloping steeply. Umbonal region narrowly rounded.

Brachial interior with free cardinal plate, perforate, laterally concave, meeting along the plane of symmetry to form a thin irregular vertical plate. Dental sockets narrow, elongate, widening and deepening anteriorly. Details of loop not determinable.

Shell substance thin; smooth except for faint growth lines. Punctae not positively determined.

*Discussion.* This form appears to agree in most characters with the genus *Cranaena* as diagnosed by Cloud (1942, p. 132) with the exception of the shape of the anterior part of the cardinal plate. In external shape this form resembles a number of species of the genus *Cryptonella*.

From *Cranaena sublingulata* Stainbrook (1941, p. 47, pl. 7, figs. 11-13, 30) from the Cedar Valley beds of Iowa, the Horn Plateau form differs in being proportionately broader, and having a more slender wedge-shaped pedicle beak. Other forms described and illustrated by Stainbrook (1941) from the Devonian of Iowa of somewhat similar shape and size to the form from the Horn Plateau Formation include *Cranaena jucunda* Hall, *C. elia* Hall, and *C. littletonensis* Stainbrook. These all differ, however, in having more inflated pedicle beaks.

In shape outline *Cranaena? cryptonelloides* is closely similar to *Cryptonella pinonensis* Walcott (1884, pp. 163-164, pl. 4, figs. 4-4b) from Upper Devonian beds at the south end of Pinon Range at the Gate, northwest of Eureka, Nevada. The Nevada form differs in being slightly more elongate.

*Cranaena? cryptonelloides* is easily distinguishable from the undescribed forms of *Cranaena* (= *Cryptonella* of some authors) present in Upper Devonian beds of the upper Mackenzie River basin which generally have strongly incurved pedicle beaks and straight anterior margins.

This new species is named from its external resemblance to some species of the genus *Cryptonella* Hall, 1861.

*Occurrence.* Holotype GSC No. 16117, and paratypes 16118 and 16119 are from the lower thin-bedded unit of the Horn Plateau Formation exposures. Paratype GSC No. 16132, and remaining specimens are from the same locality and presumably from the same stratigraphic interval.

## TRILOBITA

### Genus *Dechenella* Kayser, 1880

Type species: *Phillipsia verneuili* Barrande, 1852; subsequent designation Vogdes, 1890.

#### Subgenus *Dechenella* (*Basidechenella*) Rud. Richter, 1912

Type species: *D. (Basidechenella) kayseri* Rud. Richter, 1912; subsequent designation Vogdes, 1925.

*Dechenella (Basidechenella) sp.*

Plate XVII, figures 16-17b

*Material.* GSC No. 16120, part of a glabella attached to part of a pygidium (GSC No. 16121).

GSC No. 16121, part of a pygidium attached to part of a glabella (GSC No. 16120).

GSC No. 16122, poorly preserved cast of a pygidium embedded in matrix associated with a mould of a smaller pygidium. Latex impressions made of each.

All specimens from GSC loc. 33504; collected by B. G. Craig, 1957.

*Dimensions* (in mm).

GSC No. ....	16120	16121	16122 (cast)	16122 (mould)
Length of glabella .....	(6.8)	—	—	—
Length of pygidium .....	—	(6.3)	(6.8)	(9.6)
Maximum width of pygidium ....	—	(9.6)	(11.2)	(12)

*Description.* Glabella moderately convex, slightly expanded anteriorly; covered with fine, closely set tubercles. Lateral glabellar furrows strong posteriorly becoming weaker anteriorly; they are directed axially and posteriorly.

Pygidium relatively short with a moderately narrow, low, convex brim, closely and finely tuberculate. Axis with about twelve segments, with weakly developed axial nodes becoming indistinct posteriorly. Pleurae of about eight or more broad, relatively flat, ungrooved(?) segments separated by shallow, moderately wide furrows. All segments weakly tuberculate.

*Discussion.* The fragment of the glabella appears to compare very closely with *Dechenella (Basidechenella) pulchra* Stumm (1953, pp. 119, 120, pl. 3, fig. 4) of paratype 25514 which occurs in the Middle Devonian Gravel Point Formation of the Traverse Group, Michigan. This particular paratype is a small tuberculate relatively long glabella with distinct furrows. It differs from other material assigned by Stumm (op. cit.) to this species by having a less tapering glabella and more deeply incised furrows.

*Occurrence.* Represented only by illustrated specimens, from the lower part of the upper thick-bedded unit of the Horn Plateau Formation exposures.

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Plates I to XVII

**PLATE I**

Stereoscopic pair of vertical air photographs showing circular hill of Horn Plateau Formation exposures, east flank of Horn Plateau, District of Mackenzie. Parts of RCAF photographs A11030-167 and A11030-168. North is towards top of illustration. Scale 1 inch equals approx. 0.52 mile.

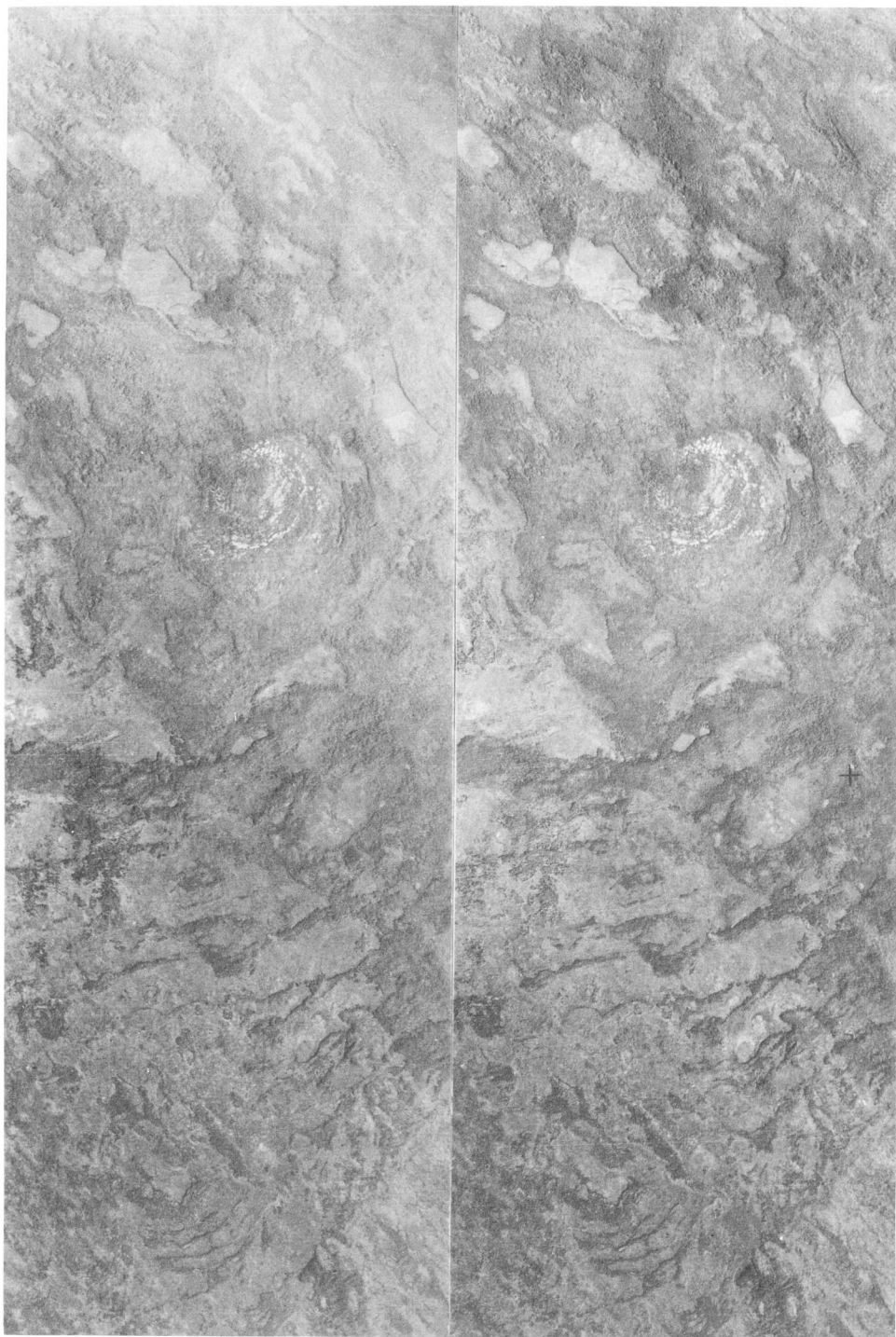


PLATE II

(Except where otherwise stated all figures are x2)

- Figures 1a-2b. *Disphyllum salicis* n. sp. (Page 8)  
1a, b. Transverse and longitudinal sections of holotype, GSC No. 16469a and b.  
2a, b. Transverse and longitudinal sections of paratype, GSC No. 16470a and b.
- Figures 3a, b. *Siphonophrentis?* sp. (Page 7)  
Transverse and longitudinal sections of GSC No. 16499a and b.
- Figures 4a-c. *Favosites* sp. (Page 6)  
Transverse and longitudinal sections of GSC No. 16498a, b, and c, x3.

