

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

BULLETIN 121

DEVONIAN CORALS FROM  
THE CANNING BASIN  
WESTERN AUSTRALIA



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# DEVONIAN CORALS FROM THE CANNING BASIN WESTERN AUSTRALIA

by

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Issued under the Authority of the Hon. A. F. Griffith, M.L.C., Minister for Mines

## **PREFATORY NOTE**

During recent years the Geological Survey of Western Australia has been studying the Devonian reef complexes of the Lennard Shelf on the northern margin of the Canning Basin. This work has been led by Dr. P. E. Playford, who describes the geology of the area in Bulletin 118, supported by a number of other investigators who have studied certain facets in more detail.

The Survey is grateful to Drs. Dorothy Hill and John Jell of the University of Queensland for their co-operation by making a detailed study of the rugose and tabulate corals, which form an important part of the Devonian fauna of the Lennard Shelf.

This comprehensive study should prove of great assistance to those who are investigating the hydrocarbon potential of the Devonian rocks in the northern portion of the Canning Basin.

4th November, 1969.

J. H. LORD,  
Director.

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## Summary

The rugose and tabulate coral faunas of the reef complexes of the northern margin of the Canning Basin (Lennard Shelf) in the Kimberley Division of Western Australia are richest in the fore-reef (Sadler Limestone, 25 species) and back-reef (Pillara Limestone, 23 species) facies. Three species occur in the Gogo Formation (inter-reef facies) and eight species in the Virgin Hills and seven in the Napier Formations (fore-reef and inter-reef facies). Five species have been recognised in the Devonian section of the overlying transgressive Fairfield Formation. The 46 species described are referred to 15 rugose and 3 tabulate genera; 9 species are new: *Metriophyllum trochoides*, *Syringaxon dickinsi*, *Phacellophyllum kimberleyense*, *Haplothecia? laciniosa*, *Hexagonaria playfordi*, *Temnophyllum occidentale*, *T. menyounense*, *T. incomptum* and *Tabulophyllum? lowryi*. Additional material of previously described species has widened our knowledge of their stratigraphical distribution and of the range of variation possible in them.

Of the Rugosa, the aulate laccophyllids are discussed and *Laccophyllum* Simpson, *Alleynia* Pořta and *Saucrophyllum* Philip are placed in synonymy with *Syringaxon* Lindström together with six other possible synonyms. Phillipsastraecidae form a major part of the fauna; amongst the cerioid disphyllinids, the genus *Hexagonaria* Gürich is revised, *H. hullensis* Hill is transferred to *Argutastrea* Crickmay and *Prismatophyllum breviamellatum* Hill is referred to *Donia* Soshkina; the relationship of *Temnophyllum* to other solitary phillipsastraecids is discussed. The relationship between *Tabulophyllum* Fenton and Fenton and solitary endophyllids is considered.

Of the Tabulata, *Alveolitella* Sokolov is considered a synonym of *Alveolites* Lamarck and it is suggested that *A. cf. saleei* Lecompte, *A. suborbicularis* Lamarck and *A. tumidus* (Hinde) may be different growth forms of the same series.

New figures are given for the type specimens of *Syringaxon siluriense* (McCoy), *Catactotoechus irregularis* Hill, *Haplothecia filata* (Schlotheim), *Hexagonaria hexagona* (Goldfuss), *Donia breviamellata* (Hill), *Argutastrea arguta* Crickmay, *A. hullensis* (Hill), *Disphyllum depressum* (Hinde) and *Temnophyllum? floriforme* Hill and a new transverse section of the type specimen of *S. siluriense* is described.

The coral fauna comprises few species but abundant individuals suggesting that the region was near the limit of coral growth. The species indicate a late Givetian to Upper Devonian age for the reef complexes.



# Introduction

Corals form an important element of the fauna of the Devonian reef complexes of the Lennard Shelf on the northern margin of the Canning Basin, Western Australia. They are also known from the Fairfield Formation which overlies the reef complexes. Most of the material used in this study is from the Geological Survey of Western Australia collection (prefixed herein GSWA) made by P. E. Playford and D. C. Lowry, and the Bureau of Mineral Resources collection (prefixed herein BMR) made by J. M. Dickins, G. A. Thomas and J. J. Veevers in collaboration with geologists of West Australian Petroleum Pty. Ltd. (WAPET). These two collections complement each other. A third (smaller) collection, part of the University of Western Australia collection (prefixed herein UWA), was made by C. Teichert.

Descriptions of earlier collections of Devonian corals from Western Australia are by Hinde (1890) and Hill (1936a, 1939b, and 1954).

The new collections emphasize that the Western Australian Devonian coral fauna was poor in species, though rich in individuals. In modern seas wealth in individuals and poverty in species is commonly found near the southern and northern limits of coral growth.

The GSWA and BMR collecting localities are shown in text-figures 1 and 2 (the prefixes G, and K refer to GSWA and BMR localities, respectively). Precise geographical co-ordinates and the formations from which these collections, and those of Teichert, were made are given in Appendix 1. The stratigraphical nomenclature and the interpretation of facies used are those of Playford and Lowry (1966) and are summarized in their figure 8, reproduced here as text-figure 3.

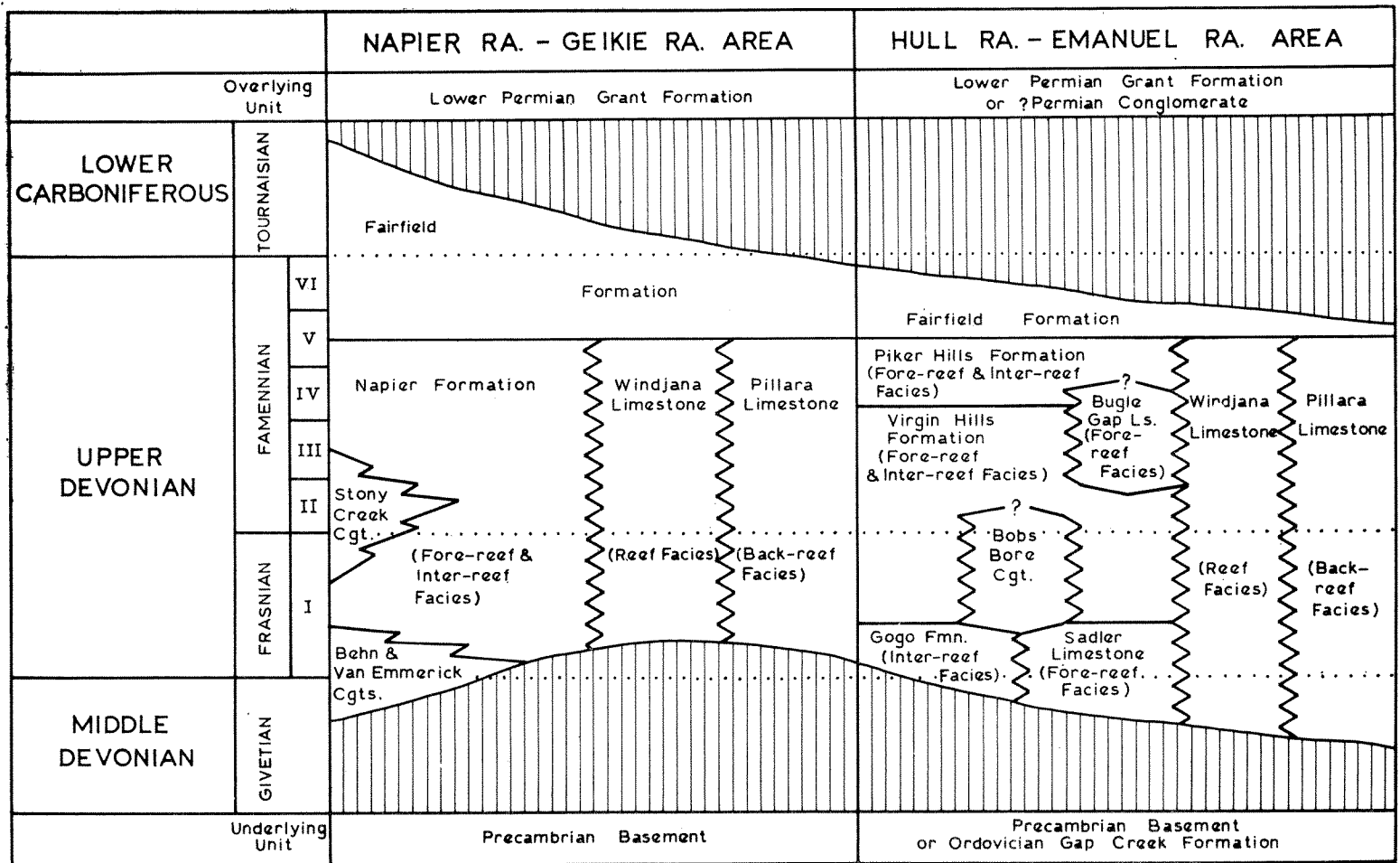
The distribution of species is shown on text-figure 4. The absence of *Favosites* and *Heliolites* and of all members of the rugosan family Ptenophyllidae is striking, and possibly means that the oldest of the faunas is no older than late Givetian, and that the bulk of the succession is Upper Devonian. The ages suggested by the various faunas together with lists of species from the different localities are given in Appendix 1.







Figure 3.



# Systematic Descriptions

Order RUGOSA Edwards & Haime, 1850

Suborder STREPTELASMATINA Wedekind, 1927

Family LACCOPHYLLIDAE Grabau, 1928

Genus *Catactotoechus* Hill, 1954

TYPE SPECIES: *Catactotoechus irregularis* Hill (1954, p. 10), see below.

DIAGNOSIS: Solitary coralla with, in early stages, a tabulate axial tube formed mainly by the dilatation to contiguity of the somewhat withdrawn axial ends of the major septa; in later stages the tube is breached and disappears; minor septa absent or sporadic in occurrence; dissepiments in a single incomplete series, each dissepiment connecting two neighbouring major septa.

REMARKS: This genus may be a junior synonym of *Nicholsoniella* Soshkina (1952) of which the type species, *Nicholsoniella baschkirica* Soshkina (1952, p. 66, pl. 2, fig. 5, text-fig. 67) from the Upper Devonian (Frasnian, beds with *Manticoceras intumescens*) of the River Belaya on the road from Kuk-Kula to Akavaz in the southern Urals was refigured from syntypes and topotypes by Soshkina (1960, pl. 6, figs. 1-5). *Nicholsoniella* is distinguished firstly by an axial tubular space formed by the confluence in a ring of the thickened and somewhat withdrawn axial ends of the major septa, and into which the cardinal fossula opens in adult stages, and secondly by the development of an imperfect dissepimentarium in the late adult stages. In the type species the cardinal septum is short in the adult stages.

The "aulos" of *Catactotoechus* is very similar; it is found only in the young stages; it is formed in the main by contiguity of the thickened and somewhat withdrawn axial ends of the major septa, but the tabulae inside it are developed independently from those outside it; in one specimen the edges of an axial tabula turn down to touch the edges of that next below, thus forming a short cylindrical box; in another the axial ends of some thickened major septa are turned aside to touch their neighbours and thus to form an imperfect "aulos". Only the first of these three types of tubular axial space has so far been described or figured in *Nicholsoniella*.

*Nalivkinella* is another genus which must be considered in relation to *Catactotoechus*. Its type species, *Nalivkinella profunda* Soshkina (1939, p. 43, pl. 11, figs. 91-95) is from the Upper Devonian (Famennian, beds with *Clymenia*, of the eastern slopes of the Urals in the region of Verkhneuralsk, north of the Popovsky Farm). The longitudinal section illustrated shows peripherally convex

but axially flat or concave tabulae. These peripheral parts were, in 1939, misidentified as dissepiments; as Soshkina (1951, p. 31) later stated, dissepiments are not present in the type material. The transverse section figured shows major septa withdrawn somewhat from the axis, and possibly flanged (Soshkina, 1939, pl. 11, fig. 92), perhaps as in *Metriophyllum*, though proof of the flanges is not available from the longitudinal section or from the descriptions. The young stages of the type species are not known from syntypes or topotypes. Spasskiy (1960, p. 84) states that the holotype is from "analogues" (sic) of the Biya Beds (Middle Devonian) near Pokrovsk; but this seems anomalous in view of Soshkina's (1939, p. 10) mention of *Clymenia*.

Recently, Oliver (1964) has considered it likely that *Amplexiphyllum* Stumm (1949, type species *Amplexus hamiltonae* Hall, 1876, pl. 19, figs. 20-23 from the Middle Devonian Hamilton group of western New York) is a subjective synonym of *Nalivkinella*; but it seems to us that fuller morphological information on the type species of *Nalivkinella* is necessary before this likelihood can be correctly assessed.

*Amplexocarinia* Soshkina (1928, type species *A. muralis* Soshkina, 1928, p. 379, text-figs. 19a-f from the Lower Permian of the River Shchugor, in the northern Urals, U.S.S.R.) is distinguished by its thin, persistent aulos. As Glinski (1963, p. 329) has noted, if the type specimen of *Nalivkinella profunda* has septal flanges, the flanged *Metriplexus* Glinski, 1963, could be a subjective synonym of *Nalivkinella*.

DISTRIBUTION: Upper Devonian, Canning Basin, Western Australia.

### **Catactotoechus irregularis Hill, 1954**

Plate 1, figs. 1-5, 20-24

1954 *Catactotoechus irregularis* Hill: p. 10, pl. 3, figs. 31-36.

HOLOTYPE: UWA 33535 from Oscar Hill, 1 mile south of Oscar Homestead, Kimberley Division, Western Australia. This locality, previously referred to the Bugle Gap Limestone, is now (Veevers, 1959, p. 23; Playford and Lowry, 1966) mapped in the Fairfield Formation in the *Spinulicosta proteus* Zone, i.e. the *Productella* Zone which Teichert (1949, p. 16) correlated with Oberdevonstufe IV of the German sequence; Famennian.

NEW MATERIAL: Numerous specimens from the same locality as the holotype (G1010, K283, U3) and from G1075, G1055 and G1011 in the Fairfield Formation; from K221, K224, K225, K226, ?K227, ?K230 in the Sadler Limestone; from K463 in the Pillara Limestone and doubtful specimens from K190 in the Virgin Hills Formation.

DIAGNOSIS: Solitary corallites with irregular expansions and contractions, maximum diameter 12 mm; with sporadic dissepiments and occasional very short minor



septa; major septa long and dilated almost to contiguity in early stages, thin and short to very short in adult stages; aulos variably developed in conical regions and later represented only by sharp marginal geniculations of the tabulae.

ONTOGENY: Series of sections were obtained through the conical parts of two topotypes; not all the sections were truly transverse, owing to the slightly curved growth form and the attachment talons. They show that the axial, tubular, tabulate space is not formed in only one way. It gets its shape either from the turning aside to contiguity of the axial ends of the thickened major septa, or from the continuation of the septal thickening over the outer surfaces of the tabulae in the region where they are downturned, or from a combination of both conditions; in some parts also, the space is defined only by the contiguity of the thickened, straight and somewhat withdrawn axial ends of the major septa.

REMARKS: New material from the Fairfield Formation used in this study and showing no deviation from the already known range of variation is from the same locality as the holotype (G1010, K283, U3), and from G1075A and G1011. Specimens from the Virgin Hills Formation at K190, are doubtfully included in this species: dissepiments are extremely rare and there are fewer septa (20-22).

A large number of specimens, from the Sadler Limestone at K221 and K230, are weathered out from the matrix and closely resemble topotypes of the species. Their external form is characteristic; the epitheca shows fine growth lamellation only, the lamellation being commonly somewhat oblique to the axis of the corallite and the obliquity varying in successive regions. No longitudinal ribs or furrows such as distinguish specimens of *Syringaxon dickinsi* sp. nov. can be found on the *Catactotoechus* specimens, but the major septa can be seen through the semi-transparent epitheca and on slightly worn specimens, and show a characteristic wide and parallel spacing. Internal structure varies in the manner suggested by the two specimens figured by Hill (1954, pl. 2, figs. 32, 33), from a condition in which the aulos is well defined and the tabulae rather distant, to a condition in which the aulos is variably developed to absent and the tabulae become incomplete and the tabularial floors tend to flatten, while the major septa withdraw somewhat unequally from the axis; at the same time sporadic dissepiments appear, more in some corallites than in others. Minor septa are consistently absent. One specimen from K463 in the Pillara Limestone is tentatively referred to *C. irregularis*.

DISTRIBUTION: Fairfield and Virgin Hills Formations, Sadler and Pillara Limestones, Canning Basin; Upper Devonian.

***Catactotoechus* sp. aff. *C. irregularis* Hill, 1954**

Plate 1, figs. 13-18

Ten small weathered incomplete corallites BMR CPC.9510-19 from K177, include five (9512, 3, 5, 7, 9) that we take to resemble *Catactotoechus irregularis*, though in 9517 the aulos is still present at a diameter of 12 mm; one (9512)

presents a transverse section almost identical with that figured by Hill (1954, pl. 3, fig. 35); three (9510, 1, 8) show a very considerable development of tabellae and irregularity in length, thickness and straightness of the septa combined with a widening of the dissepimentarium; two (9516, 8) and perhaps also 9510 show similarity to "*Caninia*" *rudis* Hill (1954) in having a wide, lonsdaleoid type of dissepimentarium, with flat tabulae and fairly long major septa. Only one of the specimens shows traces of minor septa. The material is insufficient to investigate the possibility that "*Caninia*" *rudis* may be a species of *Catactotoechus* evolved from *C. irregularis*. Only one doubtful specimen (UWA 25908) of "*C.*" *rudis* was found in the present collection (pl. 2, fig. 18).

### ***Catactotoechus tenuis* Hill, 1954**

Plate 1, fig. 10

1954 *Catactotoechus tenuis* Hill: p. 12, pl. 3, figs. 37, 38.

HOLOTYPE: UWA 33529, from Oscar Hill, 1 mile south of Oscar Homestead, Kimberley Division, Western Australia (same locality, formation and zone as holotype of *C. irregularis*).

DIAGNOSIS: Scolecoid, very slender corallites with small, nodule-like processes; without a distinct aulos but tabulae with strong marginal geniculation; major septa short and thin; dissepiments very sparse.

NEW MATERIAL: The scanty new material is from the Fairfield Formation (G1075) and occurs with *C. irregularis*.

### ***Catactotoechus obliquus* Hill, 1954**

Plate 1, figs. 6-9, 11, 12, 19

1954 *Catactotoechus obliquus* Hill: p. 11, pl. 2, figs. 30-33.

HOLOTYPE: UWA 33520 from the *Atrypa* beds, i.e. in the *Emanuella torrida* Zone of Veevers (1959) in the Sadler Limestone on the northern side of Emanuel Range, east of The Gap, Kimberley Division, Western Australia, Frasnian.

DIAGNOSIS: Solitary, with 20-24 major septa and no minor septa at an average diameter of 9-10 mm, with an impersistent aulos and with sporadic dissepiments.

NEW MATERIAL: Specimens from the Sadler Limestone (G3229, K222, K239, K245, U6, U8) are within the range of variability shown by topotypic material.

## Genus *Metriophyllum* Edwards & Haime, 1850

1850 *Metriophyllum* Edwards and Haime: p. 60.

1900 *Lopholasma* Simpson: p. 206, figs. 19-21.

?1902 *Paterophyllum* Pošta: p. 209.

TYPE SPECIES (by original designation): *Metriophyllum bouchardi* Edwards and Haime, 1850, p. lxix; described 1851, p. 318, pl. 7, figs. 1, 1a, 1b, 2, 2a; Upper Devonian, Frasnian (Beaulieu Shales and Ferques Limestone), Ferques, near Boulogne, France.

DISTRIBUTION: Middle Devonian—Lower Permian.

### *Metriophyllum trochoides* n. sp.

Plate 2, figs. 14-16

TYPE MATERIAL: Holotype—BMR CPC.9534, from K240, 1.25 miles at 233° from Longs Well, near Sadler Ridge, Kimberley Division, Western Australia; Wapet section DD2, unit C5, Sadler Limestone; *Ladjia saltica* Zone, i.e., Upper *Manticoceras* Zone of Teichert (1949), Frasnian. Paratypes—CPC 9535 and 9536, from the same locality.

DIAGNOSIS: Large trochoid *Metriophyllum* with frequent rejuvenescence, axial ends of major septa dilated and coalescent forming a large solid axial pillar commonly embayed by a prominent cardinal fossula which is bisected by the long cardinal septum; in late stages of growth axial ends of major septa in cardinal quadrants become free; minor septa recognizable only as traces in peripheral stereozone.

DESCRIPTION: The corallum is relatively large and turbinate with the apical end slightly curved. Maximum diameter of fragments in the present collections is 18 mm. All specimens show repeated rejuvenescence and one shows increase in diameter from 3.5 mm in the initial stages of rejuvenescence to 8 mm in a height of 4 mm. All the corallites are abraded and the epithecal characters are not known.

At a diameter of 16 mm there are 28 major septa pinnately arranged about a prominent closed cardinal fossula which is bisected by the long cardinal septum that extends to the axis. The major septa coalesce at the axis where they form a solid axial pillar which is incised on the cardinal side by the cardinal fossula. In sections just below the calice of mature corallites the septal ends of the major septa are dilated and coalescent in the counter quadrants only. The major septa carry long prominent flanges parallel to their upper edge. The flanges are long and upturned, subopposite to alternate on either side of the septum and at alternate levels on adjacent septa. Minor septa in the holotype can only be distinguished as traces in the narrow peripheral stereozone, but in BMR CPC.9536 there are



well developed minor septa half the length of the major septa in the cardinal quadrants. Whether these minor septa carry flanges cannot be ascertained. Tabulae are sparse and slope downwards and outwards from the axial pillar. Dissepiments are irregularly developed; they are elongate and not developed into vertical series.

REMARKS: In having a large solid axial pillar incised by a prominent cardinal fossula, *M. trochoides* resembles *Stereolasma rectum* (Hall) from the Devonian of western New York. The latter, however, shows no flanges or dissepiments.

### **Metriophyllum sp. B**

Plate 2, fig. 17

MATERIAL: One specimen BMR CPC.9537 from K173 in the Gogo Formation; Frasnian.

DESCRIPTION: The specimen is a small solitary cylindrical corallite with a maximum diameter of 9 mm and a height of 15 mm. The apical end is curved with small talons and with a prominent groove along one side similar to that described by Holwill (1963) in Gerolstein specimens of *M. gracile*. In later stages of growth the corallite is erect.

At a diameter of 9 mm there are 18 long major septa meeting at the axis where they are dilated and fused to form a stout compact axial pillar. Peripherally the septa are embedded in a stereozone up to 1 mm in width so that the interseptal loculi are small, oval, and arranged concentrically midway between the axis and the periphery. Flanges are distinguishable in both transverse and longitudinal sections. They are developed on either side of the septum in opposite or sub-opposite positions but at alternate levels on adjacent septa. They are normal to the septal surface and are slightly curved upwards at their distal ends. Minor septa are poorly developed, rarely being more than traces in the peripheral stereozone. On either side of the counter septum, the loculi are traversed by what appear to be long minor septa, extending almost to the axis; these may be the upturned edges of flanges arising on either side of the counter septum. Tabulae are sparse and are inclined downwards and outwards at about 45° to the horizontal. The tabulae may span the locus from septum to septum; or they may be supported on either side by the septal flanges. Dissepiments are absent.

The microstructure of septa in the outer stereozone consists of slender trabeculae each showing a dark irregular axis in transmitted light, these axes being separated by lamellar sclerenchyme as in rhabdacanthine and holacanthine septa; however, the irregular nature of the central axis of each trabecula suggests that the trabeculae may be tufted monacanth.

REMARKS: *Metriophyllum* sp. B is superficially very similar to *Syringaxon dickinsi* in transverse section but is distinguished by the lack of contratingent minor septa and by the absence of an aulos. In vertical section its straight, well developed

flanges are diagnostic. It is similar to the type species in having a wide peripheral stereozone and stout axial pseudocolumella but is distinguished by its thicker septa and by longer and flatter flanges.

#### Genus *Syringaxon* Lindström, 1882

- ?1850 *Trochophyllum* Edwards and Haime: p. 67.  
1882 *Syringaxon* Lindström: p. 20.  
?1895 *Permia* Stuckenberg: pp. 26, 186.  
1900 *Laccophyllum* Simpson: p. 201.  
1902 *Alleynia* Pořta: p. 4 (new name for *Nicholsonia* Pořta, 1902, p. 184, not *Nicholsonia* Schlütter. 1885b).  
?1902 *Barrandeophyllum* Pořta: p. 190.  
?1902 *Retiophyllum* Pořta: p. 180.  
?1935 *Crassiphyllum* Grove: p. 368.  
?1943 *Lindstroemia* (*Schindewolfia*) Weissermel: p. 24.  
1962 *Syringaxon* (*Saucrophyllum*) Philip: p. 172.

TYPE SPECIES: *Cyathaxonia siluriensis* McCoy, 1850, p. 281; Upper Ludlow, Underbarrow, Kendal, Westmorland, England. According to Sutherland (1965, p. 34) the type specimen is from the Bannisdale Slates.

DIAGNOSIS: Small, simple, conical or cylindrical rugose corals in which the axial ends of the major septa are dilated and laterally contiguous, forming an aulos; minor septa are short and typically contratingent; skeletal thickening usually abundant. Tabulae distant and irregularly spaced, divided by the aulos into inner and outer series; the inner tabellae are flat or slightly depressed; the outer series are declined towards the periphery; horizontal skeletal elements in loculi enclosed by the contratingent septa slope inwards and downwards from the wall or are sagging.

REMARKS: Small, solitary rugose corals with an aulos are known from the Middle Silurian to the late Permian. They are commonly easily recognised by their longitudinally strongly corrugated walls and their erect habit. Their relationships are not yet established; it is uncertain whether the aulos has developed several times in unrelated or not closely related lineages or whether these aulate corals are members of the one family and even of the one genus.

The diagnosis given above is based on our transverse section of the holotype (Sedgwick Museum A5468, pl. 4, fig. 2) of *S. siluriense*, and the diagnosis given by Butler (1935) which was drawn up from the then unsectioned holotype and from other specimens of the species from the Wenlockian and Ludlovian of England and some from Gotland.

The external features of the holotype of *S. siluriense* have been described by Butler (1935, p. 118) and Sutherland (1965, p. 34). The transverse section cut from it is 4.0 to 4.1 mm in diameter and contains 17 thick rhopaloid major

septa which are contiguous near the axis forming an aulos 0.5 mm in diameter which is lined with sclerenchyme. Minor septa are short and contratingent. The cut edges of the tabellae in the larger interseptal loculi are concave towards the periphery in transverse section suggesting that they are inclined downwards away from the aulos. Within the smaller triangular loculi enclosed by the short contratingent minor septa, only one horizontal skeletal element was intersected by the section; it is close to the outer wall and concave towards the axis suggesting that it slopes down and away from the wall at this level. In some of the other small interseptal loculi thick sclerenchymal deposits line the inside of the wall.

The Wenlock specimens described by Butler, the oldest at present known, are small, erect, with strong longitudinal ridges and furrows, and are characterised by metriophylloid early stages in which all the early major septa meet at the axis without an aulos; minor septa and aulos appear later, almost simultaneously; the septa are much thickened and the minor septa are very short and contratingent; the axial ends of the major septa are thickened and coalesce to form the aulos, which may be lined by additional layers of thickening tissue. The tabulae are divided into an axial (sagging) series and a periaxial series descending from aulos to periphery. The small interseptal loculi enclosed by the contratingent minor septa are filled with skeletal thickening.

The specimen (Sedgwick Museum A6631) from Klinteham, Gotland, figured by Butler (1935, pl. 2, fig. 7) shows longer triangular loculi enclosed by the contratingent septa. In these loculi the horizontal skeletal elements appear to sag downwards from both periphery and aulos, while the tabellae in the larger loculi are inclined downwards from the aulos to the periphery.

The synonymy of *Syringaxon* has been considered by Gorsky (1932), Butler (1935), Prantl (1938), Weissmerl (1939), Lang, Smith and Thomas (1940), Stumm (1949a), Hill (1950, 1956), Schouppé (1951), Flügel and Free (1962), Głinski (1963), and Kullmann (1965). The following genera require consideration.

The syntype specimen of *Laccophyllum acuminatum* Simpson (1900) figured by Smith (1945, pl. 1, fig. 18), the type species of the genus *Laccophyllum* Simpson, from the Silurian (Niagaran) of Perry County, Tennessee, U.S.A., showing thin septa and aulos and long contratingent minor septa should be investigated to see whether the horizontal skeletal elements are differently disposed in the short triangular interseptal loculi and in the longer, open, alternate loculi. If they are, *Saucrophyllum* Philip (see below) would be a junior subjective synonym of both *Laccophyllum* and *Syringaxon*.

Specimens from the probably Ludlovian Henryhouse Formation of Oklahoma U.S.A. figured by Sutherland (1965) as *Syringaxon adaense* Sutherland are like those from England and Gotland except that the minor septa are not inclined or contratingent. Other Henryhouse specimens with relatively thin septa, a small, thin aulos, and elongate, contratingent thin minor septa show, like the Gotland specimens, periaxial horizontal skeletal elements disposed differently in the loculi

enclosed by the contratingent septa and in the alternate open loculi; the periaxial plates slope downwards and inwards from the wall in the smaller loculi and upwards and inwards from the wall in the open loculi. These features are characteristic of the type species of *Syringaxon* (*Saucrophyllum*) Philip, 1962 and Sutherland described the Henryhouse Formation specimens as *Saucrophyllum arbucklense* Sutherland. The type specimen of *Saucrophyllum pocillum* Philip, the type species of *Saucrophyllum*, is from the Lower Devonian Boola Beds of Victoria (for discussion of age of these beds see Philip, 1962, and Addendum, Philip, 1965, and Talent, 1965).

Some of the generic names applied to Devonian members of the group are synonyms. Thus the lectotype species of *Alleynia* Pořta (1902, new name for *Nicholsonia* Pořta, 1902, not Schlüter, 1885b), *A. bohémica* (Barrande in Pořta, 1902) has as its lectotype (chosen Prantl, 1938) the specimen figured by Pořta, 1902, pl. 68, fig. 43 from the Daleje Shales gř, Hlubocepy, Czechoslovakia. It does not seem to have been sectioned. Topotypes figured by Prantl (1938, text-fig. 1, pl. 3, figs. 1 and 4) show rather thick major septa with short thin contratingent minor septa, the triangular loculi being so small that it would be difficult to find horizontal skeletal elements in them. Prantl, (1938) referred it to *Syringaxon* and placed *Alleynia* (—*Nicholsonia* Pořta) in synonymy with *Syringaxon* and this seems reasonable.

The lectotype of *Barrandeophyllum perplexum* Pořta, 1902, the type species of *Barrandeophyllum* Pořta, 1902, was chosen and figured by Prantl, 1938, pl. 2, fig. 5, from the Branik Limestones, gř, Hlubocepy Valley; it appears not to have been sectioned, but other syntypes and topotypes figured by Pořta and by Prantl show rather thin septa, a somewhat elliptical, irregular, thin aulos, and thin, long, contratingent minor septa, recalling Smith's (1945) figure of *Laccophyllum acuminatum*. It seems likely that the type species has differently disposed horizontal skeletal elements in its shorter, triangular interseptal loculi since these are shown in Pořta's syntype (1902, pl. 108, fig. 5). *Barrandeophyllum cavum* Hill (1954, pl. 3, figs. 3-9) from the Upper Devonian (Virgin Hills Formation) of Western Australia agrees with Prantl's understanding of *Barrandeophyllum*.

*Lindstroemia* (*Schindewolfia*) Weissmerl, 1943, type species by monotypy *Lindstroemia* (*Schindewolfia*) *lautenbergensis* Weissmerl, 1943, from the Silurian or early Devonian dark limestones of Heibeek near Lautenberg, in the Oberharz, has a wide peripheral stereozone, contratingent minor septa and an aulos which in places is incomplete as the axial ends of the major septa fail to coalesce. Possibly *S. lautenbergensis* is a species of *Barrandeophyllum*; there is similarity between Weissmerl's, 1943, pl. 3, fig. 5, and Prantl's, 1938, pl. 2, fig. 6, although *S. lautenbergensis* shows great thickening.

*Retiophyllum* Pořta, 1902, type species by monotypy *R. mirum* Pořta, 1902, pl. 108, fig. 6, is represented, according to Prantl (1938, p. 20), only by two badly preserved syntypes, inadequate for redescription. Bohemian species characterised by short contratingent minor septa, and somewhat thickened major septa

and aulos have been referred by Prantl (1938) to *Syringaxon*; but some of them have smooth epitheca.

*Neaxon* Kullmann, 1965 (type species — *N. regularis* Kullmann, 1965, pl. 2, figs. 1-4, from the late Emsian or early Eifelian of northern Spain) is possibly closely related to *Syringaxon*. Its minor septa are not distinguishable in sections below the calice but on the calical slopes show as small projections between the major septa and are not contratingent; they all appear approximately simultaneously whereas in *Syringaxon siluriense*, as described by Butler (1935) the counter lateral minor septa appear early before the insertion of many of the metasepta.

Pedder (1967) erected a new genus *Taralasma* for *Syringaxon radiatum* Hill 1950, from the Taravale Formation, Buchan district, Victoria; Emsian to Couvinian? (the age of this formation is discussed by Teichert and Talent (1958), Talent (1965) and Philip (1966)). This species has an imperfect aulos. In the early stages of growth, the small loculi between the contratingent minor and major septa do not contain any horizontal skeletal elements and in the larger, open interseptal loculi the periaxial tabulae slope downwards from the aulos to the periphery. In late neanic or early ephebic stages plates develop in the smaller loculi and slope downwards and inwards from the periphery. In later growth similar plates are inserted between all septa and become convex axially, representing a distinct dissepimentarium. These dissepiments become elongated, in a few cases lonsdaleoid. This suggests that the small plates in the small loculi, between contratingent minor and adjacent major septa in the genera discussed above are dissepiments. Against such an argument are the figures of *Syringaxon? furcaseptatum* Flügel and Free (1962, pl. 41, fig. 2) and of Sutherland (1965, pl. 27, figs. 1b, 2b) showing, in the very long loculi enclosed by the contratingent minor septa, horizontal skeletal elements that are inclined downwards and inwards, reaching almost to the aulos without showing the axially convex curvature characteristic of dissepiments; the plates in the open loculi are inclined downwards and outwards and extend to the periphery.

In the Upper Devonian of Western Australia *S. dickinsi* has very long, thick, contratingent minor septa with extremely narrow contained interseptal loculi and a wide peripheral stereozone completely filling the outer part of the loculi. The horizontal skeletal elements are differently disposed in the narrow and in the wide, open loculi. In the latter they slope downwards and outwards, sometimes being upturned at the periphery or occasionally U-shaped between the aulos and periphery. In the narrower loculi they are deeply sagging, the peripheral edges being obscured by skeletal thickening, or are flat and horizontal, or, in three specimens tentatively included in the species, are inclined upwards away from the wall.

On present knowledge it is difficult to evaluate the true morphological character of the inwardly declined plates of the narrow loculi contained between the contratingent minor and adjacent major septa, but we incline to the view that they are dissepimental rather than tabular.

In the Carboniferous and Lower Permian, species with a similar morphology have been included in *Trochophyllum* Edwards and Haime, 1850 (type species *T. verneuili* Edwards and Haime, 1850, p. lxvii; 1851, p. 357, pl. 5, figs. 6, 6a, Lower Carboniferous, New Providence Shales, 7 miles south of Louisville, Kentucky, U.S.A.), in *Permia* Stuckenberg, 1895 (type species, *P. iwanowi* Stuckenberg, 1895, p. 27, pl. 3, figs. 6a-g, Lower Carboniferous Limestones, R. Gubakha, near Gubakha, western slopes of Ural Mountains, Russia) and in *Crassiphyllum* Grove, 1935 (type species *Zaphrentis declinis* Miller, 1892, p. 621, pl. 1, figs. 25, 26, Lower Carboniferous, Keokuk Group, New Providence, Indiana, U.S.A.). Incomplete understanding of their type species has led to various interpretations of their taxonomic position, some regard them as synonymous while others separate them in different families. Dobrolyubova (1962, in Orlov, p. 328) has included *Permia* as a doubtful synonym of *Aulophyllum* Edwards and Haime, 1850. Pickett (1966, p. 7) from a study of topotypes of *T. verneuili* regards *Trochophyllum* as distinct from *Permia*. *Crassiphyllum* was considered a synonym of *Trochophyllum* by Stumm (1948b) and of *Permia* by Hudson (1944, 1945). Ivanovskiy (1967) considered *Permia* a synonym of *Trochophyllum*.

Whether these upper Palaeozoic genera are congeneric or homeomorphic with *Syringaxon* is doubtful on present knowledge. To progress further we need new descriptions and figures of the type specimens of the type species.

Hudson (1945, p. 360) considered the insertion of the minor septa in *Permia* to be cyclic and he described the ontogeny of the new species *Permia caverna* and *P. carbonaria* from the middle Viséan Rylstonia shale at Rylstone, Yorkshire, England. In *P. caverna* the minor septa are radial, buried in peripheral stereozone or free, and in *P. carbonaria* they appear altogether towards the end of the neanic stage and are at first short but become contratrigent and finally contrajunct in later stages of growth. In *P. cavernula* Hudson (1943), from the middle Viséan of Yorkshire, the minor septa are inserted in the *Cyathaxonia* mode and are contratrigent from the beginning. The true significance of contratrigency and the pattern of insertion of minor septa in this group of corals needs evaluating.

DISTRIBUTION: Middle Silurian (Wenlockian) to Upper Devonian (Frasnian) and possibly Carboniferous.

### ***Syringaxon dickinsi* sp. nov.**

Plate 2, figs. 1-9

TYPE MATERIAL: Holotype—BMR CPC.9521, from K121, 4 miles at 239° from Old Bohemia Homestead, Kimberley Division, Western Australia, Gogo Formation or lower Virgin Hills Formation; *Emanuella torrida* or *Ladjia saltica* Zone; Frasnian. Paratypes—BMR CPC.10255 to 10264 from K121.

OTHER MATERIAL (with number of specimens given in brackets): Gogo Formation, K126(2), K173(7), K124(1), K118(1); Bugle Gap Limestone, K180(1); Sadler Limestone, ?K223(2), ?K226(1).

DIAGNOSIS: *Syringaxon* with very long contratingent minor septa, with marked septal thickening, and aulos almost completely filled with sclerenchyme.

DESCRIPTION: The corallum is slenderly trochoid to subcylindrical and commonly erect, with strong longitudinal ridges and furrows, attaining a diameter at the calice of about 22 mm.

At a diameter of 20 mm there are 20 to 22 long major septa; the two minor septa on either side of the counter septum are as long and as thick as the counter septum; the axial ends of the major septa are dilated and coalescent, forming an aulos, which is lined internally by additional sclerenchyme laid down in layers spreading across the upper surfaces of the axial tabulae. In a zone 2 to 3 mm wide the peripheral edges of the major and minor septa coalesce to form a wide peripheral stereozone; inside, the thick axial ends of the minor septa enclose very narrow spaces between them and the major septa they lie against, leaving wide spaces to their other (cardinal) side. The axial tabellae are flat or slightly concave distally. In the wider interseptal loculi the periaxial tabellae slope downwards away from the aulos but in some are upturned at the periphery. In at least two corallites the periaxial tabellae are deeply sagging between the peripheral stereozone and the aulos in the wider loculi. In the axial ends of the narrower loculi of some corallites the horizontal skeletal elements in transverse section are concave towards the outer wall; in longitudinal section these elements slope downwards and outwards in the inner parts of the loculi but turn upwards in the central region and are obscured by the peripheral stereozone in the outer regions. In two longitudinal sections of specimens from K173 the plates in the narrow loculi slope upwards and outwards.

The septa are monacanthine with individual trabeculae 0.25—0.35 mm in diameter and inclined upwards and inwards from the periphery at approximately 30° to the horizontal. Within each monacanth the fibres diverge from the axis at a considerable angle.

REMARKS: Variation in the topotypic material is minimal with each corallite possessing relatively thick septa, wide peripheral stereozone, thickened aulos, and relatively distant periaxial tabellae. The holotype shows small short projections from the lateral surface of a septum which may be incipient flanges. At K173 variation is greater, with the septal thickening not so extensive, the aulos more open and the periaxial tabellae more common. Moderate variation can be found in the one corallite with the younger parts less thickened. In three specimens BMR CPC.9523, 4, 7, the aulos is not lined with secondary tissue and the axial tabellae are flat and numerous, as are the periaxial tabellae in the wider interseptal loculi. These specimens show the horizontal skeletal elements in the inner ends of the narrower loculi sloping upwards and inwards. Until more material from this locality is available these three corallites are tentatively included in *S. dickinsi*.

*S. dickinsi* is distinguished from previously described species of the genus by its wide stereozone, dilated septa, thickening of the aulos, and by its contratingent minor septa.

*Barrandeophyllum* sp. Hill (1954, pl. 3, fig. 10, from the Virgin Hills Formation of the Old Bohemia area) has long contratingent minor septa and well developed aulos similar to *S. dickinsi* but its septa are thinner, there is no stereozone and lonsdaleoid dissepiments are common.

DISTRIBUTION: Gogo Formation, Bugle Gap and Sadler Limestones, Canning Basin; Upper Devonian.

### **Syringaxon? sp. A.**

Plate 2, figs. 10-13

Five specimens from the Gogo Formation, K121 (2 specimens), K118 (2 specimens), K126 (1 specimen), all of which occur with *S. dickinsi* do not appear to fall within the variation of that species. The tabular floors are closely spaced and are flat domes consisting of complete or incomplete tabulae some of which are considerably thickened on their distal surface. The minor septa in our specimens are poorly developed and are not contratingent; for this reason as well as because of weak development of the aulos, and the occasional presence of dissepiments, we refer them only very doubtfully to *Syringaxon*.

