

THE DEVONIAN TETRACORAL *HAPLOTHECIA* AND NEW AUSTRALIAN PHACELLOPHYLLIDS

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(Plate vi)

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Synopsis

Research in progress on Australian Lower Devonian corals is exposing a gradation between the Cyathophyllidae and the Disphyllidae. It is therefore recommended that the Disphyllidae be demoted to subfamily rank within the Cyathophyllidae.

Haplothecia filata (Schlotheim), a disphyllinid from the Frasnian of Germany, is restudied and the genus *Haplothecia* upheld. Two phacellophyllids from New South Wales are also described: the first, *Bensonastraea praetor*, gen. et sp. nov., is from the Timor Limestone of probable Eifelian age, while the second, *Macgeea touti*, sp. nov., occurs in the Loomberah and uppermost Sulcor Limestones, both late Emsian or early Eifelian in age.

A new term, veprecula(e), is introduced for the type of spinose projections found on the sides of the septa in *Bensonastraea*.

INTRODUCTION

Preparation of systematic accounts of several Devonian tetracoral faunas in New South Wales has necessitated the undertaking of various ancillary investigations. One of these has been the restudy of the type specimen of the genus *Haplothecia*, and an evaluation of its relationship to highly carinate Australian species referred to *Phillipsastrea*.

The results of this study, together with the description of two new Australian species of a related family, form the subject of the present paper.

A NEW MORPHOLOGICAL TERM

The stability of morphological terms, which almost without exception characterizes current descriptions of tetracorals, stems mainly from Hill (1935, 1956). In these works carinae are defined as flanges, or flange-like elevations, on the sides of a septum formed by thickened trabeculae.

In *Bensonastraea*, a new genus described below, the septa bear small, but nevertheless prominent spinose projections which do not conform to the definition of carinae given above. As far as can be judged from the less than perfectly preserved available material, these are composed of fibrous skeletal material and appear to be prolongations of lateral trabeculae. If so, a very similar trabecular pattern has been figured by Rózkowska (1953, text-fig. 6) in '*Synaptophyllum*' *soshkinae* (see McLaren, 1959, for a revision of *Synaptophyllum*). Rózkowska's species possesses horseshoe dissepiments and is presumably a phacellophyllid).

It is here proposed that spinose projections of the type occurring on the septa of *Bensonastraea* be known as vepreculae, singular veprecula, from the latin meaning a small thorn. Vepreculae may be homologous with the synaptaculae of scleractinian corals.

SYSTEMATIC DESCRIPTION

Family CYATHOPHYLLIDAE Dana, 1846

According to the majority of recent classifications, the Cyathophyllidae are distinct from the Disphyllidae (= Phillipsastraeidae auct.). In reality, however, a basis for the recognition of the Cyathophyllidae has been possible only since Birenheide's (1963) redescription of *Cyathophyllum* and related genera. In view of this and other recent work (Philip, 1962; Pedder, 1966) on earlier Victorian faunas, the distinction between the families is much less clear. For example, among the fasciculate forms, species of *Tipheophyllum* such as *T. ops* and *T. cognatum* completely bridge the gap between the Cyathophyllidae and Disphyllidae, and among the massive forms this gap is bridged by species such as *Hexagonaria approximans*. It is therefore proposed that the Disphyllidae be relegated to subfamily rank within the Cyathophyllidae.

Subfamily DISPHYLLINAE Hill, 1939

HAPLOTHECIA FILATA (Schlotheim)

(Text-figs 1, 2, 4, 7)

- 1820. *Madreporites filatus* Schlotheim (*partim*), p. 359, var. α only.
- 1885. *Haplothechia filata* Schloth. sp. Frech, pp. 68, 69, Pl. 4, figs 7, 7a.
- 1951. *Phillipsastraea filata* (Schloth.), Soshkina, pp. 98–100, text-fig. 36, Pl. 18, figs 1a, b.
- 1952. *Phillipsastraea filata* (Schlotheim), Soshkina, p. 101, Pl. 42, figs 141.
- 1956. *Haplothechia filata* (Schloth.), Hill, p. 280, figs 191. 1a, b.