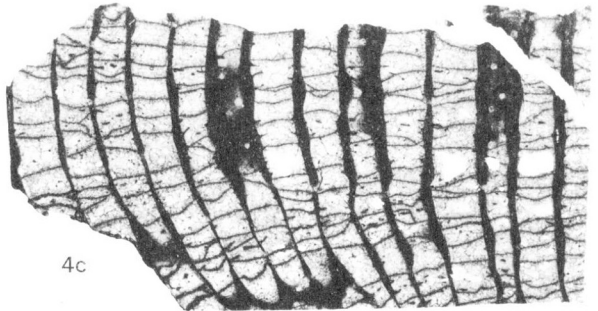
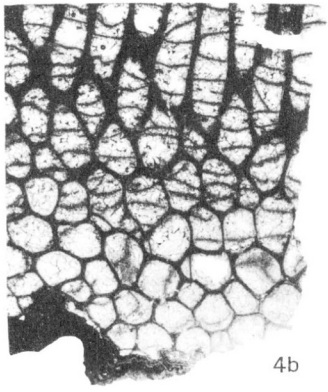
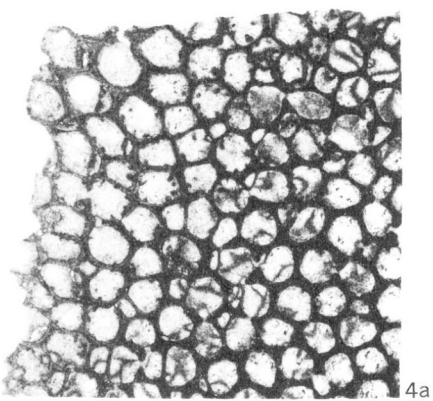
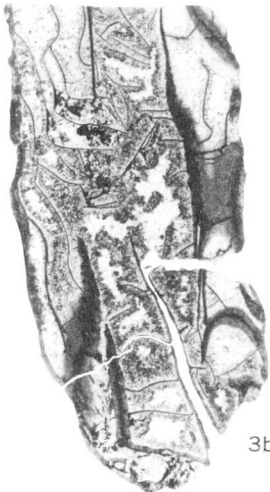
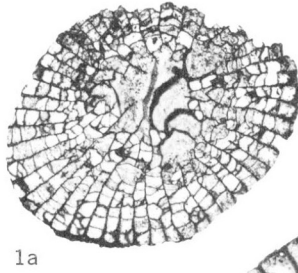
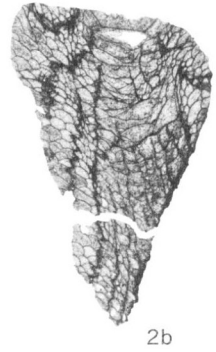
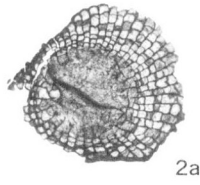
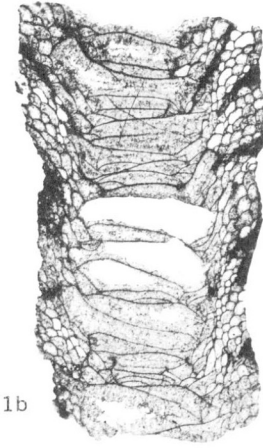
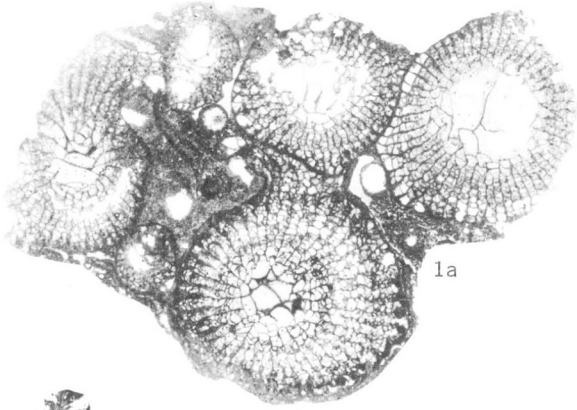




PLATE III

(All figures are magnified x2)

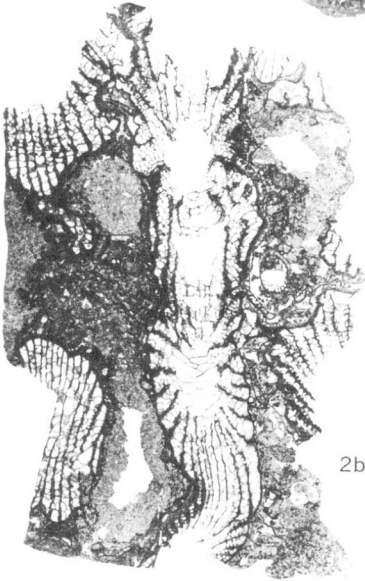
- Figures 1a-2b. *Cylindrophyllum gruensis* n. sp. (Page 9)  
1a, b. Transverse and longitudinal sections of holotype, GSC No. 16495a and b.  
2a, b. Transverse and longitudinal sections of paratype, GSC No. 16496a and b.
- Figures 3a-c. *Grypophyllum cornus* n. sp. (Page 10)  
Two transverse and one longitudinal section of holotype, GSC No. 16482a, b,  
and c.



1a



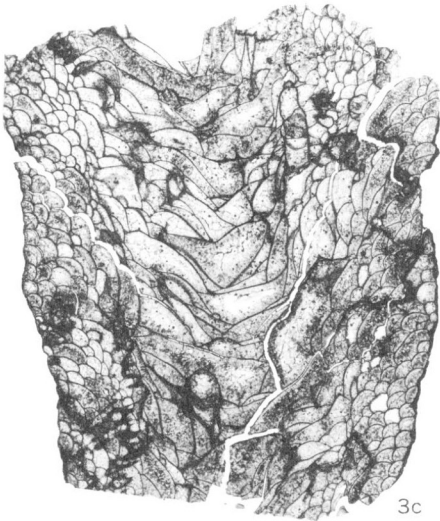
1b



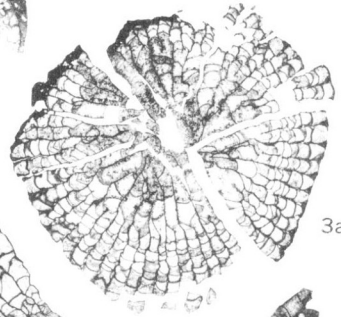
2b



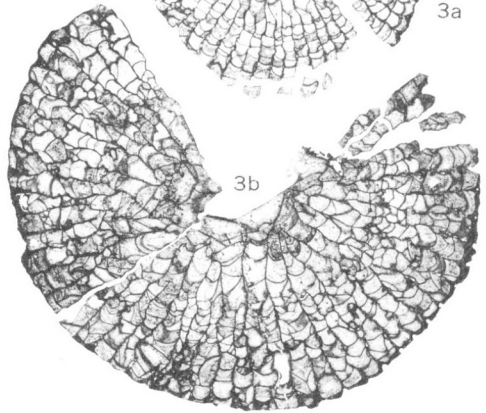
2a



3c



3a

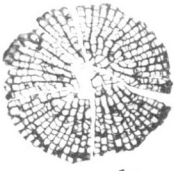


3b

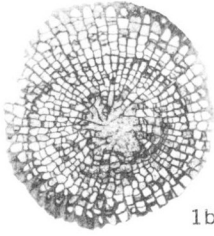
PLATE IV

(All figures are magnified x2)

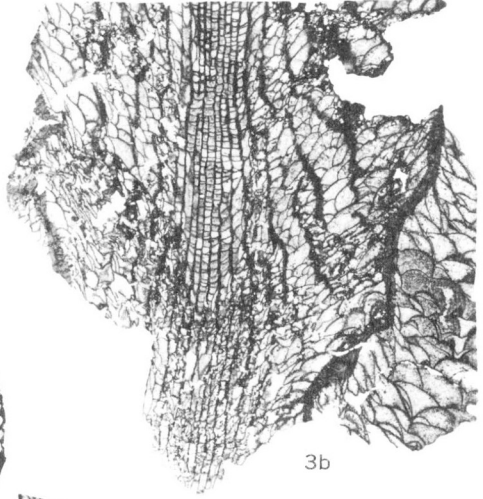
- Figures 1a-2c. *Neostingophyllum craigi* n. sp. (Page 11)  
1a-c. Two transverse and one longitudinal section of holotype, GSC No. 16477a, b, and c.  
2a-c. Two transverse and one longitudinal section of paratype, GSC No. 16478a, b, and c.
- Figures 3a-c. *Australophyllum?* cf. *A.? thomasaе* (Hill and Jones) (Page 13)  
One transverse and two longitudinal sections of GSC No. 16497a, b, and c.