Family HAPSIPHYLLIDAE Grabau, 1928

Genus **Zaphrentoides** Stuckenberg, 1895

**Zaphrentoides? excavatus** Hill, 1954

Plate 3, fig. 6

1954 *Zaphrentoides? excavatus* Hill: p. 12, pl. 3, figs. 18, 19.

NEW MATERIAL: One specimen BMR CPC.9546 from the Virgin Hills Formation at K135; another from the Fairfield Formation at G1055; a third, only doubtfully referred to the species, from the Virgin Hills Formation at K149.

Family CYATHOPHYLLIDAE Dana, 1846a

Genus **Zaphrenthis** Rafinesque and Clifford, 1820

The species listed below, having no cross-bar carinae on the septa in its late and narrow dissepimentarium, is possibly not congeneric with *Zaphrenthis phrygia*



Refinesque and Clifford, the type species. As *Zaphrenthis* is still inadequately known, no move is made to transfer the Western Australian species to a new genus.

***Zaphrenthis iocosa* Hill, 1954**

Plate 3, figs. 1-5

1954 *Zaphrenthis iocosa* Hill (sic): p. 13, pl. 3, figs. 27-30.

**HOLOTYPE:** UWA 33509, from U2, Tennis Court, Fossil Downs Homestead, Kimberley Division, Western Australia; Napier Formation, Famennian.

**DIAGNOSIS:** Nearly erect *Zaphrenthis* with apical talons, with dissepiments only in late stages and septa without cross-bar carinae in the narrow dissepimentarium; the septa withdraw from the axis a little in the adult stages.

**NEW MATERIAL:** Six specimens UWA 25845/1-6 from the type locality; 8 specimens BMR CPC.9538-45 from K255. The specimens from K255 agree reasonably well with the holotype in septal number (29 at 18-20 mm diameter) and absence of thickening of the major septa in the cardinal quadrants, though they are somewhat larger. The new material does not have the septal thickening in the cardinal quadrants shown in the specimen figured by Hill (1954, pl. 3, fig. 29); this character may not be typical of the species.

**DISTRIBUTION:** Napier Formation and Sadler Limestone, Canning Basin; Upper Devonian.

Family PHILLIPSASTRAEIDAE Römer, 1883

**DIAGNOSIS:** Solitary or colonial Rugosa with well developed complete major and minor septa, radially arranged except in a few forms having marked bilateral symmetry and cardinal fossula; septa frequently carinate, commonly fusiform or cuneate in the dissepimentarium, becoming attenuate in the tabularium. Axial structure generally absent. Trabeculae monacanth or rhipidacanth, arranged in a single series perpendicular to the dissepimentarial floor which varies from evenly inclined towards the axis to everted. Dissepimentarium well developed, of small globose dissepiments with or without specialized dissepiments—horse-shoe, flat or peneckielloid. Tabularial floors either flat tabulae or more commonly two or more series of tabellae.

**REMARKS:** A great amount of study has been devoted to this family, which is of major importance in the Devonian, since it was recognized as a cognate group in the classic work of Lang and Smith (1935b). There are differences of opinion as to its content, as shown for instance by the exclusion or inclusion of certain genera in one or other of the recent major systematic works (Lecompte, 1952; Hill, 1956; Soshkina and Dobrolyubova *in* Orlov, 1962).

The main impediment to understanding has been the lack of information on the internal structure of type specimens of species on which genera have been founded, and on the limits of variation within type species at their type localities. Discussion not based on such knowledge has very frequently proved abortive. Several workers have recently made contributions that have clarified the characters of some type species, and our knowledge of the family group is becoming more precise. Thus Smith (1945) gave a proper understanding of *Prismatophyllum*, Schouppé (1958) threw light on *Phillipsastrea* and *Pexiphyllum* and Flügel (1958) chose a lectotype for *Thamnophyllum stachei* Hornes though unfortunately he did not figure thin sections from it. Rózkowska (1960) made a useful variation study of *Peneckiella minor kunthi* (Dames) and Gliniski (1955) did important work on a group of cerioid forms from the Eifel, which work when extended may show whether *Hexagonaria* or part of it descended from *Columnaria sulcata* Goldfuss and whether *C. sulcata* itself is a stauriid or not. McLaren (1959) in an admirable study of Canadian species, has shown that *Synaptophyllum* when interpreted on the type specimen of its type species is a stauriid, and phillipsastraeid forms previously included in it have been removed to *Acinophyllum* McLaren (1959) to which possibly *Disphyllum geinitzi* Lang and Smith might belong. *Pachyphyllum bouchardi* Edwards and Haime has been illustrated with the help of syntype material by Semenoff (1961). Fedorowski (1967) gave a full revision of *Ceratophyllum typus* Gürich (= *Cyathophyllum ceratites* Goldfuss) establishing a sound basis for the genus *Ceratophyllum*. The lectotype of *Haplothezia filata* (Schlotheim) the type species of the genus has been redescribed and figured by Pedder (1966), Pickett (1967) and Scrutton (1967). We give on pl. 4 herein figures of the neotype (Pickett, 1967, p. 59) of *Hexagonaria hexagona* (Goldfuss) of the lectotype of *Haplothezia filata* and, on pl. 12, of the holotype of *Argutastrea arguta* Crickmay.

Unfortunately we still lack illustrations of thin sections of the type specimens or topotypic variation studies or both of such important species as *Hexagonaria hexagona* (Goldfuss), *Marisastrum sedgwicki* (Edwards and Haime), *Pterorrhiza marginatum* (Goldfuss), *Billingsastrea verneuili* (Edwards and Haime), *Pseudoacervularia coronata* (Edwards and Haime), *Thamnophyllum stachei* Horne and Penecke in Penecke, *Macgeea solitaria* (Hall and Whitfield), *Charactophyllum nanum* (Hall and Whitfield) and *Kunthia crateriformis* Schlüter.

The diverse taxonomic groupings of the last thirty years have been based on the differing systematic value given in different studies to the various biocharacters of the family.

Thus the presence of a pipe of horseshoe dissepiments at (or near) the boundary with the tabularium has been regarded as of specific (*Hexagonaria brownae* Hill, 1942b), genomorphic (Lang and Smith, 1935b), generic (Schouppé, 1949), subfamily (Stumm, 1949, Rózkowska, 1953, Hill, 1956), family (Soshkina, 1949) or subordinal (Schouppé, 1958) value. The pipe may be persistent or partly impersistent, and distinct to indistinct. A relatively persistent pipe is

commonly (*Pachyphyllum*, *Phacellophyllum*) associated with a calice with rim everted from the pipe and with exsert septa, reminiscent of the *Hexacoralla*. The pipe may be associated with a peripheral zone of flat dissepiments (*Trapezophyllum*); or it may be flanked by a wide or narrow peripheral series, and sometimes also by an inner series, of small dissepiments whose bases are inclined downwards from it ("*Pexiphyllum*"). Or it may be almost without flanking dissepiments (*Peneckiella*?) or it may have an external zone of flat dissepiments in addition to two flanking series of globose dissepiments (*Macgeea*).

The septa may be dilated, commonly spindlewise, especially over the zone of horseshoe dissepiments when this is present. Their trabeculae develop fan-wise from the mid-line of the horseshoe, at right angles to the curvature of the horseshoes, and are sharply demarcated from one another; each trabecula is formed of second order trabeculae which are directed out from the mid-plane of the septum and are perpendicular to the septum-to-septum curvature of the dissepiments (rhipidacanth of Jell, 1969). Septal structure in its relation to the horseshoe and other dissepiments has been discussed by Hill (1940, 1954a, 1956), Rózkowska (1948, 1953, 1960), Schouppé (1956, 1958), Schouppé and Stacul (1962, 1963), Scrutton (1968) and Jell (1969). In other phillipsastroid genera without horseshoe dissepiments, the trabeculae may be simple monacanth in which the fibres diverge at a very small angle to the axis of the trabeculae (*Paradisphyllum* Strusz) or at a considerable angle (*Disphyllum*).

The septa may be attenuate (*Billingsastraea*) or dilated, and with cross-bar or zig-zag carinae (*Prismatophyllum*); carinae are more common in taxa without horseshoe dissepiments than in those that have them.

Characters of the tabularium such as the presence ("*Megaphyllum*") or absence (*Peneckiella*) of the periaxial (supplementary) tabellae and the presence of axial supplementary tabellae have been used in generic and specific classification mainly by Soshkina. They seem to be somewhat less useful within the family than those of the dissepiments.

Colonial habit is regarded as a significant character. Thus most authors separate into different genera those species with cerioid habit (e.g. *Hexagonaria*) from those with phaceloid habit (e.g. *Disphyllum*); coralla with thamnastraeoid habit are commonly placed in *Phillipsastrea* or *Billingsastraea* and those with aphroid habit (sometimes wrongly) in *Pachyphyllum*; for those with the astraeoid habit, common in the Upper Devonian, *Frechastraea* Scrutton (1968) and possibly *Pseudoacervularia* may be available. Classifications including habitually phaceloid and habitually cerioid species in the one genus have had no lasting acceptance. Illogical as it may seem, most taxonomists have found colonial habit very useful, provided they do not permit phylogenetic speculations to enter into diagnoses.

The type of increase has been studied for its taxonomic value by Rózkowska (1957) amongst others, and at present seems of minor importance in the family, at most of specific value.

On the present state of knowledge and considering the structure and arrangement of the trabeculae, configuration of the dissepimentarial floors, development of specialized dissepiments, and septal characters (carination and dilation) as the more significant biocharacters in the suprageneric classification of this group, one of us (Jell, 1969) has proposed that the genera be grouped in five sub-families—Phillipsastraeinae Römer, Marisastrinae Rózkowska, Paradisphyllinae Jell, Disphyllinae Hill and Billingsastraeinae Jell. Such a grouping is used herein.

The ancestors of the Phillipsastraeidae may lie in the Stauriidae, as mentioned above and investigated in part by Glinski (1955). But some at least of the Russian authors who at first were inclined to such a theory have recently (Soshkina and Dobrolyubova *in* Orlov, 1962), by their association of the major part of the group with an important Silurian family including *Entelophyllum articulatum* (Wahlenberg) in a single new order, suggested a descent from that family or from the Acervulariidae, Spongophyllidae or Ptenophyllidae. Similarly, the inclusion of the Lithostrotionidae in their new order suggests that Soshkina and Dobrolyubova (*in* Orlov, 1962) consider that the Phillipsastraeidae gave rise to that important Carboniferous family. At present such phylogenetic speculations have no special base for argument.

**DISTRIBUTION:** In the Silurian this family is known only from Australia and possibly from Estonia but it was world wide during the Devonian and may have extended into the Carboniferous in China.

#### Subfamily PHILLIPASTRAEINAE Römer, 1883

**DIAGNOSIS:** Phillipsastraeids with fusiform septa composed of rhipidacanth s fanned over highly arched dissepimentarial floors; horseshoe and/or peneckielloid dissepiments form a regular or an irregular pipe near or at the inner edge of the dissepimentarium.

**DISTRIBUTION:** Devonian.

#### Genus *Phacellophyllum* Gürich, 1909

**TYPE SPECIES** (by monotypy): *Phacellophyllum caespitosum* (Goldfuss), Gürich, 1909, p. 102, pl. 31, figs. 5a, 5b; = *Lithodendron caespitosum* Goldfuss, 1826, p. 44, pl. 13, fig. 4; Lang and Smith (1935b) selected as lectotype the original of Goldfuss, 1826, pl. 13, fig. 4, from Bensberg, near Cologne, Germany; (?lower Frasnian (Jux, 1964)).

**DIAGNOSIS:** Dendroid or phaceloid phillipsastraeinids with corallites united by dissepimental tissue in axils of branches. Septa fusiform but not extensively dilated and not carinate. Dissepimentarium regular, biserial, consisting of an inner row of horseshoe dissepiments arranged in a pipe about the tabularium, and an outer row of flat dissepiments. Tabulae complete or incomplete.

**DISTRIBUTION:** Couvinian to Famennian.

***Phacellophyllum kimberleyense* n. sp.**

Plate 5, fig. 4

**MATERIAL:** Holotype—BMR CPC.9551 from K531, 14.5 miles at 113° from Prairie Hill, 19.5 miles northeast of Fossil Downs Homestead, Kimberley Division, Western Australia, Napier Formation; Upper Devonian. No other material.

**DIAGNOSIS:** Phaceloid *Phacellophyllum* with cylindrical corallites (average diameter 6 mm); increase axial; septa fusiform, irregularly carinate, slightly withdrawn from the axis; tabulae complete, slightly domed; dissepimentarium biserial with one row of horseshoe dissepiments and an outer row of flat dissepiments.

**DESCRIPTION:** The holotype is a large phaceloid corallum with cylindrical corallites evenly spaced, with centres 6 to 10 mm apart, axis to axis. The adult corallites average 6 mm in diameter varying from 5.2 to 6.7 mm. Increase is axial, two daughter corallites developing in the calice of the parent corallite, initially separated by dissepimental tissue but completing their epithecae walls when they grow free of each other. The corallite wall is thin, consisting of a very thin outer epithecal sheath and a wider inner layer of fibrous sclerenchyme in which the fibres are normal to the epitheca.

The septa are radially arranged in two orders with 14 to 16 in each order. The septa are fusiform, dilated in a zone 0.8 mm in width in the inner dissepimentarium; the major septa become attenuate in the tabularium and are slightly withdrawn from the axis leaving an axial space up to 1 mm in diameter. The minor septa are half the length of the major septa. In the dissepimentarium the lateral surfaces of the septa show irregular expansions and in many these are developed into small short carinae; the expansions originate from the lateral extension of the secondary trabeculae of the rhipidacanth forming the septa.

The tabularium is half the width of the corallite in diameter and consists of slightly arched complete tabulae supplemented occasionally at the margin by small inclined periaxial tabellae. The dissepimentarium is biserial consisting of an outer series of closely spaced flat dissepiments with 20 to 22 in 5 mm vertically and a regular inner series of small horseshoe dissepiments, 17 to 18 in 5 mm vertically. The rhipidacanth of the septa are tightly fanned over the row of horseshoe dissepiments.

**REMARKS:** This new species is founded on the holotype only, but this is well preserved showing the details of the internal structure of many corallites. It is distinct from all other previously described species of *Phacellophyllum*. In transverse section it shows some similarity to *Disphyllum* (*Synaptophyllum*) *densum* Smith, 1945, pp. 22-23, pl. 12, figs. 3a-c, from the lower Grumbler Formation, Hay River, Northwest Territories, Canada, in that its septa are slightly carinate and somewhat dilated though less so than in the Canadian form. The latter however does not show the typical phacellophylloid biserial dissepimentarium, in fact McLaren (1959, p. 30) states that the dissepiments are not of the horseshoe type.

## **Phacellophyllum** sp. B.

Plate 5, figs. 2, 3

**MATERIAL:** Two specimens BMR CPC.9549, 50 from K348, Sadler Limestone; Frasnian.

**DESCRIPTION:** The two fragments are parts of phaceloid coralla; they vary in diameter from 6.6 mm to 11 mm immediately before increase, which is axial. The septa are spindle-shaped, radially arranged in two orders with 20 to 21 in each. The minor septa are half as long as the major septa which extend half the way to the axis. The septa are straight, noncarinate in the tabularium but in places carry very short, stout carinae in the dissepimentarium. They are all slightly thickened in the zone of horseshoe dissepiments becoming attenuate axially. The dissepimentarium is narrow consisting of a single series of horseshoe dissepiments and an outer series of small, globose convex dissepiments sloping down and outwards from the inner row. Both specimens are abraded so that the character of any outer dissepiments is not known. After increase, the dissepimentarium develops as soon as the dividing wall is inserted between the developing corallites. Initially it consists of small convex dissepiments which, with growth, are replaced by a single row of peneckelloid dissepiments and later by a row of horseshoe dissepiments plus a row of convex dissepiments (pl. 5, fig. 3b). The tabularial floors are horizontal consisting of complete tabulae supplemented at various places by small inclined periaxial tabellae.

**REMARKS:** Previously the only record of *Phacellophyllum* from the Canning Basin was by Hill (1954, pl. 3, fig. 26) who figured one specimen from the Pillara Limestone (in earlier mapping it was thought to be from the Bugle Gap Limestone). The specimens from the Sadler Limestone are quite distinct from this in having thinner septa considerably withdrawn from the axis and in possessing a simpler and more open tabularium consisting almost entirely of complete tabulae.

The specimens differ from the type species of the genus in having convex dissepiments flanking the horseshoe dissepiments peripherally and it is doubtful if flat dissepiments are present at all. It is tentatively referred to *Phacellophyllum*.

### **Genus Peneckiella** Soshkina, 1939

1939 *Peneckiella* Soshkina, p. 23.

1956 *Peneckiella*; Flügel, p. 35.

1959 *Peneckiella*; McLaren, p. 22.

1968 *Peneckiella*; Scrutton, p. 271 (part).

**TYPE SPECIES:** *Diphyphyllum minus* Römer, 1855 (holotype No. 117 in the collection of the Bergakademie, Clausthal-Zellerfeld, Germany, figured Römer, 1855,

pl. 6, fig. 12) from the Upper Devonian (Frasnian), Iberg Limestone of Grund in the Harz Mountains, Germany.

DIAGNOSIS: Phaceloid; septa normally non-carinate but thickened, especially at inner edge of dissepimentarium which is narrow and commonly of one series of globose plates flattened above, each with its inner edge curved down in a three-quarter hemisphere to meet the plate next below, and its outer edge abutting against the wall at a level higher than the base of the inner edge. (These have been interpreted by Flügel (1956) and Schouppé (1958) as horseshoe plates with their outer curves amalgamated with the wall.) Septal trabecular fans may occur with zone of divergence at the axis of curvature of the upper surface of the dissepiments; trabeculae rhipidacanth. Tabulae commonly in one series and complete.

REMARKS: Thin sections of the holotype have not been figured but Schouppé (1958) gave figures of thin sections of topotypes, and diagrams. Flügel (1956) examined the holotype and gave a diagram indicating that it had a single series of horseshoe dissepiments, each with the entire edge resting on the underlying one; the outer curve of the horseshoe dissepiment is shown as parallel with and touching the wall. Schouppé (1958) gave a drawing suggesting that the outer curve of the horseshoe is amalgamate with the wall.

Rózkowska (1960) gave an admirable variation study of *Cyathophyllum kunthi* Dames from topotypes from the Upper Frasnian type locality of Mokrzyszów (formerly Oberkunzendorf), Poland. She shows that in this species, which she regards as a subspecies of *Peneckiella minor* (Römer), the dissepimentarium is extremely narrow, involving one, or at the most two, dissepimental rows. Dissepiments vary notably in size and shape, but by far the commonest type is the "peneckielloid" dissepiment, distally flattened, the outer edge leaning against (but in Rózkowska's opinion not participating in) the thick wall, and the inner edge curving sharply over to rest on the underlying dissepiment. Next in order of abundance are horseshoe dissepiments, locally developed, but irregular, and forming the inner of two series. "Horizontal" dissepiments, slightly arched upward, may appear outside the horseshoe dissepiments. Sigmoidal dissepiments are very rare. The trabecular fan of the septa is centred on the axis of the curve of horseshoe dissepiments, or on the axis of the curve of the flattened distal face of the peneckielloid dissepiments.

Schouppé (1958, pl. 5, fig. 5) figured distinct trabecular fans in topotypic material of *P. minor* but the nature of the trabeculae is not easily recognizable. Flügel (1956) made no mention of trabecular fans in his discussion of the type species. Rózkowska (1960) described *P. minor kunthi* (Dames) as having fans of thick trabeculae (0.08-0.16 mm in diameter) and stated that trabecular fans are always present. Her figures, 22, 25, 27, 28, 29, show these fans and the trabeculae can be interpreted as being rhipidacanth. Strusz (1965, p. 557) described the trabecular fans in *Disphyllum mesa* Hill, 1942c, from the Garra Formation, central New South Wales, as typically phacellophylloid, symmetrical

about the axis of the series of horseshoe and peneckielloid dissepiments. Examination of topotypic material has shown that at least in part the septa are rhipidacanthine. The Western Australia species *P. teichert* Hill, 1954, also has rhipidacanthine septa.

The tabularium is quite variable between species and even within species. The tabulae are horizontal, concave, or flattened domes and may be supplemented by small inclined periaxial tabellae.

McLaren (1959) based a new genus *Acinophyllum* on *Eridophyllum simcoense* Billings (1859, p. 132, fig. 27) from Rama's farm, near the town of Simco, Ontario; Billings' type or syntypes are lost and McLaren illustrated the species by one of Lambe's specimens (Geological Survey of Canada No. 3436a-d) from Woodstock, Ontario, from the lower Middle Devonian "Corniferous" limestone. Its dissepiments are small and globose, not horseshoe, and not peneckielloid and its septa are peripherally weakly dilated and carinate, commonly complete but sometimes incomplete. Probably *Disphyllum geinitzi* Lang and Smith (1935) is a species of *Acinophyllum*. It may well be that *Planetophyllum* Crickmay, 1960 (type species *P. planetum* Crickmay, 1960, p. 4, pl. 1, figs. 1-5, from the basal bed of the Devonian, Stony Island, Slave River, Alberta) is a junior subjective synonym of *Acinophyllum*; but its holotype is worn and may be a *Peneckiella*.

Rózkowska (1960) founded the genus *Sudetia* on the species *S. lataseptata* from the same locality as *P. minor kunthi*. It is distinguished by the almost complete absence of horseshoe dissepiments; also a single series of highly inclined plates may replace the peneckielloid single series; trabecular fans are centred near the inner edges of the peneckielloid plates; the tabulae are as in *P. minor kunthi*. She considered there was an evolutionary line from *Thamnophyllum* through *Peneckiella* to *Sudetia*, leading to the replacement of the horseshoe and outer horizontal series of dissepiments by a peneckielloid series, bringing the centre of the trabecular fan nearer to the outer wall.

Whether or not the single series of dissepiments of *Peneckiella minor* are to be considered horseshoe dissepiments, in addition to the inner series of horseshoe dissepiments developed when two series of dissepiments are present (compare Flügel, 1956, Schouppé, 1958, Rózkowska, 1960, and Strusz, 1965) is a problem which cannot be solved without an investigation of the type material. It turns on whether the dilating fibres on the outer side of a thickened horseshoe dissepiment can be distinguished by optical or other means from the fibres normally forming the inner surface of the wall. For the present we leave *Peneckiella* somewhat doubtfully in the subfamily characterized by rhipidacanthine septa and by a pipe of horseshoe dissepiments with the axis of a trabecular fan coinciding with the axis of curvature of the horseshoes, i.e., in the Phillipsastracinae.

DISTRIBUTION: ?Emsian of eastern Australia. ?Givetian to Frasnian of Western Australia, Eurasia, North America.



***Peneckiella teichert* Hill, 1954**

Plate 6, figs. 2-4

1954 *Peneckiella teichert* Hill: p. 25, pl. 2, fig. 29.

**HOLOTYPE:** UWA 33515, *Atrypa* Beds in the reef about 6.6 miles from Mount Pierre Well on Old Bohemia Road, Kimberley Division, Western Australia (K147), Sadler Limestone, Frasnian.

**NEW MATERIAL:** Sadler Limestone, type locality K147 (2 specimens), K188 (1 specimen); Pillara Limestone, G3377 (1 specimen).

**DIAGNOSIS:** Phaceloid *Peneckiella* with corallites from 4.2 to 5.6 mm in diameter; septa fusiform with 17 to 22 in each order; tabulae typically complete, mesa-shaped but occasionally incomplete, supplemented by small periaxial tabellae.

**REMARKS:** Hill's (1954) diagnosis has been slightly modified herein on the basis of additional material from K147 (2 specimens) the type locality and K188 (1 specimen) in the Sadler Limestone. These specimens have some corallites with fewer septa than the holotype. The septa are typically more dilated than those of the holotype and in some a narrow stereozone is developed about the tabularium. The major septa in some corallites are not as withdrawn from the axis as in the holotype and in some the axial space is only 0.7 mm in diameter. Occasionally the axial ends of the major septa are slightly thickened and club-shaped. The tabularial characters are more variable in the topotypes than the holotype, they tend to be incomplete in places and only slightly domed, not distinctly mesa-shaped; periaxial tabellae are more common in the topotypes. Their dissepimentarium is typically peneckielloid with one row, very rarely two, of horseshoe or peneckielloid dissepiments over which the trabeculae are usually fanned.

One specimen BMR CPC.9553 from K188 is very similar in transverse section but differs in longitudinal section in that the single row of horseshoe and peneckielloid dissepiments is replaced in parts by several rows of inclined convex dissepiments and in these areas the trabeculae typically do not show any area of divergence. Also the tabularium has more incomplete tabulae than the specimens from the type locality. However, until more material is at hand it is included in *P. teichert*.

A single specimen from G3377 in the Pillara Limestone differs from the topotypic specimens in the rarer development of trabecular fans.

Strusz (1965, p. 561) tentatively placed *P. teichert* in the synonymy of *P. mesa* (Hill), 1942c, from the Emsian?, Garra Formation, Wellington, central N.S.W. With the additional material at hand these two species appear to us to be distinct. The tabulae of *P. teichert* are not as highly domed and typically are not as distinctly mesa-shaped as those of *P. mesa*. The latter does not show any inclined periaxial tabellae and its dissepiments are more highly arched vertically.

The form described as *P. teichert* by Lenz (1961) from the lower part of the Ramparts Limestone, Lower Mackenzie Valley, Northwest Territories, Canada, is not conspecific with the Western Australia species. It is cerioid or phacelo-cerioid and the tabulae are complete and sagging.

The generic position of this species has been re-examined following the work of Flügel, Schouppé, McLaren, Rózkowska and Strusz cited above. The dissepimentarium of *P. teichert* differs from the topotype of *P. minor* figured by Schouppé in the rarer development of the inner horseshoe plates and trabecular fans; however, both are present though rarely in the holotype and in the specimen from the Pillara Limestone. Considering the variation in the dissepimentarium of *P. minor kunthi* described by Rózkowska, the Western Australian form is easily accommodated in the genus *Peneckiella*. It differs from *Acinophyllum* in the development of horseshoe and peneckielloid dissepiments and trabecular fans which are not noted in *Acinophyllum*, in its greater degree of septal thickening and scarcity of long thin yardarm trabeculae, and in the arched and mesa style of its tabulae, for in *Acinophyllum* the tabulae are sub-horizontal. These differences are slight, and raise the question whether *Peneckiella* is not a late development from *Acinophyllum* rather than from *Thamnophyllum* or *Phacellophyllum*. The possession of rhipidacanth favours the latter.

DISTRIBUTION: Sadler and lower part of Pillara Limestones, Canning Basin; Frasnian.

### ***Peneckiella* sp. A**

#### Plate 6, fig. 1

MATERIAL: One specimen UWA 26354 from U5 in the Sadler Limestone; the locality is given as "*Prismatophyllum* reef" (10 feet in diameter) on approximately the same level as the *Atrypa* beds from which the holotype of *P. teichert* was collected.

DESCRIPTION: The specimen is a large fragment of a phaceloid corallum in which the corallites are 10 to 11 mm in diameter, cylindrical and spaced about their own width apart. There are 46 to 52 fusiform septa with the minor septa half the length of the major which extend three-quarters of the way to the axis leaving an axial space 2 to 2.6 mm in diameter. The major septa are attenuate in the tabularium. Only occasional carinae are developed, from the lateral extension of the rhipidacanthine trabeculae.

The dissepimentarium is narrow, averaging 2 mm in width and typically consists of one or two rows of flattened horseshoe or peneckielloid dissepiments. The trabeculae are fanned over the mid-line of the row of dissepiments. The tabularium is wide consisting of large, flatly domed axial tabellae and small inclined periaxial tabellae so that the resulting tabularial floors are flattened domes or are mesa-shaped.

REMARKS: This specimen is very similar to *P. teichert* from the type locality, in internal characters, but differs in its larger size, more numerous septa and wider tabularium showing more incomplete tabellae. Such characters may reflect more favourable conditions in a reef environment and further collecting may show it to be conspecific with *P. teichert* from the brachiopod limestones of the same horizon.

#### Subfamily MARISASTRINAE Rózkowska, 1965

DIAGNOSIS: Phillipsastraeids with heavily carinate septa composed of distant, laterally tufted trabeculae arranged in broad symmetrical fans over arched dissepimentarial floors consisting of small globose dissepiments; tabularium narrow, tabulae complete or composed of axial and periaxial tabellae.

DISTRIBUTION: Upper Devonian.

#### Genus *Haplothecia* Frech, 1885

TYPE SPECIES (by monotypy): *Haplothecia filata* (Schlotheim) 1820 = *Madreporites filatus* Schlotheim, 1820 (*part*, var.  $\alpha$  only) from the Frasnian Iberger Kalk, Winterberg, near Grund, Germany: lectotype (see Frech, 1885, p. 68), Q. Kat. A. 138, P. 1530, Institut für Paläeontologie und Museum der Humboldt-Universität, Berlin—the original of Frech's (1885) Pl. 4, figs. 7, 7a.

DIAGNOSIS: Corallum cerioid, dividing wall relatively thick with median "dark line". Septa of two orders radially arranged, strongly carinate in the dissepimentarium and smooth in the tabularium. At the carinae the septa are trabeculate and thickened, between carinae the septa thin and seem to fail so that in the outer dissepimentarium the septa appear discontinuous; the trabeculae are compound, essentially monacanth but with "tufts" or elongated bundles of fibres originating from the axis and diverging laterally in the plane through the trabecular axis normal to the septum; the trabeculae are arranged in broad symmetrical fans over the mid-regions of the dissepimentarial floor which is commonly broadly arched; dissepiments small and globose, steeply inclined at the tabularial boundary. Tabulae closely spaced, horizontal or slightly concave. (Diagnosis based on the lectotype of the type species.)

REMARKS: Frech (1885) proposed *Haplothecia* solely for the type species which he regarded as separable from *Phillipsastrea* by its cerioid habit and strongly carinate septa that break down into a trabeculate condition. Recently Pedder (1966), Pickett (1967), and Scrutton (1967) have re-examined the lectotype of *H. filata* and have regarded it as a distinct genus on the nature of its septa, lack of horseshoe dissepiments and broadly arched dissepimentarium over which the trabeculae are broadly fanned. Having studied the lectotype kindly lent to us by Dr. H. Jaeger we have only a brief comment on the septal microstructure to add to the descriptions given by the above authors.

The septa consist of stout trabeculae that are widely spaced in a lighter coloured tissue and are expanded laterally to give prominent yard-arm carinae. The trabeculae are compound but not of the typically rhipidacanthine type; no secondary trabeculae can be differentiated but bundles or tufts of fibres seem to develop from the primary axis of the trabecula and the fibres of these bundles are extended sometimes beyond the outer surface of the trabecula. These tufts diverge outwards from the primary axis of the trabecula in the plane normal to the median plane of the septum. In this, they resemble the secondary trabeculae of the rhipidacanthids but no axis from which the fibres radiate outwards can be differentiated in the tufts. The lateral extension of these tufts causes lateral expansion to the trabeculae thus giving rise to the carinae. This type of trabecula may be intermediate between the rhipidacanthine and monacanthine types developed in the Phillipsastraecidae. Pedder (1966) described the tissue of the septa between trabeculae as apparently structureless; it is almost clear under transmitted light. With high magnifications, however, traces of fibres continuous with the fibres of the trabeculae can be observed within it in places though in other parts it is nearly homogeneous. We suspect that this lighter material was fibrous composed of the extension of the fibres of the trabeculae and that due to alteration effects it has almost lost its fibrous nature.

In the Frasnian of England and Europe there are cerioid, astreoid, and thamnasterioid species with similar heavily carinate, almost discontinuous septa, and with broadly arched dissepimentarial floors without horseshoes. Scrutton (1967) has included astreoid forms in *Haplothecia*. Rózkowska (1965) introduced *Marisastrum* (with type species *M. sedgwicki* Edwards and Haime, 1851, p. 387; 1853, p. 231, pl. 52, figs. 3, 3a, the lectotype of which is a thin slice from a beach pebble from Torquay, England (British Museum Natural History, BM48451, chosen Soshkina, 1951, p. 96)) for cerioid forms which possess full trabecular fans based on everted dissepimentarial floors, fusiform septa and incomplete tabulae but lack horseshoe dissepiments. An acetate peel kindly lent to us by Dr. C. T. Scrutton and available figures of the lectotype of the type species suggest that the septa are strongly carinate and that the trabeculae are widely spaced and may be of the same type as in *Haplothecia*. Until the vertical section of *Marisastrum sedgwicki* is available the relation of these two, possibly synonymous, genera will remain in doubt.

DISTRIBUTION: Upper Givetian to Frasnian of south-west England, Frasnian of Germany (Harz), USSR (Urals); Scrutton (1967).

### ***Haplothecia? laciniosa* n. sp.**

Plate 5, fig. 1

MATERIAL: Holotype—BMR CPC.9548, from K348, 2.75 miles at 353° from Mt. Krauss, Kimberley Division, Western Australia; Sadler Limestone; Frasnian. No other material.

DIAGNOSIS: Thamnasterioid coralla with large corallites; the septal trabeculae are distant and fanned and the carinae are irregularly subopposite in the outer dissepimentarium; the dissepimentarial floors are everted and the tabularial floors are formed by slightly arched axial tabellae and inclined periaxial tabellae.

DESCRIPTION: Small fragment of a thamnasterioid corallum with corallites evenly spaced, approximately 10 mm apart centre to centre. The tabularia vary from 4 to 5.2 mm in diameter. There are 18 to 19 major septa radially arranged and alternating with minor septa. The septa are thin and heavily carinate in the outer dissepimentarium with long, irregular subopposite carinae; in the inner dissepimentarium they are considerably dilated with only short stout yard-arm carinae developed. The carinae all originate from the lateral extensions of the fibres of the trabeculae which are widely spaced and of moderate size in the outer parts of the dissepimentarium but become closely spaced in the inner parts and are then much stouter. The trabeculae seem the same as in the type species of the genus. They are arranged in broad symmetrical fans. The major septa extend almost to the axis and are attenuate and even flexuose in the tabularium.

The tabularial floors are flattened domes consisting of an axial series of wide, flat, axial tabellae convex upwards and an incomplete periaxial series of small inclined tabellae. The dissepimentarium is broadly arched, composed of small, very globose dissepiments. Lateral dissepiments parallel to the septa are commonly based on adjacent carinae.

REMARKS: This species is only doubtfully referred to *Haplothechia* because of its thamnasterioid form and because its septa do not appear discontinuous. However, the trabeculae are widely spaced and the dissepimentarial characters are similar to those of *H. filata*. In the form of its corallum and the lace-like modification of its septa it resembles the astreoid to thamnasterioid *Haplothechia pengellyi* (Edwards and Haime) as described by Scrutton (1967) but has a more open texture and a simpler tabularium. Perhaps *H. pengellyi* and *H. laciniosa* represent a new genus in the subfamily Marisastrinae.

#### Subfamily DISPHYLLINAE Hill, 1939a

DIAGNOSIS: Phillipsastraesids with monacanthine trabeculae in which the fibres diverge at a moderate angle to the axes of the trabeculae; septa wedge—or spindle-shaped in transverse section depending on whether the dissepimentarial floor slopes uniformly towards the axis or only gradually in the outer dissepimentarium and steeply near the tabularium; septa weakly carinate or non-carinate; dissepiments small and globose; without flat, peneckielloid or horseshoe dissepiments.

DISTRIBUTION: Devonian except for possible occurrences in the Upper Silurian of New South Wales and Lower Carboniferous of China.

## Genus DISPHYLLUM de Fromental, 1861

- 1861 *Disphyllum* de Fromental, p. 302.  
1893 *Cannophyllum* Chapman, p. 45.  
1922 *Schlueteria* Wedekind, p. 3 (not *Schlueteria* Fritsch, 1887).  
1939 *Megaphyllum* Soshkina, p. 14 (not *Megaphyllum* Verhoeff, 1894).  
1939 *Pseudostringophyllum* Soshkina, p. 36.  
?1941 *Ceratinella* Soshkina, p. 36.  
?1952 *Minussiella* Bulvanker, p. 134.  
?1952 *Solominella* Ivaniya, p. 141.

TYPE SPECIES (by subsequent designation of Lang and Smith, 1934, p. 80): *Cyathophyllum caepitosum* Goldfuss, 1826, p. 60; lectotype chosen Lang and Smith, 1934, p. 80, original of Goldfuss, 1826, pl. 19, fig. 2b only (Middle Devonian; Eifel, Germany. Lang and Smith (1935b) recorded "Eifel" as the locality of the lectotype.

DIAGNOSIS: Phaceloid, with lateral or peripheral increase; septa only slightly dilated at periphery, occasionally carinate; trabeculae monacanthus projecting inwards and upwards; dissepiments in several series of small subequal plates, globose or subglobose, the innermost being highly inclined; horseshoe dissepiments not developed; tabularium simple, tabulae complete or incomplete.

REMARKS: In choosing *Disphyllum goldfussi* (Geinitz) (= *D. caepitosum* (Goldfuss)) as the type species of *Cannophyllum* Chapman, 1893, Stumm (1949) made that genus a junior objective synonym of *Disphyllum*. Lang and Smith (1935b) considered *Schlueteria emsti* Wedekind, 1922, from the upper Honsel Beds at Emst, Germany, the type species of *Schlueteria* Wedekind, 1922 (not *Schlueteria* Fritsch, 1887, a crustacean), as congeneric if not conspecific with *D. caepitosum* and *Schlueteria* Wedekind a junior subjective synonym of *Disphyllum*.

Soshkina (1939) proposed two generic names for fasciculate or simple forms which appear to be disphyllinids—*Megaphyllum*, type species *Megaphyllum poshiense* Soshkina, 1939, pp. 14-15, pl. 1, figs. 1-4, pl. 12, figs. 99-100, pl. 14, figs. 114-118, from the Poshia region, central Urals, Frasnian, not *M. katovense* Soshkina, 1939, abstracted as the type species by Soshkina (1939, p. 46) in the same work, and *Pseudostringophyllum* with type species *Pseudostringophyllum caepitosum* Soshkina, 1939, pp. 36, 54, pl. 10, figs. 81, 82; pl. 12, figs. 97, 98, from the Katav region, Southern Urals, Frasnian. Both type species are fasciculate and may be congeneric with *D. caepitosum*. *Megaphyllum* is preoccupied for a myriapod by Verhoeff (1894).

Two further Russian genera which require evaluation in relation to *Disphyllum* are *Minussiella* Bulvanker, 1952, type species *M. beljakovi* Bulvanker, 1952, p. 135, pl. 7, figs. 2, 3, from the Eifelian Tastyp Suite D<sub>2</sub>1 of Kulagay, Minusinsk Basin, southern Siberia, and *Solominella* Ivaniya, 1952, type species *S. soshkinae* (as *soshkini*) Ivaniya, 1952, pl. 4, fig. 2 (holotype), from the

middle Frasnian Glubokin horizon, on the right bank of the Strel'na at Solomino, Kuz Basin. *Minussiella* was originally considered a spongophyllid but in some subsequent works it has been given as a synonym of *Hexagonaria*. *M. beljakovi* appears to be a fasciculate disphyllinid. The holotype 39/8 is figured by Bulvanker (1952, pl. 7, figs. 2a, b) according to Bulvanker (written communication, 1968). The holotype of *S. soshkinae* has been refigured by Ivaniya (in Zheltonogova and Ivaniya, 1961, pl. D30, figs. 3a, 3b) and Ivaniya (1965, pl. 98, figs. 415, 416) and seems to be a phaceloid disphyllinid with a narrow peripheral stereozone. *Disphyllum virgatum* (Hinde) and *D. curtum* Hill from Western Australia show similar stereozones but these are seldom as well developed as in *S. soshkinae* and show great variability in development within corallites of the same corallum. Possibly *Solominella* is a synonym of *Disphyllum*.

DISTRIBUTION: Devonian.

### ***Disphyllum caespitosum* (Goldfuss), 1826**

Plate 7, figs. 1-10; Plate 8, fig. 2

1826 *Cyathophyllum caespitosum* Goldfuss: p. 60, pl. 19, fig. 2b only.

1846 *Cladocora goldfussi* Geinitz: p. 569.

1935b *Disphyllum goldfussi* (Geinitz); Lang and Smith, p. 568, pl. 35, figs. 4-8 (for synonymy).

1954 *Disphyllum goldfussi* (Geinitz); Hill, p. 18, pl. 2, figs. 11, 12, 28.

LECTOTYPE (chosen by Lang and Smith, 1934, p. 80): The original of *Cyathophyllum caespitosum* Goldfuss (1826, pl. 19, fig. 2b) from the Middle Devonian of the Eifel, Germany; it was refigured and described by Lang and Smith (1935b, p. 568, pl. 35, figs. 4-6).

MATERIAL (with number of specimens in brackets): Sadler Limestone—G1082 (15), ?K251 (1), K252 (1), K301 (1), U8 (3); Pillara Limestone—G1002 (1), G3239 (1), G3300 (1), G3366 (1), K213 (1), ?K233 (1), K313 (1).

DIAGNOSIS: Phaceloid coralla; the septa are normally only slightly thickened and non-carinate, radially arranged and a little withdrawn from the axis; the dissepiments are subequal, small and subglobose; no pipe of horseshoe dissepiments is developed; the tabulae are in two series, an axial series of flat, concave or slightly mesa-shaped plates and a periaxial series of large, inclined and dissepiment-like plates.

DISCUSSION: Like Pickett (1967) we are regarding *Disphyllum goldfussi* (Geinitz) as a junior objective synonym of *D. caespitosum* (Goldfuss). Lang and Smith (1935b) and Smith (1945) described the lectotype of the species as showing parricidal increase whereas in the Western Australian material it is lateral, nonparricidal; whether this is of specific importance or not is at the moment conjectural. The variation within *D. caespitosum* in Europe has not

been described and we are accepting wide limits of variation for this species because in Western Australian *Disphyllum* the variation is considerable in the same species from various localities and even in material from the same locality.