Type series.—Frech (1885, p. 68) states that Schlotheim's specimens included *Phillipsastrea hennahi* as well as a specimen from the Lias of Würtemberg. The specimen figured by Frech is technically a lectotype and is now in the Institut für Paläontologie und Museum der Humboldt-Universität, Berlin, where it is registered Q. Kat. A. 138, p. 1530. Previous to the present investigation it consisted of two small pieces and four transverse sections, including the one figured by Frech. Frech's longitudinal section is now lost and as no other existed, the writer was permitted to prepare a new one.

The museum label indicates that the specimen was obtained from the Iberger Kalk, Winterberg bei Grund (Harz, Germany).

Description.—The corallum is cerioid with axes of adjacent corallites 5 to 8 mm. apart. Nothing of the exterior is preserved, but the disposition of the dissepiments suggests that there would have been a relatively wide calicular platform.

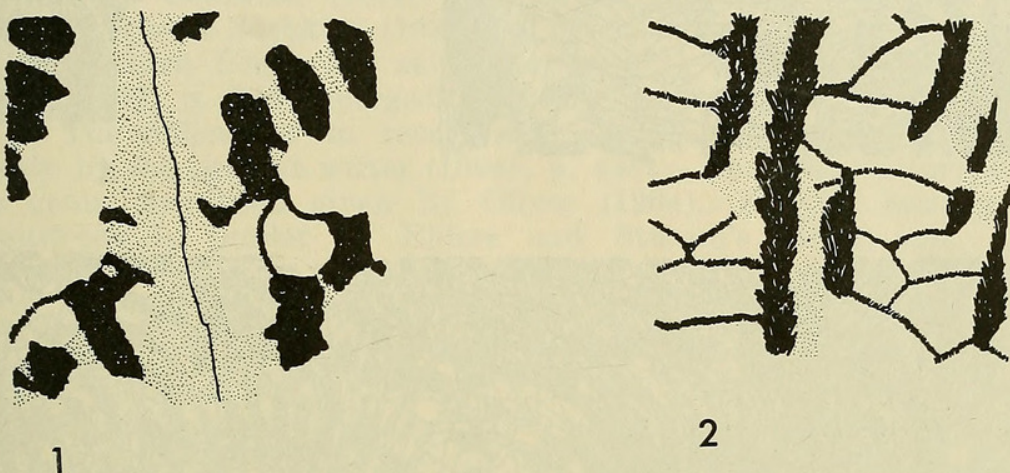
Neighbouring corallites throughout the corallum are separated by a wall, typically 2.5 to 3.5 mm. thick, composed of an apparently structureless light-coloured skeletal material divided by a dark axial plate.

Septa are not embedded in the wall. In the dissepimentarium they tend to be arranged in parallel groups so that some are almost parallel with the wall and a few are even contratingent with an adjacent septum; the arrangement suggests a thamnasterioid origin. Septal counts range from 12×2 to 13×2 in the material studied by the writer; however, Frech, who studied further specimens, gave the maximum as 15×2 . Major septa may extend to the axis, but more commonly are just withdrawn from it; the minor are either confined to the dissepimentarium, where they are scarcely differentiated from the major, or just project into the tabularium. Prominent yard-arm carinae are present in the dissepimentarium, but in the tabularium septa are smooth and thin. The carinae are so well developed that they may touch the wall where wall and septum are almost parallel. At the carinae, septa are trabeculate, whereas between them they are composed of an apparently structureless and lighter coloured material identical with that forming the wall. Frech's longitudinal section shows divergence of the trabeculae; however, this is not

as marked as in normal phacellophyllids and in fact there is no divergence at all on one side of the newly prepared section. Calcite fibres spread upwards randomly from near the trabecular axis and are not grouped in discrete fascicles.

The dissepiments are mostly small and globose and are more or less horizontally disposed; towards the tabularium they steepen so that the transition to the tabularium is abrupt. Where septum and wall lie close together, dissepiments commonly occur between them.

In both longitudinal sections of the lectotype, the tabulae, which are considerably disrupted by septa, are closely spaced and generally flat.



Figs 1, 2. *Haplothechia filata* (Schlotheim), lectotype $\times 24$. 1, Transverse section. 2, Longitudinal section. The stippling between carinae is diagrammatic and represents apparently structureless skeleton.