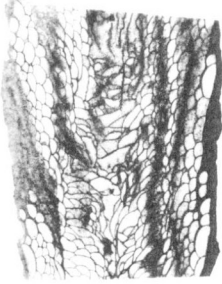
1a



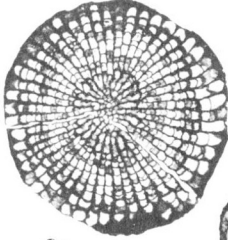
1b



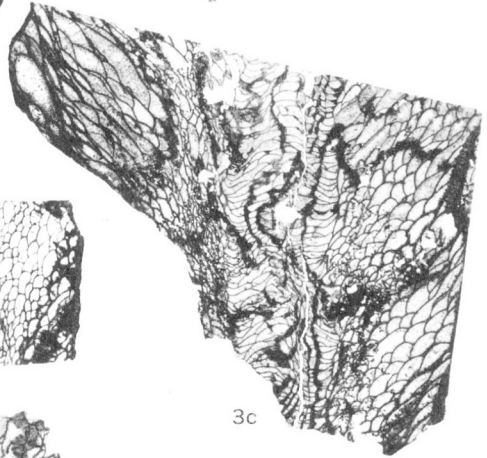
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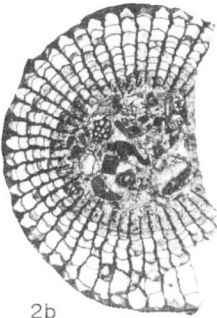
1c



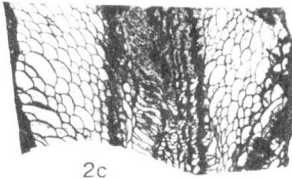
2a



3c



2b



2c



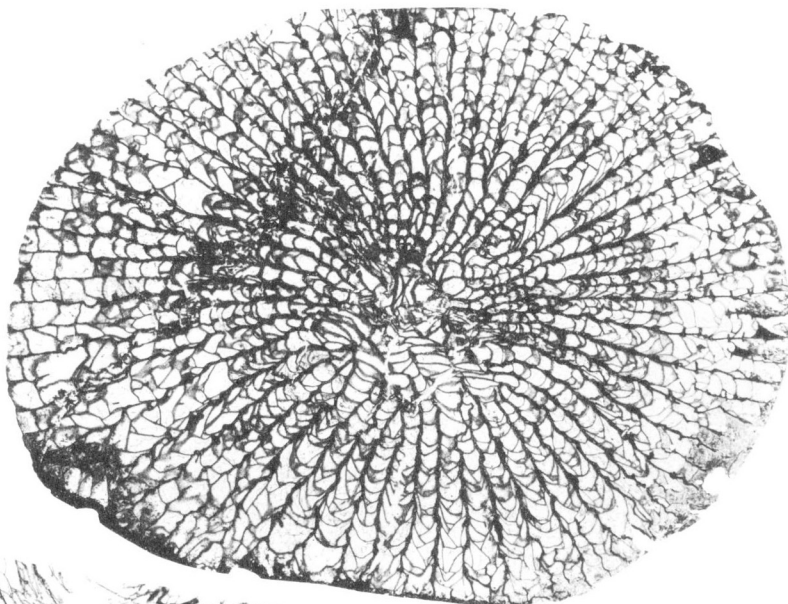
3a

PLATE V

(All figures are magnified x2)

Figures 1a-c. *Heliophyllum borealis* n. sp. (Page 15)  
Two transverse and one longitudinal section of holotype, GSC No. 16483a, b,  
and c.

1b



1c



1a

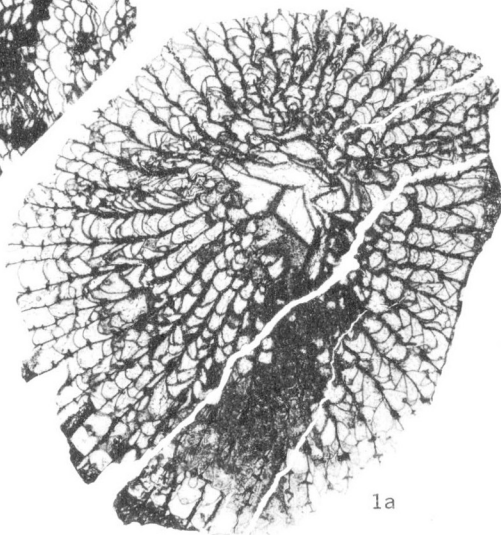


PLATE VI

(All figures are magnified x2)

- Figures 1a, b. *Heliophyllum borealis* n. sp. (Page 15)  
Transverse and longitudinal sections of paratype, GSC No. 16484a and b.
- Figures 2a-3. *Cyathophyllum (Peripaedium) greteneri* n. sp. (Page 16)  
2a, b. Transverse and longitudinal sections of holotype, GSC No. 16479a and b.  
3. Transverse section of paratype B, GSC No. 16481.

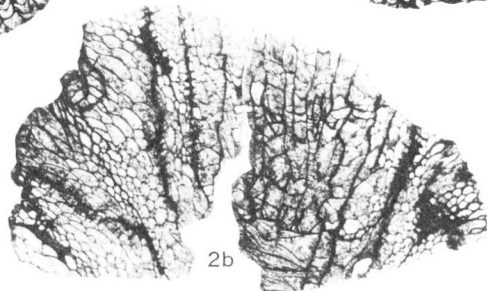
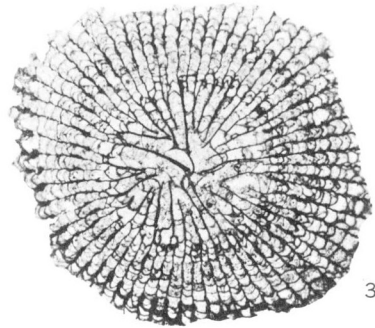
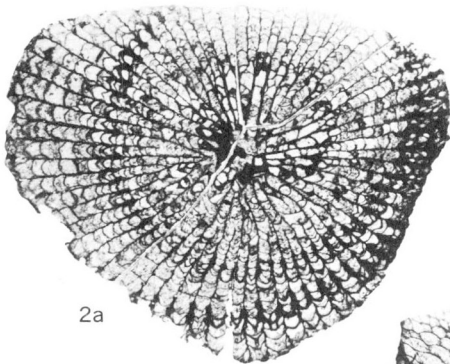
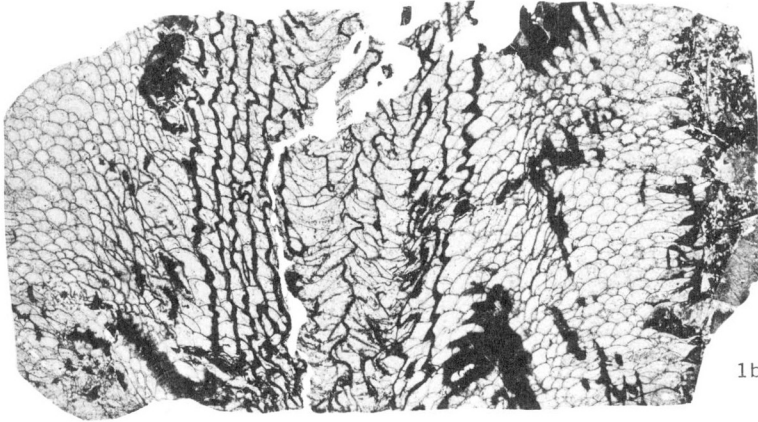
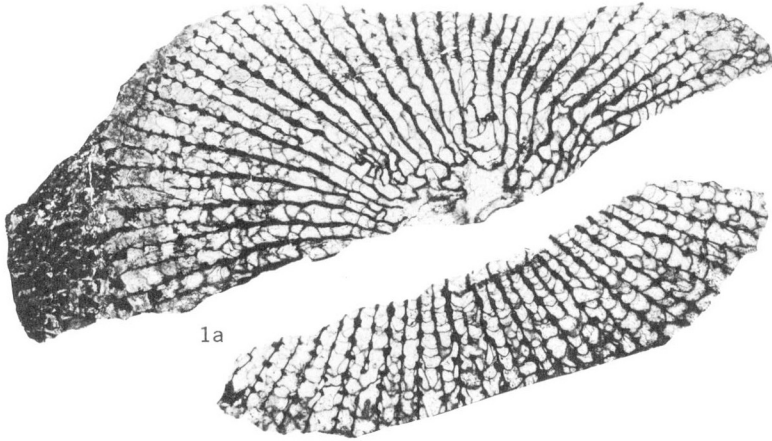