Hill (1954, p. 18, pl. 2, figs. 11, 12, 28) referred to *D. goldfussi* corals from several localities in the Pillara Limestone. An additional occurrence in the Pillara Limestone is G1002. Here, fragments of cylindrical corallites, some showing offsets, and some aggregated as in a phaceloid corallum, have a considerable range of variation in internal morphology, like that shown by the species in Europe. Large globose dissepiments are common amongst the smaller ones in the dissepimentaria, parts of some corallites showing a fairly consistent vertical series of large plates at the periphery; oblique and angulate dissepiments are characteristic at the inner edge of the dissepimentarium. Some corallites show considerable septal thickening near the inner edge of the dissepimentarium. The tabularium is that typical for the species, the width of the axial tabellae decreasing when the major septa extend further to the axis.

An abraded corallite (BMR CPC.9557) from K213 is referred to this species; its septa are withdrawn slightly further from the axis and the axial tabellae are wider than in the specimens from G1002.

A specimen GSWA F5931/1 (pl. 7, fig. 8) from G3366 showing a lateral offset may be a member of the species, though it has greater septal thickening than normal and its axial tabulae in part of the corallite are deeply concave.

One colony GSWA F7847 (pl. 7, fig. 9) from G3300 in the Pillara Limestone seems to be the same form as that described below from G1082 in the Sadler Limestone.

DESCRIPTION OF SPECIMENS FROM G1082: One small colony with tip of proto-corallite preserved, 4 fragments of colonies, and 10 cylindrical but somewhat vermiform fragments were collected from G1082. The corallum is bushlike, the corallites spreading outwards at a high angle from the parents. Increase is lateral, new offsets arising with a large diameter, 5 or 6 mm or more at point of origin, the average diameter attained by the adult being 15 mm. Several offsets may arise in quick succession from different parts of the parent. The proto-corallite of the colony has a short, conical early stage, with a talon of attachment, but then rapidly increases in diameter, growing subcylindrically and erect. The epitheca of the individual corallites shows fine growth annulation, broad, low, rounded interseptal ridges and narrow septal grooves. The calice has a wide flat or slightly everted rim and a deep pit.

At a diameter of about 13 to 15 mm there are 24-25 septa of each order. The major septa extend unequally to the axis, with or without some curving, and one may be longer and straighter than the others, extending beyond the axis, but we have not yet been able to ascertain whether it is the cardinal or counter septum. There is no obvious fossula. The minor septa are neither contratrigent nor contrajunct. The septa are thin axially but thicken towards the dissepimentarium; within the dissepimentarium they may continue a gradual



thickening towards the periphery, or in parts of some corallites, may become so thick as to be laterally contiguous in a zone at the inner edge of the dissepimentarium. In such a zone they show sections of trabeculae characteristic of the family. No trabecular fan has been distinguished in median longitudinal sections of the septa. The minor septa which attain about half the radius of the corallite, are axially a little thinner than the major septa.

The tabulae are in two series of tabellae; the axial series tends to be closely spaced and broad, horizontal, mesa-shaped or slightly concave; the periaxial plates are inclined downwards from the dissepimentarium and are large and may be somewhat globose. The tabulae are not thickened.

The dissepimentarium occupies nearly half the radius of the corallite and consists predominantly of large globose plates based horizontally or more commonly with their outer edge a little higher than their inner edge; interspersed are smaller, globose plates. The septal thickening continues on the upper surfaces of some of the dissepiments. Some of the inner dissepiments are oblique or angulate in transverse sections of the corallite.

REMARKS: This form is within the wide range of variation currently accepted for *D. caespitosum*. It is slightly larger with more septa than the material from the Pillara Limestone, and its septa are commonly considerably dilated at the inner dissepimentarium.

One fragment (BMR CPC.9558) from K252 is smaller (8 mm diameter). A large colony BMR CPC.9555 (pl. 7, fig. 10) from K313 is phacelo-ceroid with adjacent corallites in contact for much of their length. Its corallites vary from 12 to 14 mm in diameter and contain 23 to 24 major septa that show no signs of dilation at the tabularial boundary, otherwise it does not differ significantly from the material from G1082.

GSWA F5925/1 (pl. 8, fig. 2) a phaceloid corallum from G3239 is doubtfully referred to *D. caespitosum*. Its numerous tabellae are but poorly differentiated into axial and periaxial series though the tabularial floors are like those of the other Sadler specimens in being mesa-shaped or slightly arched with upturned margins.

Three cylindrical fragments UWA 26314/1, UWA 26314/16 from U8, and a specimen from K301, resemble the forms from the Pillara Limestone except that the septa tend to be dilated at the tabularial boundary as in the specimens from the Sadler Limestone described above.

BMR CPC.9557 from K233 from the top of the Pillara Limestone resembles the lectotype of *D. caespitosum* in transverse section but in longitudinal section it differs in that the tabularial floors are concave upwards, the axial and periaxial tabellae are not as well differentiated, the boundary between dissepimentarium and tabularium is well defined and the dissepiments are less globose and are inclined axially at a steeper angle. It is tentatively referred to *D. caespitosum*.

DISTRIBUTION: Givetian and Frasnian.

**Disphyllum virgatum** (Hinde), 1890

Plate 9, figs. 1-8

1890 *Cyathophyllum virgatum* Hinde: p. 194, pl. 8, figs. 1a, b.

1936a *Disphyllum virgatum* (Hinde); Hill: p. 29, pl. 1, figs. 1-3.

1954 *Disphyllum virgatum* (Hinde); Hill: p. 19, pl. 2, figs. 3-5.

**MATERIAL** (with number of specimens in brackets): Sadler Limestone—K112 (39 fragments tentatively referred to the species), K221 (1), K245 (1), K267 (1), ?K344 (1), U8 (1); Pillara Limestone—G1085 (1), K439 (1), K480 (3).

**REMARKS:** Hill (1954, p. 19) referred eight specimens (one doubtfully) from the lower part of the Pillara Limestone to *Disphyllum virgatum* (Hinde). These differed from the lectotype in their more variable septal stereozones and in the larger and more elongate tabellae of their tabularia.

Thirty-nine fragments from K112 are only tentatively referred to *D. virgatum* as it was not possible to determine whether they were parts of phaceloid colonies. The fragments, all deeply weathered, are cylindrical corallites up to 50 mm in height except one (BMR CPC.9566) which is trochoid and 25 mm in length. One specimen shows two short branches coming off the parent corallite while others show small adherent offsets. The corallites have a maximum diameter of 13.5 mm and show a greater variation in the number of septa than the type material in that the adult corallites contain between 48 and 62 septa. The major septa may be only slightly withdrawn from the axis leaving a narrow axial space 1 mm in diameter or they may extend only two-thirds of the way to the axis leaving an axial space of 3.3 mm in diameter. The dilatation of the septa is also variably developed; all are thickened at the periphery, some are slightly thickened at the innermost series of dissepiments and others are so dilated in the inner dissepimentarium that adjacent septa are in contact. In the middle parts of the dissepimentarium the septa are slightly carinate, the carinae being short blunt lateral expansions of the trabeculae. The trabeculae are monacanth 0.20 to 0.25 mm in width arranged in parallel and directed upwards and inwards at a low angle to the horizontal. The tabularial floors are saucer-shaped, consisting of an outer series of numerous, axially inclined, small convex tabellae, slightly larger than, but inosculating with the dissepiments, and an inner series of flat or slightly convex larger tabellae, their width depending on the amount of withdrawal of the major septa from the axis. The dissepimentarium is composed of small globose dissepiments either horizontal or slightly inclined axially at the epitheca but steeply inclined near the tabularium. The dissepiments at the inner margin of the dissepimentarium are commonly thickened with the thickening continuous with that of the septa.

The specimen from G1085 is doubtfully referred to *D. virgatum* as the major septa are flexuose and swirled in the tabularium and the tabulae are more

complete and distant than in the lectotype. One corallum from K267 is phacelo-ceroid with corallites smaller than the Pillara Limestone specimens, rarely attaining a diameter of 10 mm. Three coralla from K480 show great variation in the development of stereozone and in one corallite of BMR CPC.9567 it is complete and fills the whole dissepimentarium as in the variety *D. virgatum* var. *compactum* Hill, 1954, while others are similar to those of K112. A corallum from K344 shows a slightly everted dissepimentarial floor in part of the longitudinal section and tabulae more complete than in the type material; it is only very doubtfully referred to *D. virgatum*.

DISTRIBUTION: Sadler and lower part of Pillara Limestones, Canning Basin; Frasnian.

### ***Disphyllum curtum* Hill, 1954**

Plate 7, fig. 11; Plate 8, fig. 3

1954 *Disphyllum curtum* Hill: p. 22, pl. 2, fig. 8.

DIAGNOSIS: Phaceloid *Disphyllum* with septa noncarinate and cuneate in the dissepimentarium; major septa attenuate in the tabularium and withdrawn from the axis; tabulae complete and sagging; dissepimentarium narrow, of one to three vertical series of large globose dissepiments.

DESCRIPTION OF NEW MATERIAL: GSWA F7848 from G1009 in the Pillara Limestone is phaceloid with the corallites cylindrical up to 11 mm in diameter and closely spaced. Increase is non-parricidal. The septa number 21 or 22 of each order at a diameter of 9.5 mm. The septa are thickest at the periphery and thin axially but occasionally are slightly dilated over the inner row of dissepiments; the major septa extend only half way to the axis and are attenuate in the tabularium. The dissepimentarium is narrow, maximum width 1.8 mm, and is composed of large globose dissepiments, largest at the periphery where they are almost horizontally based or have their inner edge only slightly below the peripheral edge. The wide tabularium is composed almost entirely of shallowly sagging, complete tabulae.

Two specimens BMR CPC.9559, 9560 from K246 in the Sadler Limestone are tentatively included in *D. curtum*. They differ from the type in that the complete tabulae are accompanied by a series of small periaxial tabellae and the outer series of dissepiments are peripherally flattened (as seen in vertical section). The corallites are also larger, maximum diameter 13.5 mm, and contain more septa—25 or 26 of each order.

DISTRIBUTION: Sadler and Pillara Limestones, Canning Basin; Upper Devonian.

**Disphyllum** sp. aff. **D. curtum** Hill, 1954

Plate 8, fig. 2

**MATERIAL:** Six specimens— UWA 26647b, UWA 26647f, UWA 26647/2, UWA 26551c from U11, UWA 26644/1d from U10, UWA 26468/1f from U12, UWA 26551c from U22; all from the Pillara Limestone.

**DESCRIPTION:** The material consists of fragments of small bushy phaceloid coralla. Corallites are cylindrical, with average diameter 9 to 10 mm. There are 21 to 24 septa of both orders, variously thickened in two zones, one zone at the periphery and the other over the innermost row of dissepiments; in some corallites these two zones merge, and the dilatation is so extensive that adjacent septa are in contact and the dissepimentarium is replaced by a peripheral stereozone.

The major septa extend half to two-thirds of the way to the axis and the minor septa are short, less than a third of the length of the major septa. The tabularium is wide consisting of almost complete, horizontal or slightly sagging tabulae; occasionally in parts of the corallites the tabulae are slightly arched and may be supplemented by an irregular development of periaxial tabellae. The dissepimentarium is narrow consisting of one or two or more rarely three series of small globose dissepiments.

**REMARKS:** In the shortness of the septa, narrowness of the dissepimentarium and simplicity of the tabularium these specimens resemble *D. curtum*. However, the septa are much more dilated and slightly further withdrawn from the axis than in the holotype. Also in vertical section the tabulae are not consistently depressed as in the holotype nor are the dissepiments so large or so regularly arranged. These differences are those of degree and a more complete understanding of the variation within *D. curtum* may show that this form is conspecific with the holotype.

**DISTRIBUTION:** Pillara Limestone, Canning Basin; Upper Devonian.

**Disphyllum intertextum**, Hill, 1954

Plate 8, fig. 4

1954 *Disphyllum intertextum* Hill: p. 22, pl. 3, fig. 1.

The only specimen of this species previously known was the holotype. Another specimen UWA 26382 from the type locality, Paddy's Spring, northern side of Laidlaw Range, Sadler Limestone, Frasnian is sufficiently similar to the holotype to be included in the species. It differs only in that the septa are slightly shorter and the axial tabellae are broader.

### **Disphyllum sp. A**

Plate 8, fig. 6

**MATERIAL:** Two specimens from K508 in the Pillara Limestone, and one specimen from K347 in the Sadler Limestone.

**DESCRIPTION:** The coralla are phaceloid, with the corallites cylindrical and aggregated into clumps in which adjacent corallites are commonly in contact; increase is non-parricidal with one to three buds originating at the same level. Adult corallites average 9 mm in diameter but just before increase some attain 12.5 mm. There are 19 to 24 septa of both orders; the major septa extend less than half the way to the axis and the minor septa are half their length. The septa of both orders are thickened at the periphery and thin axially being occasionally slightly dilated at the boundary between the dissepimentarium and the tabularium; the major septa are attenuate in the tabularium. The dissepimentarium is very narrow, less than 1.35 mm in width, and consists of one or occasionally two rows of globose dissepiments, irregular in size and inclined down towards the tabularium. The tabularium is wide and simple composed of complete horizontal or slightly arched tabulae.

**REMARKS:** This form differs from *D. curtum* in having shorter septa, simpler tabularium, and narrower dissepimentarium.

### **Disphyllum sp. B**

Plate 8, fig. 5

UWA 26382 from U14 in the Sadler Limestone differs from the other Western Australian disphyllids in its simple structure. It is a phaceloid corallum with widely spaced corallites up to 6.5 mm in diameter. There are 18 to 20 smooth, wedge-shaped major septa which are only half the radius of the corallite in length. The minor septa are less than a third of the length of the major septa. Dissepiments are very small and are arranged in a single series. The tabularium is very simple with complete slightly arched or mesa-shaped tabulae which are widely spaced with up to 5 per 4 mm.

### **Genus *Hexagonaria* Gürich, 1896**

1861 *Polyphyllum* de Fromentel: p. 308 (not *Polyphyllum* Blanchard, 1850, a coleopteran).

1896 *Hexagonaria* Gürich: p. 171.

1909 *Hexagoniophyllum* Gürich: p. 102.

**TYPE SPECIES** (by subsequent designation of Lang, Smith and Thomas, 1940, p. 69): *Cyathophyllum hexagonum* Goldfuss (1826, p. 61) of which the lecto-

type, chosen by Lang and Smith (1935b, p. 550) as the original of Goldfuss, 1826, pl. 20, figs. 1a, b, is presumed missing; subsequently Pickett (1967, p. 58) selected a neotype—specimen 207c1 of the Goldfuss collection, Geologisch-Paläontologisches Institut, Bonn, probably from the lower Frasnian Refrath Schichten near Bensberg, near Cologne, Germany, figures pl. 4, fig. 1 herein.

**DIAGNOSIS:** Cerioid disphyllinid with fusiform major and minor septa thickest at the inner parts of the disseptimentarium, radially arranged, and typically carinate with predominantly yard-arm carinae formed by the lateral extension of the fibres of the closely spaced monacanthine trabeculae; major septa attenuate in the tabularium and meeting, or leaving a space, at the axis. Dissepiments small, numerous, globose with the outer two or three series commonly larger and typically flattened; dissepimentarial floors horizontal or slightly declined outwards near the periphery and steeply declined axially near the inner margin so that the calical platform is flat or slightly everted though steeply inclined at the tabularium; the septal trabeculae are thus arranged in broad asymmetrical half-fans or fans. Tabulae incomplete, horizontal or slightly convex, with a few supplementary periaxial tabellae.

**REMARKS:** The diagnosis is based on photographs of the neotype of the type species kindly sent to us by Dr. R. Birenheide (figured pl. 4, fig. 1), and is narrower than that customarily accepted. In longitudinal section the neotype shows some resemblances to *Cyathophyllum* except that the dissepiments are slightly more globose and the trabeculae are broader and more distinct. However, in transverse section the septa are more fusiform and carinate than is typical in cerioid species of *Cyathophyllum*.

Originally the cerioid disphyllids from Western Australia were placed in the genus *Prismatophyllum* Simpson, 1900, with type species (by original designation) *Cyathophyllum rugosum* (Hall) Edwards and Haime, 1851, p. 387, pl. 12, figs. 1, 1a-b, excluding most if not all of the synonymy; = *Prismatophyllum prisma* Lang and Smith, 1935b, p. 558; from the lower Middle Devonian of Ohio, U.S.A. (for discussion see Lang and Smith, 1935b, pp. 558-559, and Lang, Smith and Thomas, 1940, p. 104). *P. prisma* differs from *Hexagonaria hexagona* in that its septa are uniformly attenuate in the tabularium and dissepimentarium and are carinate with the carinae typically of the long, thin, yard-arm type. The septal microstructure of *P. prisma* differs in that the trabeculae are widely spaced, and while laterally expanded to form the carinae are commonly supplemented by additional trabeculae inserted in the plane of the carinae. *Prismatophyllum* shares such characters with *Billingsastrea*, some, if not the type, species of *Cylindrophyllum*, *Heliophyllum* and possibly *Zaphrenthis*, all of which may form a family group distinct from the Disphyllinae Hill.

Another group of species customarily placed in *Hexagonaria* includes forms similar to the *H. pachythea*—*H. amanshauseri* series described by Glinski (1955). Many of the specimens figured as *H. quadrigemina* (Goldfuss) belong

to this group but there is some doubt whether the lectotype should be included. These forms are distinguished by their wedge-shaped septa thickened in the outer dissepimentarium, in contrast to the fusiform septa of *H. hexagona*, and their inclined dissepimentarial floors which slope downwards and inwards from the margin and lack the broad peripheral calical platforms of the *H. hexagona* group. This group is considered separate and included in the North American genus *Argutastrea* Crickmay. *Pseudoacervularia* Schlüter (1881, p. 84) may possibly be a synonym of *Hexagonaria* but its type material is missing, and the genus cannot be objectively used until a neotype is described and figured. The genus was validated by Lang, Smith and Thomas (1940, p. 108) when they chose as type species *Acervularia coronata* Edwards and Haime, 1851, p. 416; 1853, p. 237, pl. 53, figs. 4, 4a, 4b, from the Givetian (House, 1963, p. 15) of Barton Quarry, near Mary Church, Torquay, Devonshire, England. Rózkowska (1953) referred to it some cerioid and partly cerioid, partly thamnasterioid Polish species with everted calical rims and characterised by three series of dissepiments—a median series of horseshoe dissepiments, near the inner margin of the dissepimentarium, an inner series declined from these towards the tabularium and a peripheral series declined towards the wall. She described the septa as showing wide symmetrical fans, based on the horseshoe dissepiments. She had overlooked Lang, Smith and Thomas' choice of *A. coronata* as type, and invalidly chose *A. macrommata* Römer, 1855, as type species. In 1957 she transferred all the species she had placed in *Pseudoacervularia* to *Pachyphyllum* though many of them are cerioid. The dissepimentarium and trabecular arrangements in these species are phillipsastraeoid in character as are those of *Prismatophyllum brownae* Hill, from the Sulcor Limestone, Tamworth district, New South Wales, which Pedder (1964a) nominated as type species for a new genus *Sulcorphyllum*, but which we now refer to *Trapezophyllum* Etheridge.

DISTRIBUTION: Devonian.

### ***Hexagonaria playfordi* n. sp.**

Plate 10, figs. 3-5

TYPE MATERIAL: Holotype—GSWA F5922/1 from G1082 the southeastern end of Hull Range, Kimberley Division, Western Australia; Sadler Limestone; Frasnian. Paratypes—GSWA F5922/2, F5922/3, F7849 from the type locality G1082.

OTHER MATERIAL: One doubtful specimen BMR CPC.9570 from K218, Sadler Limestone.

DIAGNOSIS: *Hexagonaria* with peripheral and non-parricidal increase, with wide dissepimentarium, the dissepimentarial floors with flat or slightly everted wide marginal part and narrow steeply inclined to vertical inner part, dissepiments elongate and moderately globose; tabularium with flat to convex inner floors,

supplemented at the dissepimentarial boundary by large dissepiment-like inclined plates. Septal trabeculae monacanthous diverging fan-wise in the septal plane at the crest of the dissepimentarial floors; no series of horseshoe dissepiments developed.

DESCRIPTION: The coralla are large, sub-hemispherical and cerioid; at the edges of the colony the free sides of the corallites are curved; in the body of the corallum the corallites are straight sided, except where young corallites, which mostly have curved sides, are accommodated. Unweathered calices have sharp dividing walls and slightly everted dissepimented rims, in which the major septa stand as strong radial and not carinate ridges tapering both towards the dividing wall and into the tabularium; the calicular pit is moderately shallow with steeply sloping sides.

The maximum diameter of the larger corallites, which are five to seven-sided, ranges from 15 to 20 mm; the maximum width of the sides in these large corallites ranges from 8 to 12 mm; average diameter of the larger corallites is approximately 15 mm.

The common walls between corallites may show a median line of fine dense carbonate, with on either side a narrow fibrous zone continuous from one septal base to the next, its carbonate needles midway between septa being arranged at right-angles to the median line; but as the septa are approached the angle gradually lessens until the fibres proceed outwards from the mid-line of the base of the septum. In other places, the fibrous walls include dense patches which might possibly be axes of second order trabeculae. The common wall between corallites varies in thickness from 0.125 to 0.375 mm between opposite or subopposite interseptal loculi, the thickness increasing as the septa bounding the loculi are approached.

The septa number 22, 23, 23, and 21 of each order in the four largest corallites of the holotype and 25 of each order in a corallite from another corallum. The major septa extend from the wall almost and slightly unequally to the axis; they are radial, curving slightly near the axis so that they appear directed towards an axial bar rather than a point; this axial bar may lie in the axial plane, and one of the septa lying in the plane may be longer than the remainder, as if it were either the cardinal or the counter septum, but no distinct cardinal fossula is recognisable. The minor septa are always thinner than their neighbouring major septa, varying in thickness and length from corallite to corallite and from one part of a corallite to another. They mostly fail to reach the inner edge of the dissepimentarium; they may be thin and disappear or they may be represented by separated trabeculae. The major septa are thickest towards the inner margin of the dissepimentarium, and thin at either end; in a few places in the corallum they may thin and disappear peripherally, though their bases are always to be seen on the wall, with characteristic triangular section. In transverse sections where the septa are of intermediate thickness the trabeculae are bead-like thickenings separated by short thin segments of septum; where the septa are very thick,



the individual trabeculae are distinguishable only by variation in the direction of the septal needles, which radiate from their axes. In some places the fibrous thickenings of the septa continue on to the surfaces of the inner rows of dissepiments; this is quite marked in younger corallites. In radial sections of the septa centres of the septal trabeculae are about 0.25 mm apart. Each originates at the wall and curves upwards and inwards, its curvature being normal to the inclination and curvature of the neighbouring dissepiments. Where the dissepimental floors are everted in widening dissepimentaria the trabeculae may become vertical or curve back outwards from an area of divergence.

The dissepiments are rather elongate, sub-sequal, sub-globose plates which are steeply inclined and more elongate at the boundary with the tabularium; outwards from the tabularium they become less inclined or horizontal; when the calice is everted those in the outer part of the dissepimentarium are declined outwards. No pipe of horseshoe dissepiments is developed. In transverse sections of the corallites, the inner dissepiments are closely spaced and fairly regular and appear shallowly concave towards the axis, even in the loculi between major septa from which the minor septa have withdrawn; only rarely is there an inosculation of two smaller plates; the outer dissepiments are irregular and appear concave outwards. Where the septa are thickest the septal thickening spreads across the surfaces of the inner dissepiments.

The tabulae are in two series of tabellae, and are always unthickened. The inner series is of horizontal or very shallowly convex plates grouped so that one or two narrower ones are based on one wider one. The other series is of more globose plates, inclined downwards from the inner dissepiments; in transverse section they lie axially to the minor septal ends even when these are perfectly developed.

REMARKS: In its septal characters this species resembles *Hexagonaria laxa* Róźłowska from the Givetian of Dziewki, Poland; but the development of eversion in the dissepimental (or calical) floors distinguishes it from that species. It somewhat resembles *Donia brevilamellata* (Hill) from the Kimberley Division.

BMR CPC.9570, tentatively included in this species, is similar in all respects to the topotypic material except that its dissepimentarium does not show the typical horizontal or everted outer platform.

DISTRIBUTION: Sadler Limestone, Canning Basin; Frasnian.

#### Genus **Donia** Soshkina, 1951

1951 *Donia* Soshkina, p. 114.

TYPE SPECIES (by original designation): *Donia russiensis* Soshkina (1951, p. 114, pl. 16, fig. 3; pl. 24, figs. 1-3); holotype (*ibid*, pl. 16, fig. 3), thin section

59 of collection 837, Palaeontological Institute, Moscow, from the Orlov region, Russian Platform, Frasnian stage, Liven layer.

DIAGNOSIS: Corallum cerioid or subcerioid. Septa confined to dissepimentarium, withdrawn from periphery and axis and thickened spindle-wise or with carinae; interrupted and represented by short septal segments or discrete trabeculae; minor septa may be absent altogether. Tabulae complete or incomplete; flatly convex or concave, supplemented peripherally by dissepiment-like tabellae declined towards the axis. Dissepiments large, flat rather than globose, and in the outer parts of the dissepimentarium horizontally based or even inclined downwards and outwards reflecting an everted calice.

DISCUSSION: This genus is very close to *Hexagonaria*, from which it differs in the simultaneous strong development of three features which may be seen separately or less strongly developed in various species of *Hexagonaria*. These are (1) flattening and coarsening of the dissepiments combined with a slight eversion of the calical rims and a weakly fan-like arrangement of the trabeculae; (2) suppression of the minor septa, and (3) withdrawal of the major septa to the dissepimentarium leaving flat or slightly concave complete or incomplete tabulae which may be supplemented periaxially by inclined tabellae. In the type species a fourth character of peripheral thinning of the septa combined with withdrawal from the periphery is present; it is only occasionally seen in the Chinese and Western Australian species herein transferred to the genus.

*Tabellaephyllum* Stumm, 1948a (with type species *T. peculiare* Stumm, 1948a, p. 41, pl. 12, figs. 1, 2, 9, 11, the holotype, stored in the U.S. National Museum, from the Upper Devonian Martin Limestone of the limestone hill just north of Moore's Gulch, western edge of Bisbee quadrangle, Arizona) must be considered in relation to *Donia*. It is cerioid, each corallite with a broad calical rim and deep axial pit; beneath the rim are long and small dissepiments convex transversely as well as longitudinally, and beneath the pit are concave tabularial floors each formed by a single saucer-like tabula or by two or more dissepiment-like large tabellae. Stumm believed it was derived from *Spongophyllum*. Hill's suggestion (1956) that it might be a tabulatan lacks support; the wall has not been shown to be perforate. Soshkina (1951) placed in it a Russian Frasnian cerioid species *T. rosiforme* Soshkina, which also lacks septa but in which the tabulae are mostly complete and horizontal, with a few periaxial inclined plates; she assigned *Tabellaephyllum* with *Donia* to the Peneckiellidae. Soshkina (1954) transferred *Tabellaephyllum* to the Endophyllidae, because of the characteristic bunches of flat axial tabellae in one of the species referred to the genus. However, Soshkina and Dobrolyubova in Orlov (1962) replaced the genus based on *T. peculiare* Stumm in the Disphyllidae close to *Donia*. Liao (1965) considered *Donia* to be closely allied to *Hexagonaria*.

Probably synonymous with *Tabellaephyllum* is *Utaratuia* Crickmay (1960, with type species *U. laevigata* Crickmay, 1960, p. 5, pl. 1, figs. 6-9, pl. 8, fig. 1; the holotype, figs. 8 and 9 *loc. cit.* is from the Hume formation, "low Middle

Devonian Limestone", Rainbow Arch, Carcajou River Northwest Territories, Canada, and is in the collection of the Paleontological Research Institution, Ithaca, New York). The morphology of these two genera is one which can be obtained by loss of septa in different lineages; all we have to guide us is the horizontal skeletal elements, and to us the tabulae of both *T. peculiare* and *U. laevigata* are more like those of disphyllids than of spongophyllids or endophyllids. Another possibility is that one or both of these represent cerioid Cystiphyllina, and this is Pedder's (1964b) view of *Utaratuia*.

*Sciophyllum* Harker and McLaren (1950) is an aseptate cerioid genus with flat tabulae; its authors consider it a lithostrotionid, and it is probably a homeomorph rather than a synonym of *Donia*. Its type species is *S. lambarti* Harker and McLaren (1950, p. 31, pl. 4, figs. 1-5 all of which are of the holotype, Geological Survey of Canada No. 9667 from the Carboniferous of the Yukon-Alaska Boundary, long. 141°W, lat. 68° 48' 40" N).

DISTRIBUTION: Frasnian of the Russian platform and western Kwantung, China; Givetian and Frasnian of Western Australia; Middle Devonian of Yunnan.

### ***Donia breviamellata* (Hill), 1936a**

Plate 10, figs. 1, 2; plate 11, figs. 1-5

1936a *Prismatophyllum breviamellatum* Hill: p. 32, text-figs. 6-8.

1954 *Hexagonaria breviamellata* (Hill); Hill: p. 15, pl. 1, figs. 12, 13; pl. 2, fig. 1.

HOLOTYPE: UWA 2515 from the Pillara Limestone? of Price's Creek, Emanuel ("Rough") Range, Kimberley Division, Western Australia; figured Hill, 1936a, text-figs. 6-8 and Hill, 1954, pl. 2, fig. 1; Late Givetian.

NEW MATERIAL (with number of specimens in brackets): G3359 (1), G3364 (1), G3366 (1), G3367 (1), K208 (1), K209 (1), K211 (1), K279 (1), K404 (3), K438 (1).

DIAGNOSIS: *Donia* with major septa seldom discontinuous or withdrawn from periphery; minor septa reduced to striae on the outer wall.

DESCRIPTION: The additional material from the Pillara Limestone shows considerable variation in length of major septa, in septal thickening and in slope of the calical rim; in most corallites there is a broad flat rim, with a narrow steep slope into the calicular pit; but in others the outer dissepiments are steeply inclined (see Hill, 1954, pl. 2, fig. 1b); range in septal number at a diameter of 8 mm, which is the average adult diameter in the new material, is 16-19. In some corallites (of some coralla) the septa extend unequally into the tabularium and (in a few corallites) some almost reach the axis. There are 8 monacanthine trabeculae in 2.5 mm measured at right angles to their course; there is no evidence of second

order trabeculae in the monacanth. After studying the range of variation in the new material we are reinforced in the view that one species only is represented.

REMARKS: This Australian species differs from the type species mainly in the absence of marked discontinuity in the major septa, especially at the periphery. It seems to us to support Soshkina's view that *Donia* is a disphyllinid.

The species was originally known only from the holotype, but two specimens were found in the collections from the Pillara Limestone used in Hill's 1954 study, and they seemed sufficiently close for her to assign them to the species, though with some reservations. Thus the holotype shows most corallites with major septa extending a short way into the tabularium, whereas the additional material has most corallites with major septa not extending into the tabularium; in the holotype the septa are thinner and the dissepimental floors (calical rims) are moderately steeply sloping and the plates of fairly uniform size whereas in the new material the dissepimental floors and calical rims are flattened.

It seems to us almost certain that this species has evolved from a cerioid species of *Hexagonaria* by degeneration of the minor septa, withdrawal of the major septa from the tabularium, with flattening to slight concavity of the axial tabulae, and with the development of a broad flat calical rim by the flattening of the outer parts of the marginal dissepiments. It could possibly be related to *Hexagonaria gneudnensis* Hill (1954) from the nearby Carnarvon Basin.

DISTRIBUTION: Lower part of Pillara Limestone, Canning Basin; Givetian and early Frasnian.

### Genus *Argutastrea* Crickmay, 1960

TYPE SPECIES (by original designation): *Argutastrea arguta* Crickmay, 1960, p. 11, pl. 7, figs. 3-5, the holotype of which is No. 27036, Paleontological Research Institution, Ithaca, New York, U.S.A., from the western end of Carcajou Ridge, Northwest Territories, Canada, in talus with *Stringocephalus chasmog*, *Charactophyllum* sp. etc., from the lower beds of the Ramparts Formation; 65° 36' N lat., 128° 15' W long., the Ramparts Formation is considered equivalent to the Kee Scarp Formation which is regarded as mid Middle Devonian. Thin sections from the holotype are figured herein (pl. 7, fig. 1), for the first time.

DIAGNOSIS: Cerioid disphyllinid with deep bell-shaped calice; septa radially arranged, typically noncarinate but occasionally faintly carinate in the dissepimentarium; septa of both orders dilated in the outer dissepimentarium, becoming attenuate axially; the major septa are either extended almost to the axis or withdrawn leaving a wide axial space; dissepiments small, subequal, numerous and sub-globose, typically inclined at a moderate angle down towards the axis; tabularia variable but commonly biserial with a periaxial series of small inclined plates surrounding a series of flat or slightly domed tabellae; trabeculae monacanth, almost parallel and directed upwards and inwards from the periphery.

REMARKS: *Argutastrea* is here interpreted on the holotype of the type species kindly lent to us by Mrs. K. V. W. Palmer and on a specimen of *A. arguta* from the lower part of the Ramparts Formation, *Stringocephalus* zone, at the Ramparts of the Mackenzie River, Northwest Territories, Canada, kindly given to us by Dr. C. H. Crickmay. The type species is refigured herein. We regard *Argutastrea* as a cerioid genus with internal characters—cuneate septa, septal structure, and dissepimentaria—similar to those of the phaceloid *Disphyllum caespitosum*, the type species of that genus.

OTHER SPECIES REFERRED TO GENUS: It seems possible that the Middle Devonian cerioid forms of the *H. pachythea*—*H. amanshauseri* group from the Eifelian of Germany described by Glinski (1955) may be correctly referable to this genus. The specimens included in the synonymy of *Cyathophyllum quadrigeminum* Golds-fuss, 1826, p. 59, pl. 19, figs. 1a-b from the Middle Devonian and Frasnian of France, Belgium, Turkey, and the U.S.S.R. by Flügel and Schimunek (1960) are considered congeneric with Glinski's species. The lectotype of *Cyathophyllum quadrigeminum*, however, as figured by Lang and Smith, 1935a, pl. 12, figs. 5-7 and Smith, 1945, pl. 14, figs. 5a, 5b, shows very thin septa that are rarely thickened at the periphery and the forms with cuneate septa commonly equated with it may not be conspecific with it. *Cyathophyllum darwini* Frech, 1885, p. 36 (in part); Frech, 1886, p. 73, pl. 3, figs. 2, 2a, and *Hexagonaria penecke* Glinski, 1955, p. 95 (= *Cyathophyllum darwini* Frech of Penecke, 1903, p. 147, pl. 5, figs. 2a, 2b) and *Montastraea boloniensis* de Blainville, 1830, p. 339, (for synonymy see *Prismatophyllum boloniense* (de Blainville), Smith, 1945, p. 50) can also be included in this European group of cerioid disphyllinids. *Cyathophyllum arcticum* Meek, 1867, p. 79, pl. 9, figs. 8, 8a-b; (see Smith, 1945, p. 47) and *Hexagonaria loewi* Stumm, 1953, p. 759; (= *Cyathophyllum quadrigeminum* mut. nov. *arctica* Loewe, 1913, p. 9, pl. 2, figs. 3a-c) are very similar to the European "*quadrigeminum*" and similar forms are known from the Frasnian of Northwestern Canada and Alaska (Smith, 1945), ?Middle Devonian of Ellesmereland (Loewe, 1913) and the ?Couvinian of Morocco (Le Maitre, 1947, pl. 8, figs. 1-5), and are listed as occurring in the Givetian of Armenia (Sayutina, 1965, p. 5). Other North American species possibly to be included in this genus are: *Hexagonaria impedita* Crickmay, 1960, p. 9, pl. 6, figs. 1-4 from the Couvinian of Northwest Territories, Canada; *Hexagonaria atypica* Crickmay, 1960, p. 9, pl. 6, figs. 4, 5, and *Hexagonaria gemmifera* Crickmay, 1960, p. 8, pl. 5, figs. 6-8, from the Givetian of Northwest Territories, Canada; *Prismatophyllum williamsi* Fritz, Lennon, and Norris, 1957, p. 30, pl. 4, figs. 1-3 from the upper Givetian Williams Island Formation, northern Ontario, Canada; *Cyathophyllum cristatum* Rominger, 1876, p. 108 (interpreted on *Prismatophyllum cristatum* Rominger; Sloss, 1939, pp. 71-72, pl. 10, figs. 1-5), *Prismatophyllum cristatum microcarinata* Sloss, 1939, p. 72, pl. 10, figs. 1-4, *Prismatophyllum paucisep-tatum* Sloss, 1939, pp. 70-71, pl. 10, figs. 10-13, from the Traverse Beds of Michigan, U.S.A. Sayutina (1965, p. 5) lists *P. cristatum* from the Givetian of Armenia.

From Asia, *Megaphyllum longiseptatum* Ivaniya, 1953, pp. 33-35, pl. 4, figs. 19-20 from the Frasnian of the Kuz Basin is tentatively included in *Argutastrea*, as are three species *Hexagonaria amylovesiculosa* Liao, 1965, pp. 201, 211, pl. 1, figs. 4a-b, *Hexagonaria asymmetrica* Liao, 1965, pp. 200-201, 211, pl. 1, figs. 3a-b, and *Hexagonaria yohi* Liao, 1965, pp. 200, 210, pl. 1, figs. 2a-b, from the Frasnian of western Kwantung, China, and *Cyathophyllum lavalii* Mansuy, 1913, p. 6, pl. 1, fig. 10 (interpreted on Fontaine, 1961, pp. 99-100, pl. 10, figs. 6-7) from the Devonian of Vietnam.

*Hexagonaria hullensis* Hill, 1954, pp. 16, 17, pl. 1, figs. 20-23 from the Givetian and Frasnian of the Kimberleys, and *Hexagonaria gneudnensis* Hill, 1954, p. 18, pl. 1, figs. 1a, 1b, from the Givetian and possibly early Frasnian Gneudna Formation of the Carnarvon Basin, Western Australia, are herein referred to *Argutastrea*.

DISTRIBUTION: This genus is only known from the Middle and lower Upper Devonian.

### ***Argutastrea hullensis* (Hill), 1954**

Plate 9, fig. 8; plate 12, figs. 2-4; plate 13, figs. 1-3;  
plate 14, figs. 1-5.

1954 *Hexagonaria hullensis* Hill: pp. 16-17, pl. 1, figs. 20-23.

HOLOTYPE: BMR CPC.501 (= R 15 7K<sub>2</sub>) from grey massive limestone in the Pillara Limestone 850-870 feet above the base of the formation which rests on Precambrian in Hull Range, 2 miles south of Shady Creek Gap, Kimberley Division, Western Australia; late Givetian or Frasnian.

NEW MATERIAL (with number of specimens indicated in brackets): Pillara Limestone—G1002 (6), G1005 (2), G1006 (1), G1078 (1), G1083 (1), G1085 (7), G3323 (1), U4 (1), K313 (1), K406 (1), K439 (3), K460 (1), K462 (2), K463 (6), K464 (1), K467 (1), K469 (1); Sadler Limestone—G3227 (1), K224 (1), K227 (1), K240 (1), K242 (1), K243 (1), K264 (4), K266 (3), ?K267 (1), K268 (2).

EXTENDED DIAGNOSIS: Coralla typically cerioid with some phacelo-cerioid; sides of corallites straight or curved mature corallites up to 12 mm in diameter. Septa attenuate in tabularium and major septa normally reaching somewhat unequally to the axis; septa in most corallites of most coralla dilated at the periphery and thinning gradually towards the axis, but in other corallites and coralla they are dilated in irregular zones, one at the periphery and one at the inner margin of the dissepimentarium; septa number between 18 and 22 of each order in corallites of 6 mm diameter; minor septa usually fully developed but in parts of some corallites withdrawn towards the periphery. Tabularial floors of an inner series of

convex plates, in some coralla forming tall domes, in others low domes or occasionally shallow saucers, and a periaxial series of dissepiment-like plates inclined downwards towards the axis. Dissepiments small, subglobose and steeply inclined when only two series are present, additional peripheral series less steeply inclined. Inner series may be thickened, the thickening being in continuity with that of the inner zone of septal thickening.

REMARKS: The new collection shows that great variability lies largely within the ranges established in the original description. A few coralla have greater average corallite diameter than indicated originally. In some coralla the growth is in thick fingers in which most of the corallites are cerioid, but the habit may be fundamentally fasciculate, though cerioid when several buds arise at once from one corallite to form a thick finger. In another (BMR CPC.9578, pl. 14, fig. 5) the corallites are not as tightly packed as in most of the cerioid forms; the corallites have curved sides and the corallum becomes phacelo-cerioid in its upper parts. This specimen also shows a thick peripheral stereozone such as is common in forms from the Sadler Limestone. One corallum at least (GSWA F5917/2) shows that though new corallites in general rise by the growth of a new wall across the edge or corner of a large corallite, entirely within the dissepimentarium of the parent, and thus non-parricidally, new corallites may also arise parricidally by the growth of the new wall at the boundary between dissepimentarium and tabularium.

Possibly a distinct variety is represented by the sample of 7 specimens collected from G1085. Here the average corallite size is somewhat larger than the originally described norm, with 20 to 25 septa of each order as against 17 to 22; the septa are only seldom thickened in an inner zone, the norm is for septa to thin gradually towards and to be somewhat withdrawn from the axis, associated with a widening of the axial tabulae and a narrowing of the inclined periaxial tabellar zone. These fairly consistent internal differences are associated with a type of growth by which a few corallites grow more rapidly than those of surrounding areas and the outermost of the clump have curved outer outlines. The community is not herein regarded as a distinct subspecies.

DISTRIBUTION: Sadler and Pillara Limestones, Canning Basin; Upper Devonian.

### Genus *Temnophyllum* Walther, 1928

- 1928 *Temnophyllum* Walther: p. 120.  
1939 *Diplophyllum* Soshkina: p. 39; not *Diplophyllum* Hall, 1851, p. 399.  
1940 *Temeniophyllum* Lang, Smith and Thomas: p. 131 (*nom. van.*).  
?1961 *Alaiophyllum* Goryanov: p. 70.

