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SOURCES OF ILLUSTRATIONS

Explanation of the use of index numbers for citing sources of illustrations is given in the Editorial Preface.

(25) **Agassiz, Alexander**
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(37) **Wright, E. P., & Studer, Théophile**

ZOANTHARIA—GENERAL FEATURES

By J. W. Wells and Dorothy Hill

Subclass ZOANTHARIA de Blainville, 1830

[=Helianthoïda Latreille, 1825; Zoantha Blainv., 1834; Zoocorallia polyactinia, Phytocorallia polyactinia, Phytocorallia dodecactinia Ehrenberg, 1834; Anthozoa helianthoida Johnston, 1837 (*partim*); Actinaria Dana, 1846; Hexacorallia, Tetracorallia Haeckel, 1866; Hexactiniae Schneider & Rötteken, 1871; Hexacoralla + Rugosa Nicholson in Lankester, 1877; Zoanthactiniaria + Rugosa van Beneden, 1898; Actinanthida Delage & Hérouard, 1901; Dodecacorallia Carlgren, 1908]

Solitary and colonial anthozoans, with or without calcareous trabecular exoskeleton, characterized by coupled and paired mesenteries, and by insertion of new pairs of mesenteries, generally after the first 6, in 2 (ventrolateral), 4 (lateral and ventrolateral), or all 6 primary exocoeles. *Ord.-Rec.*

Representatives of the Zoantharia are divided into orders according to arrangement of their mesenteries and corresponding septa if a skeleton is present.

Classification of Zoantharia

1. Septa inserted only within "bifurcated" outer ends of 4 original septa (cardinal, counter, and alars) Heterocorallia
2. Mesenterial pairs, after first 6, inserted only in ventrolateral exocoeles .... Zoanthiniaria
3. Septa inserted in 4 spaces: between cardinal and alar septa, and between alar and counter-lateral septa (?mesenterial pairs inserted in lateral and ventrolateral exocoeles) .... Rugosa
4. Mesenterial pairs (and septa) inserted in dorsolateral, lateral, and ventrolateral exocoeles .... Hexactiniaria
   - A. One tentacle over each exocoele and entocoele; exoskeleton
     - i. Absent .... Actiniaria
     - ii. Present .... Scleractinia
   - B. More than one tentacle over each exocoele and entocoele; skeleton absent .... Corallimorpharia

5. Mesenterial arrangement unknown; septa short, equal, acanthine, generally 12 in number ....TABULATA

Genera and subgenera of the Zoantharia recorded as fossils total 831 and 60, respectively, distributed as follows: Rugosa, 333 genera and 12 subgenera; Heterocorallia, 2 genera and 2 subgenera; Scleractinia, 388 genera and 46 subgenera; and Tabulata, 108 genera. In addition, 3 genera of Actiniaria are doubtfully reported to be represented by fossils.

ZOANTHINIARIA, CORALLIMORPHARIA, AND ACTINIARIA

By J. W. WELLS and DOROTHY HILL

Order ZOANTHINIARIA van Beneden, 1898

[=Actinaria LAMOUROUX, 1824 (*partim*); Zoantharia coriacés DE BLAINVILLE, 1830; Zoanthina coriaces EHRENBERG, 1834; Zoanthidae GRAY, 1840; Zoanthinae MILNE-EDWARDS & HAIME, 1851; Zoanthacea VERRILL, 1865; Zoantharia KLUNZINGER, 1877 (*non* BLAINV., 1830); Zoantheae HERTWIG, 1882; Zoanthida HAECKEL, 1896; Zoanthidea BOURNE, 1900].

Mostly colonial anemones (Figs. 132*f*, 163), with mesenterial pairs beyond the first 6 inserted only in intermesenterial spaces on each side of ventral directive pair. *Rec.*

Includes 5 or 6 genera, most abundant in warm shallow waters. Unknown as fossils.

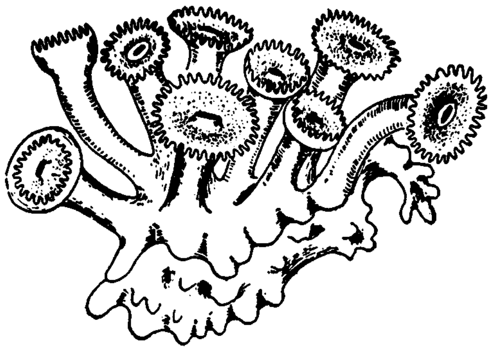

FIG. 163. Zoanthid colony, Rec., Bermuda, ×1 (L. H. HYMAN, *Invertebrates: Protozoa through Ctenophora,* McGraw-Hill, New York).

Order CORALLIMORPHARIA Stephenson, 1937

[=Stichodactylina DELAGE & HÉROUARD, 1901; Asclerocorallia CARLGREN, 1949 (*non* PAX, 1940)]

Solitary or colonial anemones, with principal tentacles cyclically arranged and secondary tentacles developed from the same exo- and entocoeles. No basilar muscles or ciliated mesenterial tracts. Mesenteries inserted cyclically in all 6 primary exocoeles. *Rec.*

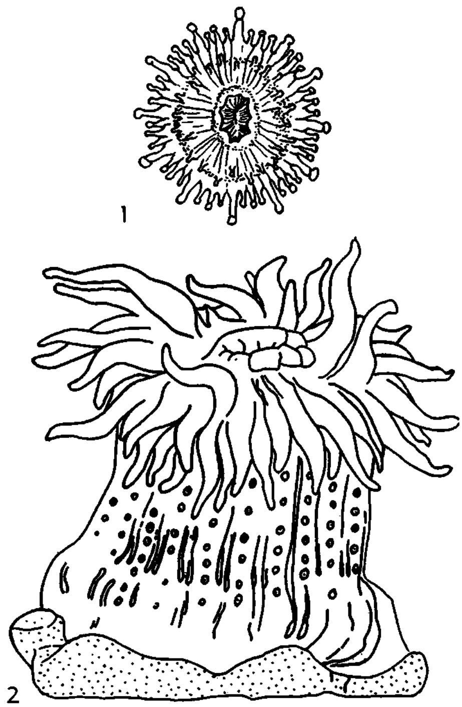

FIG. 164. Corallimorpharia and Actiniaria. *1, Corallimorphus rigidus,* Rec., S.Ind.O., 1,950 fathoms; oral aspect, ×0.5 (R.HERTWIG). *2, Stomphia coccinea,* Rec., Eu.; ×1 (DANIELSSEN).

A small but widely distributed group, including 10 living genera, with no known fossil representatives. It is regarded as coordinate with the Scleractinia, from which it differs by (1) lack of skeleton, (2) tentacular arrangement (Fig. 164,*1*), (3) somewhat more varied nematocysts, and (4) presence of cells in the mesogloea.

Order ACTINIARIA R.Hertwig, 1882

[=Actinina Ehrenberg, 1834; Actiniadae Gray, 1840; Actinidae Dana, 1846; Zoantharia malacodermata Milne-Edwards & Haime, 1851 (*partim*); Actinacea Verrill, 1865; Actinida Haeckel, 1876; Hexactinia Götte, 1898 (*partim*); Malacactiniae (*partim*), Edwardsidea Bourne, 1900; Hexactinidae Delage & Hérouard, 1901 (*partim*)]

Solitary skeletonless anemones (Fig. 164, *2*), with mesenterial pairs beyond the first 6 cyclically inserted in primary exocoeles (or rarely in lateral entocoeles) in dorsoventral succession (Fig. 132*h*). Tentacles cyclically arranged, commonly retractile and only one over each exo- and entocoele. *Rec.*

The small family Ptychodactidae, containing 2 genera, with a number of supposedly primitive features as regards musculature, nematocysts, and mesenterial structures, is considered by Carlgren to constitute a separate order (Ptychodactiaria).

The suborder Endocoelactaria, comprising a small group in which new mesenterial pairs beyond the first 6 are developed by introduction of pairs oriented like directives in the lateral exocoeles, has been suggested as related to the Rugosa, which differ, if septal and mesenterial equivalence be granted, by having the new mesenteries after the first secondaries apparently introduced only in the ventral sides of the lateral exocoeles (Fig. 132,*h*).

Although about 200 living genera and some 700 species of actiniarians are distinguished, fossil forms are not certainly known; a few genera have been attributed to Actiniaria, however.

?**Mackenzia** Walcott, 1911 (**M. costalis*). Originally identified as an holothurian, it has been referred by Clark to the Edwardsiidae, a primitive actiniarian family. *M.Cam.*(Burgess sh.), B.C.

?**Palaeactis** Dollfus, 1875 (**P. vetula*). *M.Ord.(Llandeil.)*, Fr.

?**Palaeactinia** Ruedemann, 1934 (**P. halli*). Possibly an actinodendrid. *M.Ord.(Mohawk.)*, N.Y.

RUGOSA

By Dorothy Hill

CONTENTS

MORPHOLOGY

GENERAL FEATURES OF SKELETON

The Rugosa are an extinct, Paleozoic order of corals forming calcareous skeletons in which the radial plates **(septa)** of each individual skeleton **(corallite)** are generally more noticeable than the transverse plates. The septa are typically of 2 orders, major and minor, alternating in size; in solitary corallites, after the insertion of the first 6 septa, the remaining major septa are inserted at 4 points only. In many Rugosa the only transverse plates are the arched, flat, or sagging **tabulae;** in others, the **tabularium** (space occupied by the tabulae) is surrounded by smaller, commonly arched and inclined plates called **dissepiments,** the marginal zone occupied by them being the **dissepimentarium.** Another type of marginal zone **(marginarium),** common in Rugosa, is a zone of dense calcareous tissue without loculi, a marginal stereozone.

MICROSTRUCTURE

By analogy with Scleractinia, the skeleton is an exoskeleton which must have been laid down by the ectoderm of the base of the polyp. The calcareous tissue is **sclerenchyme,** but use of this term is common only as applied to elements which are notably thickened. The basal ectoderm is considered to have exuded a gel in which $CaCO_3$ crystallized out in needles ("fibers") according to the laws of spherulitic crystallization and at right angles to the secreting ectodermal surface (3). The exudation and crystallization are probably periodic, for growth lamination may be distinguished across the length of the fibers. The fibers of the septa and other radial elements crystallized in the gel secreted in radial upfolds (invaginations) in the base of the polyp, while the transverse elements and those parts of the wall between the peripheral edges of the septa were deposited in the gel

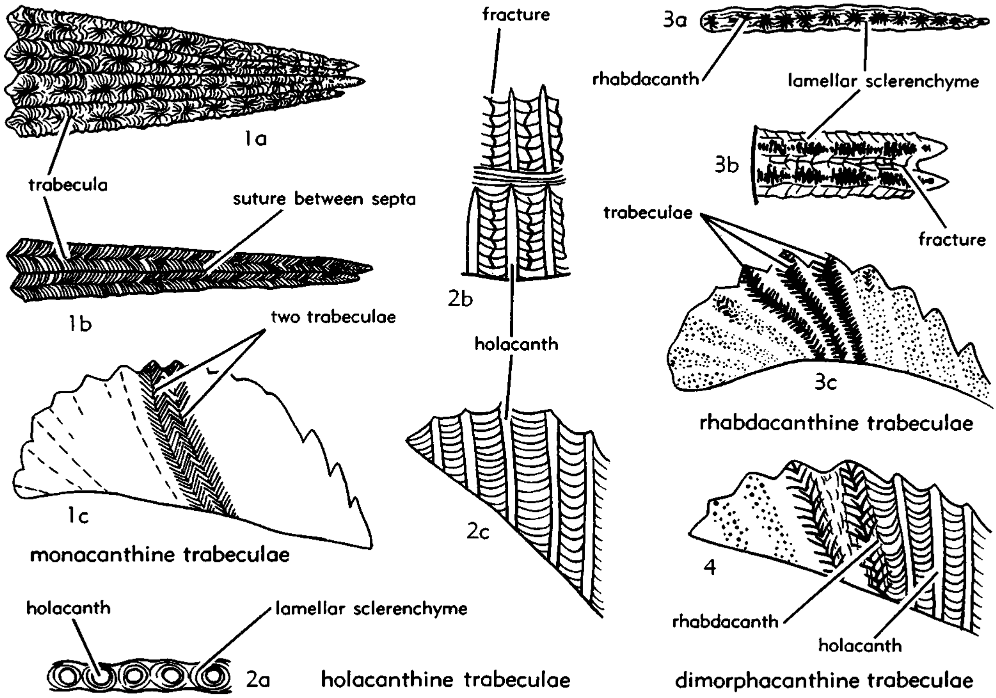

FIG. 165. Rugose coral morphology; types of trabeculae. *1*, Monacanths in *Porpites porpita* (LINNÉ), Sil., Eu.; *1a*, 4 septa in transv. sec. cut at right angles to trabeculae; *1b*, 2 septa in transv. sec. cut obliquely to trabeculae; *1c*, 1 septum in long. sec., structure of only 2 trabeculae being shown; enlarged (85). *2*, Holacanths in *Tryplasma primum* HILL, M.Sil., Eng.; *2a*, transv. sec. cut at right angles to trabeculae; *2b*, transv. sec. cut obliquely to trabeculae; *2c*, long. sec.; enlarged (85). *3*, Rhabdacanths in *Rhabdocyclus porpitoides* LANG & SMITH, Sil., Eng.; *3a*, transv. sec. cut at right angles to trabeculae; *3b*, transv. sec. cut obliquely to trabeculae; *3c*, long. sec. with 3 central trabeculae shown in median long. sec., others in tangent. long. sec.; enlarged (85). *4*, Dimorphacanthine septa in *Tryplasma primum* HILL, M.Sil., Eng.; long. sec., 2 cut medially, 3 trabeculae at right being holacanths; enlarged (85).

exuded by the ectoderm of the unfolded parts.

Skeletal tissue deposited by unfolded ectoderm shows planar control of the spherulitic crystallization, for in tabulae and dissepiments the fibers lie at right angles to the upper and lower surfaces of the plates, the plane of control being the uniform ectodermal surface secreting the gel. When the secretory surface is not uniform, the fibers deposited from a more advanced point may be grouped in a radiating aggregate of the type termed "fascicle" in much scleractinian literature; but such a grouping is by no means a fundamental unit of the coral skeleton; fascicles will not be found where perfect planar control exists.

Tissue formed by the crests of the upfolds shows control by points in, or by the line of, the crest. Puntal control is commoner than linear, for most septa consist of cylindrical or flattened spines called trabeculae (Fig. 165), each apparently formed by continuous deposition from one or more persistent centers of calcification in a conical hollow at the crest of the upfold. The trabeculae of a septum may be separate or contiguous, and their nature and arrangement vary from genus to genus and family to family. A trabecula may be a simple **monacanth** in which the fibers are related to one center only, radiating upward and outward from the axis formed by upward shifting of the center; or its fibers may be related to any number of separate, smaller, transient centers grouped about the main one, thus forming a **rhabdacanth** (17). The fibrous nature of the skeletal elements may be ob-

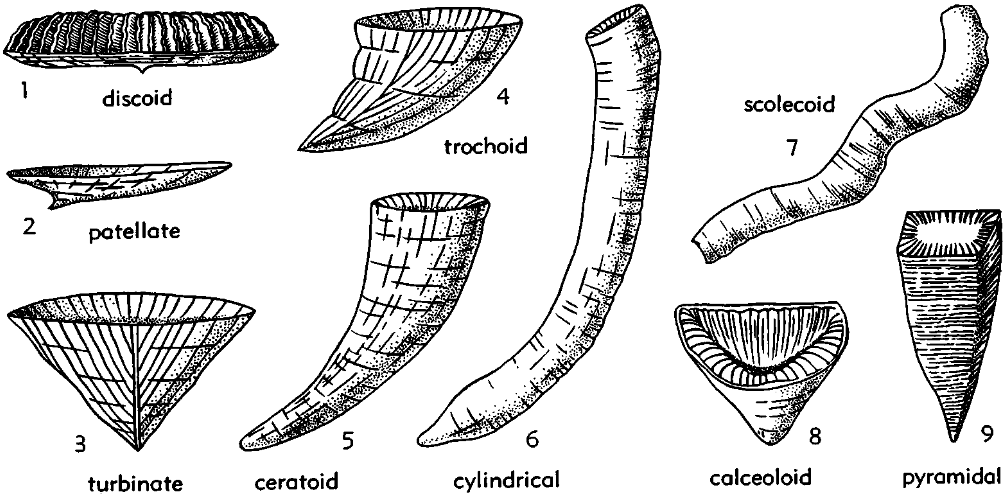

FIG. 166. Rugose coral morphology; types of simple coralla (85). *1, Porpites porpita* (LINNÉ), Sil., Eu.; ×2. *2, Rhabdocyclus fletcheri* (EDW.-H.), Sil., Eng.; ×1.5. *3, Phaulactis* sp., Sil., Eng.; ×1. *4, Zaphrenthis* sp., M.Dev., N.Am.,; ×1. *5, Streptelasma* sp., Sil., Eng.; ×1. *6, Amplexus* sp., L.Carb., Eng.; ×0.3. *7, Helminthidium mirum* LINDSTRÖM, Sil., Eu.; ×1. *8, Calceola sandalina* (LINNÉ), L.Dev.-M.Dev., Eu.-Asia-Afr.-Austral.-N.Am.; ×1. *9, Goniophyllum fletcheri* (EDW.-H.), Sil., Eng.; ×1.

scured either by original failure of the material to crystallize spherulitically or, more usually, by recrystallization before or during fossilization. Some parts of an individual may show the fibrous nature perfectly, while in other similar parts it is obscured. Growth lamellation may be emphasized, either by recrystallization or by original failure of the fibers to come out of the gel spherulitically, and this may be combined with a complete recrystallization to clear calcite of the axial parts of the trabeculae, causing for instance the perfect rhabdacanthine septa of *Tryplasma* to be replaced by a series of seemingly structureless rods of clear calcite, termed **holacanths,** set in **lamellar sclerenchyme.** Such obscurations are as characteristic of genera and families as are the patterns they obscure.

The trabeculae are variously arranged in the septa. In most Rugosa they lie in the median plane of the septum and project upward and inward toward the axis of the corallite; their course is invariably at right angles to the successive platforms of dissepiments. In a few genera, an area of divergence of the septal trabeculae is observed within the dissepimentarium, where the trabeculae of one part of a septum are directed peripherally in the opposite sense to the remainder which are directed axially (e.g., *Acervularia*); an outward direction at right angles to the successive tabulae is taken by the trabeculae in radial plates in any axial structure. In the Phillipsastraeidae with thick septa, the trabeculae diverge from the median plane toward the faces (sides) of the septum. In some genera, trabeculae may develop in other than the median plane of the septum and may then form an open network *(Arachnophyllum)*.

In the septa of many genera the fibers all appear to proceed from the mid-plane toward the septal faces at exactly the same angle, so that individual trabeculae cannot be distinguished; such an attitude results from spherulitic crystallization under linear control, the line being the crest of the septal invagination; this is in contrast to trabecular growth resulting from control by a number of separated points along the crest.

The latest fibrous growth lamellae of many thick septa may be seen in parts of some corals to be continuous with those of neighboring tabulae or dissepiments; this indicates a septal invagination so deep that the fibers initiated at its crest are lengthened by its smooth side, which is continuous over change of slope with the unfolded ectoderm between the invaginations.

FORM OF CORALLA

SOLITARY CORALS

Turning from the fine structure of the skeletal elements to megascopic characters of the skeleton, we note that **solitary corallites** may be curved or erect, and the fundamental shape appears to be a reversed cone. Depending on the apical angle of the cone and other characteristics, such as the growth form of the mature region and occurrence of sharp angulations or flattened areas (Fig. 166), the shape may be designated as **ceratoid** (very slenderly conical, horn-shaped), **cylindrical** (nearly straight and of uniform diameter except in the apical region), **scolecoid** (like cylindrical but irregularly bent in the manner of a worm), **trochoid** (regularly expanding from an apical angle of about 40 degrees), **turbinate** (like trochoid but with wider apical angle, about 70 degrees), **patellate** (with still wider apical angle, about 120 degrees), **discoid,** nearly all in a single plane, **calceoloid** (like the tip of a slipper, as in *Calceola*), or **pyramidal** with flattened sides which meet at angles (Fig. 166).

Solitary corallites are laterally and basally sheathed in a thin film of ?granular (?nonfibrous) $CaCO_3$, the **epitheca** (Fig. 167,*3*) lying upon the **corallite wall,** which is not a simple unit. In some corallites, the wall is formed by the peripheral edges of the septa thickening to contiguity; in others, a nontrabeculate fibrous lining bridges the space between each such peripheral edge, the fibers lying radially. This lining may be quite thin, but where the fibers lengthen

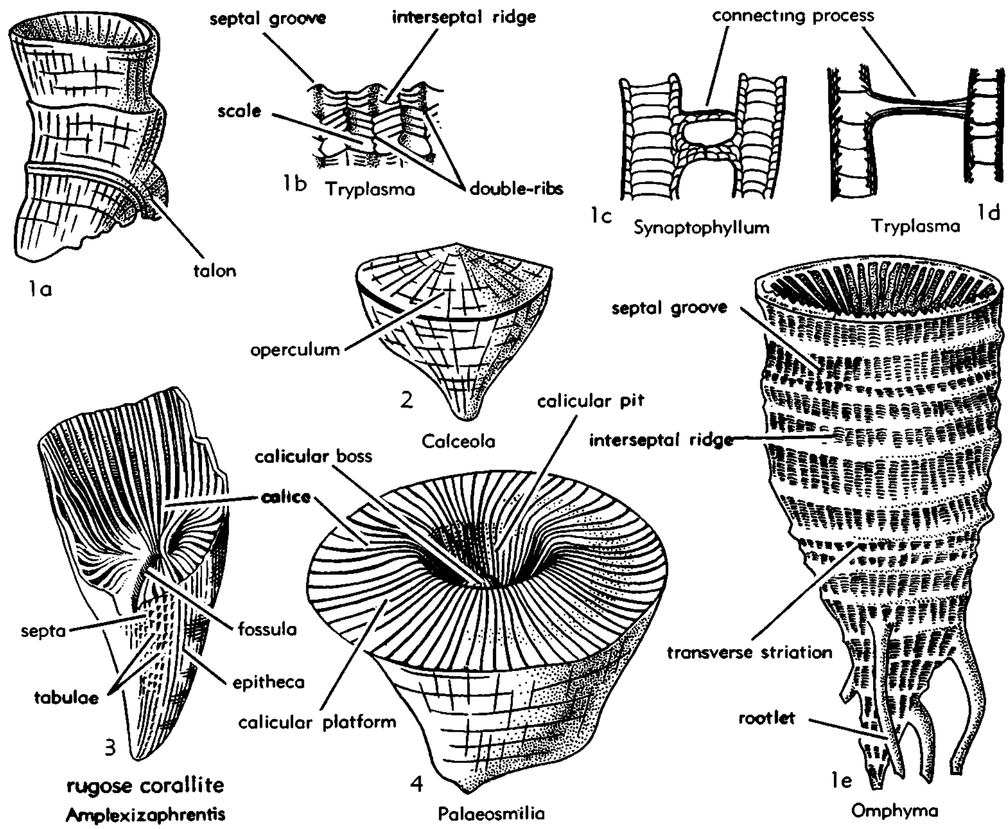

Fig. 167. Rugose coral morphology; epithecal and calical characters (85). *1a, Tryplasma* sp., M.Sil., Eng.; ×1. *1b, Tryplasma lovéni* (Edw.-H.), M.Sil., Eu.; enlarged. *1c, Synaptophyllum simcoense* (Bill.), Dev., N.Am.; ×2. *1d, Tryplasma lonsdalei* Etheridge, M.Sil., N.S.W.; ×2. *1e, Ketophyllum subturbinatum* (Orb.), Sil., Eu.; ×1. *2, Calceola sandalina* (Linné), M.Dev., Eu.-Asia-Afr.-Austral.-N.Am.; ×1. *3, Amplexizaphrentis enniskilleni* (Edw.-H.), L.Carb., Eu.; ×1. *4, Palaeosmilia murchisoni* Edw.-H., L.Carb., Eu.; ×1.

greatly, a marginal stereozone may be formed.

The lateral epithecate surfaces of the corallite are vertically grooved, each such depression corresponding in position to a major or a minor septum and being therefore termed a **septal groove; scales** may be attached to these furrows and the **interseptal ridges** ocurring between them *(Tryplasma)*. Transverse or growth wrinklings of the epitheca may also be noted. Buttressing outgrowths **(talons)** from the cone of attachment and rootlike structures **(radiciform processes** or **rootlets** and **spines)** may assist in anchoring the corallite (Fig. 167, *1a,1e*).

COMPOUND CORALS

The entire skeleton of a compound organism is termed a **corallum.** This term is traditionally used for the skeleton of the whole organism whether compound or solitary. A compound corallum is called **fasciculate** if the corallites are cylindrical and not in contact. Fasciculate coralla may be classified as **dendroid** (irregularly branching), or **phaceloid** (with neighboring corallites more or less parallel, not in contact but joined at some points by connecting processes, Fig. 168,*1*). Compound coralla are described as **massive** if neighboring corallites are in contact and polygonal in section. Massive coralla

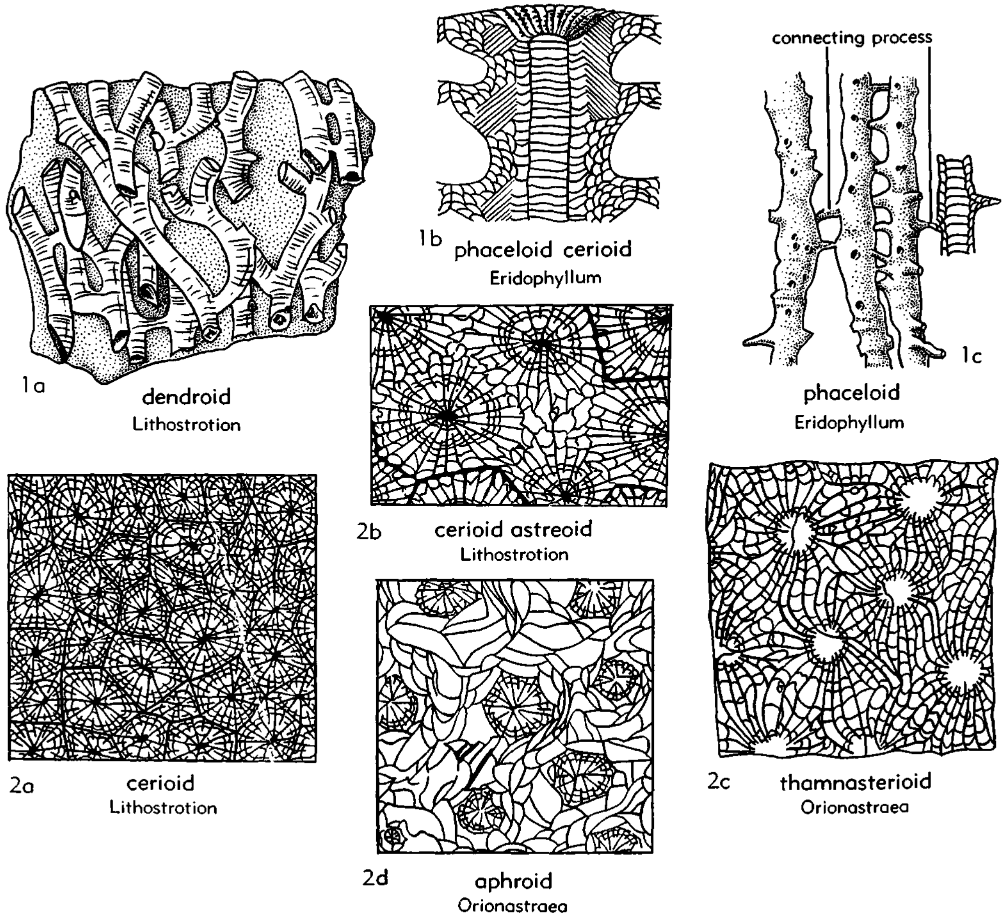

FIG. 168. Rugose coral morphology; types of compound coralla (85). *1a, Lithostrotion irregulare* (PHILLIPS), L.Carb., Eu.; ×1. *1b, Eridophyllum colligatum* (BILL.), Dev., N.Am.; median long. sec., ×1.3. *1c, Eridophyllum simcoense* (BILL.), Dev., N.Am.; corallite in median long. sec., ×1.5. *2a, Lithostrotion arachnoideum* (M'COY), L.Carb., Eng.; transv. sec., ×1. *2b, Lithostrotion columnare* ETHERIDGE, L.Carb., E.Austral.; transv. sec., ×1.5. *2c, Orionastraea garwoodi* HUDSON, L.Carb., Eng.; transv. sec., ×2. *2d, Orionastraea lonsdaleoides* HILL, L.Carb., E.Austral.; transv. sec., ×1.5.

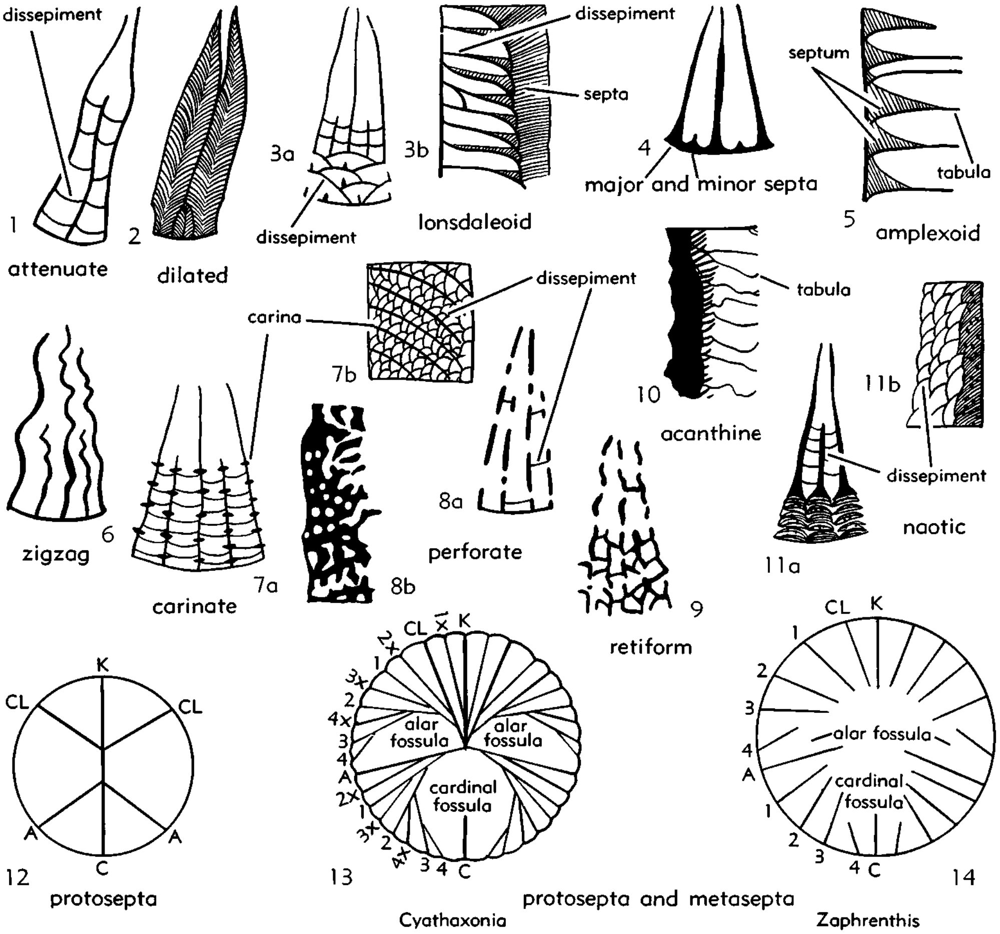

FIG. 169. Rugose coral morphology; types and insertion of septa (85n). *1-11,* Types of septa, diagrammatic, enlarged; *1,2,3a,4,6,7a,8a,9,11a,* transv. secs.; *3b,5,7b,8b,10,11b,* median long. secs.; *12-14* insertion of septa, diagrammatic, enlarged; *12,* showing 6 protosepta; *13, Cyathaxonia,* numerals indicating order of insertion of septa, those marked with "x" staying short (minor septa), others lengthening and becoming major septa; *14, Zaphrenthis,* numerals indicating order of insertion of metasepta, minor septa being inserted later in cycle, after which insertion proceeds as in *Cyathaxonia.* A= alar septum; C= cardinal septum; CL= counter-lateral septum; K= counter septum.

(Fig. 168,*2*) are clothed in a common epitheca. They are distinguished as (1) **cerioid,** if each corallite is defined by a wall; (2) **astreoid,** if the individual corallites lose their walls without reduction of the septa, which usually alternate in neighboring corallites; (3) **thamnasterioid,**[1] if the septa of neighboring corallites are confluent and arranged between the axes of corallites like lines of force between poles in a magnetic field; or (4) **aphroid,** if the septa have withdrawn from the periphery so that those of neighboring corallites are united by dissepiments only. Meandroid coralla are not known in Rugosa.

CALICE

The **calice** is the distal surface of a corallite, and is a mold of the base of the polyp (Fig. 167,*3,4*). Many corallites have an

[1] The structure of corals in which "the septa of neighbouring corallites become confluent" originally was designated by LANG (1923, *Trends in British Carboniferous Corals,* Geol. Assoc., Proc., v. 34, p. 123) as "thamnastraeoid," without reference suggesting that the name was derived from the scleractinian *Thamnastraea* LESAUVAGE, 1832 (=*Thamnasteria* LESAUVAGE, 1823). Accordingly, HILL sees no reason to alter spelling to "thamnasterioid," as is done by WELLS and used in the *Treatise;* also, she prefers "astraeoid" rather than "astreoid" (*Astrea* LAMARCK, 1801), although no genus bears the name *Astraea.*—EDITOR.

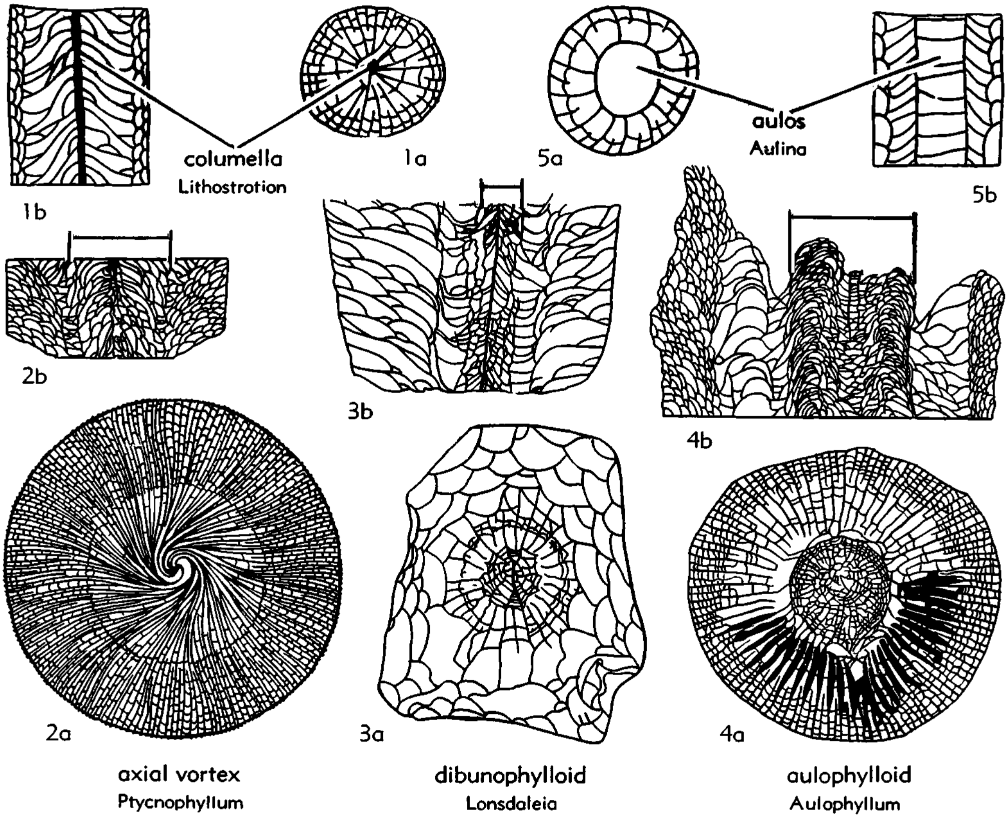

FIG. 170. Rugose coral morphology; axial structures (85). *1, Lithostrotion* sp., L.Carb., Eu.; *1a,b,* transv. and median long. secs., enlarged. *2, Ptychophyllum stokesi* EDW.-H., Sil., Can.; *2a,b,* transv. and median long. secs., X1. *3, Lonsdaleia laticlavia* SMITH, L.Carb., Eng.; *3a,b,* transv. and median long. secs., X1.7. *4, Aulophyllum fungites* (FLEMING), L.Carb., Eu.; *4a,b,* transv. and median long. secs., X1.25. *5, Aulina furcata* SMITH, L.Carb., Eng.; *5a,b,* transv. and median long. secs., X2.

evenly rounded bowl-shaped calice, ranging in depth from a very shallow saucer-like shape to a deep beaker-like form. The calice in some genera, particularly those with marginaria, shows marked differentiation of inner and outer parts, the outer area (which may be nearly plane or everted) constituting a **calicular platform,** while the central part is abruptly depressed **(calicular pit)** or raised in a rounded to sharp-pointed prominence **(calicular boss)** (Fig. 167,*4*). In pyramidal or calceoloid coralla, the calice may be closed by an independent plate or plates, the **operculum** (Fig. 167,2), evidently drawn into a position of closure by the retraction of the polyp.

SEPTA

MAJOR SEPTA

The first skeletal elements to be laid down upon the initial deposit from the attached planula, the basal epitheca are 6 of the major septa, termed **protosepta.** These are first the **cardinal septum** and its opposite, the **counter septum,** marking the plane of bilateral symmetry of the corallite, commonly with their axial ends conjoined; then the 2 **alar septa,** one on each side of the cardinal septum, and later the 2 **counter-lateral septa,** between the alar septa and the counter septum. This order of appearance is not, however, invariable. Insertion of later **metasepta** takes place at 4 points only, pinnately, immediately on each side of the cardinal septum, and on the counter side of each alar septum (Fig. 169, *12-14*). The septa inserted at each of these points form a **quadrant;** in some corals more septa are developed in the counter than in the cardinal quadrants, which accordingly are smaller, and septal insertion is then said to be accelerated in the counter quadrants; in other corals, the opposite occurs.

MINOR SEPTA

So-called minor septa are distinguished by their shorter length as compared with major septa and by their placement between the major septa so as to alternate with them. In some genera, the minor septa may be seen to enter almost simultaneously with neighboring major septa, one on the counter side of any major septum before another on its cardinal side. In others, although septal grooves corresponding to the minor septa appear almost simultaneously, as above, with their neighboring major septal grooves, the minor septa themselves are nonexistent, or so small as to escape notice until a later stage when they all appear together right around the corallite, after which new minor septa appear as in the former case. In some Artinskian and later Rugosa, irregularities in the normal septal insertion occur which indicate a transition from the rugose, pinnate type to the hexacoral, cyclic type (42). **Contratingent** minor septa lean on their neighboring major septa on the counter sides; the minor septa on either side of the counter septum may be long. A third **(tertiary)** order of septa is observed in some genera, between major and minor septa (*Iranophyllum,* Fig. 211,*2*).

SPECIAL TYPES

The **septa** are variously developed in the Rugosa, not only in their trabecular constitution as described above but in their shapes (Fig. 169,*1-11*). Generally the septa are laminar, i.e., the trabeculae are closely united without intervening openings to form a continuous sheet; but **acanthine** septa occur, with the trabeculae separate distally or throughout. Septa may be **long** or **short, attenuate, thin,** or commonly **dilated** in whole or in part; in the Zaphrenticae a septum may be thicker within the tabularium than in the dissepimentarium. **Rhopaloid** septa are expanded at their inner edges and are club-shaped in section (*Ufimia,* 177,*12*). Thickening of the septa is effected by elongation of the fibers, accretion lamellae showing that the process is periodic (possibly related to feeding times). Where thickening affects the septa in a particular zone of the coral, a **stereozone** is formed (peripheral stereozone of *Kodonophyllum,* Fig. 172,*2*). A septum may have a number of irregular, upwardly directed, slender, or cylindrical **axial lobes** springing from its axial edge, as in Streptelasmatidae (cf. the "paliform lobes" of Scleractinia). It may be represented in an axial structure by a **septal lamella,** which is a radial axial plate not in continuity with it. Its distal (calicular) edge may show teeth representing the growing tips of trabeculae. The sides of a septum may be smooth, provided with small denticulations, or flanged. The flanges may be parallel to the calicular edge, as in Cyathaxoniicae, or parallel to the trabeculae, of which they are then lateral extensions called **carinae,** or **yard-arm** carinae if those of both sides of the septum are opposite *(Heliophyllum),* or zigzag carinae if they are sub-opposite *(Entelophyllum)* (Fig. 169, *7*).

The septa may not be continuous vertically and radially. Thus **amplexoid** septa are fully developed only on upper surfaces of the tabulae, but above this position they extend progressively a shorter distance from the epitheca, as in *Amplexus* (Fig. 169,*5*). **Lonsdaleoid** septa are discontinuous toward the opposite peripheral edge; they do not extend continuously through the dissepimentarium, but break up the dissepiments for a certain distance only, dying out toward the epitheca in a series of septal crests, each resting on a platform of dissepiments. **Perforate** septa are rare among the Rugosa, but occur, with **retiform** septa (perforate septa connected in an irregular network) in the Calostylidae (Fig. 169,*8,9*). A **naotic** septum is represented in its peripheral parts by a series of closely spaced, dissepiment-like plates, each connected by short rods of $CaCO_3$, each rod representing the axis of an imperfectly developed trabecula (for example, in *Naos,* Fig. 169,*11*).

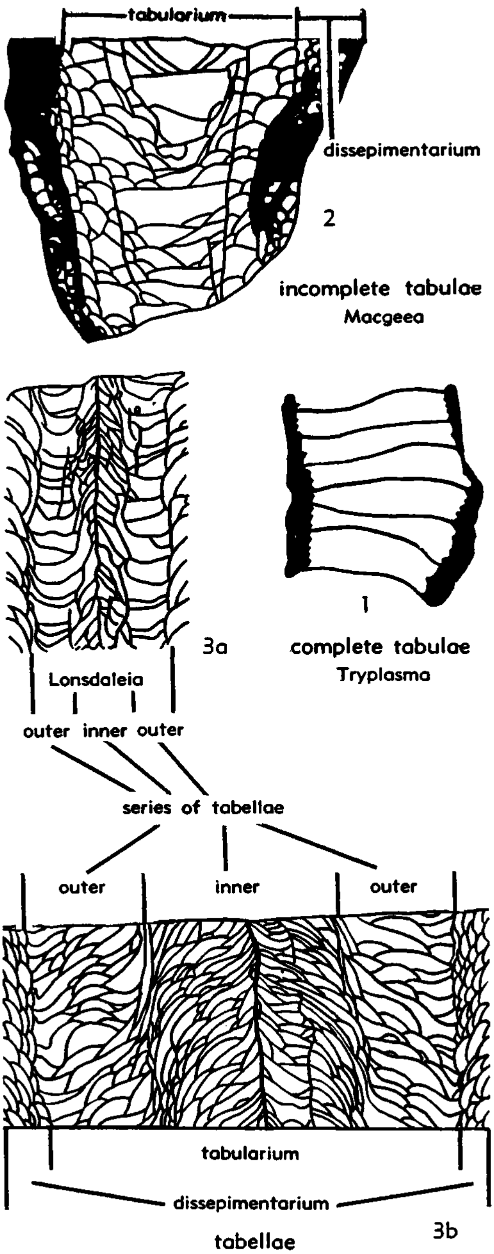

FIG. 171. Rugose coral morphology; types of tabulae (85). *1, Tryplasma* sp., Sil., Eu.; median long. sec., ×1.5. *2, Macgeea* sp., U.Dev., Eu.; median long. sec., ×1.5. *3a, Lonsdaleia laticlavia* SMITH, L.Carb., Eng.; enlarged. *3b, Dibunophyllum bipartitum* (M'COY), L.Carb., Eu.; ×2.

FOSSULAE

Consequent upon the rugose plan of tetrameral, pinnate septal insertion, interseptal loculi of unusual shape and size occur at the points of insertion; these are **fossulae,** the largest being naturally at the cardinal septum, and termed the **cardinal fossula,** or simply the fossula (Fig. 169,*13,14*). The other two are the **alar fossulae.** A **counter fossula** may develop but is not connected with the insertion of new septa. The fossulae may be marked further by quite sharp depression of the tabulae therein. A fossula is **open** if the adjacent septa do not join around its axial end, **closed** if they do; and it may be variously shaped in transverse section, according to the genus or family. In some corals there is a narrowing of the dissepimentarium at the fossula.

AXIAL STRUCTURES

Axial structures commonly are formed from the axial parts of septa reinforced by transverse skeletal elements (Fig. 170); these axial parts tend to be continuous with the peripheral parts only in very young stages. Thus, the axial lobes of many of the Streptelasmatidae form an axial structure. Many genera have a **columella** formed by the vertical prolongation of the axial end of the counter septum (Fig. 170,*1*) which may be swollen by the adherence of vestigial axial ends of the other septa (*Carruthersella,* Fig. 197,*5*). Others have an **axial vortex** formed by the similar twisting of the axial ends of the long major septa (*Ptychophyllum,* Fig. 170,*2*). Still others have an axial structure composed of the axial parts of septa (septal lamellae), usually discontinuous in adult stages from the septa to which they belong and united by transverse skeletal elements; such may be **clisiophylloid,** like a spider web, with a short medial plate derived from the conjoined cardinal and counter septum in the young stages (*Clisiophyllum,* Fig. 195,*1*), **dibunophylloid** (Fig. 170,*3*; 196,*1*), bisected by a medial plate, or **aulophylloid** (Fig. 170,*4*), without a medial plate. An **aulos** (inner tube) may be formed from the similar turning aside of the axial edges of the septa to meet their neighbors, as well as in other ways (Fig. 170,*5*).