PLATE VII

(All figures are magnified x2)

- Figures 1a, b. *Cyathophyllum (Peripaedium) greteneri* n. sp. (Page 16)  
Transverse and longitudinal sections of paratype A, GSC No. 16480 a and b.
- Figures 2a-c. *Sinospongophyllum* cf. *S. planotabulatum* Yoh 1937 (Page 19)  
Two transverse and one longitudinal section of GSC No. 16476a, b, and c.
- Figures 3a-5b. *Stringophyllum (Sociophyllum) redactum* n. sp. (Page 20)  
3a, b. Transverse and longitudinal sections of paratype A, GSC No. 16472a and b.  
4a-c. Two transverse and one longitudinal section of paratype C, GSC No. 16474a,  
b, and c.  
5a, b. Transverse and longitudinal sections of holotype, GSC No. 16471a and b.

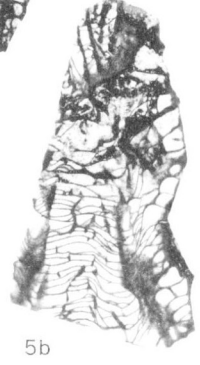
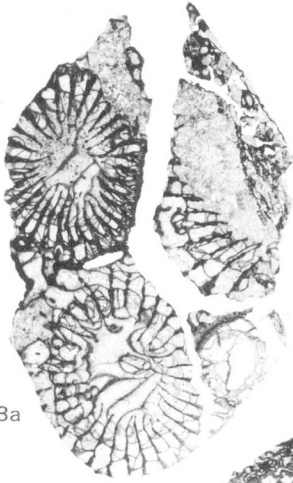
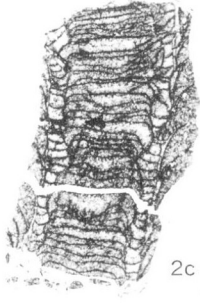
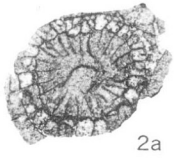
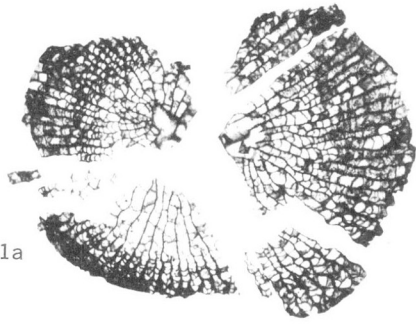


PLATE VIII

(All figures are magnified x2)

- Figures 1a-2b. *Stringophyllum (Sociophyllum) redactum* n. sp. (Page 20)  
1a, b. Transverse and longitudinal sections of paratype B, GSC No. 16473a and b.  
2a, b. Transverse and longitudinal sections of paratype D, GSC No. 16475a and b.
- Figures 3a-4b. *Lekanophyllum* cf. *L. punctatum* Wedekind (Page 23)  
3a, b. Transverse and longitudinal sections of specimen A, GSC No. 16493a and b.  
4a, b. Transverse and longitudinal sections of specimen B, GSC No. 16494a and b.

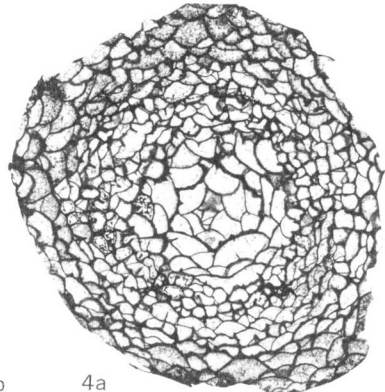
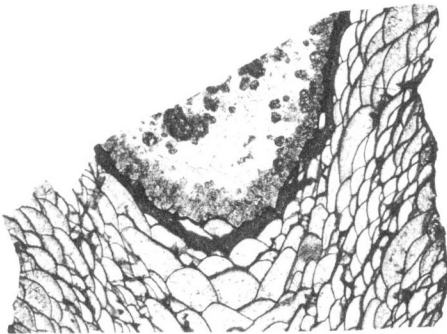
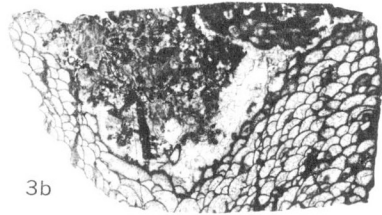
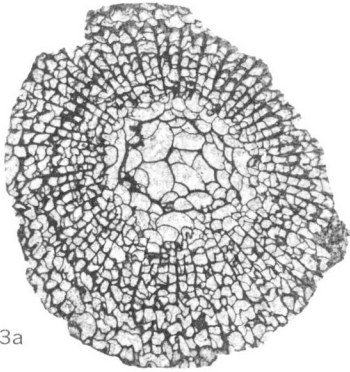
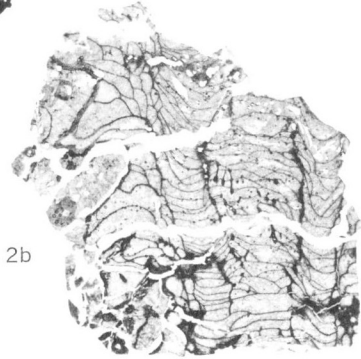
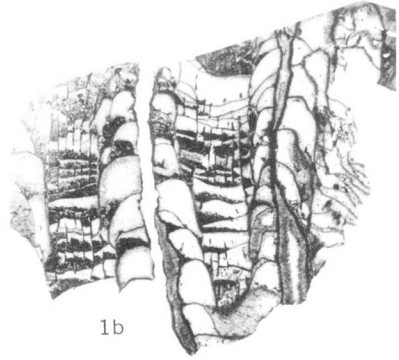
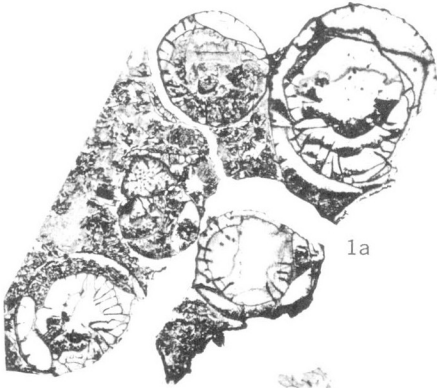


PLATE IX

(All figures are magnified x2)

- Figures 1a-4c. *Cystiphyllodes spinosum* n. sp. (Page 24)
- 1a, b. Transverse and longitudinal sections of holotype, GSC No. 16489a and b.
  - 2a, b. Transverse and longitudinal sections of paratype A, GSC No. 16490a and b.
  - 3a-c. Two transverse and one longitudinal section of paratype B, GSC No. 16491a, b, and c.
  - 4a-c. Two transverse and one longitudinal section of paratype C, GSC No. 16492a, b, and c.