TYPE SPECIES (by subsequent designation of Lang, Smith and Thomas, 1940, p. 132): *Temnophyllum latum* Walther, 1928 (p. 123, text-fig. 14, on p. 124), upper Middle Devonian, apparently from Grund, Harz Mountains, Germany.

**DIAGNOSIS:** Solitary disphyllinid with septa thickened in the outer part of the dissepimentarium either to contiguity or thinning towards outer and inner edges; in the thickened zone the septal trabeculae are subhorizontal; the dissepiments are small, and their bases are almost vertical in the outer parts of the dissepimentarium; tabularial floors are concave, each consisting of wide, horizontal or concave axial tabellae and smaller periaxial tabellae.

**REMARKS:** Stumm (1949a, p. 36) considered *Diplophyllum* Soshkina, 1939, type species *D. verrucosum* Soshkina 1939, p. 39, pl. 7, figs. 63-65) from the Upper Devonian (Frasnian) of the Katav region, Suchkov Ravine, brown argillaceous limestone of the Orlov ore bearing suite, to be a synonym of *Temnophyllum*, and this seems most likely. *Diplophyllum* Soshkina is a junior homonym of *Diplophyllum* Hall, 1851 and *D. verrucosum* may well be called *T. verrucosum*.

Wang (1950, p. 219) regarded *Kunthia* Schlüter, 1885a, as a subjective synonym of *Temnophyllum* and *Charactophyllum* as a subgenus. However, no thin sections are known of the type specimens of the type species of either of these, and they are not at present usable with accuracy.

To assign any solitary phillipsastraeid to its correct genus is still not possible with any degree of confidence, owing to our ignorance of the type specimens of the type species of several of the genera.

Four generic names have been applied to solitary species with a pipe of horseshoe dissepiments, with or without a peripheral pipe of horizontal dissepiments. These are *Pterorrhiza* Ehrenberg, 1834 (see Glinski, 1961, p. 284, footnote and Pickett, 1967, pp. 27, 28), *Macgeea* Webster, 1889, *Pexiphyllum* Walther, 1928, and *Protomacgeea* Rózkowska, 1956 (type species by original designation *P. dobruchnensis* Rózkowska, 1956, text-figs. 2-4 from the middle Couvinian of Grzegorzowice in Poland). As no Western Australian solitary species has this pipe of horseshoe dissepiments, this group of phillipsastreins is not further considered.

*Ceratophyllum* Gürich, 1896, type species *Ceratophyllum typus* Gürich, 1896, p. 181, from Stinkholken, Szydlowik, Poland, Middle Devonian (possibly lower Givetian) has been variously used because the internal characters of the type specimens of *C. typus* were not available. Following Fedorowski's (1967) selection of the neotype and description of the type species, *Ceratophyllum* is interpreted as a solitary phillipsastraeid with arched dissepimentarial floors, trabecular fans and possibly rhipidacanthine trabeculae but lacking horseshoe dissepiments. Thus it is included in the Marisastrinae Rózkowska, 1965, with the genera *Haplothecia* Frech and *Marisastrum* Rózkowska. Rózkowska (1965) and Fedorowski (1967) both regarded it as closely related to *Marisastrum*.

*Gurieviskiella* Zheltonogova in Zheltonogova and Ivaniya, 1961, type species *G. cylindrica* Zheltonogova in Zheltonogova and Ivaniya, 1961, p. 404, pl. D53, fig. 3, from the lower Emsian Malobachat beds, Salair region, central Asia, is also a solitary phillipsastraeid with strongly everted dissepimentarial floors, and trabecular fans. It has been interpreted by Jell and Hill (1969) to include the



solitary forms with internal structure similar to that of the phaceloid *Paradisphyllum* Strusz, 1965, especially in the septal microstructure. It is distinguished from the Phillipsastraeinae and Marisastrinae in not having rhipidacanthine trabeculae; it differs from *Temnophyllum* and other solitary disphyllinids by its arched dissepimentaral floors, trabecular fans, and the fibrous nature of the septa resulting from the low angle of divergence of the fibres from the axis of the trabeculae.

Genera known from reasonable but not full illustrations of the type specimens of their type species are *Temnophyllum* Walther, 1928, *Sinodisphyllum* Sun, 1958 (type species by original designation *S. variabile* Sun, 1958, founded on four figured syntypes from the *Sinodisphyllum variabile* zone in the Frasnian Lungkouchung formation (= W<sub>7</sub> of Tsien), Hsianghsiang, Hunan); and *Mansuyphyllum* Fontaine, 1961 (type species by original designation *Cyathophyllum annamiticum* Mansuy, holotype No. 861, Musée du service Géologique de Saigon, from the Devonian of the region of Ron in central Vietnam). *Pseudocampophyllum* Ivanovskiy, 1958 (type species by original designation *P. enisseicum* Ivanovsky, 1958, pl. 1, figs. 1-4, holotype No. 17, slide 30, from the Upper Givetian Bevan suite of Chayzy-Kozy, Kapchaly to the west of Abakan, Minusinsk Province, southern Siberia) may well be a disphyllinid because of its small globose dissepiments and concave tabulae supplemented by periaxial tabellae; it has thin flexuous septa, of which the minor septa are contrasting. Ivanovskiy described it as solitary with parricidal offsets or branching and colonial.

Of these, *Sinodisphyllum* may prove a junior subjective synonym of *Temnophyllum*, if the first figured of the syntypes, that of Sun, 1958, pl. 4, figs. 1a-e is chosen as lectotype, for this is characterised by septal thickening in the early stages, though the thickening is more notable in the tabularial parts than in the dissepimentarium; if any of the other syntypes are chosen, *Sinodisphyllum* may prove a senior subjective synonym of *Mansuyphyllum*, which is noted for the development of angulate dissepiments associated with rather thin septa and a wide tabularium; should all four syntypes of *S. variabile* prove conspecific, a case for the merging of both *Sinodisphyllum* and *Mansuyphyllum* could be made, depending on an analysis of the variation of septal thickening in *Temnophyllum*. However, the types of *S. variabile* and *M. annamiticum* are both large, attaining diameters of 30 mm, but the types of *T. latum* are small, and this habit may have some significance. *Mictophyllum* Smith, another large coral, differs from this group in its domed tabulae, but its type also requires further investigation.

*Ceratinella* Soshkina (1941; not Emerton, 1882, an arachnid) is another genus of which the type specimens are large and may very well prove to be *Sinodisphyllum* or *Mansuyphyllum* when the types are studied. Its type species, by monotypy, is *Campophyllum soetenicum* Schlüter (1885a) from the Middle Devonian of the Soetenich Syncline in the Eifel.

*Alaiophyllum* Goryanov, 1961, type species *A. jarushevskiyi* Goryanov, 1961, pp. 71-74, pl. 8, figs. 1-3, from the Middle Devonian, Givetian, Boordy range, southern Fergana, central Asia, resembles *Temnophyllum* in all respects

except that the septa are consistently short and project only a very short distance into the tabularium. We regard it doubtfully as a synonym of *Temnophyllum*.  
DISTRIBUTION: Late Couvinian?, Givetian to Frasnian.

***Temnophyllum turbinatum* Hill, 1954**

Plate 16, figs. 12-14

1954 *Temnophyllum turbinatum* Hill: p. 23, pl. 2, figs. 13, 14.

HOLOTYPE: BMR CPC.523 from Long's Well, Kimberley Division, Western Australia; in the Pillara Limestone between 1,350 and 1,500 feet above the contact with the Ordovician; Frasnian.

NEW MATERIAL (with number of specimens indicated in brackets): Pillara Limestone—G1003 (1), K445 (1); Sadler Limestone—K265 (3, doubtfully referred to *T. turbinatum* as the septa are withdrawn from the axis and the tabularial floors are sagged), K239 (1), K245 (1), K246 (4), ?K247 (1), K265 (1), K266 (2).

EXTENDED DIAGNOSIS: Solitary, turbinate corallites up to 24 mm in diameter with approximately 30 to 33 septa of each order at diameters of 20 to 22 mm. Major septa long, slightly more dilated in the dissepimentarium than the minor septa, and somewhat dilated in the tabularium; the septa are sometimes in contact in the central parts of the dissepimentarium; the minor septa may be replaced by a narrow zone of angulate dissepiments at the inner parts of dissepimentarium. Tabularium wide consisting of large, elongate, horizontal or slightly domed tabellae; dissepiments small and globose.

DISTRIBUTION: Pillara and Sadler Limestones, Canning Basin; Upper Devonian.

***Temnophyllum* spp. cf. *T. turbinatum* Hill, 1954**

Plate 15, figs. 10-12; plate 16, figs. 5-11

(a) Plate 15, figs. 10-12. Four specimens from the Pillara and Sadler Limestones, K463 (1), G1003 (1), K245 (2) resemble *T. turbinatum* in tabularial characters but differ in being smaller, in having an almost complete peripheral stereozone and in slight eversion of the dissepimentarial floors.

(b) Plate 16, fig. 5. One specimen BMR CPC.9589, from the Pillara Limestone, 160 to 309 feet above the contact of the Pillara Limestone and the Precambrian, Mountain Home Range, Margaret River, Kimberley Division, somewhat resembles *T. turbinatum* but the septa are thinner and extend to the axis where they interdigitate, with several septa confluent with the septa on the opposite side of the corallite.

(c) Plate 16, fig. 6. Nine specimens from K244 (6), K215 (2), G3229 (1), are similar to *T. turbinatum* in transverse section except they are smaller and the minor septa are not replaced by angulate dissepiments at the inner dissepimentarium. Although narrower the tabularium is similar to that of *T. turbinatum*.

DESCRIPTION: The specimens are all small fragments of what appear to be solitary corallites. The maximum corallite diameter is 13.5 mm. There are 24 to 28 septa of each order and both orders are so dilated as to be in contact in the middle and inner parts of the dissepimentarium; in some the peripheral parts are also in contact so that a continuous stereozone replaces the dissepimentarium. The minor septa are two-thirds the length of the major and both orders taper axially inside the stereozone. The major septa are thin and straight in the tabularium and are slightly withdrawn from the axis. The septa are monacanthine with parallel trabeculae inclined upwards and inwards at a low angle to the horizontal. The dissepimentarium is narrow and when the dissepiments are discernible they are small, globose, steeply declined and usually thickened. The tabularium is typically arched, composed of small convex tabellae.

(d) Plate 16, figs. 7-9. Three specimens from K353 are distinguished from *T. turbinatum* which they resemble in size and habit, by the shortness of the septa, the narrowness of the dissepimentarium and the wide simple tabularium consisting of complete tabulae.

DESCRIPTION: Large trochoid corallites with curved conical early stage. The maximum diameter observed is 18 mm. The septa number 46 to 58. The major septa are very short less than half the radius of the corallite and the minor septa are barely more than ridges on the inside of the corallite wall. The septa are thickest at the periphery but thin rapidly axially becoming attenuate in the tabularium.

The tabularium is wide and simple consisting of almost complete horizontal or slightly sagged tabulae with occasional small supplementary tabellae at the margin. The dissepimentarium is narrow consisting of moderately large, elongate, steeply inclined dissepiments. The septa are monacanthine with large trabeculae subhorizontal or inclined upwards and inwards at a low angle to the horizontal.

(e) Plate 16, fig. 10. UWA 26263 from U9 differs from the other Western Australian temnophyllids in that its septa are carinate in the dissepimentarium between the peripheral and inner stereozones.

(f) Plate 16, fig. 11. Three poorly preserved specimens from K301, K316, K343 show septal dilation at the periphery and in zones within the dissepimentarium as in *T. turbinatum* but differ from that species in that their tabularial floors are deeply sagged and widely spaced consisting of large, thickened complete sagging tabulae. The dissepiments are large and steeply inclined axially.

***Temnophyllum occidentale* n. sp.**

Plate 15, figs. 1-9

TYPE MATERIAL: Holotype—GSWA F5931/7 from G3366, southern end of Home Range, Kimberley Division, Western Australia; Pillara Limestone, late Givetian. Paratypes—GSWA F5931.1, F5931.2, F5931.5, 6, 8, 9; F5931.11 to 20; F5931.22 to 28 all from G3366.

OTHER MATERIAL: Some 70 corallites from the type locality.

DIAGNOSIS: Small, curved conical, attached to substrate by talon; septal thickening variable, forming incomplete peripheral or internal stereozones, or thickening the septa in their mid-length; septal trabeculae slightly convex, sub-horizontal or inclined upwards and inwards at a maximum of 45°.

DESCRIPTION: The corallum is solitary and small, attaining a maximum diameter of 20 mm in a maximum height of 45 mm. The average diameter attained is about 12 mm and the average height about 25 mm, but there is a great range in size in the 70 or so individuals of the collection from the type locality. The corallum curves at first and, usually from the under (convex) side of the curve, attachment outgrowths form a long talon, above which the corallite tends to grow erect, but to continue to increase in diameter at a gradually decreasing rate. Some individuals show a lateral talon of attachment, starting not from the apex but from some distance up the corallite and from the concave side of the curve. One young individual was observed attached to the side of a mature corallite (GSWA F5931/2, pl. 15, fig. 16). Rejuvenescence is common, the new calical rim commonly forming at the outer edge of an internal stereozone. The epitheca shows fine growth annulation but only faint longitudinal (septal) grooves; there are also contractions and expansions of diameter, adding to the diversity of appearance between individuals.

The number of septa varies somewhat. At a diameter of about 20 mm, 29 or 30 septa of each order are present; at 10-15 mm there may be 23-28 of each order but 27 may occur at 10 mm and 23 may occur at 15. The septa may be straight or their axial ends may curve a little, usually in the one sense; the major septa normally are subequal and leave a small septal-free space at the axis; in some individuals, a wider free space is seen and this seems to be characteristic of the whole individual, not only of the adult stage. The septa are not attenuate in the tabularium, they tend to thicken slightly as they near the dissepimentarium. In the dissepimentarium the septa may thicken laterally, this may be in mid-length so that they become spindle-shaped in transverse section of the corallite; or the thickening may be greatest at the periphery; or there may be two zones of thickening, one at the periphery and the other at a variable distance towards the inner margin of the dissepimentarium; such stereozones are only partial stereozones, not encircling the coral. Dilatation increases the lateral width of the septal trabeculae, so that a characteristic series of "bow-ties" is seen in transverse

section; each trabecula is pinnately fibrous in longitudinal section. The trabeculae are inclined from sub-horizontal to about 45° and are curving. The sides of the septa are thus not perfectly smooth, but are slightly ribbed at the trabeculae and slightly furrowed between them. In some stereozones, the septal thickening extends on to the upper surfaces of the dissepiments connecting the septa. The thickening tends to disappear as the calice is approached. The minor septa are normally thinner than the major septa, and half as long. Cardinal and counter septa and fossula are not usually distinguishable but in GSWA F5931/22 (pl. 15, fig. 5), the cardinal septum is seen to be short in a cardinal fossula.

The tabulae are of two series of tabellae; the axial tabellae tend to be wide, close and flat or slightly domed or saucer-like and the periaxial tabellae to be large and inclined, so that the tabularial floors sag deeply with slightly arched or horizontal bottoms. They are unthickened.

The dissepiments are mostly small; the peripheral dissepiments may be slightly peneckielloid in early stages; the others may be globose or sub-globose, and are steeply inclined; the number of series may be as large as 7, and the radial width of the dissepimentarium 4 to 5 mm in large corallites.

REMARKS: In having its trabeculae subhorizontally inclined and not fanned, this species is easily distinguished from *T? floriforme* Hill (1954, pl. 2, fig. 26) from the Pillara Limestone 1.5 miles south of Mt. Elma. It differs from *T. turbinatum* Hill in its more trochoid or subcylindrical form, in its development of a fossula, its reduction of the cardinal septum and its deeper tabularial floors.

### ***Temnophyllum menyouense* n. sp.**

Plate 15, figs. 13-16

TYPE MATERIAL: Holotype—GSWA F5933/4 from G1008, 4.5 miles southeast of the southern entrance of Menyous Gap, Kimberley Division, Western Australia, Pillara Limestone; late Givetian or early Frasnian.

OTHER MATERIAL: Paratypes—F5933.1 to 3, F5933.5, 6 from G1008. Five specimens from K353.

DIAGNOSIS: Large conico-cylindrical corallites; septa thickest at the periphery, thinning axially; major septa attenuate in the tabularium and withdrawn from the axis; minor septa replaced by angulate dissepiments in the inner dissepimentarium. Tabularium sagging with deep central pit formed of two series, an axial series of large concave tabellae and a periaxial series of convex inclined tabellae; dissepiments small and inclined.

DESCRIPTION: All the specimens are thought to be of solitary corallites, not of pieces from a colony, because of their large size and lack of any signs of connecting processes.

They are conico-cylindrical, most are erect, a few are slightly curved. The maximum diameter observed is 22 mm and the minimum 7 mm. In adult corallites there are 30 to 33 septa of each order. The septa of both orders are attenuate axially, and thicken very gradually towards the periphery; they do not become so thick as to be contiguous laterally; the minor septa are but little thinner than the major septa and may withdraw a little from the inner edge of the dissepimentarium leaving oblique or angulate dissepiments there. In some zones of some corallites skeletal thickening may continue from septum to septum over the upper surface of a dissepiment. The major septa are slightly withdrawn from the axis and are little curved. The peripheral two rows of dissepiments tend to be at the same level in all interseptal loculi so that in transverse section two peripheral rings may be seen subparallel to the wall. The dissepimentarium is about half the radius of the corallite. The dissepiments are subglobose and mostly moderately large, inclined at about 45° at the periphery but steepening in the inner rows, some with their upper surfaces thickened in continuity with the septal thickening. The tabularial floors are sagging with a relatively deep central pit. Each floor consists of a periaxial series of inclined, elongate, convex tabellae and an axial series of larger, saucer-like tabellae. The tabellae are unthickened.

REMARKS: This species is distinguished from *T. turbinatum* and *T. occidentale* by its thin wedge-shaped septa and sagging tabularial floor.

Five specimens from K353 in the Sadler Limestone show more variation in the thickening of the cuneate septa and withdrawal of the septa from the axis than the material from the Pillara Limestone.

DISTRIBUTION: Sadler and Pillara Limestones, Canning Basin; Upper Devonian.

### ***Temnophyllum incomptum* n. sp.**

Plate 16, figs. 1-4

TYPE MATERIAL: Holotype—BMR CPC.9583, from K573, eastern entrance of Old Wagon Track, Napier Downs, 7.5 miles at 314° from Napier Downs Homestead, Kimberley Division, Western Australia, Wapet's section Dmp 5, unit C3, 280 feet above base of section DMP 5; Pillara Limestone; Upper Devonian. Paratypes—BMR CPC.10265 to 10272 from K573.

OTHER MATERIAL: 2 specimens from K572; 1 specimen (U.W.A. 26412) from the *Manticoceras* section, Bugle Gap, top bed of fifth hill from north to south in front of reef limestone.

DIAGNOSIS: Small, cylindrical, solitary or weakly colonial temnophyllid, with wide, peripheral stereozone; major septa considerably withdrawn from the axis and minor septa restricted to the stereozone; tabularium simple with large, horizontal tabellae.

DESCRIPTION: All the specimens are weathered fragments; they are all cylindrical or subcylindrical but some show an early conical form. None of the corallites has its initial tip preserved. Two specimens BMR CPC.9583 and 9587 show small lateral offsets that have not developed to maturity and another, 9588, has two lateral offsets developing almost to the same diameter as that of the parent corallite before increase. Thus it is thought that the fragments are from solitary or weakly colonial corallites and not from phaceloid or dendroid coralla. The maximum corallite diameter is 10.6 mm with the average approximately 9.5 mm.

There are 20 to 23 septa of each order at a diameter of 9.5 mm. The septa are thickened in the dissepimentarium and usually adjacent septa are in contact so that a wide peripheral stereozone, one-third the radius of the corallite in width, is developed. In some specimens the stereozone is not complete all the way around the corallite and the septa are thickest at the periphery and taper axially. The major septa extend a half to two-thirds the way to the axis and thin rapidly in the outer tabularium; their axial ends are straight and thin. The minor septa do not project further than the inner margin of the stereozone. In some, where the stereozone is not developed to the inner edge of the dissepimentarium, the minor septa are replaced by angulate dissepiments. The septa are monacanthine with the trabeculae 0.25 to 0.30 mm in width, subparallel and directed upwards and inwards from the periphery at less than 30° to the horizontal. The tabularium is wide and simple consisting of horizontal floors composed of an axial series of wide flat tabellae supplemented at the margin by an incomplete row of slightly globose periaxial tabellae. The dissepiments, where distinguishable in the thick stereozone, are small, globose and steeply declined axially.

REMARKS: This species differs from the other Western Australian species of *Temnophyllum* in its cylindrical form, its short major septa that do not project very far out of a complete peripheral stereozone and its simple tabularium. In these characters it resembles *Alaiophyllum jarushevski* Goryanov, 1961, the type species of that genus. However, *T. incomptum* is distinguished by its smaller size, more complete horizontal tabulae and fewer supporting periaxial tabellae.

DISTRIBUTION: Pillara Limestone, Canning Basin; Upper Devonian.

### ***Temnophyllum?* floriforme Hill, 1954**

Plate 17, figs. 1-3

1954 *Temnophyllum?* *floriforme* Hill: p. 24, pl. 2, fig. 26.

NEW MATERIAL: Specimens from U13 in the Pillara Limestone and K245 in the Sadler Limestone.

REMARKS: The holotype (BMR CPC.543) from the Pillara Limestone was the only specimen of this species known previously; these additional specimens are

now somewhat doubtfully added. In the holotype the septa are very thick in the dissepimentarium, in the outer parts of which they consist of discrete trabeculae which diverge laterally from the median plane of the septum. In the inner dissepimentarium the trabeculae are "bow-tie" like in transverse section, i.e.—wider across than along the septum—but at the periphery they are discrete and equidimensional. Naotic dissepiments are developed between the peripheral separate trabeculae. The trabeculae are asymmetrically fanned over the central part of the dissepimentarium as seen in longitudinal section. In BMR CPC.9597 only in one place and in the extreme peripheral parts is there any suggestion that the trabeculae diverge laterally from the median plane of the septum. The dissepimentarium does not show the same degree of eversion as that of the holotype but the tabularium is broadly arched with a central sag as in the holotype.

The structure, including the septal microstructure, of the inner parts of the corallite is typically disphyllinid but the peripheral modification of the septa into discrete trabeculae and naotic dissepiments and the highly everted dissepimentarium are otherwise unknown in *Temnophyllum*.

DISTRIBUTION: Pillara and Sadler Limestones, Canning Basin; Upper Devonian.

#### Suborder **Columnariina** Rominger, 1876

#### Family **Endophyllidae** Torley, 1933

#### Genus **Tabulophyllum** Fenton and Fenton, 1924

- 1924 *Tabulophyllum* Fenton and Fenton: p. 30.  
?1928 *Apolythophyllum* Walther: p. 135.  
?1937 *Sinospongophyllum* Yoh: p. 56.  
?1939 *Diversophyllum* Sloss: p. 65.

TYPE SPECIES (by original designation): *Tabulophyllum rectum* Fenton and Fenton, 1924, p. 31, pl. 6, figs. 8-12 from the Upper Devonian, Frasnian, Hackberry Group of Iowa. A transverse section and external view of the holotype (7834 in the University of Michigan collections) were figured by Smith (1945, pl. 2, fig. 10, pl. 3, fig. 8) and the external view by Watkins (1959, pl. 16, fig. 12) but none of the figures are sufficiently informative. Topotypes have been figured by Fenton and Fenton (1924), by Smith (1945) and by Watkins (1959).

DIAGNOSIS (based on published figures of the holotype and topotypes of the type species): Solitary Rugosa with long major septa somewhat withdrawn from the axis and with minor septa reduced to low ridges on the dissepiments; lonsdaleoid dissepiments disrupt the septa in a peripheral zone of variable width. Neither skeletal thickening, nor a distinctive fossula, nor cardinal or counter septa of distinctive length are seen in adult stages. The tabularium is wide,



the tabularial floors are low to flat-topped domes with the edges curved into a somewhat asymmetrical peripheral trough, and the tabulae are complete or incomplete.

DISCUSSION: Four genera have been considered synonymous with *Tabulophyllum*. These are:

(1) *Sinospongophyllum* Yoh (1937) with monotype *S. planotabulatum* Yoh (1937, pl. 6, figs. 2-5) from the Givetian of Kwangsi; the type species is characterised by skeletal thickening and by a relatively narrow dissepimentarium, but otherwise could well be synonymous with *Tabulophyllum*. Hill (1942a, pl. 1, figs. 9-11) described an eastern Australian Lower Devonian (?Coblenzian) species.

(2) *Apolythophyllum* Walther (1928) with type species (chosen Lang, Smith and Thomas (1940, p. 18) *A. normale* Walther (1928, p. 144, figs. 33 and 34) from the Upper Devonian, Frasnian, ?Iberg limestone of Grund, Harz Mountains, Germany. See Lang, Smith and Thomas (1940), Stumm (1949a), Wang (1950), Soshkina (1951, 1952, 1954, 1960) and Bulvanker (1958).

(3) *Diversophyllum* Sloss (1939) with type species *Zaphrenthis traversensis* Winchell (1866, p. 90) of which the holotype, probably from the Givetian, Gravel Point zone (possibly the "lower Blue Shale" of the Traverse Group of Michigan) has been figured by Sloss (1939, pl. 11, fig. 13); topotypes have been figured by Watkins (1959, pl. 16, figs. 1-9) and Stumm (1962, pl. 2, fig. 6). See also Pitrat (1962) and Soshkina (1951, 1954, 1960).

These three genera could well prove synonymous with *Tabulophyllum*.

(4) *Blothrophyllum* Billings (1859), type species *B. decorticatedum* Billings (1859, p. 130, fig. 25) from the Corniferous (Onondaga) limestone of Canada West (Ontario) has apparently not been revised from type or topotypic material since Lambe (1901, pl. 15, figs. 1, 1a) gave diagrammatic transverse and longitudinal sections; the latter closely resembles *Tabulophyllum* but the transverse section, although it shows a lonsdaleoid zone, also shows a marked fossula encroaching on the dissepimentarium, a feature not characteristic of the Endophyllidae. Wang (1950) considered the genus a synonym of *Tabulophyllum*, but this has not proved generally acceptable.

Soshkina (1951, 1952, 1954, 1960) considered that only "astraeoid" species like the type species *Endophyllum bowerbanki* Edwards and Haime (1851, p. 168, 394, figured Edwards and Haime, 1853, pl. 53, fig. 1, from the Devonian, Givetian, of Barton Quarry near Torquay, England) should be retained in *Endophyllum* Edwards and Haime (1851), and that cerioid species with a strong wall to the corallites should be transferred to *Tabulophyllum*. However, Ivaniya (in Zheltonogova and Ivaniya, 1961) and Soshkina (in Orlov, 1962) have now defined *Endophyllum* to include such cerioid forms, and with this we agree.

DISTRIBUTION: If one accepts the synonymy of the first three genera with *Tabulophyllum*, the range of the latter is Lower Devonian of Australia (?Coblenzian),

upper Middle Devonian of U.S.A., China; Upper Devonian (Frasnian) of Canada, western Europe, Russian platform, Urals, Armenia, Kazakhstan, and Kuz Basin. If *Sinospongophyllum* and *Diversophyllum* are not synonymous, the range is Upper Devonian only. Upper Devonian species as a group are characterised by the weak development of the peripheral stereozone and other skeletal thickening, and those of the Russian platform show a marked tendency to form colonies with only a few young corallites.

***Tabulophyllum? lowryi* n. sp.**

Plate 17, fig. 5

TYPE MATERIAL: Holotype—Corallum with proximal and distal ends destroyed, GSWA F5932, from G1007 near Tunnel Creek, Kimberley Division, Western Australia, Napier Formation; Upper Devonian. No other material.

DESCRIPTION (based on one transverse and one longitudinal thin section through the mature parts of the corallite): The corallum is large and probably solitary, with an adult diameter of 40 mm at which the width of the dissepimentarium is 12 mm and the diameter of the tabularium 16 mm.

The septa number 35 of each order. In the outer parts of the dissepimentarium those of both orders are disrupted by large irregular lonsdaleoid dissepiments. The major septa are much more persistent than the minor; in the peripheral zone of the tabularium and for a variable distance thence into the inner zone of the dissepimentarium they are moderately thick, with rough sides. In this inner zone they are buttressed by small shard-like plates the inner ends of which proceed from their sides (into which they continue as part of the septal thickening) at angles increasing from inner to outermost plate from about 5° to about 30°; the outer ends of the plates are based in clumps on the lonsdaleoid dissepiments, each clump indicating the thickness of the "parent" septum. Such an arrangement suggests that there was not enough carbonate to render the wide septum fully solid at its triangular base on the dissepiment. Small dense spots occur in these clumps, possibly indicating centres and axes of calcification; they bear no fixed relation to the median plane of the septum. The septal trabeculae are thin, contiguous and directed at right angles to the curvature of the dissepiments abutting against them.

In the axial part of the tabularium, there is a swirl of long major septal lamellae, most of which are thin, but some are slightly thickened. No central space is left in the tabularium. As shown by median longitudinal section of the corallite these lamellae are slightly and irregularly flexuous vertically.

The minor septa are lamellar only in and near the tabularium; elsewhere they are usually represented only by low ridges on the surfaces of some dissepiments, but in places may form continuous segments passing through three or more

dissepiments; on the lonsdaleoid dissepiments they are represented, like the neighbouring major septa, by clumps of "shards" with dense calcification centres. The minor septa are not contratingent.

There is no distinctively shaped cardinal fossula, and the cardinal and counter septa show no difference in length or thickening.

The dissepiments vary in direction in different parts of the corallite; peripherally they are inclined from about 45° to about 60°, but steepen inwards and at the junction with the tabularium they are vertical. They are very flatly curved, very elongate plates, of varying sizes. The larger, lonsdaleoid or disruptive dissepiments have a somewhat irregular convexity. The smaller, shard-like elements lining or buttressing the septa are almost without convexity. Some of the dissepiments show thickening continuous with that of neighbouring septa. The small dissepiments of the inner zone are deeply concave or even geniculate between the septa.

The tabularial floors are low domes with outer edges somewhat upturned to form a shallow and asymmetric peripheral trough, and both complete and incomplete tabulae occur. At irregular intervals in the growth of the corallum, a tabular floor may be somewhat thickened, the thickening being continuous with that of the neighbouring septal lamellae.

REMARKS: No similar species has been described from Australia.

It is not close to the type species and may, indeed, prove to be a new genus. Of overseas forms, the closest are the specimens (University of Queensland F38873, F38803) of an undescribed species from the Frasnian (F2j) of Boussu, Belgium, figures of which are appended (pl. 17, figs. 6, 7).

DISTRIBUTION: Napier Formation, Canning Basin; Upper Devonian.

## Family STRINGOPHYLLIDAE Wedekind, 1922

### Genus *Stringophyllum* Wedekind, 1922

TYPE SPECIES (by original designation): *Stringophyllum normale* Wedekind, 1922, p. 9, text-figs. 5, 6, from the Middle Devonian, Givetian *Stringocephalus* limestone of Sundwig near Iserhohn, Sauerland, Germany. The holotype is represented by two thin sections in the Senckenberg Museum, Bonn, SMF Wedekind 4534 (original of Wedekind's fig. 5) and SMF Wedekind 4524 (original of Wedekind's fig. 6).

DIAGNOSIS: Corallum solitary or phaceloid; septa rather thick, each consisting of a single series of very large monacanthi which may be isolated from one another; long major septa bilaterally arranged about the cardinal-counter plane; minor septa tend to be imperfectly developed; dissepimentarium usually lonsdaleoid; tabulae close, complete and sagging, with deepening along median plane.

DISTRIBUTION: Lower to Middle Devonian.

**Stringophyllum sp. A.**

Plate 17, fig. 4

1954 *Spongophyllum?* sp. Hill: p. 29, pl. 1, fig. 17.

**MATERIAL:** Two small fragments (GSWA F7850, F7852) from the Pillara Limestone at G3365, G3366.

**REMARKS:** These are referred to *Stringophyllum*; one of them shows in median longitudinal section the characteristic very large monacanthine trabeculae of a septum, and the other, although not showing monacanth, agrees in its other characters.

In all probability the fragment from near the base of the Pillara Limestone (with *Stringocephalus*) in the Home Range about 0.8 miles northwest of Mountain Home Spring, described as *Spongophyllum?* sp. by Hill (1954) is the same species.

The species indicates a Givetian age; the genus is not known in the Frasnian.

**Order TABULATA Edwards and Haime, 1850**

**Family PACHYPORIDAE Gerth, 1921**

**Genus *Thamnopora* Steininger, 1831**

***Thamnopora angusta* Lecompte, 1939**

Plate 18, figs. 1-5

1939 *Thamnopora angusta* Lecompte: p. 815, pl. 16, figs. 17-20.

1954 *Thamnopora angusta* Lecompte; Hill: p. 30, pl. 2, fig. 15.

**NEW MATERIAL:** From localities G1002, G1003, G1098, K439, K461 and K509, all in the Pillara Limestone; U9, U14 in the Sadler Limestone.

**REMARKS:** The identification of the material from G1003 is somewhat doubtful, because the average diameter of the corallites is rather larger than the typical and the specimens in this and in other respects seem intermediate between *T. boloniensis* (Gosselet) and *T. angusta*. The material from G1098 and G1003 is silicified.

**Thamnopora boloniensis** (Gosselet), 1877

Plate 18, figs. 6-8

1877 *Favosites boloniensis* Gosselet: p. 271.

1939 *Thamnopora boloniensis* (Gosselet); Lecompte: p. 122, pl. 17, figs. 1-24; pl. 18, fig. 1.

1954 *Thamnopora boloniensis* (Gosselet); Hill: p. 30, pl. 2, figs. 16-18.

NEW MATERIAL (with number of specimens given in brackets): Pillara Limestone—G1078 (1), K439 (3), K461 (3), K462 (1), K463 (10), K467 (1); Sadler Limestone—G1004 (2), G1082 (1), G3229 (1), K215 (1), K221 (1), K222 (1), ?K226 (4), K236-252 (doubtful silicified fragments), K264-271 (abundant), K300 (1), K301 (1), ?K403 (1), U9 (1); Virgin Hills or Gogo Formation—K189 (1), ?K312 (1).

REMARKS: Hill (1954, p. 30) noted that in specimens from the Pillara Limestone the corallites are smaller than is typical for the Belgian material and that spini-form processes are apparently absent.

Family ALVEOLITIDAE Duncan, 1872

Genus **Alveolites** Lamarck, 1801

1801 *Alveolites* Lamarck: p. 375.

1939 *Alveolites* Lamarck; Lecompte: p. 17.

1952 *Alveolitella* Sokolov: p. 77.

For remarks on the synonymy see below under *Alveolites tumidus*.

**Alveolites suborbicularis** Lamarck, 1801

Plate 18, figs. 9-11

1801 *Alveolites suborbicularis* Lamarck: p. 186.

1939 *Alveolites suborbicularis* Lamarck; Lecompte: p. 19, pl. 1.

1939 *Alveolites suborbicularis* Lamarck; Hill: p. 145, pl. 1, fig. 4.

1954 *Alveolites suborbicularis* Lamarck; Hill: p. 34, pl. 2, fig. 5.

MATERIAL: Specimens from the following localities are assigned tentatively to the species: Pillara Limestone—G1003, G1006 (1), G1083 (1), K467 (1), K101 (one specimen is very doubtfully referred to *A. suborbicularis* because the corallites are more thickened than usual), K330, K406; Sadler Limestone—G3229, K112, K234, K236, K243, K244, K246, K248, K252, K265-267, K270, K271, K348, K403, U9; Napier Formation—K549.

REMARKS: Lecompte (1939) remarked on the protean nature of *A. suborbicularis*, *A. duponti* Lecompte, *A. tenuissimus* Salée and other species, and concluded that within the mass of a reef, little variation was shown; but on the flanks of the reefs, in the covering shales, the colony is constructed of superposed lamellae, which may cap the upper surfaces of finger-like branches which have grown in from the main mass. Lecompte noted that the calical characters of several Belgian species are like those of *A. suborbicularis* and suggested that some differences of form at present regarded as constituting distinct species, such as the cylindrical branches of *Alveolites subaequalis* Edwards and Haime, 1851, may in fact turn out to be only additional formae of *A. suborbicularis*. The Lennard Shelf reef environment would seem to be an ideal place for the study of the control of form by ecology.

The specimen from G1003 is a thin encrusting sheath, recalling the growth form of *A. suborbicularis* forma *lamellosus* Lecompte (1939, p. 24, pl. 2, fig. 3, from the Middle Frasnian of the Dinant Basin). The branches from K112 are large and thick and are only tentatively included in this species.

DISTRIBUTION: Givetian of England and Germany; cosmopolitan in the Frasnian.

### ***Alveolites saleei* Lecompte, 1933**

1933 *Alveolites saleei* Lecompte: p. 47, pl. 4, fig. 3.

1939 *Alveolites saleei* Lecompte; Lecompte: p. 29, pl. 3, figs. 5-8; pl. 4, figs. 1-3.

HOLOTYPE (by monotypy): I. G. 3378 Musée Royal d'Histoire Naturelle de Belgique from Couvin 6158 on the southern border of Dinant Basin; in the middle Frasnian F<sub>2</sub>i shales with *Spirifer pachyrhynchus*.

DIAGNOSIS: Corallum lamellar, asymmetrical, with lower face of dichotomising subcylindrical branches from which arise more or less thick sheaths uniting and covering the branches, the sheath on the upper surface of the lamella being continuous. Calices 0.8 mm wide and 0.4 to 0.5 mm high; transverse section of the corallites subpolygonal in the axis of the branching nuclei, alveolitoid outside.

DISTRIBUTION: Frasnian, Belgium.

### ***Alveolites* sp. cf. *A. saleei* Lecompte, 1933**

Plate 20, figs. 1-4

MATERIAL: K301 and G1082 in the Sadler Limestone, several fragmentary specimens.

REMARKS: The specimens from G1082 leave no doubt that they are from a colony or colonies with the growth form of *A. saleei*. The photograph (pl. 20, fig. 4) of

the lower surface of a large fragment (GSWA F5265) shows the branches enveloped on their dorsal surface by the sheathing outgrowths from the branches, outgrowths that form a thick dorsal cap to the colony; that the sheaths are continuous with the branches is seen from pl. 20, fig. 3. The corallites differ little in their dimensions and characters from those of *A. suborbicularis*, and it is not impossible that this material represents merely a growth form of the latter. This possibility of relationship can best be studied in the field. Again, the finger-like branches are so like those called *Alveolites tumidus* that field investigation is called for to establish whether the latter are merely branches of *A. sp. cf. A. saleei* not covered by their unifying dorsal sheath.

### ***Alveolites tumidus* (Hinde), 1890**

#### **Plate 19, figs. 3-7**

1890 *Pachypora tumida* Hinde: p. 197, pl. 8, fig. 3.

1936 *Alveolites tumidus* (Hinde); Hill: p. 35, pl. 1, figs. 11-14.

1954 *Alveolites tumidus* (Hinde); Hill: p. 33, pl. 2, figs. 19-21, 23, 24.

**MATERIAL:** Pillara Limestone—G1002, G1003, G3239, K209, K213, K406, K461 (1 doubtful specimen), ?K463, K467 (1), K528, K572 (4?), K573 (1), U7 (1), U11 (1); Sadler Limestone—G1004 (1), G1082, G1099 (1), G3229 (1), K215 (silicified specimens), K216, K222, K224, K238-248 (common), K264-268 (doubtful identifications), K271, K301, K403, U9; Virgin Hills or Gogo Formations—K312.

**REMARKS:** The material from K213 is doubtfully referred to *A. tumidus* as the partially silicified fragments are of slender branches like those of *Alveolites sp. cf. A. saleei* but the calices are regularly alveolitoid at the surface and the corallites are polygonal at the axis as in *A. tumidus*. Several specimens from K463 show the typical form, size and shape of *A. tumidus* but some are more slender and resemble *Alveolites sp. cf. A. caudatus* except they lack the irregularity in shape of calice and the meandrine appearance of the axial corallites characteristic of the latter species.

In addition, as already recorded above, cylindrical fragments not reasonably separable from *A. tumidus* occur at G1082 where thin finger-like, unsheathed, irregularly cylindrical fragments are associated with thin and thick cylindrical fragments sheathed dorsally in curving outgrowths from themselves and from neighbouring branches, to form a thick lamellar colony as in *Alveolites saleei* Lecompte.

This occurrence, together with Lecompte's (1939) careful field observations on *Alveolites* in the Givetian and Frasnian of the Dinant Basin, make it doubtful whether the finger-like branches of *Alveolites* regarded by Sokolov (1952, 1955, in Orlov, 1962) as characteristic of his new genus *Alveolitella* are other than growth

forms of species of *Alveolites*. Sokolov founded his genus on *Alveolites fecundus* (Salée) Lecompte (1939, p. 57, pl. 9, figs. 2, 3) from the Givetian of the Dinant Basin, Belgium at Durbury 8328 (Nos. 406, 408, of which No. 406 of Lecompte, pl. 9, fig. 3, was chosen by Sokolov, 1955, as lectotype).

*A. fecundus*, it should be noted, resembles *A. saleei* in having a sheath, albeit thin, growing out from its branches and sheathing them, though the colony is described as if hand-like and growing vertically rather than mainly laterally as in *A. saleei*, and Lecompte does not indicate that the sheathing is confined to one side of the colony as in *A. saleei*. While such a growth form might have stabilised to be characteristic of a genus, it seems better to us to regard *Alveolitella* as a junior subjective synonym of *Alveolites*.

DISTRIBUTION: Pillara and Sadler Limestones, Virgin Hills Formation, Canning Basin, Upper Devonian.

***Alveolites* sp. cf. *A. intermixtus* Lecompte, 1939**

Plate 19, figs. 8, 9

cf. 1939 *Alveolites intermixtus* Lecompte: p. 50, pl. 9, fig. 4.