TABULAE AND DISSEPIMENTS

Tabulae are the chief horizontal skeletal

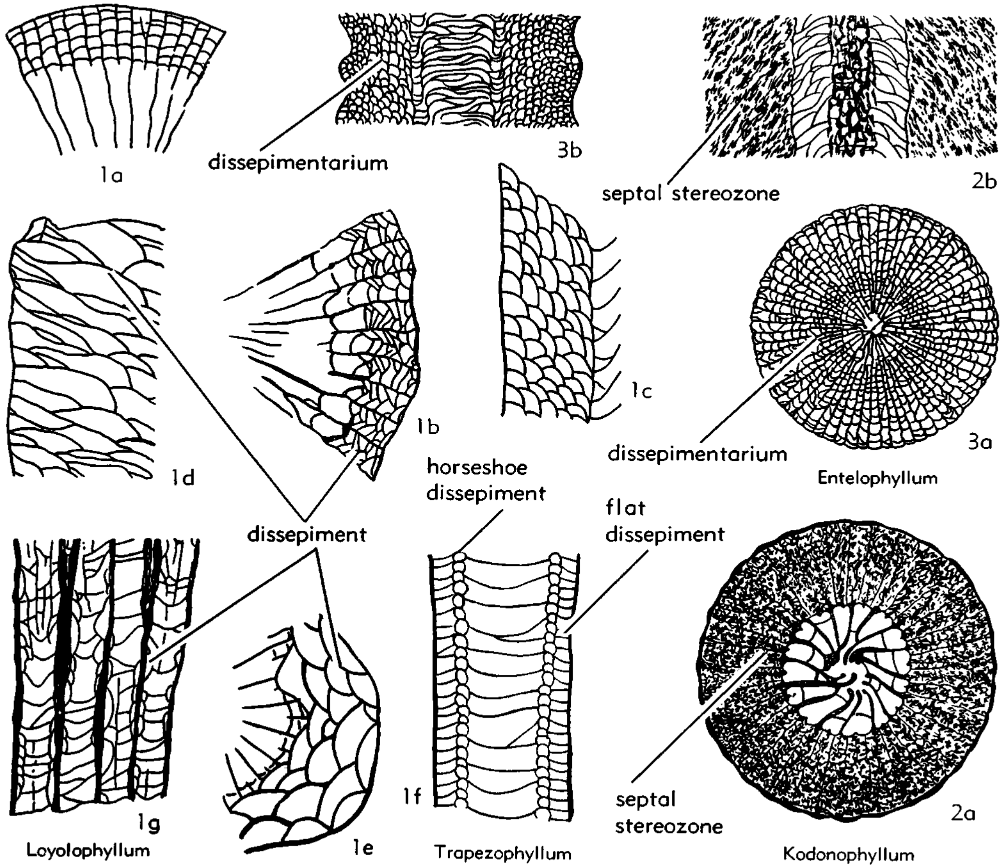

FIG. 172. Rugose coral morphology; dissepiments and marginaria (85). *1a, Caninia subibicina* M'COY, L. Carb., Eu.; part of transv. sec. showing dissepiments arranged in regular concentric pattern; enlarged. *1b, Caninia juddi* (THOMSON), L.Carb., Eu.; part of transv. sec. showing dissepiments arranged in herringbone pattern; enlarged. *1c, Caninia* sp., part of median long. sec. showing many vertical series of dissepiments, corresponding to structure of *1a,b*. *1d,e, Lonsdaleia duplicata* (MARTIN), L.Carb., Eu.; parts of long and transv. secs. showing lonsdaleoid dissepiments; enlarged. *1f, Trapezophyllum elegantulum* ETHERIDGE, Dev., Vict.; median long. sec. showing inner series of horseshoe dissepiments and outer series of flat dissepiments, ×3. *1g, Loyolophyllum cresswelli* CHAPMAN, L.Dev., Vict.; median long. sec. showing isolated dissepiments, ×3. *2, Kodonophyllum truncatum* (LINNÉ), Sil., Eu.; *2a,b,* transv. and median long. secs. showing marginarium composed of septal stereozone, ×2. *3, Entelophyllum articulatum* (WAHLENBERG), Sil., Eu.; *3a,b,* transv. and median long. secs. showing marginarium composed of dissepimentarium, ×2.

elements of the Rugosa (Fig. 171). In the Cyathaxoniicae and Streptelasmatidae, they alone are developed; but in many others the space which they occupy **(tabularium)** is surrounded by a **marginarium** (Fig. 172, *2,3*), which is either a peripheral stereozone or a zone of dissepiments comprising a **dissepimentarium.** Each tabula may be a complete floor, or each may be replaced by a number of smaller plates **(tabellae)** which together form a floor and is thus incomplete. They may be domed, horizontal, or inversely conical, or with a median boss or notch.

The development of dissepiments (Fig. 172, *1*) seems not to be possible without minor septa, though many genera may develop minor septa without developing **dissepiments.** They are small, curved or globose plates inclined parallel to the calical slope of the dissepimentarium, each overlapped slightly by its outer neighbor. In a **regular** dissepimentarium each is developed entirely in the interseptal loculus between a major and a minor septum, its side edges being drawn upward at the septal faces; the upward concavity so formed may become an-

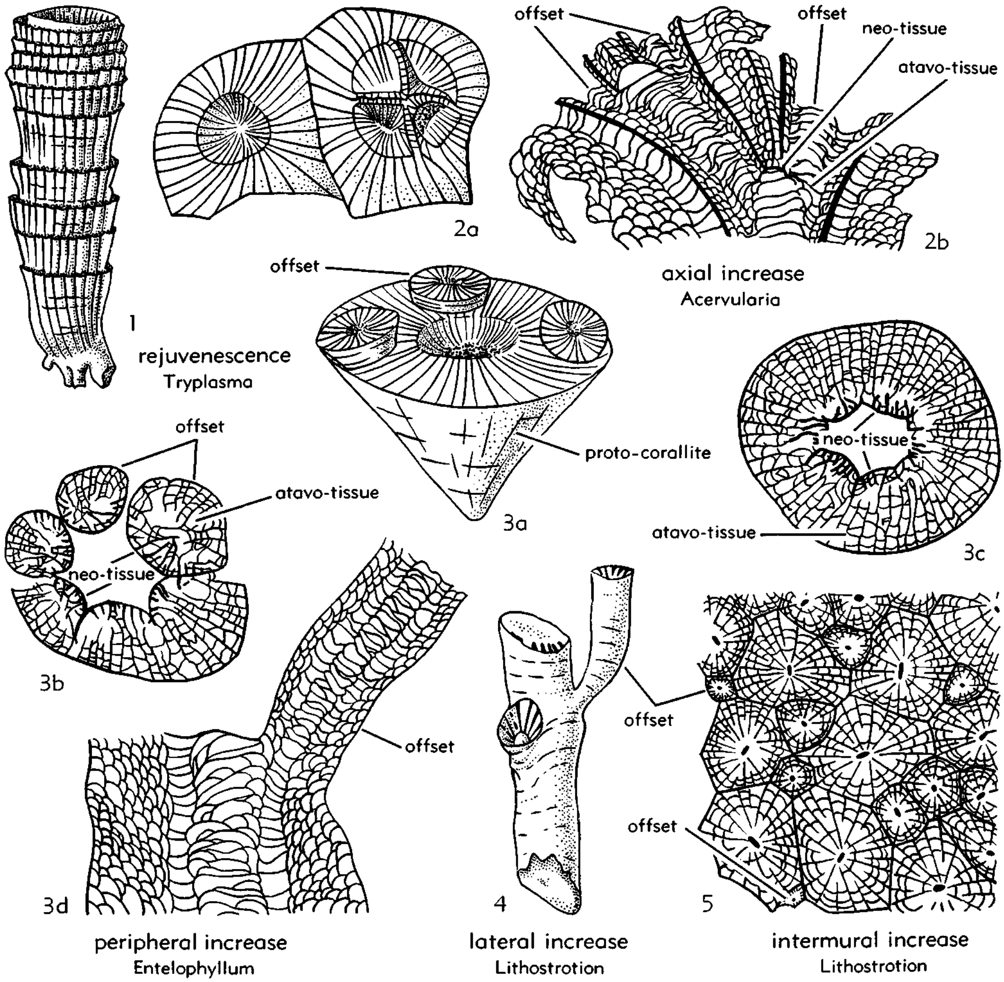

FIG. 173. Rugose coral morphology; rejuvenescence and increase (85). *1, Tryplasma lovéni* (EDW.-H.), Sil., Eu.; ×1. *2, Acervularia ananas* (LINNÉ), M.Sil., Eu.; *2a,* calical view; *2b,* median long. sec.; enlarged. *3, Entelophyllum articulatum* (WAHLENBERG), Sil., Eu.; *3a,* external view; *3b,c,* successive transv. secs.; *3d,* median long. sec.; enlarged. *4, Lithostrotion affine* (FLEMING), L.Carb., Eng.; ×1. *5, Lithostrotion* sp., L.Carb., Scot.; enlarged.

gular. A **herringbone** dissepimentarium forms where the minor septa fail, and the dissepiments between neighboring major septa inosculate. In a **lonsdaleoid** dissepimentarium, large dissepiments with a convex upper surface develop, associated with vertical discontinuities in the septa extending across more than one interseptal loculus. **Horseshoe** dissepiments occur in some phillipsastreids (Fig. 172,*1f*); these are dissepiments in single series placed vertically one above the other, horizontally based and with tall domes. In many Columnariina isolated dissepiments occur, both top and bottom edges being adherent to the wall. **Lateral** (blister-like) dissepiments may be developed similarly along the sides of septa (*Mochlophyllum,* Fig. 218,*1*). In some genera, flat dissepiments occur in association with a stereozone (*Acervularia*).

INCREASE OF CORALLITES

The original corallites of colonies are **protocorallites,** and those produced by **increase** are **offsets.** Three types of increase characterize the Rugosa (Fig. 173). (1) In

axial increase, the old corallite ceases to grow as such; 2 or more offsets are formed, occupying its whole calice, and are built up at the periphery of this old calice by the extension of its septa and epitheca, but at its axis by new septa laid down above its tabularium. (2) In **peripheral increase,** which does not necessarily cause the old corallite to cease growth, small offsets arise from the old calice in its outer septate zone. (3) In **lateral increase** (in branching coralla) or **intermural increase** (in cerioid coralla), the offsets appear to project laterally through or to spring from the wall of the old corallite.

"Rejuvenescence" is often observed (Fig. 173,*1*). A corallite, instead of continuing its growth with increasing or constant diameter, suddenly becomes much constricted, usually leaving a ledge of older calice round the constricted part. It then increases in diameter, and the process may be repeated. During rejuvenescence the corallite recapitulates earlier growth stages in a condensed form.

GLOSSARY OF MORPHOLOGICAL TERMS APPLIED TO CORALS

By Raymond C. Moore, Dorothy Hill, and John W. Wells

For convenience of reference, an alphabetically arranged glossary of morphological terms applied to corals has been prepared, including together terms commonly employed for description of Rugosa, Heterocorallia, Scleractinia, and Tabulata. This is advantageous because many terms are applied to 2 or more of these ordinal divisions of the Zoantharia.

Classification of the terms is indicated typographically, (1) those thought to be most important because most generally used being printed in boldface capital letters (as **SEPTUM**); (2) less universally used terms being printed in uncapitalized letters (as **amplexoid septum**); and (3) least important terms printed in italics (as *cnidocil*).

H=Heterocorallia; R=Rugosa; S=Scleractinia; T=Tabulata

acanthine septum. Type composed of a vertical or steeply inclined series of trabeculae and commonly marked by spinose projections along axially directed margin of septum (*see* other types: amplexoid, dilated, fenestrate, laminar, lonsdaleoid, naotic, retiform, rhopaloid) (R, S, T).

AHERMATYPIC. Not reef-forming.

ALAR FOSSULA. Relatively prominent interseptal space developed in position of an alar septum or adjoining it on side toward counter septum (*see* closed fossula, open fossula, also other types: cardinal, counter) (R).

ALAR SEPTUM (symbol, A). One of 2 protosepta located about midway between cardinal and counter septa, distinguished by insertion of newly formed metasepta on side facing counter septum (*see* other types: cardinal, counter, counter-lateral) (R).

alveolitoid. Type of reclined corallite having a vaulted upper wall and nearly plane lower one parallel to surface of adherence of colony, as in *Alveolites* (T).

ambulacrum. Trough of coenosteum separating collines on surface of some meandroid coralla (S).

amplexoid septum. Type characterized by extreme shortness except where septum is extended axially on distal side of a tabula, as in *Amplexus* (*see* other types: acanthine, dilated, fenestrate, laminar, lonsdaleoid, naotic, retiform, rhopaloid) (R).

anthoblast. *Acrosmilia* stage of ontogeny derived by transverse division from a solitary *Fungia* individual by extratentacular budding (*see* anthocaulus, anthocyathus) (S).

anthocaulus. *Acrosmilia* stage of ontogeny derived by transverse division from a solitary *Fungia* individual of sexual generation (*see* anthoblast, anthocyathus) (S).

anthocyathus. Neanic *Fungia* stage after separation from an anthocaulus or anthoblast (S).

aphroid. Massive corallum like astreoid type but with septa shortened peripherally, adjacent corallites being united by a dissepimental zone (*see* astreoid, cerioid, meandroid, plocoid, thamnasterioid) (R, S).

astreoid. Massive corallum in which septa of each corallite are fully developed but walls between corallites are lacking, septa of adjacent corallites generally in alternating position (*see* aphroid, cerioid, meandroid, plocoid, thamnasterioid) (R).

aulophylloid. Type of axial structure like that termed clisiophylloid but lacking a medial plate, as in *Aulophyllum* (*see* clisiophylloid, dibunophylloid, axial structure, axial vortex) (R).

AULOS. Axial structure consisting of tube commonly formed by abrupt sideward deflection of inner edges of septa and junction of them with neighbors (*see* axial structure) (R).

AXIAL. With reference to corallite oral-aboral axis.

AXIAL INCREASE. Budding of corallites in coralla characterized by appearance of dividing walls between newly formed corallites approximately in position of axis of parent (*see* lateral increase, peripheral increase, intermural increase) (R, T).

axial lobe. Irregular upwardly directed slender extension from axial edge of a septum (R).

AXIAL STRUCTURE. Collective term for various longitudinal structures in axial region of corallite, whether a solid or spongy rodlike columella or an axial vortex (*see* axial vortex, aulos, aulophylloid, clisiophylloid, dibunophylloid) (R, S).

axial vortex. Longitudinal structure in axial region of corallite formed by twisting of inner edges of major septa associated commonly with transverse skeletal elements (*see* axial structure, aulophylloid, clisiophylloid, dibunophylloid) (R).

axis of divergence. Generally vertical or oblique line in septum from which trabeculae incline inward and outward (*see* fan system) (R,S).

basal disc. Aboral fleshy part of coral polyp, typically subcircular in outline (*see* oral disc, basal plate) (S).

basal plate. Thin, initially formed part of corallite from which septa begin to be built upward (S).

calceoloid. Solitary corallite shaped like tip of a pointed slipper, as in *Calceola,* with angulated edges between flattened and rounded sides (*see* cylindrical, discoid, patellate, pyramidal, scolecoid, trochoid, turbinate) (R).

CALICE. Oral surface of corallite, generally bowl-shaped (H, R, S).

calicoblast layer. Part of ectoderm of coral polyp lying against skeleton.

calicular boss. Sharp-pointed protuberance in central part of calice in some corallites (R, S).

calicular pit. Abruptly depressed central part of calice in some corallites, surrounded by a calicular platform (R).

calicular platform. Part of calice floor having a subhorizontal plane or outwardly sloping (everted) form; generally surrounds a calicular pit (R).

canalicula. Minute canal, as in extended mesenterial chambers of some scleractinians.

CARDINAL FOSSULA. Relatively prominent interseptal space developed in position of cardinal septum (*see* closed fossula, open fossula, also other types: alar, counter) (R).

CARDINAL SEPTUM (symbol, C). Protoseptum in plane of bilateral symmetry of a corallite, distinguished from other protosepta by insertion of newly formed metasepta adjacent to it on both sides (*see* other types: alar, counter, counter-lateral) (R).

CARINA. Flangelike elevation on side of septum formed by thickened trabecula (*see* types: yard-arm, zigzag) (R).

cateniform. Corallum with corallites united laterally as palisades which appear chainlike in cross section, the palisades commonly forming a network (T).

ceratoid. Very slenderly conical, horn-shaped solitary corallite (R, S).

cerioid. Massive corallum in which walls of adjacent polygonal corallites are closely united (R, S, T).

CIRCUMMURAL BUDDING. Type of polystomodaeal budding with indirectly linked stomodaea arranged around discontinuous collines or monticules of corallum (*see* circumoral, intramural types of polystomodaeal budding) (S).

CIRCUMORAL BUDDING. Type of polystomodaeal budding with directly linked stomodaea arranged concentrically around central parent stomodaeum (*see* circummural, intramural types of polystomodaeal budding) (S).

clisiophylloid. Type of axial structure with short medial plate in cardinal-counter plane, in transverse sections resembling a spider web, as in *Clisiophyllum* (*see* aulophylloid, dibunophylloid, axial structure, axial vortex) (R).

closed fossula. Prominent interseptal space inclosed toward axis of corallite by united edges of septa (*see* fossula, open fossula) (R).

cnidocil. Same as nematocyst.

coenenchymal. Collective term for corallum having common skeletal tissue uniting individual corallites (S, T).

COENENCHYME. Collective term for both coenosteum and coenosarc (S, T).

coenosarc. Common soft tissue connecting coral polyps in a colony.

COENOSTEUM. Skeletal deposits formed between individual corallites of a colony (S).

colline. Protuberant ridge of corallum surface between corallites (*see* monticule).

COLUMELLA. Solid or nonsolid calcareous axial structure formed by various modifications of inner edges of septa; commonly projects into calice in form of a calicular boss (R, S). (*See* axial structure, axial vortex, also various types of columella: trabecular, parietal, spongy, fascicular, styliform, lamellar.)

column. Smooth cylindrical body wall of coral polyp between basal and oral discs (S).

complete mesentery. Defined by attachment of mesentery to stomodaeum (*see* incomplete mesentery).

complete tabula. Type consisting of a single platform, not composed of several small plates joined together (*see* incomplete tabula) (R, S, T).

compound synapticula. Type consisting of broad bars formed by fusion of opposed ridges on adjacent septa (*see* simple synapticula) (S).

compound trabecula. Composed of bundles of sclerodermites (*see* simple trabecula) (S).

connecting tubule. Subhorizontal tubular connection between neighboring corallites in fasciculate coralla (R, T).

contratingent. Minor septum that leans against adjoining major septum on side toward counter septum (R).

CORALLITE. Exoskeleton formed by an individual coral polyp (*see* protocorallite, corallum) (H, R, S, T).

CORALLUM. Exoskeleton of a coral colony or solitary coral (H, R, S, T).

costa. Prolongation of septum on outer side of corallite wall (S).

COUNTER FOSSULA. Relatively prominent interseptal space developed in position of the counter septum (*see* closed fossula, open fossula, also other types: alar, cardinal) (R).

COUNTER-LATERAL SEPTUM (symbol, KL). One of 2 protosepta that adjoin counter septum on either side (*see* other types: alar, cardinal, counter) (R).

COUNTER SEPTUM (symbol, K). Protoseptum opposite cardinal septum in position (see other types: alar, cardinal, counter-lateral) (R).

couple. Corresponding mesenteries on either side of dorsoventral plane (S).

cuneiform. Wedge-shaped corallite (S).

cupolate. Corallite with flat base and highly convex oral surface (S).

cylindrical. Nearly straight solitary corallite with subequal diameter except near base (*see* calceoloid, discoid, patellate, pyramidal, scolecoid, trochoid, turbinate) (H, R, S).

dendroid. Irregularly branching types of fasciculate corallum (*see* foliose, massive, phaceloid, ramose, reptant, umbelliferous) (R, S).

dibunophylloid. Type of axial structure like that termed clisiophylloid but with longer medial plate joining cardinal and counter septa, as in *Dibunophyllum* (*see* aulophylloid, clisiophylloid, axial structure, axial vortex) (R).

dicentric. Type of corallite formed by polyp retaining distomodaeal condition permanently (*see* monocentric, tricentric, polycentric) (S).

dilatated septum. Type partly or wholly thickened (*see* other types: acanthine, amplexoid, fenestrate, laminar, lonsdaleoid, naotic, retiform, rhopaloid) (R).

direct linkage. Type of intratentacular budding characterized by development of 2 or more mouths with stomodaea inside same tentacular ring and with mesenterial strands connecting adjacent stomodaea (*see* indirect linkage, trabecular linkage, lamellar linkage) (S).

DIRECTIVE COUPLE. Pair (couple) of mesenteries in so-called dorsoventral plane of coral polyp characterized by pleats on opposite rather than facing sides of mesenteries.

directive mesentery. One of 2 mesenteries of a directive couple.

discoid. Solitary corallite with button-like form (*see* calceoloid, cylindrical, patellate, pyramidal, scolecoid, trochoid, turbinate) (R, S).

DISSEPIMENT. Small domed plate forming a cyst-like enclosure in peripheral region of a corallite (R, S, T).

DISSEPIMENTARIUM. Peripheral zone of corallite interior occupied by dissepiments (R, S).

distal. Direction away from point of origin of a corallite (*see* proximal) (H, R, T).

DISTOMODAEAL BUDDING. Having 2 stomodaea developed within a common tentacular ring and 2 interstomodaeal couples of mesenteries between original and each new stomodaeum (*see* tristomodaeal, triple stomodaeal, and polystomodaeal types of budding) (S).

dorsal. In oral aspect of polyp, direction away from pleats of first lateral protocnemes (*see* ventral) (S).

ectoderm. Outer layer of oral and basal discs, tentacles, and column wall of coral polyp (*see* endoderm, mesogloea).

EDGE ZONE. Fold of body wall of coral polyp extending over edge of wall.

endoderm. Inner layer of outer body walls of coral polyp and occurring as a double lamina in mesenteries (*see* ectoderm, mesogloea).

endotheca. Collective term for dissepiments inside corallite wall (S).

entocoele. Space within pair of mesenteries (*see* exocoele).

ENTOSEPTUM. Septum developed within a mesenterial entocoele (*see* exoseptum) (S).

entotentacle. Tentacle occupying position over an entocoelous mesenterial chamber (*see* exotentacle).

EPITHECA. Sheath of skeletal tissue laterally surrounding a corallite comprising extension of basal plate (R, S, T).

exocoele. Space between adjacent pairs of mesenteries (*see* entocoele).

EXOSEPTUM. Septum developed within a mesenterial exocoele (*see* entoseptum) (S).

exotentacle. Tentacle occupying position over an exocoelous mesenterial chamber (*see* entotentacle).

EXOTHECA. Collective term for dissepiments outside of corallite wall (S).

extramural. Occurring outside of wall of a corallite.

EXTRATENTACULAR BUDDING. Formation of new coral polyps by invagination of the edge zone or coenosarc outside of ring of tentacles surrounding mouth of parent (*see* intratentacular budding) (S).

FAN SYSTEM. Fan-shaped pattern formed by diverging trabeculae in plane of septum (*see* axis of divergence) (S).

fascicular columella. Axial structure formed by twisted vertical ribbons or rods resembling pali or paliform lobes (*see* other types: lamellar, styliform, trabecular) (S).

fasciculate. Corallum with cylindrical corallites which are somewhat separated from one another but may be joined by connecting tubules (R, S, T).

fenestrate. Regularly perforated septum (S).

flabellate. Fan-shaped corallite or meandroid corallum with single continuous laterally free linear series of corallites (S).

foliaceous. Same as foliose.

foliose. Type of corallum with laminar branches (*see* dendroid, fasciculate, massive, phaceloid, ramose, reptant, umbelliferous) (R, S, T).

FOSSULA. Interseptal space distinguished by its unusual shape and size (*see* types; alar, cardinal, counter, closed, open) (R).

HERMATYPIC. Reef-forming.

herringbone dissepimentarium. Type in which dissepiments between major septa inosculate, minor septa failing (*see* regular dissepimentarium) (R).

holacanth. Trabecula seemingly consisting of a clear rod of calcite, as in septa of *Tryplasma* (R).

horseshoe dissepiment. Type with horizontal base and strongly arched top part, arranged in single vertical series (*see* lateral dissepiment) (R).

hydnophoroid. Type of corallum with corallite centers arranged around protuberant collines or monticules (S).

incomplete mesentery. Defined by lack of attachment to stomodaeum (*see* complete mesentery).

incomplete tabula. Type consisting of several small plates (tabellae) joined together (*see* complete tabula) (R, S, T).

INCREASE. Addition of corallites to colonies by budding (*see* axial increase, lateral increase, intermural increase, peripheral increase) (R, T).

incrusting. Thin coralla adhering to a surface and following its irregularities (S, T).

indirect linkage. Type of intratentacular budding characterized by development of 2 or more mouths with stomodaea inside same tentacular ring and with one or more couples of mesenteries between each pair of neighboring stomodaea (*see* direct linkage, trabecular linkage, lamellar linkage) (S).

INTERMURAL INCREASE. Budding of corallites in cerioid coralla characterized by sideward outgrowth of offsets, initial parts of which become surrounded by growing wall of parent corallite (*see* axial increase, lateral increase, peripheral increase) (R, T).

interseptal ridge. Longitudinal elevation on outer side of corallite wall, corresponding in position to space between a pair of adjacent septa inside of wall (*see* septal groove) (H, R).

intramural. Within column wall of a polyp.

INTRAMURAL BUDDING. Type of polystomodaeal budding with stomodaea directly or indirectly linked in a single linear series (*see* circummural types of polystomodaeal budding) (S).

INTRATENTACULAR BUDDING. Formation of new coral polyps by invagination of oral disc of parent inside ring of tentacles surrounding its mouth (*see* extratentacular budding) (S).

lamellar columella. Platelike axial structure, in rugose corals generally in plane of cardinal and counter septa, in scleractinians oriented parallel with longer axis of calice (*see* other types: fascicular, styliform, trabecular) (R, S).

lamellar linkage. Connection between corallite centers corresponding to direct linkage of stomodaea (*see* direct linkage, indirect linkage, trabecular linkage) (S).

laminar septum. Longitudinal radial partitioning wall in corallite formed of trabeculae that are contiguous throughout their length (H, R, S, T).

lateral dissepiment. Type having blister-like form developed in isolated manner on sides of septa (*see* horseshoe dissepiment) (R).

LATERAL INCREASE. Budding of corallites in fasciculate coralla characterized by sideward outgrowth of offsets (*see* axial increase, peripheral increase, intermural increase) (R, T).

linear series. Corallites arranged in a confluent row enclosed within continuous walls (S).

longitudinal skeletal element. Part of corallite oriented in direction of growth of polyp (H, R, T).

lonsdaleoid septum. Type characterized by discontinuity toward peripheral edge of septum, as in *Lonsdaleia* (*see* other types: acanthine, amplexoid, dilated, fenestrate, laminar, naotic, retiform, rhopaloid) (R).

MAJOR SEPTUM. One of the protosepta or metasepta (*see* minor septum) (H, R, S).

MARGINARIUM. Peripheral part of interior of a corallite distinguishable from tabularium by difference in constituent structures, generally abundant dissepiments or dense deposit of skeletal tissue producing a stereozone (R, T).

MASSIVE. Corallum composed of corallites closely in contact with one another (*see* dendroid, fasciculate, foliose, ramose, reptant, umbelliferous) (R, S, T).

meandroid. Corallum characterized by meandering rows of confluent corallites with walls only between the rows (*see* aphroid, astreoid, cerioid, plocoid, thamnasteroid) (S, T).

mesenterial filament. Ribbon-like prolongation of inner free margin of a mesentery.

MESENTERY. Fleshy radially disposed lamina attached to inner surface of oral disc and column wall of coral polyp.

mesogloea. Noncellular jelly-like middle layer of outer walls and mesenteries of coral poyps (*see* ectoderm, endoderm).

metacneme. One of the mesenteries developed after appearance of protocnemes (S).

METASEPTUM. One of the main septa of a corallite other than protosepta, generally distinguished by their extension axially much beyond that of minor septa (*see* major septum) (H, R, S).

MINOR SEPTUM. One of the relatively short septa that commonly are inserted between adjacent major septa (R, S).

monacanth. Simple trabecula in which fibers are related to a single center of calcification) (R).

monocentric. Type of corallite formed by a monostomodaeal polyp (*see* dicentric, tricentric, polycentric) (S).

monostomatous. Single-mouthed; refers to solitary coral polyps.

monostomodaeal. Polyp stomodaea each having its own tentacular ring after originating by di- or tristomodaeal budding (S).

monticule. Protuberant portion of corallum surface produced in circummural budding (S).

MURAL PORE. Circular or oval small hole in wall between adjoining corallites, as in some tabulates (T).

naotic septum. Type characterized by development peripherally in a series of closely spaced dissepiment-like plates, as in *Naos* (*see* other types: acanthine, amplexoid, dilated, fenestrate, laminar, lonsdaleoid, retiform, rhopaloid) (R).

NEMATOCYST. Stinging or adhesive body characteristic of cnidarians.

OFFSET. New corallite in corallum formed by "budding" (H, R, S, T).

open fossula. Prominent interseptal space not inclosed toward axis of corallite by united edges of septa (*see* fossula, closed fossula) (R).

OPERCULUM. Lidlike covering of calice in some corallites, formed of one or more independent plates (R).

oral disc. Aboral part of coral polyp above column, its center containing the mouth (*see* basal disc).

orthocneme. Longitudinal muscle sheet produced on surface of a sterigmatocneme, by cleavage and elongation toward axis of coral polyp giving rise to complete mesenteries.

pair. Adjacent mesenteries with pleats facing one another (S).

paliform lobe. Structure closely resembling a palus but formed by detached trabecular offset from inner edge of a septum, appearing in vertical succession and differing from pali in not being formed as a result of substitution (*see* palus) (S).

PALUS (pl., pali). Vertical lamella or pillar developed along inner edge of certain entosepta, comprising remnant part of a pair of exosepta joined at their inner margins (*see* paliform lobe) (S).

paratheca. Corallite wall formed by closely spaced dissepiments (*see* septotheca, synapticulotheca) (S).

parietal columella. Same as trabecular columella (S).

parricidal budding. Production of new polyp from inner surface of fragment of parent consisting of wedge-shaped part split off lengthwise (S).

patellate. Low solitary corallite with sides expanding from apex at angle of about 120 degrees (*see* calceoloid, cylindrical, discoid, pyramidal, scolecoid, trochoid, turbinate) (R, S).

perforate. Type of wall between corallites of some colonies characterized by presence of many irregularly arranged small openings through wall (S, T).

PERIPHERAL INCREASE. Budding of corallites in coralla characterized by offsets that arise in marginarial or coenenchymal tissue (*see* axial increase, lateral increase, intermural increase) (R, T).

peristome. Part of oral disc surrounding mouth of coral polyp.

phaceloid. Fasciculate corallum having subparallel corallites (*see* dendroid, foliose, massive, ramose, umbelliferous) (R, S, T).

PLANULA. Free-swimming larval stage of coral polyp.

pleat. Longitudinal fold of retractile muscle fibers with associated mesogloea on side of a mesentery.

plocoid. Massive corallum in which corallites have separated walls and are united by costae, dissepiments or coenosteum (term originally used with different meaning for Rugosa, but since abandoned) (S).

polycentric. Type of corallite formed by polyp retaining polystomodaeal condition permanently (*see* monocentric, dicentric, tricentric) (S).

POLYSTOMODAEAL BUDDING. Having more than 3 stomodaea developed within a common tentacular ring (*see* distomodaeal, tristomodaeal, triple stomodaeal types of budding and intramural, circumoral, and circummural types of polystomodaeal budding) (S).

Pourtalès plan. Arrangement of septa in some scleractinians (notably dendrophylliids) characterized by much greater development of exosepta than that of entosepta (S).

protocneme. One of mesenteries of first 12 (forming 6 mesenteric couples and pairs) developed in early ontogeny of the coral polyp (*see* metacneme) (S).

protocorallite. First-formed corallite of a colony (R, S, T).

PROTOSEPTUM. One of 6 first-formed septa of a corallite (H, R, S).

proximal. Direction toward point of origin of a corallite (*see* distal) (H, R, T).

pyramidal. Solitary corallite with flattened sides that meet at angles (*see* calceoloid, cylindrical, discoid, patellate, scolecoid, trochoid, turbinate) (R).

QUADRANT. Space in interior of a corallite bounded by cardinal septum and an alar septum or by counter septum and an alar septum (R).

radiciform process. Rootlike epithecal outgrowth of corallite wall, serving for fixation (*see* talon) (R, S, T).

ramose. Branching form of cerioid, plocoid, thamnasterioid, hydnophoroid, or meandroid corallum (*see* dendroid, fasciculate, foliose, massive phaceloid, reptant, umbelliferous (R, S, T).

reclined. Corallite growing and opening obliquely with respect to surface of corallum (*see* alveolitoid) (T).

regular dissepimentarium. Type in which dissepiments are developed only in spaces between major and minor septa (*see* herringbone dissepimentarium (R).

reptant. Corallite with creeping habit, growing attached along one side to some foreign body (*see* dendroid, fasciculate, foliose, massive, phaceloid, ramose, umbelliferous) (R, S, T).

reptoid. Creeping (*see* reptant).

retiform septum. Type of perforate septum composed of an irregular network of skeletal tissue (*see* other types: acanthine, amplexoid, dilated, fenestrate, laminar, lonsdaleoid, naotic, rhopaloid) (R).

rhabdacanth. Trabecula characterized by shifting centers of fibrous growth grouped around a main one (R).

rhopaloid septum. Type characterized by distinctly thickened axial edge, appearing club-shaped in cross section (*see* other types: acanthine, amplexoid, dilated, fenestrate, laminar, lonsdaleoid, naotic, retiform) (R).

rootlet. See radiciform process (R, S).

scale. Small platelike structure attached to septal grooves and interseptal ridges in some corallites, as *Tryplasma* (R).

SCLERENCHYME. Calcareous tissue of corallites; term used especially for notably thickened parts of skeleton (*see* stereome) (R).

sclerodermite. Center of calcification and surrounding cluster of calcareous fibers; apparent primary element in septa (S).

scolecoid. Solitary corallite of cylindrical type but bent irregularly in wormlike manner (*see* calceoloid, cylindrical, discoid, patellate, pyramidal, trochoid, turbinate) (R, S).

SEPTAL CYCLE. All septa belonging to a single stage in ontogeny of corallite as determined by order of appearance of septal groups, 6 protosepta comprising first cycle and later-formed exosepta and entosepta in constantly arranged succession being introduced in sextants (S).

septal dentation. Same as septal tooth (S).

SEPTAL GROOVE. Longitudinal furrow on outer side of corallite wall, corresponding in position to a septum on inner side of wall (*see* interseptal ridge) (H, R).

septal lamella. Radially disposed longitudinal plate in axis of a corallite aligned with a septum but not joined to it (R).

septal tooth. Small projection along upper margin of a septum formed by extension of a trabecula beyond calcareous tissue connecting it with others (S).

septotheca. Corallite wall formed by thickened outer parts of septa along axis of trabecular divergence (*see* paratheca, synapticulotheca) (S).

SEPTUM. Radially disposed longitudinal partition of corallite occurring between or within mesenterial pairs (*see* acanthine, alar, amplexoid, cardinal, counter, counter-lateral, dilated, entoseptum, exoseptum, fenestrate, laminar, lonsdaleoid, major, metaseptum, minor, naotic, retiform, rhopaloid) (H, R, S, T).

simple synapticula. Type formed by union of 2 opposed granulations (*see* compound synapticula) (S).

simple trabecula. Composed of a series of single sclerodermites (*see* compound trabecula) (S).

SOLITARY. Corallite of polyp not forming part of a colony (H, R, S).

solum. Small subhorizontal plate in tubule of coenenchyme, as in *Heliolites* (T).

spongy columella. See trabecular columella (S).

squamula. Small plate projecting subhorizontally in eavelike manner from wall of corallite toward axis, as in *Emmonsia* (T).

STEREOME. More or less dense calcareous skeletal deposit, generally covering and thickening various parts of corallite (S).

STEREOZONE. Area of dense skeletal deposits in a corallite, generally peripheral or subperipheral in position (R, S, T).

sterigmatocneme. Longitudinal muscle sheet appearing as bulge in endoderm of coral polyp's body wall forming base for development of a mesentery.

stomodaeum. Esophagus-like tubular passageway or pharynx leading from mouth of coral polyp to gastrovascular cavity.

styliform columella. Solidly fused and longitudinally projecting axial structure, in scleractinians with entosepta fused to it by secondary stereome (*see* other types: fascicular, lamellar, trabecular) (R, S).

substitution. Replacement of a temporary exoseptum by a permanent entoseptum (S).

synapticula. Small rods or bar connecting opposed faces of adjacent septa and perforating mesenteries between them (*see* types: simple, compound) (S).

synapticulotheca. Corallite wall formed by one or more rings of simple or compound synapticulae along axis of trabecular divergence (*see* paratheca, septotheca) (S).

TABELLA. Small subhorizontally disposed plate in central part of corallite forming part of an incomplete tabula (R, T).

TABULA. Transverse partition of corallite, nearly plane, or upwardly convex or concave, extending to outer walls or occupying only central part of corallite (H, R, S, T).

tabular dissepiment. Somewhat flat plates extending across an entire scleractinian corallite or confined to its axial part (*see* tabula) (S).

TABULARIUM. Axial part of the interior of a corallite in which tabulae are developed (H, R, S, T).

talon. Buttress produced by outgrowth of corallite wall, serving as aid in fixation (*see* radiciform process) (R).

TENTACLE. Movable tubular extension of soft integument rising from oral disc of coral polyp, closed terminally at tip, commonly simple but rarely forked (*see* entotentacle, exotentacle).

thamnasterioid. Massive corallum characterized by absence of corallite walls and by confluent septa that join neighboring corallites together, with pattern of septa resembling lines of force in a magnetic field (*see* aphroid, astreoid, cerioid, meandroid, plocoid; also footnote, p. F239) (R, S).

theca. See wall.

TRABECULA. Pillar of radiating calcareous fibers comprising skeletal element in structure of septum and related components (*see* simple trabecula, compound trabecula, monocanth, rhabdacanth) (H, R, S, T).

trabecular columella. Spongy axial structure formed of trabeculae loosely joined with synapticulae or paliform lobes (*see* other types: fascicular, lamellar, styliform) (S).

trabecular linkage. Connection between corallite centers corresponding to indirect linkage of stomodaea (*see* direct linkage, indirect linkage, lamellar linkage) (S).

trabecular spine. More or less completely isolated trabeculae in plane of a septum; may be vertically discontinuous with interruption by endotheca (S).

transverse division. Formation of new coral polyps by separation of parent by splitting into 2 parts transverse to oral-aboral axis (S).

tricentric. Type of corallite formed by polyp retaining tristomodaeal condition permanently (*see* monocentric, dicentric, polycentric) (S).

triple stomodaeal budding. Same as tristomodaeal budding except that 3 stomodaea invariably form triangle and only one interstomodaeal couple of mesenteries occurs between each pair of neighboring stomodaea (*see* distomodaeal, tristomodaeal, and polystomodaeal budding) (S).

tristomodaeal budding. Having 3 stomodaea developed within a common tentacular ring, occurring in series or forming a triangle, with 2 interstomodaeal couples of mesenteries between original and each new stomodaeum (*see* distomodaeal, triple stomodaeal, and polystomodaeal types of budding) (S).

trochoid. Solitary horn-shaped corallite with sides regularly expanding from apex at angle of about 40 degrees (*see* calceoloid, cylindrical, discoid, patellate, pyramidal, scolecoid, turbinate) (R, S).

turbinate. Solitary horn-shaped corallite with sides expanding from apex at angle of about 70 degrees (*see* calceoloid, cylindrical, discoid, patellate, pyramidal, scolecoid, trochoid) (R, S).

tympanoid. Squat drum-shaped form of corallite (S).

umbelliferous. Corallum having corallites arranged like ribs of an umbrella, growing outward in whorls (T).

ventral. In oral aspect of polyp, direction toward which the pleats of the first couples of lateral protocnemes face (S).

WALL. Skeletal deposit inclosing column of polyp and uniting outer edges of septa; it is variously formed in different corallites (*see* septotheca, paratheca, synapticulotheca) (S).

yard-arm carinae. Oppositely placed carinae that give appearance of yard-arms along a mast to cross sections of septum (*see* zigzag carinae) (R).

zigzag carinae. Not quite oppositely placed carinae on the 2 sides of a septum (*see* yard-arm carinae) (R).

zooxanthella. Symbiotic unicellular yellow-brown protistan in endoderm of hermatypic coral polyps.

CLASSIFICATION

MAIN FEATURES

General agreement has not yet been reached on subdivision of the Rugosa. The rugose coral studies of the last half century, led by STANLEY SMITH, have been concerned very largely with the fixing and precise description of type species and type specimens, and with the description of stratigraphical assemblages, all based on thin sections of coralla as an essential preliminary to systematic classification (33). Much further such work is required before safe conclusions can be drawn, for we are still ignorant of the precise internal structure of the type specimens of many species; and perhaps we would be well advised to wait yet longer before attempting systematic classification into families and superfamilies. Nevertheless, several such attempts, all differing widely, have been made recently, and another is made herein. The classification here proposed has benefited from correspondence with Dr. SMITH, and Dr. M. LECOMPTE, and from study of the published views of WANG (53), STUMM (52) and others, though there are still differences of opinion between us. It does not seem as if any single character, such as septal structure, is the key to subdivision of the Rugosa.

It is considered herein that three suborders of rugose corals may be recognized, each with characteristic marginaria and tabulae; these are termed Streptelasmatina, Columnariina, and Cystiphyllina. The Streptelasmatina may be divided into two superfamilies, the Cyathaxoniicae and Zaphrenticae, and while the former appear to have had a common descent, parts of the latter probably derived from different Cyathaxoniicae, as well as from *Streptelasma* itself. It is not improbable that all Streptelasmatina developed from *Lambeophyllum,* but our knowledge of the morphology of this oldest of Rugosa genera is not precise. The Scleractinia may well have developed from Permian Cyathaxoniicae. In the Streptelasmatina, the tabulae are fundamentally domed; in the Cyathaxoniicae, the marginarium, if developed, is a narrow to moderately wide stereozone, while in the Zaphrenticae it may be a wide septal stereozone or a dissepimentarium in which the dissepiments are small, globose, and interseptal, not disrupting the major septa. The septa of the Zaphrenticae show many different complex arrangements of the trabeculae and they may have lobed axial edges; an axial structure is common, particularly in late forms.

The Columnariina are possibly all descended from *Columnaria alveolata* GOLDF. Their tabulae are horizontal or broad flat-topped domes, or axially sagging; in late forms an axial structure develops. Marginaria, where developed in width, are distinctive; a single series of impersistent dissepiments may form, or more commonly, a wide septal stereozone may be replaced by long lonsdaleoid dissepiments which disrupt the major septa. None have septa with lobed axial edges and typically the septa are thin in the tabularium.

The Cystiphyllina are possibly all derived from Ordovician *Tryplasma;* they are characterized by acanthine septa and are divided into 4 families. The Tryplasmatidae have complete flat tabulae and a marginal stereozone in which the cores of the trabeculae appear set in lamellar sclerenchyme. In the Cystiphyllidae, in which the tabulae are incomplete and inversely conical, the marginarium is a dissepimentarium with discrete trabeculae based on the dissepiments. If WEDEKIND's (54, 55) biostratigraphical conclusions are correct, in the Devonian these discrete trabeculae united to form the partly laminar septa of the Digonophyllidae. This suborder died out with the Devonian.

A tabular summary of suprageneric divisions recognized in the order Rugosa showing stratigraphic range of each as now known and including record of the number of genera and subgenera recognized in each taxonomic unit follows. The presence of 8 genera in a family, for example, is indicated by "(8)" and occurrence of 4 genera and 8 subgenera in a family or other taxonomic division is shown as "(4; 8)."

Suprageneric Divisions of Rugosa

Rugosa *(order),* septa introduced in 4 quadrants with tendency to produce bilateral symmetry (333; 12). *Ord.-Perm.*

Streptelasmatina *(suborder),* marginarium com-

prising a septal stereozone or dissepimentarium, tabulae mostly domed (218). *Ord.-Perm.*
Cyathaxoniicae *(superfamily)* (77). *Ord.-Perm.*
Metriophyllidae (18). *Ord.-Perm.*
Laccophyllidae (4). *Sil.-Perm.*
Petraiidae (2). *Sil.-Dev.*
Polycoeliidae (21). *?Sil., Dev.-Perm.*
Polycoeliinae (10). *?Sil., Carb.-Perm.*
Plerophyllinae (6). *M.Dev.-Perm.*
Endotheciinae (1). *Perm.*
Tachylasmatinae (4). *Carb.-Perm.*
Hadrophyllidae (8). *L.Dev.-M.Carb.*
Cyathaxoniidae (2). *Carb.-Perm.*
Amplexidae (1). *L.Carb.*
Lophophyllidiidae (5). *Carb.-Perm.*
Timorphyllidae (5). *L.Carb.-L.Perm.*
Hapsiphyllidae (11). *L.Carb.-L.Perm.*
Zaphrenticae *(superfamily)* (141). *Ord.-Perm.*
Streptelasmatidae (24). *M.Ord.-M.Dev.*
Streptelasmatinae (18). *M.Ord.-M.Dev.*
Kodonophyllinae (4). *L.Sil.-L.Dev.*
Acrophyllinae (2). *L.Dev.*
Halliidae (12). *Ord.-Dev.*
Lykophyllinae (8). *Ord.-Sil.*
Halliinae (4). *L.Dev.-M.Dev.*
Arachnophyllidae (8). *Sil.-Dev.*
Arachnophyllinae (6). *Sil.*
Kyphophyllinae (1). *Sil.*
Ptychophyllinae (1). *Sil.*
Acervulariidae (3). *Sil.*
Mycophyllidae (4). *M.Sil.-L.Dev.*
Zaphrentidae (9). *Dev.*
Phillipsastraeidae (21). *M.Sil.-L.Carb.*
Phillipsastraeinae (14). *Sil.-L.Carb.*
Phacellophyllinae (7). *Dev.*
Craspedophyllidae (1). *Dev.*
Lithostrotionidae (13). *L.Carb.-L.Perm.*
Aulophyllidae (24). *Carb.-Perm.*
Aulophyllinae (15). *Carb.-Perm.*
Amygdalophyllinae (7). *L.Carb.*
Yatsengiinae (2). *L.Perm.*
Cyathopsidae (19). *L.Carb.-Perm.*
Calostylidae (3). *Sil.*
Columnariina *(suborder)* (60; 2). *Ord.-Perm.*
Stauriidae (18). *Ord.-Dev., ?L.Carb.*
Spongophyllidae (5). *M.Sil.-U.Dev.*
Chonophyllidae (14). *Sil.-Dev.*
Chonophyllinae (5). *Sil.*
Endophyllinae (8). *?Sil., Dev.*
Blothrophyllinae (1). *M.Dev.*
Ptenophyllidae (10). *Sil.-Dev.*
Stringophyllidae (1). *L.Dev.-M.Dev.*
Lonsdaleiidae (12; 2). *Carb.-Perm.*
Lonsdaleiinae (6). *Carb.*
Waagenophyllinae (6; 2). *L.Perm.*
Cystiphyllina *(suborder)* (30; 10). *Ord.-Dev.*
Tryplasmatidae (9). *Ord.-Dev.*
Cystiphyllidae (7). *Sil.*
Goniophyllidae (6). *Sil.-Dev.*
Digonophyllidae (8; 10). *Dev.*
Zonophyllinae (6). *L.Dev.-M.Dev.*
Digonophyllinae (2; 10). *M.Dev.*
Incertae sedis (25). *Ord.-Perm.*

STRATIGRAPHIC DISTRIBUTION

SUMMARY STATEMENT

The Rugosa are first known in Blackriveran strata of Middle Ordovician age in North America; they immediately spread round the globe, but remained relatively unimportant until the late Early Silurian and Middle Silurian, which were times of active reef-building and rapid evolution of new forms. They are less abundant in Upper Silurian and lower Lower Devonian strata but late Early Devonian and Middle Devonian times once more produced a great wealth of new forms. The Late Devonian was in most parts a lean epoch, but the Early Carboniferous was another time of great activity in coral evolution. Until the Devonian the Rugosa was in general less important in numbers of individuals than the Tabulata, and during the Devonian approximate equality was attained; but the Early Carboniferous accession of coral vitality did not affect the Tabulata, which then became relatively unimportant. Middle and Late Carboniferous times saw corals flourishing in only a few regions; but in the Artinskian there was a fresh access of vigor, this time on a much-lessened scale; by the end of the Artinskian practically all of the Rugosa, save members of the Cyathaxoniicae, had died out; and though these had failed by the end of the Permian, it was apparently from this group that the Mesozoic, Tertiary, and Recent Scleractinia arose (42).