Remarks.—Frech (1885, p. 68) proposed the genus *Haplothechia* solely for this species. Subsequently the genus received little attention until reassessed by Lang and Smith (1935, pp. 549, 550), exactly 50 years later. Although Lang and Smith's conclusion that it is synonymous with *Phillipsastrea* has gained wide acceptance (Stumm, 1949, p. 35; Wang, 1950, p. 220; Soshkina, 1951, p. 98; Schouppé, 1958, p. 233; Soshkina and Dobrolyubova, in Orlov, 1962, p. 336), there is no indication that they examined topotypic material. Indeed both their description, which minimizes the differences between *Haplothechia filata* and *Phillipsastrea sensu stricto*, and their figures, which illustrate specimens that are not necessarily *Haplothechia*, suggest that they did not.

Thanks to Drs. Jaeger and Forbes it has been possible to compare the lectotype of *Haplothechia filata* with a topotypic specimen (Sedgwick Museum No. H43c, d from Barton Quarry, Devon) of *Phillipsastrea hennahi*, the type species of *Phillipsastrea*. The latter is thamnasterioid to subcerioid, has a phacellophyllid zone of trabecular divergence as well as a few horseshoe dissepiments and is, therefore, a phacellophyllid and not a disphyllinid.

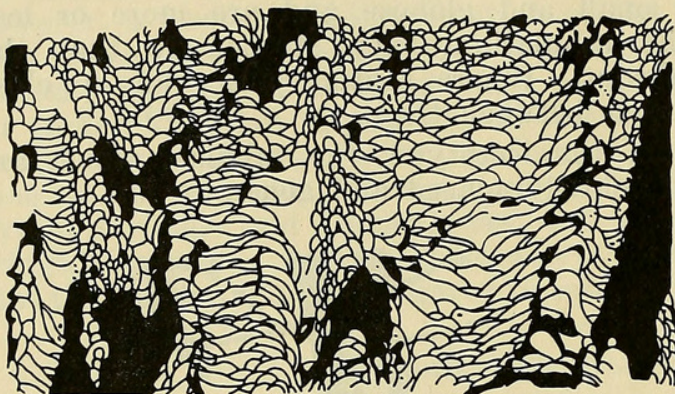
The allotment of *Haplothechia* to the Disphyllinidae must be regarded as provisional. The genus may have evolved from *Phillipsastrea* but, for the moment at least, the family Phacellophyllidae is reserved for corals having a normal phacellophyllid zone of trabecular divergence.

Family PHACELLOPHYLLIDAE Wedekind, 1921

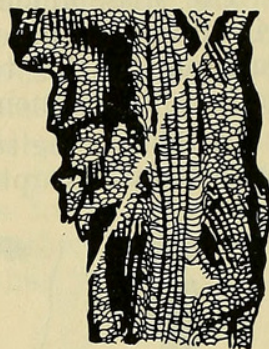
Genus BENSONASTRAEA nov.

Name derivation.—Patronym for W. N. Benson, pioneer geologist of the Great Serpentine Belt of New South Wales and Greek, ἀστρον = star, with traditional ending for coral genera.

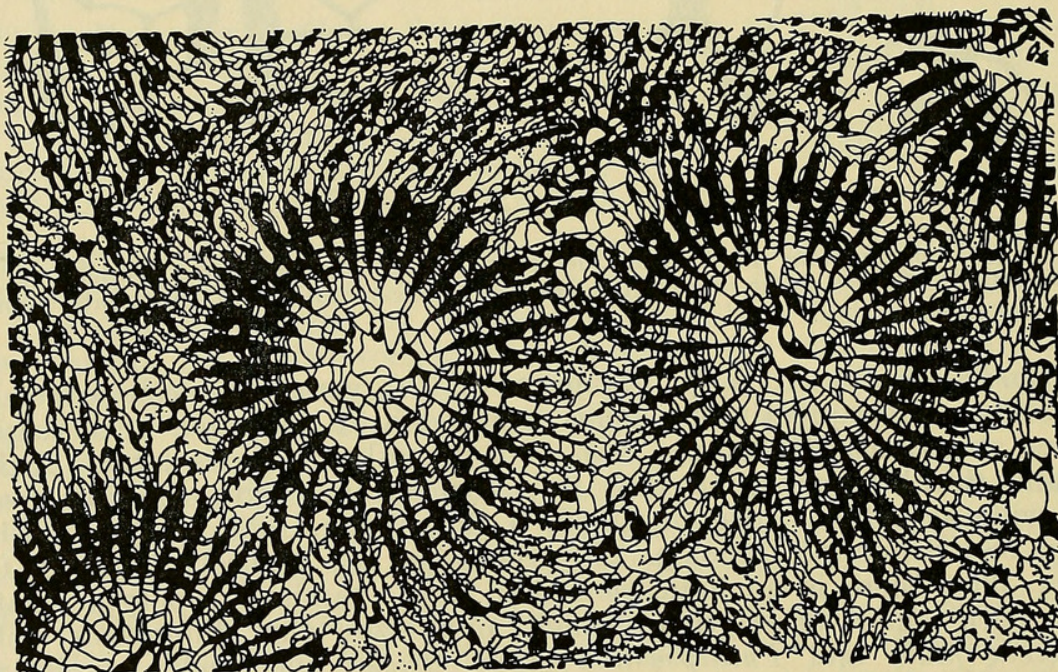
Type species.—*Bensonastrea praetor*, sp. nov., see below.