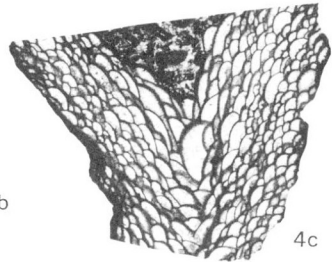
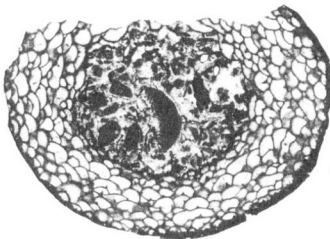
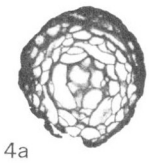
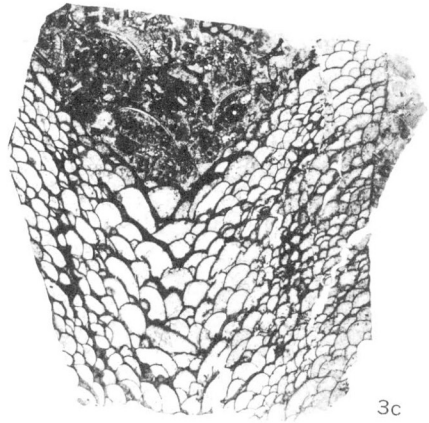
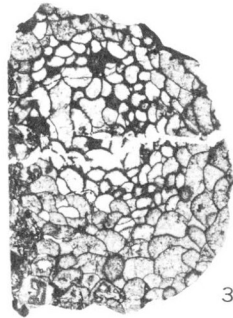
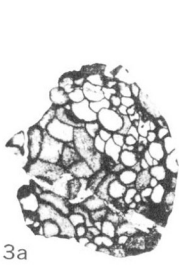
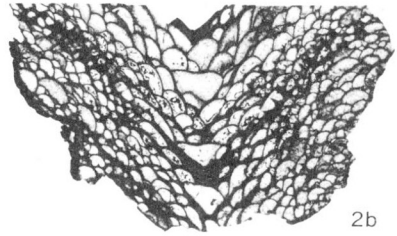
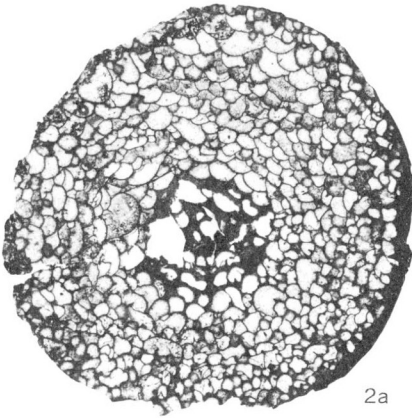
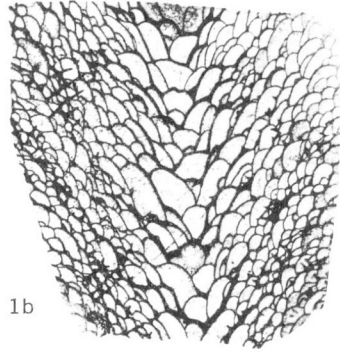
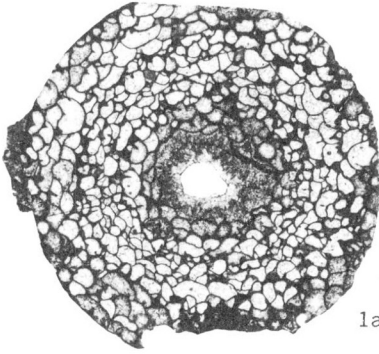
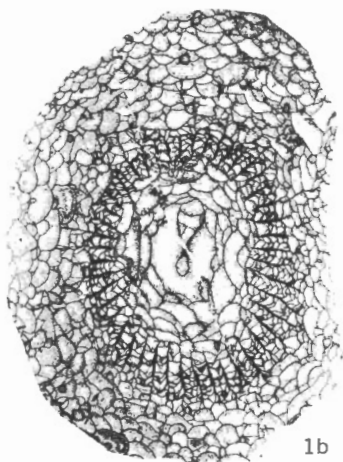


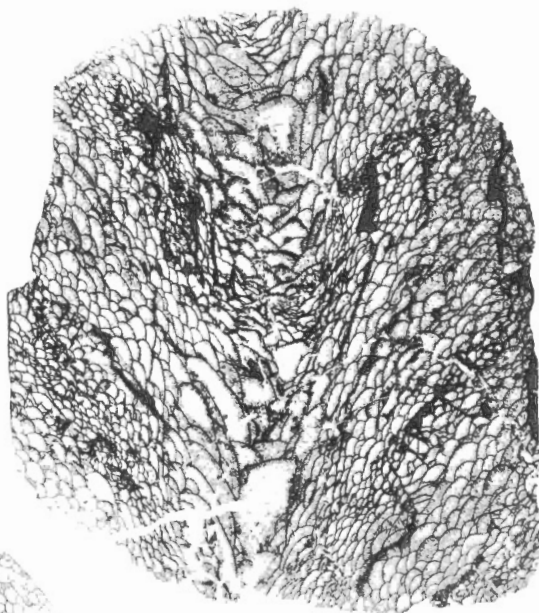
PLATE X

(All figures are magnified x2)

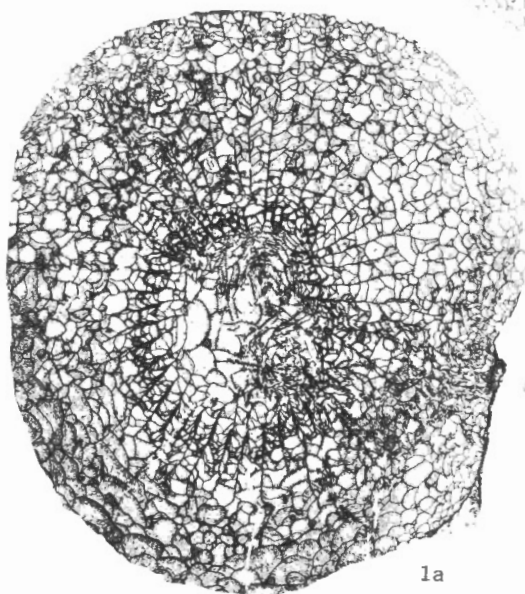
- Figures 1a-2b. *Atelophyllum nebracis* n. sp. (Page 25)  
1a-c. Two transverse and one longitudinal section of holotype, GSC No. 16485a, b,  
and c.  
2a, b. Transverse and longitudinal sections of paratype A, GSC No. 16486a and b.



1b



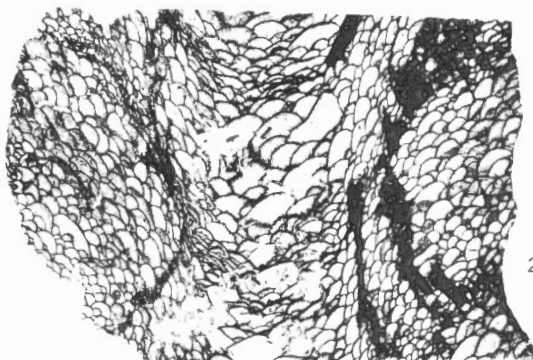
1c



1a



2a



2b



PLATE XI

(All figures are magnified x2)

- Figures 1-2d. *Atelophyllum nebracis* n. sp. (Page 25)  
1. Longitudinal section of holotype, GSC No. 16485d.  
2a-d. Transverse and longitudinal sections of paratype B, GSC No. 16487a, b, c,  
and d.

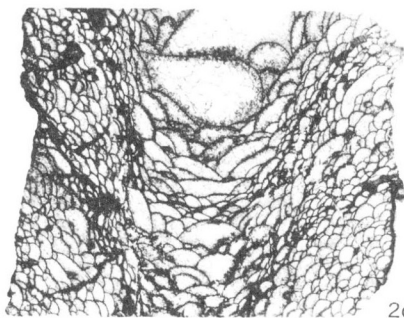
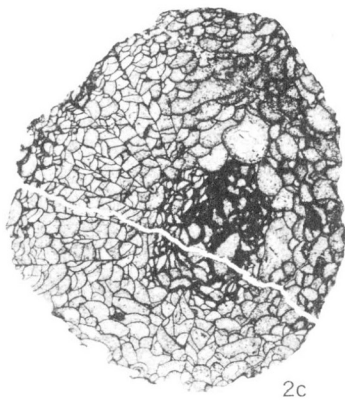
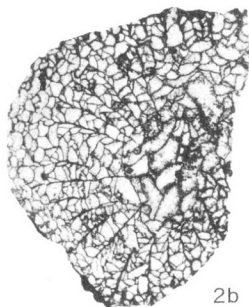
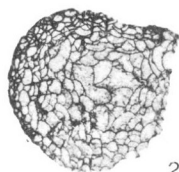
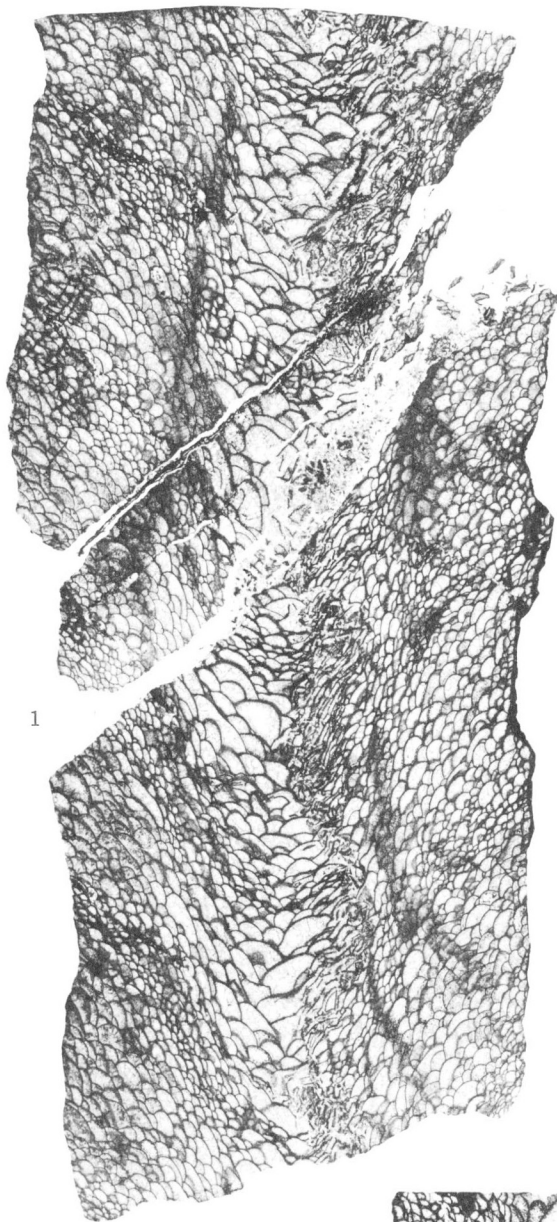
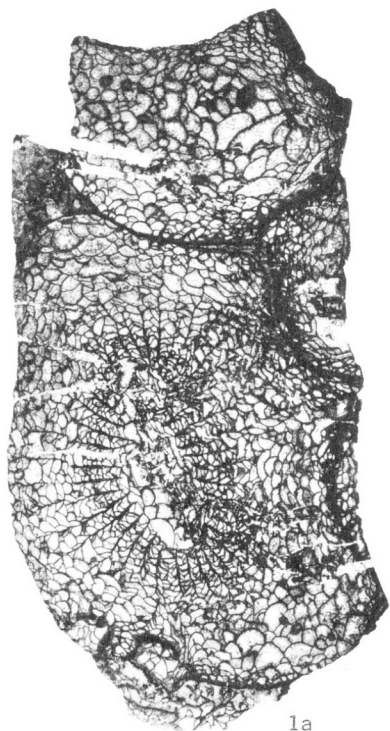