RELATIVE IMPORTANCE OF RUGOSA IN SUCCESSIVE PERIODS

ORDOVICIAN

The Rugosa first appeared in Blackriveran strata in the shallow seas associated with the Appalachian geosyncline and it is quite probable that all three suborders were represented therein, the Streptelasmatina by *Lambeophyllum,* the Columnariina by nonspinose *Columnaria,* and the Cystiphyllina by spinose *"Columnaria."* They are thus of later appearance than the Tabulata, and the possible relation between Tabulata and Rugosa is to be sought in these early North American strata.

During the Ordovician, the Rugosa are fewer in species and individuals than the Tabulata, and all are without dissepimentaria, the only type of marginarium developed being a rather narrow septal stereozone. Further, the tabulae are complete or represented each by only 2 or 3 tabellae. Streptelasmatina and Stauriidae are common, Tryplasmatidae rare.

SILURIAN

Early in the Silurian the curious Calostylidae appeared, forms with perforate septa, reticulate axial structures, and marginaria unknown in other forms. Perforate septa are common in the Scleractinia; the Calostylidae seem to have tried this mode in the Silurian, but were unsuccessful and left no descendants in the Devonian.

Four bursts of evolutionary activity have occurred in the Rugosa since their appearance in the Middle Ordovician. The first of these was in late Llandovery times, when the three suborders separately evolved dissepimentaria. Thus, in the Streptelasmatina, we find the Lykophyllinae and the Arachnophyllinae with their characteristic small interseptal dissepiments; in the Columnariina, the early endophylloid, *Strombodes contortiseptatum* Dybowski, developed its characteristic lonsdaleoid dissepiments which disrupt the major septa in a septal stereozone; and in the Cystiphyllina, the Cystiphyllidae and Goniophyllidae entered with their cystlike plates and discrete trabeculae. The Middle Silurian saw a continuation of this burst; all these families, together with the Streptelasmatidae, Metriophyllidae, Columnariina, and Tryplasmatidae, which continued on from the Ordovician, developed many new forms; and the 2 characteristically Devonian families, Ptenophyllidae and Phillipsastraeidae, originated, though their representatives remained rare.

Whether this first burst of evolution was promoted by exploitation of the reef habitat is unclear; there may have been some connection. Coral reefs were already known in the Ordovician, though rarely, if we understand by reefs, structures which grew above the level of the surrounding sea floor, maintaining their upward growth against wave-base erosion by the activities of their framework organisms (algae, stromatoporoids, or corals) and by filling in the interstices in the framework by lime flour, shells, echinoderms, and their detritus; but the Middle and Upper Silurian rocks contain many such reefs, in which, however, Rugosa played a part minor to that of Stromatoporoidea, Tabulata, and probably also of algae. In these Silurian reefs, solitary as well as colonial Rugosa occur.

DEVONIAN

The next climax of evolutionary activity is not clearly to be correlated with the assumption of some new morphological feature like the dissepiment in the first climax; most of its vitality of change went into the wealth of families and species produced in the late Early and early Middle Devonian, and cannot as yet be bracketed with climatic or other geographical factors. In the Zaphrenticae, the new subfamily Halliinae and the Zaphrentidae appeared, probably first in America, and the Phillipsastraeidae developed in great fecundity and variability, experimenting with the horseshoe dissepiment and with complex arrangements of trabeculae in the septa. The Streptelasmatidae themselves produced one or 2 genera with the small globose interseptal dissepiments of other families. Cyathaxoniicae diversified a little also. In the Columnariina, the Stauriidae and Endophyllinae were only moderately active, but the Ptenophyllidae reached their acme, experimenting like the new Stringophyllidae in septal arrangement and structure, and dying out in the Late Devonian. In the Cystiphyllina, the Tryplasmatidae waned and were extinct by the late Middle Devonian; but the record shows a great burst of activity in the Digonophyllidae, which, according to Wedekind, experimented in the production of laminar septa from discrete trabeculae. These also became extinct before the end of the Devonian.

CARBONIFEROUS

The transition from Devonian to Carboniferous coincided with the greatest transformation of rugose faunas, the chief feature being the development generally of axial structures in all 3 suborders. The primitive Cyathaxoniicae alone continued the slow evolution of its old families, but one new family, the Timorphyllidae, developed an axial structure. Of the Zaphrenticae, the older families Streptelasmatidae, Halliidae, Zaphrentidae, and Phillipsastraeidae seem to have become extinct, but 2 new families, Lithostrotionidae and the Aulophyllidae, each characterized by axial structure, developed. In the Columnariina, also, the Stauriidae and Endophyllinae became extinct; the new family is the Lonsdaleiidae with axial structures.

PERMIAN

The fourth great change in the Rugosa was the final disappearance, during the Artinskian, of all families except those of the Cyathaxoniicae, which were distinguished by having their protosepta developed more strongly than the metasepta, and by characteristic rhopaloid septa.

The earliest Scleractinia may have developed directly from these Polycoeliidae as surmised by SCHINDEWOLF (42), by the general assumption of dominance by the 6 protosepta, the limiting of the minor septa to 6, and the insertion of tertiary and later septa in the counter quadrants as well as in the cardinal and alar quadrants. The last Rugosa were extinct by the end of the Permian.

ECOLOGY

Like the compound Scleractinia today, compound Rugosa frequently acted as framework organisms in reefs; whether these profuse growths then, as now, occurred only in warm shallow seas is still for consideration; the sedimentary environment of the Paleozoic reefs certainly indicates a depth of formation quite similar to that of today, and, in the Carboniferous, at least, profuse coral growth, and in some places reef growth apparently occurred in warm-water seas (23).

In the Paleozoic too, it seems that small, solitary corals (Cyathaxoniicae) were able to exist in numbers in conditions where the large compound corals could not flourish, the sedimentary environment suggesting deeper seas with less light; while in the Carboniferous at least the large, solitary Rugosa, chiefly Zaphrenticae, appear to have flourished best in intermediate environments (18).

ONTOGENY

Studies on the growth of individual corallites have been practically confined to solitary corals, and have concentrated in the main on the position and order of insertion of the septa. Fundamentally, it seems that 6 protosepta are first inserted, but their order of appearance is not invariable (18); a common mode is cardinal and counter together and conjoined, then the 2 alar septa, and last the 2 counter-lateral septa. Thereafter, major septa of the Rugosa are inserted in only 4 positions, on either side of the cardinal septum and on the counter side of the alar septa; minor septa may appear with these major septa, or may delay and be inserted as a cycle between them.

Another aspect of ontogenetic studies is the indication they may give of phylogeny. CARRUTHERS' (4) work on the Carboniferous cyathaxoniicid *Zaphrentites delanouei* shows that the arrangement of septa characteristic of the adult appears in the pre-adult stage in the ontogeny of its descendent species; but the number of such ancestors reflected in the ontogeny is limited. Individuals of a species share a characteristic ontogeny.

Dissepimentaria do not appear in the earliest stages; nor do complex axial structures.

Rejuvenescence (reversion of the corallites to an earlier ontogenetic stage) is common in Rugosa, and is often associated with a contraction in diameter; sometimes too, the marginarium of the calice is deserted by the polyp at the time of rejuvenescence, and grows again only as the diameter increases.

EVOLUTIONARY TRENDS

(1) The most important of the trends in development of the Rugosa seems to have been the production of a marginarium between the epitheca and tabularium. Many kinds of marginarium were evolved, but they may be grouped into 3 main types:
   i. A septal stereozone, formed by the expansion to contiguity of the peripheral edges of the septa.
   ii. A regular dissepimentarium, in which a series of small highly arched dissepiments with troughlike upper surfaces developed in the loculi between major and minor septa.
   iii. A lonsdaleoid dissepimentarium, in which a series of moderately large blister-like dissepiments disrupt both major and minor septa; in many they seem to have developed within a septal stereozone.

(2) A universal trend is toward the replacement of complete tabulae by tabellae.

(3) Another trend is carried on in a great variety of ways; it is towards complication in arrangement of the trabeculae within the septa, and this affects the Streptelasmatina particularly. In the Cystiphyllina it is a trend by which laminar septa are developed from the discrete trabeculae of the primitive members of the suborder. A manifestation of this trend also may be responsible for the development in many late Paleozoic Rugosa of all the fibers at right angles to the median plane of the septum. A few Cyathaxoniicae are affected by a rhopaloid swelling of the axial edges of the septa.

(4) A trend which is unimportant from the point of view of number of genera affected is seen in the predominance of the protosepta over the remaining septa in some Cyathaxoniicae.

(5) Also unimportant in the number of genera affected, is a 5th trend, toward development of a 3rd order of septa (tertiary septa) between the major and minor septa, at different times, as in the Silurian *Acervularia* and the Artinskian *Iranophyllum.*

(6) Similarly, the development of perforate septa in the Silurian Calostylidae may be recognized as a trend. This and trends 4 and 5 affecting the septa seem to be forerunners of developments characteristic in Scleractinia.

(7) Another trend affecting the septa, which may appear in any lineage, is their withdrawal from the axis, generally combined with masking of their original pinnate arrangement and with their thinning.

(8) A very important development is the axial structure. This forms infrequently before the Early Carboniferous, but it then appears in most families, either as a simple axial rod, continuous or discontinuous with the counter septum, or as a complex of tabellae and septal lamellae. Axial structures may disappear in an apparent reversal of this trend, the septa withdrawing from the axis, and the tabulae flattening.

(9) The formation of compound from solitary coralla may be noted as a trend, culminating in such compaction of the corallites that plocoid coralla are developed. Stratigraphic evidence suggests that solitary corals may evolve from compound, in an apparent reversal of this trend.

SYSTEMATIC DESCRIPTIONS

Order RUGOSA Milne-Edwards & Haime, 1850

[*nom. transl.* NICHOLSON, 1872 (*ex* suborder Rugosa M.EDW.-H., 1850)] [=suborder Stauracea VERRILL, 1865; subclass Tetracorallia HAECKEL, 1866 (*partim*); subclass Tetracoralla HKL., 1870 (*partim*); order Pterocorallia FRECH, 1890; order Tetraseptata GRABAU, 1913 (*non* HAACKE, 1879); Tetracoelia YABE & SUGIYAMA, 1940]

Solitary or compound epithecate corals with septa typically in 2 orders alternating in length but in some with 1 or 3 orders; symmetry bilateral; in solitary corallites, after insertion of the first 6 protosepta with metasepta inserted in 4 positions only, on the counter side of each alar septum and on each side of the cardinal septum. A marginarium, consisting of a dissepimentarium or a peripheral stereozone formed by thickening of the septa, may be developed around the tabularium in the zone of minor septa. Tabulae may be conical, domed, horizontal, sagging (in some with a median trough), or inversely conical; each tabula may be complete, consisting of one plate, or incomplete, consisting of a number of tabellae. An axial structure may develop. *Ord.-Perm.*

Diversity of structure in the Rugosa is great, but the order seems divisible into 3 suborders in which diagnostic characters are shape of the tabulae, type of marginarium, arrangement of the septa, and arrangement of trabeculae within the septa. Nevertheless, a character dominant in one superfamily may appear in another.

Suborder STREPTELASMATINA Wedekind, 1927

[*nom. correct.* HILL, 1954 (*pro* suborder Streptelasmacea WDKD., 1927)] [Includes ?Cyathophylloidea, Zaphrentoidea NICHOLSON, in NICH. & LYDEKKER, 1889]

Solitary or conical Rugosa with marginarium a septal stereozone or dissepimentarium composed typically of small, globose interseptal dissepiments; tabulae typically domed. *Ord.-Perm.*

Superfamily CYATHAXONIICAE Milne-Edwards & Haime, 1850

[*nom. transl.* HILL, herein (*ex* Cyathaxoniidae, *nom. correct.* STUMM, 1949, *pro* Cyathaxonidae M.EDW.-H., 1850)] [Includes Semiplana POČTA, 1902; =Metriophyllacea HUDSON, 1945]

Small solitary corals with marked longitudinal costation; marginarium a very narrow septal stereozone, without dissepiments and with tabulae declined from the axis. Major septa are at first long and grouped in quadrants joining in the axial region to form an aulos (Laccophyllidae) or vertical rodlike columella free from the counter septum throughout growth (Cyathaxoniidae); septa in cardinal quadrants may be thicker and fewer than in counter quadrants; cardinal septum may shorten and counter septum be very long and produced vertically at the axis as a columella (Lophophyllidiidae); septa may withdraw unequally from union at the axis and may have their axial edges swollen (Polycoeliidae); minor septa may be long and contratingent, leaning on or toward adjacent major septa on the counter side; major septa may be flanged parallel to their distal edges but are without axial lobes. *Ord.-Perm.*

Family METRIOPHYLLIDAE Hill, 1939

[=?Lindstroemiidae POČTA, 1902 (*nom. correct.* GRABAU, 1928, *pro* Lindströmiidae POČTA, 1902)]

Small, solitary Rugosa with marginarium a very narrow stereozone. All major septa unite at the axis with axial end of counter septum swollen laterally in some forms; cardinal fossula on the convex side of corallum and false counter fossula opposite; minor septa short; the septa may be flanged parallel to their calical edges. Tabulae distant. *Ord.-Perm.*

Lambeophyllum OKULITCH, 1938 [**Cyathophyllum profundum* CONRAD, 1843]. Corallum with very deep calice; septa in young stages very short, later uniting in quadrants which join the unswollen axial end of counter septum; cardinal septum inconstant; septa not flanged. *M.Ord.*, N.Am.——FIG. 174,*1*. **L. profundum* (CONRAD); *1a,b*, transv. secs., ×2 (62).

Duncanella NICHOLSON, 1874 [**D. borealis*]. Very small, slender, erect, apex without epitheca; major septa straight, unflanged, uniting axially; minor septa absent. *M.Sil.*, N.Am.

Asthenophyllum GRUBBS, 1939 [**A. orthoseptatum*]. Very small; major septa twisting slightly together to form an axial structure; minor septa short, tabulae rare. *M.Sil.*, N.Am.——FIG. 174,*2*. **A. orthoseptatum; 2a,b,* side views, ×2; *2c,d,* diagrams of septa (82).

Amplexiphyllum STUMM, 1949 [**Amplexus hamiltonae* HALL, 1876]. Septa withdrawn from axis except at apex, unflanged; tabulae distant, complete, shallow domes (52). *M.Dev.*, N.Am.——FIG. 174,*3*. **A. hamiltonae* (HALL); *3a,b,* transv. and long. secs., ×1 (127).

Stewartophyllum BUSCH, 1941 [**Amplexus intermittens* HALL, 1876]. Very small, major septa dilated, withdrawing from axis in adult stage; tabulae tall domes; no minor septa (52). *Up.M. Dev.*, N.Am.——FIG. 174,*4*. **S. intermittens* (HALL); *4b,a,c,* side view, transv. and long. secs., ×1 (63).

Metriophyllum M.EDW.-H., 1850 [**M. bouchardi*] [=*Lopholasma* SIMPSON, 1900; *?Paterophyllum* POČTA, 1902; *Lophelasma* LANG-S.-T., 1940 (*nom. van. pro Lopholasma*)]. Straight thick septa bearing horizontal flanges usually with upturned edges; axial edge of counter septum not swollen nor produced into a columella but union of septa at the axis forms a solid axial pillar (46). *M.Dev.-U.Dev.*, N.Am.-Eu.-Austral.——FIG. 174,*5*. **M. bouchardi*, U.Dev., Eu.; *5a-c,* transv. and 2 long. secs., ×1 (117).

Stereolasma SIMPSON, 1900 [**Streptelasma rectum*

HALL, 1876 (*partim*)] [=*Stereoelasma* LANG-S.-T., 1940 (*nom. van. pro Stereolasma*)]. Like *Metriophyllum* but septa not flanged (52). *M.Dev.*, N.Am.——FIG. 174,*7*. **S. rectum* (HALL); *7a,b*, transv. and long. secs., ×2 (115).

Nalivkinella SOSHKINA, 1939 [**N. profunda*]. Major septa flanged, and withdrawn evenly from axis, leaving axial space in which tabulae sag; no aulos; minor septa very short (48). *U.Dev.*, USSR.——FIG. 174,*10*. **N. profunda; 10a-c*, 2 transv. secs. and long. sec., ×2 (122).

Buschophyllum STUMM, 1949 [**Caninia complexa* BUSCH, 1941]. Septa meet at axis in metriophylloid manner in all save adult stage when they withdraw, leaving an axial space; minor septa very short (52). *Up.M.Dev.*, N.Am.

Rotiphyllum HUDSON, 1942 [**Densiphyllum rushianum* VAUGHAN, 1908]. Septa dilated, with extra thickening in inner third of their course, joined at axis forming a dense axial structure; counter septum may be longer than others; minor septa long, contratingent (27). *L.Carb.*, Eu.-N.Am.; *L. Perm.(?Artinsk.)*, N.Z.——FIG. 174,*13*. **R. rushianum* (VAUGHAN) Visé., Eu.; transv. sec., ×2 (132).

Meniscophyllum SIMPSON, 1900 [**M. minutum*] [=*?Heptaphyllum* CLARK, 1924; *?Caenophyllum* CLARK, 1926]. Like *Rotiphyllum* but with counter and counter-lateral septa thinning and withdrawing a little from axis, and without minor septa (10). *L.Carb.*, Eu.-N.Am.——FIG. 174,*8*. **M. minutum*, Miss., N.Am.; transv. sec., ×2 (115).

Disophyllum TOLMACHEV, 1924 [**D. symmetricum;* SD TOLMACHEV, 1933]. Counter septum and septa of counter quadrants become thin and withdraw slightly from axis in adult stages (18). *L.Carb.*, Sib.——FIG. 174,*9*. **D. symmetricum;* transv. sec., ×2 (131).

Bradyphyllum GRABAU, 1928 [**B. bellicostatum*] [=*?Heterelasma* GRABAU, 1922 (*non* GIRTY, 1908; *nec* LANG-S.-T., 1940, *nom. van. pro Heterolasma* EHLERS, 1919)]. Like *Metriophyllum* but without flanges on septa which withdraw from axis in late stages, the cardinal septum being then very short and the counter septum not longer than others; alar septa on convex and concave sides of corallum (13). *M.Carb.*, China.——FIG. 174,*12*. **B. bellicostatum; 12a,b*, transv. secs., ×3 (81).

Empodesma MOORE & JEFFORDS, 1945 [**E. imulum*]. Calice very oblique, septa dilated except distally, metriophylloid in arrangement only just above tabulae, withdrawing from the axis between tabulae into a calophylloid arrangement with the cardinal, counter, and 2 alar septa longer than others; cardinal and counter septa remain in contact longer (39). *Penn.*, N.Am.——FIG. 174,*11*. **E. imulum*, Tex.; *11a,b*, transv. secs., ×2 (104).

Stereocorypha MOORE & JEFFORDS, 1945 [**S. annectans*]. Like *Metriophyllum* but with fossula on concave side and septa without flanges (39). *Penn.*, N.Am.——FIG. 174,*14*. **S. annectans*, Tex.; *14a,b*, transv. secs., ×2 (104).

Duplophyllum KOKER, 1924 [**D. zaphrentoides* (*non Cyathophyllum? zaphrentoides* ETHERIDGE, 1891)]. Septa in early stages thin toward axis where they join but in adult stages are thickened axially and may withdraw; minor septa very long, contratingent; counter septum not enlarged (29). *Perm.(Artinsk.)*, Timor.——FIG. 174,*15*. **D. zaphrentoides;* transv. sec., ×2 (95).

?Lindstroemia NICHOLSON & THOMSON, 1876 [*nom. correct.* GRABAU, 1928 (*pro Lindströmia*)] [**L. columnaris*] [=*?Stereolasma* SIMPSON, 1900]. Small, with axial structure; septal thickening and arrangement as in *Stereolasma* (type specimens missing, 52). *Dev.*, N.Am.——FIG. 174,*6*. **L. columnaris; 6a,b*, transv. and long. secs., ×2 (105).

?Centrocellulosum THOMSON, 1883 [**C. densothecum*]. *L.Carb.(Visé)*, Scot.

?Antiphyllum SCHINDEWOLF, 1952 [**A. inopinatum*]. Septa not united axially; cardinal septum long and swollen axially; counter septum short. *U.Carb.(Namur.)*, Ger.

Family LACCOPHYLLIDAE Grabau, 1928

[=Syringaxonidae HILL, 1939; Amplexocarininae SOSHKINA in SOSHK.-D.-P., 1941]

Small, solitary Rugosa with axial ends of major septa united at an aulos which divides horizontal inner tabellae from inclined outer tabellae; minor septa contratingent, dissepiments absent. *Sil.-Perm.*

Syringaxon LINDSTRÖM, 1882 [**Cyathaxonia siluriensis* M'COY, 1850] [=*Laccophyllum* SIMPSON, 1900; *Alleynia* POČTA, 1902 (*pro Nicholsonia* POČTA, 1902, *non* KIÄR, 1899; *nec* SCHLÜTER, 1885; *nec* others)]. Septa and aulos considerably thickened (46). *Sil.-Dev.*, Eu.-N.Am.——FIG. 175, *2*. **S. siluriense* (M'COY), Sil., Eu.; *2a,b*, transv. and long. secs., ×1 (117).

Barrandeophyllum POČTA, 1902 [**B. perplexum*] [=*Retiophyllum* POČTA, 1902]. Septa and aulos thin, aulos commonly imperfect; minor septa may not form (40). *M.Dev.-U.Dev.*, Eu.-Austral.——FIG. 175,*1*. **B. perplexum*, M.Dev., Boh.; *1a,b*, transv. and long. secs., ×2 (108).

Trochophyllum M.EDW.-H., 1850 [**T. verneuili*] [=*Permia* STUCKENBERG, 1895; *Crassiphyllum* GROVE, 1935]. Septa and aulos extremely thickened; no minor septa (51). *L.Carb.*, Eu.-Asia-N.Am.——FIG. 175,*4*. *T. cavernulum* (HUDSON), Eng.; *4a,b*, transv. and long. secs., ×2 (89).

Amplexocarinia SOSHKINA, 1928 [**A. muralis*] [=*Amplexicarinia* LANG-S.-T., 1940 (*nom. van.*); *?Paralleynia* SOSHK., 1936]. Septa and aulos thin (49). *Perm.*, Eu.——FIG. 175,*3*. **A. muralis*, Artinsk., USSR; *3a-c*, transv. secs., ×2 (123).

Family PETRAIIDAE de Koninck, 1872

[*nom. correct.* GRABAU, 1922 (*pro* Petraiadae KON., 1872)] [=Petrainae DYBOWSKI, 1873; Petraiaidae SANFORD, 1939]

Small solitary Rugosa with thin septa typically meeting at the axis, minor septa being inserted alternately with the metasepta; calice very deep. *Sil.-Dev.*

Petraia MÜNSTER, 1839 [**P. decussata* MÜNSTER, 1839 *(partim)*; SD MILLER, 1889 (=**P. radiata* MÜNSTER, 1839, *partim*)]. Septa very thin, minor septa long, contratingent; no septal flanges, tabulae few. *U.Sil.*, Ger.——FIG. 175,6. **P. radiata*; *6a*, transv. sec., ×5; *6b*, side view, ×2 (113).

Orthophyllum POČTA, 1902 [**O. bifidum* BARRANDE in POČTA, 1902; SD LANG-S.-T., 1940]. Like *Petraia* but septa somewhat withdrawn from axis, order of septal insertion unknown (40). *L.Dev.-M.Dev.*, Boh.——FIG. 175,5. **O. bifidum*, L.Dev., Boh.; *5a,b*, transv. sec. and side view, ×1 (108).

Family POLYCOELIIDAE Roemer, 1883

[*nom. correct* SCHINDEWOLF, 1952 (*pro* Polycoelidae ROEMER, 1883, *ex Polycoelia* KING, 1849, =*Calophyllum* DANA, 1846,

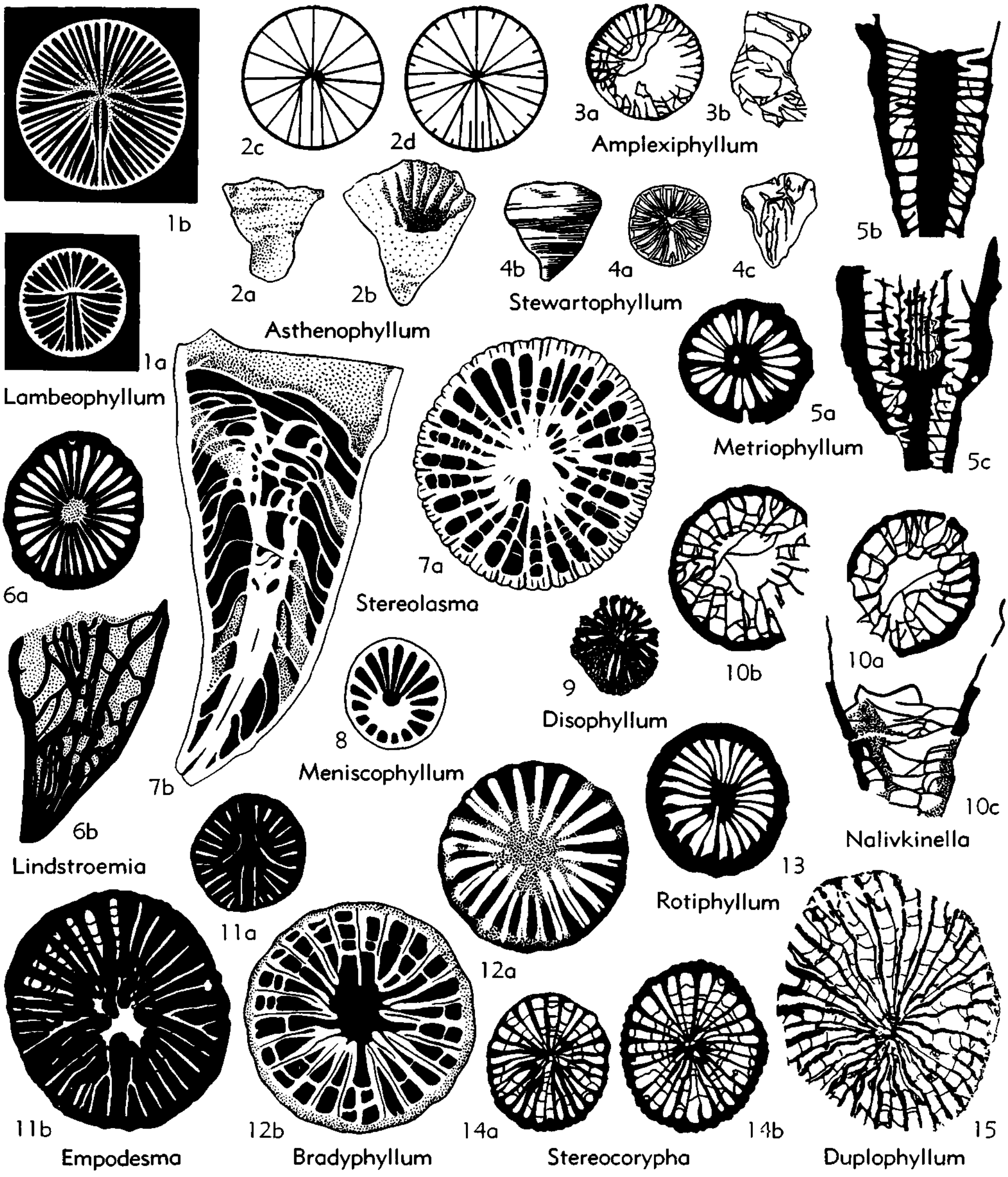

FIG. 174. Streptelasmatina (Cyathaxoniicae): Metriophyllidae (p. F257-F258).

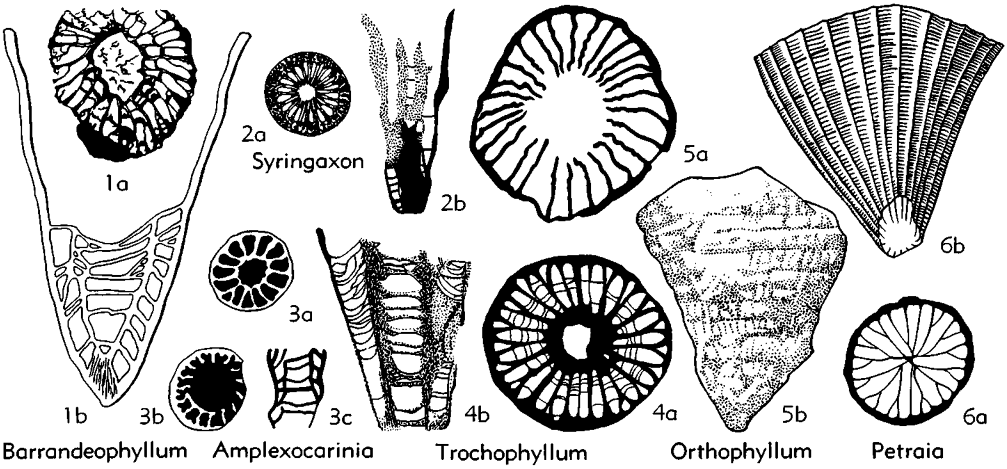

FIG. 175. Streptelasmatina (Cyathaxoniicae): Laccophyllidae, Petraiidae (p. F258-F259).

obj.)] [=Polycaeliens, Polycoeliens DE FROMENTEL, 1861 (invalid vernacular names); Plerophyllidae KOKER, 1924; Polycoelacea LECOMPTE, 1952 (superfam.); Calophyllidae STUMM, 1953]

Small solitary Rugosa in which some or all of the 6 protosepta are longer and thicker than other septa; counter septum not produced vertically into a columella; tabulae are tall domes flattened or slightly concave axially. Dissepiments absent except in highly developed genera. *?Sil., Dev.-Perm.*——FIG. 176, *1-4*. Young stages of subfamilies of Polycoeliidae, ×5 (113).

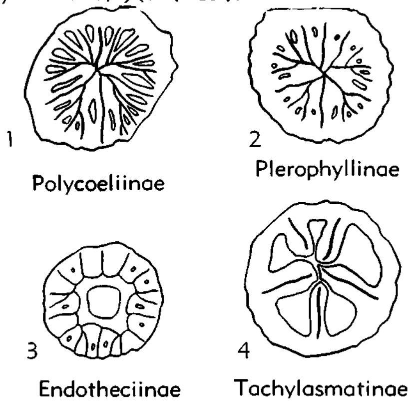

FIG. 176. Streptelasmatina (Cyathaxoniicae): Characters of subfamilies of Polycoeliidae illustrated by transverse sections (85).

Subfamily POLYCOELIINAE Roemer, 1883

[*nom. transl.* SCHINDEWOLF, 1942 (as Polycoelinae) *et correct.*, SCHIND., 1952 (*ex* Polycoelidae ROEMER, 1883)] [=Sochkineophyllinae GRABAU, 1928]

Four protosepta (cardinal, counter and 2 alar) longer and commonly thicker than other septa, especially near axial edges. *?Sil., Carb.-Perm.*

Claviphyllum HUDSON, 1942 [**Cyathopsis? eruca* M'COY, 1851]. Septa meeting axially in young stages; in adult stages all but the rhopaloid counter septum (which may be slightly produced vertically into a low columella) withdrawn from axis, but 2 neighboring lateral septa in each quadrant are outstanding and rhopaloid; cardinal septum short; tabellae globose (27). *L.Carb.*, Eu.——FIG. 177,*5*. **C. eruca* (M'COY); transv. sec., ×2 (89).

Fasciculophyllum THOMSON, 1883 [**F. dybowskii;* SD GREGORY, 1917]. Septa meeting axially in young stages, long, thin, possibly flanged and, except counter septum, only slightly withdrawn in adult stages (27). *L.Carb.*, Eu.——FIG. 177,*2*. **F. dybowskii;* transv. sec., ×2 (130).

Kinkaidia EASTON, 1945 [**K. trigonalis*]. Counter and 2 alar septa dominant, axial edges not markedly rhopaloid; cardinal septum short; metasepta short in young stages (28). *Miss.*, N.Am.——FIG. 177,*1*. **K. trigonalis;* transv. sec., ×3 (72).

Clinophyllum GROVE, 1935 [**Zaphrentis chouteauensis* MILLER, 1891]. Calical floor highly oblique, counter quadrants on longer side of corallum; counter septum dominant, cardinal septum strong, alar septa short; minor septa developed only between counter and counter-lateral septa (10). *Miss.*, N.Am.——FIG. 177,*3*. **C. chouteauense* (MILLER); *3a*, side view, ×1; *3b,c*, transv. and long. secs., ×3 (72).

Calophyllum DANA, 1846 [**C. donatianum* KING, 1850 (=**Turbinolia donatiana* KING, 1848 =**Cyathophyllum profundum* GEINITZ, 1842)] [=*Polycoelia* KING, 1849 (obj.) (*non* DE FROMENTEL, 1860, *nec* FUHRMANN, 1907); *Tetraphyllum* LUDWIG, 1865; *?Phryganophyllum* DE KONINCK, 1872; *Gerthia* GRABAU, 1928; *Pycnocoe-*

lia SCHINDEWOLF, 1952 (*pro Weissermelia* SCHINDEWOLF, 1942, *non* LANG-S.-T., 1940)]. Cardinal, counter and 2 alar septa equally developed, longer and thicker than others; septa united axially in quadrants in young stages (42). *L.Carb.-Perm.*, Eu.-Asia-Austral.——FIG. 177,*4*. **C. profundum* (GEINITZ), Perm., Eu.; *4a,b,* transv. secs., ×3 (113).

Tetralasma SCHINDEWOLF, 1942 [**T. quadriseptata*]. Like *Calophyllum* but with 2 counter-laterals and metasepta extremely short (42). *L.Carb.*, Ger.——FIG. 177,*6*. **T. quadriseptata; 6a,b,* transv. secs., ×3 (113).

Sochkineophyllum GRABAU, 1928 [**Plerophyllum artiense* SOSHKINA, 1925]. In late stages counter septum, 2 alar septa and 1 or 2 metasepta in each quadrant are outstanding, with slightly swollen axial edges; cardinal septum short (42). *L.Carb.-Perm.*, Eu.-Asia.——FIG. 177,*13*. **S. artiense* (SOSHKINA), L.Perm.(Artinsk.), USSR; *13a,b,* transv. and long. secs., ×2 (122).

Prosmilia KOKER, 1924 [**Plerophyllum cyathophylloides* GERTH; SD LANG-S.-T., 1940]. Like *Calophyllum* but with regular, moderately wide dissepimentarium in adult stages (42). *Perm.(Artinsk.)*, Timor.——FIG. 177,*11*. **P. cyathophylloides* (GERTH); *11a,b,* transv. and long. secs., ×2 (95).

?**Anisophyllum** M.EDW.-H., 1850 [**A. agassizi*]. Cardinal? and 2 alar septa taller, thicker and longer than others, meeting at axis; no columella (38). *Sil.*, N.Am.——FIG. 177,*8*. **A. agassizi; 8a,b,* side and calical views, ×1 (73).

?**Lophophrentis** CHI, 1935 [**L. trilobata*]. *Carb.*, China.

Subfamily PLEROPHYLLINAE Koker, 1924

[*nom. transl.* GRABAU, 1928 (*ex* Plerophyllidae KOKER, 1924)]

Five protosepta (cardinal, 2 alar and 2

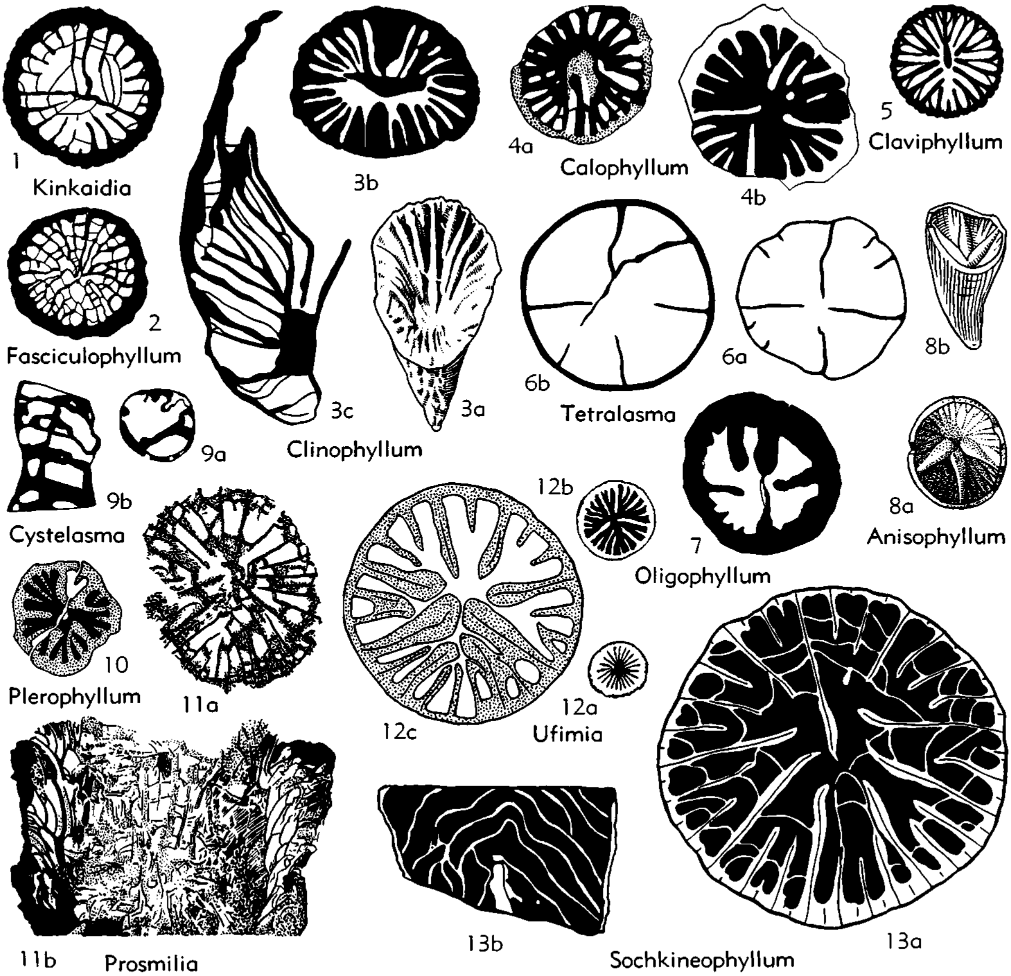

FIG. 177. Streptelasmatina (Cyathaxoniicae): Polycoeliidae (p. F260-F262).

counter-lateral) longer and thicker than other septa; counter septum long in young but shortened in adult stages; septa pinnately arranged, meeting at axis in early stages. No dissepiments or inner wall. *M. Dev.-Perm.*

Oligophyllum POČTA, 1902 [**O. quinqueseptatum*]. Counter-lateral septa club-shaped, dilated more than alar and cardinal septa, which are typically not swollen axially (42). *M.Dev.*, Boh.——FIG. 177,*7*. **O. quinqueseptatum;* transv. sec., ×2 (108).

Plerophyllum HINDE, 1890 [**P. australe;* SD GRABAU, 1928] [=*Timorosmilia* KOKER, 1924]. Of the 5 dominant protosepta the 2 counter-lateral are outstanding (42). *U.Dev.-Perm.*, Eu.-Asia-Austral. ——FIG. 177,*10*. **P. australe,* Perm.(Artinsk.), Austral.; transv. sec., ×2 (113).

Cystelasma MILLER, 1891 [**C. lanesvillense* MILLER, 1892]. With epithecal talons; short cardinal, 2 alar and 2 counter-lateral septa developed, commonly without metasepta; no minor septa; septa may be separated from wall by large globose dissepiments (51). *Miss.*, N.Am.——FIG. 177,*9*. **C. lanesvillense, 9a,b,* transv. and long. secs., ×2 (127).

Ufimia STUCKENBERG, 1895 [**U. carbonaria*] [=*Rhopalolasma* HUDSON, 1936; *Rhopalelasma* LANG-S.-T., 1940]. Like *Plerophyllum* but with cardinal septum short in adult stages, leaving only 4 outstanding protosepta (2 alars, 2 counter-laterals) (42). *U.Dev.-Perm.*, Eu.-Asia.——FIG. 177, *12a,b*. **U. carbonaria,* Carb., USSR; *12a,b,* transv. secs., ×1 (126).——FIG. 177,*12c*. **U. tachyblastum* (HUDSON), type species of *Rhopalolasma,* L.Carb., Eu.; transv. sec., ×3 (89).

Pseudobradyphyllum DOBROLYUBOVA, 1940 [**P. nikitini*]. Septa metriophylloid in arrangement in early stages but withdrawn slightly from axis in adult stages, cardinal and counter being shortest; longest septa are counter-laterals, alars, and metasepta nearest cardinal (7). *U.Carb.(Gshel.)*, USSR. ——FIG. 178,*3*. **P. nikitini; 3a,b,* transv. and long. secs., ×2 (68).

Pleramplexus SCHINDEWOLF, 1940 [**P. similis*]. Like *Plerophyllum* in young stages, but in ephebic stages all septa shorten toward periphery (42). *Perm.(Artinsk.)*, Timor.——FIG. 178,*7*. **P. similis; 7a,b,* transv. and long. secs., ×2 (113).

Subfamily ENDOTHECIINAE, Schindewolf, 1942

[=Endotheciidae (*nom. transl.* LECOMPTE, 1952)]

Like Plerophyllinae but with inner wall formed between septa; no dissepiments. *Perm.*

Endothecium KOKER, 1924 (*non* FRASER, 1935) [**E. apertum;* SD LANG-S.-T., 1940]. Alar septa outstanding, cardinal and counter short; septa withdrawn from axis with inner wall near their axial ends (42). *Perm.(Artinsk.)*, Timor.——FIG. 178,*2*. **E. apertum;* transv. sec., ×1 (95).

Subfamily TACHYLASMATINAE Grabau, 1928

[*nom. correct.* HILL, herein (*pro* Tachylasmainae GRABAU, 1928)] [=Pentaphyllinae SCHINDEWOLF, 1942; Tachyelasmidae HILL, 1948; Tachyelasminae HILL, 1952]

Cardinal, 2 alar and 2 counter-lateral septa outstanding; counter septum may be absent throughout or developed only in late stages; metasepta inserted relatively late and not pinnately; without dissepiments. *Carb.-Perm.*

Cryptophyllum CARRUTHERS, 1919 [**C. hibernicum*] [=*?Pentaphyllum* DE KONINCK, 1872]. Septa not all radial in course (42). *L.Carb.-Perm.*, Eu.-Asia. ——FIG. 178,*5*. **C. hibernicum,* L.Carb., Eu.; transv. sec., ×2 (64).

Pseudocryptophyllum EASTON, 1944 [**P. cavum*] [=*Hexalasma* SOSHKINA, 1928; *Hexelasma* LANG-S.-T., 1940 (*non* HOEK, 1915)]. Six protosepta dominant, may be only septa developed (10). *Miss.*, N.Am.; *Perm.(Artinsk.)*, USSR.——FIG. 178,*6a-c*. **P. cavum* Miss., N.Am.; *6a,b,* transv. secs., ×3; *6c,* long. sec., ×3 (10).——FIG. 178, *6d,e*. *P. primitivum* (SOSHKINA), type species of *Hexalasma,* Artinsk., USSR; *6d,e,* transv. secs., ×4 (123).

Tachylasma GRABAU, 1922 [**T. cha*] [=*Tachyelasma* LANG-S.-T., 1940 (*nom. van.*); *Prionophyllum* SCHINDEWOLF, 1942]. Cardinal septum short in adult stages (42). *Perm.(Artinsk.)*, Asia-Austral.——FIG. 178,*1*. **T. cha,* China; transv. sec., ×1 (81).

Pentamplexus SCHINDEWOLF, 1940 [**P. simulator*]. Young stages like *Cryptophyllum* with 5 dominant septa; in adult stages all septa shorten toward periphery, leaving wide axial space (42). *Perm. (Artinsk.)*, Timor.——FIG. 178,*4*. **P. simulator;* transv. sec., ×2 (113).

Family HADROPHYLLIDAE Nicholson in Nicholson & Lydekker, 1889

Small, simple, broadly trochoid to button-shaped corals with flattened or recurved calices; septa arranged in quadrants; minor septa short, contratingent. Tabulae and dissepiments absent. *L.Dev.-M.Carb.*

Combophyllum M.EDW.-H., 1850 [**C. osismorum*]. Small, free, discoid; without epitheca; minor septa long, thinner than major septa, with bare edges of septa on lower surface of disc crenulate; fossula well marked, with low cardinal septum (38). *L. Dev.*, Fr.——FIG. 179,*1*. **C. osismorum; 1a-c,* top, base, side, ×2 (73).

Hadrophyllum M.EDW.-H., 1850 [**H. orbignyi*]. Discoid to very widely trochoid; cardinal septum in prominent fossula somewhat contracted near periphery, other septa meeting in wall of fossula, those of counter quadrants radially arranged, others pinnate (52). *L.Dev.-M.Dev.*, N.Am.——Fig. 179, *2.* **H. orbignyi*, M.Dev., N.Am.; *2a,b,* top, side, ×1 (73).

Xenocyathellus Bassler, 1937 [**Homalophyllum thedfordensis* Stewart, 1936]. Very small, calceoloid, flattened, attached on cardinal side; cardinal fossula contracted near periphery, with short cardinal septum; counter quadrants with many fewer septa (52). *L.M.Dev.*, N.Am.——Fig. 179,*5.* **X. thedfordensis* (Stewart); *5a,b,* side, ×1; *5c,d,* transv. secs., ×3 (125).

Microcyclus Meek & Worthen, 1868 (*non* Simroth, 1896) [**M. discus*]. Flat, discoid, very small, fossula opening inward into a wide shallow axial depression with slopes formed by contact of axial edges of major septa (52). *M.Dev.*, N.Am.——Fig. 179,*8.* **M. discus; 8a,b,* top, base, ×1 (102).