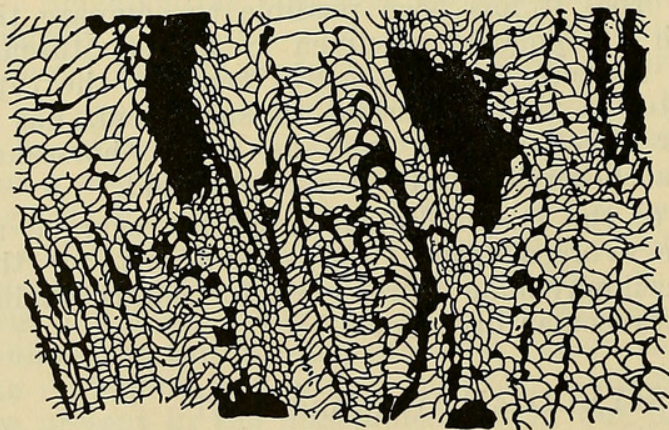
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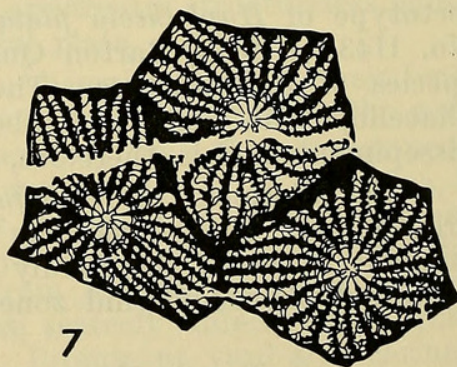
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Figs 3-7. 3, 5, 6, *Bensonastrea praetor*, gen. et sp. nov., holotype $\times 3$. 4, 7, *Haplothechia filata* (Schlotheim), lectotype $\times 3$.

Diagnosis.—Corallum thamnasterioid. Septa vepreculate. Trabeculae divergent exterior of the tabularium. Dissepimentarium and tabularium complex. Five zones present in dissepimentarium; from periphery inwards these are: broad zone of large and small, normal and lateral dissepiments; narrow zone of flat dissepiments; narrow zone of small outwardly-convex dissepiments; series of horseshoe dissepiments; and a narrow zone of inwardly-convex dissepiments. Tabularium divided into a narrow outer zone of flat tabellae; a periaxial zone of outwardly-convex tabellae; and a central region of more or less flat tabulae.

Remarks.—The new genus most obviously recalls *Keriophylloides* and *Billingsastraea*. Soshkina (1951, p. 102) erected *Keriophylloides* for *Keriophyllum astraeiforme* Soshkina (1936, pp. 62–64, figs 71, 72), an Eifelian species from the northern Urals, but subsequently, with Dobrolyubova as co-author (in Orlov, 1962, p. 336), merged the genus in *Billingsastraea* Grabau (1917, p. 957). The difficulties in recognizing *Billingsastraea* have been outlined previously by the present writer (1964b, p. 447); since then a further account of the genus has been given by Oliver (1964). Oliver's interpretation of *Billingsastraea* is similar to Ehlers and Stumm's (1953) and, if correct, *Keriophylloides* would be distinguished from it by its carinae which appear to be of the veprecular rather than the yard-arm type, its highly arched dissepiments giving rise to an exsert calicular rim, and by the dilation of its septa immediately exterior of the tabularium.