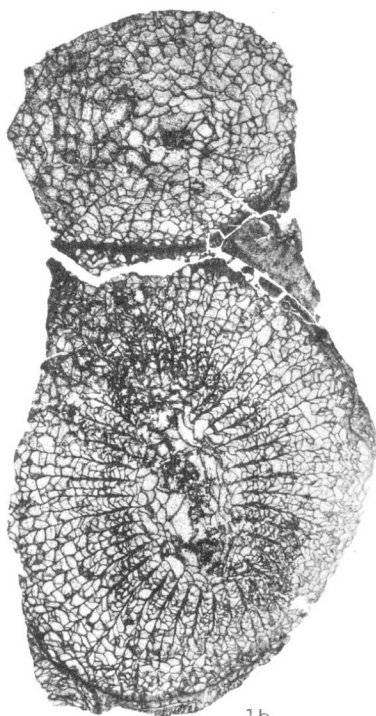
PLATE XII

(All figures are magnified x2)

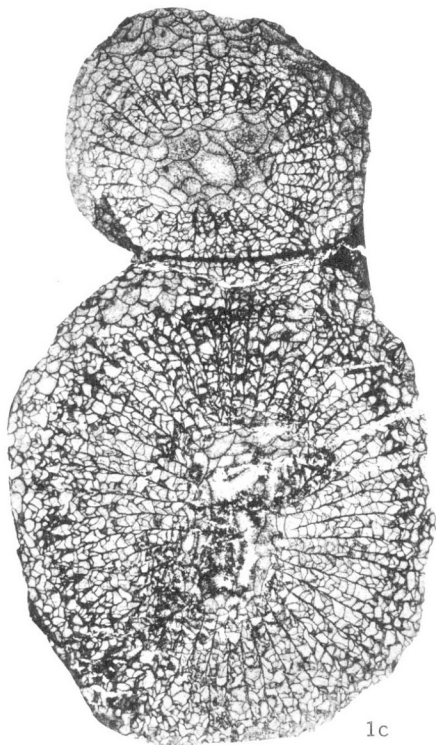
Figures 1a-d. *Atelophyllum nebracis* n. sp. (Page 25)  
Transverse sections of paratype C, GSC No. 16488a, c, d, and e (the larger corallite) and paratype D, GSC No. 16500a, c, d, and e (the smaller corallite).



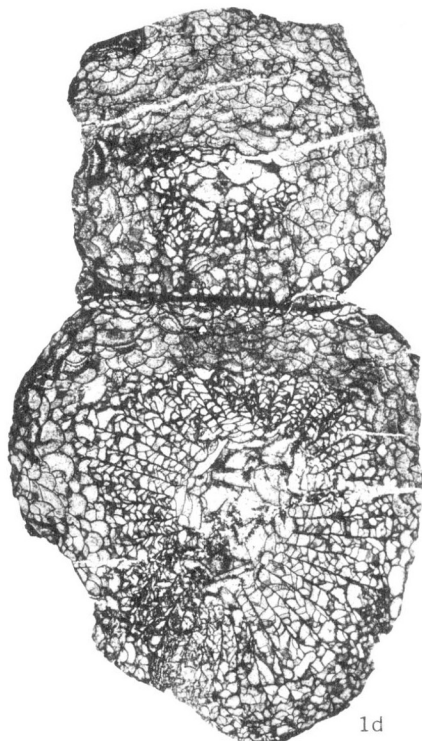
1a



1b



1c



1d

### PLATE XIII

(Figures are natural size unless otherwise indicated)

- Figures 1a-c. *Conocardium* sp. (Page 32)  
Left, anterior, and posterior views (x3) of GSC No. 16044.
- Figures 2a-4e. *Schizophoria fasciostella* n. sp. (Page 33)  
2a, b. View of pedicle valve, and same at x2 of paratype GSC No. 16045.  
3. Pedicle valve of a young individual, paratype GSC No. 16046.  
4a-e. Brachial, pedicle, anterior, posterior, and lateral views of an adult individual, holotype GSC No. 16047.
- Figures 5a-7. *Gypidula?* spp. (Page 35)  
5a, b. Lateral and posterior views of individual embedded in coral matrix, GSC No. 16048.  
6. Lateral view of gerontic individual, GSC No. 16049.  
7. Pedicle view of a weakly costate individual, GSC No. 16050.
- Figures 8a-e. *Pentamerella* sp. (Page 36)  
Brachial, pedicle, anterior, posterior, and lateral views of a nearly complete individual, GSC No. 16051.
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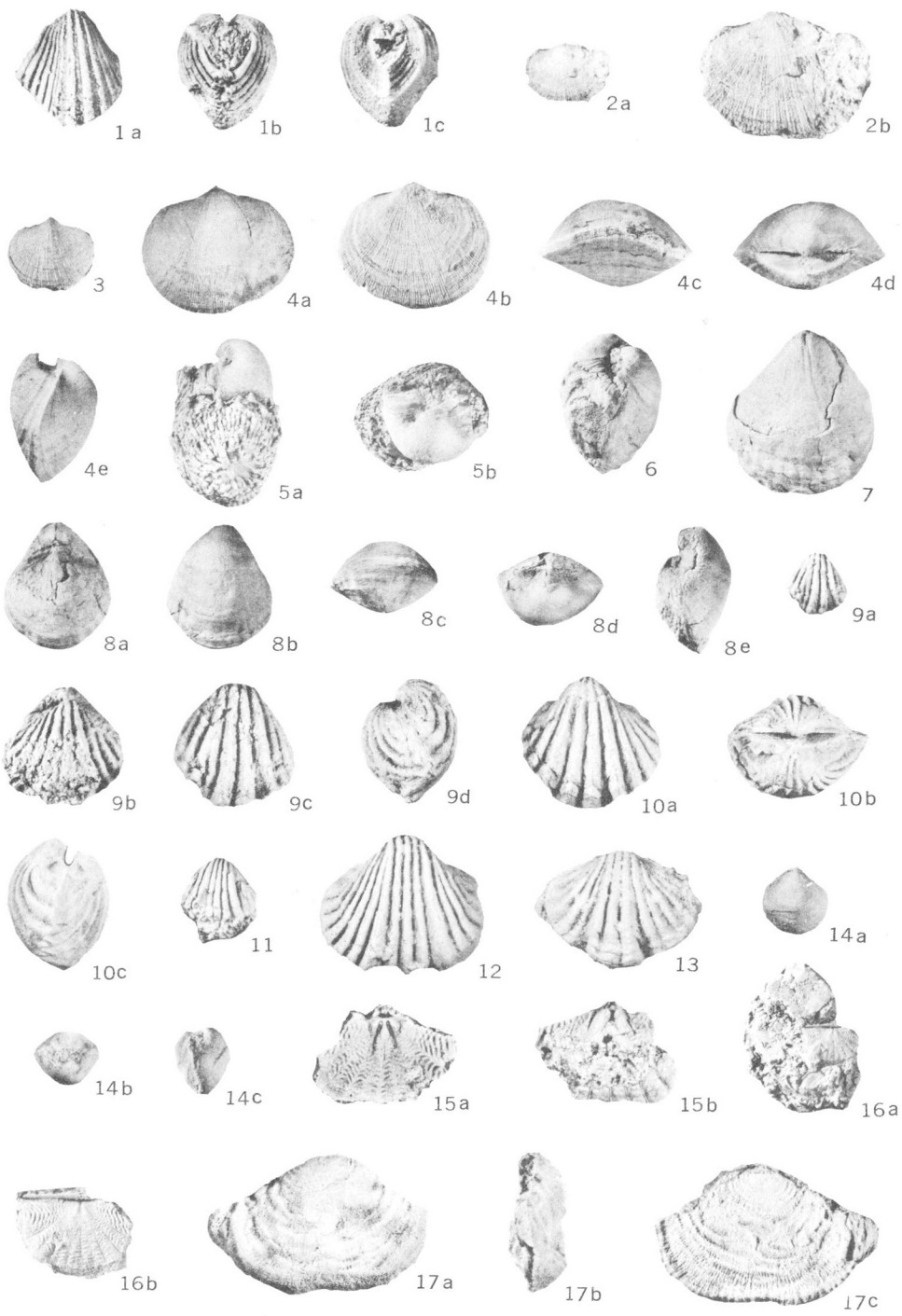