Dipterophyllum Roemer, 1883 [**Zaphrentis glans* White, 1862]. Short, turbinate, with counter and cardinal septa shortened so that a deep median trough crosses calice (1). *Miss.*, N.Am.——Fig. 179,*7.* **D. glans* (White); *7a,* top, ×2; *7b,* side, ×1 (60).

Baryphyllum M.Edw.-H., 1850 [**B. verneuilianum*]. Discoid; septa exsert except for small axial epithecate part of base; counter septum short, cardinal septum dominant and very long; septa twist remarkably in adults (1). *Miss.*, N.Am.——Fig. 179, *4.* **B. verneuilianum*, *4a,b,* top, base, ×1 (60).

Gymnophyllum Howell, 1945 [**G. wardi*]. Like *Baryphyllum* but with cardinal and counter developed equally with other septa. *Penn.*, N.Am. ——Fig. 179,*3.* **G. wardi; 3a-c,* top, base, side, ×1 (87).

Cumminsia Moore & Jeffords, 1945 [**Hadrophyllum aplatum* Cummins, 1891]. Patellate, apex almost central, epitheca without septal grooves; quadrants diverge from inner edge of rather short counter septum; cardinal septum short, fossula long and parallel-sided, expanding outwards near periphery; oldest metasepta are longest in each quadrant (39). *Penn.*, N.Am.——Fig. 179,*6.* **C. aplata* (Cummins), Tex.; *6a,b,* top, base, ×1 (104).

Family CYATHAXONIIDAE Milne-Edwards & Haime, 1850

[*nom. correct.* Stumm, 1949 (*pro* Cyathaxonidae M.Edw.-H., 1850)] [=Cyathaxoninae (*nom. transl.* Dybowski, 1873)]

Small, ceratoid rugose corals with tall columella developed independently of the major septa but in contact with them and with long minor septa inserted alternately

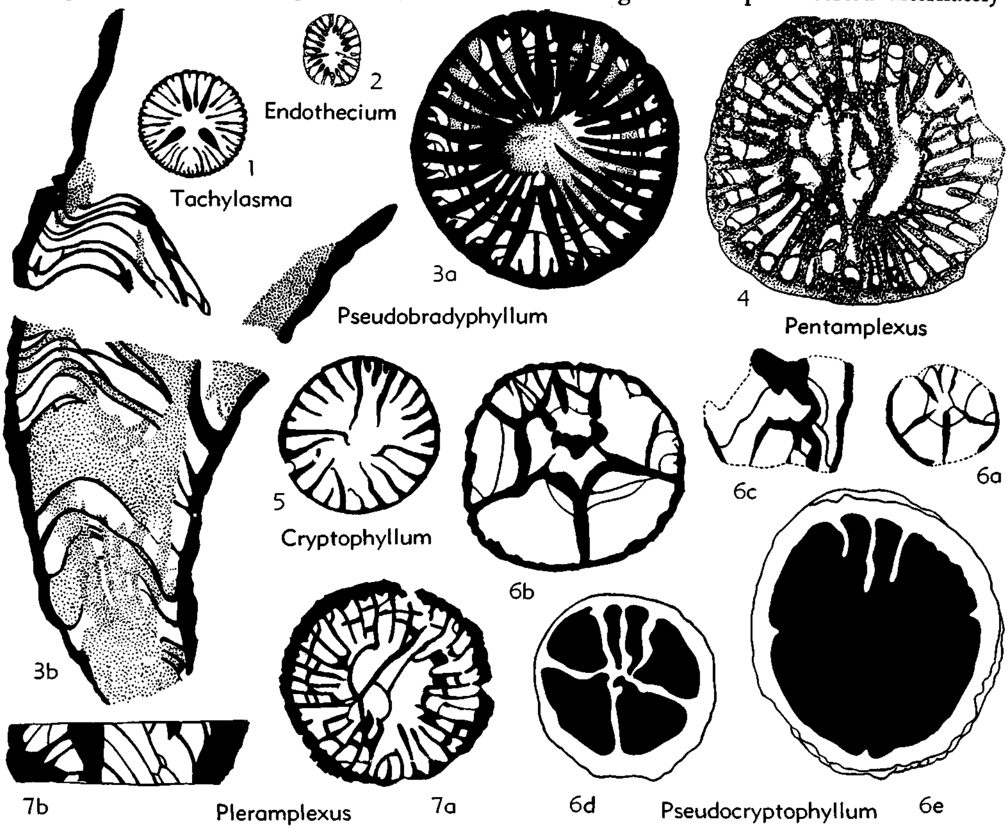

Fig. 178. Streptelasmatina (Cyathaxoniicae): Polycoeliidae (p. F262).

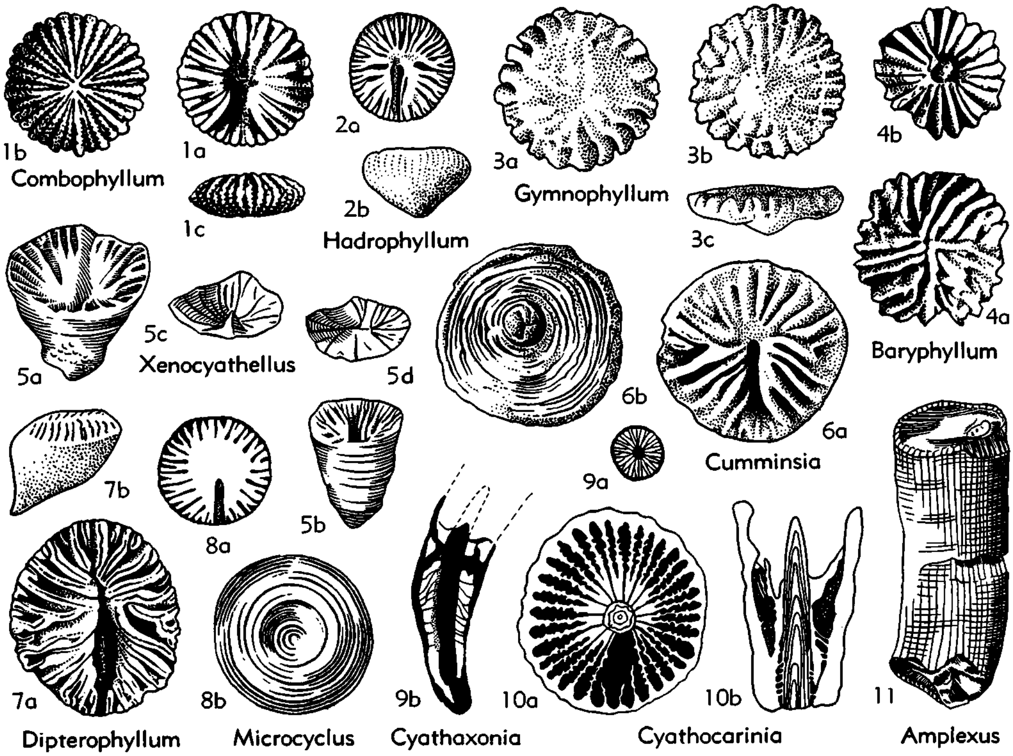

FIG. 179. Streptelasmatina (Cyathaxoniicae): Hadrophyllidae, Cyathaxoniidae, Amplexidae (p. F262-F264).

with the metasepta; complete tabulae inclined outward to the epitheca; dissepiments lacking. *Carb.-Perm.*

Cyathaxonia MICHELIN, 1847 [**C. cornu;* SD M. EDW-H., 1850] [=?*Zaphrentula* BOLKHOVITNOVA, 1915]. Septa without flanges; minor septa long and contratingent (10). *L.Carb.,* N.Am.-Eu.-Asia-Austral.——FIG. 179,9. **C. cornu,* L.Carb., Eu.; *9a,b,* transv. and long. secs., ×2 (64).

Cyathocarinia SOSHKINA, 1928 [**C. tuberculata;* SD LANG-S.-T., 1940]. Like *Cyathaxonia* but with sides of septa strongly tuberculated (49). *Perm. (Artinsk.),* USSR.——FIG. 179,*10*. **C. tuberculata; 10a,b,* transv. and long. secs., ×4 (123).

Family AMPLEXIDAE Chapman, 1893

[=Amplexinae (*nom. transl.* WANG, 1947)]

Solitary, without marginarium; tabulae flat, with down-turned edges; major septa thin, continuous vertically only at peripheral edges, but may extend toward axis as low, short ridges developed only on upper surfaces of tabulae; minor septa absent or appearing very late. *L.Carb.*

May possibly be more closely related to Cyathopsidae than to the Cyathaxoniicae.

Amplexus SOWERBY, 1814 [**A. coralloides*]. Long, cylindrical or scolecoid; interseptal ridges absent; tabulae with cardinal and alar fossular depressions. *L.Carb.,* Eu.——FIG. 179,*11*. **A. coralloides;* side, ×0.5 (124).

Family LOPHOPHYLLIDIIDAE Moore & Jeffords, 1945

[=?Lophophyllidae GRABAU, 1928; Lophophyllidiinae, *nom. correct.* WANG, 1950 (*pro* Lophophyllidinae, *nom. transl.* WANG, 1947)]

Small solitary coralla without dissepiments and with conical tabulae; septa long, arranged in quadrants in young stages, meeting enlarged counter septum at the axis; columella formed by swollen, vertically produced axial edge of the counter septum which may be reinforced by vestigial axial ends of other septa; cardinal septum shortened and other septa withdrawn from the axis in adult stages, commonly rhopaloid. *Carb.-Perm.*

Lophocarinophyllum Grabau, 1922 [**L. acanthiseptum*]. Columella a prolongation of counter septum only, no septal lamellae taking part; septa flanged parallel to their distal edges (28). *Carb.*, China.——Fig. 180,*1*. **L. acanthiseptum; 1a,b,* transv. secs., ×3; *1c,* long. sec., ×3 (91).

Lophophyllidium Grabau, 1928 [**Cyathaxonia prolifera* McChesney, 1860 [=*Sinophyllum* Grabau, 1928; *?Malonophyllum* Okulitch & Albritton, 1937]. Columella wide, typically with radial lamellae conjoined to median lamella but not tabellate, may be separated from counter septum in adult stages; axial edges of other septa, except cardinal, may be thickened and fused to one another in a collar around the columella (28). *Penn.-Perm.*, N.Am.-Eu.-Asia.——Fig. 180,*3*. **L. proliferum* (McChesney), Penn., USA; *3a,b,* transv. secs., ×3; *3c,* long. sec., ×3 (91).

Stereostylus Jeffords, 1947 [**S. lenis*]. Columella a simple expansion of axial end of the long counter septum, from which it may separate in adult stages; other septa typically only slightly swollen at axial edges, subequal (28). *Penn.-L.Perm. (Artinsk.)*, N.Am.-USSR-?N.Z.——Fig. 180,*5*. **S. lenis,* Penn., USA; *5a-c,* transv. secs., ×3; *5d,* long. sec., ×3 (91).

Lophamplexus Moore & Jeffords, 1941 [**L. eliasi*]. Like *Stereostylus,* but columella discontinuous or lacking in upper part of corallite. *Penn.-L.Perm.*, N.Am.——Fig. 180,*4*. **L. eliasi,* L.Perm., Kans.; *4a-c,* transv. secs., ×2; *4d,* long. sec., ×2 (91).

Lophotichium Moore & Jeffords, 1945 [**L. vescum*]. Septa long, thin and flanged, meeting long counter septum with its slight rhopaloid swelling axially in all save the late adult stages, when they withdraw, those of the cardinal quadrants re-

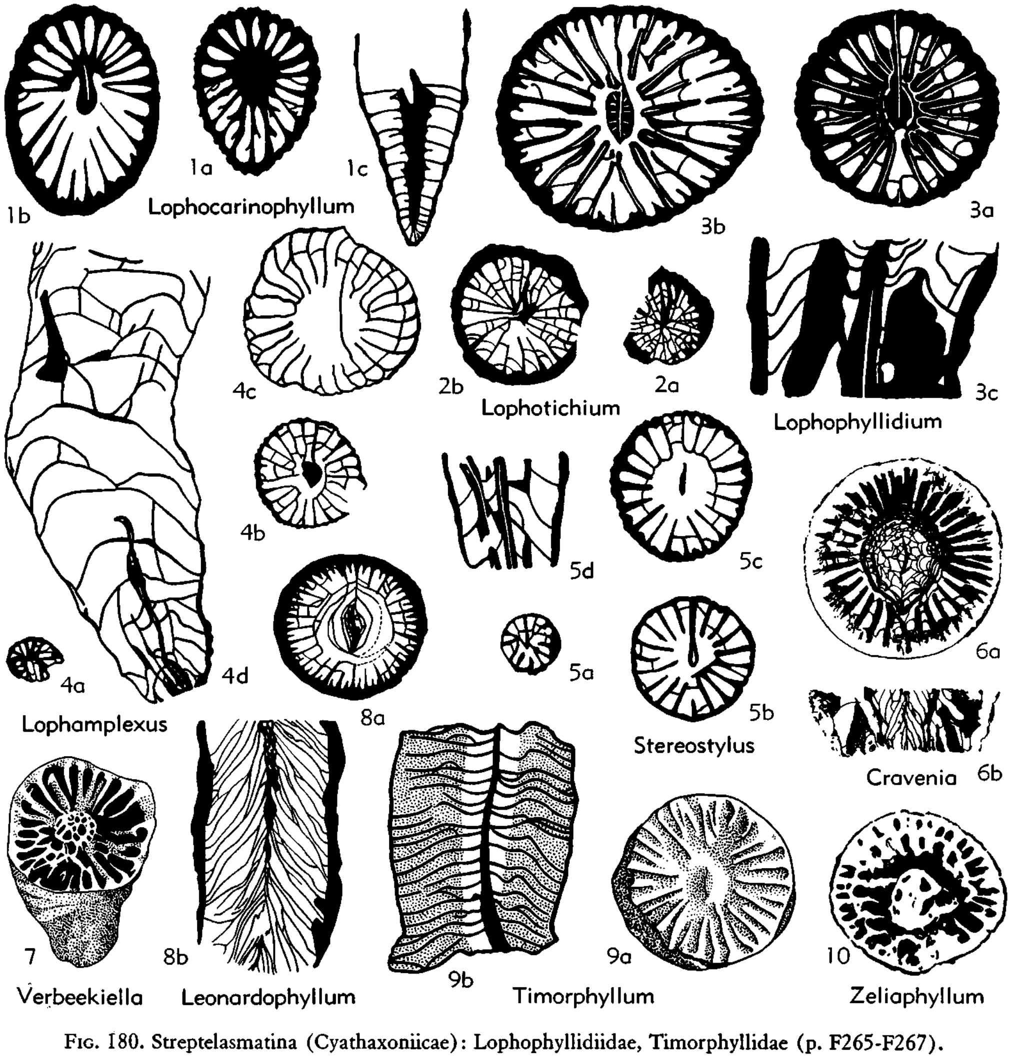

Fig. 180. Streptelasmatina (Cyathaxoniicae): Lophophyllidiidae, Timorphyllidae (p. F265-F267).

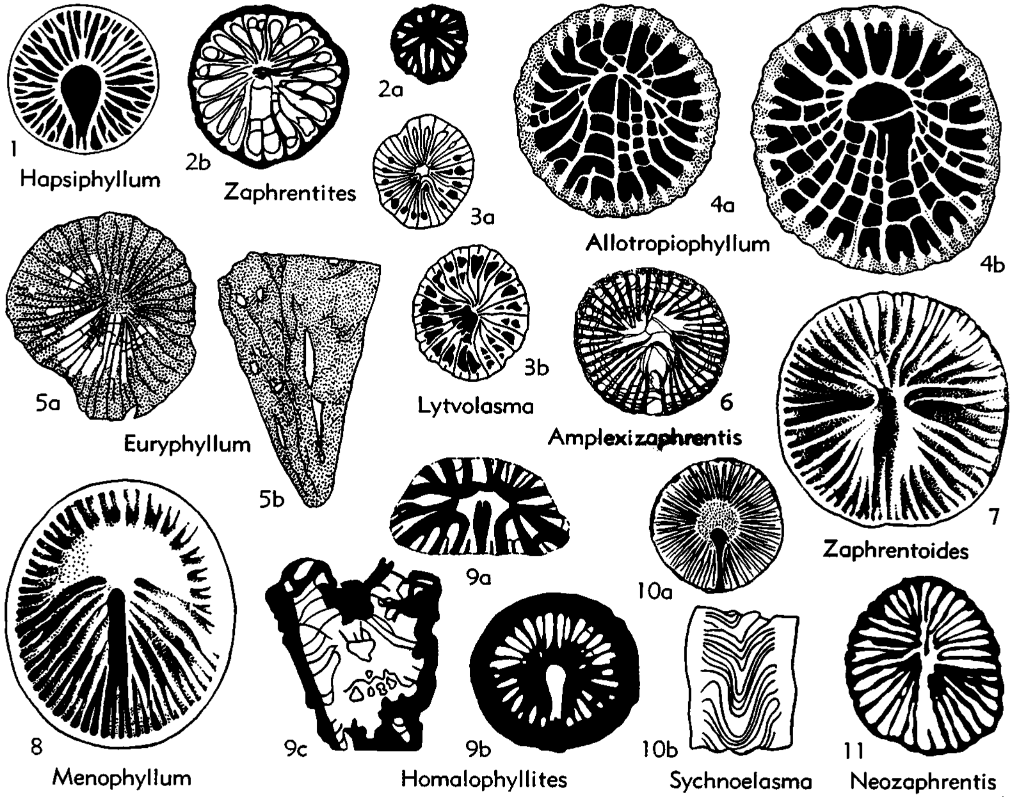

FIG. 181. Streptelasmatina (Cyathaxoniicae): Hapsiphyllidae (p. F267-F268).

treating first, leaving counter septum and its columellar vertical prolongation dominant (39). *Penn.*, N.Am.——FIG. 180,2. **L. vescum,* Tex.; *2a,b,* transv. secs., ×3 (104).

?**Lophophyllum** M.EDW.-H., 1850 [**L. konincki*]. *L.Carb.(Tournais.),* Belg.

Family TIMORPHYLLIDAE Soshkina in Soshkina, Dobrolyubova & Porfiriev, 1941

[*nom. transl.* HILL, herein (*ex* Timorphyllinae SOSHK. in SOSHK.-D.-P., 1941)]

Solitary coralla, typically without dissepiments; with an axial structure of median lamella, radial lamellae, and tabellae; with narrow peripheral stereozone and conical tabulae. *L.Carb.-L.Perm.(Artinsk.).*

Cravenia HUDSON, 1928 [**C. rhytoides*]. Small; axial structure dibunophylloid; no dissepiments (18). *L.Carb.,* Eng.——FIG. 180,6. **C. rhytoides,* Tournais., Eng.; *6a,b,* transv. and long. secs., ×2 (89).

Zeliaphyllum HERITSCH, 1936 [**Z. suessi*] [=*Zelaeophyllum* LANG-S.-T., 1940]. Axial structure of tabellae and lamellae irregularly interwoven; minor septa short; only one series of dissepiments (14). *L.Perm.(Artinsk.),* Carnic Alps. ——FIG. 180,*10*. **Z. suessi;* transv. sec., ×3 (84).

Timorphyllum GERTH, 1921 [**T. wanneri*]. Somewhat scolecoid, with smooth epitheca; axial structure simple, comprising a barlike columella typically separate from septa in adult stages, buttressed by sharply upturned narrow axial parts of tabulae, which are otherwise flat but downturned at the edges; no dissepiments (12). *L.Perm.(Artinsk.),* Asia.——FIG. 180,*9*. **T. wanneri,* Timor; *9a,b,* calical view, long. sec., ×1 (79).

Verbeekiella GERTH, 1921 [*pro Verbeekia* PENECKE, 1908 (*non* FRITSCH, 1887; *nec* SILVESTRI, 1908)] [**Verbeekia permica* PENECKE, 1908]. Axial structure large, with well-defined wall separating its tabellae from periaxial tabellae; skeletal dilatation common; radial lamellae numerous, medial plate generally not dominant; no dissepiments (12). *L.Perm.(Artinsk.),* Eu.-Asia-Austral.——FIG. 180,7. **V. permica* (PENECKE), Timor; side, ×1 (79).

Leonardophyllum MOORE & JEFFORDS, 1941 [**L. distinctum*]. Axial structure without defined wall; counter septum typically continuous with medial lamella; peripheral stereozone moderately wide; no dissepiments. *L.Perm.(Leonard.),* N.Am.——FIG. 180,*8*. **L. distinctum,* W.Tex.; *8a,b,* transv. and long. secs., ×2 (104).

Family HAPSIPHYLLIDAE Grabau, 1928

[=Zaphrentoididae SCHINDEWOLF, 1938; Zaphrentoidinae (*nom. transl.* WANG, 1950); Zaphrentoidida (superfam.) (*nom. transl.* SCHIND., 1952)]

Small, solitary, ceratoid or trochoid coralla with fossula bounded laterally by cardinal lateral septa and axially (in younger stages at least) by a wall consisting of fused axial ends of major septa of the counter quadrants. The septa may withdraw from the axis. Tabulae incomplete, conical, with highest point at inner edge of the fossula. No dissepiments. Minor septa present or absent. *L.Carb.-L.Perm.(Artinsk.).*

Group I

Fossula on the shorter, concave side of the corallum. *L.Carb.-L.Perm.*

Hapsiphyllum SIMPSON, 1900 [**Zaphrentis calcariformis* HALL, 1882 (=*Zaphrentis cassedayi* M.EDW., 1860)] [=*Enallophyllum* GREEN, 1901]. Fossula expanded axially; septa arranged pinnately in cardinal and radially in counter quadrants; minor septa long, contratingent; cardinal septum short in adult stages (10). *Miss.,* N.Am.-Eu.——FIG. 181,*1*. **H. cassedayi* (M.EDW.), N.Am.; transv. sec., ×2 (115).

Zaphrentites HUDSON, 1941 [*non* VON BUBNOFF, 1926, p. 150 *(?lapsus calami)*] [**Zaphrentis parallela* CARRUTHERS, 1910] [?=*Cypellophyllum* TOLMACHEV, 1933 (*pro Craterophyllum* TOLMACHEV, 1931, *non* FOERSTE, 1909, *nec* BARBOUR, 1911)]. Septa may withdraw from fossula, first in cardinal quadrants, then in counter quadrants, so that radial arrangement supersedes earlier pinnate arrangement; minor septa absent or extremely short (26). *L.Carb.,* Eu.-Asia.——FIG. 181,*2*. **Z. parallela* (CARRUTHERS), Eu., *2a,b,* transv. secs., ×3 (64).

Canadiphyllum SUTHERLAND, 1954 [**C. knoxi*]. Septa dilated; fossula parallel-sided, met by septa of cardinal quadrants almost at right angles; alar fossulae almost bisect corallite; septa of counter quadrants almost perpendicular to alar fossula. *Miss.,* B.C.

Allotropiophyllum GRABAU, 1928 [**A. sinense*]. Major septa of counter quadrants and (in some) alar and first metasepta of cardinal quadrants grouped in a narrow crescentic area on the counter (convex) side, other major septa directed to a point or points on its inner side roughly midway between the corallum axis and epitheca; major septa amplexoid in late stages; minor septa absent or very short (13). *L.Carb.-L.Perm.(Artinsk.),* Eu.-Asia.——FIG. 181,*4*. **A. sinense,* Artinsk., Asia, *4a,b,* transv. secs., ×5 (81).

Amplexizaphrentis VAUGHAN, 1906 [**Zaphrentis bowerbanki* THOMSON, 1883; SD LANG-S.-T., 1940] [=*Triplophyllites* EASTON, 1944; *?Barytichisma* MOORE & JEFFORDS, 1945]. Corallum large, may be subquadrate in section; fossula commonly oblique and septa wavy, arranged inequilaterally; withdrawal from axis may begin first in counter quadrants; minor septa very short; cardinal septum long at first, short later (10). *L.Carb.,* Eu-Asia-N.Am.; *Penn.,* N.Am.——FIG. 181,*6*. *A. curvilinea* THOMSON, L. Carb., Scot.; transv. sec., ×1 (130).

Zaphriphyllum SUTHERLAND, 1954 [**Z. disseptum*]. Like *Amplexizaphrentis* but with normal dissepimentarium. *Miss.,* Can.

Lytvolasma SOSHKINA, 1925 [**L. asymetricum*] [=*Lytvelasma* LANG-S.-T., 1940]. Septa few and dilated, slightly and irregularly withdrawn from axis; fossula shallow, open axially in adult stages when cardinal septum is short (49). *L.Perm.(Artinsk.),* USSR.——FIG. 181,*3*. **L. asymetricum; 3a,b,* transv. secs., ×2 (123).

Euryphyllum HILL, 1937 [**E. reidi*]. Calice oblique, septa initially much dilated, dilatation decreasing first midway between periphery and axis; counter septum long and thin. *L.Perm.(Artinsk.),* Austral.-N.Z.——FIG. 181,*5*. **E. reidi,* Austral.; *5a,b,* transv. and long. secs., ×2 (85).

Group II

Fossula on the longer, convex side of the corallum. *L.Carb.*

Zaphrentoides STUCKENBERG, 1895 [**Zaphrentis griffithi* M.EDW.-H., 1851; SD SCHINDEWOLF, 1938]. Minor septa very short. Type specimen insufficiently known (10). *L.Carb.,* Eu.-N.Am.——FIG. 181,*7*. **Z. griffithi* (M.EDW.-H.), Eu., calical view, ×1 (73).

Menophyllum M.EDW.-H., 1850 [**M. tenuimarginatum*]. Fossula long, narrow, deep and parallel-sided, containing a short cardinal septum in adult stages; major septa of counter quadrants equal, short and withdrawn from axis (38). *L.Carb.,* Fr.——FIG. 181,*8*. **M. tenuimarginatum,* Tournais., Fr.; calical view, ×2 (73).

Homalophyllites EASTON, 1944 [**Lophophyllum calceola* WHITE & WHITFIELD, 1862]. Fossula expanded axially with bounding septa reinforced by thickening; cardinal septum short; convex side of corallum flattened near apex (10). *Miss.,* N.Am.——FIG. 181,*9*. **H. calceola* (WHITE-W.); *9a,* neanic transv. sec., ×6; *9b,* ephebic transv. sec., ×3; *9c,* long. sec., ×3 (72).

Neozaphrentis GROVE, 1935 [**Zaphrentis tenella* MILLER, 1891]. Counter septum longer than others but not swollen axially; cardinal septum short, fossula oblique and variably placed, usually on the convex side; septa not rhopaloid (10). *Miss.,* N.

Am.——FIG. 181,*11*. **N. tenella* (MILLER); transv. sec., ×3 (72).

Sychnoelasma LANG-S.-T., 1940 [*pro Verneuilia* STUCKENBERG, 1895 (*non* HALL & CLARKE, 1894)] [**Verneuilia urbanowitschi* STUCK., 1895]. Major septa withdrawn equally from axis, leaving space in which the tabulae are infundibuliform (33). *L.Carb.*, USSR.——FIG. 181,*10*. **S. urbanowitschi* (STUCK.); *10a,b*, transv. and long. secs., ×1 (126).

Superfamily ZAPHRENTICAE Milne-Edwards & Haime, 1850

[*nom. transl.* HILL, herein (*ex* Zaphrentidae M.EDW.-H., 1850)] [=Zaphrentoidea, ?Cyathophylloidea NICHOLSON in NICH. & LYDEKKER, 1889; Streptelasmacea WEDEKIND, 1927; Streptelasmaticae HILL, 1954]

Solitary or compound, with marginarium consisting either of a septal stereozone or a regular or herringbone dissepimentarium; among forms with a septal stereozone, the septa bear axial lobes; tabulae conical or domed, rarely sagging. *Ord.-Perm.*

NICHOLSON based his conception of the Zaphrentoidea on the Hapsiphyllidae, rather than on *Zaphrenthis*, although he names *Zaphrenthis ("Zaphrentis")* as the typical genus.

The Cyathopsidae are placed in this superfamily somewhat doubtfully because many of them possess a lonsdaleoid dissepimentarium such as is typical of the Columnariina, but otherwise they are morphologically quite close to the Aulophyllidae. The ontogeny of the early Cyathopsidae suggests that they developed from a member of the Hapsiphyllidae, herein regarded as Cyathaxoniicae.

Family STREPTELASMATIDAE Nicholson in Nicholson & Lydekker, 1889

[*nom. correct.* WEDEKIND, 1927 (*pro* Streptelasmidae NICH. in NICH.-L., 1889)] [=Streptelasmaidae GRABAU, 1922]

Solitary and conical or fasciculate coralla, with short minor septa and marginarium consisting of a septal stereozone; dissepiments typically not developed; major septa lobed axially; early uniform septal dilatation decreasing from the axis outwards; tabulae domed, complete or incomplete. *M.Ord.-M.Dev.*

Subfamily STREPTELASMATINAE Nicholson in Nicholson & Lydekker, 1889

[*nom. transl.* LECOMPTE, 1952 (as Streptelasminae (*ex* Streptelasmatidae, *nom. correct.* WEDEKIND., 1927, *pro* Streptelasmidae NICH. in NICH.-L., 1889)] [Includes Dinophyllidae WANG, 1947; Dalmanophyllinae LECOMPTE, 1952; Dinophyllinae (*nom. transl.* LECOMPTE, 1952)]

Septal stereozone only moderately wide, if present; axial edges of septa and axial lobes typically not forming a conical boss in calice. *M.Ord.-M.Dev.*

Streptelasma HALL, 1847 [**S. corniculum;* SD C. F. ROEMER, 1861] [=*Streptoplasma* HALL, 1847; *Palaeocyathus* FOERSTE, 1888]. Solitary; septa long; axial lobes few, forming a loose, narrow axial structure (20). *M.Ord.-M.Sil.*, N.Am.-Eu.-Asia-Austral.——FIG. 182,*1*. **S. corniculum*, M.Ord., N.Am.; *1a,b*, transv. and long. secs., ×1 (66).

Palaeophyllum BILLINGS, 1858 [**P. rugosum*]. Like *Streptelasma* but phaceloid (30). *M.Ord.-U.Ord.*, N.Am.-Eu.——FIG. 182,*2*. **P. rugosum*, ?U.Ord., Can.; *2a*, side of corallum, ×1; *2b,c*, transv. and long. secs., ×1 (96).

Coelostylis LINDSTRÖM, 1880 [**C. törnquisti* (=*Cyathaxonia? törnquisti* LIND., 1873)]. Solitary; septa with axial lobes; bladelike columella projecting into calice. *M.Ord.*, Swed.——FIG. 182,*8*. **C. toernquisti* (LIND.); long. sec., ×1 (100).

Grewingkia DYBOWSKI, 1873 [**Clisiophyllum buceros* EICHW., 1855; SD SHERZER, 1891] [=*Kiaerophyllum* WEDEKIND, 1927]. Solitary; septa short, axial lobes numerous, axial structure wide and present even in young stages (55). *U.Ord.*, Eu.-N.Am.——FIG. 182,*10*. *G. kiaeri* (WDKD.), type species of *Kiaerophyllum*, Norway; *10a,b*, transv. secs., ×1.5; *10c*, long. sec., ×1.5 (137).

Brachyelasma LANG-S.-T., 1940 [*pro Dybowskia* WEDEKIND, 1927 (*non* DALL, 1876, *nec* others)] [**Dybowskia prima* WDKD., 1927]. Solitary; septa short; axial lobes and axial structure absent in adult stages (55). *U.Ord.*, Eu.——FIG. 182,*5*. **B. primum* (WDKD.), Norway; *5a,b*, transv. and long. secs., ×1 (137).

Dalmanophyllum LANG & SMITH, 1939 [**Cyathaxonia dalmani* M.EDW.-H., 1851] [=*Centrotus* LINDSTRÖM in THOMSON & NICHOLSON, 1876 (*non* FABRICIUS, 1803); *Tyria* SCHEFFEN, 1933 (*non* HÜBNER, 1819)]. Solitary or compound; major septa long and thick, with axial lobes joining a bladelike columella produced upward from axial parts of conjoined cardinal and counter septa; minor septa very short, septal stereozone narrow. *L.Sil.-M.Sil.*, Eu.——FIG. 182,*6a,b*. **D. dalmani* (M.EDW.-H.); *6a,b*, transv. and long. secs., ×2 (73).——FIG. 182,*6c*. *D. inserta* (SCHEFFEN), type species of *Tyria*, L.Sil., Norway; transv. sec., ×5 (112).

Dinophyllum LINDSTRÖM, 1882 [**D. involutum* (=*Clisiophyllum hisingeri* M.EDW.-H., 1851)] [=*Streptophyllum* GRABAU in CHI, 1931]. Solitary; long major septa with few axial lobes but reaching to axis where, with or without convolution of their thin axial ends, they form an axial structure with steeply conical tabulae; minor septa extremely short (37). *L.Sil.-M.Sil.*, Eu.-Asia.——

FIG. 182,*3*. **D. hisingeri* (M.EDW.-H.), M.Sil., Gotl.-Sib.; *3a*, calical view, ×1; *3b*, long. sec., ×1 (100).

Rhegmaphyllum WEDEKIND, 1927 [**Turbinolia turbinata* HISINGER, 1831 (*partim*) (?=*Zaphrentis? conulus* LINDSTRÖM, 1868); SD SOSHKINA, 1937] [=*Regmaphyllum* WDKD., 1927; *Rhegmatophyllum* LANG-S.-T., 1940 (*nom. van.*)]. Solitary; major septa meeting near axis around inner edge of strongly marked fossula; axial lobes few; cardinal septum thin or short (55). *M.Sil.*, Eu.-Asia.——FIG. 182,*9*. *R. conulus* (LIND.), Gotl.; *9a,b*, secs., ×1; *9c*, calical view of septa, diagrammatic (100).

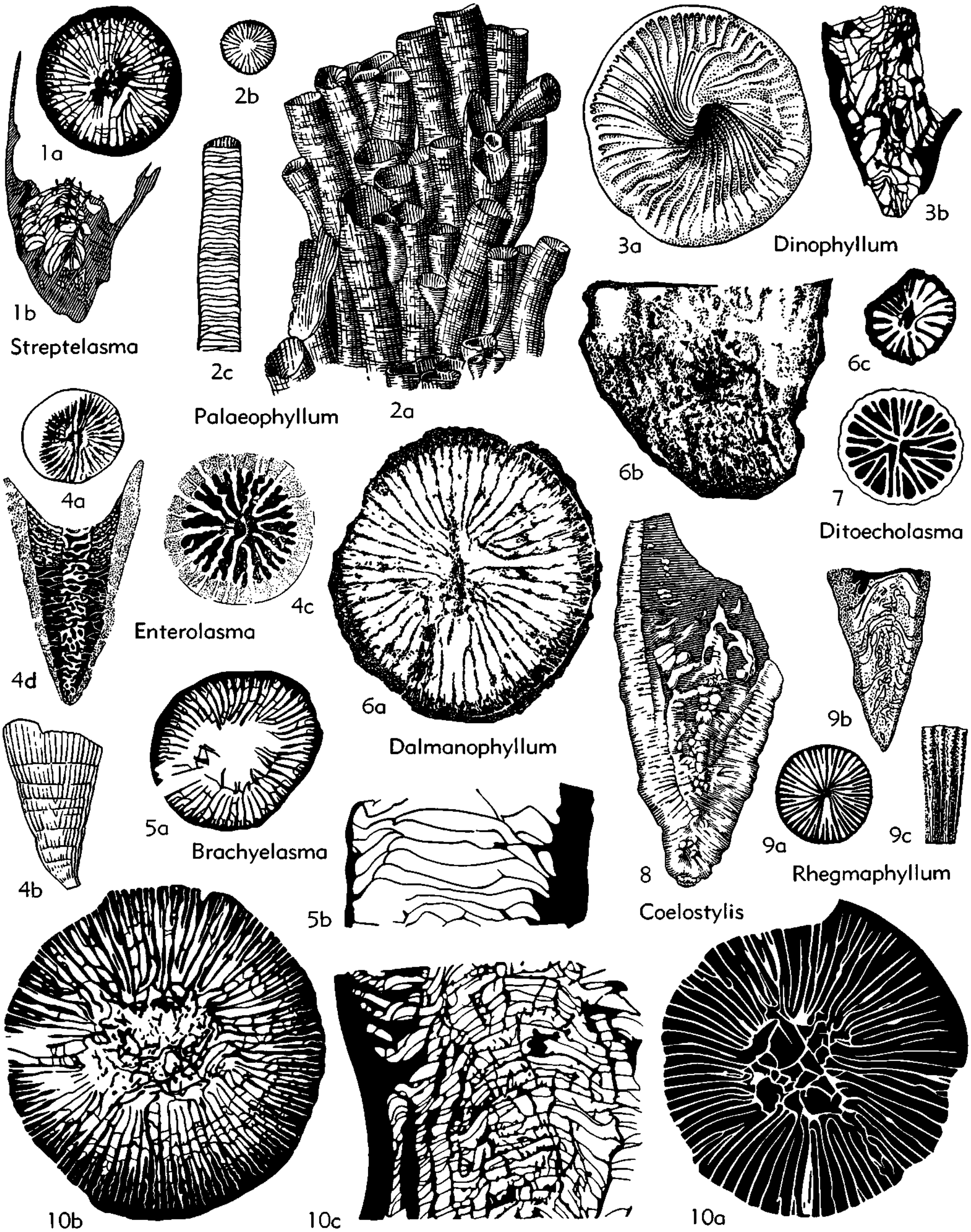

FIG. 182. Streptelasmatina (Zaphrenticae): Streptelasmatidae (p. F268-F270).

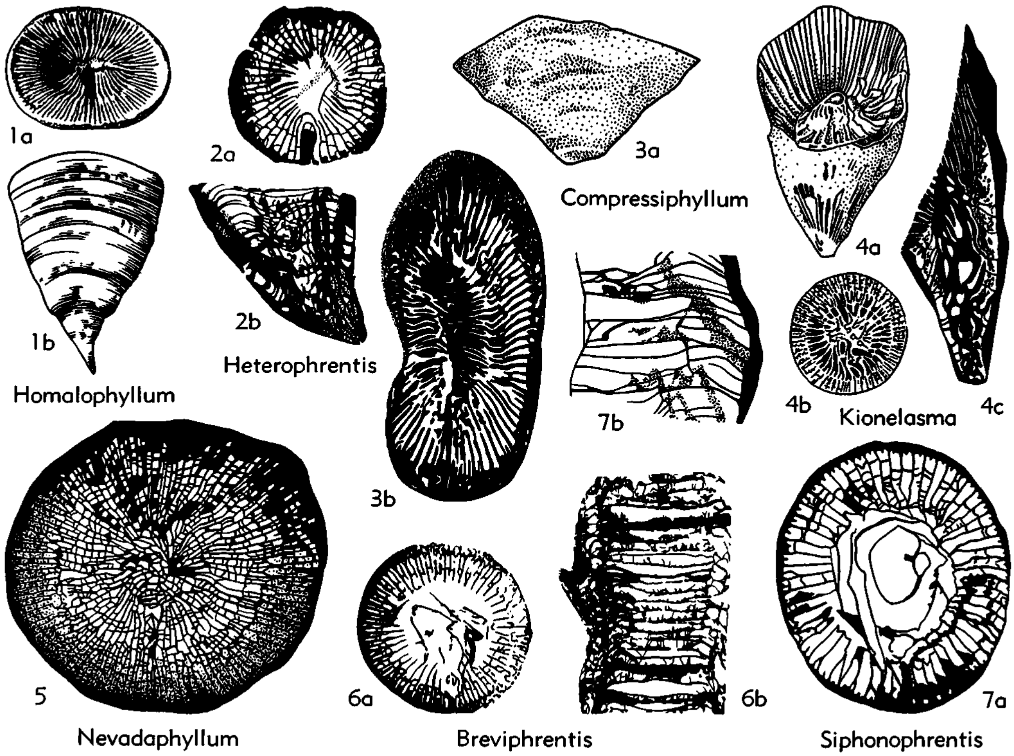

FIG. 183. Streptelasmatina (Zaphrenticae): Streptelasmatidae (p. F270-F271).

Ditoecholasma SIMPSON, 1900 [**Petraia fanningana* SAFFORD, 1869] [=*Ditoechelasma* LANG-S.-T., 1940 *(nom. van.)*]. Solitary, slender; septal stereozone very narrow, septa grouped as in *Petraia,* minor septa long; axial septal lobes forming spongy axial structures; tabulae sagging axially, incomplete. *M.Sil.,* N.Am.——FIG. 182,*7*. **D. fanninganum* (SAFFORD); transv. sec., ×2 (115).

Enterolasma SIMPSON, 1900 [**Streptelasma (Petraia) stricta* HALL, 1874] [=*Enterelasma* LANG-S.-T., 1940 *(nom. van.)*]. Solitary, small, septal stereozone narrow, septa with sides tuberculate and axial edges lobed; cardinal and counter septa long (44). *L.Dev.,* N.Am.——FIG. 182,*4*. **E. strictum* (HALL); *4a,b,* calice, side, ×1; *4c,d,* transv. and long. secs., ×2 (127).

Kionelasma SIMPSON, 1900 [**Streptelasma mammiferum* HALL, 1882] [=*Cionelasma* LANG-S.-T., 1940 *(nom. van.)*]. Solitary, septal stereozone wide; dense axial structure formed from swollen and twisted axial lobes and edges of major septa united by dilating tissue (44). *L.Dev.,* N.Am.——FIG. 183,*4*. **K. mammiferum* (HALL); *4a,* side, ×0.5; *4b,c,* transv. and long secs., ×1 (127).

Heterophrentis BILLINGS, 1875 [**H. spatiosa* BILL., 1875 (=*Zaphrentis spatiosa* BILL., 1858; *Zaphrentis prolifica* BILL., 1858); SD MILLER, 1889] [=*Triplophyllum* SIMPSON, 1900]. Solitary, large, conical, flattened in lateral parts of counter quadrants, wtih fossula on convex side; septal stereozone very narrow; septa with sparse axial lobes, withdrawn from axis; tabulae shallow domes with axial depression (52). *L.Dev.-M.Dev.,* N.Am.——FIG. 183,*2*. **H. prolifica* (BILL.); *2a,b,* transv. and long. secs., ×1 (127).

Compressiphyllum STUMM, 1949 [**Zaphrentis compressa* ROMINGER, 1876 (*non* M.EDW.-H., 1860); renamed *Zaphrentis davisana* MILLER, 1889]. Like *Heterophrentis* but compressed laterally with flattened alar regions (52). *L.Dev.,* N.Am.——FIG. 183,*3*. **C. davisanum* (MILLER); *3a,* side, ×0.5; *3b,* calice, ×1 (127).

Homalophyllum SIMPSON, 1900 [**Zaphrentis ungula* ROMINGER, 1876]. Solitary, small, flattened on the fossular, convex side; with long major and short minor septa (44). *L.Dev.-M.Dev.,* N.Am. ——FIG. 183,*1*. **H. ungula* (ROMINGER); *1a,b,* calice and side, ×1 (127).

Siphonophrentis O'CONNELL, 1914 [**Caryophyllia gigantea* LESUEUR, 1821]. Solitary, large, subcylindrical with septa withdrawn from axis, leaving wide space with very sparse axial lobes; septal stereozone very narrow; tabulae mesa-shaped, depressed at fossula (52). *L.Dev.-M.Dev.,* N.Am. ——FIG. 183,*7*. **S. gigantea* (LESUEUR); *7a,b,* transv. and long. secs., ×1 (127).

Breviphrentis Stumm, 1949 [**Amplexus invaginatus* Stumm, 1937]. Solitary, cylindrical, with septa withdrawn from axis and complete only on tops of the tabulae, which become flat-topped domes with down-turned edges; tabulae not depressed at fossula which is on convex side (52). *L.Dev.-M.Dev.*, Nev.——Fig. 183,*6*. **B. invaginata* (Stumm); *6a,b*, transv. and long. secs., ×1 (127).

Nevadaphyllum Stumm, 1937 [**N. masoni*]. Large, solitary; septal stereozone partly replaced by a regular dissepimentarium of small globose interseptal dissepiments; major septa numerous and convolute in the tabularium, where the domed tabulae are incomplete (52). *L.Dev.*, N.Am.——Fig. 183,*5*. **N. masoni;* transv. sec., ×1 (127).

?**Strobilasma** Scheffen, 1933 [**S. dentatum*] [=*Strobilelasma* Lang-S.-T., 1940 *(nom. van.)*]. *L.Sil.*, Norway.

Subfamily KODONOPHYLLINAE Wedekind, 1927

[*nom. transl.* Lecompte, 1952 (*ex* Kodonophyllidae Wdkd., 1927)]

Marginarium a wide septal stereozone. *L.Sil.-L.Dev.*

Schlotheimophyllum Smith, 1945 [**Fungites patellatus* Schlotheim, 1820]. Solitary, large discoid or patellate with reflexed calicular platform; minor septa long, septal stereozone wide; major septa long and twisted at axis into loose axial structure, axial lobes few (44). *L.Sil.-M.Sil.*, Eu. ——Fig. 184,*3*. **S. patellatum* (Schloth.); *3a,b*, transv. and long. secs., ×1 (97).

Kodonophyllum Wedekind, 1927 [**Streptelasma milne-edwardsi* Dybowski, 1873 (=*Madrepora truncata* Linné, 1758)] [=*Patrophontes* Lang & Smith, 1927; *Codonophyllum* Lang-S.-T., 1940 *(nom. van.)*]. Fasciculate or solitary with flat or sloping calicular platform; otherwise like *Schlotheimophyllum* (31). *M.Sil.-U.Sil.*, Eu.——Fig. 184,*1*. **R. truncatum* (Linné); *1a,b*, transv. and long. secs., ×2 (98).

Circophyllum Lang & Smith, 1939 [*pro Rhysodes* Smith & Tremberth, 1927 (*non* Illiger in Dalman, 1823)] [**Rhysodes samsugnensis* Smith-T., 1927]. Fasciculate, corallites slender and septal stereozone narrow; major septa long, straight, united axially by secondary thickening. *U.Sil.*, Gotl.