Bensonastraea is distinguished from both of these genera, and also from the polyonymous genus *Phillipsastrea* d'Orbigny (1849, p. 12), by its complex dissepimentarium. *Sulcorphyllum* Pedder (1964a, p. 366) and *Pseudoacervularia sensu* Rózkowska (1953, p. 49) *non* Lang, Smith and Thomas (1940, p. 108) in some respects resemble the new genus, but are cerioid, have a different dissepimentarium, and lack vepreculae.

At the present time, only the type species is referred to *Bensonastraea* which may prove to be but a local offshoot from the central plexus of the Phacellophyllidae.

BENSONASTRAEA PRAETOR, gen. et sp. nov.

(Pl. vi, figs 1, 6, 7; text-figs 3, 5, 6)

Name derivation.—Latin, *praetor* = leader.

Type series.—Holotype, Geological Survey of New South Wales No. 3463, Timor Limestone (probably Eifelian), Portion 133, Parish of Lincoln, County Brisbane, N.S.W.; the collector is not recorded.

Diagnosis.—Large *Bensonastraea* with axes of adjacent corallites 12 to 23 mm. apart and tabularium normally 5 to 6 mm. in diameter. Septal count 17×2 to 21×2 .

Description.—The corallum is thamnasterioid and apparently large; when first seen by the author, the holotype had already been cut and yet measured approximately $80 \times 65 \times 80$ mm. Axes of adjacent adult corallites are separated by from 12 to 23 mm. and the tabularium is normally 5 to 6 mm. in diameter. No exterior surface is preserved.

There are 17×2 to 21×2 septa in adult corallites, although differentiation into two orders is evident only in the tabularium. Throughout most of the dissepimentarium septal arrangement is thamnasterioid with the peripheral ends of the septa being either confluent with, abutted against, or withdrawn from, a septum of an adjacent corallite; arrangement is radial in the tabularium. In the outer region of the dissepimentarium where vepreculae are abundant, the septa are thin and locally degenerate, being represented by vepreculae only. In the region of the horseshoe dissepiments, however, they are strongly dilated and are also asymmetrically (peripheral end blunter) fusiform in transverse

section; vepreculae are fewer here and generally masked by thick sclerenchyme. In the tabularium septa are thin, straight or sinuous, and smooth; the major commonly extend to within about 1 mm. of the axis, whereas the minor terminate close to the inner margin of the dissepimentarium. Trabeculae diverge in a zone opposite the horse-shoe dissepiments.

Five concentric zones may be distinguished in the dissepimentarium. The outermost of these is the broadest and consists of both large and small dissepiments; lateral dissepiments are characteristic of this zone. The next zone is one of flat, sloping or sagging dissepiments. Inside these there is a narrow and, in places, discontinuous zone of small outwardly-convex dissepiments, typically up to three deep. Irregularly superposed horse-shoe dissepiments form the next zone; these vary considerably in size and some are sigmoidal. The innermost zone consists of small inwardly-convex dissepiments, typically two to four deep.

The peripheral part of the tabularium is formed of flat tabellae, inside which there is a periaxial series of generally upwardly and outwardly convex plates. Flat, or only gently arched or sagging tabulae occupy the central region of the tabularium.

MACGEEA TOUTI, sp. nov.

(Pl. vi, figs 2-5, 8-11; text-figs 8-11)

- ? 1917. *Zaphrentis typlasmoides* Dun, p. 218. *Nomen nudum et oblitum*.
 1918. *Zaphrentis* (?) sp. (sp. et subgen nov. ?); Dun in Benson, pp. 335, 375, 376, text-fig. 3, Pl. 34, fig. 1.
 1922. *Zaphrentidae* (new genus); Benson, p. 143(60).

Name derivation.—Patronym for S. M. Tout who, according to Benson (1918, p. 322), "was the first to bring the Loomberah limestones under scientific notice".

Type series.—Holotype and paratypes 1-4, University of New England Nos. F8851-8855 respectively, collected by the author from the Loomberah Limestone (late Emsian or early Eifelian) in Portion 58, Parish of Loomberah, County Parry, N.S.W. Paratypes 5, 6, University of New England Nos. F8856, 8857 respectively, collected by the author from the uppermost beds of the Sulcor Limestone (late Emsian or early Eifelian) at the northern end of the outcrop in Portion 249, Parish of Burdekin, County Inglis, N.S.W.