One specimen BMR CPC.9607 from K353 resembles *A. intermixtus* Lecompte (1939, pp. 50-1 pl. 9, fig. 4) from the Couvinian Co<sub>2</sub>c of the Dinant Basin, in growth form, in size and in having the corallites arranged in ranks one above the other. Another specimen, BMR CPC.9606, from K549 in the Napier Formation is somewhat crushed but appears to be conspecific with 9607.

***Alveolites* sp. aff. *A. multiperforatus* Salée, 1933**

Plate 19, figs. 1, 2

aff. 1933 *Alveolites multiperforatus* Salée MS in Lecompte: p. 39, pl. 3, figs. 1, 1a, 1b.  
1936a *Alveolites* sp. aff. *A. multiperforatus* Salée; Hill: p. 33, pl. 1, figs. 9, 10.

Two fragments, from K530, in their simplicity of structure, erectness of corallites, uniform thickening of corallite walls, and large mural pores, resemble the specimens Hill (1936a) referred to *A. aff. multiperforatus* Salée.

***Alveolites* sp. *A.***

Plate 20, fig. 5

One specimen BMR CPC.9608 from K463 in the Pillara Limestone is within the range of variation of *A. tumidus* in corallite size and branch diameter but



differs in that the corallites of the axial part of the branch are irregular and somewhat meandrine as in *A. sp. cf. A. caudatus*. It differs from the latter in corallite size and the corallites in the axial region are much thicker walled.

***Alveolites caudatus* Hill, 1954**

1954 *Alveolites caudatus* Hill: p. 32, pl. 1, figs. 10, 11.

DISTRIBUTION: Gneudna Formation, Carnarvon Basin; Givetian-?Frasnian.

***Alveolites sp. cf. A. caudatus* Hill, 1954**

Plate 20, figs. 6, 7

MATERIAL: This form is relatively abundant in: Virgin Hills Formation—K312; Sadler Limestone—K105, K214, K221-227, K236, K238, K244-246, K250, K272, K274, K403; Pillara Limestone—K213, K350, K406, K442, K448-K460, K461, K503, K504, K510.

REMARKS: Hill (1954) proposed *A. caudatus* for ramose alveolitids with slender branches and irregularly polygonal calices from the Gneudna Formation of the Carnarvon Basin, Western Australia. Similar slenderly branched forms occur through the Upper Devonian of the Lennard Shelf. The new material is mainly fragmentary and in size of branch is slightly larger than the Gneudna specimens being up to 8 mm in width. Specimens may be sheathed by a thin laminar growth wherein the corallites are like those in the branch. The larger branches compare in size with the smaller branches of *A. tumidus*. The corallites are moderately thin walled; in the axial part of the branch they are inclined at a low angle to the axis, irregularly polygonal and in places meandriform; but in the peripheral part their walls are much thickened and the corallites are almost normal to the surface. In tangential sections the corallites are irregular, more polygonal than alveolitoid. Septal spines projecting inwards from the fibrous stereozone of the corallites are not observed. Tabulae are flat and 1 mm apart. Mural pores are circular, and large 0.15 mm in diameter. Although the Lennard Shelf material differs from the holotype of *A. caudatus* in the diameter of its branches and in having thinner-walled axial corallites, it is considered to be very close morphologically to *A. caudatus*.

DISTRIBUTION: Pillara and Sadler Limestone, Virgin Hills Formation, Canning Basin; Upper Devonian.

Family AULOPORIDAE Edwards and Haime, 1851

Genus *Aulopora* Goldfuss, 1829

*Aulopora recta* Hill, 1954

Plate 20, fig. 12

1954 *Aulopora recta* Hill: p. 34, pl. 3, fig. 20.

MATERIAL: One specimen from G1001.

REMARKS: Hill (1954) described this species from beds correlated with the Upper Devonian, Stage III of the West German sequence.

*Aulopora* sp. cf. *A. liniformis* Lecompte, 1939

Plate 20, fig. 8

cf. 1939 *Aulopora liniformis* Lecompte: p. 18, pl. 15, fig. 5.

MATERIAL: A specimen BMR CPC.9611 from K222.

REMARKS: This closely resembles *Aulopora liniformis* from the Givetian, Gib of the Dinant Basin, in form of corallum and size of corallite. The corallum is a filiform network encrusting a cylindrical *Catactotoechus*. The corallites are up to 6 mm in length and average 0.5 mm in width with calices up to 1 mm in diameter.

*Aulopora* sp. *A.*

Plate 20, fig. 10

MATERIAL: Two colonies of *Aulopora*, from G1003, in the Pillara Limestone and one from the Sadler Limestone of G1082.

DESCRIPTION: The coralla from G1003 have a reptant, retiform base, the spaces of the net being 4- to 7-sided; the corallites of the net are about 1 mm in diameter, opening upwards at right angles in calices little if any wider than the reptant parts, and raised very little above the reptant parts. From points on the net, somewhat larger corallites, reptant for the greater part of their length, spread like a flat bush with the branches in the horizontal plane; each corallite opens upwards at right angles in a calice of about the same diameter as the reptant part. One colony encrusts a stromatoporoid, the other an *Alveolites*.

A second retiform encrustation, of smaller size and corallite dimensions, is seen on *Alveolites* sp. cf. *A. saleei* from the Sadler Formation of locality G1082. It does not show any corallites other than those of the net.

***Aulopora* spp.**

Plate 20, figs. 9, 11

Fragments of *Aulopora* have been collected from K112 (specimen BMR CPC.9614), K243, K244, K246, K248, K267 and K348.

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## Appendix 1

### LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
G 1001	Lennard River	288,300	2,778,300	northern end of Oscar Range	Napier Formation	Upper Devonian	<i>Aulopora recta</i>	
G 1002	Noonkanbah ....	380,000	2,691,600	near northern entrance of Menyous Gap	Pillara Limestone	early Frasnian	<i>Argutastrea hullensis</i> <i>Disphyllum caespitosum</i> <i>Thamnopora angusta</i> <i>Alveolites tumidus</i>	
84 G 1003	Noonkanbah ....	381,000	2,691,200	0·25 miles from northern entrance to Menyous Gap	Pillara Limestone	early Frasnian	<i>Temnophyllum turbinatum</i> <i>Temnophyllum</i> sp. <i>Thamnopora angusta</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> <i>Aulopora</i> sp. A	
G 1004	Noonkanbah ....	303,300	2,689,500	2 miles southeast of northern entrance to Menyous Gap, Pillara Range	Sadler Limestone	Frasnian ....	<i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i>	
G 1005	Noonkanbah ....	382,300	2,690,400	1·2 miles southeast of northern entrance to Menyous Gap	Pillara Limestone	early Frasnian	<i>Argutastrea hullensis</i>	
G 1006	Noonkanbah ....	383,800	2,688,800	2·75 miles southeast of northern entrance to Menyous Gap	Pillara Limestone	early Frasnian or late Givetian	<i>Argutastrea hullensis</i> <i>Alveolites suborbicularis</i>	

G 1007	Lennard River	301,700	2,783,900	near Tunnel Creek, southeast of Fairfield Homestead	Napier Formation	Upper Devonian	<i>Tabulophyllum? lowryi</i>	<i>Spinulicosta proteus</i> Zone, same locality as K 283 and U 3
G 1008	Noonkanbah ....	385,200	2,684,200	Home Range, 4·5 miles southeast of southern entrance to Menyous Gap	Pillara Limestone	late Givetian (or early Frasnian)	<i>Temnophyllum menyouse</i>	
G 1009	Lennard River	330,000	2,767,500	Oscar Plateau ....	Pillara Limestone	Upper Devonian	<i>Disphyllum curtum</i>	
G 1010	Noonkanbah ....	335,200	2,730,000	Oscar Hill, 12 miles at 310° from Fitzroy Crossing, Oscar Range	Fairfield Formation	Famennian	<i>Catactotoechus irregularis</i>	
G 1011	Lennard River	276,600	2,784,500	southeast of Mt. Percy, Oscar Range	Fairfield Formation	Famennian	<i>Catactotoechus irregularis</i>	
G 1055	Mount Ramsay	423,600	2,716,000	Horseshoe Range	Fairfield Formation	Famennian	<i>Catactotoechus irregularis</i>	
G 1075	Noonkanbah ....	337,300	2,723,700	5·5 miles south-southeast of Oscar Hill, Oscar Range	Fairfield Formation	Famennian	<i>Zaphrentoides? excavatus</i> <i>Catactotoechus irregularis</i> <i>C. tenuis</i>	
G 1078	Mount Ramsay	411,600	2,704,200	Hull Range ....	Pillara Limestone	early Frasnian	<i>Argutastrea hullensis</i> <i>Thamnopora boloniensis?</i>	
G 1082	Mount Ramsay	414,800	2,698,800	southeastern end of Hull Range	Sadler Limestone	Frasnian ....	<i>Hexagonaria playfordi</i> <i>Disphyllum caespitosum</i> <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. cf. <i>A. saleei</i> <i>Alveolites tumidus</i>	
G 1083	Mount Ramsay	414,700	2,698,800	southeast end of Hull Range	Pillara Limestone	early Frasnian	<i>Argutastrea hullensis</i> <i>Alveolites suborbicularis</i>	
G 1085	Mount Ramsay	414,900	2,698,200	southeast end of Hull Range	Pillara Limestone	early Frasnian	<i>Argutastrea hullensis</i> <i>Disphyllum virgatum</i>	
G 1098	Noonkanbah ....	371,300	2,688,400	Outcamp Hill, Pillara Range	Pillara Limestone	early Frasnian (or late Givetian)	<i>Thamnopora angusta</i>	

LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS—continued

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
G 1099	Noonkanbah ....	371,900	2,688,800	Outcamp Hill, Pillara Range	Sadler Limestone	Frasnian ....	<i>Alveolites tumidus?</i>	
G 3224	Mount Ramsay	404,100	2,695,700	near Minnie Pool	Pillara Limestone	Upper Devonian	<i>Argutastrea</i> sp. probably <i>A. hullensis</i>	
G 3227	Noonkanbah ....	392,900	2,664,100	Sadler Ridge ....	Sadler Limestone	Frasnian ....	<i>Argutastrea hullensis</i>	
G 3229	Noonkanbah ....	393,600	2,662,800	near Sadler Ridge	Sadler Limestone	Frasnian ....	<i>Catactotoechus obliquus</i> <i>Temnophyllum</i> sp. <i>Thamnopora boloniensis</i> <i>Thamnopora</i> sp. indet. <i>Alveolites suborbicularis</i> <i>A. tumidus?</i>	
G 3233	Noonkanbah ....	389,200	2,665,800	northeast end of Gap Creek, Emanuel Range	Pillara Limestone	late Givetian to early Frasnian	<i>Disphyllum</i> sp.	
G 3239	Noonkanbah ....	384,600	2,667,800	near Sadler Ridge	Pillara Limestone	late Givetian to early Frasnian	<i>Disphyllum caespitosum</i> <i>Alveolites tumidus?</i>	
G 3300	Noonkanbah ....	373,000	2,689,200	1 mile northeast of Outcamp Hill, near Pillara Range	Pillara Limestone	early Frasnian (or late Givetian)	<i>Disphyllum caespitosum</i>	Same coral as at G 1082
G 3323	Mount Ramsay	402,800	2,713,300	near Siphon Spring, Horse Spring Range	Pillara Limestone	Frasnian ....	<i>Argutastrea hullensis</i>	
G 3359	Noonkanbah ....	390,500	2,683,200	near Gap Spring, Emanuel Range	Pillara Limestone	late Givetian to early Frasnian	<i>Donia brevilamellata</i>	

G 3364	Noonkanbah ....	389,300	2,681,700	2 miles east of Mountain Home Spring	Pillara Limestone	late Givetian	<i>Donia breviamellata</i> <i>Disphyllum</i> ? sp.	
G 3365	Noonkanbah ....	386,500	2,682,000	Mountain Home Spring	Pillara Limestone	late Givetian	<i>Stringophyllum</i> sp. A. Rugosa gen. et sp. indet.	indet. sp. is same as Hill, 1954, pl. 1, fig. 15
G 3366	Noonkanbah ....	389,800	2,677,800	southern end of Home Range	Pillara Limestone	late Givetian	<i>Donia breviamellata</i> <i>Disphyllum caespitosum</i> <i>Temnophyllum occidentale</i> <i>Stringophyllum</i> sp. A. <i>Donia breviamellata</i>	
G 3367	Noonkanbah ....	389,200	2,677,400	southern end of Hull Range	Pillara Limestone	late Givetian	<i>Donia breviamellata</i>	
G 3377	Mount Ramsay	408,300	2,659,700	1 mile south of Waggon Pass, Lawford Range	Pillara Limestone	early Frasnian	<i>Peneckiella teichertii</i>	
K 101	Mount Ramsay	414,100	2,666,150	5 miles at 334° from Old Bohemia Home- stead	Pillara Limestone	late Frasnian	<i>Alveolites suborbicularis</i> ?	
K 105	Mount Ramsay	412,800	2,664,250	4·5 miles at 319° from Old Bohemia Home- stead	? Virgin Hills Formation	Frasnian ....	<i>Alveolites</i> sp. cf. <i>A. caudatus</i>	
K 112	Mount Ramsay	411,400	2,655,550	4 miles at 247·5° from Old Bohemia Home- stead	? Sadler Limestone	Frasnian ....	<i>Disphyllum virgatum</i> <i>Alveolites suborbicularis</i> <i>Aulopora</i> sp.	
K 118	Mount Ramsay	413,250	2,655,900	3 miles at 245° from Old Bohemia Home- stead	Gogo Formation	early Frasnian	<i>Syringaxon dickinsi</i> <i>Syringaxon</i> ? sp. A.	Wapet's section DP 2, base of unit A1
K 121	Mount Ramsay	412,000	2,654,700	4 miles at 239° from Old Bohemia Home- stead	Gogo or lower Virgin Hills Formations	Frasnian ....	<i>Syringaxon dickinsi</i> <i>Syringaxon</i> ? sp. A.	



LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS—continued

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
K 124	Mount Ramsay	414,000	2,654,700	Same as K 121	Gogo Formation	Frasnian ....	<i>Syringaxon dickinsi</i> ....	125' above lowest beds of formation exposed at this locality
K 126	Mount Ramsay	414,000	2,654,700	Same as K 121 ....	Gogo Formation	Frasnian ....	<i>Syringaxon dickinsi</i> .... <i>Syringaxon</i> ? sp. A.	187-213' above base of formation exposed at the locality
K 135	Mount Ramsay	413,950	2,661,400	3 miles at 308° from Old Bohemia Home-stead	Virgin Hills Formation	Upper Devonian	<i>Zaphrentoides</i> ? <i>excavatus</i>	
88 K 138	Mount Ramsay	409,400	2,660,150	Bugle Gap, 6 miles at 280° from Old Bohemia Home-stead	Virgin Hills or Gogo Formation	Frasnian ....	Rugosa gen. et sp. indet.	
K 147	Mount Ramsay	....	....	Position doubtful	Sadler Limestone	Frasnian ....	<i>Peneckiella teichertii</i> ....	possibly same locality as U 5
K 149	Mount Ramsay	408,650	2,649,700	7 miles at 227° from Old Bohemia Home-stead, southeastern end of Bugle Gap, 3.5 miles at 061° from Pinnacle Spring	Virgin Hills Formation	Upper Devonian	? <i>Zaphrentoides excavatus</i>	
K 173	Mount Ramsay	413,250	2,655,100	3.5 miles at 240° from Old Bohemia Home-stead	? Gogo Formation	Frasnian ....	<i>Syringaxon dickinsi</i> .... <i>Metriophyllum</i> sp. B.	Wapet's section DP 2, unit A

K 177	Mount Ramsay	411,450	2,654,000	4.5 miles at 237° from Old Bohemia Home- stead	Virgin Hills Formation	Upper Devonian	<i>Catactotoechus</i> sp. aff. <i>C. irregularis</i>	
K 180	Mount Ramsay	413,500	2,651,700	4.5 miles at 214° from Old Bohemia Home- stead	Bugle Gap Limestone	Famennian	<i>Syringaxon dickinsi</i> ....	Wapet's section DP 2 unit A-J ; given as Fairfield Formation ; <i>Spinulicosta proteus</i> Zone by Veevers, 1959
K 188	Mount Ramsay	409,650	2,651,850	6.25 miles at 235° from Old Bohemia Home- stead	Sadler Formation	Frasnian ....	<i>Peneckiella teichertii</i>	
K 189	Mount Ramsay	409,400	2,653,600	5.5 miles at 241° from Old Bohemia Home- stead	Virgin Hills Formation	Upper Devonian	<i>Thamnopora boloniensis</i> ? <i>Alveolites</i> sp. cf. <i>A.</i> <i>caudatus</i> ?	given by BMR as Sadler Limestone
K 190	Mount Ramsay	410,100	2,653,950	5 miles at 241° from Old Bohemia Home- stead	Virgin Hills Formation	Upper Devonian	<i>Catactotoechus irregularis</i>	
K 201	Noonkanbah ....	373,000	2,726,700	3.5 miles at 002° from Macs Hill	Napier Formation	Upper Devonian	<i>Thamnopora boloniensis</i>	Wapet's section DL 3 ; given by BMR as approximately 750' above base of " Fossil Downs Formation "
K 208	Noonkanbah ....	389,050	2,665,250	1.75 miles at 133° from Prices Hill	Pillara Limestone	late Givetian to early Frasnian	<i>Donia brevilamellata</i> ....	Wapet's section DMP 2, unit C 1, 100' above base of formation
K 209	Noonkanbah ....	389,050	2,665,250	as above ....	Pillara Limestone	late Givetian to early Frasnian	<i>Donia brevilamellata</i> .... <i>Alveolites tumidus</i>	Wapet's section DMP 2, unit C 2, 188' above base of formation
K 211	Noonkanbah ....	389,400	2,665,600	as above ....	Pillara Limestone	late Givetian to early Frasnian	<i>Donia brevilamellata</i> ....	Wapet's section DMP 2, unit D 2, 263' above base of formation

LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS—continued

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
K 213	Noonkanbah ....	389,400	2,665,600	as above ....	Pillara Limestone	Frasnian ....	<i>Disphyllum caespitosum</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i> <i>Alveolites tumidus</i> ?	Wapet's section DMP 2, unit E 2 ; <i>Ladjia saltica</i> Zone, 450' above base of formation
K 215	Noonkanbah ....	390,950	2,663,950	3·5 miles at 130·5° from Prices Hill, Sadler Ridge, Emanuel Range	Sadler Limestone	Frasnian ....	<i>Temnophyllum</i> sp. .... <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i> <i>Aulopora</i> sp.	Wapet's section DD 1, unit A 2 ; <i>Ladjia saltica</i> Zone, 25' above base of formation
06 K 216	Noonkanbah ....	391,000	2,664,000	as above ....	Sadler Limestone	Frasnian ....	<i>Alveolites tumidus</i> .... <i>Aulopora</i> sp.	Wapet's section DD 1, unit A 3 ; <i>Ladjia saltica</i> Zone 50' above base of formation
K 218	Noonkanbah ....	391,100	2,664,100	as above ....	Sadler Limestone	Frasnian ....	<i>Hexagonaria playfordi</i> ?	Wapet's section DD 1, unit A 5 ; <i>Ladjia saltica</i> Zone ? 100' above base of formation
K 221	Noonkanbah ....	391,850	2,664,550	as above ....	Sadler Limestone	Frasnian ....	<i>Catactotoechus irregularis</i> <i>Disphyllum virgatum</i> <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i>	Wapet's section DD 1, unit D 1 ; <i>Emanuella torrida</i> Zone, 480' above base of formation
K 222	Noonkanbah ....	391,950	2,664,600	as above ....	Sadler Limestone	Frasnian ....	<i>Catactotoechus</i> sp. indet. <i>Catactotoechus obliquus</i> <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i> <i>Aulopora</i> sp. cf. <i>A. liniformis</i>	Wapet's section DD 1, unit D 2 ; <i>Emanuella torrida</i> Zone, 540' above base of formation

K 223	Noonkanbah ....	392,000	2,664,650	as above	....	Sadler Limestone	Frasnian ....	<i>Syringaxon dickinsi</i> ? .... <i>Alveolites</i> sp. cf. <i>A.</i> <i>caudatus</i> ? <i>Alveolites</i> sp.	Wapet's section DD 1, unit D 3 ; <i>Emanuella</i> <i>torrida</i> Zone, 575' above base of formation
K 224	Noonkanbah ....	392,050	2,664,700	as above	....	Sadler Limestone	Frasnian ....	<i>Catactotoechus irregularis</i> <i>Argutastrea hullensis</i> <i>Alveolites</i> sp. cf. <i>A.</i> <i>caudatus</i> ? <i>Alveolites tumidus</i>	Wapet's section DD 1, unit D 4 ; <i>Emanuella</i> <i>torrida</i> Zone, 605' above base of formation
K 225	Noonkanbah ....	392,150	2,664,750	as above	....	Sadler Limestone	Frasnian ....	<i>Catactotoechus irregularis</i> <i>Disphyllum</i> ? sp. indet. <i>Alveolites</i> sp. cf. <i>A.</i> <i>caudatus</i> ?	Wapet's section DD 1, unit D 5 ; <i>Emanuella</i> <i>torrida</i> Zone, 675' above base of formation
K 226	Noonkanbah ....	392,200	2,664,775	as above	....	Sadler Limestone	Frasnian ....	<i>Catactotoechus irregularis</i> <i>Syringaxon dickinsi</i> ? disphyllinid <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. cf. <i>A.</i> <i>caudatus</i> ?	Wapet's section DD 1, unit D 6 ; <i>Emanuella</i> <i>torrida</i> Zone, 725' above base of formation
K 227	Noonkanbah ....	392,250	2,664,800	as above	....	Sadler Limestone	Frasnian ....	<i>Catactotoechus irregularis</i> disphyllinid (cerioid) possibly <i>Argutastrea</i> <i>hullensis</i> <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. cf. <i>A.</i> <i>caudatus</i> ?	Wapet's section DD 1, unit D 7 ; <i>Emanuella</i> <i>torrida</i> Zone, 775' above base of formation
K 228	Noonkanbah ....	392,300	2,664,850	as above	....	Sadler Limestone	Frasnian ....	<i>Catactotoechus</i> sp. indet. <i>Disphyllum</i> sp. indet.	Wapet's section DD 1, unit E 1 ; <i>Emanuella</i> <i>torrida</i> Zone, 800' above base of formation
K 230	Noonkanbah ....	392,270	2,665,100	as above	....	Sadler Limestone	Frasnian ....	<i>Catactotoechus irregularis</i> ? disphyllinid (solitary)	Wapet's section DD 1, unit E 3 ; <i>Emanuella</i> <i>torrida</i> Zone, 935' above base of formation

LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS—continued

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
K 233	Noonkanbah ....	393,000	2,662,950	1.25 miles at 233° from Long's Well, Sadler Ridge, Emanuel Range	Pillara Limestone	late Givetian to Frasnian	<i>Disphyllum caespitosum</i> ?	Wapet's section DD 2, 80' below contact with Sadler Limestone
K 234	Noonkanbah ....	393,100	2,663,100	as above ....	Sadler Limestone	Frasnian ....	<i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i>	Wapet's section DD 2, unit B 1 ; <i>Ladjia saltica</i> Zone, 53' above base of formation
K 236	Noonkanbah ....	393,125	2,663,125	as above ....	Sadler Limestone	Frasnian ....	Disphyllinid .... <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i> ?	Wapet's section DD 2, unit C 1 ; <i>Ladjia saltica</i> Zone, 64' above base of formation
K 237	Noonkanbah ....	393,125	2,663,125	as above ....	Sadler Limestone	Frasnian ....	<i>Thamnopora boloniensis</i>	Wapet's section DD 2, unit C 2 ; <i>Ladjia saltica</i> Zone, 68' above base of formation
K 238	Noonkanbah ....	393,150	2,663,150	as above ....	Sadler Limestone	Frasnian ....	<i>Thamnopora boloniensis</i> .... <i>Alveolites</i> sp. cf. <i>A. caudatus</i> <i>Alveolites tumidus</i> ?	Wapet's section DD 2, unit C 3 ; <i>Ladjia saltica</i> Zone, 72' above base of formation
K 239	Noonkanbah ....	393,150	2,663,150	as above ....	Sadler Limestone	Frasnian ....	<i>Catactotoechus obliquus</i> .... <i>Temnophyllum turbinatum</i> <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i>	Wapet's section DD 2, unit C 4 ; <i>Ladjia saltica</i> Zone, 74' above base of formation
K 240	Noonkanbah ....	393,175	2,663,200	as above ....	Sadler Limestone	Frasnian ....	<i>Metriophyllum trochoides</i> <i>Argutastrea hullensis</i> <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i>	Wapet's section DD 2, unit C 5 ; <i>Ladjia saltica</i> Zone, 76' above base of formation

K 241	Noonkanbah ....	393,175	2,663,250	as above	....	Sadler Limestone	Frasnian ....	<i>Thamnopora boloniensis</i> .... <i>Alveolites tumidus</i>	Wapet's section DD 2, unit C 6 ; <i>Ladjia saltica</i> Zone, 78' above base of formation
K 242	Noonkanbah ....	393,175	2,663,250	as above	....	Sadler Limestone	Frasnian ....	<i>Argutastrea hullensis</i> .... <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i>	Wapet's section DD 2, unit C 7 ; <i>Ladjia saltica</i> Zone, 80' above base of formation
K 243	Noonkanbah ....	393,175	2,663,250	as above	....	Sadler Limestone	Frasnian ....	<i>Argutastrea hullensis</i> .... <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> <i>Aulopora</i> sp.	Wapet's section DD 2, unit C 8 ; <i>Ladjia saltica</i> Zone, 82' above base of formation
K 244	Noonkanbah ....	393,200	2,663,275	as above	....	Sadler Limestone	Frasnian ....	<i>Temnophyllum</i> sp. .... <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites</i> sp. cf. <i>A.</i> <i>caudatus</i> ? <i>Alveolites tumidus</i> <i>Aulopora</i> sp.	Wapet's section DD 2, unit C 9 ; <i>Ladjia saltica</i> Zone, 87' above base of formation
K 245	Noonkanbah ....	393,200	2,663,300	as above	....	Sadler Limestone	Frasnian ....	<i>Catactotoechus obliquus</i> .... <i>Disphyllum virgatum</i> <i>Temnophyllum turbinatum</i> <i>Temnophyllum</i> ? <i>flori-</i> <i>forme</i> ? <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. cf. <i>A.</i> <i>caudatus</i> ? <i>Alveolites tumidus</i>	Wapet's section DD 2, unit C 10 ; <i>Ladjia saltica</i> Zone, 89' above base of formation

LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS—continued

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
K 246	Noonkanbah ....	393,200	2,663,300	as above ....	Sadler Limestone	Frasnian ....	<i>Catactotoechus</i> sp. .... <i>Disphyllum curtum</i> ? disphyllinid ? (solitary) <i>Temnophyllum turbinatum</i> <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> <i>Aulopora</i> sp.	Wapet's section DD 2, unit C 11 ; 93' above base of formation
K 247	Noonkanbah ....	393,250	2,663,350	as above ....	Sadler Limestone	Frasnian ....	<i>Temnophyllum turbinatum</i> ? <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i>	Wapet's section DD 2, unit D 2 ; 109' above base of formation
K 248	Noonkanbah ....	393,250	2,663,350	as above ....	Sadler Limestone	Frasnian ....	<i>Temnophyllum</i> sp. .... <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i>	Wapet's section DD 2, unit D 3 ; 111' above base of formation
K 250	Noonkanbah ....	393,400	2,663,600	as above ....	Sadler Limestone	Frasnian ....	Disphyllinid .... <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i>	Wapet's section DD 2, unit D 5 ; 153' above base of formation
K 251	Noonkanbah ....	393,450	2,663,650	as above ....	Sadler Limestone	Frasnian ....	<i>Disphyllum caespitosum</i> ? <i>Thamnopora boloniensis</i>	Wapet's section DD 2, unit D 7 ; 228' above base of formation
K 252	Noonkanbah ....	393,550	2,663,750	as above ....	Sadler Limestone	Frasnian ....	<i>Disphyllum caespitosum</i> <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i>	Wapet's section DD 2, unit D 8 ; 420' above base of formation
K 255	Noonkanbah ....	393,750	2,663,950	as above ....	Sadler Limestone	Frasnian ....	<i>Zaphrentis iocosa</i> ....	Wapet's section DD 2, unit E 1 ; 755' above base of formation

K 264	Noonkanbah ....	383,100	2,689,300	4.5 miles at 335° from Mountain Home Spring near Menyous Gap, Pillara Range	Sadler Limestone	Frasnian ....	<i>Argutastrea hullensis</i> .... <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i> ?	Wapet's section DD 3, unit B 1 ; 50' above base of formation
K 265	Noonkanbah ....	383,150	2,689,350	as above ....	Sadler Limestone	Frasnian ....	<i>Temnophyllum turbinatum</i> <i>Rugosa</i> gen. et. sp. nov. <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> ? <i>Aulopora</i> sp.	Wapet's section DD 3, unit C 1 ; 118' above base of formation
K 266	Noonkanbah ....	383,175	2,689,375	as above ....	Sadler Limestone	Frasnian ....	<i>Argutastrea hullensis</i> .... <i>Temnophyllum turbinatum</i> <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> ?	Wapet's section DD 3, unit C 2 ; 148' above base of formation
K 267	Noonkanbah ....	383,200	2,689,400	as above ....	Sadler Limestone	Frasnian ....	<i>Disphyllum virgatum</i> .... <i>Argutastrea hullensis</i> ? <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> <i>Aulopora</i> sp.	Wapet's section DD 3, unit C 3 ; 163' above base of formation
K 268	Noonkanbah ....	383,250	2,689,450	as above ....	Sadler Limestone	Frasnian ....	<i>Argutastrea hullensis</i> .... <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i> ?	Wapet's section DD 3, unit C 4 ; 187' above base of formation
K 270	Noonkanbah ....	383,350	2,689,550	as above ....	Sadler Limestone	Frasnian ....	<i>Thamnopora boloniensis</i> .... <i>Alveolites suborbicularis</i> <i>Alveolites</i> sp.	Wapet's section DD 3, unit C 6 ; <i>Ladjia saltica</i> Zone, 214' above base of formation
K 271	Noonkanbah ....	383,350	2,689,550	as above ....	Sadler Limestone	Frasnian ....	<i>Disphyllinid</i> .... <i>Thamnopora boloniensis</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> <i>Alveolites</i> sp.	Wapet's section DD 3, unit C 7 ; <i>Ladjia saltica</i> Zone, 230' above base of formation



LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS—*continued*

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
K 272	Noonkanbah ....	343,400	2,689,550	as above ....	Sadler Limestone	Frasnian ....	<i>Alveolites</i> sp. cf. <i>A. caudatus</i>	Wapet's section DD 3, unit C 8 ; <i>Ladjia saltica</i> Zone, 244' above base of formation
K 274	Noonkanbah ....	343,550	2,689,750	as above ....	Sadler Limestone	Frasnian ....	<i>Disphyllum</i> sp. .... <i>Alveolites</i> sp. cf. <i>A. caudatus</i>	Wapet's section DD 3, unit D 3 ; <i>Ladjia saltica</i> Zone, 335' above base of formation
K 276	Noonkanbah ....	383,750	2,689,950	as above ....	Sadler Limestone	Frasnian ....	<i>Aulopora</i> sp. <i>Temnophyllum</i> ? sp. .... <i>Alveolites</i> sp.	Wapet's section DD 3, unit E 4 ; <i>Ladjia saltica</i> Zone, 431' above base of formation
K 279	Noonkanbah ....	369,300	2,693,950	6.5 miles at 282° from northern entrance of Menyous Gap, Pillara Range	Pillara Limestone	late Givetian	<i>Donia breviamellata</i>	
K 283 = G 1010 = U 3	Noonkanbah ....	336,500	2,720,000	Oscar Hill, 12 miles at 310° from Fitzroy Crossing, Oscar Range	Fairfield Formation	Famennian....	<i>Catactotoechus irregularis</i>	<i>Spinulicosta proteus</i> Zone same locality as G 1010 and U 3
K 300	Noonkanbah ....	383,000	2,689,950	4.75 miles at 337° from Mountain Home Spring, Pillara Range	Sadler Limestone	Frasnian ....	Disphyllinid (solitary) <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. <i>Aulopora</i> sp.	

K 301	Noonkanbah ....	382,900	2,689,700	as for K 300 at top of hill, just to the south	Sadler Limestone	early Frasnian	<i>Disphyllum caespitosum</i> <i>Temnophyllum</i> sp. <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. cf. <i>A. saleei</i> <i>Alveolites tumidus</i>	
K 305	Noonkanbah ....	384,450	2,690,600	5 miles at 348° from Mountain Home Spring	Virgin Hills Formation	Frasnian ....	Disphyllinid (solitary) .... <i>Thamnopora</i> sp.	Wapet's section DP 5, unit B 3, 800' above base of formation
K 312	Noonkanbah ....	384,450	2,690,600	as above	apparently at boundary of Gogo and Virgin Hills Formations	Frasnian ....	<i>Thamnopora boloniensis</i> .... <i>Alveolites tumidus</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i> <i>Aulopora</i> sp.	Wapet's section DP 5, unit C 11 or D 1 approx 1,050' above base of section
K 313	Noonkanbah ....	387,000	2,686,150	2.5 miles at 009° from Mountain Home Spring	Pillara Limestone	late Givetian to early Frasnian	<i>Disphyllum caespitosum</i> <i>Argutastrea hullensis</i>	
K 316	Mount Ramsay	422,500	2,724,500	4.5 miles at 227° from Barramundi Pool	Fairfield Formation	Famennian....	<i>Temnophyllum</i> sp. ....	Wapet's section DL 2, unit D 2 ; <i>Spinulicosta proteus</i> zone
K 330	Mount Ramsay	426,700	2,718,700	6.5 miles at 182° from Barramundi Pool	Pillara Limestone	Famennian....	<i>Alveolites suborbicularis</i>	
K 343	Mount Ramsay	423,000	2,706,000	0.25 miles at 011° from Painted Rocks	Virgin Hills Formation or Sadler Limestone	Upper Devonian	<i>Temnophyllum</i> sp.	
K 344	Mount Ramsay	....	....	Painted Rocks area	? Sadler Limestone	Frasnian ? ....	<i>Disphyllum virgatum</i> ? ....	position not known precisely
K 346	Mount Ramsay	413,600	2,704,450	3 miles at 356° from Mt. Krauss at base of hill	Sadler Limestone	Frasnian ....	Disphyllinid (solitary)	
K 347	Mount Ramsay	413,600	2,704,450	as for K 346 but near top of hill	Sadler Limestone	Frasnian ....	<i>Disphyllum</i> sp. <i>A.</i>	

LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS—*continued*

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
K 348	Mount Ramsay	413,450	2,703,750	2.75 miles at 353° from Mount Krauss	Sadler Limestone	Frasnian ....	<i>Phacellophyllum</i> sp. B. <i>Haplothecia</i> ? <i>laciniosa</i> <i>Alveolites suborbicularis</i> <i>Aulopora</i> sp.	
K 350	Mount Ramsay	412,700	2,703,400	2.25 miles at 342° from Mount Krauss	Pillara Limestone	early Frasnian	Disphyllinids (solitary) <i>Alveolites</i> sp. cf. <i>A. caudatus</i>	
K 351	Mount Ramsay	413,500	2,706,050	4 miles at 356° from Mount Krauss	Sadler Limestone	Frasnian ? ....	<i>Alveolites</i> sp. indet.	
86 K 353	Mount Ramsay	413,850	2,706,400	4.25 miles at 358° from Mount Krauss	Sadler Limestone	Upper Devonian	<i>Temnophyllum menyouense</i> <i>Temnophyllum</i> sp. <i>Alveolites</i> sp. cf. <i>A. intermixtus</i>	
K 403	Noonkanbah ....	....	....	near Wapet's section DD 2	Sadler Limestone	Frasnian ....	<i>Thamnopora boloniensis</i> ? <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i> ?	precise location not known
K 404	Noonkanbah ....	....	....	spot collection from Gap Creek, Emanuel Range	Pillara Limestone	late Givetian	<i>Donia brevilamellata</i> ....	precise locality not known ; base of cliff
K 406	Noonkanbah ....	....	....	as above ....	Pillara Limestone	late Givetian	<i>Argutastrea hullensis</i> .... disphyllinid <i>Thamnopora</i> sp. <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i>	above K 404

K 438	Noonkanbah ....	389,500	2,678,750	Home Range, 2·5 miles on 136° from Mountain Home Spring	Pillara Limestone	late Givetian	<i>Donia brevilamellata</i>	
K 439	Noonkanbah ....	382,500	2,689,900	1·25 miles at 137° from northern entrance to Menyous Gap, Pillara Range	Pillara Limestone	early Frasnian ?	<i>Argutastrea hullensis</i> <i>Disphyllum virgatum</i> <i>Temnophyllum</i> sp. <i>Thamnopora angusta</i> <i>Thamnopora boloniensis</i>	
K 442	Noonkanbah ....	380,700	2,689,850	Menyous Gap, Pillara Range	Pillara Limestone	late Givetian	<i>Alveolites</i> sp. cf. <i>A. caudatus</i>	Wapet's section DMP 1, unit A 1 ; 0-38' above base of section
K 445	Noonkanbah ....	380,800	2,690,000	as above ....	Pillara Limestone	late Givetian ?	<i>Temnophyllum turbinatum</i>	Wapet's section DMP 1, unit A 3 ; 100' above base of section
K 446	Noonkanbah ....	380,825	2,690,050	as above ....	Pillara Limestone	late Givetian ?	<i>Alveolites</i> sp. cf. <i>A. caudatus</i> ?	Wapet's section DMP 1, unit A 3 ; about 120' above base of section
K 448	Noonkanbah ....	380,850	2,690,100	as above ....	Pillara Limestone	late Givetian to early Frasnian	<i>Alveolites</i> sp. cf. <i>A. caudatus</i>	Wapet's section DMP 1, unit A 5 ; 170-200' above base of section
K 460	Noonkanbah ....	380,850	2,690,150	as above ....	Pillara Limestone	late Givetian to early Frasnian	<i>Argutastrea hullensis</i> .... <i>Alveolites</i> sp. cf. <i>A. caudatus</i>	Wapet's section DMP 1, unit A 10 ; 900' above base of section
K 461	Noonkanbah ....	381,000	2,690,800	as above ....	Pillara Limestone	late Givetian to early Frasnian	<i>Thamnopora angusta</i> ? .... <i>Thamnopora boloniensis</i> <i>Alveolites</i> sp. cf. <i>A. caudatus</i> <i>Alveolites tumidus</i> ?	Wapet's section DMP 1, unit A 10 ; 900-1000' above base of section
K 462	Noonkanbah ....	381,000	2,690,900	as above ....	Pillara Limestone	early Frasnian ?	<i>Argutastrea hullensis</i> .... <i>Thamnopora boloniensis</i> ?	Wapet's section DMP 1, unit A 10 ; 1000' above base of section

LIST OF LOCALITIES WITH DETERMINATIONS OF CORALS—continued

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
K 463	Noonkanbah ....	381,050	2,690,950	as above ....	Pillara Limestone	early Frasnian?	<i>Catactotoechus irregularis</i> <i>Argutastrea hullensis</i> <i>Temnophyllum</i> sp. <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i> ?	Wapet's section DMP 1, unit A 11; 1000-1080' above base of section
K 464	Noonkanbah ....	381,050	2,690,950	as above ....	Pillara Limestone	early Frasnian	<i>Alveolites</i> sp. <i>A.</i> <i>Argutastrea hullensis</i> ?	Wapet's section DMP 1, unit A 11; 1080-1140' above base of section
K 467	Noonkanbah ....	381,100	2,691,300	as above ....	Pillara Limestone	early Frasnian	<i>Argutastrea hullensis</i> .... <i>Thamnopora boloniensis</i> <i>Alveolites tumidus</i>	Wapet's section DMP 1, unit A 12; 1300' above base of section
K 469	Noonkanbah ....	381,100	2,691,300	as above ....	Pillara Limestone	early Frasnian	<i>Argutastrea hullensis</i> ....	Wapet's section DMP 1, unit A 12; about 1300' above base of section
K 480	Mount Ramsay	....	....	high in cliffs near Horse Spring	? Pillara Limestone	Frasnian? ....	<i>Disphyllum virgatum</i> .... <i>Alveolites</i> sp.	locality not known precisely
K 503	Lennard River	375,500	2,745,500	6 miles at 168° from Prairie Hill, Geikie Gorge area	Pillara Limestone	Upper Devonian	<i>Alveolites</i> sp. cf. <i>A. caudatus</i>	
K 504	Lennard River	375,400	2,745,000	6.5 miles at 169° from Prairie Hill, Geikie Gorge area	Pillara Limestone	Upper Devonian	<i>Alveolites</i> sp. cf. <i>A. caudatus</i>	
K 508	Lennard River	350,000	2,747,600	1.25 miles at 161° from Mt. Wilson	Pillara Limestone	Upper Devonian	<i>Disphyllum</i> sp. <i>A.</i> ....	Wapet's section DMP 3, unit A 1; 50' above base of section
K 509	Lennard River	350,000	2,747,600	as above ....	Pillara Limestone	Upper Devonian	<i>Thamnopora angusta</i> ....	Wapet's section DMP 3, unit B 1; 275' above base of section