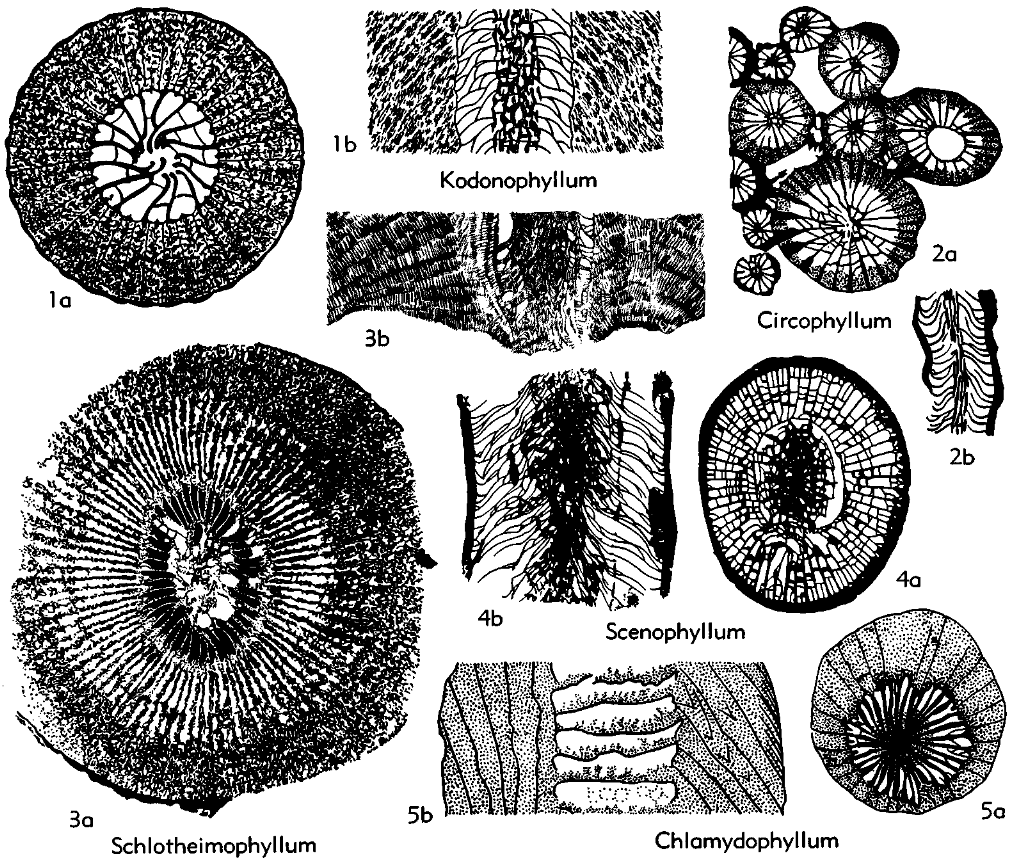

Fig. 184. Streptelasmatina (Zaphrenticae): Streptelasmatidae (p. F271-F272).

——FIG. 184,2. **C. samsugnense* (SMITH-T.); *2a,* transv. sec., ×2; *2b,* long. sec., ×1 (120).

Chlamydophyllum POČTA, 1902 [**C. obscurum*]. Solitary, with very wide septal stereozone from which major septa project with moderate thickening into tabularium; major septa may unite at axis in proximal parts of corallum, and on surface of tabulae in distal parts, being then withdrawn between tabulae; axial lobes few and thickened (40). *L.Dev.,* Eu.-Austral.——FIG. 184,5. **C. obscurum,* Czech.; *5a,b,* transv. and long secs., ×2 (108).

Subfamily ACROPHYLLINAE Stumm, 1949

[*nom. transl.* HILL, herein (*ex* Acrophyllidae STUMM, 1949)]

Marginarium a narrow septal stereozone or dissepimentarium; axial edges of septa and axial lobes forming with tabulae a conical boss in calice (52). *L.Dev.*

Scenophyllum SIMPSON, 1900 [**Zaphrentis conigera* ROMINGER, 1876]. Solitary, large, conico-cylindrical, with numerous long major septa with axial lobes based on close, tall, conical tabulae forming an axial structure with a dominant long irregular lamella in its counter-cardinal plane; septal stereozone narrow (52). *L.Dev.,* N.Am.——FIG. 184,4. **S. conigerum* (ROMINGER); *4a,b,* transv. and long. secs., ×1 (127).

Acrophyllum THOMSON & NICHOLSON, 1876 [**Clisiophyllum oneidaense* BILLINGS, 1859]. Like *Scenophyllum* but with marginarium of angulo-concentric dissepiments in which minor septa are suppressed (52). *L.Dev.,* N.Am.

Family HALLIIDAE Chapman, 1893

Solitary coralla typically with elongate cardinal septum; marginarium comprising a narrow septal stereozone or regular dissepimentarium of small, globose, interseptal dissepiments and thin septa; septa dilated and in contact in the tabularium, dilatation decreasing first from the axial edges and in counter quadrants; septa without axial lobes; in curved coralla the deep fossula is on the convex side; tabulae domed or sagging, usually incomplete. *Ord.-Dev.*

Subfamily LYKOPHYLLINAE Wedekind, 1927

[*nom. transl.* HILL, herein (*ex* Lykophyllidae WDKD., 1927)] [=Neocystiphyllidae WDKD., 1927; ?Stratiphyllidae SCHEFFEN, 1933; Pycnactidae HILL, 1940]

Pinnate arrangement of the septa moderate or weak. *Ord.-Sil.*

Holophragma LINDSTRÖM, 1896 [**Hallia calceoloides* LIND., 1866 *(partim)*]. Calceoloid, small; long cardinal septum on the flattened side; marginarium a septal stereozone without dissepiments (37). *U.Ord.,* N.Am.; *Sil.,* Gotl.——FIG. 185,1. **H. calceoloides* (LIND.), Sil., Gotl.; *1a,b,* side views, ×1; *1c,* calice, ×2 (100).

Onychophyllum SMITH, 1930 [**O. pringlei*]. Small; long cardinal and short counter septa continuous in young stages; septa of counter quadrants short, dilated and in contact; septa of cardinal quadrants longer, thinner and with axial edges bent like a claw toward counter septum; no minor septa or dissepiments (45). *L.Sil.,* Eng.——FIG. 185,3. **O. pringlei; 3a-h,* transv. secs. (inverted), ×2 (117).

Pycnactis RYDER, 1926 [**Hyppurites mitratus* SCHLOTHEIM *(partim),* 1820]. Solitary, major septa dilated, contiguous and pinnately arranged, cardinal septum long; minor septa extremely short, dissepiments absent except at rim of calice. *Sil.,* Eu.——FIG. 185,5. **P. mitrata* (SCHLOTH.); transv. sec., ×3 (137).

Phaulactis RYDER, 1926 [**P. cyathophylloides*] [=*Mesactis* RYDER, 1926; *Desmophyllum* (*non* EHRENBERG, 1834), *Lykophyllum, Lykocystiphyllum, Neocystiphyllum* WEDEKIND, 1927; *Semaiophyllum* VOLLBRECHT in WDKD., 1927; *Hercophyllum* JONES, 1936; *Lycophyllum, Lycocystiphyllum, Semaeophyllum* LANG-S.-T. *(nom. van.),* 1940; all synonyms or possibly subgenera of *Phaulactis*]. Solitary, large; dissepimentarium regular and wide, septa unthickened in it but dilated in tabularium, dilatation decreasing in adult; tabulae domed, flat or sagging, complete or incomplete; pinnate arrangement of septa generally not marked, and cardinal septum commonly not elongate (55). *M.Sil.-U.Sil.,* Eu.-N.Am.-Austral.——FIG. 185, *4a-d. P. tabulata* (WDKD.), type species of *Lykophyllum,* Gotl.; *4a,b,* transv. and long. secs., ×2; *4c,d,* transv. secs., ×3 (137).——FIG. 185,*4e,f. P. shearsbyi* (SÜSSMILCH), type species of *Hercophyllum,* N.S.W.; *4e,f,* transv. and long secs., ×1 (85).

Lamprophyllum WEDEKIND, 1927 [**L. degeeri*]. Solitary; marginarium a herringbone dissepimentarium, minor septa suppressed; major septa thin, short; tabulae horizontal, complete and incomplete (55). *M.Sil.-U.Sil.,* Eu.-N.Am.——FIG. 185, 2. **L. degeeri,* Eu.; *2a,b,* transv. and long. secs., ×1 (137).

?**Pseudocystiphyllum** WANG, 1947 [**P. lini*]. Large, subcylindrical; marginarium a lonsdaleoid dissepimentarium; tabulae concave, incomplete, septa thin and in a narrow irregular zone in outer tabularium. *M.Sil.,* China.——FIG. 186,1. **P. lini; 1a,b,* transv. and long. secs., ×1 (136).

?**Stratiphyllum** SCHEFFEN, 1933 [*non Stratophyllum* SMYTH, 1933 (=*Ethmoplax* SMYTH, 1933, *nom. van.; nec Stratiphyllum* LANG-S.-T., 1940, *nom. van.*)] [**S. cavernosum*]. *L.Sil.,* Norway.

?**Phragmophyllum** SCHEFFEN, 1933 [**P. corrivatum*]. *L.Sil.,* Norway.

Subfamily HALLIINAE Chapman, 1893

[*nom. transl.* STUMM, 1949 (*ex* Halliidae CHAPMAN, 1893)] [=Papiliophyllinae STUMM, 1949; Aulacophyllidae SOSHKINA, 1951]

Pinnate arrangement of septa well marked. *L.Dev.-M.Dev.*

Hallia M.Edw.-H., 1850 [**H. insignis*]. Cardinal, counter and 2 alar septa differently developed from others, the cardinal very long and in deep fossula on convex side; septa of cardinal quadrants longer than others and directed pinnately (30°) to the cardinal septum; septa of counter quadrants radial, directed at 30° toward alar septa; marginarium a septal stereozone in youth, a regular dissepimentarium later (52). *L.Dev.*, N.Am.——Fig. 186, *5*. **H. insignis;* side, ×1 (73).

Aulacophyllum M.Edw.-H., 1850 [**Caninia sulcata* d'Orbigny, 1850] [=*Pinnatophyllum* Grabau, 1922]. Like *Hallia* but cardinal septum extremely short, leaving fossula empty (52). *L.Dev.-M.Dev.*, N.Am.; *M.Dev.*, N.S.W.——Fig. 186,*3a*. **A. sulcatum* (Orb.), L.Dev., N.Am.; side, ×1 (106).——Fig. 186,*3b,c*. *A. scyphus* (Rominger), type species of *Pinnatophyllum*, M.Dev., N.Am.; *3b,c*, calice, side, ×1 (127).

Odontophyllum Simpson, 1900 [**Aulacophyllum convergens* Hall, 1882]. Like *Aulacophyllum* but with long thin cardinal septum; distal edges of septa denticulate (52). *L.Dev.-M.Dev.*, N.Am.——Fig. 186,*2*. **O. convergens* (Hall); *2a*, calice, ×1; *2b,c*, transv. and long. secs., ×1 (127).

Papiliophyllum Stumm, 1937 [**P. elegantulum*] [=*Eurekaphyllum* Stumm, 1937]. Like *Aulacophyllum* but with lonsdaleoid dissepimentarium and septa withdrawing from axis (52). *L.Dev.*-

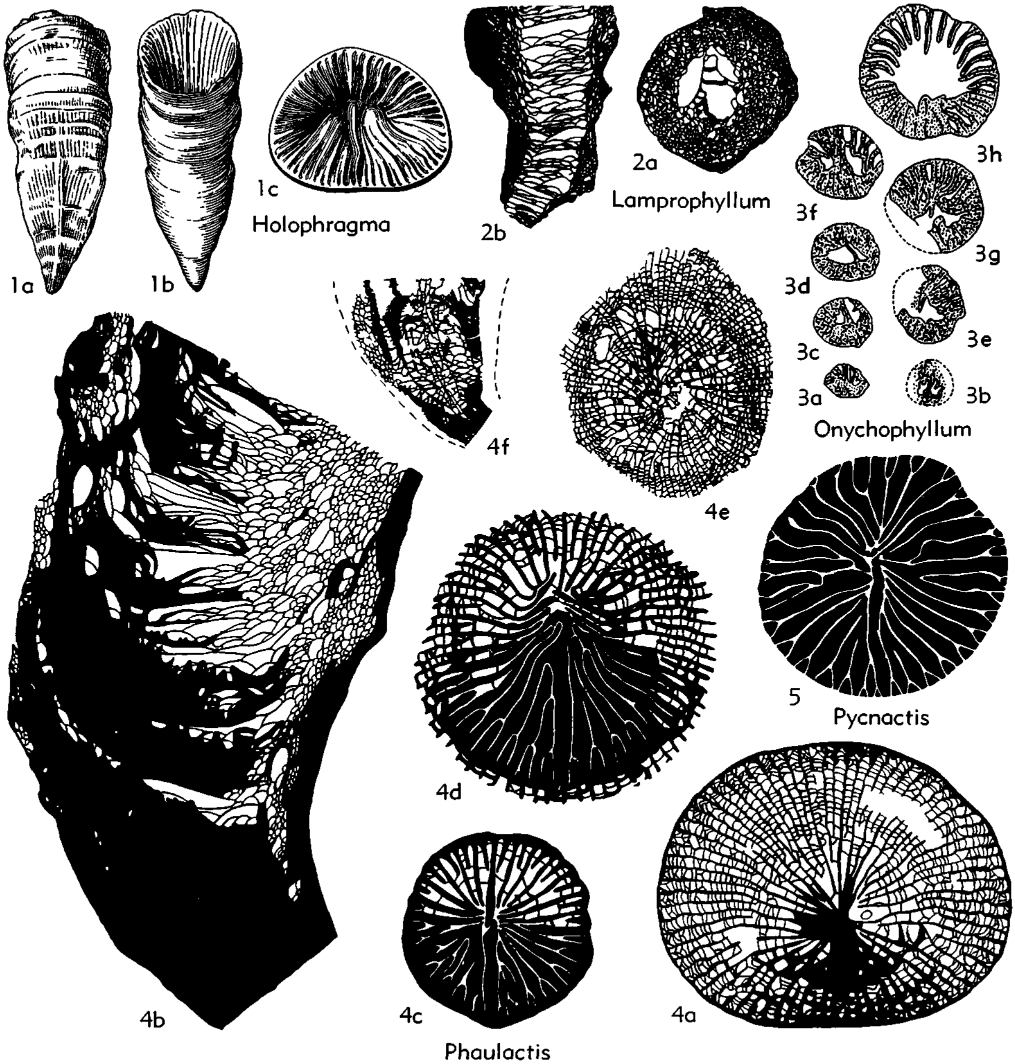

Fig. 185. Streptelasmatina (Zaphrenticae): Halliidae (p. F272).

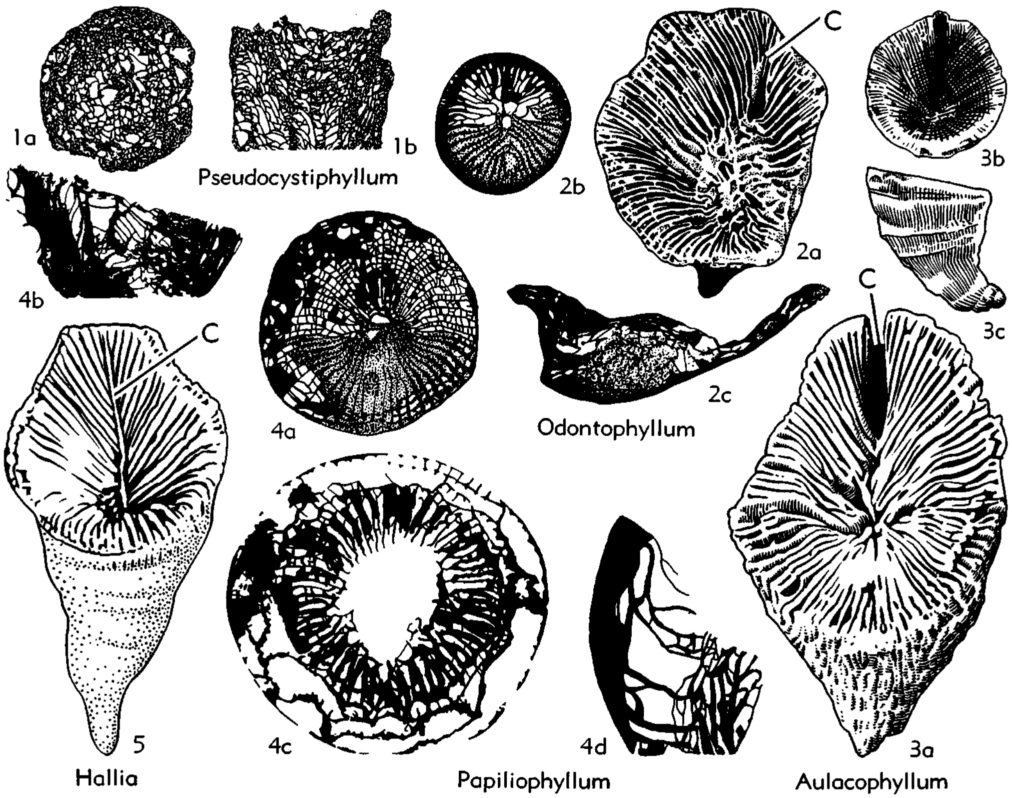

FIG. 186. Streptelasmatina (Zaphrenticae): Halliidae (p. F272-F274).

M.Dev., Nev.——FIG. 186,*4a,b*. **P. elegantulum* L.Dev., Nev.; transv. and long. secs., ×1 (127). ——FIG. 186,*4c,d*. *P. breviseptatum* (STUMM), type species of *Eurekaphyllum*, L.Dev., Nev.; transv. and long. secs., ×1 (127).

Family ARACHNOPHYLLIDAE Dybowski, 1873

Solitary or compound; marginarium a regular dissepimentarium, in some with a few lonsdaleoid dissepiments; major septa either meeting in an axial boss formed by steeply domed tabulae without axial lobes or withdrawn slightly from the axis, where tabular domes flatten or sag axially. *Sil.-Dev.*

Subfamily ARACHNOPHYLLINAE Dybowski, 1873

[*nom. transl.* HILL, herein (*ex* Arachnophyllidae DYB., 1873] [=Entelophyllidae, Entellophyllidae (misprint) HILL, 1940; Entelophyllinae (*nom. transl.* WANG, 1950)]

Septa may be represented by a network of vertical trabeculae or may be carinate; dissepiments small, globose. *Sil.*

Arachnophyllum DANA, 1846 [**Acervularia baltica* SCHWEIGGER (*partim*), LONSDALE, 1839 (=*Strombodes murchisoni* M.EDW.-H., 1851) SD LANG & SMITH, 1927] [=*Favastraea* ORB., 1850 (*non* LANG-S.-T., 1940, *nom. van pro Favastrea* DE BLAINVILLE, 1834); *Darwinia* DYBOWSKI, 1873 (*non* BATE, 1857; *nec* others); *Arachniophyllum* LANG-S.-T., 1940 (*nom. van. pro Arachnophyllum* DANA, 1846) (*non* SMYTH, 1915)]. Astreoid; tabularium narrow, tabulae steeply domed, incomplete; dissepimentarium very wide, of numerous small dissepiments based horizontally, in which septa develop sporadically; septa thickened and contiguous, or each a network of small trabeculae standing vertically on the dissepiments but not piercing more than 1 or 2 successive dissepimental platforms (31). *L.Sil.-M.Sil.*, Eu.-N.Am.-Austral.——FIG. 187,*3*. **A. murchisoni* (M.EDW.-H.), Eu.; *3a,b*, transv. and long. secs., ×2 (98).

Petrozium SMITH, 1930 [**P. dewari*]. Fasciculate, corallites slender, like *Entelophyllum* but with numerous long septa meeting to form an axial structure; tabulae without axial sag (45). *L.Sil.*, Eng.——FIG. 187,*1*. **P. dewari; 1a,b*, transv. secs., ×2; *1c*, long. sec., ×2 (117).

Entelophyllum WEDEKIND, 1927 [**Madreporites articulatus* WAHLENBERG, 1821; SD LANG-S.-T., 1940] [=*Xylodes* LANG-S., 1927 (*non* WATERHOUSE, 1876); *Stereoxylodes* WANG, 1947]. Solitary or fasciculate; septa commonly with zigzag carinae, may be thickened, slightly withdrawn from axis; a narrow regular zone of flat tabellae at outer margins of the tabular domes which usually sag axially (55). *M.Sil.-U.Sil.*, Eu.-Asia-N.Am.-E.Austral.——FIG. 187,*2a,b*. **E. articulatum* (WAHLENBERG), Eu.; *2a,b*, transv. and long. secs., ×2 (98).——FIG. 187,*2c*. *E. pseudodianthus* (WEISSERMEL), type species of *Stereoxylodes*), Eu.-Asia-N.Am.; transv. sec., ×2 (98).

Tenuiphyllum SOSHKINA, 1937 [**T. ornatum*]. Like *Petrozium* but cerioid and with some lonsdaleoid dissepiments (47). *M.Sil.*, Urals.——FIG. 187,*5*. **T. ornatum; 5a,b*, transv. and long. secs., ×2 (122).

Craterophyllum FOERSTE, 1909 [*non* BARBOUR, 1911; *nec* TOLMACHEV, 1931] [**Chonophyllum (Craterophyllum) vulcanius;* SD LANG-S.-T., 1940] [=*Naos* LANG, 1926]. Large, solitary, with inverted calice; septa long, major and minor equal, naotic, with or without narrow interseptal loculi with dissepiments; tabularium narrow, tabulae incomplete. *M.Sil.*, N.Am.——FIG. 188,*3a*. **C. vulcanius;* calice, ×1 (75).——FIG. 188,*3b,c*. *C. pagoda* (SALTER), type species of *Naos;* transv. and long. secs., ×1 (97).

Weissermelia LANG-S.-T., 1940 [*pro Ptilophyllum* SMITH-T., 1927 (*non* GUÉRIN-MÉNEVILLE, 1845; *non Weissermelia* SCHINDEWOLF, 1942)] [**Ptilophyllum lindströmi* SMITH-T., 1927]. Phaceloid, corallites slender; septa thin, carinate; major reaching axis; tabulae incomplete, axially depressed; dissepimentarium wide, peripheral plates large, interseptal, horizontally based and flattened. *U.Sil.*, Gotl.——FIG. 187,*4*. **W. lindstroemi* (SMITH-T.); *4a,b*, transv. and long. secs., ×3 (120).

Subfamily KYPHOPHYLLINAE Wedekind, 1927

[*nom. transl.* HILL, herein (*ex* Kyphophyllidae WDKD., 1927)]

Solitary; septa not carinate, large lonsdaleoid dissepiments predominant over small globose dissepiments. *Sil.*

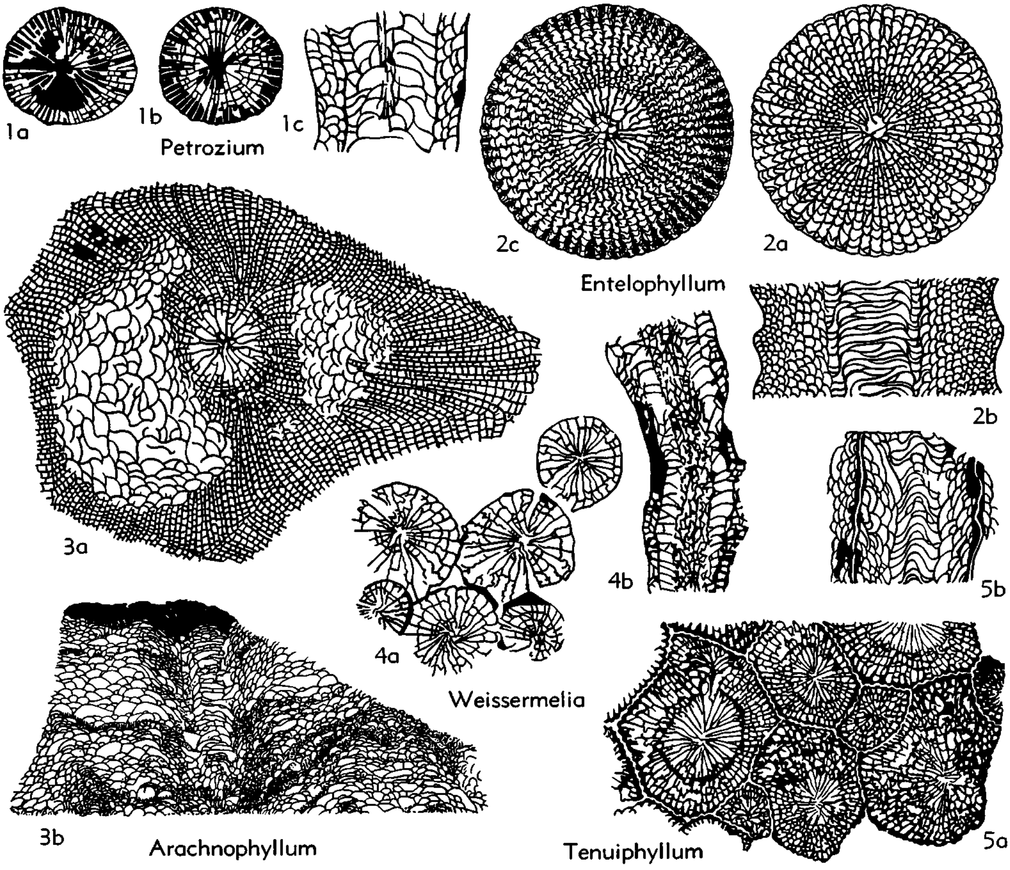

FIG. 187. Streptelasmatina ((Zaphrenticae): Arachnophyllidae (p. F274-F275).

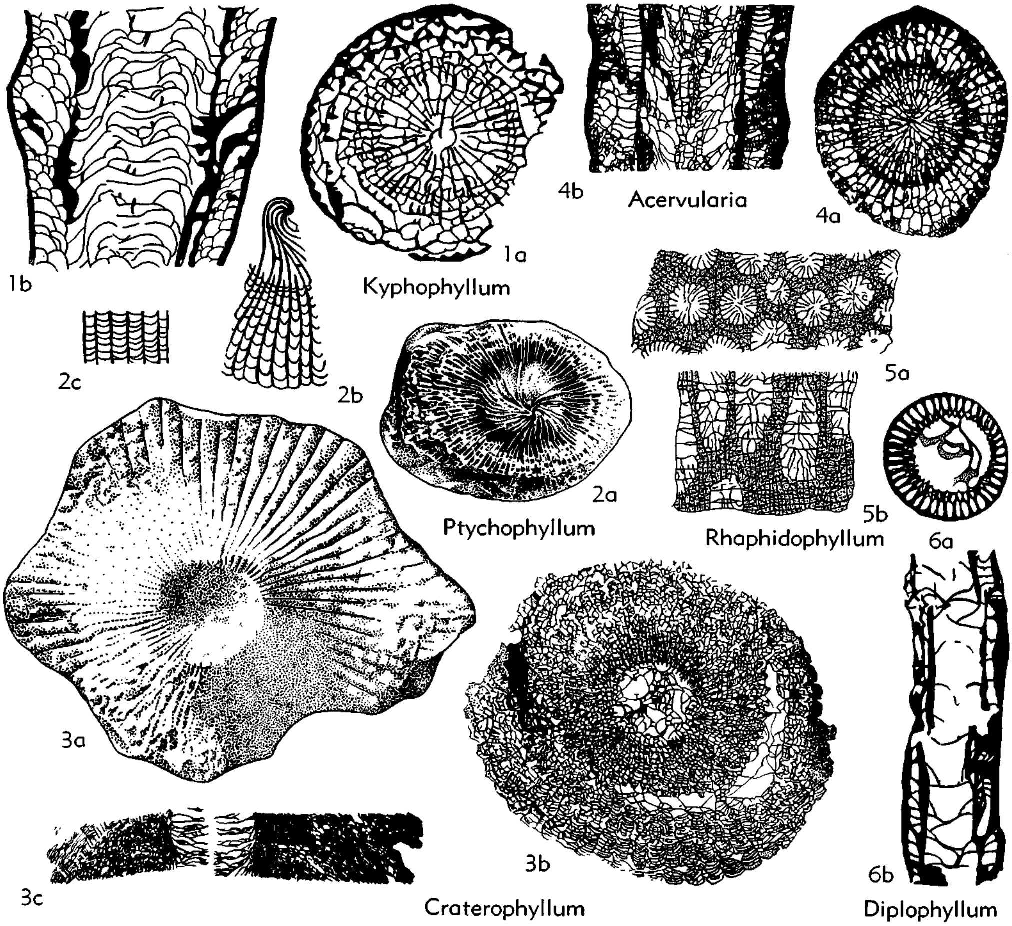

FIG. 188. Streptelasmatina (Zaphrenticae): Arachnophyllidae, Acervulariidae (p. F275-F277).

Kyphophyllum WEDEKIND, 1927 [**K. lindströmi*] [=*Cyphophyllum* LANG-S.-T., 1940 *(nom. van.)*] (55). *M.Sil.*, Gotl.——FIG. 188,*1*. **K. lindstroemi; 1a,b,* transv. and long. secs., ×2 (137).

Subfamily PTYCHOPHYLLINAE Dybowski, 1873

[*nom. transl.* HILL, herein (*ex* Ptychophyllidae DYB., 1873)]

Large, solitary; major septa reaching axis, their axial ends similarly curved; with elongate blister-like dissepiments lining sides of septa. *Sil.*

Ptychophyllum M.EDW.-H., 1850 [**P. stokesi*] [=*Cystiphorolites* MILLER, 1889 (*pro Vesicularia* ROMINGER, 1876, *non* THOMPSON, 1830)]. With wide reflexed dissepimentarium; fossula in tabularium; tabulae domes, incomplete (46). *M.Sil.*, N.Am.——FIG. 188,*2*. **P. stokesi; 2a,* calice, ×0.5; *2b,c,* transv. and long. secs., ×1 (117).

Family ACERVULARIIDAE Lecompte, 1952

[=Acervulariens DE FROMENTEL, 1861 (invalid vernacular name)]

Phaceloid or cerioid with axial, quadripartite increase; marginarium a complex dissepimentarium; septa carinate and dilated near inner ends of long minor septa, forming a wall within the dissepimentarium, at which septal trabeculae diverge; tabulae inversely conical. *Sil.*

Acervularia SCHWEIGGER, 1819 [**A. baltica* (=*Madrepora ananas* LINNÉ, 1758)] [=*Floscularia* EICHWALD, 1829 (*non* CUVIER, 1798, *nec* OKEN, 1815); *Favastrea* DE BLAINVILLE, 1834; *Favastraea* LANG-S.-T., 1940 *(nom. van.)* (*non* D'ORBIGNY, 1850); *Arachnium* KEYSERLING, 1846; *Cyathogonium* CHAPMAN, 1893; *Rhabdophyllum* WEDEKIND, 1927]. Tabulae complete or in part incomplete;

dissepimentarium with 3 zones, an outer comprising 2 or more series of globose plates, a middle consisting of flat plates just outside the inner wall, and an inner composed of globose plates inside this wall and merging into the tabulae; major septa long; third order septa may develop (31). *Sil.*, Eu.—FIG. 188,*4*. **A. ananas* (LINNÉ); *4a,b*, transv. and long. secs., ×2 (117).

Diplophyllum HALL, 1851 (*non* SOSHKINA, 1939) [**D. caespitosum*]. Like *Acervularia* but with only flat dissepiments developed, septa not extending beyond inner wall, and tabulae complete. *M.Sil.*, N.Am.——FIG. 188,*6*. **D. caespitosum; 6a,b*, transv. and long. secs., ×2 (118).

?**Rhaphidophyllum** LINDSTRÖM, 1882 [**R. constellatum*]. Cerioid; septa each a lamina within the narrow marginarium of small regular dissepiments, but within the wide tabularium each represented by long, separated spines, directed upward and inward; tabulae flat, complete (35). *Sil.*, Sib.——FIG. 188,*5*. **R. constellatum; 5a,b*, transv. and long. secs., ×2 (100).

Family MYCOPHYLLIDAE Hill, 1940

[*ex Mycophyllum* LANG-S.-T., 1940 (*nom. van. pro Mucophyllum* ETHERIDGE, 1894)] [=Pseudamplexinae STUMM, 1949]

Solitary, with tabularium surrounded by a broad marginarium as wide as the minor septa are long, in which the septa are so dilated as to be in contact; trabeculae rhabdacanthine, but lamellar sclerenchyme not continuous from one septum to another; tabulae horizontal, complete; no dissepiments. *M.Sil.-L.Dev.*

Mucophyllum ETHERIDGE, 1894 [**M. crateroides*] [=*Mycophyllum* LANG-S.-T., 1940 (*nom. van.*)]. Corallites broadly trumpet-shaped, peripheral stereozone expanding at calice into a wide rim that may be everted (20). *M.Sil.-U.Sil.*, Austral.-Gotl.——FIG. 189,*3*. **M. crateroides*, M.Sil., N.S.W.; *3a*, long. sec., ×1; *3c*, transv. sec. septa, ×1; *3b*, tang. long. sec. septa, ×1 (85).

Pseudamplexus WEISSERMEL, 1897 [**Zaphrentis ligeriensis* BARROIS, 1889] [=*Pselophyllum* POČTA,

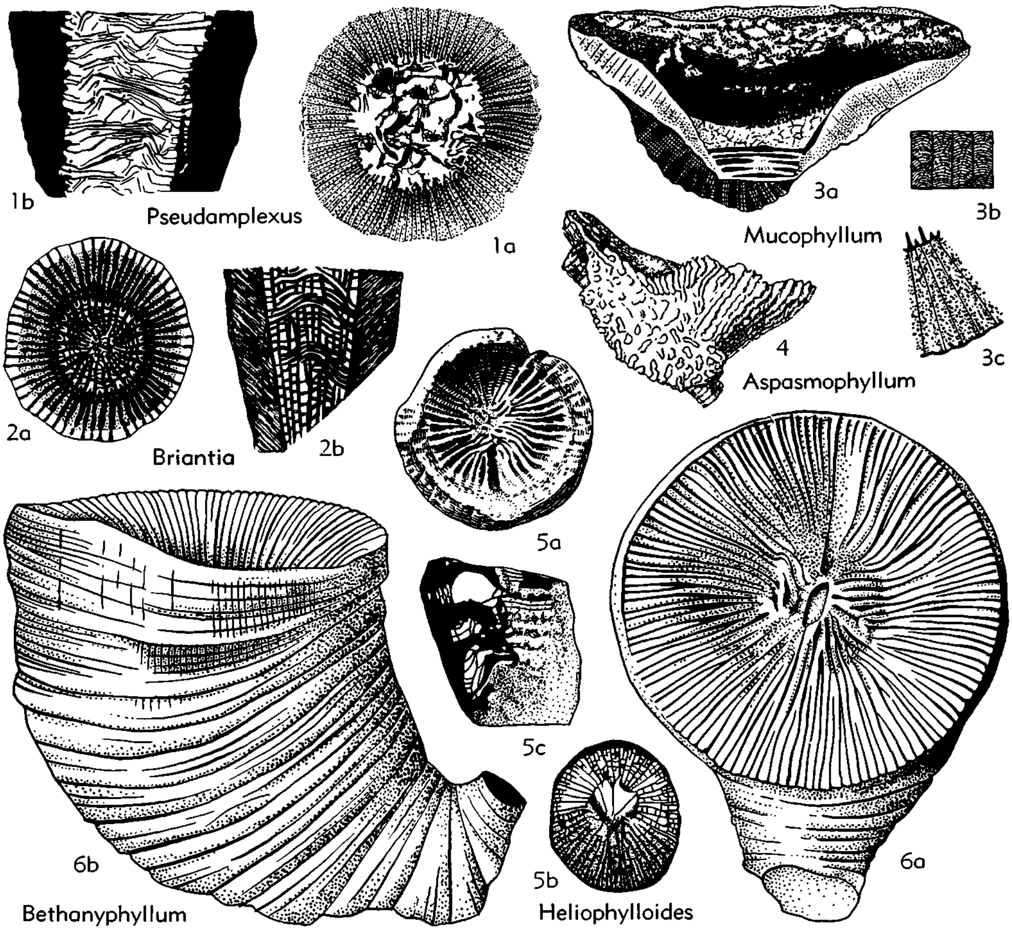

FIG. 189. Streptelasmatina (Zaphrenticae): Mycophyllidae, Zaphrentidae (p. F277-F278).

1902; *Pseliophyllum* LANG-S.-T., 1940 *(nom van.); Pseudomphyma* WEDEKIND, 1927]. Corallites conico-cylindrical, large with wide tabularium (55). *Sil.-L.Dev.*, Eu.-Austral.——FIG. 189,*1*. *P. bohemicus* (POČTA), type species of *Pselophyllum*, L.Dev., Czech.; *1a,b*, transv. and long. secs., ×0.5 (108).

Briantia BARROIS, 1889 [**B. repleta*]. Solitary, marginarium a broad septal stereozone; major septa long and thin in tabularium, almost reaching axis; tabulae broadly domed, complete or incomplete (52). *L.Dev.*, Fr.——FIG. 189,*2*. **B. repleta; 2a,b*, transv. and long. secs., ×1 (59).

Aspasmophyllum C. F. ROEMER, 1880 [**A. crinophilum*]. Corallum very broadly conical adherent by outgrowths from sides and base, usually attached to a crinoid stem (52). *M.Dev.*, Ger.——FIG. 189,*4*. **A. crinophilum;* side, ×1 (110).

Family ZAPHRENTIDAE Milne-Edwards & Haime, 1850

[*nom. correct.* ROEMER, 1883 (*ex* Zaphrentinae M.EDW.-H., 1850, *ex Zaphrentis* HAIME, 1850, *nom. van. pro Zaphrenthis* RAFINESQUE & CLIFFORD, 1820)] [=?Cyathophyllidae DANA, 1846; Zaphrentiniens DE FROMENTEL, 1861 (invalid vernacular name); Heliophyllidae NICHOLSON in NICH. & LYDEKKER, 1889; Zaphrenthidae MOORE & JEFFORDS, 1945; Zaphrentiadae MINATO, 1943; ?Bethanyphyllidae STUMM, 1949]

Solitary or compound, marginarium (when developed) a regular dissepimentarium; major septa either meet in an axial boss formed by steeply domed tabulae, or withdraw from the axis when the tabular domes flatten or sag axially; septa commonly carinate. *Dev.*

This name has been used previously for small solitary corals which herein are placed in the Cyathaxoniicae; the type genus of the family *(Zaphrenthis)* differs from the Cyathaxoniicae and from the conception attached to its name by possessing a dissepimentarium in its calical borders, within which the septa have crossbar carinae; and the type genus leads on, as SMITH (46) has shown, to *Heliophyllum* HALL.

Zaphrenthis RAFINESQUE & CLIFFORD 1820 [**Z. phrygia* RAFINESQUE & CLIFFORD*;* SD MILLER, 1889 (=*Caryophyllia cornicula* LESUEUR, *partim*, 1821] [=*Zaphrentis* HAIME, 1850 *(nom. van.); Helenterophyllum, Heliophrentis* GRABAU, 1910]. Major septa long, dilated equally in the tabularium where they are in contact axially; a narrow dissepimentarium of single globose dissepiments appears in the calical rim, in which the septa are thin with yardarm carinae (46). *Dev.*, N.Am.——FIG. 190,*3*. **Z. phrygia; 3a,b*, calice, long. sec., ×1 (113).

Heliophylloides STUMM, 1949 [**Cyathophyllum brevicorne* DAVIS, 1887]. Like *Zaphrenthis* but with dissepimentarium better and earlier developed and with major septa commonly withdrawn from the axis, when the tabular domes become flat-topped (52). *L.Dev.*, N.Am.——FIG. 189,*5*. **H. brevicornis* (DAVIS); *5a*, calice, ×1; *5b,c*, transv. and long. secs., ×1 (127).

Heliophyllum HALL in DANA, 1846 [**Strombodes helianthoides? (sic)* GOLDF., HALL, 1843 (=*Heliophyllum halli* M.EDW.-H., 1850) (*non* =*Cyathophyllum helianthoides* GOLDF., 1826)] [=*Heliogonium* CHAPMAN, 1893]. Corallites large, aggregated or weakly compound; septa with yardarm carinae, which may be dilated in the tabularium, when all are thickened equally; fossula marked by narrowing of the wide dissepimentarium and by axial ends of neighboring septa being short and curving around it; tabulae shallowly domed with axial sag or sagging, incomplete (52). *L.Dev.-M.Dev.*, N.Am.; *M.Dev.*, Morocco; *Dev.*, S.Am.——FIG. 190,*4*. **H. halli* M.EDW.-H., N.Am.; *4a,b*, transv. and long. secs., ×1 (127).

Radiophyllum HILL, 1942 [**Entelophyllum arborescens* HILL & JONES, 1940]. Like *Heliophyllum* but septa not carinate, long and thin with lateral blister-like plates; fossula not marked; tabulae shallowly domed, incomplete; subequal, large globose tabellae. *L.Dev.*, E.Austral.——FIG. 190,*1*. **R. arborescens* (HILL & JONES); *1a,b*, transv. and long. secs., ×1 (85).

Keriophyllum WEDEKIND, 1923 [**K. heiligensteini*] [=*Ceriophyllum* LANG-S.-T., 1940 *(nom. van.)*]. Corallites turbinate; septa thin, with zigzag carinae; fossula not marked; tabulae domed, may be complete (52). *M.Dev.*, Eu.——FIG. 190,*2*. **K. heiligensteini*, Eifel; *2a*, transv. sec., ×2; *2b*, long. sec. of dissepimentarium, ×2 (137).

Moravophyllum KETTNEROVA, 1932 [**M. ptenophylloides*]. Like *Heliophyllum* but with very numerous long septa without yardarm carinae, thin in tabularium in adult (52). *Up.M.Dev.*, Eu.——FIG. 190,*5*. **M. ptenophylloides*, Czech.; *5a,b*, transv. and long. secs., ×1 (93).

?Tortophyllum SLOSS, 1939 [**Zaphrentis cystica* WINCHELL, 1866]. Large, solitary, with numerous, long, thin, noncarinate septa, convolute in an axial structure with domed tabulae not sagging axially; regular dissepimentarium wide, narrowing at fossula (52). *Up.M.Dev.*, Mich.——FIG. 190,*6*. **T. cysticum* (WINCHELL); *6a,b*, transv. and long. secs., ×1 (116).

?Cyathophyllum GOLDF., 1826 [**C. dianthus;* SD DANA, 1846]. *M.Dev.*, Ger.(Eifel). GOLDFUSS' 6 figured syntype specimens are probably all different species. M.EDW.-H. (1851) selected the original of pl. 15, fig. 13, as type by excluding the other 5. This has not been sectioned; it may be close to *Heliophyllum*.

?Bethanyphyllum STUMM, 1949 [**Cyathophyllum robustum* HALL, 1876]. Large, curved, fossula on convex side; major and minor septa long, thin. *Up.M.Dev.*, N.Am.——FIG. 189,*6*. **B. robustum* (HALL); *6a,b*, calice, side view, ×1 (83).

Family PHILLIPSASTRAEIDAE C. F. Roemer, 1883

[*ex Phillipsastraea* d'Orbigny, 1850 (*nom. van. pro Phillipsastrea* Orb., 1849)] [=Phillipsastraeidea Roemer, 1883 (misprint); Disphyllidae Hill, 1939; Mictophyllidae Hill, 1940; Phillipsastreidae Hill, 1954]

Compound or solitary; major and minor septa, carinate or dilated, typically reaching epitheca; minor septa long; marginarium a wide dissepimentarium of globose, usually small dissepiments, commonly with one vertical series of plates which are horseshoe-shaped in vertical section, with septal trabeculae diverging from the mid-plane; the trabeculae are slender and when the septum is dilated, they curve out laterally from its median plane in regular zones; tabularium in 2 regions separated at axial edges of major septa which are somewhat withdrawn from the axis; tabellae of axial region horizontal, periaxial ones being inclined either inward or outward. *M.Sil.-L.Carb.* (maximum *Dev.*).

Subfamily PHILLIPSASTRAEINAE C. F. Roemer, 1883

[*nom. transl.* Hill, herein (*ex* Phillipsastraeidae C.F.Roemer, 1883)] [=Disphyllinae Hill, 1939 (*nom. transl.* Wang, 1948, *ex* Disphyllidae Hill, 1939; includes Breviphyllinae Taylor, 1951]

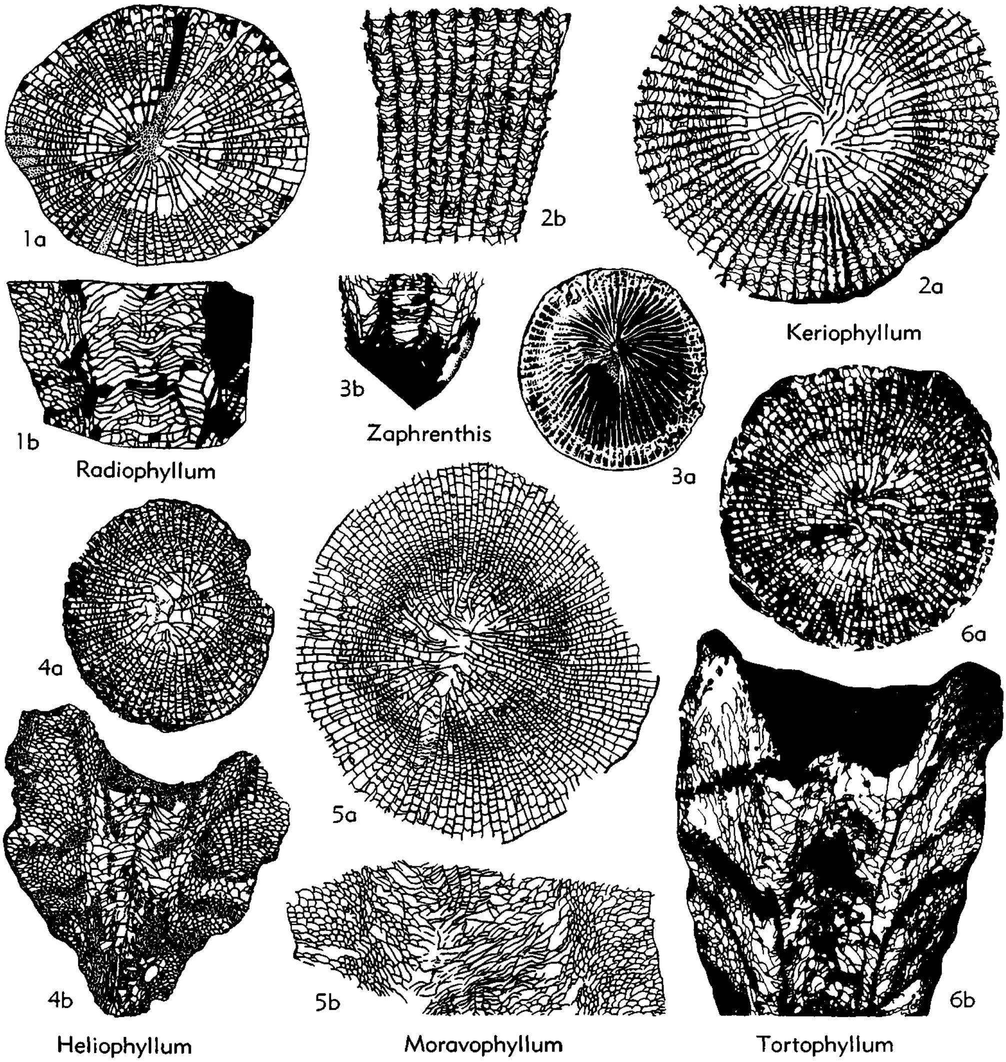

Fig. 190. Streptelasmatina (Zaphrenticae): Zaphrentidae (p. F278).