Diagnosis.—Solitary ceratoid to cylindrical tetracoral with a maximum known length and diameter 70 and 19 mm. respectively. Septa considerably dilated and commonly contiguous in a zone immediately exterior of the tabularium; trabeculae divergent in this zone. Septal counts 18×2 to 24×2 at maturity. Dissepimentarium in two parts, an outer of predominantly flat plates and an inner of small and commonly masked horse-shoe dissepiments. Tabulae variable, mostly short and arched.

Description.—All available specimens are completely embedded in matrix; from thin sections the corallum appears to be ceratoid in early stages and subcylindrical to cylindrical at maturity. Rejuvenescence occurred rarely. Specimens up to 70 mm. long and 19 mm. in diameter are known; however, diameters in excess of 15 mm. are unusual.

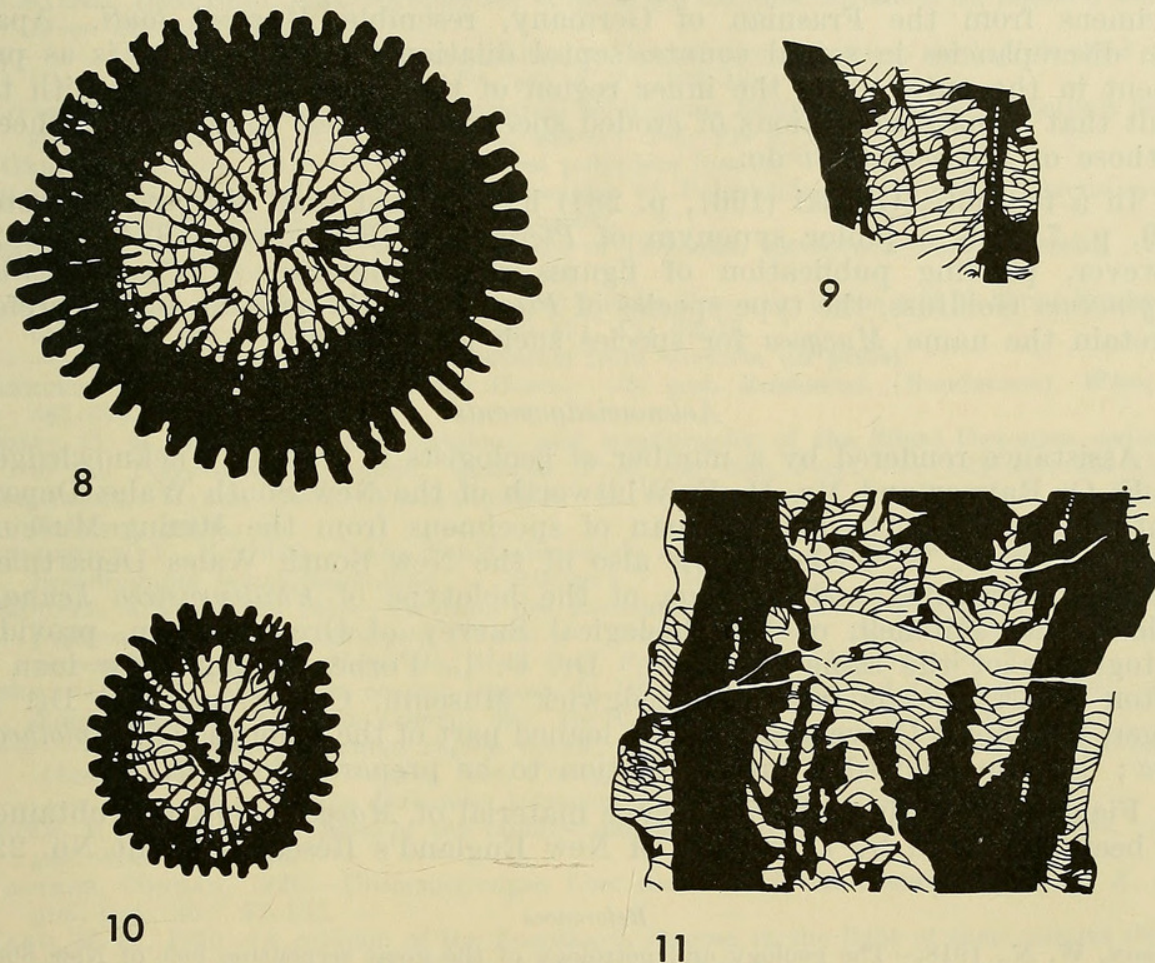
An epitheca is preserved in a minority of specimens; where present it is between 0.15 and 0.25 mm. thick and consists of a thin dark axial plate and an inner lighter layer.