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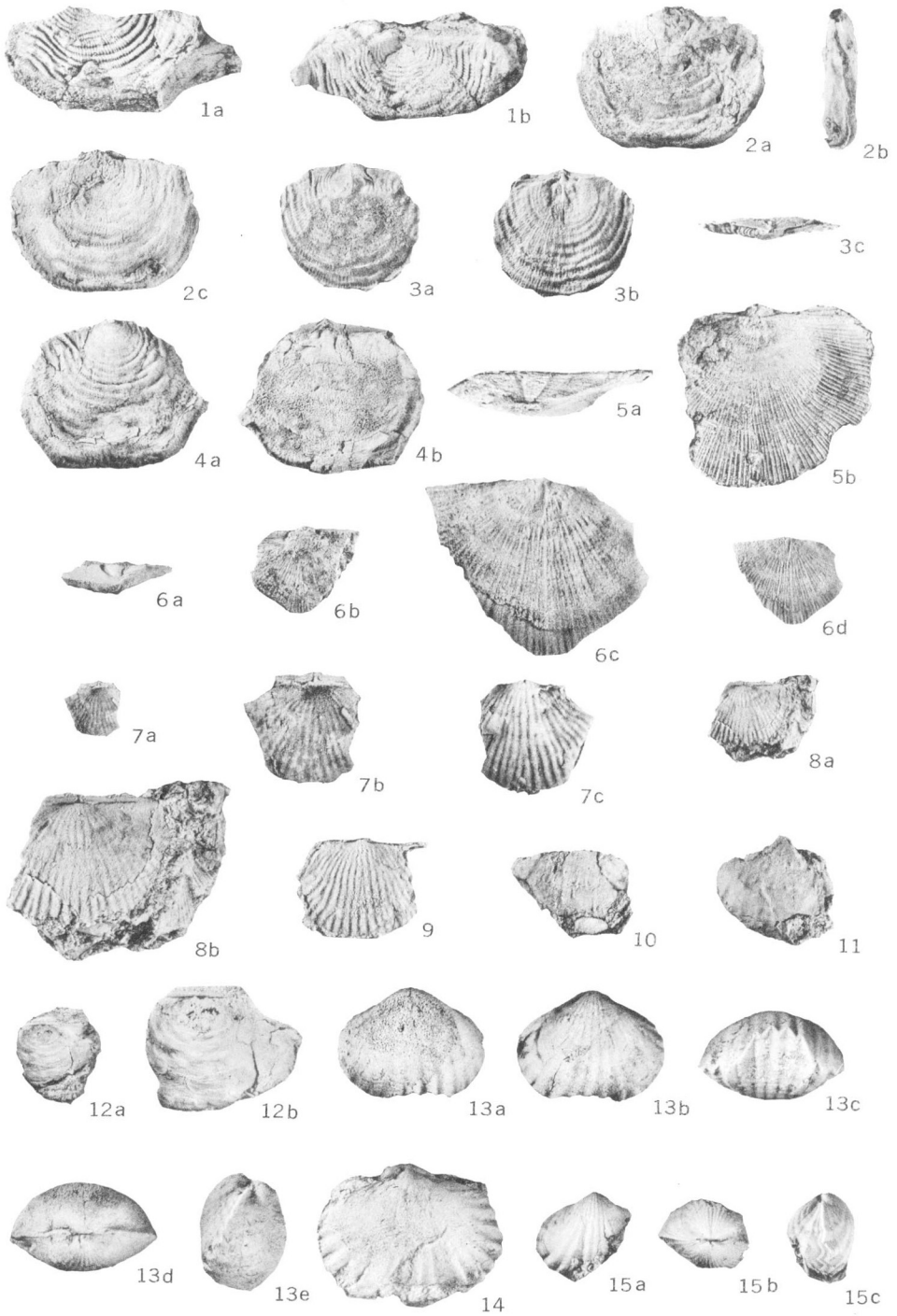




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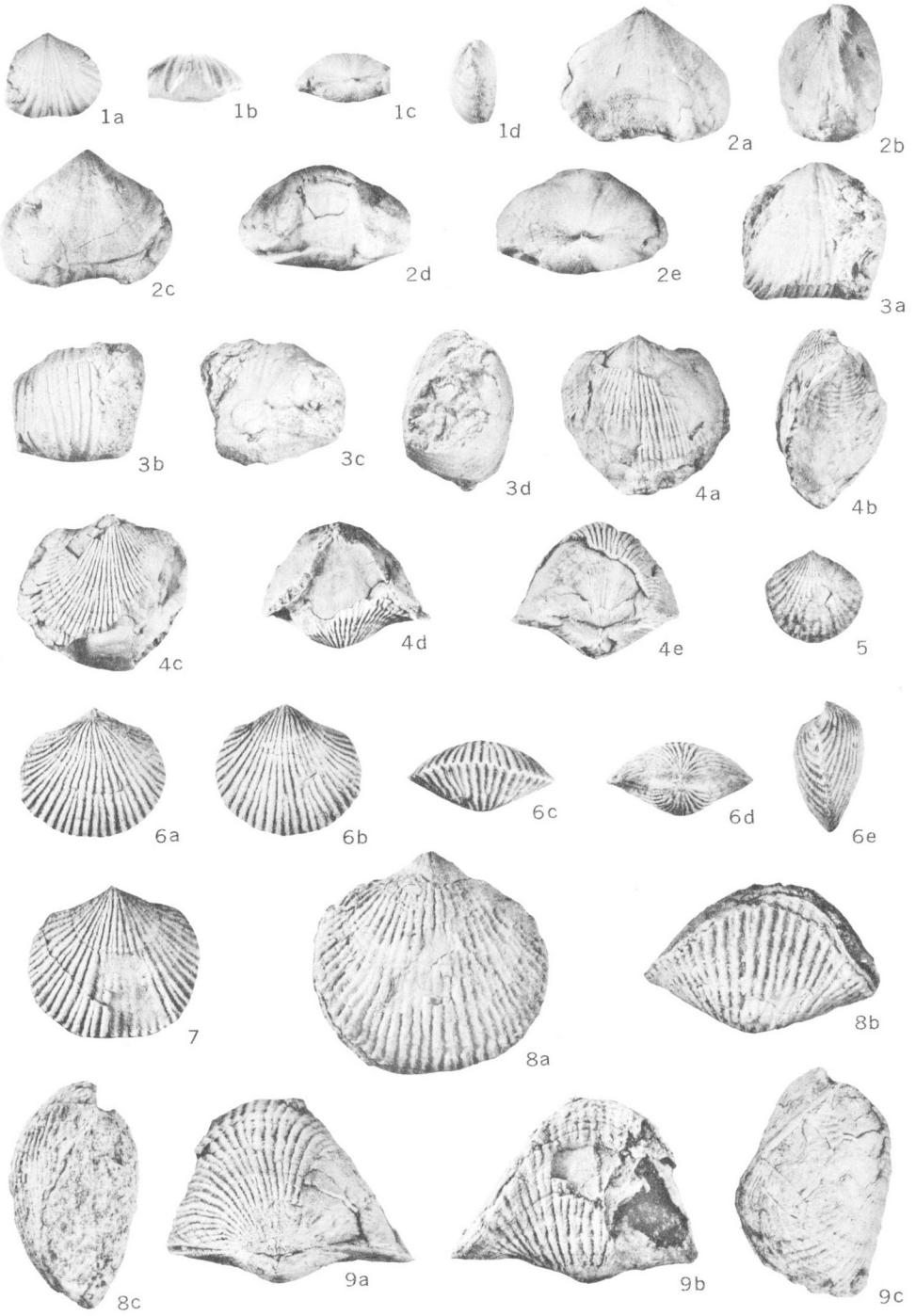