No aulos or well-defined series of horseshoe dissepiments developed. *Sil.-L.Carb.*

Disphyllum de Fromentel, 1861 [**Cyathophyllum caespitosum* Goldfuss, 1826 *(partim);* SD Lang & Smith, 1934] [=*Schlüteria* Wedekind, 1922 (*non* Fritsch, 1887; *nec* others); *Pseudostringophyllum, Megaphyllum* Soshkina, 1939 (*non* Verhoeff, 1894); *Ceratinella* Soshk., 1941 (*non* Emerton, 1882)]. Phaceloid, with lateral or peripheral increase; septa only slightly dilated, carinate in some; dissepiments in several series of small, equal plates, the innermost being highly inclined; horseshoe dissepiments not developed (32). *M.Sil.,* N.S.W.; *Dev.,* cosmop.——Fig. 191,*10.* **D. caespitosum* (Goldf.), M.Dev., Eu.; *10a,b,* transv. and long. secs., ×2 (97).

Cylindrophyllum Simpson, 1900 (*non* Yabe & Hayasaka, 1915) [**C. elongatum*] [=*Cylindrohelium* Grabau, 1910; *Spinophyllum* Wedekind, 1922]. Like *Disphyllum* but septa with yardarm carinae; tabulae commonly complete (52). *L.Dev.-M.Dev.,* N.Am.; *Up.M.Dev.,* Ger.——Fig. 191,*8.* **C. elongatum, L.Dev.,* N.Am.; long. sec., ×1 (117).

Synaptophyllum Simpson, 1900 [**Diphyphyllum arundinaceum* Billings, 1859]. Like *Disphyllum* but corallites commonly connected by lateral prolongations of dissepimentarium; septa thickest near inner margin of dissepimentarium; trabeculate thickening spreads as a coating over the dissepiments (52). *Dev.,* N.Am.——Fig. 191,*6.* **S. arundinaceum* (Bill.); *6a,b,* transv. and long. secs., ×4 (98).

Breviphyllum Stumm, 1949 [**Amplexus lonensis* Stumm, 1937]. Solitary, with short septa; tabulae flat, complete; dissepimentarium regular, narrow (52). *L.Dev.,* N.Am.-Eu.-Austral.——Fig. 191,*5.* **B. lonense* (Stumm); transv. sec., ×1 (127).

Phillipsastrea d'Orbigny, 1849 [**Astraea hennahi* Lonsdale, 1840 *(partim);* SD M.Edw.-H., 1850] [=*Phillipsastraea* Orb., 1850; *Smithia* M.Edw.-H., 1851 (*non* Saussure, 1855; *nec* others); *Streptastrea* Sandberger & Sandberger, 1856; *Pseudoacervularia* Schlüter, 1881; *Streptastraea* Lang-S.-T., 1940 *(non. van.)*]. Massive, with walls between corallites absent; septa dilated, especially at inner margin of dissepimentarium (32). *Dev.,* Eu.-Asia-Austral.——Fig. 191,*3a.* **P. hennahi* (Lonsd.), U.Dev., Eu.; *3a,* transv. sec., ×2 (117). ——Fig. 191,*3b. P. currani* Etheridge, ?M.Dev., N.S.W.; *3b,* long. sec., ×2 (117).

Billingsastraea Grabau, 1917 [**Phillipsastrea verneuili* M.Edw-H., 1851] [=*?Asterocycles* Vanuxem, 1842; *Radiastraea* Stumm, 1937]. Like *Phillipsastrea* but septa carinate and attenuate; tabulae flat-topped domes (52). *L.Dev.-M.Dev.,* N.Am.; *M.Dev.,* Eu.——Fig. 191,*7.* **B. verneuili* (M.Edw.-H.); upper surface, ×1 (73).

Hexagonaria Gürich, 1896 [**Cyathophyllum hexagonum* Goldfuss, 1826; SD Lang-S.-T., 1940] [=*Polyphyllum* de Fromentel, 1861 (*non* Blanchard, 1850); *Prismatophyllum* Simpson, 1900; *Hexagoniophyllum* Gürich, 1909]. Cerioid; septa thin, carinate or dilated, long, in some meeting or intertwining at the axis, when axial tabellae may be arranged in an axial structure, otherwise withdrawn slightly from axis when the axial tabellae are horizontal, periaxial ones being inclined inward or outward; dissepiments small and globose, numerous (52). *Dev.,* cosmop.; *L.Carb.,* China.——Fig. 191,*2.* **H. hexagona* (Goldf.), M.Dev., Eu.; *2a,b,* transv. and long. secs., ×1 (127).

Haplothecia Frech, 1885 [**Madrepora filata* Schlotheim (*partim,* var.*α*), 1820]. Cerioid, but dividing walls weak; septa with regular close yardarm carinae; trabeculae diverge in mid-region of dissepimentarium (11). *U.Dev.,* Ger.——Fig. 191, *1.* **H. filata* (Schloth.); *1a,b,* transv. and long. secs., ×2 (77).

Ceratophyllum Gürich, 1896 [**C. typus*]. Solitary, ceratoid, with complete or incomplete broad flat tabulae and narrow dissepimentarium (52). *M. Dev.,* Ger.

Kunthia Schlüter, 1885 [**K. crateriformis*]. Small, solitary, with calical floor extending almost to apex of cone; septa as in *Temnophyllum* (52). *M.Dev.,* Ger.——Fig. 191,*4.* **K. crateriformis; 4a,b,* calice, side view, ×1 (113).

Mictophyllum Lang & Smith, 1939 [**M. nobile*]. Large, solitary, with a wide herringbone dissepimentarium in which minor septa are suppressed (46). *M.Dev.,* Austral.; *U.Dev.,* Can.——Fig. 192, *7.* **M. nobile,* U.Dev., Can.; *7a,b,* transv. and long. secs., ×1 (117).

Temnophyllum Walther, 1928 [**T. latum;* SD Lang-S.-T., 1940] [=*Diplophyllum* Soshkina, 1939 (*non* Hall, 1851); *Temeniophyllum* Lang-S.-T., 1940 *(nom. van.)*]. Small, ceratoid, with outer half of septa in the dissepimentarium so dilated as to be in contact; trabeculae slender, curving outward from median plane of septum; dissepiments small and globose, merging with outer tabellae (52). *Up.M.Dev.,* Ger.; *U.Dev.,* USSR. ——Fig. 191,*11a. T. ornatum* Walther, Up.M. Dev., Ger.; *11a,* transv. sec., ×2 (135).——Fig. 191,*11b.* **T. latum,* Up.M.Dev., Ger.; *11b,* long. sec., ×2 (135).

Charactophyllum Simpson, 1900 [**Campophyllum nanum* Hall & Whitfield, 1872]. Small, solitary, with moderately dilated and carinate septa widely withdrawn from axis; dissepimentarium narrow, formed of steeply inclined plates; trabeculae slender but not divergent (46). *U.Dev.,* N.Am.—— Fig. 191,*9.* **C. nanum* (Hall-W.), *9a,b,* transv. and long. secs., ×2 (117).

?Lyliophyllum Kelus, 1939 [**L. pulcherrimum*]. Weakly compound, a few conico-cylindrical individuals united by lateral processes; internal structure unknown (52). *M.Dev.,* Pol.

Subfamily PHACELLOPHYLLINAE Wedekind, 1921

[=Pexiphyllidae WALTHER, 1928; Phacellophyllidae (*nom. transl.* KETTNEROVA, 1932); Thamnophyllidae, Peneckiellidae SOSHKINA, 1947; Pachyphyllinae STUMM, 1948]

Without aulos but with a well-defined series of horseshoe dissepiments. *Dev.*

Thamnophyllum PENECKE, 1894 [*T. stachei; SD LANG & SMITH, 1935]. Dendroid, corallites united

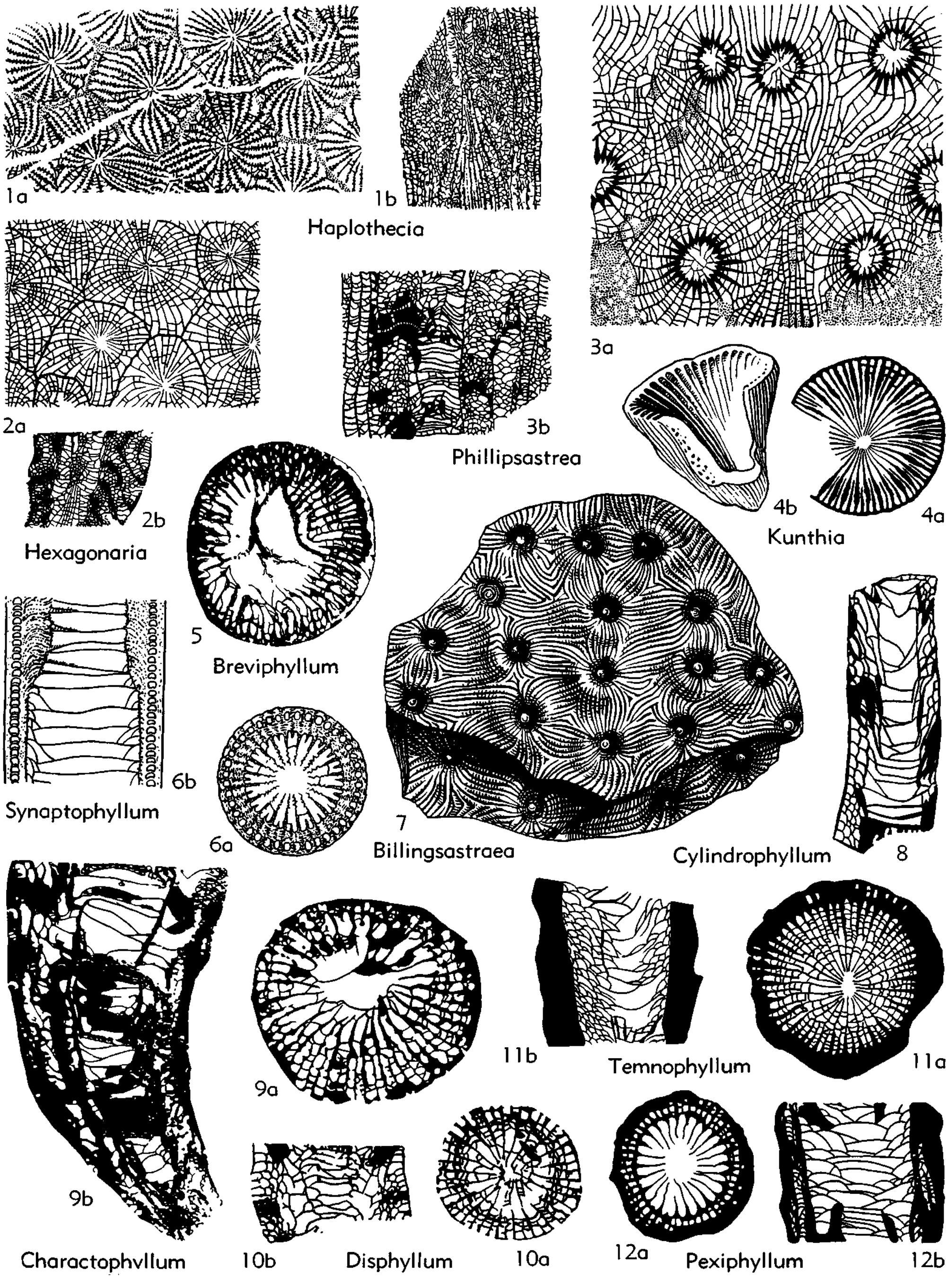

FIG. 191. Streptelasmatina (Zaphrenticae): Phillipsastraeidae (p. F280-F282).

by dissepimental tissue at axils of branches; septa short, dilated, the trabeculate thickening distributed over the very small dissepiments, of which one series comprises horseshoe plates; tabulae commonly complete (32). *L.Dev.-M.Dev.*, Eu.-Austral.——FIG. 192,*4*. **T. stachei*, Aus.; *4a,b*, transv. and long. secs., ×2 (98).

Trapezophyllum ETHERIDGE, 1899 [**Cyathophyllum elegantulum* DUN, 1898]. Cerioid; dissepiments an outer series of flat plates and inner vertical series of horseshoe plates; tabulae complete (19). *L.Dev.-M.Dev.*, E.Austral.——FIG. 192,*8*. *T. coulteri* HILL, L.Dev., N.S.W.; transv. sec., ×2 (85).

Phacellophyllum GÜRICH, 1909 [**Lithodendron caespitosum* GOLDFUSS, 1826] [=*Fascicularia* DYBOWSKI, 1873 (*non* LAMARCK, 1816, *nec* M. EDW. in BUSK, 1859); *Phacelophyllum* LANG-S.-T., 1940 (*nom. van.*)]. Dendroid or phaceloid; branches may be united in their axils by dissepimental tissue; dissepiments in 2 series, an outer of flat plates and an inner vertical series of horseshoe-shaped plates (32). *M.Dev.-U.Dev.*, Eu.——FIG. 192,*6*. **P. caespitosum* (GOLDF.), M.Dev., Eu.; *6a,b*, transv. and long. secs., ×2 (98).

Peneckiella SOSHKINA, 1939 [**Diphyphyllum minus* F. A. ROEMER, 1855]. Phaceloid or cerioid; septa short, tabulae commonly in one series and complete; one series of dissepiments, horseshoe-shaped but flattened above (48). *U.Dev.*, Eu.——FIG. 192,*3*. **P. minus* (ROEMER); *3a,b*, transv. and long. secs., ×1 (77).

Pachyphyllum M.EDW.-H., 1850 [**P. bouchardi*] [=*Medusaephyllum* F. A. ROEMER, 1855]. Massive, may be aphroid, with walls between corallites absent; septa dilated at inner margin of dissepimentarium; innermost dissepiments a vertical series of horseshoe-shaped plates, coated by trabeculate extensions from the dilated septa (52). *U.Dev.*, Eu.-N.Am.——FIG. 192,*5*. *P. ibergense* (F. A. ROEMER), type species of *Medusaephyllum*, Ger.; *5a,b*, transv. and long. secs., ×2 (77).

Macgeea WEBSTER, 1889 [**Pachyphyllum solitarium* HALL & WHITFIELD, 1873; SD FENTON & FENTON, 1924]. Solitary or with a few offsets, epitheca not extending to rim of calice so that peripheral edges of septa are exposed distally; septa somewhat dilated in the moderately wide dissepimentarium, which includes one vertical series of horseshoe-shaped dissepiments; trabeculae slender, laterally curving and divergent from horseshoe dissepiments (46). *U.Dev.*, N.Am.,-Asia-Austral.——FIG. 192,*2*. **M. solitaria* (HALL-W.), N.Am.; *2a*, side, ×1; *2b,c*, transv. and long. secs., ×2 (98).

Pexiphyllum WALTHER, 1928 [**P. rectum;* SD LANG-S.-T., 1940]. Small, slender, solitary, with septa much dilated in dissepimentarium, which includes one vertical series of horseshoe-shaped plates and other globose plates (52). *U.Dev.*, Eu.——FIG. 191,*12*. **P. rectum*, Ger.; *12a,b*, transv. and long. secs., ×2 (135).

Family CRASPEDOPHYLLIDAE Dybowski, 1873

[=Eridophylliens DE FROMENTEL, 1861 (invalid vernacular name); Crepidophyllidae GRABAU in YÜ, 1934; Eridophyllinae STUMM, 1949]

Compound, with carinate or dilated septa, minor ones long; marginarium a wide dissepimentarium with small mostly globose plates; carinae curving upward and inward from peripheral bases of septa; an aulos separates horizontal axial tabellae from outwardly declined periaxial tabellae. *Dev.*

Eridophyllum M.EDW.-H., 1850 [**E. seriale*] [=*Craspedophyllum* DYBOWSKI, 1873 (subj.); *Crepidophyllum* NICHOLSON & THOMSON, 1876; *Schistotoecholasma* STEWART, 1938; *Schistotoechelasma* LANG-S.-T., 1940 (*nom. van.*)]. Phaceloid; septa but slightly dilated, carinate in some; dissepiments in several series of small equal plates, the innermost highly inclined; with an aulos (52). *L.Dev.-M.Dev.*, N.Am.; *M.Dev.*, Morocco.——FIG. 192,*1*. **E. seriale; 1a,b*, transv. and long. secs., ×1 (125).

Family LITHOSTROTIONIDAE d'Orbigny, 1851

[*pro* Lithodendroninae M.EDW.-H., 1850, *ex Lithodendron* PHILLIPS, 1836 (*non* SCHWEIGGER, 1819) =*Lithostrotion* FLEMING, 1828] [=Nematophyllinae M'COY, 1851; Stylaxiniens DE FROMENTEL, 1861 (invalid vernacular name); Axophylloidae (invalid), Diphyphyllinae DYBOWSKI, 1873; Stylaxinidae GERTH, 1921; Lithostrotiontidae GRABAU in CHI, 1931; includes Diphyphyllinae DYBOWSKI, 1873]

Compound Rugosa with an axial structure, generally a columella formed by elongation and vertical prolongation of axial end of counter septum, and conical tabulae; with a regular concentric dissepimentarium in which major and minor septa are continuous; diphymorphs are characteristic, when the axial structure disappears and tabulae flatten (19). *L.Carb.-L.Perm.*

Lithostrotion FLEMING, 1828 [**L. striatum* FLEMING; SD ICZN Opinion 117 (=*Madrepora verticalis* PARKINSON, 1808)] [=*Lithostrotium* AGASSIZ, 1846; *Nemaphyllum, Stylaxis, Siphonodendron* M'COY, 1849; *Lasmocyathus* D'ORBIGNY, 1849; *Nematophyllum* M.EDW.-H., 1850; *Petalaxis* M. EDW.-H., 1852; *?Fischerina* STUCKENBERG, 1904 (*non* TERQUEM, 1878); *Cystidendron, Cystistrotion* SCHINDEWOLF, 1927; *Stylostrotion* CHI, 1935]. Phaceloid or cerioid; typically with columella, long major septa, and large conical tabulae, generally supplemented by outer, smaller and nearly horizontal tabulae; dissepiments absent in very small forms, normal and well developed in large forms; increase nonparricidal; diphymorphs common (18). *L.Carb.*, cosmop.; *M.Carb.*, C.Eu.-Asia.——FIG. 193,*2*. *L. clavaticum* THOMSON, L.Carb., Scot.; *2a,b*, long. and transv. secs., ×1 (85).

Orionastraea Smith, 1916 [**Sarcinula phillipsi* M'Coy, 1849; SD Smith, 1917] [=?*Protolonsdaleiastraea* Gorsky, 1932]. Astreoid, thamnasterioid or aphroid; like *Lithostrotion* but with columella weakly developed or absent; septa withdrawn from axis, and in some from periphery also when dissepiments become lonsdaleoid (18). *L. Carb.*, Eu.-Asia-Austral.——Fig. 193,*3*. *O. phillipsi* (M'Coy), Eu.; transv. sec., ×2 (117).

Diphyphyllum Lonsdale, 1845 [**D. concinnum*] [=*Depasophyllum* Yü, 1934 (*non* Grabau, 1936); *Donophyllum* Fomichev, 1939]. Like fasciculate *Lithostrotion* but with columella failing to develop, and with tabulae domed or flattened axially and downturned peripherally (18). *L.Carb.*, Eu.-Asia-Austral.——Fig. 193,*4*. *D. lateseptatum* (M'Coy), Br.I.; *4a,b*, transv. secs., ×2; *4c,d*, long. secs., ×2 (118).

Stylastraea Lonsdale, 1845 [*non* de Fromentel, 1861] [**S. inconferta;* SD Miller, 1889] [=*Diphystrotion* Smith & Lang, 1930]. Cerioid, but with columella absent or reduced to spines on successive flat or slightly domed tabulae; minor septa discontinuous through inosculating dissepi-

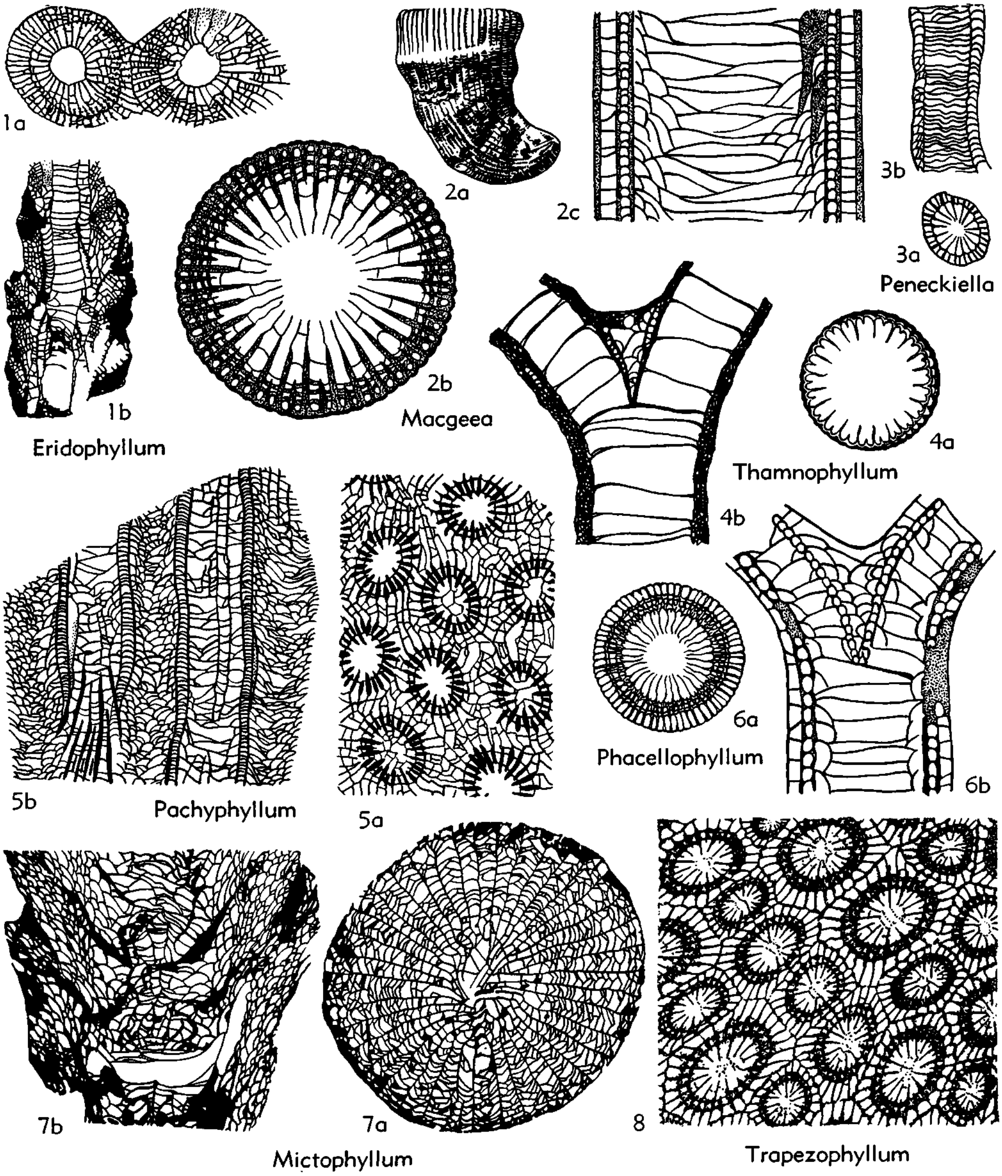

Fig. 192. Streptelasmatina (Zaphrenticae): Phillipsastraeidae, Craspedophyllidae (p. F280-F282).

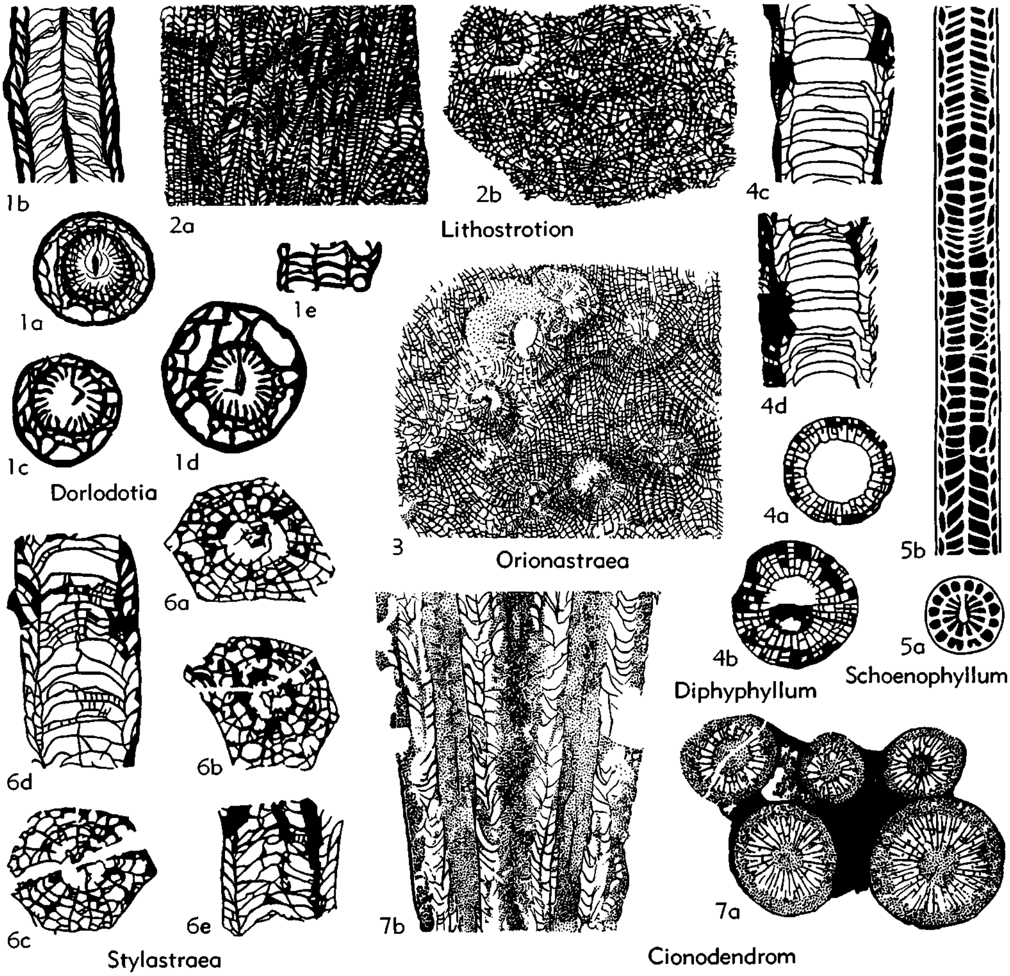

FIG. 193. Streptelasmatina (Zaphrenticae): Lithostrotionidae (p. F282-F284).

ments (18). *L.Carb.*, Eu.——FIG. 193,6. **S. inconferta,* USSR; *6a-c,* transv. secs., ×2; *6d,e,* long. secs., ×2 (118).

Schoenophyllum SIMPSON, 1900 [**S. aggregatum*]. Slender, fasciculate, with a single series of dissepiments and columella formed by elongation of counter septum (44). *Miss.*, N.Am.——FIG. 193, 5. **S. aggregatum, 5a,b,* transv. and long. secs., ×2 (115).

Cionodendrom BENSON & SMITH, 1923 [**C. columen*]. Fasciculate, like *Lithostrotion* but with a large dense round axial structure formed by axial septal ends fused with columella (15). *L.Carb.*, N.S.W.——FIG. 193,7. **C. columen; 7a,b,* transv. and long. secs., ×3 (61).

Dorlodotia SALÉE, 1920 [**D. briarti*] [=?*Lytvophyllum* DOBROLYUBOVA in SOSHK.-D.-P., 1941]. Fasciculate, like *Lithostrotion* but with lonsdaleoid dissepimentarium (18). *L.Carb.*, Fr.-Ger.-?China; *?L.Perm.(Artinsk)*, USSR.——FIG. 193,*1a,b.* **D. briarti,* L.Carb., Fr.; *1a,b,* transv. and long. secs., ×1 (111).——FIG. 193,*1c-e. L. tschernowi* (SOSHKINA), Artinsk., USSR; *1c,d,* transv. secs., ×2; *1e,* long. sec., ×2 (122).

Nemistium SMITH, 1928 [**N. edmondsi*]. Dendroid, with peripheral, parricidal increase; with narrow, regular dissepimentarium, short major septa and axial structure consisting of an irregular medial plate with few straggling septal lamellae impersistent in axial zone of globose, regularly superposed tabellae, from which the outer tabellae slope downward (18). *L.Carb.(Visé.)*, Eng.-Scot.——FIG. 194,2. **N. edmondsi*, Visé., Eng.; *2a,* transv. sec., ×2; *2b,c,* long. secs., ×2 (117).

Aulina SMITH, 1916 [**A. rotiformis*]. Compound, with regular dissepimentarium and aulos but no columella; septa may have zigzag but not yardarm carinae in dissepimentarium (18). *L.Carb.* (D_2-

Namur.), Eu.-Asia.——Fig. 194,6. **A. rotiformis,* Namur., Br.I.; *6a,b,* transv. and long. secs., ×2, ×3 (117).

Arachnastraea Yabe & Hayasaka, 1916 [**A. manchurica*] [=*Cystophorastraea* Dobrolyubova, 1935; *Cystiphorastraea* Lang-S.-T., 1940 *(nom. van.)*]. Corallum astreoid, thamnasterioid, or aphroid; septa thin, major septa meeting conjoined cardinal and counter septa which are only faintly thickened to suggest a medial plate; tabulae conical, complete or incomplete; dissepimentarium regular (57). *M.Carb.,* USSR; *?L.Perm.(Artinsk.),* Manch.——Fig. 194,*3b,c.* **A. manchurica* ?Artinsk., Manch.; *3b,c,* long. and transv. secs., ×2 (140).——Fig. 194,*3a,d. A. molli* (Stuckenberg), type species of *Cystophorastraea,* M.Carb., USSR; *3a,d,* transv. and long. secs., ×2 (68).

Tschussovskenia Dobrolyubova, 1936 [**T. captiosa*]. Like *Nemistium,* but with impersistent dissepimentarium, and axial series of tabellae seldom

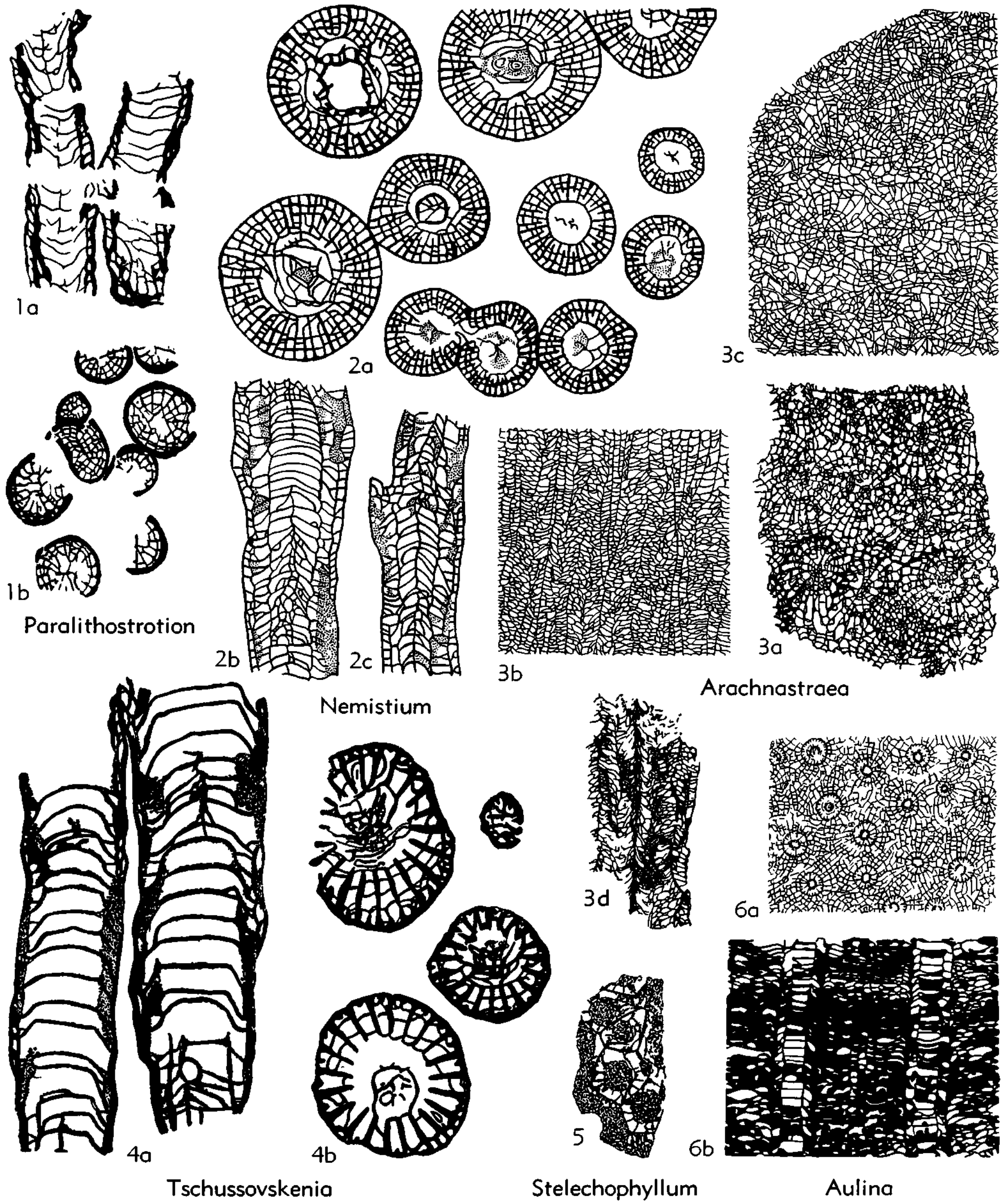

Fig. 194. Streptelasmatina (Zaphrenticae): Lithostrotionidae (p. F284-F286).

differentiated (49). *U.Carb.-L.Perm.(Artinsk.)*, USSR.——FIG. 194,*4*. **T. captiosa; 4a,b,* long. and transv. secs., ×2 (68).

Stelechophyllum TOLMACHEV, 1933 [*pro Stylophyllum* TOLM., 1924 (*non* REUSS, 1854] [**Stylophyllum venukoffi* TOLM., 1924; SD TOLM., 1933]. Cerioid, with long major septa almost meeting at axis, without distinct columella or median plate, and with border of lonsdaleoid dissepiments (18). *L.Carb.(Tournais.)*, W.Sib.——FIG. 194,*5*. **S. venukoffi* (TOLM.); transv. sec., ×1 (131).

?**Paralithostrotion** GORSKY, 1938 [**P. jermolaevi*]. Fasciculate, with *Lithostrotion*-like columella, single series of dissepiments, rudimentary minor septa, and concave tabulae (53). *Carb.*, N.Zem. ——FIG. 194,*1*. **P. jermolaevi; 1a,b,* long. and transv. secs., ×2 (80).

Family AULOPHYLLIDAE Dybowski, 1873

Simple or less commonly compound Rugosa with numerous septa, a regular dissepimentarium, incomplete conical tabulae, and generally an axial structure. Septa are equally spaced and seldom curved about the small, open cardinal fossula, which is marked by extension of the tabularium into the dissepimentarium; major septa may be dilated in the tabularium, particularly in cardinal quadrants; minor septa may be degenerate. Dissepiments are small and globose, concentric, angulo-concentric, or inosculating, rarely lonsdaleoid. The axial structure normally consists of straight or curved septal lamellae, commonly with a columella or median plate, and an inner series of tabellae. *Carb.-Perm.*

Subfamily AULOPHYLLINAE Dybowski, 1873

[*nom. transl.* HILL, herein (*ex* Aulophyllidae DYBOWSKI, 1873)] [=Rhodophyllesia THOMSON, 1874 (tribe); Aspidophyllacea THOMSON, 1875; Diplocyathophyllidae THOMSON, 1882 (invalid, not based on generic name); Clisiophyllidae NICHOLSON & THOMSON, 1883; Clisaxophyllidae GRABAU in YÜ, 1934, Dibunophyllinae, Koninckophyllinae WANG, 1950]

Tabularial part of fossula short, open and narrowing axially. *Carb.-Perm.*

Clisiophyllum DANA, 1846 [**C. keyserlingi* M'COY, 1849; SD DINGWALL, 1926] [=*Arachniophyllum* SMYTH, 1915 (*non* LANG-S.-T., 1940, *nom. van. pro Arachnophyllum* DANA, 1846); *Clisaxophyllum* GRABAU in CHI, 1931; *Clisiaxophyllum* LANG-S.-T., 1940 *(nom. van)*]. Solitary, with normal minor septa in a regular dissepimentarium; axial structure wide, with thin septal lamellae about half as numerous as major septa, commonly convolute and abutting on a short, thickened median plate (18). *L.Carb.*, Eu.-Asia.——FIG. 195,*1a,b*. **C. keyserlingi* M'COY, Visé.-Namur., Eu.; *1a,b,* transv. and long. secs., ×1 (85).——FIG. 195,*1c,d*. *C. coniseptum* (KEYSERLING) (type species of *Clisaxophyllum*), Carb., USSR; ×1 (94).

Aulophyllum M.EDW.-H., 1850 [**Clisiophyllum prolapsum* M'COY, 1849 (=*Turbinolia fungites* FLEMING, 1828)] [=*Cyclophyllum* DUNCAN & THOMSON, 1867 (*pro Cyclocyathus* DUNCAN & THOMSON, 1867, *non* M.EDW.-H., 1850); ?*Setamainella* MINATO, 1943]. Solitary, with dissepimentarium as in *Clisiophyllum;* axial structure a compact, well-defined column, cuspidate in transverse section and built up of closely packed lamellae and tabellae without a median plate (18). *L. Carb.(Visé.)*, Eu.-N.Afr.-?Japan.——FIG. 195,*3a,b*. **A. fungites* (FLEMING), *Visé.*, Eu.-N.Afr.; *3a,b,* transv. and long. secs., ×1 (85).——FIG. 195,*3c*. **S. hayasakai* MINATO, Visé., Japan; *3c,* transv. sec., ×2 (103).

Auloclisia LEWIS, 1927 [**A. mutatum*]. Like *Aulophyllum,* but axial column with dibunophylloid medial plate in young stages (18). *L.Carb.(Visé.)*, W.Eu.——FIG. 195,*2*. **A. mutatum; 2a,b,* transv. secs., ×1; *2c,* long. sec., ×1 (99).

Dibunophyllum THOMSON & NICHOLSON, 1876 [**D. muirheadi* (=*Clisiophyllum bipartitum* M'COY, 1849); SD GREGORY, 1917] [=*Rodophyllum* THOMSON, 1874; *Rhodophyllum, Aspidiophyllum, Kurnatiophyllum* THOMSON, 1875; *Kumatiophyllum* THOMSON, 1876 *(nom. van.), Aspidophyllum* THOMSON-N., 1876; *Cymatiophyllum (nom. van.), Albertia* THOMSON, 1878 (*non* DUJARDIN, 1838, *nec* RONDANI, 1843); *Histiophyllum* THOMSON, 1879; *Centrephyllum* THOMSON, 1880; *Centrophyllum* THOMSON, 1883 *(nom. van.); Cymatophyllum (nom. van.), Centrolamellum* THOMSON, 1901; ?*Protodibunophyllum* LISSITZIN, 1925]. Solitary, with inner parts of minor septa degenerate, leaving inner dissepiments inosculating; axial structure variable, typically one-third as wide as corallite, consisting of a median plate and 4 to 8 septal lamellae on either side; less typically, the lamellae may become curved, the median plate disappear, or the bilateral arrangement be lost (18). *L.Carb.*, Eu.-N.Afr.-N.Am.; *M.Carb.*, Carpathians-Japan. ——FIG. 196,*1a*. **D. bipartitum bipartitum* (M'COY) (lectotype of *D. muirheadi*), Eu.; transv. sec., ×1 (85).——FIG. 196,*1b*. *D. bipartitum bipartitum* (M'COY, 1849, lectotype), Eu.; long. sec., ×1 (85).——FIG. 196,*1c,d*. *D. bipartitum koninckі* (M.EDW.-H.) (lectotype of *Aspidiophyllum koninckianum* THOMSON, type of this genus), Br.I.; transv. and long. secs., ×1 (85).——FIG. 196,*1e,f*. *D. bipartitum konincki* (M.EDW.-H.) (lectotype of *Kurnatiophyllum concentricum* THOMSON, type of this genus), Br.I.; transv. and long. secs., ×1 (130).——FIG. 196,*1g*. *D. bipartitum craigianum* (THOMSON) (type species of *Rodophyllum*). Visé.-Namur., Br.I.; transv. sec., ×1 (85).

Koninckophyllum THOMSON & NICHOLSON, 1876 [**K. magnificum;* SD THOMSON, 1883] [=*Lophophylloides* STUCKENBERG, 1904; *Eostrotion* VAUGHAN, 1915; ?*Neokoninckophyllum* FOMICHEV,

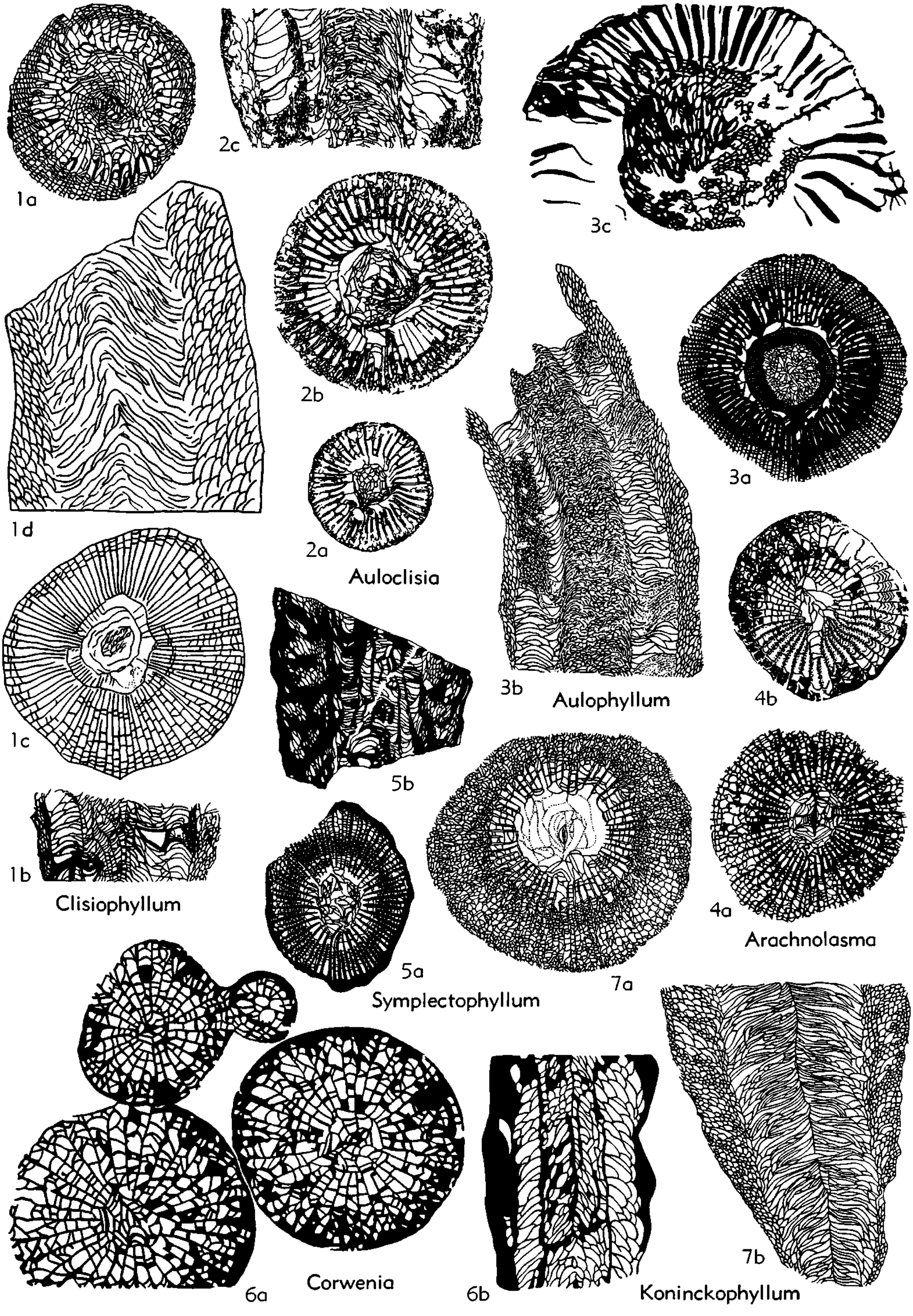

FIG. 195. Streptelasmatina (Zaphrenticae): Aulophyllidae (p. F286-F289).

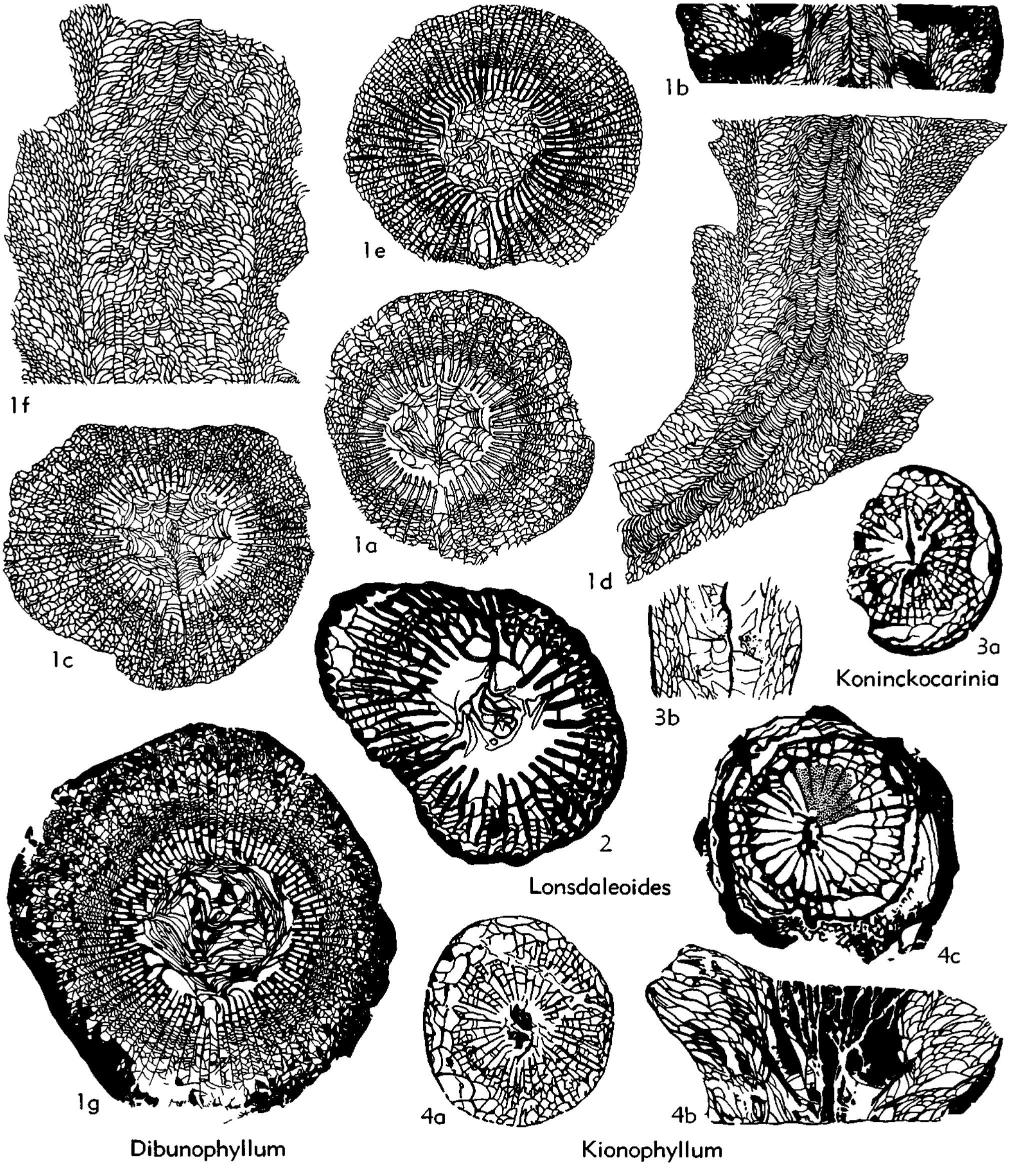

FIG. 196. Streptelasmatina (Zaphrenticae): Aulophyllidae (p. F286-F290).