Arrangement of the septa is radial, or faintly pinnate about the presumed cardinal-counter plane. The major septa extend to near and in some cases beyond the axis, and may be rhopaloid or forked axially; the minor just intrude the tabularium. Both orders of septa are considerably dilated in the dissepimentarium, appearing fusiform or wedge-shaped in transverse section, and are

commonly contiguous just exterior of the tabularium. In the tabularium they are irregularly bent and variably carinate. Septal counts vary from 18×2 to 24×2 in adult specimens.

Trabeculae diverge in the normal phacellophyllid manner. Fibre fascicles are prominent as dark regions in most sections, although individual fibres can not be discerned.

A series of flat or gently convex plates forms the outer region of the dissepimentarium; this may be as much as 2 mm. wide, although it has been eroded from most specimens at the type localities. A collar of relatively small horse-shoe dissepiments constitutes the inner part of the dissepimentarium;



Figs 8–11. *Macgeea touti*, sp. nov. $\times 3$. 8, 11, holotype. 9, paratype 4. 10, paratype 2.

however, in many cases this is largely obscured by dilation of the septa. The horse-shoe dissepiments are normally superposed, but in some specimens from the Sulcor Limestone (e.g. paratype 6), short subsidiary strings of horse-shoe dissepiments branch from the main collar into the outer part of the dissepimentarium.

The tabularium, which is one-half to three-fifths the total width of the coral, is composed of numerous tabulae varying considerably in width and curvature; locally these may be invested by sclerenchyme.

Remarks.—The relatively wide zone of flat dissepiments, the degree of dilation of the septa in the zone of trabecular divergence, and the low ratio between the number of septa and diameter, distinguish *Macgeea touti* from the majority of previously described species which are, of course, Givetian or Frasnian in age.

Macgeea (?) *murchisoni* (Penecke, 1894, pp. 595, 596, Pl. 7, figs 15–17) is probably the closest known species. It was originally proposed for a fragment

from the Emsian of the Carnic Alps and has subsequently been reported to be present in the Eifelian of both the type area (Heritsch, 1935, pp. 188, 189) and Armenia (Soshkina, 1952, p. 84, Pl. 18, fig. 65). Penecke's species differs from the new one in having more septa at a given diameter, and broader and more widely spaced tabulae. Specimens from the Emsian at Chalonnès (Le Maître, 1934, pp. 148, 149, Pl. 5, figs 3, 4) and from the Givetian at Ville De-d'Ardin (Le Maître, 1937, pp. 111–113, Pl. 7, figs 3–5, 11, 12; Pl. 8, fig. 7), which have been referred to *Thamnophyllum murchisoni*, are quite unrelated to *Macgeea touti*, as are the specimens, which have been compared with *T. murchisoni* (Firtion, 1957, p. 127, Pl. 5, figs 6, 7), from the Givetian of the Val de Bruche.

A number of species of *Pexiphyllum*, established by Walther (1928) on specimens from the Frasnian of Germany, resemble *Macgeea touti*. Apart from discrepancies in septal counts, septal dilation in these species is as prominent in the outer as in the inner region of the dissepimentarium, with the result that transverse sections of eroded specimens do not simulate cog-wheels, as those of *Macgeea touti* do.

In a footnote, Glinski (1961, p. 284) has claimed that *Macgeea* (Webster, 1889, p. 710) is a junior synonym of *Pterorrhiza* (Ehrenberg, 1834, p. 312). However, pending publication of figures of the interior of *Cyathophyllum marginatum* Goldfuss, the type species of *Pterorrhiza*, the present author prefers to retain the name *Macgeea* for species such as *M. touti*.

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EXPLANATION OF PLATE VI

All figures $\times 2$

Figs 1, 6, 7. *Bensonastraea praetor*, gen. et sp. nov., holotype. Figs 2-5, 8-11. *Macgeea touti*, sp. nov. 2, 9, paratype 5; 3, 11, holotype; 4, paratype 2; 5, paratype 1; 8, paratype 6; 10, paratype 3.



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