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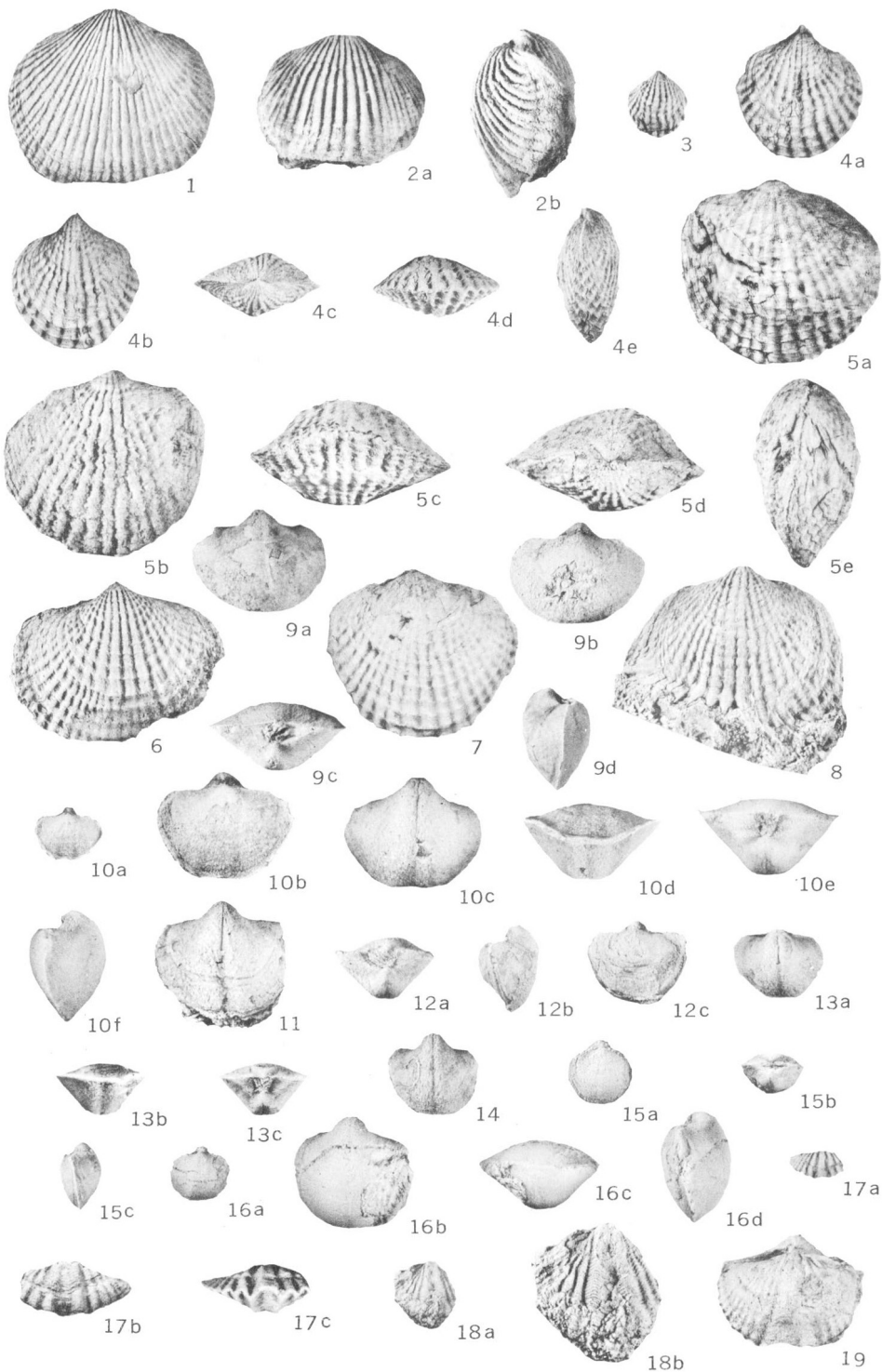
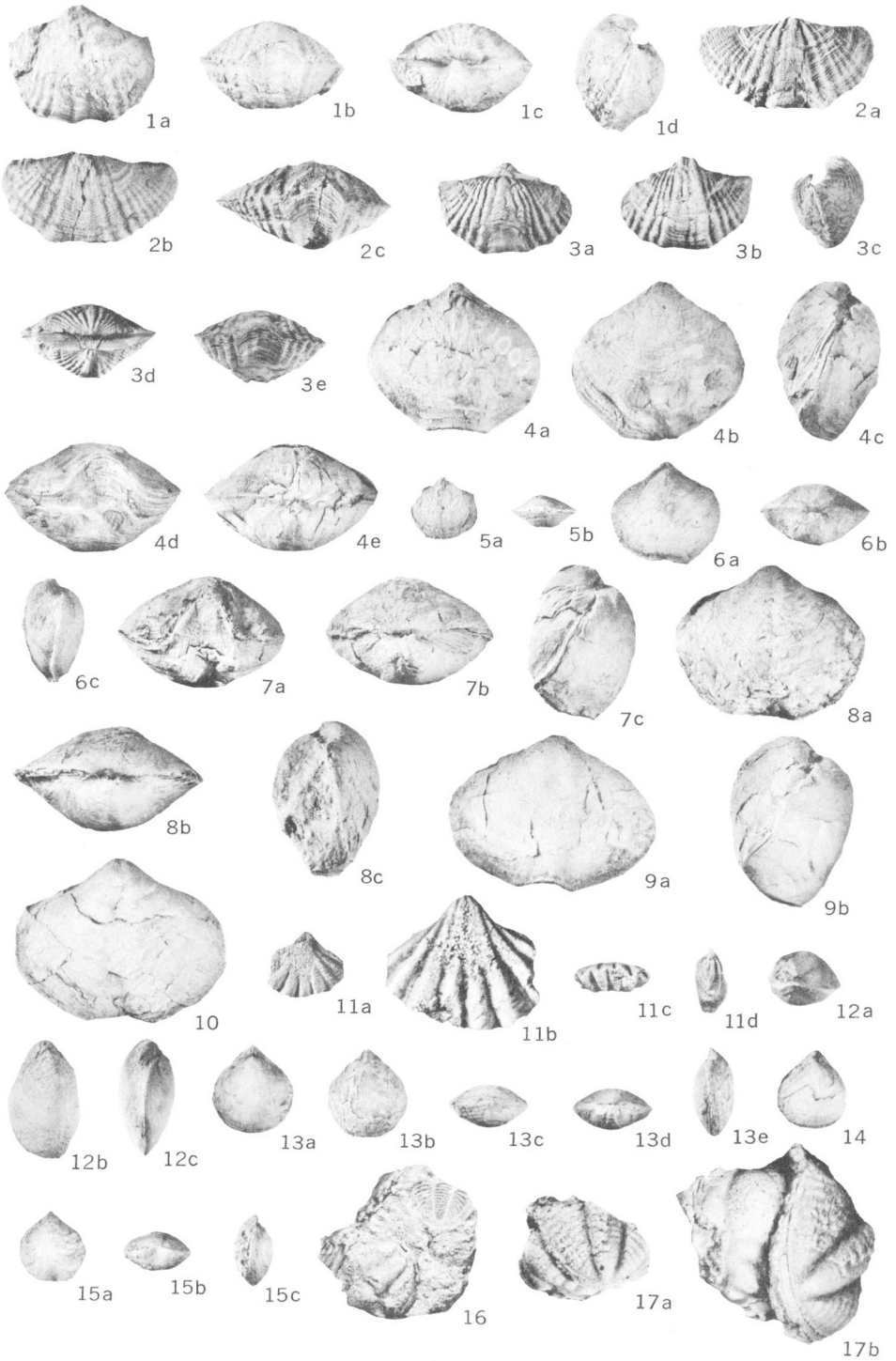


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