1939]. Solitary or fasciculate; minor septa may be shortened axially in dissepimentarium; axial structure a columella, which may be supported by a few septal lamellae; tabulae tented and incomplete; if columella is absent, the tabulae flatten and may become complete (18). *Carb.*, Eu.-Asia-N.Am. ——FIG. 195,7. **K. magnificum,* Visé.-Namur., Br.I.; transv. and long. secs., ×1 (85).

Arachnolasma GRABAU, 1922 [**Lophophyllum sinense* YABE & HAYASAKA, 1920] [=*Yuanophyllum* YÜ, 1931; *Arachnelasma* LANG-S.-T., 1940 *(nom. van.)*]. Like *Dibunophyllum* but with narrow axial structure, in which the median plate is much thickened and septal lamellae fewer (3 to 5) on each side (58). *L.Carb.*, China; *M.Carb.*, Spitz. ——FIG. 195,*4a.* **A. sinense* (YABE-H.), L.Carb., China; transv. sec., ×1 (140).——FIG. 195,*4b. A. kansuense* (YÜ) (type species of *Yuanophyllum*), L.Carb., China; transv. sec., ×1 (143).

Corwenia SMITH & RYDER, 1926 [**Lonsdaleia rugosa* M'COY, 1849]. Fasciculate, with dibunophylloid axial structure and dissepimentarium (18).

L.Carb., Eu.-Asia.——FIG. 195,*6*. **C. rugosa* (M'COY), Visé., Eu.; *6a,b*, transv. and long. secs., ×2 (119).

Carruthersella GARWOOD, 1913 [**C. compacta*]. Solitary, small; columella of tightly packed septal lamellae abutting on a medial plate; septa dilated, dissepimentarium narrow, with lonsdaleoid plates peripherally (18). *L.Carb.*, Eng.——FIG. 197,*5*. **C. compacta*, U.Tournais., Eng.; *5a,b*, transv. and long. secs., ×3 (78).

Symplectophyllum HILL, 1934 [**S. mutatum*]. Solitary; axial structure variable, dibunophylloid; skeletal thickening great, not regular; septa naotic peripherally (16). *L.Carb.*, E.Austral.——FIG. 195, *5*. **S. mutatum*, Visé., E.Austral.; *5a,b*, transv. and long. secs., ×1 (85).

Nagatophyllum OZAWA, 1925 [**N. satoi*]. Fasciculate, corallites large; axial structure consisting of median plate surrounded by tightly packed tabellae without septal lamellae; major and minor septa long, naotic peripherally; dissepimentarium wide; tabulae conical. *L.Carb.-M.Carb.*, Japan.——FIG. 197,*3*. **N. satoi*; *3a,b*, transv. and long. secs., ×2 (107).

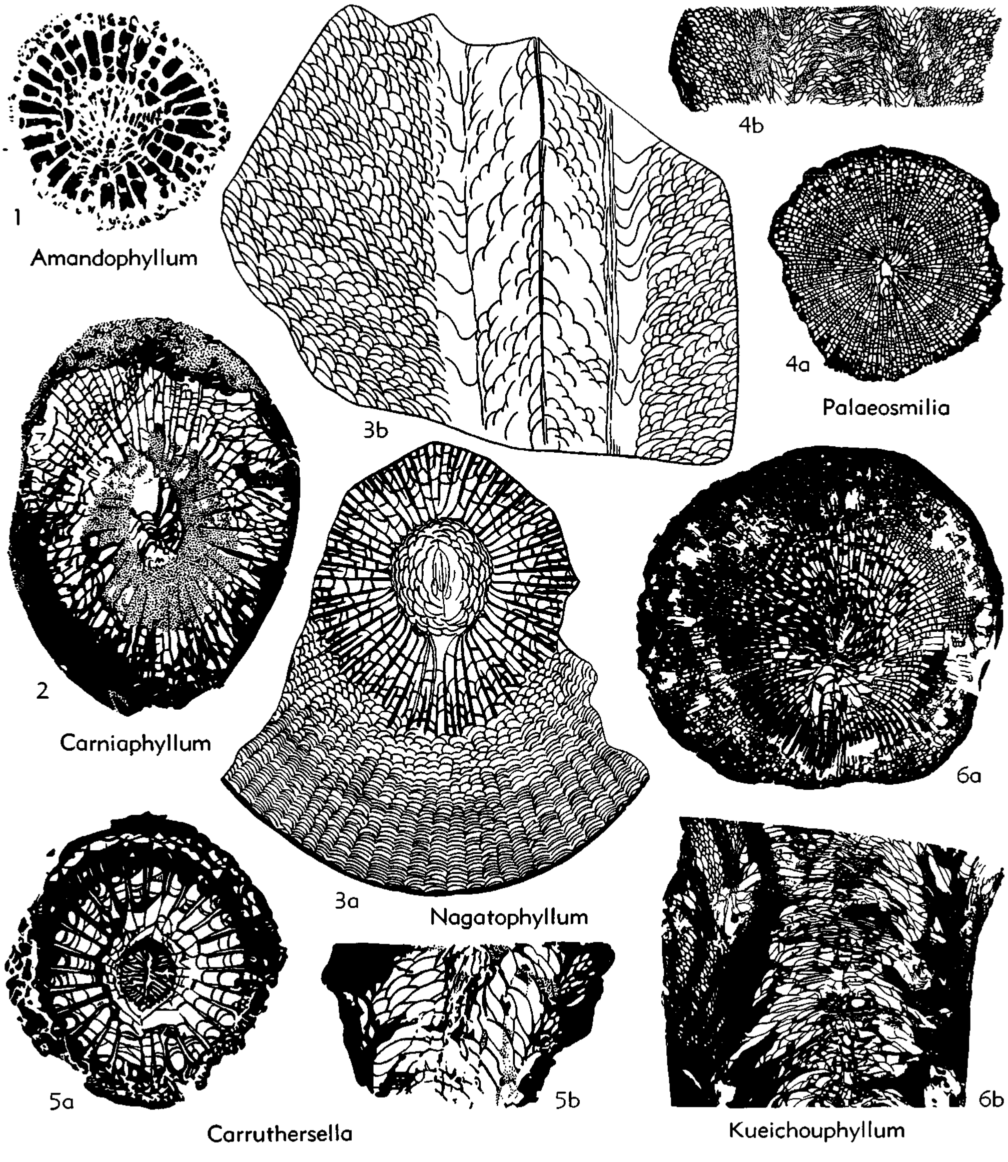

FIG. 197. Streptelasmatina (Zaphrenticae): Aulophyllidae (p. F289-F290).

Lonsdaleoides HERITSCH, 1936 [**L. boswelli*]. Like *Symplectophyllum* but corallum compound and bushy, with large corallites (14). *L.Perm. (Artinsk.)*, Carnic Alps.——FIG. 196,*2*. **L. boswelli;* transv. sec., ×2 (84).

Kionophyllum CHI, 1931 [**K. dibunum*] [=*Geyerophyllum* HERITSCH, 1936; *Cionophyllum* LANG-S.-T., 1940 *(nom. van.)*]. Like *Koninckophyllum* but with lonsdaleoid dissepiments peripherally and septal lamellae irregularly reinforcing columella (5). *M.Carb.*, China; *U.Carb.(Triticites zone)*, Carnic Alps.——FIG. 196,*4a,b*. **K. dibunum* M. Carb., China; *4a,b,* transv. and long. secs., ×1 (65).——FIG. 196,*4c*. **K. carnicum* (HERITSCH) (type species of *Geyerophyllum*), U.Carb. *(Triticites* zone), Carnic Alps; transv. sec., ×2 (84).

Koninckocarinia DOBROLYUBOVA, 1937 [**K. flexuosa*]. Solitary, conico-cylindrical, with one septum produced into an elongated columella not reached by other septa; septa with tuberculate sides; peripheral dissepiments lonsdaleoid, others normal; tabulae flat, with upturned edges (6). *M.Carb.*, USSR.——FIG. 196,*3*. **K. flexuosa; 3a,b,* transv. and long. secs., ×2 (68).

Carniaphyllum HERITSCH, 1936 [**C. gortanii*]. Solitary, with axial structure consisting of long thickened medial plate surrounded by tabellae arranged tent-wise, and rarely crossed by septal lamellae; dissepimentarium regular, wide (14). *M.Carb.*, USSR; *L.U.Carb.(Auernig)*, Carnic Alps.——FIG. 197,*2*. **C. gortanii,* U.Carb.(Auernig), Carnic Alps; transv. sec., ×3 (84).

Amandophyllum HERITSCH, 1941 [**Clisiophyllum carnicum* HERITSCH, 1936]. Solitary, axial structure of 4 or 6 septal lamellae developed on either side of an irregular, unthickened median lamella to which some run parallel; dissepimentarium narrow, dissepiments inosculating; minor septa may be withdrawn to periphery (14). *M.Carb.*, USSR; *L.U.Carb.(?Triticites* zone), Carnic Alps.——FIG. 197,*1*. **A. carnicum* (HERITSCH), L.U.Carb., Carnic Alps; transv. sec., ×3 (84).

Subfamily AMYGDALOPHYLLINAE Grabau in Chi, 1935

[*nom. transl.* HILL, herein *(ex* Amygdalophyllidae GRABAU in CHI, 1935)] [=?Campophyllidae, ?Campophyllinae WEDEKIND, 1921; Palaeosmiliidae HILL, 1940]

Fossula deepened, lengthened or expanded axially in tabularium; septa very numerous. *L.Carb.*

Cyathoclisia DINGWALL, 1926 [**C. tabernaculum*]. Dissepimentarium regular, minor septa normal; axial structure crowded with convolute septal lamellae as numerous as the major septa and commonly continuous with them; median plate small and thickened; tabellae not clearly differentiated by change of slope into inner and outer series; fossula expanding into outer part of tabularium (18). *L.Carb.(Tournais.)*, W.Eu.——FIG. 198,*5*. **C. tabernaculum; 5a,b,* transv. and long. secs., ×1 (67).

Heterocaninia YABE & HAYASAKA, 1920 [**H. tholusitabulata*]. Large, solitary, with loose axial structure of curved septal lamellae about one-sixth as numerous as septa and mostly not continuous with them, usually without distinct medial plate; minor septa absent, but dissepimentarium wide, with inosculating dissepiments; major septa dilated in tabularium in cardinal quadrants; fossula with short cardinal septum (58). *L.Carb.*, China.——FIG. 198,*6*. **H. tholusitabulata; 6a,b,* transv. and long. secs., ×1 (140).

Kueichouphyllum YÜ, 1931 [**K. sinense*] [=*Yabeella* YÜ, 1934; *Kesenella* NAGAO & MINATO, 1941]. Like *Heterocaninia* but with long minor septa developed in the wide dissepimentarium (58). *L.Carb.*, Asia; *M.Carb.*, Spitz.——FIG. 197,*6*. **K. sinense,* L.Carb., Asia; *6a,b,* transv. and long. secs., ×1 (143).

Turbophyllum PARKS, 1951 [**T. multiconum*] [=*Faberophyllum* PARKS, 1951]. Like *Heterocaninia* but with long minor septa and septa not generally dilated in tabularium; axial structure weak, as in *Heterocaninia,* or with sharply tented axial tabellae. *L.Carb.*, N.Am.

Amygdalophyllum DUN & BENSON, 1920 [**A. etheridgei*] [=*Echigophyllum* YABE & HAYASAKA in HAYASAKA, 1924; *?Carinthiaphyllum* HERITSCH, 1936; *Ekvasophyllum* PARKS, 1951]. Solitary, with large columella, almond-shaped in section, made of dilated axial ends of the long major septa welded together with intercalated septal lamellae to form a medial plate; with wide normal dissepimentarium and incomplete domed tabulae having upturned edges (15). *L.Carb.*, E.Austral.-Eu.-Asia; *M.Carb.*, Eu.——FIG. 198,*1*. **A. etheridgei,* Visé., E.Austral.; *1a,b,* transv. and long. secs., ×1 (70).

Palaeosmilia M.EDW.-H., 1848 [**P. murchisoni*] [=*Strephodes* M'COY, 1849; *Palastraea* M'COY, 1851; *Palaeastraea* LANG-S.-T., 1940 *(nom. van.); ?Campophyllum* M.EDW.-H., 1850; *Clisiophyllites* LÖWENECK, 1932]. Solitary or compound, with numerous long septa, wide regular dissepimentarium, and fossula narrow at outer part of tabularium, widening slightly in middle of tabularium; major septa reach the axial structure of incomplete, domed tabulae sagging at the axis; no septal lamellae (18). *L.Carb.*, cosmop.——FIG. 197,*4*. **P. murchisoni,* Visé., Eu.; *4a,b,* transv. and long. secs., ×1 (85).

Aphrophyllum SMITH, 1920 [**A. hallense*]. Like *Palaeosmilia,* but with corallites elongated in the counter-cardinal plane, some skeletal dilatation; dissepimentarium may have an irregular lonsdaleoid border (15). *L.Carb.*, E.Austral.——FIG. 198, *2*. **A. hallense,* Visé., E.Austral.; *2a,b,* transv. and long. secs., ×1 (85).

Subfamily YATSENGIINAE Hill, nov.

Corallites slender, septa few, minor septa poorly developed, dissepimentarium very narrow; axial structure dibunophylloid, commonly without regular medial plate. *L. Perm.(Artinsk.).*

Yatsengia HUANG, 1932 [**Y. asiatica*]. Fasciculate, axial structure surrounded by an outer series of tabellae sloping downward and outward; dissepimentarium commonly not crossed by the poorly developed minor septa, dissepiments inosculating; major septa dilated in tabularium (25). *L.Perm. (Artinsk.),* Asia.——FIG. 198,*3*. **Y. asiatica; 3a,b,* transv. and long. secs., ×4 (88).

Protowentzelella PORFIRIEV, 1941 [**P. simplex*]. Like *Yatsengia* but cerioid, axial structure typically weakly developed (49). *L.Perm.(Artinsk.),* Eu.-Asia.——FIG. 198,*4*. **P. simplex,* Eu.; *4a,b,* transv. and long. secs., ×2 (123).

Family CYATHOPSIDAE Dybowski, 1873

[*ex Cyathopsis* D'ORBIGNY, 1849 (=*Caninia*, MICHELIN in GERVAIS, 1840)] [=Caniniidae HILL, 1938]

Solitary or fasciculate Rugosa with an open tabular fossula; septa typically dilated

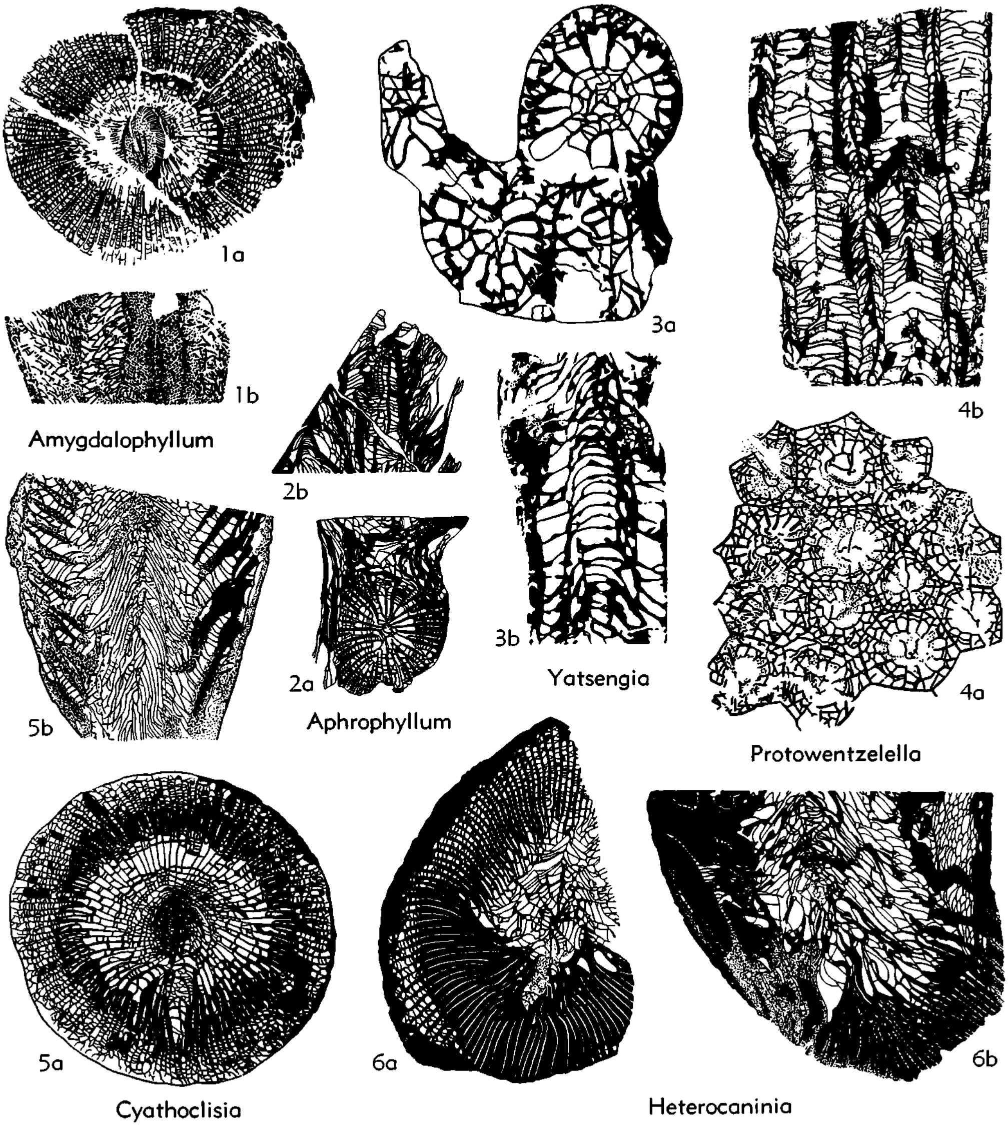

FIG. 198. Streptelasmatina (Zaphrenticae): Aulophyllidae (p. F290-F291).

and amplexoid in the wide tabularium; tabulae complete, domed or flat, with downturned edges; marginarium a regular or (in some) a lonsdaleoid dissepimentarium; cardinal septum short, counter septum commonly elongate. *L.Carb.-Perm.*

The appearance of a lonsdaleoid dissepimentarium in some genera suggests relationship to the Columnariina, but all other characters are indicative of the Zaphrenticae.

Caninia MICHELIN in GERVAIS, 1840 (*non* OWEN, 1846) [**C. cornucopiae*] [=*Cyathopsis* D'ORBIGNY, 1849 (*non* THOMSON, 1883) (obj.); *Pseudozaphrentoides* STUCKENBERG, 1904; *Peetzia* TOLMACHEV, 1924]. Solitary; in youth, the long major septa are slightly sinuous, with lanceolate dilatation in tabularium, particularly in cardinal quadrants; septa become amplexoid and less dilated in adult stages, when a marginarium of concentric, inosculating or lonsdaleoid dissepiments may develop; fossula open, neighboring septa curving about it; tabulae flat with downturned margins (18). *Carb.-Perm.*, N.Am.-Eu.-Asia-Austral.——FIG. 199,*2*. **C. cornucopiae* L.Carb., Eu.; *2a,b*, transv. secs., ×1; *2c*, long. sec., ×1 (64).

Siphonophyllia SCOULER in M'COY, 1844 [**S. cylindrica*] [=*Paleocaninia* LISSITZIN, 1925]. Large, solitary; like *Caninia* but with a wide lonsdaleoid dissepimentarium. *L.Carb.*, Eu.——FIG. 199,*1*. **S. cylindrica;* transv. sec., ×1 (121).

Caninophyllum LEWIS, 1929 [**Cyathophyllum archiaci* M.EDW.-H., 1852] [=?*Neocaninia* LISSITZIN, 1925]. Large, solitary, dissepimentarium wide, with angulate, not lonsdaleoid dissepiments; fossula open; major septa long, not confluent at axis, dilated in cardinal quadrants of tabularium in youth (18). *L.Carb.*, Eu.-Asia; *M.Carb.-U.Carb.*, USSR.——FIG. 199,*7*. **C. archiaci* (M.EDW.-H.), L.Carb., Eu.; *7a,b*, transv. secs., ×1 (99).

Bothrophyllum TRAUTSCHOLD, 1879 [**B. conicum* (FISCHER) TRAUT. (?=*Turbinolia conica* FISCHER, 1830)] [=*Rossophyllum, Pseudocaninia* STUCKENBERG, 1888]. Like *Caninophyllum* but with axial ends of longer major setpa commonly joined to an elongate counter septum forming a weak, impersistent axial structure; major septa dilated in tabularium, those of counter quadrants less than those in cardinal quadrants. *L.Carb.*, Eu.-N.Am.-Austral.; *M.Carb.-U.Carb.*, USSR.-China.——FIG. 199,*6a,b*. **B. conicum* (FISCHER), *M.Carb.*, USSR; *6a,b*, transv. secs., ×2 (68).——FIG. 199,*6c,d*. *B. novum* (STUCKENBERG) (type species of *Rossophyllum*), M.Carb., USSR; *6c,d*, transv. and long. secs., ×1 (126).

Lithodrumus GREENE, 1904 [**L. veryi*] [=*Lithodrymus* LANG-S.-T., 1940 *(nom. van.)*]. Solitary, fasciculate, or cerioid; corallites large; dissepimentarium wide, minor septa withdrawn to periphery, leaving inosculating dissepiments; lonsdaleoid dissepiments may occur; major septa withdrawn somewhat from axis; tabulae flat, complete, with downturned edges. *Carb.*, Eu.-Asia-N.Am.

Timania STUCKENBERG, 1895 [**T. schmidti*]. Large, solitary; tabular fossula expanding inward, with ends of major septa in cardinal quadrants twisting sharply across its inner end; counter septum very long, septa in counter quadrants radially arranged; minor septa withdrawn to outer part of dissepimentarium which is not lonsdaleoid (50). *M.Carb.-U.Carb.*, USSR-Spitz.——FIG. 199,*4*. **T. schmidti*, M.Carb., USSR; *4a,b*, transv. and long. secs., ×1 (126).

Gshelia STUCKENBERG, 1888 [**G. rouilleri*]. Like *Timania* but with more evenly developed dissepimentarium in which minor septa extend to the tabularium; counter septum longer than others only in young stages, when it is connected with a platelike columella absent in adult (7). *M.Carb.*, China; *U.Carb.*, USSR.——FIG. 199,*3*. **G. rouilleri*, U.Carb., USSR; *3a,b*, transv. and long. secs., ×1 (68).

?**Bordenia** GREENE, 1901 [**B. zaphrentiformis*]. Solitary, with an epithecal talon; septa amplexoid; no dissepimentarium (51). *L.Carb.*, N.Am.——FIG. 199,*5*. **B. zaphrentiformis; 5a,b*, calice, nat. long. sec., ×1 (127).

?**Vesiculophyllum** EASTON, 1944 [**Chonophyllum sedaliense* WHITE, 1880]. Peripheral dissepiments irregular, lonsdaleoid, inner dissepiments small, regular; major tabulae sagging deeply and incomplete (10). *Miss.*, N.Am.——FIG. 200,*5*. **V. sedaliense* (WHITE); *5a*, transv. sec., ×3; *5b*, long. sec., ×2 (72).

?**Enygmophyllum** FOMICHEV, 1931 [**E. taidonense*] [=*Aenigmatophyllum* LANG-S.-T., 1940 *(nom. van.)*]. Dissepimentarium narrow, regular; major septa withdrawn from wide axial space in which the tabulae have a wide deep flat-bottomed depression. *L.Carb.*, USSR.——FIG. 200,*6*. **E. taidonense; 6a,b*, transv. and long. secs., ×1 (76).

?**Uralinia** STUCKENBERG, 1895 [**Heliophyllum multiplex* LUDWIG, 1862; SD LANG-S.-T., 1940] [=?*Pseudouralinia* YÜ, 1931 (?subgenus)]. Dissepimentarium of lonsdaleoid dissepiments only, septa represented only by short ridges at outer edges of tabularium (50). *L.Carb.*, USSR-China.——FIG. 200,*4a*. **U. multiplex* (LUDWIG); transv. sec., ×1 (126).——FIG. 200,*4b,c*. *P. tangpakouensis* (YÜ) (type species of *Pseudouralinia*), China; *4b,c*, transv. and long. secs., ×1 (143).

?**Cystophrentis** YÜ, 1931 [**C. kolaohoensis*] [=*Cystiphrentis* LANG-S.-T., 1940 *(nom. van)*]. Like *Caninia* but with more and longer septa in counter than in cardinal quadrants, and without minor septa (58). *L.Carb.*, China.——FIG. 200,*1*. **C. kolaohoensis; 1a,b*, transv. secs., ×2 (143).

?**Humboldtia** STUCKENBERG, 1895 [**H. rossica*]. Large, solitary; dissepimentarium lonsdaleoid;

septa of cardinal quadrants few, dilated and grouped around the cardinal and alar fossulae; septa of counter quadrants many, long and grouped about counter fossula; counter septum short; tabulae incomplete (50). *L.Carb.*, USSR-Fr.——FIG. 200,*3*. **H. rossica*, USSR; transv. sec., ×1 (126).

?**Keyserlingophyllum** STUCKENBERG, 1895 [**Cystiphyllum obliquum* KEYSERLING, 1846; SD LANG-S.-T., 1940]. Solitary; dissepimentarium wide in counter, narrow in cardinal quadrants; major septa long and dilated in tabularium but thinning in counter quadrants in adult; septa grouped pinnately about marked cardinal and alar fossulae, radially arranged in counter quadrants; tabulae

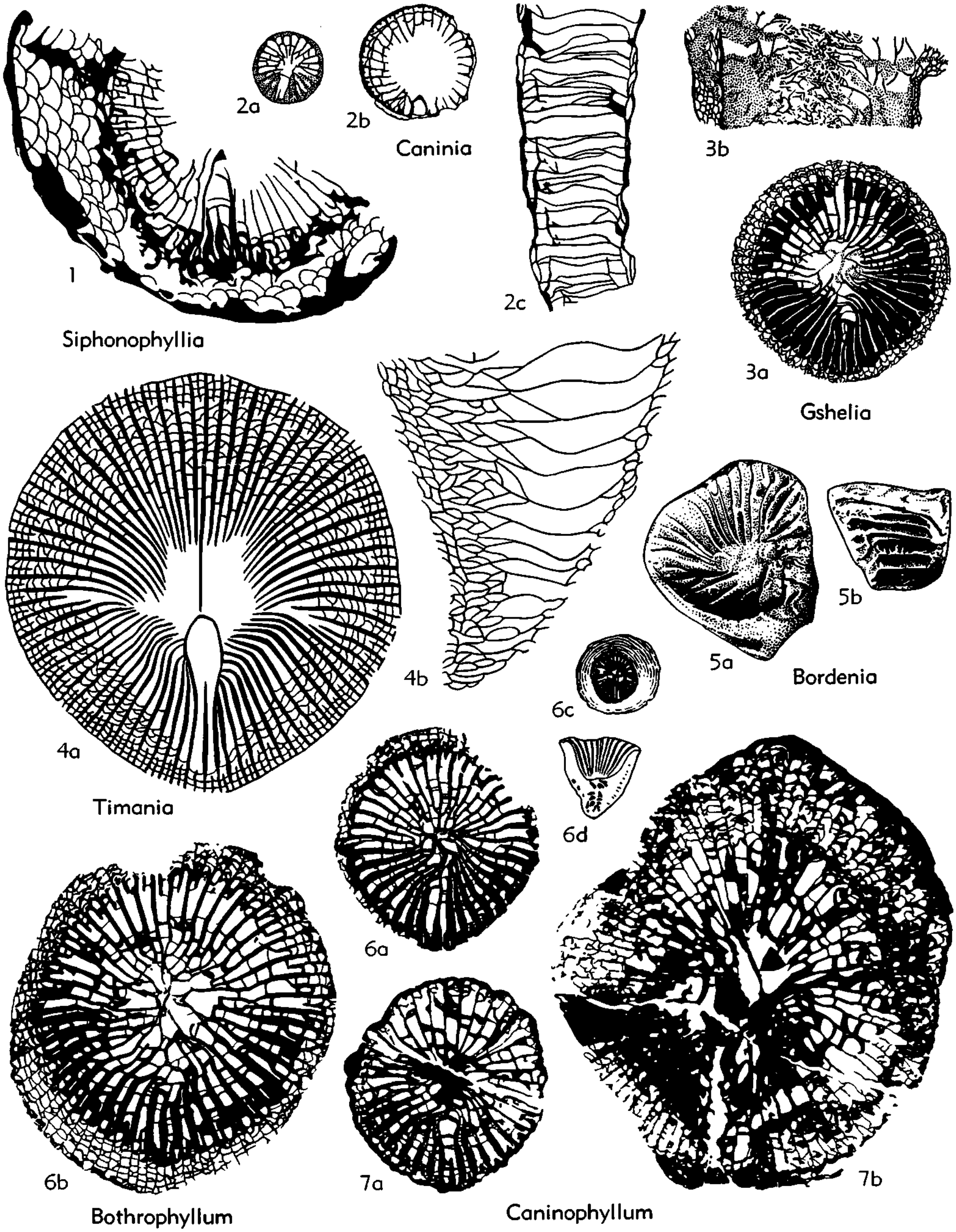

FIG. 199. Streptelasmatina (Zaphrenticae): Cyathopsidae (p. F292).

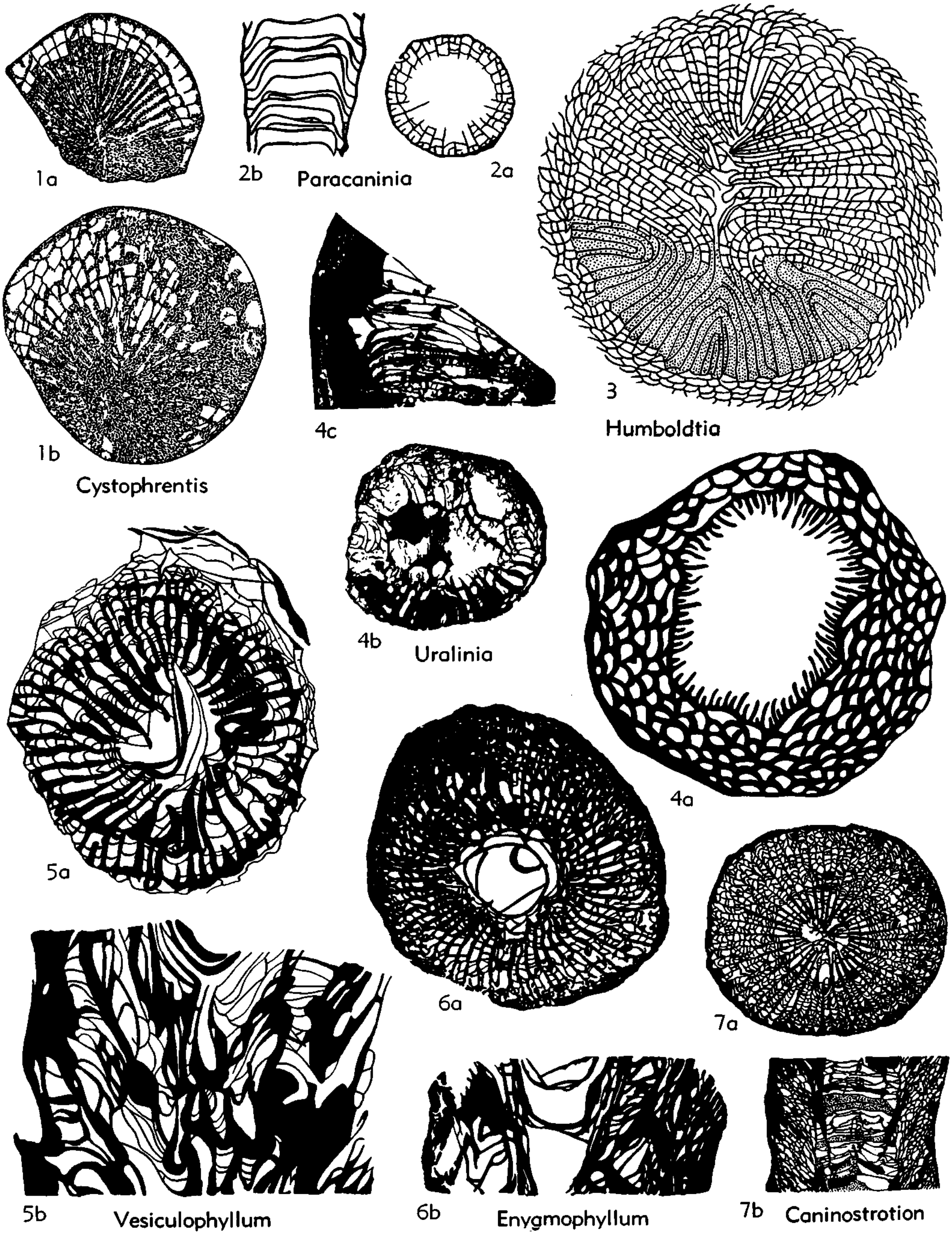

Fig. 200. Streptelasmatina (Zaphrenticae): Cyathopsidae (p. F292-F295).

flat (50). *L.Carb.*, USSR.——Fig. 201,*4*. **K. obliquum* (Keys.); *4a,b*, transv. and long. secs., ×1 (126).

?**Kakwiphyllum** Sutherland, 1954 [**K. dux*]. Solitary; elongated in counter-cardinal plane; with lonsdaleoid dissepiments peripherally and normal dissepiments within; septa grouped; tabulae incomplete, may rise to axial boss. *Miss.*, Can.

?**Liardiphyllum** Sutherland, 1954 [**L. hagei*]. Solitary; with irregular large, lonsdaleoid dissepiments, a long counter septum and septa of cardinal quadrants dilated. *Miss.*, Can.

?**Paracaninia** Chi, 1937 [**P. sinensis*]. Like *Caninia* but with epithecal spines, and without dissepiments, although short minor septa occur; septa amplexoid in cylindrical parts of corallum. *L.Perm.(Artinsk.),* China.——Fig. 200,*2*. **P. sinensis; 2a,b,* transv. and long. secs., ×1 (65).

?**Endamplexus** Koker, 1924 [**E. dentatus*] [=*Endoamplexus* Lang-S.-T., 1940 *(nom. van.)*]. Solitary; septa short, thick, irregular, in places separated from epitheca by an irregular lonsdaleoid dissepimentarium (29). *L.Perm.(Artinsk.),* Timor. ——Fig. 201,*1*. **E. dentatus;* transv. sec., ×1 (95).

?**Caninostrotion** Easton, 1943 [**C. variabilis*]. Large, conical, with peripheral increase; dissepimentarium not completely crossed by minor septa, some dissepiments angulate; major septal ends in tabularium dilated, usually stopping short of axis, but a few may form an impersistent axial structure. May be an aulophyllid. *U.Miss.(Chester.),* N. Am.; *U.Carb.(Namur.),* Scot.——Fig. 200,*7*. **C. variabilis,* Chester., Ark.; *7a,b,* transv. and long. secs., ×1 (72).

?**Caninella** Gorsky, 1938 [**C. pulchra*]. Dissepimentarium regular, wide, with lateral dissepiments on septa. *Genus inquirendum;* fig'd. specimens crushed axially. May be an aulophyllid. *L.Carb.,* USSR.——Fig. 201,*3*. **C. pulchra; 3a,b,* transv. and long. secs., ×1 (80).

?**Rylstonia** Hudson & Platt, 1927 [**R. benecom-*

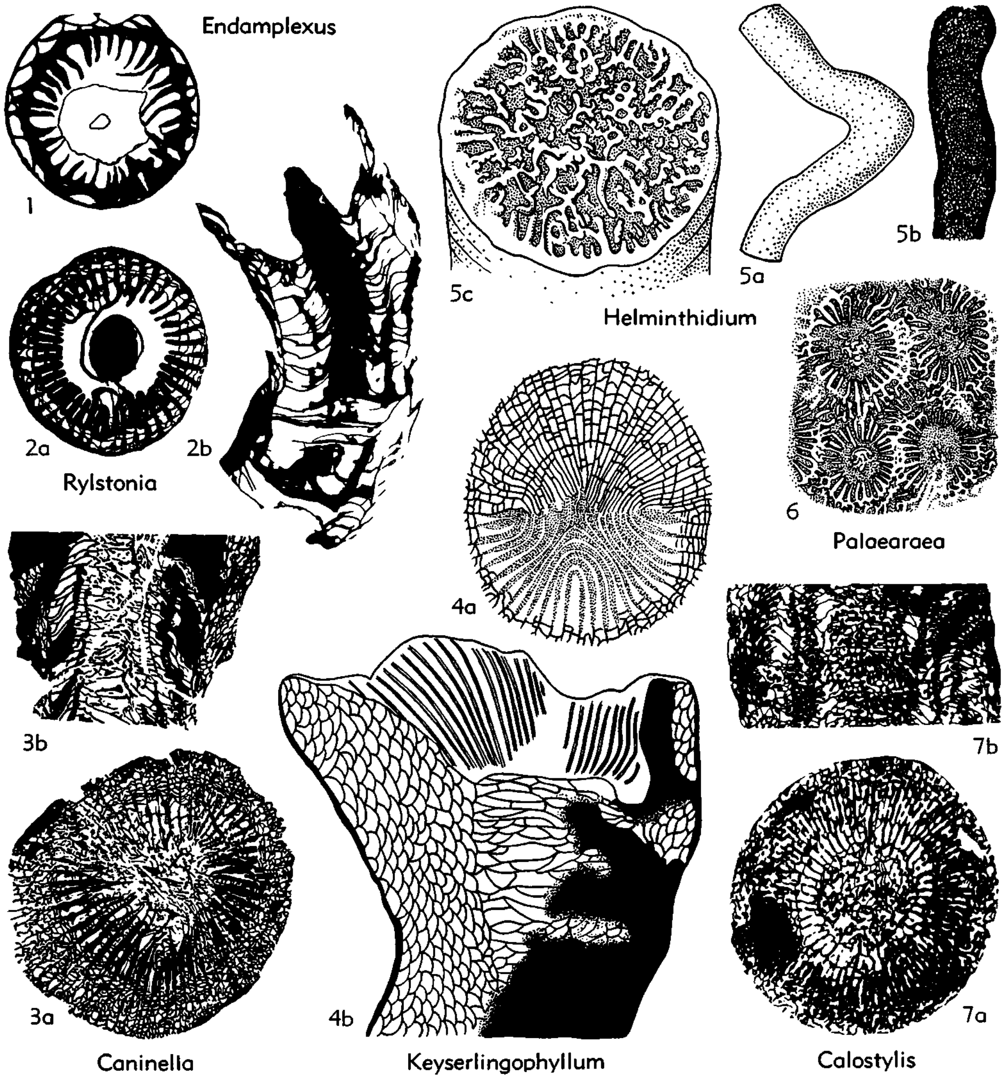

Fig. 201. Streptelasmatina (Zaphrenticae): Cyathopsidae, Calostylidae (p. F293-F296).

pacta] [=*Hettonia* HUDSON & ANDERSON, 1928]. Curved, conico-cylindrical to cylindrical; marginarium narrow, of large concentric dissepiments, minor septa degenerate; major septa dilated and in contact at first, dilatation disappearing first in counter quadrants; an axial structure of dilated median septal lamellae may develop discontinuous from the septa, when the incomplete tabulae are arched axially and incomplete, or the axial structure may disappear when the incomplete tabulae sag. May be an aulophyllid. *L.Carb.(Visé.)*, Eng.——FIG. 201,*2*. *R. fallax* (HUDSON & ANDERSON) (type species of *Hettonia*); *2a,b*, transv. and long. secs., ×1 (90).

Appendix to STREPTELASMATINA

Family CALOSTYLIDAE C. F. Roemer, 1883

Solitary and colonial corals with major and minor septa perforate; axial ends of long major septa lobed and reticulate, forming a spongy axial structure; tabulae domed, slender, complete and distant; dissepiments of unusual type, large, distant, slender and almost horizontally based; epitheca developed in bands which fail to cover the corallum. *Sil.*

The systematic position of this family is doubtful.

Calostylis LINDSTRÖM, 1868 [**C. cribraria* (=*Clisiophyllum denticulatum* KJERULF, 1865)] [=*Hemiphyllum* TOMES, 1887]. Solitary, conical, epithecate in apical region only; with narrow peripheral zone where the highly perforate major and minor septa are connected by irregular septal elements (46). *L.Sil.-M.Sil.*, Eu.-N.Am.——FIG. 201,*7*. **C. denticulata* (KJERULF), M.Sil., Eu.; *7a,b*, transv. and long. secs., ×2 (117).

Helminthidium LINDSTRÖM, 1882 [**H. mirum*]. Solitary, scolecoid; all trace of radial arrangement of the perforate and reticulate septa is lost (46). *M.Sil.-U.Sil.*, Eu.——FIG. 201,*5*. **H. mirum; 5a,b*, side, long. sec., ×1; *5c*, transv. sec., ×4 (100).

Palaearaea LINDSTRÖM, 1882 [**P. lopatini*]. Astreoid; axial structure marked (35). *Sil.*, Sib.——FIG. 201,*6*. **P. lopatini;* transv. sec., ×2 (100).

Suborder COLUMNARIINA Rominger, 1876

[*nom. correct.* HILL, 1954 (*pro* Columnariae ROMINGER, 1876)] [=Columnariacea SOSHKINA, 1947; Stauriacea MOORE, 1952; includes Deuteroseptata GRABAU, 1922 (*partim*)]

Corallum compound or (less commonly) solitary; marginarium absent in oldest forms, but later it develops as a septal stereozone which may be replaced by a lonsdaleoid dissepimentarium, or an incomplete series of elongate dissepiments; septa invariably thin in tabularium, somewhat withdrawn from axis, not lobed axially; tabulae complete and flat or with downturned edges, or sagging medially; late forms develop an axial structure of septal lamellae and conical tabellae. Axial increase may occur. *Ord.-Perm.*

Family STAURIIDAE Milne-Edwards & Haime, 1850

[*nom. correct.* HILL, herein (*pro* Stauridae M.EDW.-H., 1950)] [=Cyathophylloidae, Cyathophylloinae, Densiphyllinae DYBOWSKI, 1873; Columnariae ROMINGER, 1876; ?Fletcherinae ZITTEL, 1876; Columnaridae NICHOLSON, 1879; ?Coelophyllidae ROEMER, 1883; Favistellidae CHAPMAN, 1893; Columnariadae LAMBE, 1901; ?Fletcheriidae WEISSERMEL, 1939; Columnariidae HILL, 1939; Columnariinae STUMM, 1949; ?Pycnostylidae STUMM in SHROCK & TWENHOFEL, 1953]

Fasciculate and cerioid coralla with slender corallites; a marginarium may develop as a narrow peripheral stereozone; a single series of elongate dissepiments, discontinuous vertically may occur between major and minor septa. *Ord.-Dev., ?L.Carb.*

Favistella DANA, 1846 [**Columnaria alveolata* GOLDFUSS, 1826 (VAN CLEVE in WHITE, 1882) (=*F. stellata* HALL, 1847)] [=*Favistella* HALL, 1847]. Cerioid, with major septa reaching almost to axis; minor septa very short; marginarium absent; tabulate with downturned edges (24). *M.Ord.-U.Ord.*, cosmop.——FIG. 202,*5*. **F. alveolata* (GOLDF.), N.Am.; *5a,b*, transv. and long. secs., ×1.5 (98).

Cyathophylloides DYBOWSKI, 1873 [**C. kassariensis;* SD SHERZER, 1891]. Cerioid, with major septa running together in groups axially, and with long minor septa; marginarium absent, tabulae highly domed and incomplete (9). *Ord.*, Est.——FIG. 202, *3*. **C. kassariensis; 3a,b*, transv. and long. secs., ×3 (139).

Densiphyllum DYBOWSKI, 1873 [**D. thomsoni;* SD SHERZER, 1891] [=*Pycnophyllum* LINDSTRÖM, 1873; *Densyphyllum* THOMSON, 1883]. Small, solitary; minor septa buried in wide peripheral septal stereozone; major septa straight and touching at axis; tabulae flat; no dissepiments (9). *Sil.*, Est.——FIG. 202,*2*. **D. thomsoni; 2a,b*, transv. and long. secs., ×2, ×4 (71).

Stauria M.EDW.-H., 1850 [**S. astreiformis* (=*Madrepora favosa* LINNÉ, 1758)] [=*Ceriaster* LINDSTRÖM, 1883]. Like *Favistella* but with axial increase (quadripartite or quinquepartite) and with a few elongate dissepiments at periphery (38). *U.Sil.*, Balt.-China.——FIG. 202,*1*. **S. favosa* (LINNÉ), Gotl.; *1a*, transv. sec., ×2; *1b*, long. sec., ×1 (119).

Loyolophyllum CHAPMAN, 1914 [**Columnaria (Loyolophyllum) cresswelli*]. Like *Favistella* but with shorter septa and a discontinuous vertical series of elongate, in part lonsdaleoid dissepiments and with sagging tabulae; increase intermural (19). *L.Dev.*, Austral.——Fig. 202,*4*. **L. cresswelli*, Vict.; *4a,b*, transv. and long. secs., ×2 (85).