K 510	Lennard River	350,000	2,747,600	as above ....	Pillara Limestone	Upper Devonian	<i>Alveolites</i> sp. cf. <i>A. caudatus</i>	Wapet's section DMP 3, unit B 2; 280' above base of section
K 511	Lennard River	350,000	2,747,600	as above ....	Pillara Limestone	Upper Devonian	Disphyllinid ....	Wapet's section DMP 3, unit B 2; 440' above base of section
K 528	Lennard River	375,200	2,738,200	4.5 miles at 230° from J.K. Yard, immediately south of Fitzroy River	Pillara Limestone	Upper Devonian	<i>Alveolites tumidus</i> ?	
K 530	Lennard River	378,000	2,742,600	1.75 miles at 261° from J.K. Yard, immediately south of Fitzroy River	Pillara Limestone or Napier Formation	Upper Devonian	Disphyllinid <i>Alveolites</i> aff. <i>multi-perforatus</i> <i>Alveolites</i> sp.	
K 531	Lennard River	396,600	2,746,500	14.5 miles at 113° from Prairie Hill	Napier Formation	Upper Devonian	<i>Phacellophyllum kimberleyense</i>	
K 539	Lennard River	313,300	2,752,200	Linesmans Creek	Napier Formation	Upper Devonian	<i>Alveolites</i> or <i>Coenites</i> sp.	Wapet's section DO 1, unit A 1; 115' above base of section
K 540	Lennard River	313,300	2,752,200	Linesmans Creek	Napier Formation	Upper Devonian	<i>Thamnopora boloniensis</i> ....	Wapet's section DO 1, unit B 5; 315' above base of section
K 549	Lennard River	285,600	2,806,200	Carpenters Gap, southeast of Windjana Gorge	Napier Formation	Upper Devonian	<i>Alveolites suborbicularis</i> <i>Alveolites</i> sp. cf. <i>A. intermixtus</i>	Wapet's section DN 4, unit B 1; about 100' above base of formation
K 550	Lennard River	285,600	2,806,200	Carpenters Gap, southeast of Windjana Gorge	Napier Formation	Upper Devonian	<i>Thamnopora</i> sp. indet. ....	Wapet's section DN 4, unit B 5; 290' above base of formation
K 572	Lennard River	244,900	2,837,700	eastern entrance of old wagon track to Napier Downs, 7.5 miles at 314° from Homestead	Pillara Limestone	Upper Devonian ....	<i>Temnophyllum incomptum</i> <i>Alveolites tumidus</i>	Wapet's section DMP 5, unit C 2; ? <i>Ladja saltica</i> zone, 275' above base of formation
K 573	Lennard River	244,900	2,837,700	as above ....	Pillara Limestone	Upper Devonian	<i>Temnophyllum incomptum</i> <i>Alveolites tumidus</i>	Wapet's section DMP 5, unit C 3; ? <i>Ladja saltica</i> zone

LIST OF LOCALITIES WITH DETERMINATION OF CORALS—continued

Locality Number	1 : 250,000 Map Sheet	Co-ordinates (Yds)		Locality	Formation	Age	Corals	Remarks
		East	North					
U 1	....	....	....	crossing of Old Halls Ck. road over ck., 0.7 miles west of Mt. Pierre Creek	Virgin Hills Formation	Upper Devonian	<i>Caninia?</i> sp. cf. <i>C. rudis</i>	Teichert field No. A4
U 2	....	....	....	around tennis court, Fossil Downs homestead	Napier Formation	Famennian....	<i>Catactotoechus</i> sp. indet. <i>Zaphrenthis iocosa</i> Tabulata gen. et. sp. indet.	Teichert field No. A21
U 3	....	....	....	highest brachiopod limestone south of Oscar homestead	Fairfield Formation	Famennian....	<i>Catactotoechus irregularis</i>	Teichert field No. B7, B9, B10; same locality as G 1010 and K 283
U 4	....	....	....	west side of northern entrance to Menyous Gap; loose boulders from limestone below <i>Atrypa</i> limestone	Pillara Limestone	early Frasnian?	<i>Argutastrea hullensis</i> ....	Teichert field No. B72-3
U 5	....	....	....	<i>Prismatophyllum</i> reef (about 10' diameter) 6.6 miles from Mt. Pierre Well, Old Bohemia Rd.	Sadler Limestone	Frasnian ....	<i>Peneckiella</i> sp. A. ....	Teichert field No. B92-8

U 6	....	....	....	....	....	low hill of yellow limestone in front (north) of main limestone cliff, 1·5 miles southwest of Longs Well	Sadler Limestone	early Frasnian	<i>Catactotoechus obliquus</i> .... <i>Thamnopora</i> sp. <i>Alveolites</i> sp.	Teichert field No. C44
U 7	....	....	....	....	....	lower part of talus slope west of southern entrance of Menyous Gap in basal part of section	Pillara Limestone	late Givetian?	Disphyllinid .... <i>Rugosa</i> gen. et. sp. nov. <i>Alveolites tumidus</i> ?	Teichert field No. B59
U 8	....	....	....	....	....	near Prices Creek Gap	Sadler Limestone	early Frasnian	<i>Catactotoechus obliquus</i> <i>Disphyllum virgatum</i> <i>Disphyllum caespitosum</i> Disphyllinid	Teichert field No. C57-59
U 9	....	....	....	....	....	near Longs Well, Sadler Ridge, Emanuel Range	Sadler Limestone	early Frasnian	<i>Temnophyllum</i> sp. .... <i>Thamnopora boloniensis</i> <i>Thamnopora angusta</i> <i>Alveolites suborbicularis</i> <i>Alveolites tumidus</i> <i>Disphyllum</i> sp. aff. <i>D. curtum</i>	Teichert field No. D10
U 10	....	....	....	....	....	near Napier Downs Station northern side of Napier Range	Pillara Limestone	Upper Devonian		Teichert field No. F3
U 11	....	....	....	....	....	as for U 10	Pillara Limestone	Upper Devonian	<i>Disphyllum</i> sp. aff. <i>D. curtum</i> <i>Alveolites tumidus</i>	Teichert field No. F4
U 12	....	....	....	....	....	near Napier Downs Station southern side of range	Pillara Limestone	Upper Devonian	<i>Disphyllum</i> sp. aff. <i>D. curtum</i> Disphyllinid	Teichert field No. K50, E 18
U 13	....	....	....	....	....	southeastern end of Napier Range	? Pillara Limestone	Upper Devonian	<i>Temnophyllum floriforme</i>	Teichert field No. KP 126
U 14	....	....	....	....	....	Paddys Spring, northern side of Laidlaw Range	Sadler Limestone	Frasnian ....	<i>Disphyllum intertextum</i> .... <i>Disphyllum</i> sp. <i>B.</i> <i>Thamnopora angusta</i> ?	Teichert field No. H22





## PLATE INDEX

## Explanation of Plate 1

### Catactotoechus

All figures X3 unless otherwise specified; geographic data of localities are given in Appendix 1.

Figs. 1-5. *Catactotoechus irregularis* Hill.

1. UWA 33535, HOLOTYPE, *a*, T.S., *b*, L.S., X2; G1010, Oscar Hill, Kimberleys, Western Australia, Fairfield Formation—Zone of *Spinulicosta proteus*, Famennian.
2. GSWA F5992, T.S.; G1011, Fairfield Formation; Famennian.
3. UWA 25820/9, T.S.; U7, Fairfield Formation; Famennian.
4. GSWA F5261, X1, G1075, Fairfield Formation; Famennian.
5. UWA 25820/7, T.S., U7, Fairfield Formation; Famennian.

Figs. 6-9. *Catactotoechus obliquus* Hill.

6. BMR CPC.9507, T.S.; K245, Sadler Formation; Frasnian.
7. GSWA F5266/9, *a*, T.S., *b*, L.S., X2; G3229, Sadler Limestone; Frasnian.
8. GSWA F5266, XI; G3229, Sadler Limestone; Frasnian.
9. GSWA F5266/15, *a*, T.S., *b*, L.S.; G3229, Sadler Limestone; Frasnian.

Fig. 10. *Catactotoechus tenuis* Hill.

10. GSWA F5262/1, *a*, T.S., *b*, L.S., X2; F1075, Fairfield Formation; Famennian.

Figs. 11, 12. *Catactotoechus obliquus* Hill.

11. UWA 26314/3, *a*, T.S., *b*, L.S.; U17, Sadler Limestone; Frasnian.
12. UWA 26296/2, *a*, T.S., *b*, L.S.; U14, Sadler Limestone; Frasnian.

Figs. 13-18. *Catactotoechus* sp. aff. *C. irregularis* Hill.

13. BMR CPC.9513, T.S.; K177, Virgin Hills Formation; Upper Devonian.
14. BMR CPC.9511, T.S.; K177, Virgin Hills Formation; Upper Devonian.
15. BMR CPC.9516, T.S.; K177, Virgin Hills Formation; Upper Devonian.
16. BMR CPC.9518, T.S.; K177, Virgin Hills Formation; Upper Devonian.
17. BMR CPC.9512, T.S.; K177, Virgin Hills Formation; Upper Devonian.
18. BMR CPC.9510, T.S.; K177, Virgin Hills Formation; Upper Devonian.

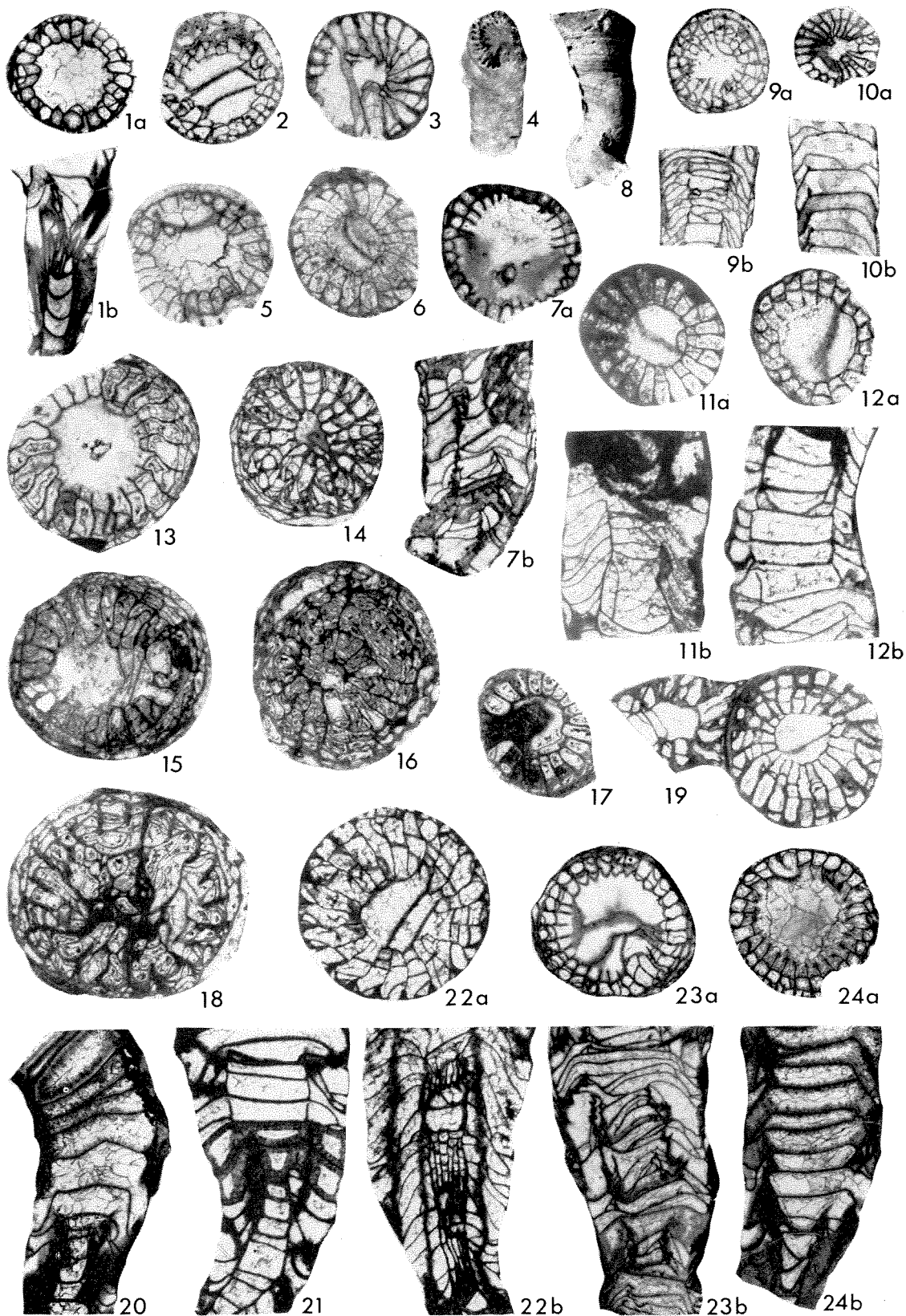
Fig. 19. *Catactotoechus obliquus* Hill.

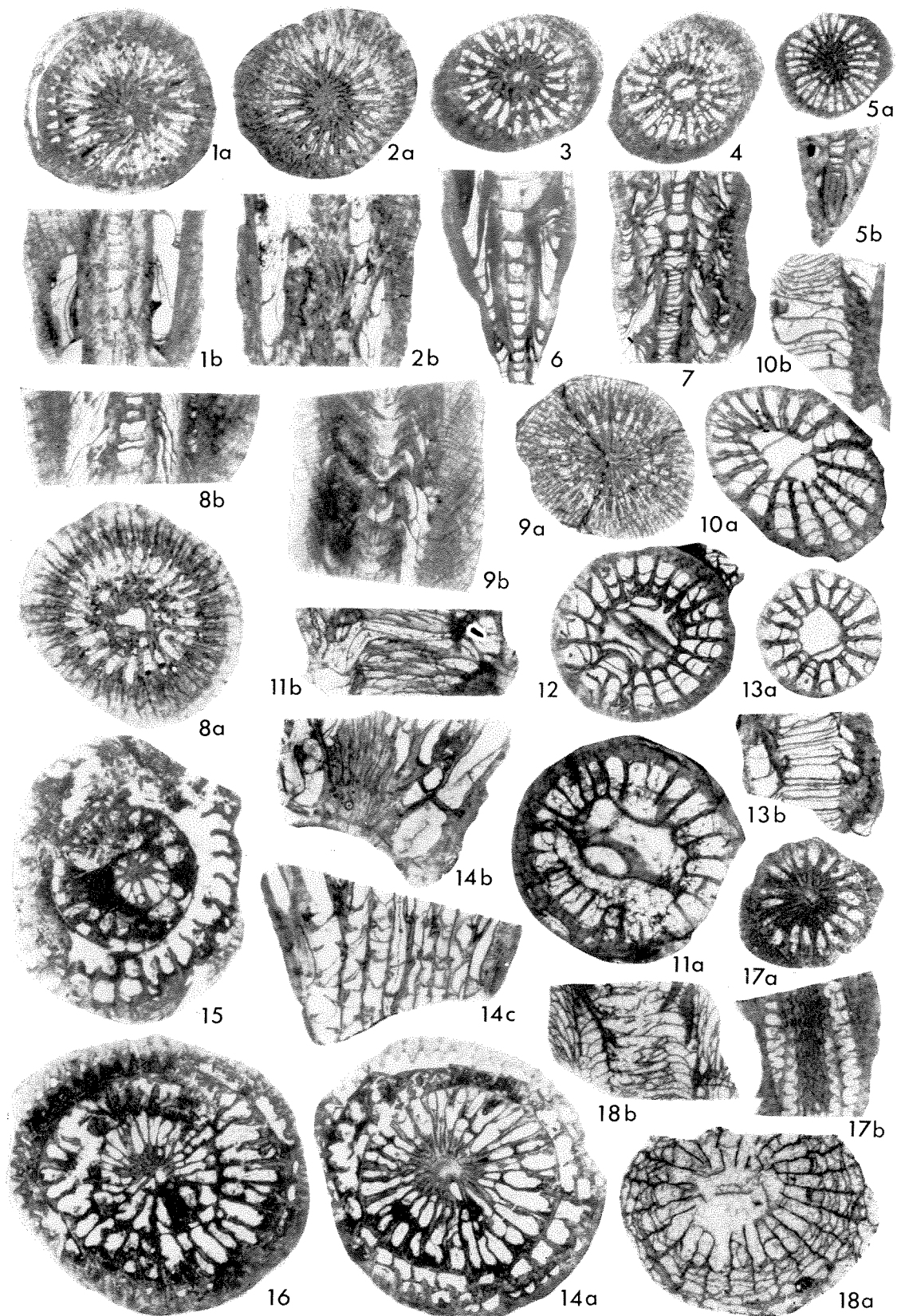
19. BMR CPC.9520, T.S.; K222, Sadler Limestone; Frasnian.

Figs. 20-24. *Catactotoechus irregularis* Hill.

20. GSWA F5261/12, L.S.; G1075, Fairfield Formation, Famennian.
21. BMR CPC.9508, L.S.; K224, Sadler Limestone; Frasnian.
22. BMR CPC.9509, *a*, T.S., *b*, L.S.; K224, Sadler Limestone; Frasnian.
23. GSWA F5928/4-8, *a*, T.S., *b*, L.S.; G1010, Fairfield Formation; Famennian.
24. GSWA F5261/11, *a*, T.S., *b*, L.S.; G1075, Fairfield Formation; Famennian.

PLATE 1





## Explanation of Plate 2

### **Syringaxon, Metriophyllum, Caninia**

All figures X3; geographic data of localities are given in Appendix 1.

Figs. 1-9. *Syringaxon dickinsi* sp. nov.

1. BMR CPC.9521, HOLOTYPE, *a*, T.S., *b*, L.S.; K121, 3.75 miles at 239° from Old Bohemia Homestead, Kimberleys, Western Australia, Gogo or lower Virgin Hills Formation; Frasnian.
2. BMR CPC.9522, *a*, T.S., *b*, L.S.; K121, Gogo or lower Virgin Hills Formation; Frasnian.
3. BMR CPC.9523, T.S.; K173, Gogo Formation; Frasnian.
4. BMR CPC.9524, T.S.; K173, Gogo Formation; Frasnian.
5. BMR CPC.9525, *a*, T.S., *b*, L.S.; K121, Gogo or lower Virgin Hills Formation; Frasnian.
6. BMR CPC.9526, L.S.; K223, Sadler Limestone; Frasnian.
7. BMR CPC.9527, L.S.; K173, Gogo Formation; Frasnian.
8. BMR CPC.9528, *a*, T.S., *b*, L.S.; K124, Gogo or lower Virgin Hills Formation; Frasnian.
9. BMR CPC. 9529, *a*, T.S., *b*, L.S.; K121, Gogo or lower Virgin Hills Formation; late Givetian to Frasnian.

Figs. 10-13. *Syringaxon?* sp. *A*.

10. BMR CPC.9530, *a*, T.S., *b*, L.S.; K118, Gogo Formation; early Frasnian.
11. BMR CPC.9531, *a*, T.S., *b*, L.S.; K121, Gogo or lower Virgin Hills Formation; Frasnian.
12. BMR CPC.9532, T.S.; K126, Gogo or lower Virgin Hills Formation; Frasnian.
13. BMR CPC.9533, *a*, T.S., *b*, L.S.; K121, Gogo or lower Virgin Hills Formation; Frasnian.

Figs. 14-16. *Metriophyllum trochoides* sp. nov.

14. BMR CPC.9534, HOLOTYPE, *a*, T.S., *b*, L.S., *c*, Tg.S.; K240, Sadler Ridge, Kimberleys, Western Australia, Sadler Limestone; Zone of *Ladjia saltica*; Frasnian.
15. BMR CPC.9535, T.S.; K240, Sadler Limestone; Frasnian.
16. BMR CPC.9536, T.S.; K240, Sadler Limestone; Frasnian.

Fig. 17. *Metriophyllum*, sp. *B*.

17. BMR CPC.9537, *a*, T.S., *b*, L.S.; K173, Gogo or lower Virgin Hills Formation; Frasnian.

Fig. 18. *Caninia?* sp. cf. *C. rudis* Hill.

18. UWA 25908, *a*, T.S., *b*, L.S.; U1, Virgin Hills Formation; Upper Devonian.

## Explanation of Plate 3

### **Zaphrentis, Zaphrentoides**

All figures X3; geographic data of localities are given in Appendix 1.

Figs. 1-5. *Zaphrentis iocosa* Hill.

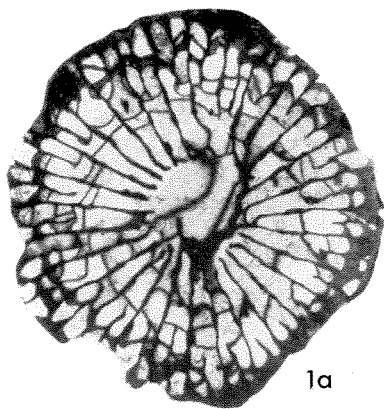
1. BMR CPC.9538, *a*, T.S., *b*, L.S.; K255, Sadler Limestone; Frasnian.
2. BMR CPC.9539, T.S.; K255, Sadler Limestone; Frasnian.
3. BMR CPC.9540, *a*, T.S., *b*, L.S.; K255, Sadler Limestone; Frasnian.
4. BMR CPC.9541, *a*, T.S., *b*, L.S.; K255, Sadler Limestone; Frasnian.
5. UWA 25845/6, *a*, *b*, T.S., *c*, L.S.; U2, Napier Formation; Famennian.

Fig. 6. *Zaphrentoides? excavatus* Hill.

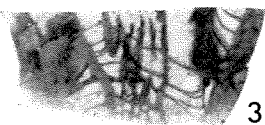
6. BMR CPC.9546, T.S.; K135, Virgin Hills Formation; Upper Devonian.

Figs. 7, 8. *Rugosa* gen. et. sp. nov.

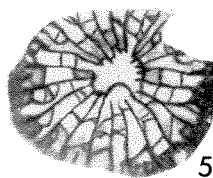
7. BMR CPC.9547, *a*, T.S., *b*, L.S.; K265, Sadler Limestone; Frasnian.
8. UWA 26431, *a*, T.S., *b*, L.S.; U15, Pillara Limestone; late Givetian?



1a



3b



5a



6



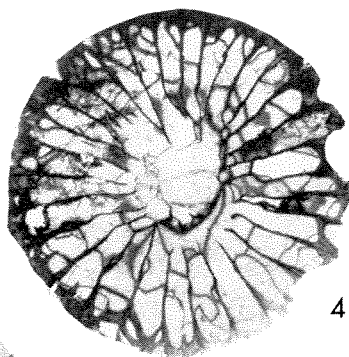
3a



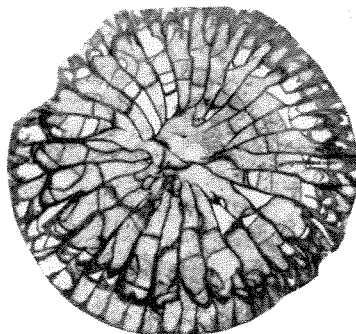
5c



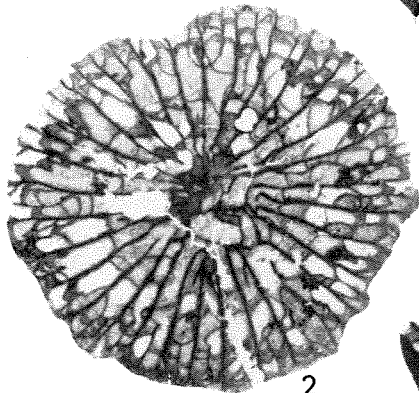
1b



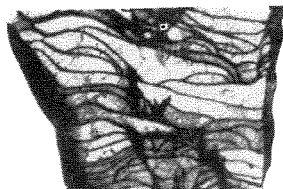
4a



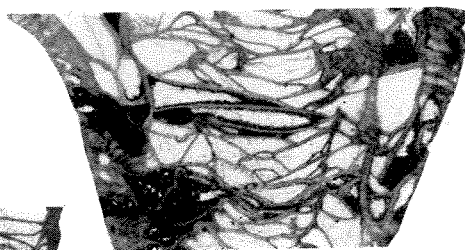
5b



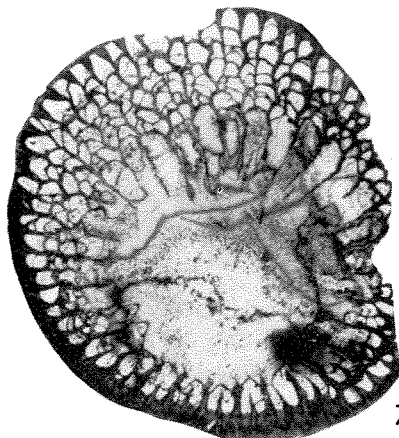
2



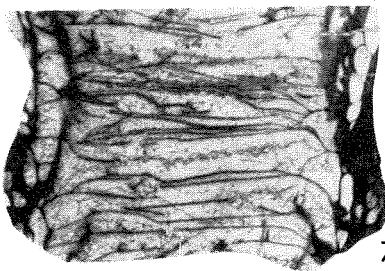
4b



8b



7a

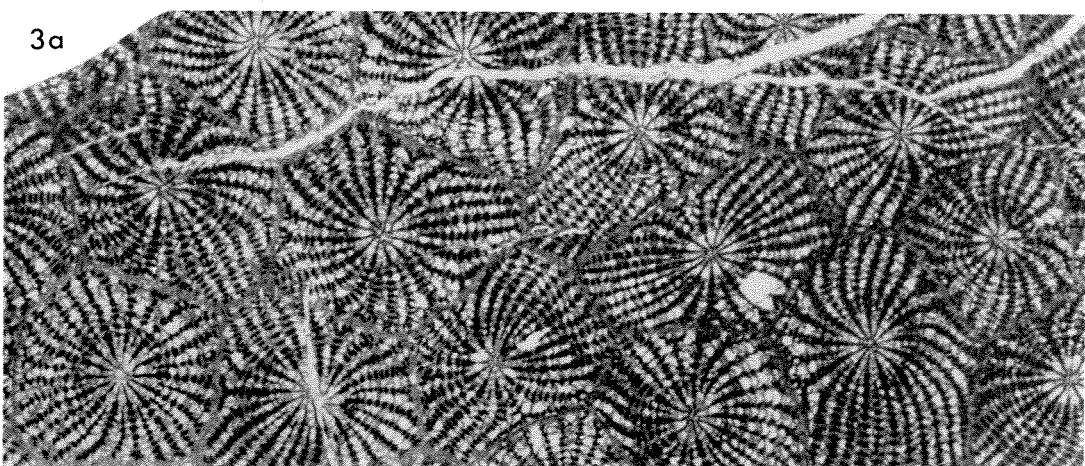
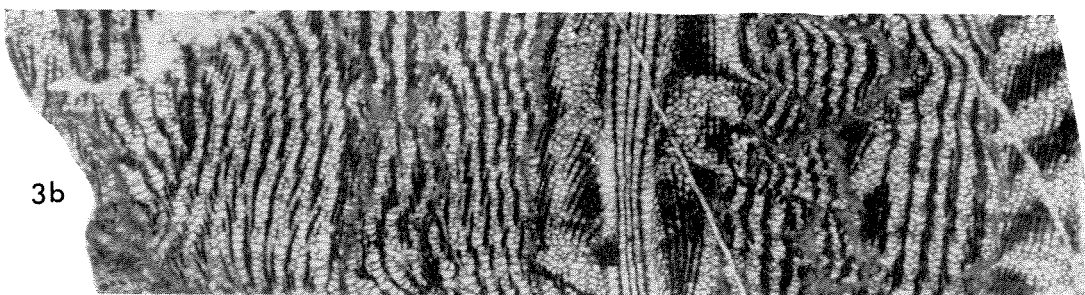
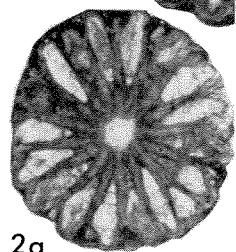
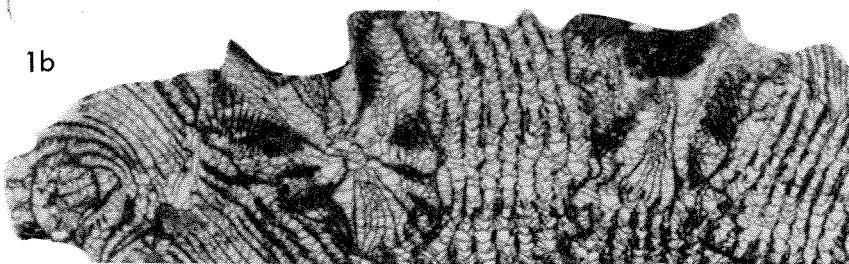
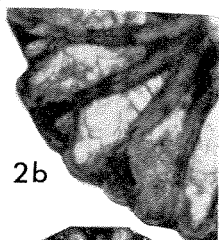
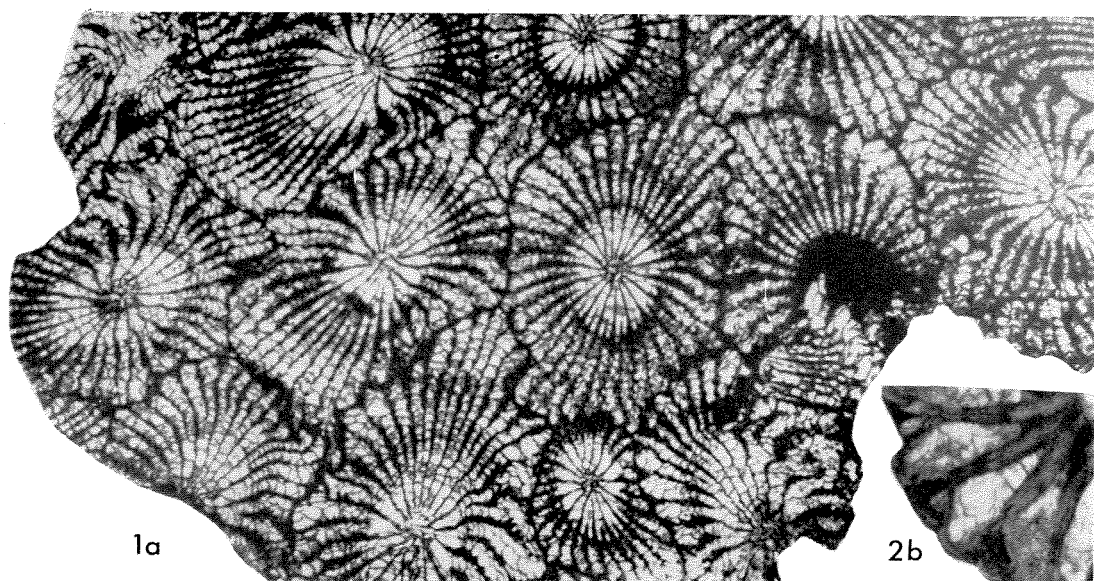


7b



8a





## Explanation of Plate 4

### **Syringaxon, Hexagonaria, Haplothecia**

Fig. 1. *Hexagonaria hexagona* (Goldfuss).

1. GMB0 207c, Geologisch- Paläontologisches Institut Bonn. NEOTYPE (selected Pickett 1967, p. 58), *a*, T.S., *b*, L.S., X2; Bensberg, near Cologne, Germany; probably lower Frasnian Refrath Schichten near Bensberg.

Fig. 2. *Syringaxon siluriense* (McCoy).

2. S.M. A5468, Sedgwick Museum, Cambridge, England, HOLOTYPE, *a*, T.S. X6, *b*, L.S. X12; Underbarrow, Kendal, Westmorland, England, Bannisdale Slates; Upper Ludlow.

Fig. 3. *Haplothecia filata* (Schlotheim).

3. Q. Kat. A138, P.1530, Institut für Paläontologie und Museum der Humboldt-Universität, Berlin, LECTOTYPE, *a*, T.S., *b*, L.S., X4; Winterberg, near Grund, Germany, Iberger, Kalk, Frasnian.

Explanation of Plate 5

**Haplothecia, Phacellophyllum**

All figures X2 unless otherwise specified; geographic data of localities are given in Appendix 1.

Fig. 1. *Haplothecia? laciniosa* sp. nov.

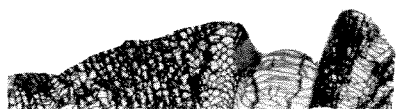
1. BMR CPC.9548, HOLOTYPE, *a*, T.S., *b*, L.S.; K348, 2.75 miles at 353° from Mount Krauss, Kimberleys, Western Australia; Sadler Formation; Frasnian.

Figs. 2, 3. *Phacellophyllum* sp. *B*.

2. BMR CPC.9549, *a*, T.S., *b*, L.S., K348, Sadler Limestone; Frasnian.
3. BMR CPC.9550, *a*, T.S., *b*, L.S., K348, Sadler Limestone; Frasnian.

Fig. 4. *Phacellophyllum kimberleyense* sp. nov.

4. BMR CPC.9551, HOLOTYPE, *a*, T.S., *b*, T.S. X4, *c*, L.S., *d*, L.S. X4; K531, 14.5 miles at 113° from Prairie Hill, Kimberleys, Western Australia; Napier Formation; Upper Devonian.



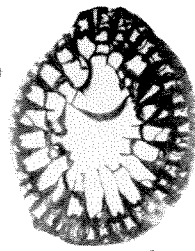
1b



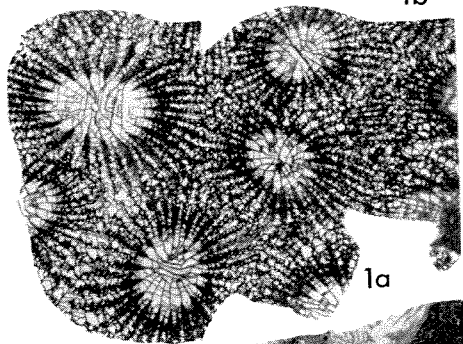
2a



3b



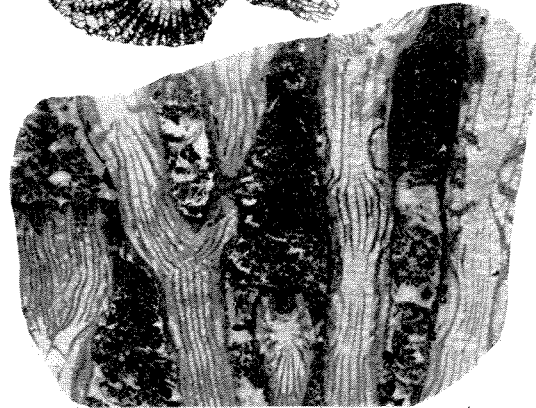
3a



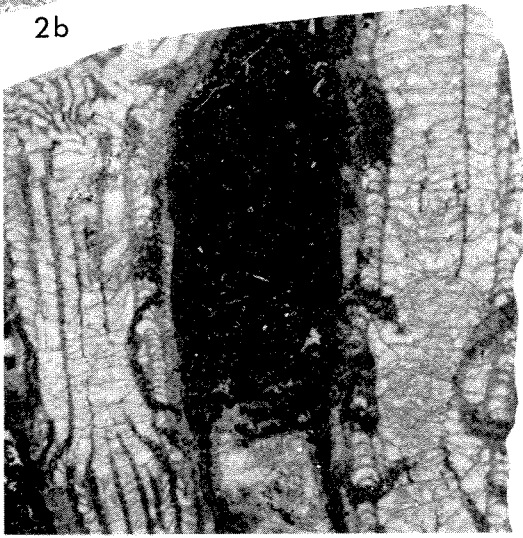
1a



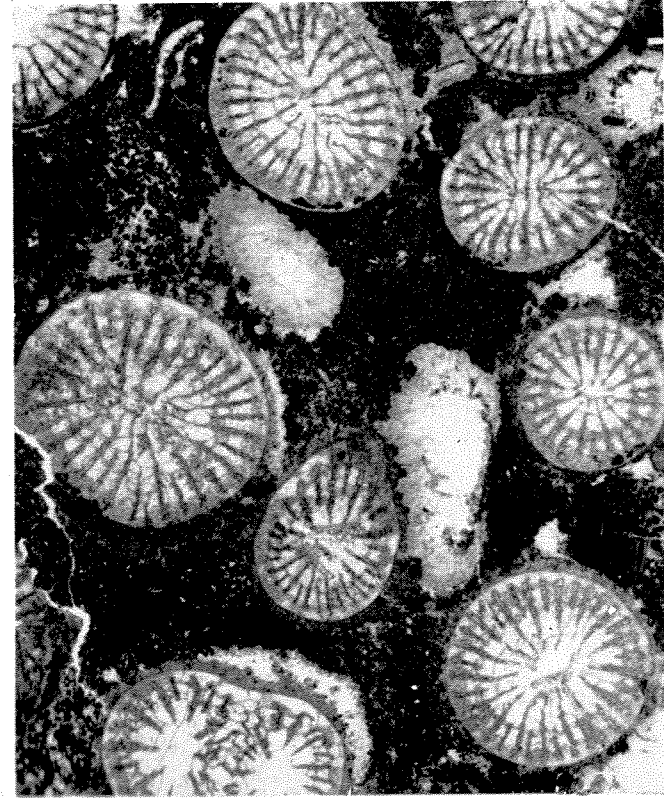
2b



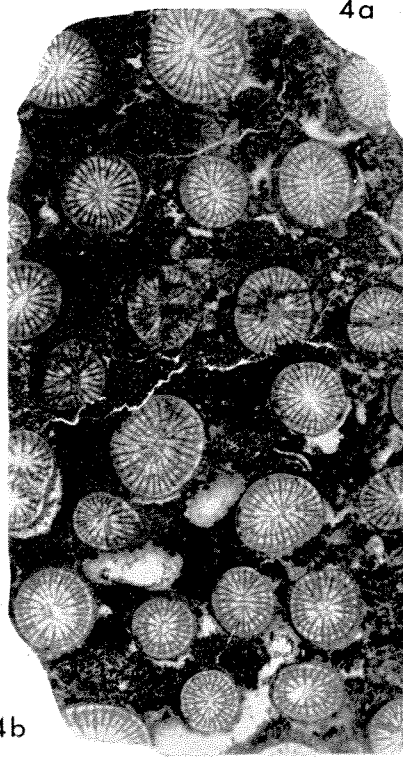
4c



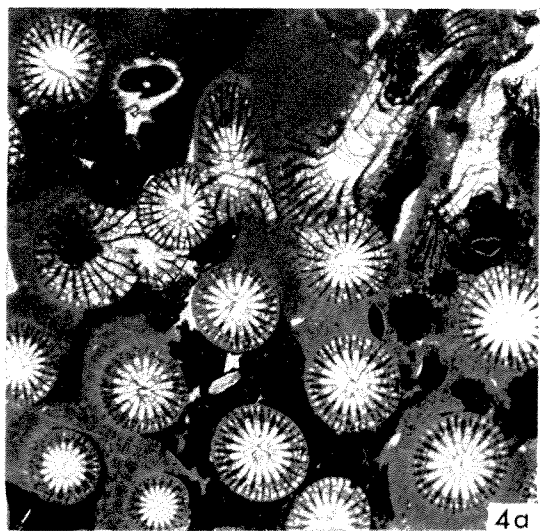
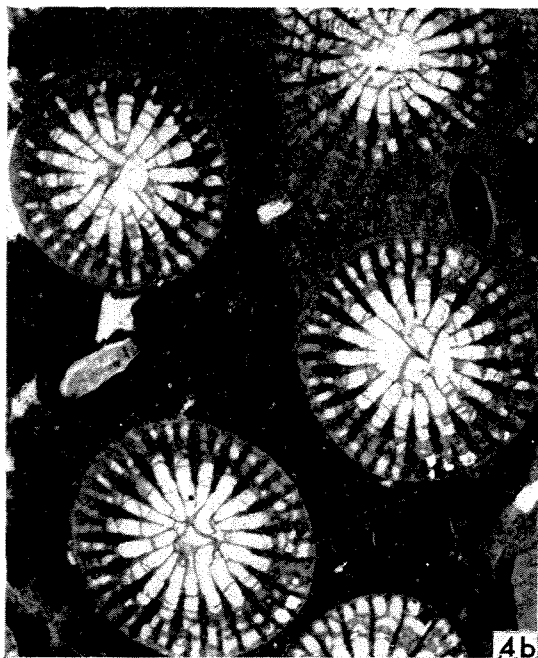
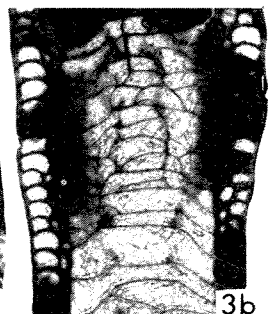
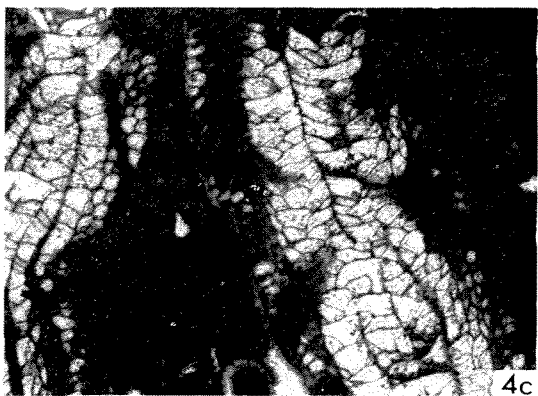
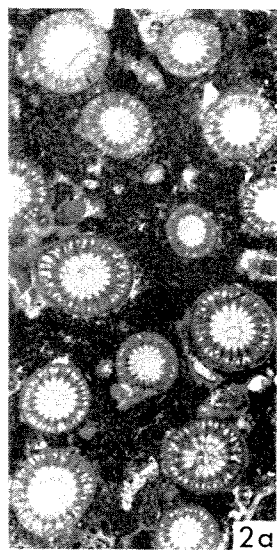
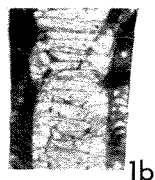
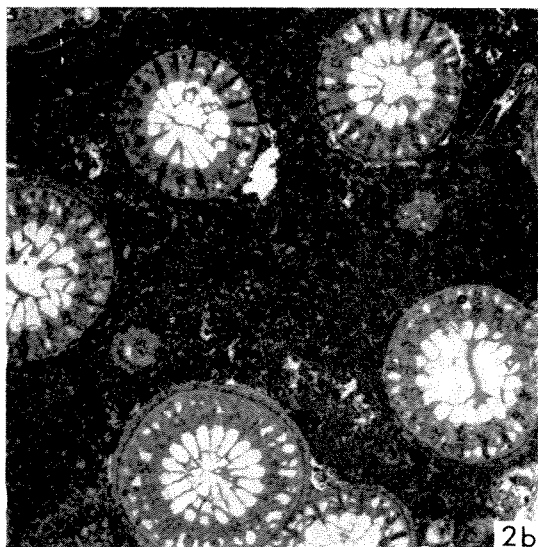
4d



4b



4a



## Explanation of Plate 6

### **Peneckiella**

Geographic data of localities are given in Appendix 1.

Fig. 1. *Peneckiella* sp. *A*.

1. UWA 26354, *a*, T.S., *b*, L.S., X2; U12, Sadler Limestone; Frasnian.

Figs. 2-4. *Peneckiella teichertii* Hill.

2. BMR CPC.9552, *a*, T.S. X2, *b*, T.S. X4, *c*, L.S. X2; K147, Sadler Limestone; Frasnian.
3. GSWA F5990, *a*, T.S., *b*, L.S., X4; G3377, Pillara Limestone; early Frasnian.
4. BMR CPC.9553, *a*, T.S. X2, *b*, T.S. X4, *c*, L.S. X4; K188, Sadler Limestone, Frasnian.

## Explanation of Plate 7

### **Disphyllum**

All figures X2; geographic data of localities are given in Appendix 1.

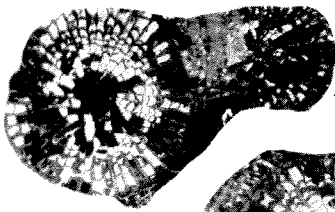
Figs. 1-10. *Disphyllum caespitosum* (Goldfuss).

1. GSWA F7843, *a*, T.S., *b*, L.S.; G1082, Sadler Limestone; Frasnian.
2. BMR CPC.9554, *a*, T.S., *b*, L.S.; K301; Sadler Limestone; Frasnian.
3. GSWA F5264, X1; G1082, Sadler Limestone; Frasnian.
4. GSWA F7844, *a*, T.S., *b*, L.S.; G1082, Sadler Limestone; Frasnian.
5. GSWA F5922/1, *a*, T.S., *b*, L.S.; G1082, Sadler Limestone; Frasnian.
6. GSWA F7845, L.S.; G1002, Pillara Limestone; early Frasnian.
7. GSWA F7846, *a*, T.S., *b*, L.S.; G1002, Pillara Limestone; early Frasnian.
8. GSWA F5931/1, L.S., G3366, Pillara Limestone; late Givetian.
9. GSWA F7847, T.S.; G3300, Pillara Limestone; early Frasnian or late Givetian.
10. BMR CPC.9555, T.S.; K313, Pillara Limestone; late Givetian to Frasnian.

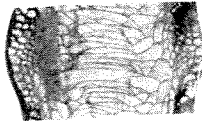
Fig. 11. *Disphyllum curtum* Hill.

11. GSWA F7848, *a*, T.S., *b*, L.S.; G1009, Pillara Limestone; late Givetian to early Frasnian.

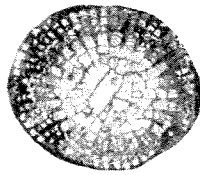




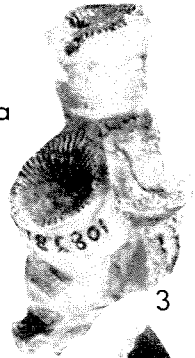
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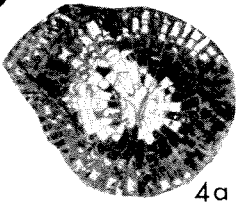
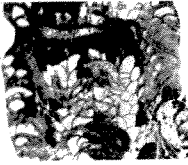
2b



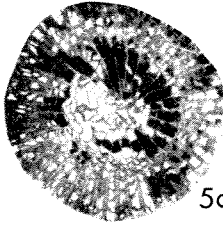
2a



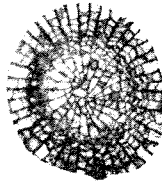
3



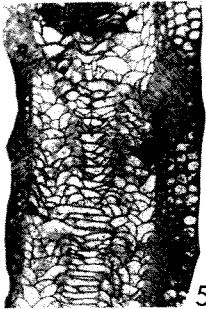
4a



5a



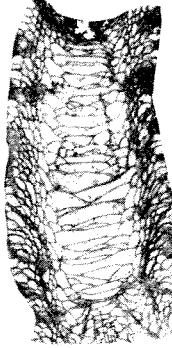
7a



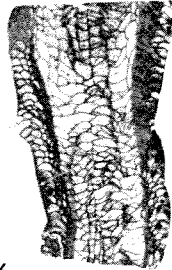
5b



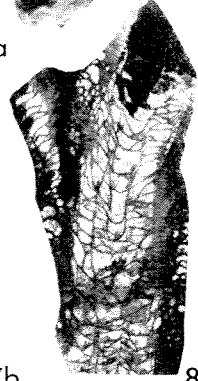
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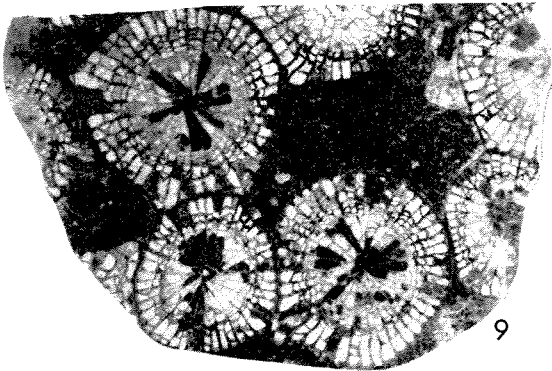
6



7b



8

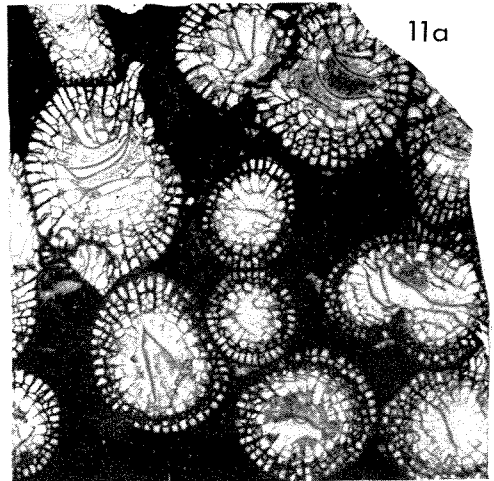
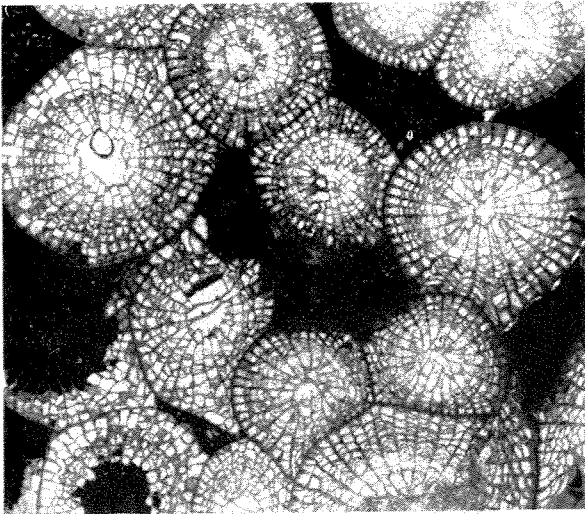


9



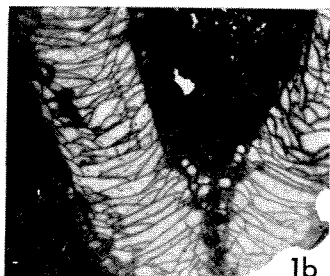
11b

10

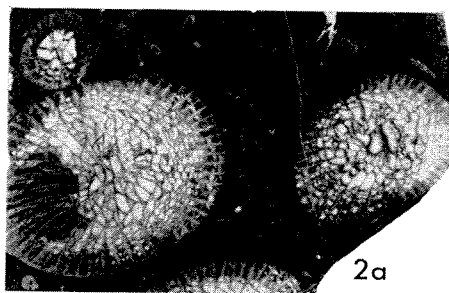


11a

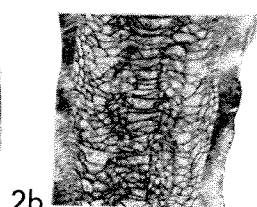




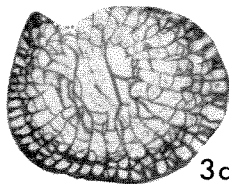
1b



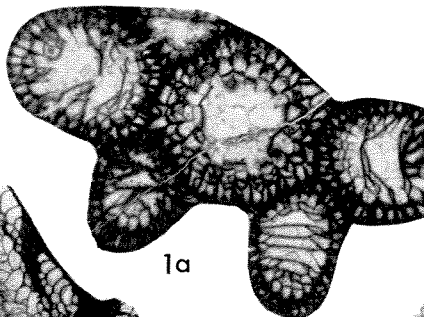
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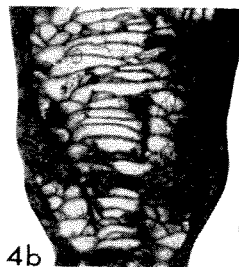
2b



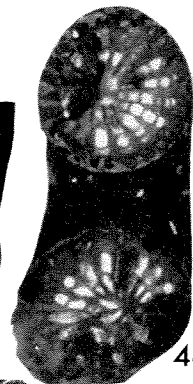
3a



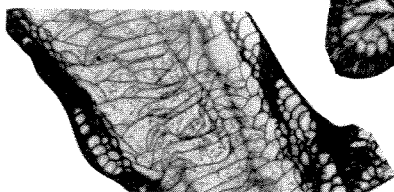
1a



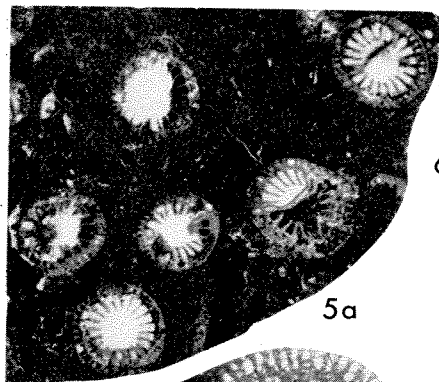
4b



4a



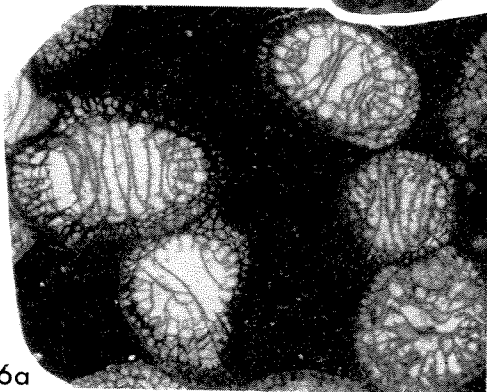
3b



5a



6b



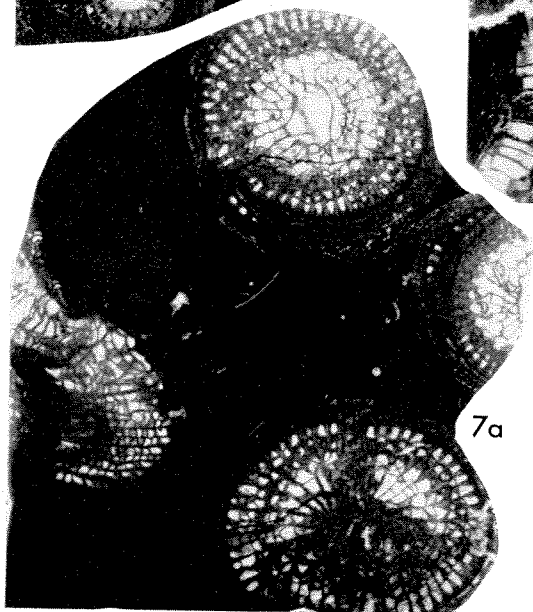
6a



5b



7c



7a



7b

## Explanation of Plate 8

### **Disphyllum**

All figures X2 unless otherwise specified; geographic data of localities are given in Appendix 1.

Fig. 1. *Disphyllum* sp. aff. *D. curtum* Hill.

1. UWA 26647, *a*, T.S., *b*, L.S.; U21, Pillara Limestone, Upper Devonian.

Fig. 2. *Disphyllum caespitosum?* (Goldfuss).

2. GSWA F5925/1, *a*, T.S., *b*, L.S.; G3239, Pillara Limestone; late Givetian to early Frasnian.

Fig. 3. *Disphyllum curtum* Hill.

3. BMR CPC.9559, *a*, T.S., *b*, L.S.; K246, Sadler Limestone; Frasnian.

Fig. 4. *Disphyllum intertextum* Hill.

4. UWA 26382, *a*, T.S., *b*, L.S., X4; U28, Sadler Limestone; Frasnian.

Fig. 5. *Disphyllum* sp. *B*.

5. UWA 26382/1, *a*, T.S., *b*, L.S.; U28, Sadler Limestone; Frasnian.

Fig. 6. *Disphyllum* sp. *A*.

6. BMR CPC.9561, *a*, T.S., *b*, L.S.; K511, Pillara Limestone; Upper Devonian.

Fig. 7. *Disphyllum depressum* (Hinde).

7. GSWA 10039, HOLOTYPE, *a*, T.S., *b*, T.S., *c*, L.S.; probably opposite Mt. Krauss, Kimberleys, Western Australia (see Hill, 1936a, p. 28); Upper Devonian.

## Explanation of Plate 9

### **Disphyllum, Argutastrea**

All figures X2 unless otherwise specified; geographic data of localities are given in Appendix 1.

Figs. 1-5. *Disphyllum virgatum* (Hinde).

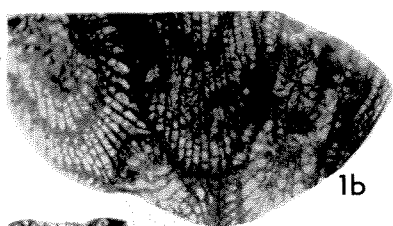
1. BMR CPC.9562, *a*, T.S., *b*, L.S.; K267, Sadler Limestone; Frasnian.
2. GSWA 1004, HOLOTYPE, *a*, T.S., *b*, L.S., *c*, L.S.; opposite Mt. Krauss, Kimberleys, Western Australia; ?Frasnian.
3. BMR CPC.9563, *a*, T.S., *b*, L.S.; K112, Sadler Limestone; Frasnian.
4. BMR CPC.9564, *a*, T.S., *b*, L.S., *c*, L.S. X4; K480, Pillara Limestone; Frasnian.
5. BMR CPC.9565, *a*, T.S., *b*, L.S.; K480, Pillara Limestone; Frasnian.

Figs. 6, 7. *Disphyllum virgatum?* (Hinde).

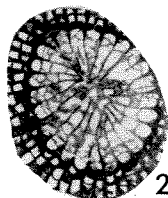
6. BMR CPC.9568, *a*, T.S., *b*, L.S.; K344, Sadler Limestone; ?Frasnian.
7. GSWA F5269, *a*, T.S., *b*, L.S.; G1085, Pillara Limestone; early Frasnian.

Fig. 8. *Argutastrea hullensis?* (Hill).

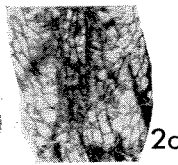
8. GSWA F5269/5, *a*, T.S., *b*, L.S.; G1085, Pillara Limestone; early Frasnian



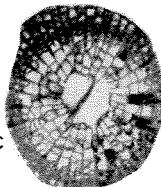
1b



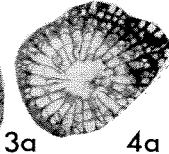
2a



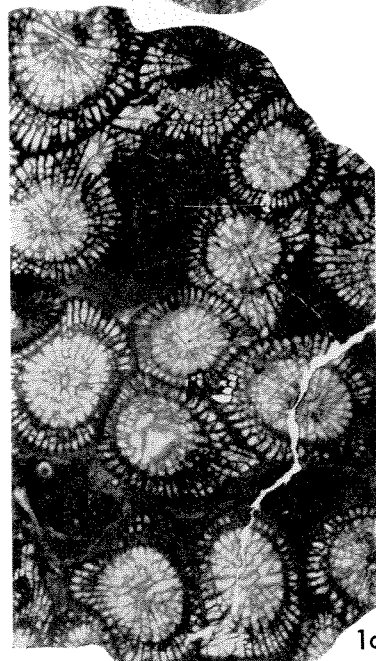
2c



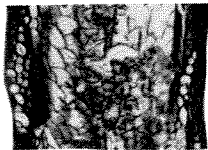
3a



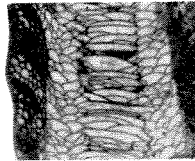
4a



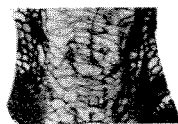
1a



2b



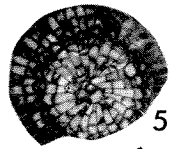
3b



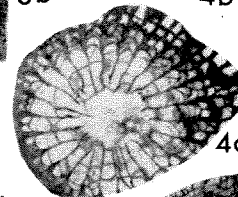
4b



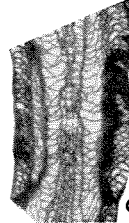
6a



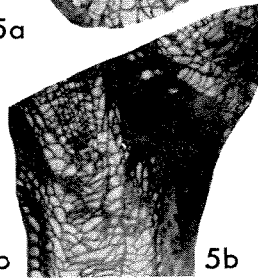
5a



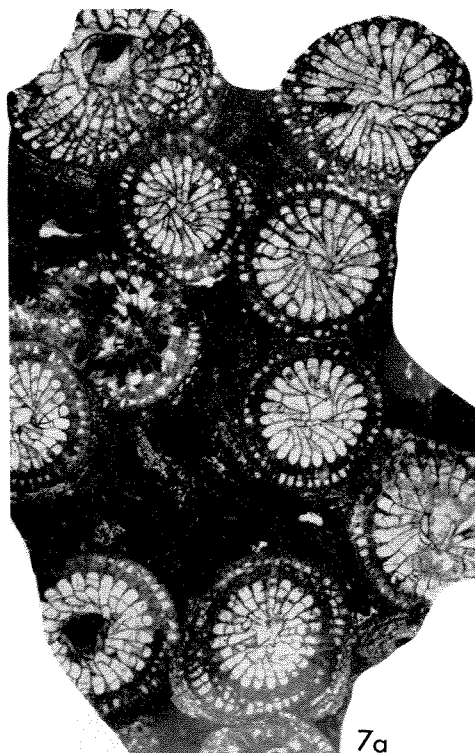
4c



6b



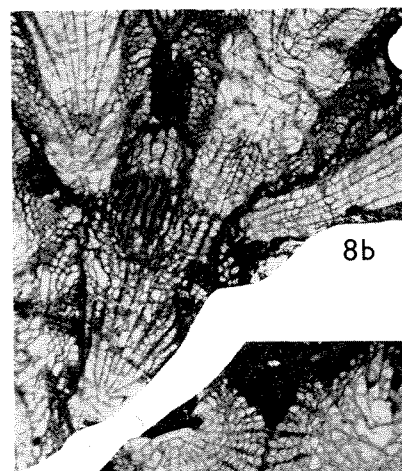
5b



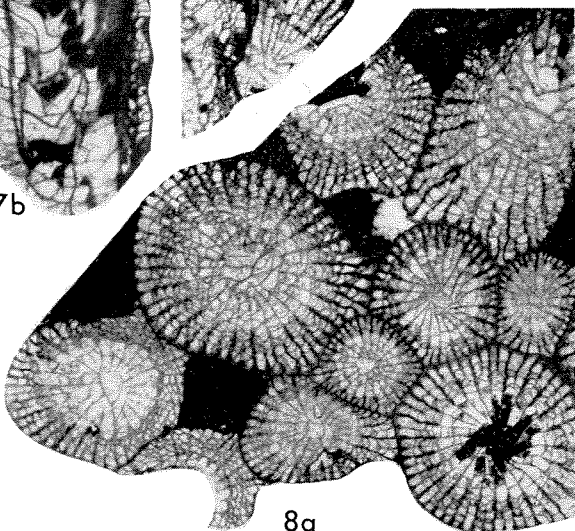
7a



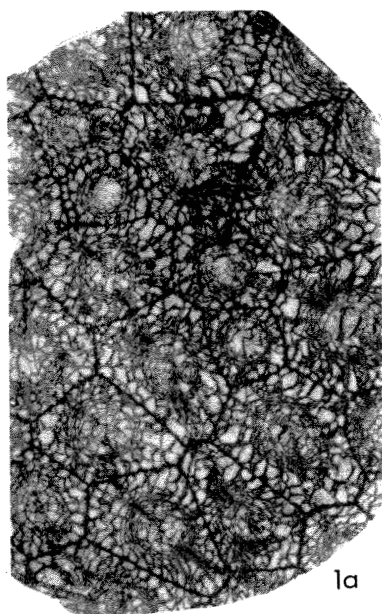
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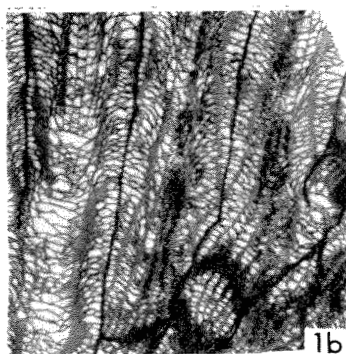
8b



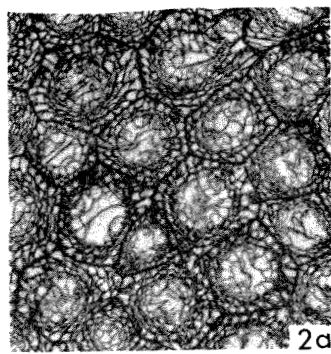
8a



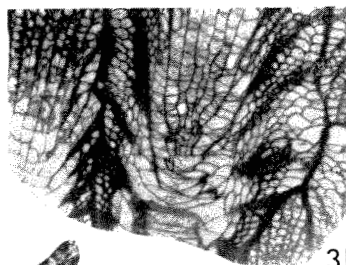
1a



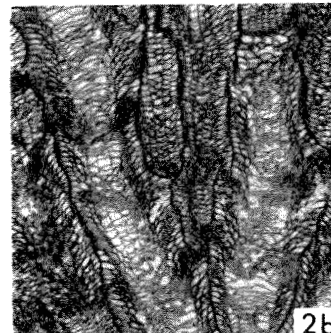
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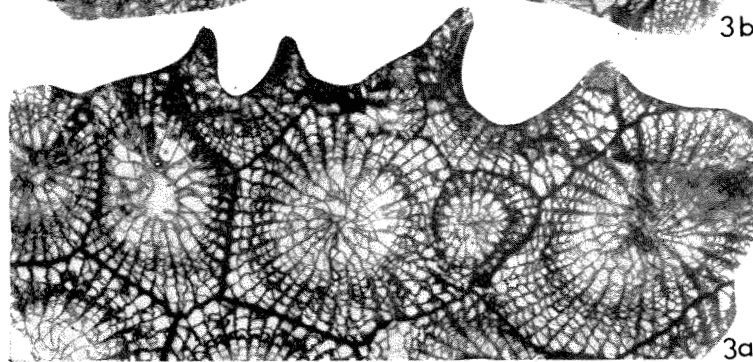
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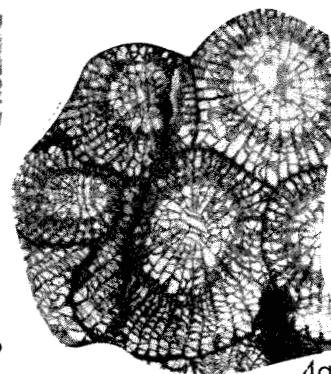
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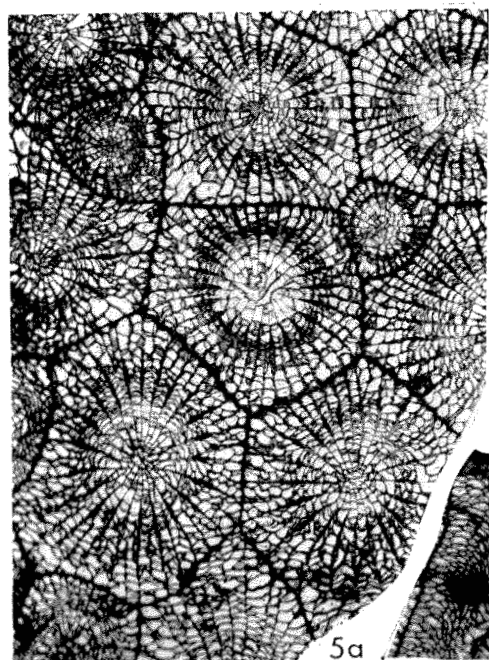
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3a



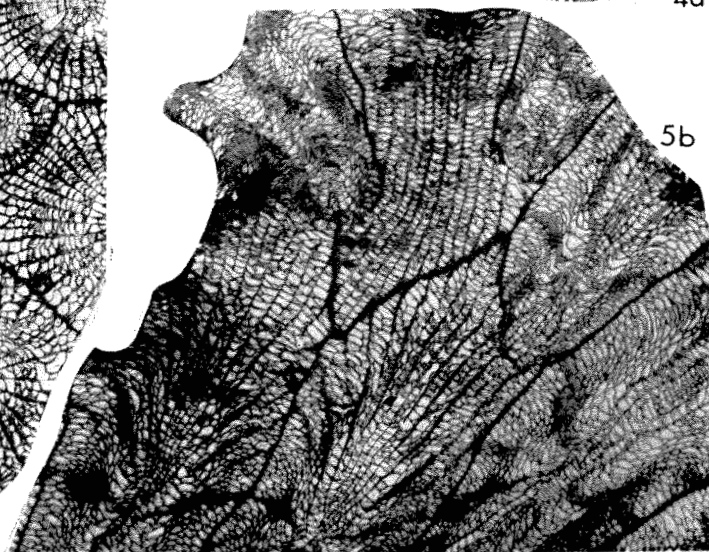
4a



5a



4b



5b

## Explanation of Plate 10

### **Hexagonaria, Donia**

All figures X2; geographic data of localities are given in Appendix 1.

Figs. 1, 2. *Donia brevilamellata* (Hill).

1. BMR CPC.9569, *a*, T.S., *b*, L.S.; K404, Pillara Limestone; late Givetian.
2. GSWA F5950, *a*, T.S., *b*, L.S.; G33678, Pillara Limestone; late Givetian.

Figs. 3-5. *Hexagonaria playfordi* sp. nov.

3. BMR CPC.9570, *a*, T.S., *b*, L.S.; K218, Sadler Limestone; Frasnian.
4. GSWA F5922/2-3, *a*, T.S., *b*, L.S.; G1082, Sadler Limestone; Frasnian.
5. GSWA F5922/1, HOLOTYPE, *a*, T.S., *b*, L.S.; G1082, southeast end of Hull Range, Kimberleys, Western Australia, Sadler Limestone; Frasnian.

## Explanation of Plate 11

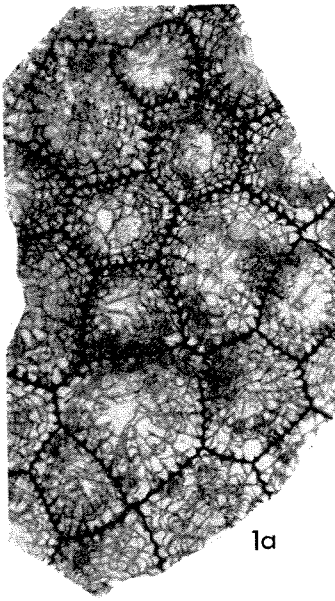
### **Donia**

All figures X2; geographic data of localities are given in Appendix 1.

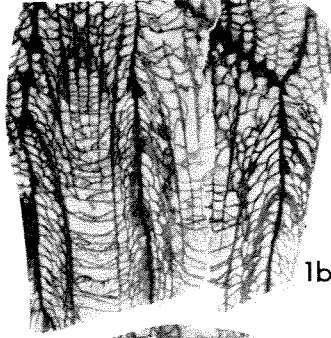
Figs. 1-5. *Donia brevilamellata* (Hill).

1. UWA 2515, HOLOTYPE, *a*, T.S., *b*, L.S.; Price's Creek, Emanuel ("Rough") Range, Kimberleys, Western Australia, Pillara Limestone; late Givetian to Frasnian.
2. GSWA F5952/, *a*, T.S., *b*, L.S.; G3359B, Pillara Limestone; late Givetian to early Frasnian.
3. BMR CPC. 9571, *a*, T.S., *b*, L.S.; K208, Pillara Limestone; Givetian to early Frasnian.
4. GSWA F5956/C<sub>3</sub>, *a*, T.S., *b*, L.S.; G3366, Pillara Limestone; late Givetian.
5. BMR CPC.9572, thin sect.; K404, Pillara Limestone; late Givetian.

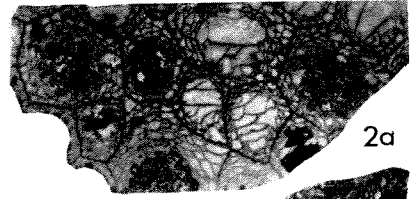




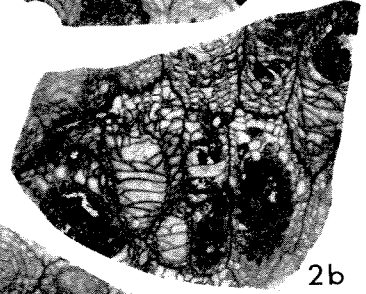
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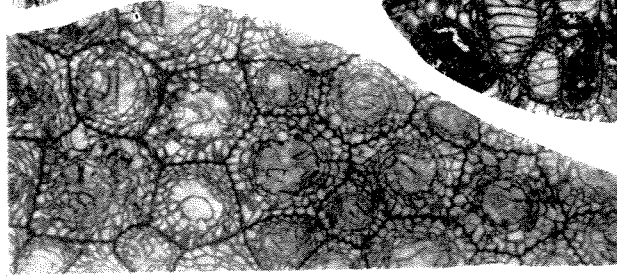
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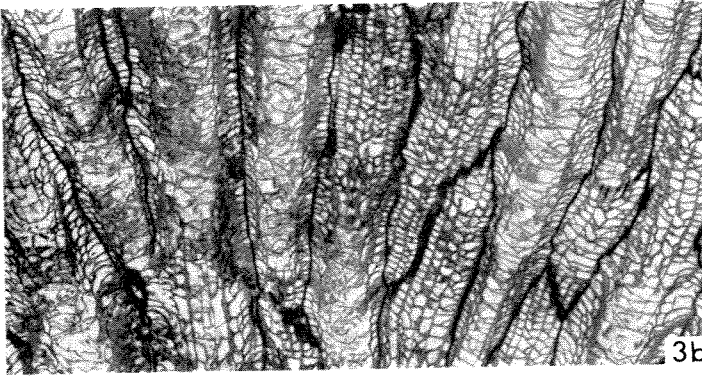
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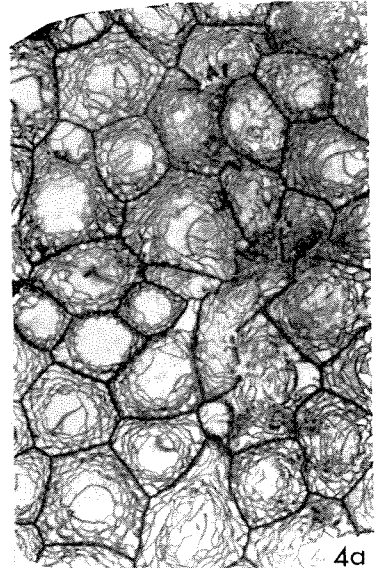
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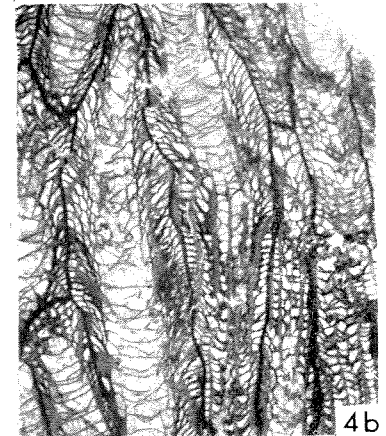
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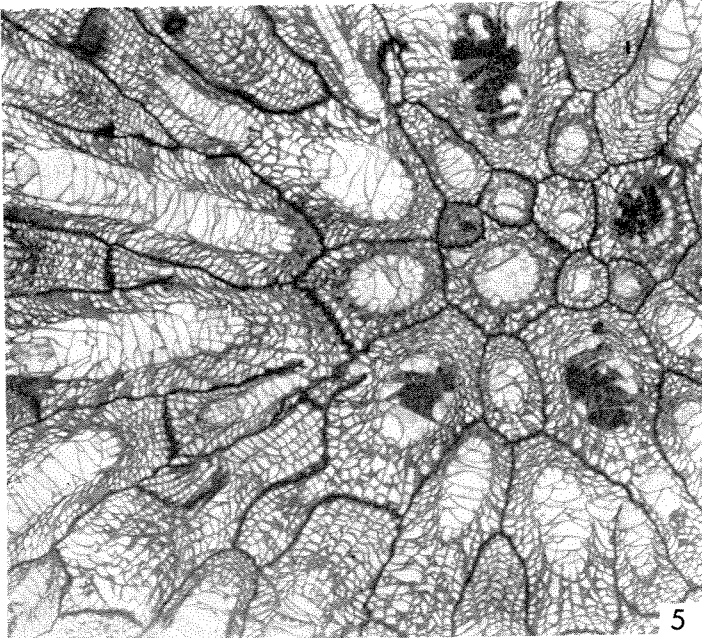
3b



4a

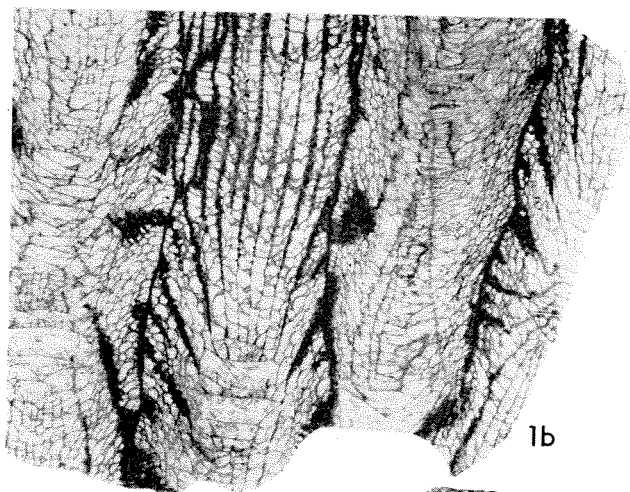


4b

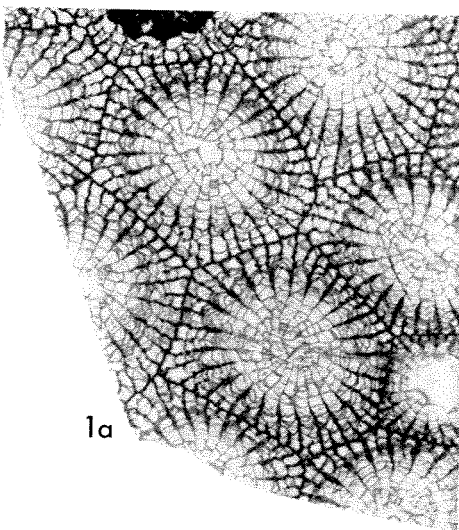


5

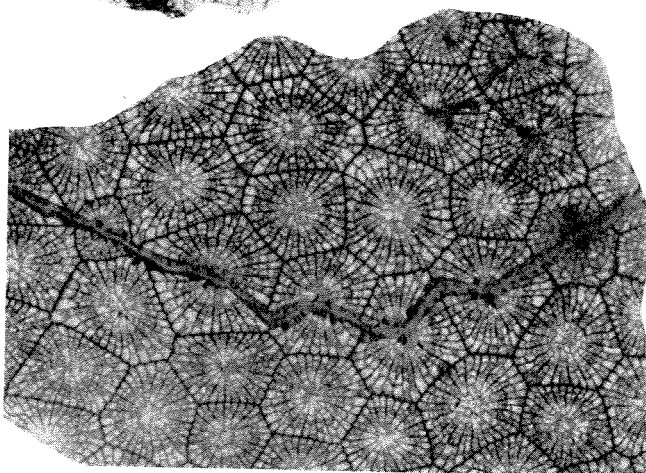




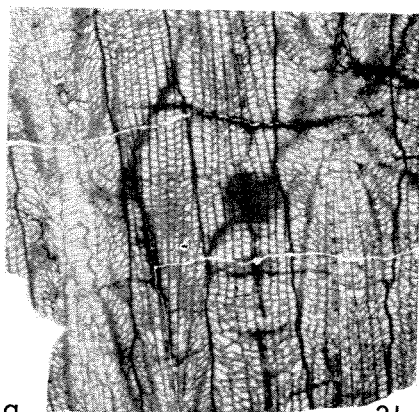
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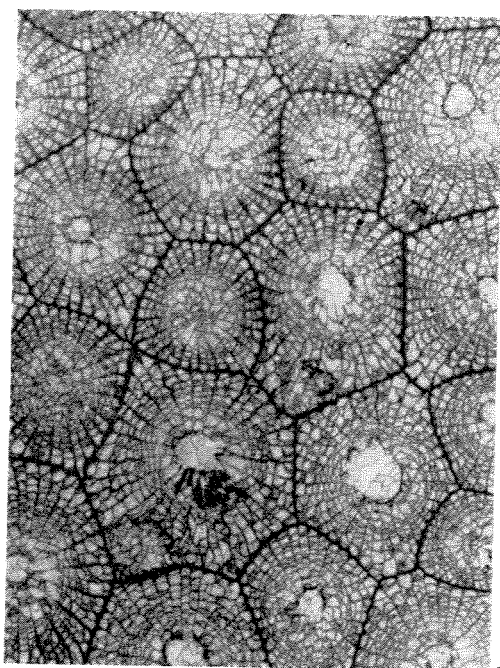
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2a



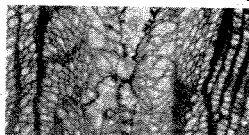
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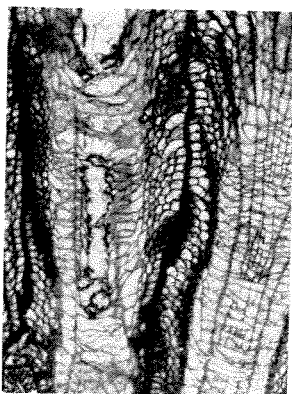
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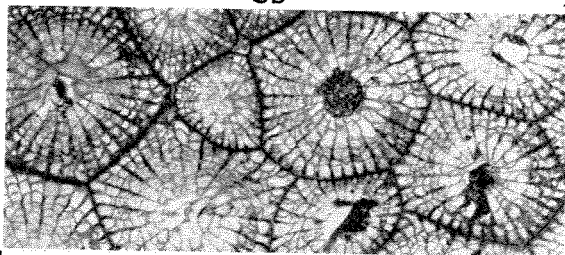
4b



3b



4c



4a

## Explanation of Plate 12

### **Argutastrea**

All figures X2; geographic data of localities are given in Appendix 1.

Fig. 1. *Argutastrea arguta* Crickmay.

1. No. 27036, Holotype, Paleontological Research Institution, Ithaca, New York, *a*, T.S., *b*, L.S.; west end of Carcajou Ridge, Northwest Territories, Canada, 65°36'N. lat., 128°15'W. long., lower beds of the Ramparts Formation; Middle Devonian.

Figs. 2-4. *Argutastrea hullensis* (Hill).

2. GSWA F5919/1, *a*, T.S., *b*, L.S.; G1005, Pillara Limestone; early Frasnian.
3. GSWA F5917/2, *a*, T.S., *b*, L.S.; G1002, Pillara Limestone; early Frasnian.
4. GSWA F5269/1, *a*, T.S., *b*, L.S., *c*, L.S.; G1085, Pillara Limestone; early Frasnian.

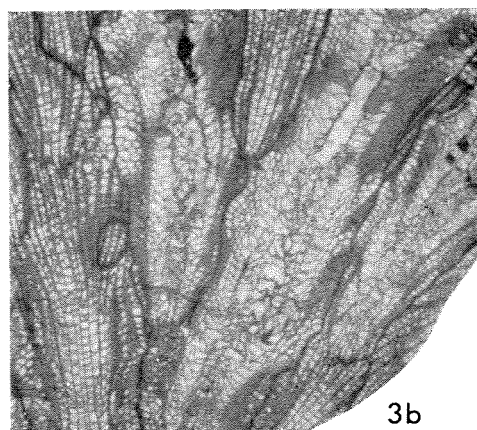
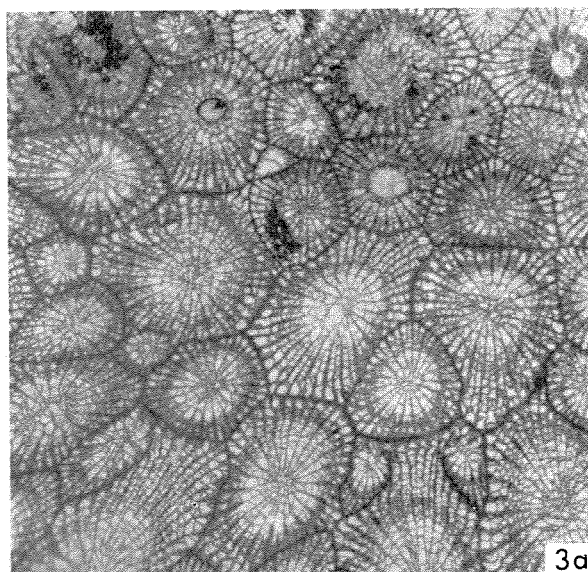
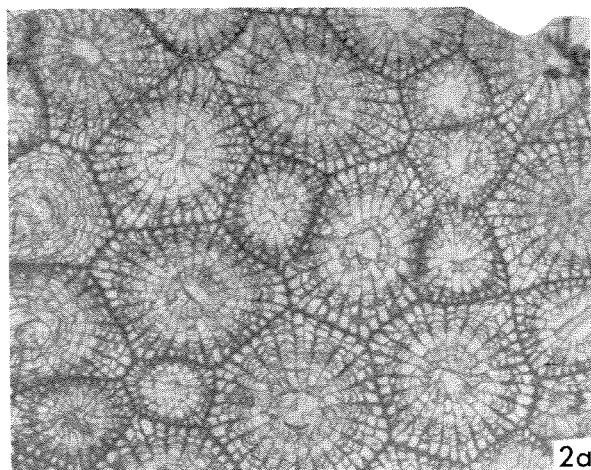
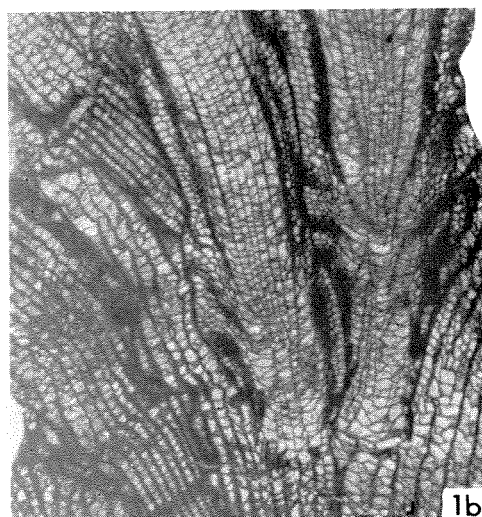
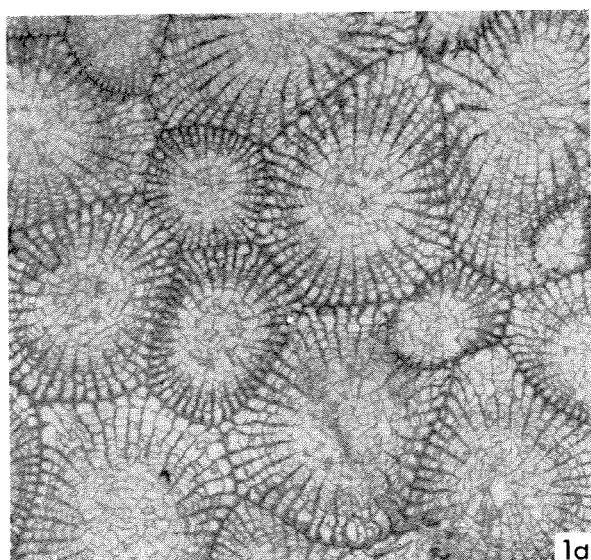
## Explanation of Plate 13

### **Argutastrea**

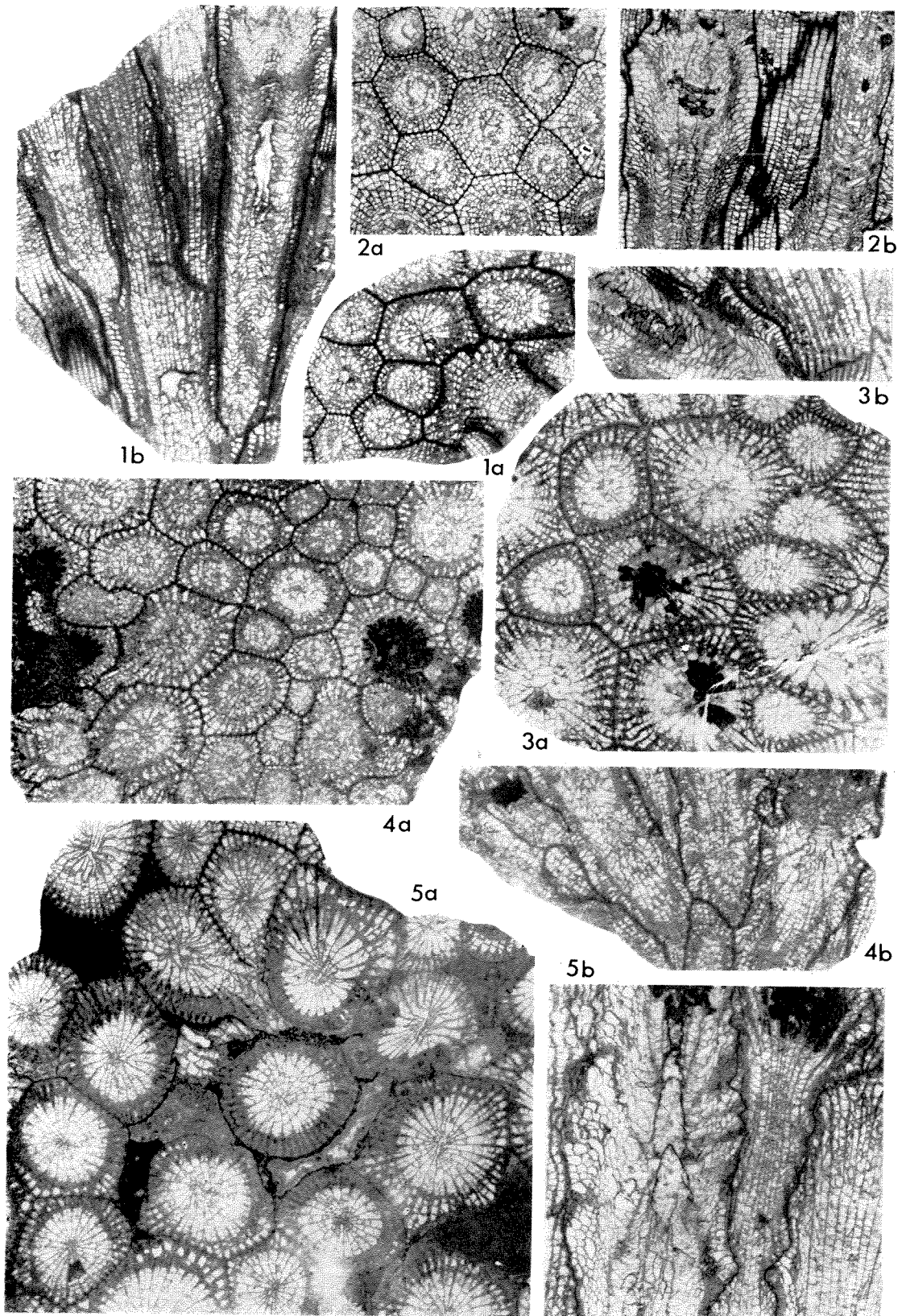
All figures X2; geographic data of localities are given in Appendix 1.

Figs. 1-3. *Argutastrea hullensis* (Hill).

1. BMR CPC.9573, *a*, T.S., *b*, L.S.; K439, Pillara Limestone; early Frasnian.
2. BMR CPC.9574, *a*, T.S., *b*, L.S.; K450, Pillara Limestone; late Givetian to early Frasnian.
3. BMR CPC.9575, *a*, T.S., *b*, L.S.; K463, Pillara Limestone; early Frasnian.







## Explanation of Plate 14

### **Argutastrea**

All figures X2; geographic data are given in Appendix 1.

Figs. 1-5. *Argutastrea hullensis* (Hill).

1. BMR CPC.501, HOLOTYPE, *a*, T.S., *b*, L.S.; Hull Range, 2 miles south of Shady Creek Gap, Kimberleys, Western Australia, between 850 and 870 feet above base of Pillara Limestone; late Givetian to Frasnian.
2. GSWA F5930, *a*, T.S., *b*, L.S.; G3323, Pillara Limestone; Frasnian.
3. BMR CPC.9576, *a*, T.S., *b*, L.S.; K266, Sadler Limestone; Frasnian.
4. BMR CPC.9577, *a*, T.S., *b*, L.S.; K268, Sadler Limestone; Frasnian.
5. BMR CPC.9578, *a*, T.S., *b*, L.S.; K264, Sadler Limestone; Frasnian.

## Explanation of Plate 15

### **Temnophyllum**

All figures X2 unless otherwise specified; geographic data of localities are given in Appendix 1.

Figs. 1-9. *Temnophyllum occidentale* sp. nov.

1. GSWA F5931/2, *a*, T.S., *b*, L.S.; G3366, Pillara Limestone; late Givetian.
2. GSWA F5931, T.S.; G3366, Pillara Limestone; late Givetian.
3. GSWA F5931/16, T.S.; G3366, Pillara Limestone; late Givetian.
4. GSWA F5931/19, T.S.; G3366, Pillara Limestone; late Givetian.
5. GSWA F5931/22, T.S.; G3366, Pillara Limestone; late Givetian.
6. GSWA F5931/18, T.S.; G3366, Pillara Limestone; late Givetian.
7. GSWA F5931/7, HOLOTYPE, *a*, XI, *b*, T.S., *c*, L.S.; G3366, southern end of Home Range, Kimberleys, Western Australia; Pillara Limestone; late Givetian.
8. GSWA F5931/24, *a*, T.S., *b*, L.S.; G3366, Pillara Limestone; late Givetian.
9. GSWA F5931/8 *a*, T.S., *b*, L.S.; G3366, Pillara Limestone; late Givetian.

Figs. 10-12. *Temnophyllum* sp.

10. GSWA F5936/5, *a*, T.S., *b*, L.S.; G1003, Pillara Limestone; early Frasnian.
11. BMR CPC.9579, *a*, T.S., *b*, L.S.; K248, Sadler Limestone; Frasnian.
12. BMR CPC.9580, *a*, T.S., *b*, L.S.; K245, Sadler Limestone; Frasnian.

Figs. 13-16. *Temnophyllum menyouse* sp. nov.

13. GSWA F5933/4, HOLOTYPE, *a*, T.S., *b*, L.S.; G1008, Home Range 4.5 miles southeast of southern entrance to Menyouse's Gap, Kimberleys, Western Australia, Pillara Limestone; late Givetian (or early Frasnian).
14. GSWA F5933/2, *a*, T.S., *b*, L.S.; G1008, Pillara Limestone; late Givetian (or early Frasnian).
15. BMR CPC.9581, *a*, T.S., *b*, L.S.; K353, Sadler Limestone; Upper Devonian.
16. BMR CPC.9582, *a*, T.S., *b*, L.S.; K353, Sadler Limestone; Upper Devonian.

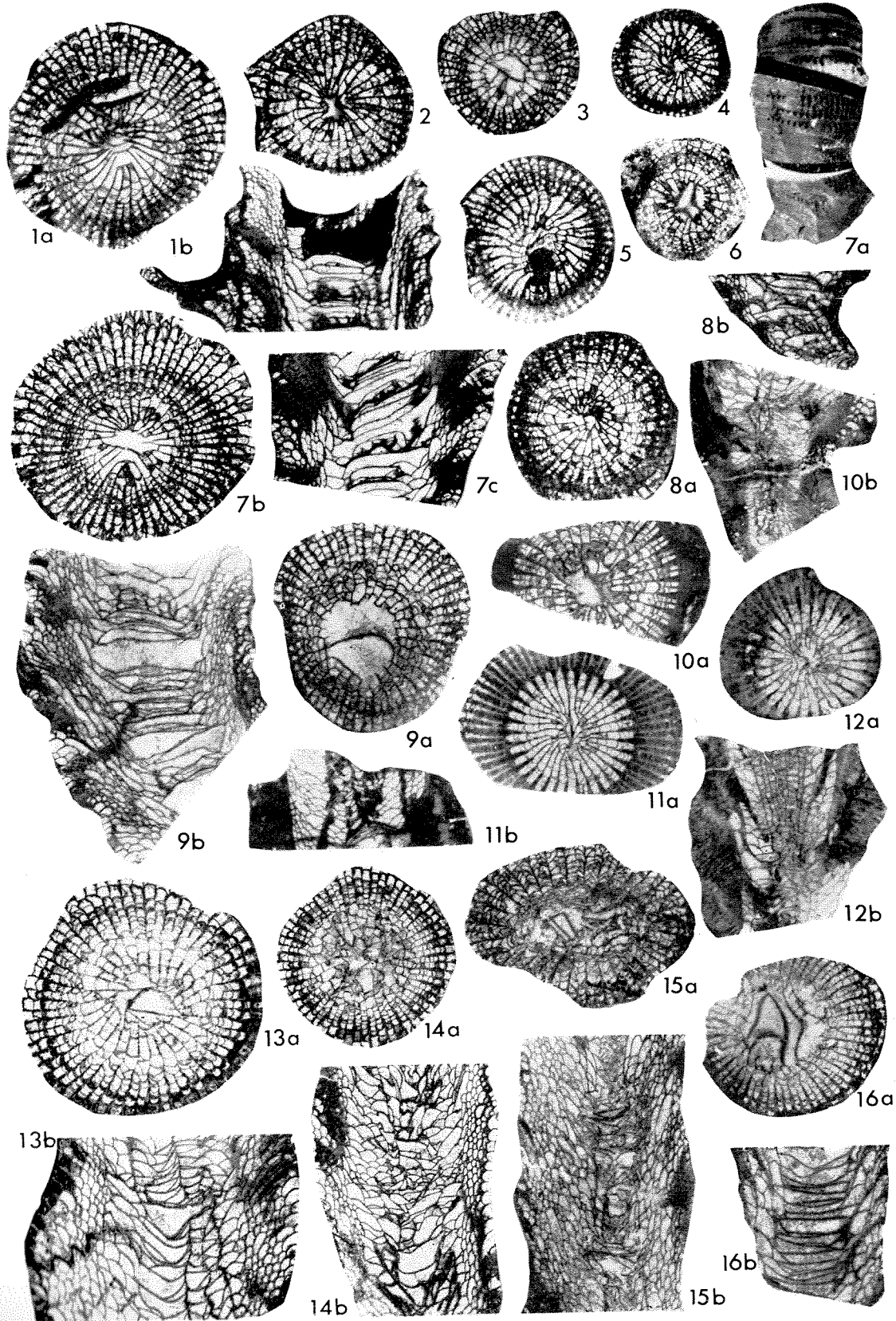
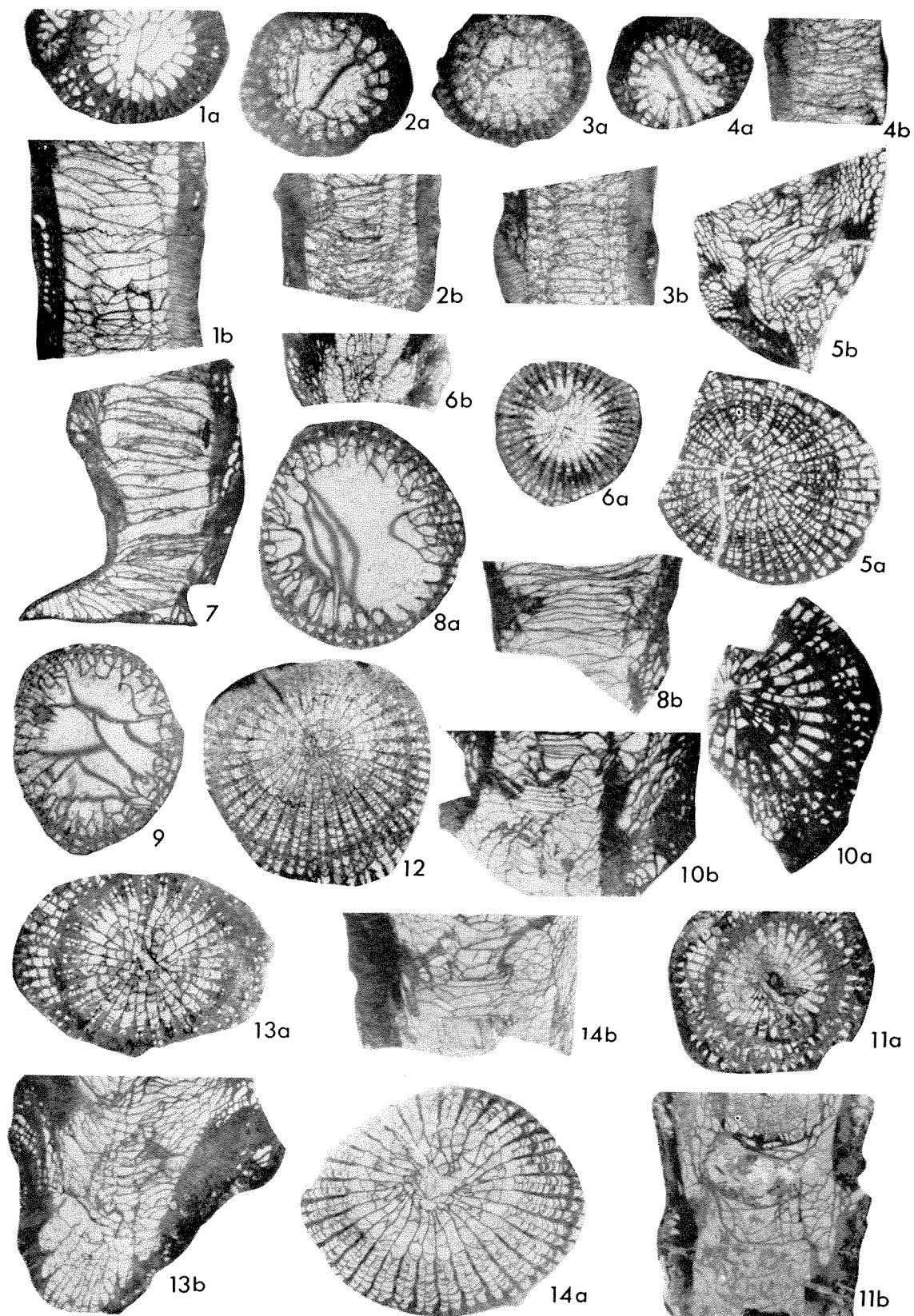




PLATE 16



## Explanation of Plate 16

### **Temnophyllum**

All figures X2 unless otherwise specified; geographic data of localities are given in Appendix 1.

Figs. 1-4. *Temnophyllum incomptum* sp. nov.

1. BMR CPC.9583, HOLOTYPE, *a*, T.S., *b*, L.S.; K573, eastern entrance of old Wagon Track, Napier Downs, Kimberleys, Western Australia, 280 feet above base of Pillara Limestone; Upper Devonian.
2. BMR CPC.9584, *a*, T.S., *b*, L.S.; K573, Pillara Limestone; Upper Devonian.
3. BMR CPC.9585, *a*, T.S., *b*, L.S.; K573, Pillara Limestone; Upper Devonian.
4. BMR CPC.9586, *a*, T.S., *b*, L.S.; K573, Pillara Limestone; Upper Devonian.

Figs. 5-11. *Temnophyllum* spp. cf. *T. turbinatum* Hill.

5. BMR CPC.9589, *a*, T.S., *b*, L.S.; Mountain Home Range, Pillara Limestone; late Givetian to Frasnian.
6. BMR CPC.9590, *a*, T.S., *b*, L.S.; K245, Sadler Limestone; Frasnian.
7. BMR CPC.9591, L.S.; K276, Sadler Limestone; Frasnian.
8. BMR CPC.9592, *a*, T.S., *b*, L.S.; K353, Sadler Limestone; Upper Devonian.
9. BMR CPC.9593, T.S.; K353, Sadler Limestone; Upper Devonian.
10. UWA 26263/1j, *a*, T.S., *b*, L.S.; U19, Sadler Limestone; early Frasnian.
11. BMR CPC.9596, *a*, T.S., *b*, L.S.; K301, Sadler Limestone; early Frasnian.

Figs. 12-14. *Temnophyllum turbinatum* Hill.

12. GSWA F5936/4, T.S.; G1003 Pillara Limestone; early Frasnian.
13. BMR CPC.9594, *a*, T.S., *b*, L.S.; K266, Sadler Limestone; Frasnian.
14. BMR CPC.9595, *a*, T.S., *b*, L.S.; K266, Sadler Limestone; Frasnian.

Explanation of Plate 17

**Temnophyllum, Stringophyllum, Tabulophyllum**

All figures X2; geographic data of localities are given in Appendix 1.

Fig. 1. *Temnophyllum? floriforme?* Hill.

1. BMR CPC.9597, *a*, T.S., *b*, L.S.; K245, Sadler Limestone; Frasnian.

Figs. 2, 3. *Temnophyllum? floriforme* Hill.

2. BMR CPC.543, HOLOTYPE, *a*, T.S., *b*, L.S.; 1.5 miles south of Mt. Elma north of Margaret River, Kimberleys, Western Australia; Pillara Limestone; late Givetian to Upper Devonian.
3. UWA 26640, *a*, T.S., *b*, L.S.; U26, ?Pillara Limestone; Upper Devonian.

Fig. 4. *Stringophyllum* sp. *A*.

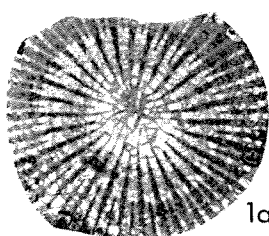
4. GSWA F7850, *a*, T.S., *b*, L.S.; G3366, Pillara Limestone; late Givetian.

Fig. 5. *Tabulophyllum? lowryi* sp. nov.

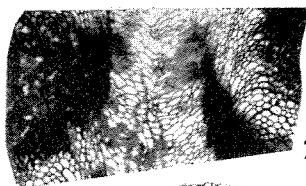
5. GSWA F5932, HOLOTYPE, *a*, T.S., *b*, L.S.; G1007, near Tunnel Creek, Kimberleys, Western Australia, Napier Formation; Upper Devonian.

Figs. 6, 7. *Tabulophyllum* sp.

6. Univ. Qd F38803, *a*, T.S., *b*, L.S.; Boussu, Belgium; Frasnian (F2j).
7. Univ. Qd F38873, *a*, T.S., *b*, L.S.; Boussu, Belgium; Frasnian (F2j).



1a



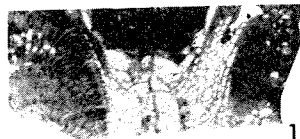
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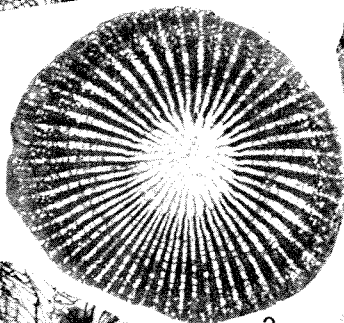
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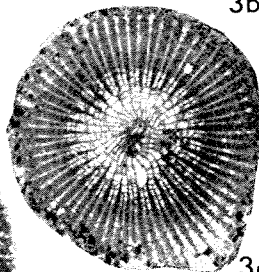
4a



1b



2a



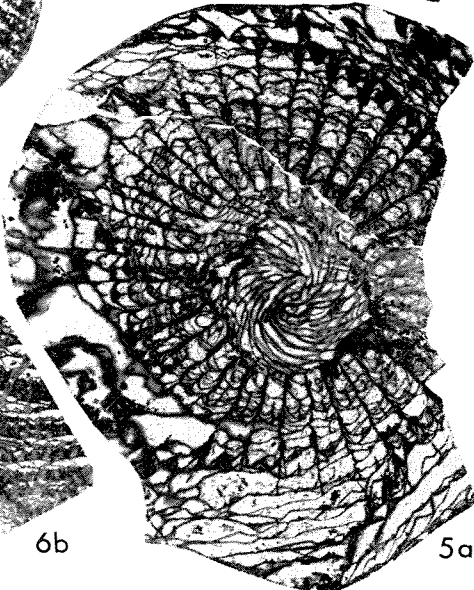
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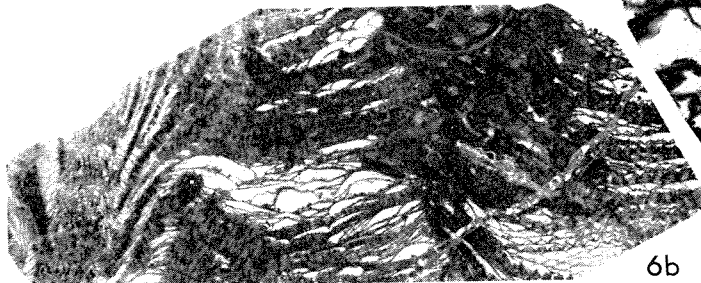
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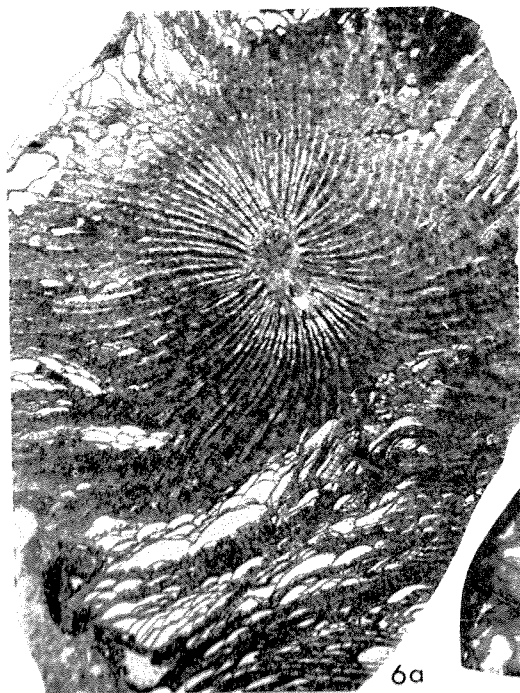
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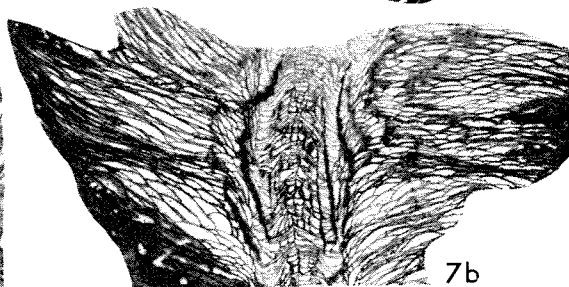
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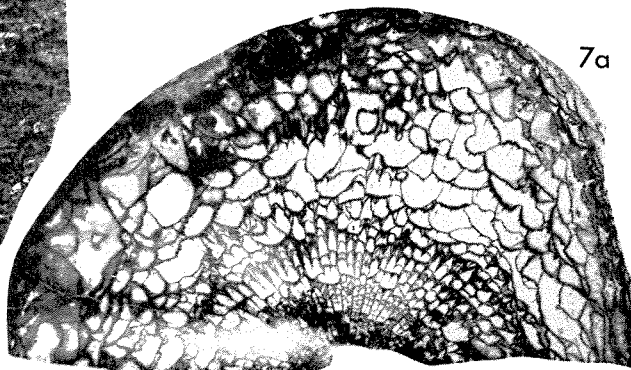
6b



6a

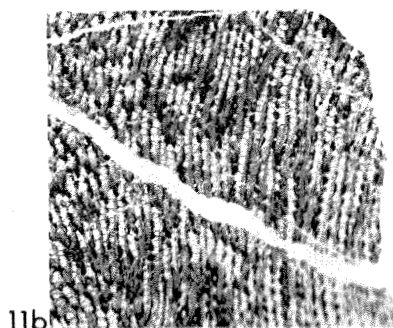
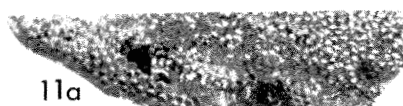
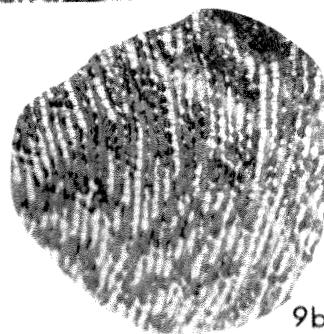
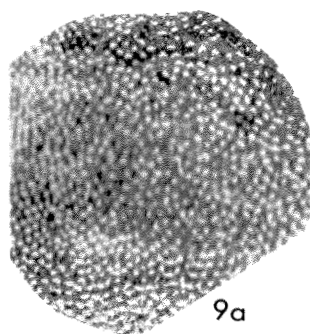
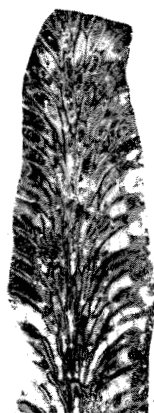
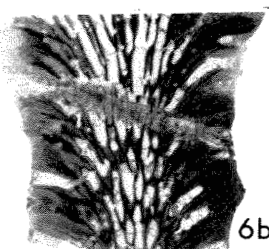
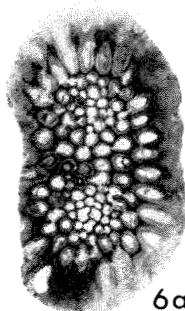
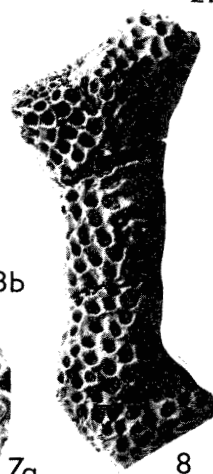
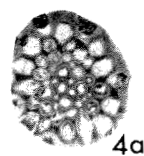
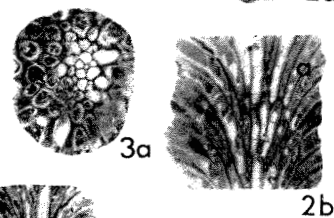
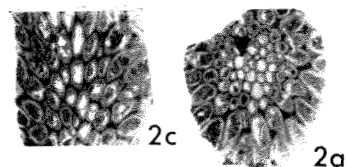
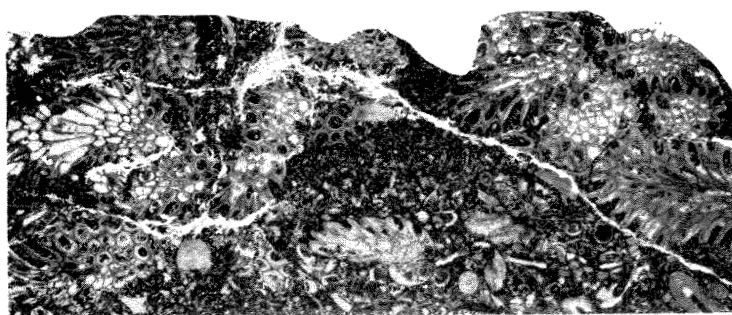


7b



7a

PLATE 18



## Explanation of Plate 18

### **Thamnopora, Alveolites**

All figures X2 unless otherwise specified; geographic data of localities are given in Appendix 1.

Figs. 1-5. *Thamnopora angusta* Lecompte.

1. GSWA F5953/15, thin section; G1002, Pillara Limestone; early Frasnian.
2. BMR CPC.9598, *a*, T.S., *b*, L.S., *c*, Tg.S.; K463, Pillara Limestone; early Frasnian.
3. GSWA F5959/3, *a*, T.S., *b*, L.S.; G1003, Pillara Limestone; early Frasnian.
4. GSWA F5953/12, *a*, T.S., *b*, L.S.; G1002, Pillara Limestone; early Frasnian.
5. GSWA F5953, XI; G1002, Pillara Limestone; early Frasnian.

Figs. 6-8. *Thamnopora boloniensis* (Gosselet).

6. BMR CPC.9599, *a*, T.S., *b*, L.S.; K439 Pillara Limestone; early Frasnian.
7. GSWA F5960/5, *a*, T.S., *b*, L.S.; G1082, Sadler Limestone; Frasnian.
8. GSWA F5267, XI; G3229, Sadler Limestone; Frasnian.

Figs. 9-11. *Alveolites suborbicularis* Lamarck.

9. BMR CPC.9600, *a*, T.S., *b*, L.S.; K266, Sadler Limestone; Frasnian.
10. BMR CPC.9601, thin section; K112, Sadler Limestone; Frasnian.
11. GSWA F5997, *a*, T.S., *b*, L.S.; G1083, Pillara Limestone; early Frasnian.

## Explanation of Plate 19

### **Alveolites**

All figures X2 unless otherwise specified; geographic data of localities are given in Appendix 1.

Figs. 1, 2. *Alveolites* sp. aff. *A. multiperforatus* Salée.

1. BMR CPC.9602, *a*, T.S., *b*, L.S.; K530, Napier Formation; Upper Devonian.
2. BMR CPC.9603, *a*, T.S., *b*, L.S.; Long's Well, Pillara Limestone; late Givetian to early Frasnian.

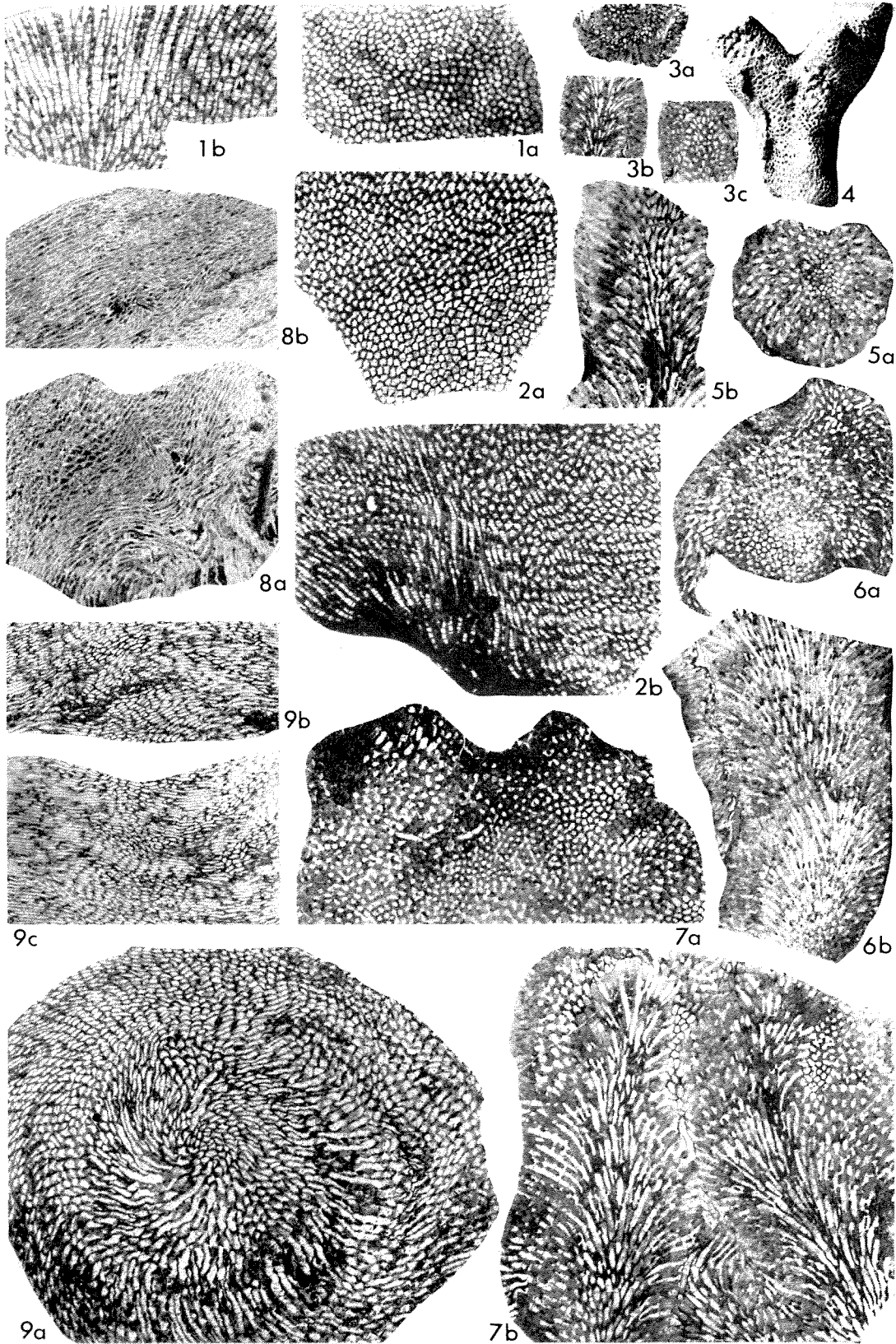
Figs. 3-7. *Alveolites tumidus* (Hinde).

3. BMR CPC.9604, *a*, T.S., *b*, L.S., *c*, Tg.S.; K463, Pillara Limestone; early Frasnian?
4. GSWA F5954, XI; G1003, Pillara Limestone; early Frasnian.
5. GSWA F5927/9-11, *a*, T.S., *b*, L.S.; G1002, Pillara Limestone; early Frasnian.
6. GSWA F5954/2, *a*, T.S., *b*, L.S.; G1003, Pillara Limestone; early Frasnian.
7. BMR CPC.9605, *a*, T.S., *b*, L.S.; K264, Sadler Limestone; Frasnian.

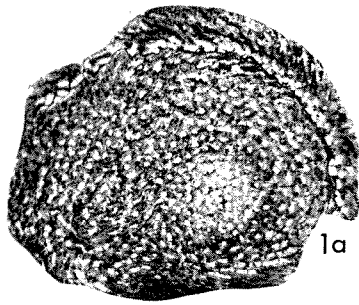
Figs. 8, 9. *Alveolites* sp. cf. *A. intermixtus* Lecompte.

8. BMR CPC.9606, *a*, T.S., *b*, Obl. S.; K549, Napier Formation; Upper Devonian.
9. BMR CPC.9607, *a*, T.S., *b*, L.S., *c*, L.S.; K353, Sadler Limestone; Frasnian.

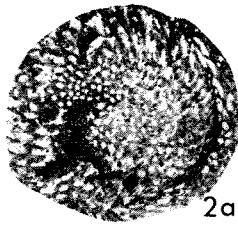




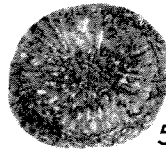




1a



2a



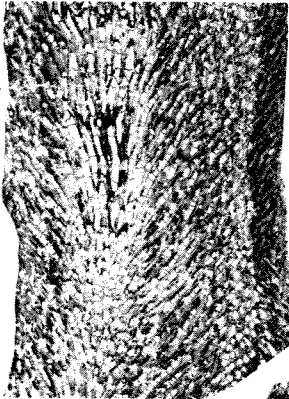
5a



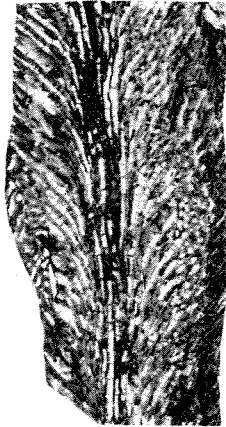
6b



7a



1b



2b



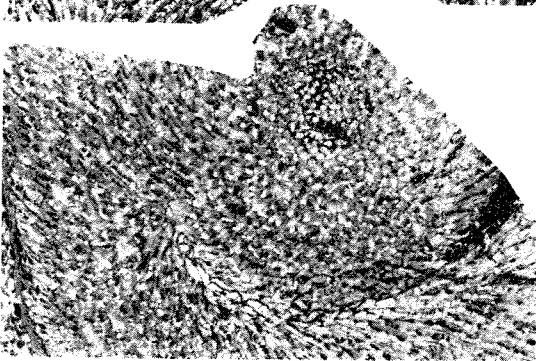
5b



6a



7b



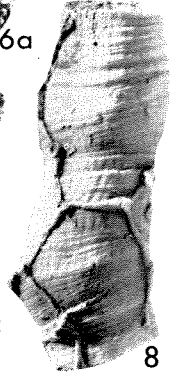
3



9



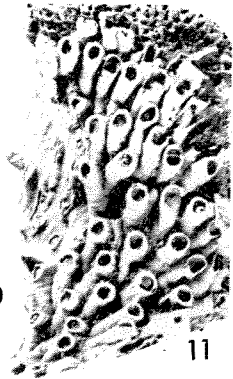
6c



8



12



11



4



10

## Explanation of Plate 20

### **Alveolites, Aulopora**

All figures X2 unless otherwise specified; geographic data of localities are given in Appendix 1.

Figs. 1-4. *Alveolites* sp. cf. *A. saleei* Lecompte.

1. GSWA F5265/1-3, *a*, T.S., *b*, L.S.; G1082, Sadler Limestone; Frasnian.
2. GSWA F5265/4-6, thin section; G1082, Sadler Limestone; Frasnian.
3. GSWA F5265/14, *a*, T.S., *b*, L.S.; G1082, Sadler Limestone; Frasnian.
4. GSWA F5265, XI; G1082, Sadler Limestone; Frasnian.

Fig. 5. *Alveolites* sp. *A*.

5. BMR CPC.9608, *a*, T.S., *b*, L.S.; K463, Pillara Limestone; early Frasnian?

Figs. 6, 7. *Alveolites* sp. cf. *A. caudatus* Hill.

6. BMR CPC.9609, *a*, T.S., *b*, L.S., *c*, L.S.; K510, Pillara Limestone; Upper Devonian.
7. BMR CPC.9610, *a*, T.S., *b*, L.S.; K448, Pillara Limestone; late Givetian to early Frasnian.

Fig. 8. *Aulopora* sp. cf. *A. liniformis* Lecompte.

8. BMR CPC.9611; K222, Sadler Limestone; Frasnian.

Fig. 9. *Aulopora* sp.

9. BMR CPC.9612; K244, Sadler Limestone; Frasnian.

Fig. 10. *Aulopora* sp. *A*.

10. GSWA F5920/1, thin section; G1003, Pillara Limestone; early Frasnian.

Fig. 11. *Aulopora* sp.

11. BMR CPC.9613; K238, Sadler Limestone; Frasnian.

Fig. 12. *Aulopora recta* Hill.

12. GSWA F5929, XI; G1001, Napier Formation; Upper Devonian.



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