Fasciphyllum Schlüter, 1885 [**F. conglomeratum* (=*Fascicularia? conglomerata* Schlüter, 1880)]. Fasciculate; corallites slender, with peripheral stereozone inside which a single series of elongate dissepiments develops between the thin, long major and short minor septa; tabulae distant and

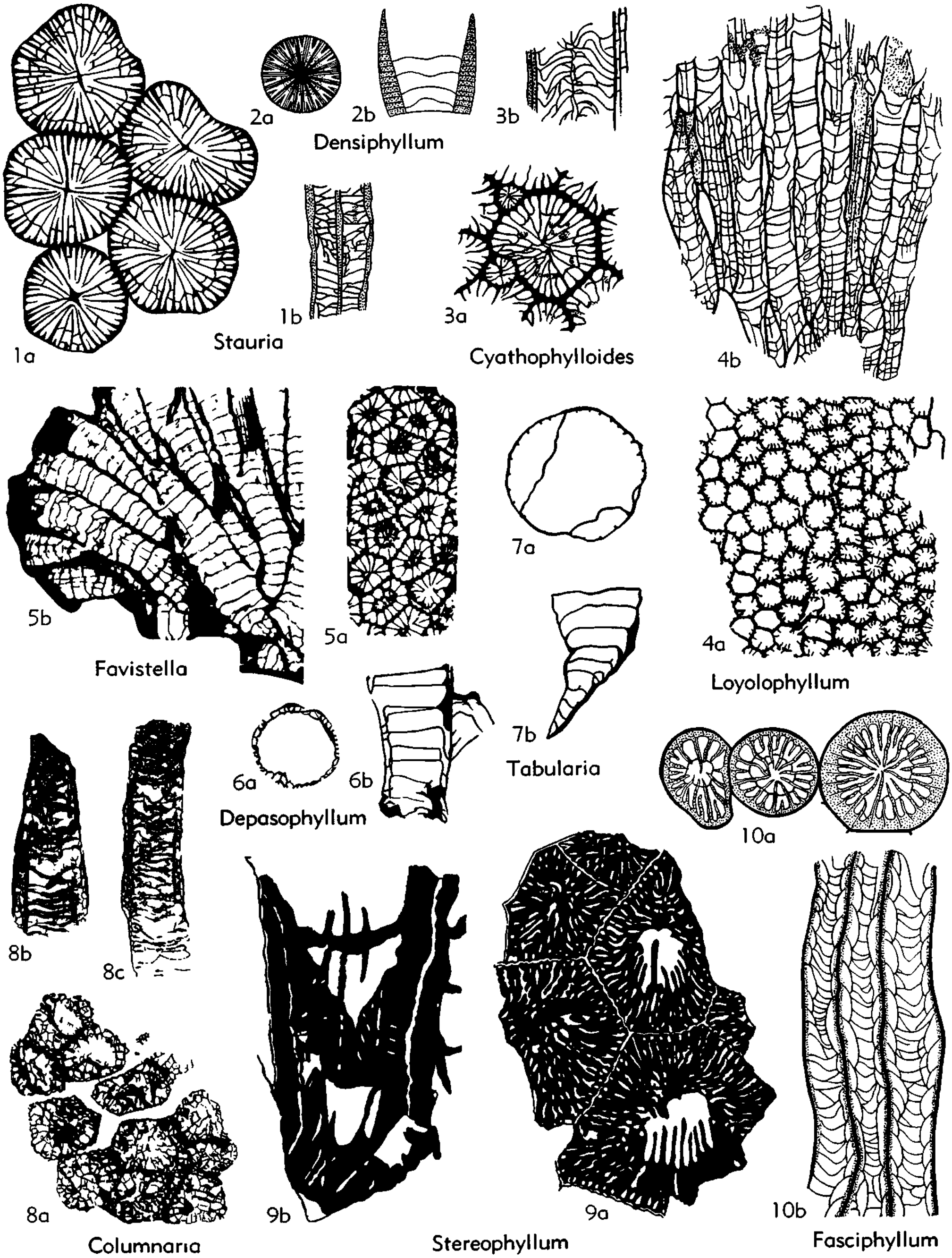

Fig. 202. Columnariina: Stauriidae (p. F296-F298).

sagging. (22). *L.Dev.-M.Dev.*, Eu.-Austral.——FIG. 202,*10*. **F. conglomeratum* (SCHLÜTER), M. Dev., Ger. (Eifel); *10a*, transv. sec., ×4; *10b*, long. sec., ×2 (114).

Vepresiphyllum ETHERIDGE, 1920 [**V. falciforme*]. Cerioid, major septa with lateral and axial upcurved spines, minor septa very short, marginarium absent; tabulae sagging (52). *L.Dev.-M.Dev.*, Austral.

Columnaria GOLDFUSS, 1826 (*non* LEVINSON, 1909) [**C. sulcata;* SD M'COY, 1849] [=*Lithostroma* RAFINESQUE in BRONGNIART, 1829]. Cerioid, septa short, dissepiments absent or small, in 1 or 2 series; tabulae complete (19). *M.Dev.*, Eu.——FIG. 202, *8*. **C. sulcata; 8a*, transv. sec., ×1.5; *8b,c*, long. secs., ×1.5 (98).

?**Tabularia** SOSHKINA, 1937 [**T. turiensis*]. Solitary, cylindroconical, small; septa very short thin lamellae; tabulae complete, flat, with fossular depression and median sag (47). *M.Sil.*, USSR.——FIG. 202,*7*. **T. turiensis; 7a,b*, transv. and long. secs., ×2 (122).

?**Amplexoides** WANG, 1947 [**Amplexus appendiculatus* LINDSTRÖM, 1883]. Solitary, with major septa as long low ridges on tabulae; minor septa very short; tabulae complete, flat, marginarium a narrow septal stereozone. *M.Sil.*, China.

?**Fletcheria** M.EDW.-H., 1851 [**F. tubifera*] [=*Pycnostylus* WHITEAVES, 1884; *?Synamplexus* GRABAU, 1922]. Phaceloid, with axial increase typically quadripartite; septa very short, thin; no dissepiments; tabulae flat, complete (38). *M.Sil.*, Eu.-N.Am.-Austral.

?**Stereophyllum** SOSHKINA, 1937 [*non* SCHLÜTER, 1889; *nec* GRABAU, 1917] [**S. massivum*]. Cerioid, with long unequal major septa and long minor septa; marginarium a wide septal stereozone; no dissepiments; tabulae flat, complete (47). *U.Sil.-L.Dev.*, USSR.——FIG. 202,*9*. **S. massivum*, U.Sil., USSR; *9a,b*, transv. and long. secs, ×2 (122).

?**Placophyllum** SIMPSON, 1900 [**P. tabulatum*]. Phaceloid; corallites without marginarium, tabulae distant, complete, shallowly domed, septal arrangement unknown (52). *L.M.Dev.*, Can.——FIG. 203,*6*. **P. tabulatum;* long. sec., ×1 (115).

?**Depasophyllum** GRABAU, 1936 [*non* YÜ, 1934] [**D. adnetum*]. Phaceloid; corallites without marginarium, tabulae with very sharply downturned edges, commonly resting on the tabula next below; septa very short, thin; no minor septa (52). *M.Dev.*, USA.——FIG. 202,*6*. **D. adnetum; 6a,b*, transv. and long. secs., ×1 (127).

?**Cyathopaedium** SCHLÜTER, 1889 [*pro Coelophyllum* C. F. ROEMER, 1883 (*non* SCUDDER, 1875; *nec* SCHRAMMEN, 1924)] [**Calophyllum paucitabulatum* SCHLÜTER, 1880]. Fasciculate; corallites with distant horizontal tabulae and septa developed only as low nonspinose ridges at periphery and on upper surfaces of tabulae (43). *M.Dev.*, Ger.——FIG. 203,*7*. **C. paucitabulatum* (SCHLÜTER); *7a*, side view of corallum, ×1; *7b*, calice of corallite showing peripheral increase, ×1; *7c*, long. sec., ×1 (114).

?**Fletcherina** LANG-S.-T., 1955 [*pro Yabeia* LANG-S.-T., 1940 (*non Yabeia* RESSER & ENDO, 1935), *pro Cylindrophyllum* YABE & HAYASAKA, 1915 (*non* SIMPSON, 1900)] [**Cylindrophyllum simplex* YABE-H.]. Fasciculate, corallites without septa or marginarium, tabulae complete and horizontal (22). *Dev.*, China; *U.M.Dev.*, Queensl.——FIG. 203,*2*. **Y. simplex* (YABE-H.), Dev., China; *2a,b*, transv. and long. secs., ×1 (140).

?**Decaphyllum** FRECH, 1885 [**D. koeneni*]. Massive; marginarium of each corallite a wide septal stereozone merging with neighbors without bounding wall; counter laterals, alars, and youngest septa neighboring the cardinal septum may be longer and stronger than the rest, meeting at the axis; tabulae flat (11). *U.Dev.*, Ger.——FIG. 203,*1*. **D. koeneni;* surface, ×4 (77).

?**Kwangsiphyllum** GRABAU & YOH in YOH, 1931 [*pro Syringophyllum* GRABAU & YOH in YOH, 1929 (*non* M.EDW-H., 1850; *nec* ULRICH in MILLER, 1889)] [**Syringophyllum permicum* GRABAU & YOH in YOH, 1929]. Fasciculate, corallites slender, with connecting tubules; major septa short, minor septa absent or very short, tabulae complete, horizontal; no dissepiments. *L.Carb.*, China.

Family SPONGOPHYLLIDAE Dybowski, 1873

[=Spongophyllinae (*nom. transl.* WEDEKIND, 1922)]

Septa attenuate, minor septa and commonly major septa discontinuous; major septa carinate in tabularium; dissepimentarium wide, dissepiments lonsdaleoid in part; tabulae close, thin, complete, and sagging (52). *M.Sil.-U.Dev.*

Spongophyllum M.EDW.-H., 1851 [**S. sedgwicki*] [=*?Grabauphyllum* FOERSTE, 1917]. Cerioid (52). *M.Sil.*, Austral.-?Ohio; *M.Dev.*, cosmop.——FIG. 203,*3*. **S. sedgwicki*, M.Dev., Eu.; *3a,b*, transv. and long. secs., ×2 (127).

Battersbyia M.EDW.-H., 1851 [**B. inaequalis*]. Phaceloid (41). *Dev.*, Eng.

Neomphyma SOSHKINA, 1937 [**N. originata*]. Solitary, cylindrical (47). *U.Sil.-Dev.*, USSR.——FIG. 203,*4*. **N. originatum*, U.Sil., USSR; *4a,b*, transv. and long. secs., ×4 (122).

Zenophila HILL, 1940 [**Phillipsastraea walli* ETHERIDGE, 1892]. Thamnasterioid or aphroid (20). *M. Sil.*, N.S.W.——FIG. 203,*5*. **Z. walli* (ETHERIDGE); *5a,b*, transv. and long. secs., ×2 (85).

?**Tabellaephyllum** STUMM, 1948 [**T. peculiare*]. Cerioid; septa absent, large, irregular, rather flat-lying dissepiments merging with sagging incomplete tabulae. *U.Dev.*, N.Am. May belong to the Tabulata, subfamily Micheliniinae.——FIG. 203,*8*. **T. peculiare, 8a,b*, transv. and long. secs., ×2 (127).

Family CHONOPHYLLIDAE Holmes, 1887

Solitary or compound Rugosa, commonly with rejuvenescence contractions; corallites large, with marginarium consisting of a septal stereozone broken up by large lonsdaleoid dissepiments; septa long and attenuate in tabularium, tabulae complete, domes or flattened domes. *Sil.-Dev.*

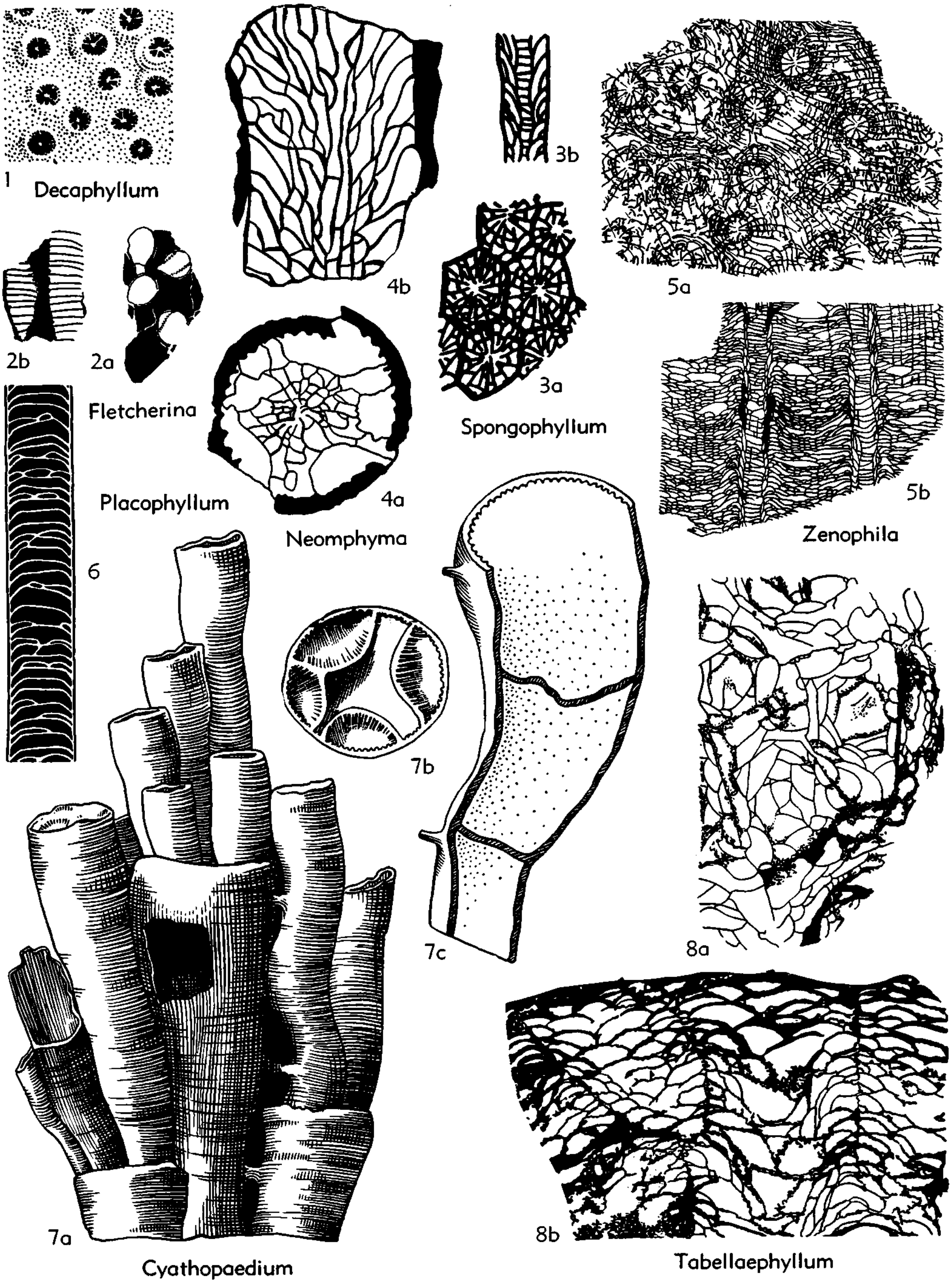

FIG. 203. Columnariina: Stauriidae, Spongophyllidae (p. F298).

Subfamily CHONOPHYLLINAE Holmes, 1887

[*nom. transl.* STUMM, 1949 (*ex* Chonophyllidae HOLMES, 1887)] [=Omphymatidae WEDEKIND, 1927; Ketophyllidae LECOMPTE, 1952)

Solitary or compound; tabulae flat and grouped (55). *Sil.*

Chonophyllum M.EDW.-H., 1850 [**Cyathophyllum perfoliatum* GOLDFUSS in M.EDW.-H., 1850 (*pro Cyathophyllum plicatum* GOLDF., 1826, *partim*)] [=*Omphyma* WEDEKIND, 1927 (*non* RAFINESQUE & CLIFFORD, 1820) The type specimen of *O. verrucosum* RAF. & CLIFFORD, the type species of *Omphyma* RAF. & CLIFFORD cannot be traced; the locality and horizon are uncertain and the description of the species is insufficient for certain identification]. Solitary or compound, septa dilated wedgewise, thickening toward the periphery; tabularium very narrow (46). Many species unrelated to the type have been referred to *Chonophyllum,* giving rise to confused ideas of the family. No vertical section of *C. perfoliatum* has been figured; the transverse section is very like that illustrated by WEDEKIND (55) as *Omphyma flabellatum,* which is known from vertical section and seems closely related to *Ketophyllum. M.Sil.-U.Sil.,* Gotl.——FIG. 204,*3a.* **C. perfoliatum* (GOLDF.); transv. secs., ×1 (117).——FIG. 204,*3b. C. flabellatum* (WDKD.); long. sec., ×1 (137).

Ketophyllum WEDEKIND, 1927 [**K. elegantulum*] [=*Omphyma auctt.* (*non* RAFINESQUE & CLIFFORD, 1820); *?Heterolasma* EHLERS, 1919 (=*Heterelasma* LANG-S.-T., 1940 (*nom. van. pro Heterolasma*); *non* GIRTY, 1908; *nec* GRABAU, 1922); *Dokophyllum* WDKD., 1927; *Cetophyllum, Docophyllum* LANG-S.-T., 1940]. Solitary, with flat, grouped tabulae and with long septa, slightly dilated wedgewise in the marginarium, continued over upper surfaces of tabulae as thin, low ridges; fossula marked by depression in tabulae (55). *M. U.Sil.,* Eu.-China.——FIG. 204,*6. K. incurvatum* WDKD., M.Sil., Gotl.; *6a,b,* transv. and long. secs., ×1 (137).

?Lindstroemophyllum WANG, 1947 [**L. involutum*]. Solitary, with a few very convolute major septa which meet at the axis and are developed axially as low ridges on upper surfaces of tabulae. *M.Sil.,* China.——FIG. 204,*4.* **L. involutum,* Yunnan; *4a,b,* transv. and long. secs., ×1 (136).

?Mictocystis ETHERIDGE, 1908 [**M. endophylloides*]. Aphroid very large corallites with wide marginarium of lonsdaleoid dissepiments, and tabularium of flat, close, complete tabulae with downturned edges; major septa developed as long crests on upper surfaces of tabulae only. *Sil.,* Austral.——FIG. 204,*1.* **M. endophylloides,* N.S.W.; surface, ×0.25 (74).

?Yassia JONES, 1930 [**Spongophyllum enorme* ETHERIDGE, 1913] [=*Crinophyllum* JONES, 1932]. Very large cerioid corallites with moderately wide marginarium of very large lonsdaleoid dissepiments; tabulae flat, complete; septa very attenuate and discontinuous to absent (20). *M.Sil.,* Austral.——FIG. 205,*2.* **Y. enormis* (ETH.), N.S.W.; *2a,b,* transv. and long. secs., ×1 (92).

Subfamily ENDOPHYLLINAE Torley, 1933

[*nom. transl.* WANG, 1948 (*ex* Endophyllidae TORLEY, 1933)] [=?Pilophyllidae HILL, 1942]

Solitary or compound; tabulae flat-topped domes; major septa convolute in tabularium (22). *?Sil., Dev.*

Sinospongophyllum YOH, 1937 [**S. planotabulatum*]. Solitary, with a few very large lonsdaleoid dissepiments; septa withdrawn from axis; tabulae broad, flat-topped domes (52). *L.Dev.-M.Dev.,* Asia-Austral.——FIG. 204,*5.* **S. planotabulatum,* M.Dev., Kwangsi; *5a,b,* transv. and long. secs., ×1 (142).

Endophyllum M.EDW.-H., 1851 [**E. bowerbanki;* SD SCHLÜTER, 1889] [=*Nicholsonia* SCHLÜTER, 1885 (*non* DAVIS, 1885; *nec* KIÄR, 1899; *nec* POČTA, 1902; *nec* others)]. Subfasciculate, cerioid or aphroid; corallites large, with septal stereozone broken up by large irregular lonsdaleoid dissepiments; major septa long, attenuate, and commonly convolute in tabularium; tabulae complete, domes, mostly flattened (22). *M.Dev.,* Eu.-Asia-E.Austral.——FIG. 205,*3a,b. E. abditum* M.EDW-H., Eu.; *3a,b,* transv. and long. secs., ×1 (117).——FIG. 205,*3c.* **E. bowerbanki,* Eu.; long. sec., ×1 (114).

Sanidophyllum ETHERIDGE, 1899 [**S. davidis*]. Alternatingly phaceloid and cerioid, the cerioid parts being periodic thin horizontal expansions of the septal stereozone; no dissepiments (21). *Up. M.Dev.,* Austral.——FIG. 206,*5.* **S. davidis,* N.S.W.; *5a,* side of weathered corallum showing successive levels of tabulae, ×0.25; *5b,c,* secs., ×1 (74).

Tabulophyllum FENTON & FENTON, 1924 [**T. rectum*] [=*Apolythophyllum* WALTHER, 1928]. Solitary with talons; septa mostly thin in the wide, irregular lonsdaleoid dissepimentarium, amplexoid; tabularium compressed, tabulae flat-topped domes (52). *U.Dev.,* N.Am.-Eu.-W.Austral.——FIG. 205, *1a,b. T. normale* (WALTHER) (type species of *Apolythophyllum*), Ger.; *1a,b,* transv. and long. secs., ×1 (135).——FIG. 205,*1c,d.* **T. rectum* N.Am.; *1c,d,* long. and transv. secs., ×1 (117).

?Strombodes SCHWEIGGER, 1819 [*non* GISTL, 1857; *nec* SJÖBRING, 1902] [**Madrepora stellaris* LINNÉ, 1758; SD M'COY, 1849] [=*Strombastraea* EHRENBERG, 1834; *Donacophyllum* DYBOWSKI, 1873]. Alternately phaceloid and cerioid, the cerioid parts being horizontal expansions from the marginarium which is a septal stereozone interrupted by large lonsdaleoid dissepiments; tabulae axially sagging domes, complete or incomplete (46). *L.Sil.-M.Sil.,* Eu.——FIG. 204,*2a-c.* **S. stellaris* (LINNÉ), Gotl.-Oesel; *2a,* side of corallum, ×1 (117); *2b,* transv. sec., ×1 (71); *2c,* long. sec., ×1 (117).——FIG. 204,*2d. S. schrenkii* (DYBOWSKI) (lectotype of

Donacophyllum), Balt.; long. sec., ×1 (71).

?Pilophyllum Wedekind, 1927 [**P. keyserlingi*]. Solitary or (less commonly) fasciculate; major septa thin and convolute in tabularium; marginarium a septal stereozone interrupted by lonsdaleoid dissepiments; tabulae incomplete, domed (55). *U.Sil.*, Gotl.——Fig. 206,*3*. **P. keyserlingi; 3a,b*, transv. and long. secs., ×1 (137).

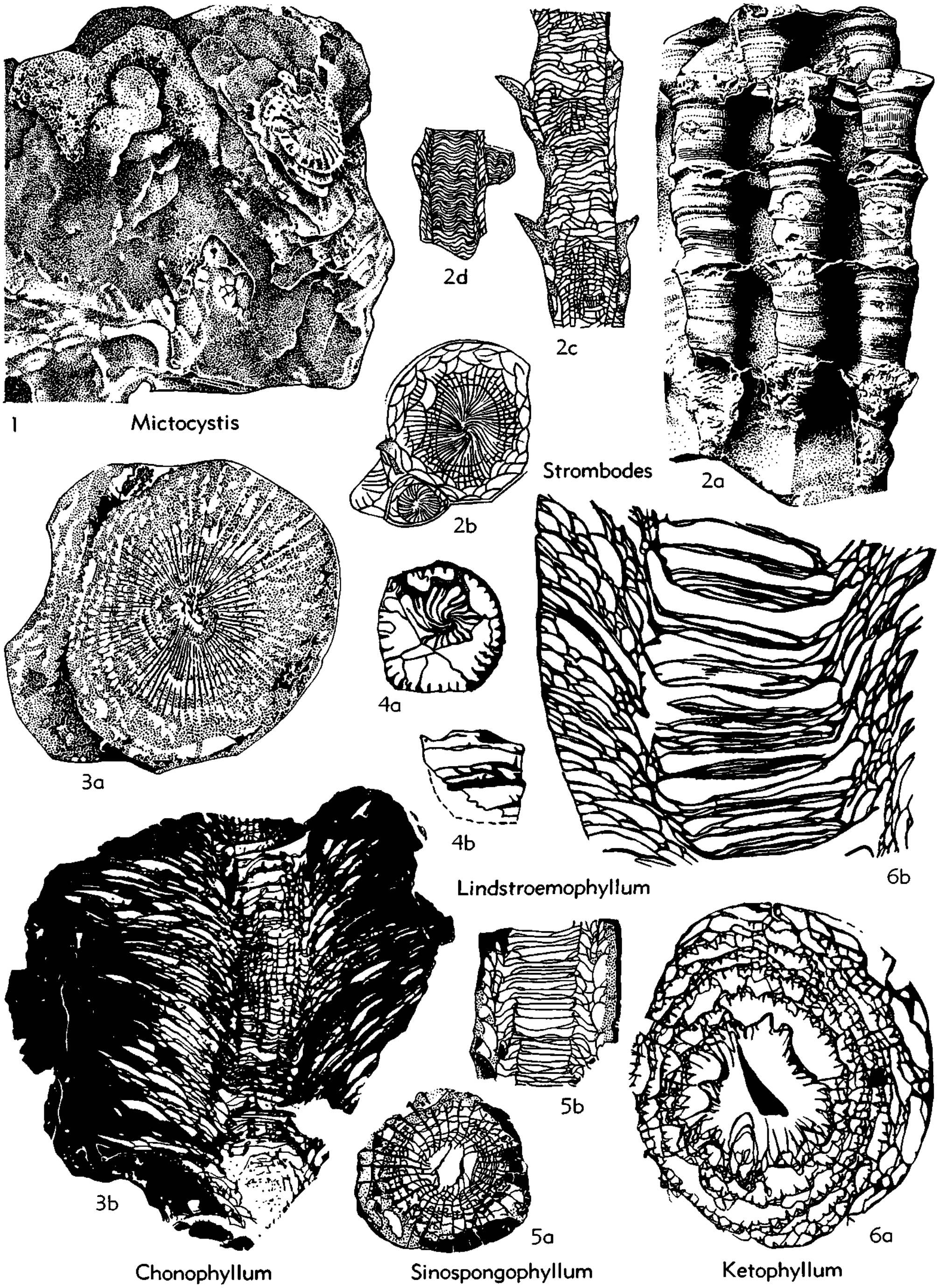

Fig. 204. Columnariina: Chonophyllidae (p. F300).

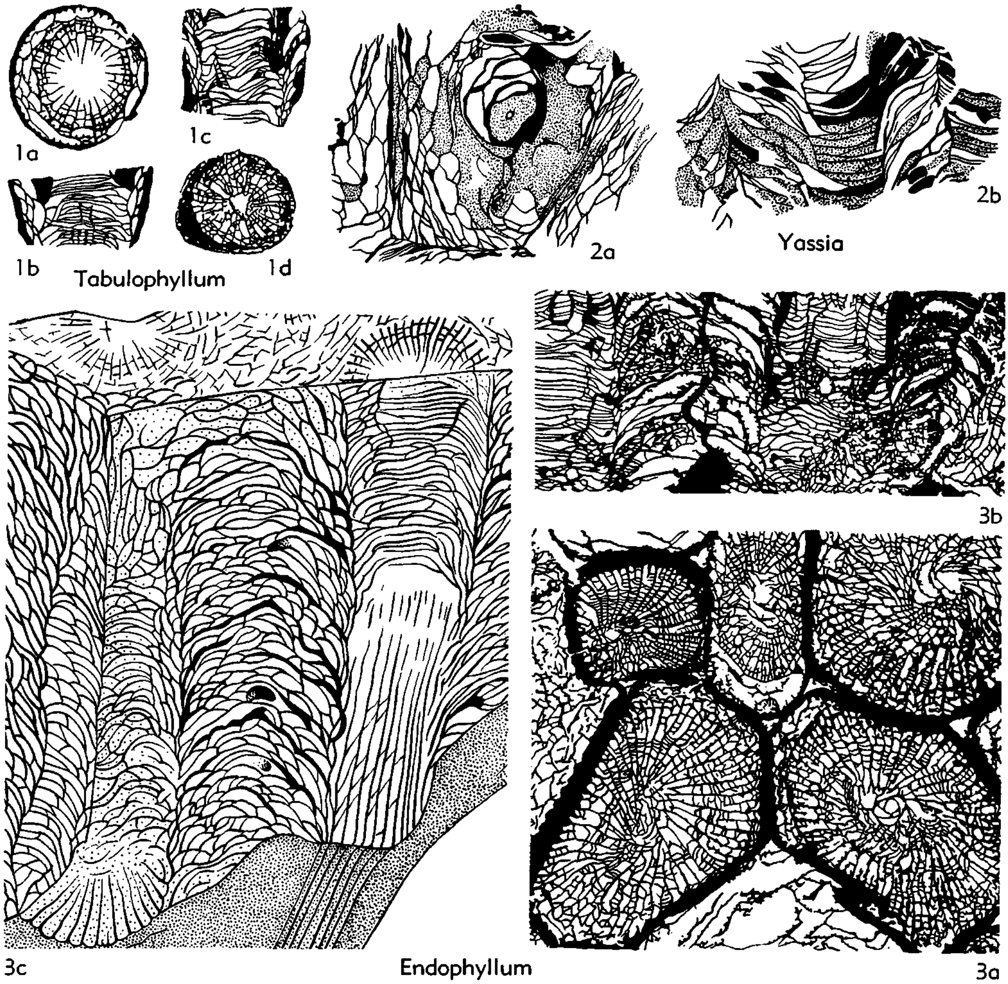

Fig. 205. Columnariina: Chonophyllidae (p. F300).

?**Diversophyllum** Sloss, 1939 [**Zaphrentis traversensis* Winchell, 1866]. Large, solitary; septa long, straight, meeting at axis, attenuate, except in marginarium which is a septal stereozone containing lonsdaleoid dissepiments in adult stages; tabulae flat (52). *M.Dev.-U.Dev.,* N.Am.——Fig. 206,*1*. **D. traversense* (Winch.), Mich.; *1a,b,* transv. and long. secs., ×1 (116).

?**Iowaphyllum** Stumm, 1949 [**Smithia johanni* Hall & Whitfield, 1872]. Astreoid and aphroid; marginarium a septal stereozone much interrupted by large lonsdaleoid dissepiments; septa thin in outer part of narrow tabularium; tabulae steeply domed, forming a false aulos at which axial edges of septa are dilated (52). *M.Dev.* (Czech.)-*U.Dev.* (N.Am.).——Fig. 206,*4*. **I. johanni* (Hall-W.), Iowa; *4a,b,* transv. and long. secs., ×1 (127).

Subfamily BLOTHROPHYLLINAE Stumm, 1949

Solitary; tabulae flat-topped domes with a depression in the well-marked cardinal fossula (52). *L.M.Dev.*

Blothrophyllum Billings, 1859 [**B. decorticatum*]. Large, solitary, with wide lonsdaleoid dissepimentarium; thin straight major septa confined to outer parts of tabularium; tabulae complete flat-topped domes, with down-sinking at the cardinal fossula (52). *L.M.Dev.,* N.Am.——Fig. 206,*2*. **B. decorticatum; 2b,a,* corallite partly long. bisected, transv. sec., ×0.5 (96).

Family PTENOPHYLLIDAE Wedekind, 1923

[*ex Ptenophyllum* Wdkd., 1923 (=*Acanthophyllum* Dybowski, 1873, subj.)] [=Stenophyllidae Wdkd., 1924; Actinocystidae WDKD., 1927; Acanthophyllidae HILL, 1939; Acanthophyllinae (*nom. transl.* WANG, 1948); Leptoinophyllidae, Leptoinophyllinae, Grypophyllinae STUMM, 1949]

Solitary and compound corals with elongate septa and wide dissepimentarium, lonsdaleoid in early forms but with regular small globose dissepiments in later forms; major septa long, unequal, their axial ends commonly flanged and typically arranged in 4 groups differing in curvature; axial ends of outer septa of each group directed toward longer ends of inner septa; trabeculae so closely spaced as to obscure lines of contact; fossula insignificant; tabulae shallow funnel-shaped, very close and incomplete; tabellae elongate. *Sil.-Dev.*

This family is somewhat doubtfully placed in the Columnariina; its small dissepiments suggest affinities with the Zaphrenticae, but *Spongophylloides,* from which its members seem to stem, has a lonsdaleoid dissepimentarium apparently developed as in the Columnariina from a peripheral septal stereozone. The infundibuliform tabulae also suggest affinities with the Spongophyllidae and the Stringophyllidae. The inconspicuousness of the fossula appears a columnariine rather than a zaphrentid character.

Cymatelasma HILL & BUTLER, 1936 [**C. corniculum*]. Solitary, with marginarium a wide septal stereozone lacking dissepiments; major septa thin and flanged in the tabularium, as in *Spongophylloides. L.Sil.-U.Sil.,* Eng.——FIG. 207,*3*. **C. corniculum,* L.Sil.(U.Llandov.), Eng.; *3a,b,* transv. and long. secs., ×3 (86).

Spongophylloides MEYER, 1881 [**S. schumanni* (=*Cystiphyllum grayi* M.EDW-H., 1851)] [=*Actinocystis* LINDSTRÖM, 1882]. Solitary, with lonsdaleoid dissepimentarium; major septa have lateral flanges parallel to their upper edges (31). *M.Sil.-U.Sil.,* Eu.-N.Am.——FIG. 208,*4*. **S. grayi* (M.EDW.-H.), M.Sil., Eu.; *4a,* transv. sec., ×2 (98); *4b,* long. sec., ×2 (BUTLER).

Acanthophyllum DYBOWSKI, 1873 [**Cyathophyllum heterophyllum* M.EDW.-H., 1851; SD SCHLÜTER, 1889] [=?*Grypophyllum, Mesophylloides* WEDEKIND, 1922; *Ptenophyllum* WDKD., 1923; *Astrophyllum, Rhopalophyllum* WDKD., 1924; *Stenophyllum* AMANSHAUSER in WDKD., 1925 (*non* VERHOEFF, 1897); *Leptoinophyllum* WDKD., 1925;

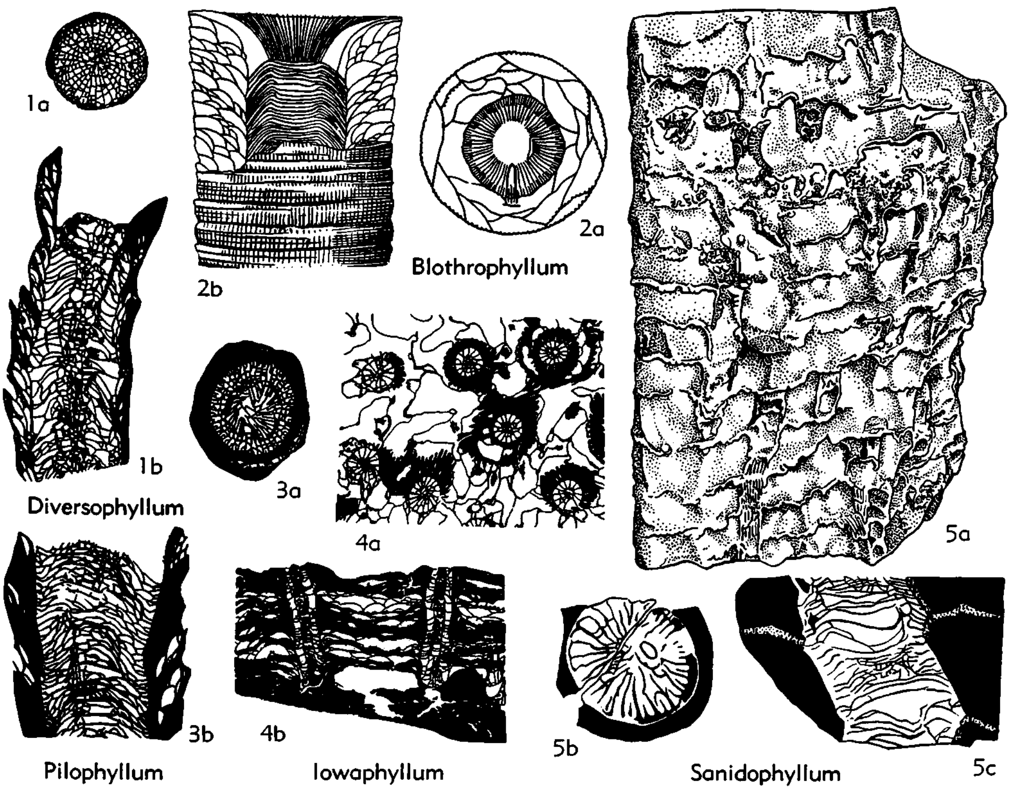

FIG. 206. Columnariina: Chonophyllidae (p. F300-F302).

?*Hooeiphyllum* TAYLOR, 1951]. Solitary; septa commonly with modifications such as lateral cystose dissepiments; major septa dilated more than minor, and parts in the tabularium may be much dilated in young stages (22). *M.Sil.-U.Sil.,* Eu.-N.Am.; *L. Dev.-M.Dev.,* cosmop.——FIG. 207,*1a. Acanthophyllum* sp., Dev., Eu.; long. sec., ×3 (137).——FIG. 207,*1b. A. fibratum* (WDKD.), L.M.Dev., Ger. (Eifel); transv. sec., ×3 (137).——FIG. 207,*1c,d. A.? denckmanni* (WDKD.) (type species of *Grypophyllum*), U.M.Dev., Ger.; *1c,d,* transv. and long. secs., ×2 (137).

Xystriphyllum HILL, 1939 [**Cyathophyllum dunstani* ETHERIDGE, 1911]. Cerioid; corallites as in *Acanthophyllum* but septa thin in tabularium (21). *L.Dev.-M.Dev.,* Eu.-Austral.——FIG. 207,*2.* **X. dunstani* (ETH.), L.M.Dev., Queensl.; *2a,b,* transv. and long. secs., ×2 (85).

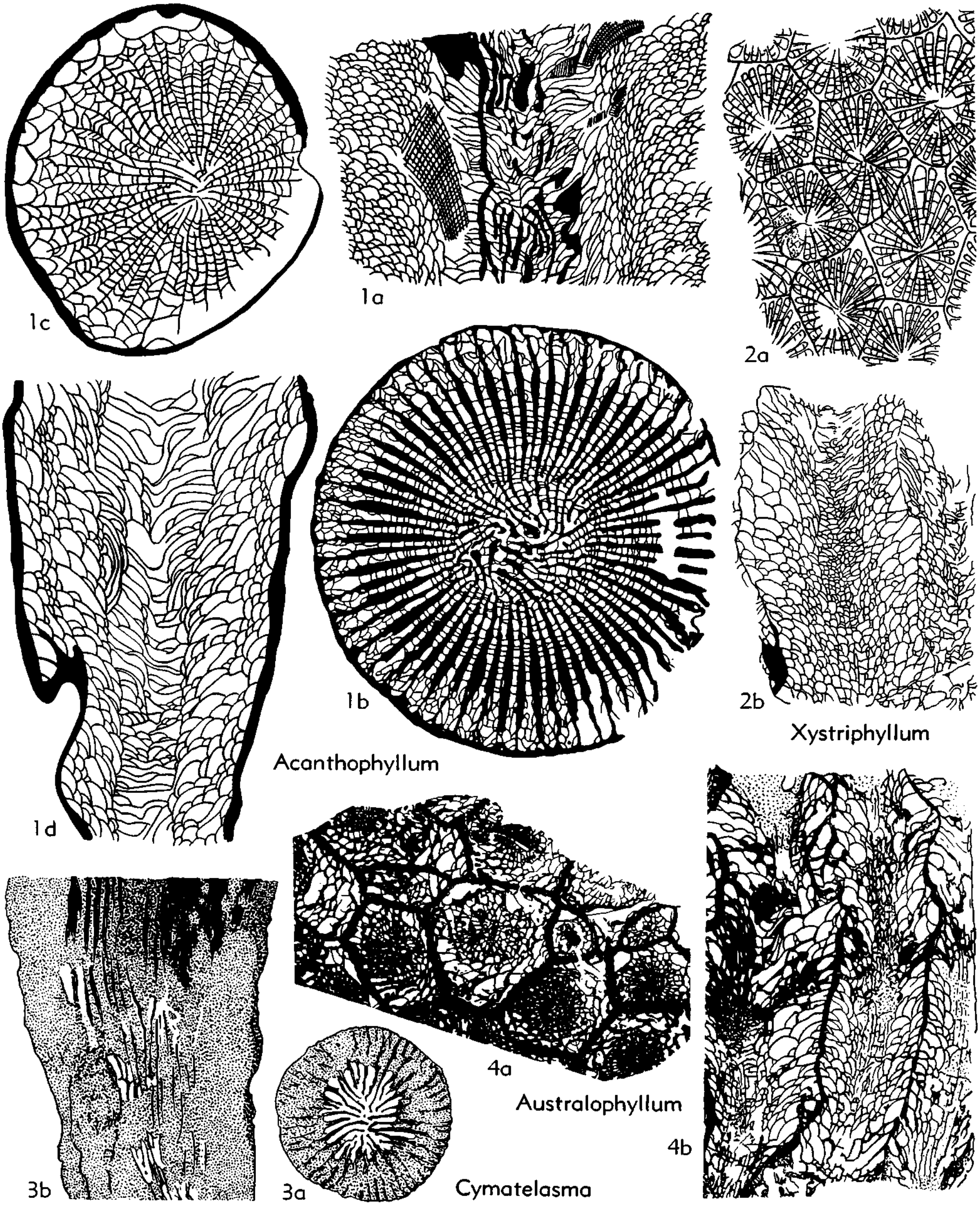

FIG. 207. Columnariina: Ptenophyllidae (p. F303-F306).

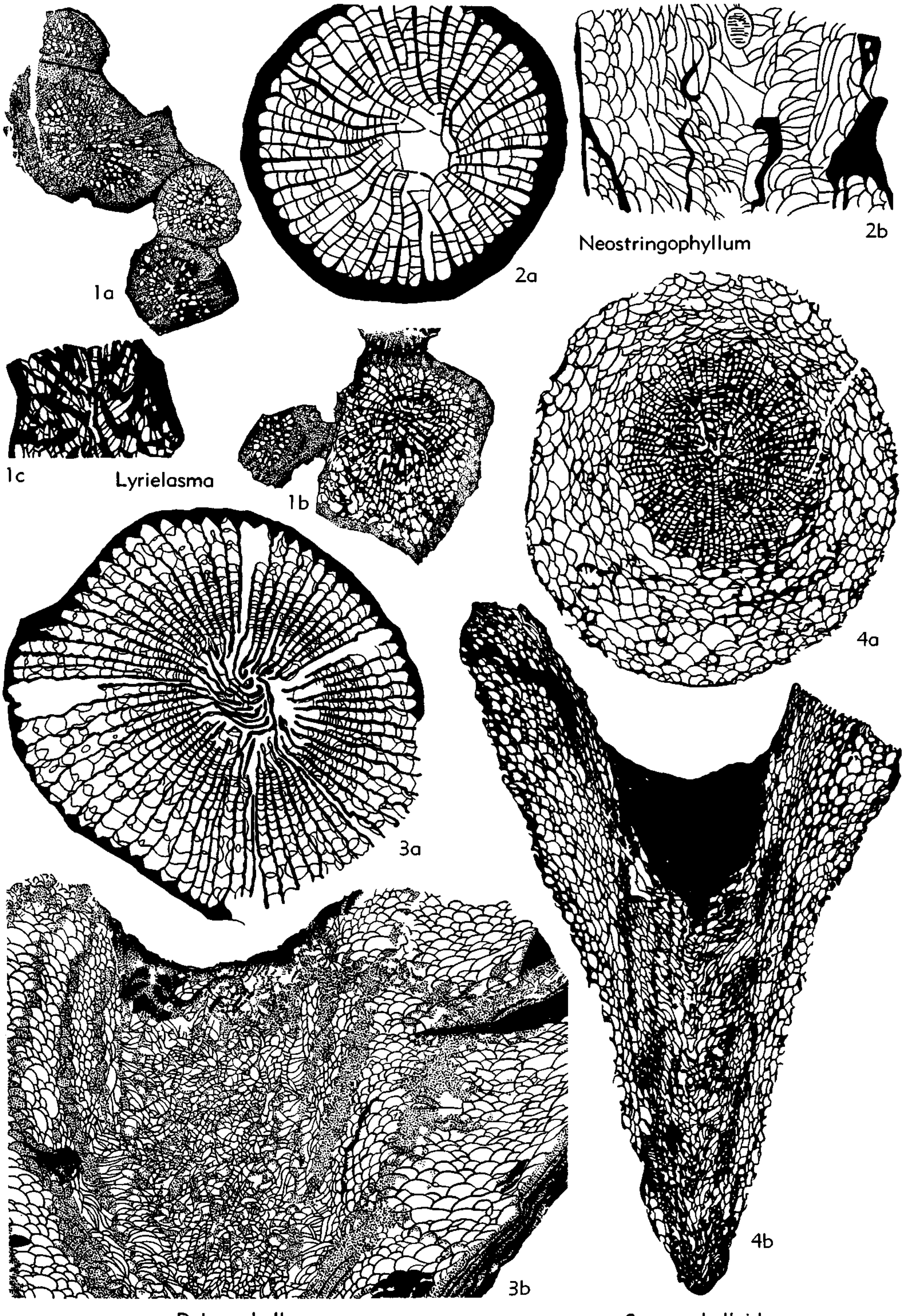

Fig. 208. Columnariina: Ptenophyllidae (p. F303-F306).

Eddastraea HILL, 1942 [**Phillipsastraea grandis* DUN in BENSON, 1918]. Like *Xystriphyllum* but thamnasterioid, with very large corallites (21). *L. Dev.* or *M.Dev.*, E.Austral.-?Ellesm.——FIG. 209,*2*. **E. grandis* (DUN), E.Austral.; *2a,b,* transv. and long. secs., ×2 (85).

Lyrielasma HILL, 1939 [**Cyathophyllum subcaespitosum* CHAPMAN, 1925]. Phaceloid, like *Acanthophyllum* but with septa dilated at their bases, and with their unequal axial ends in a bipartite pattern (19). *L.Dev.-M.Dev.*, E.Austral.-N.Am.——FIG. 208,*1*. **L. subcaespitosum* (CHAPMAN), M.Dev., Vict.; *1a,b,* transv. secs., ×2; *1c,* long. sec., ×2 (85).

Australophyllum STUMM, 1949 [**Spongophyllum cyathophylloides* ETHERIDGE, 1911]. Cerioid, like *Xystriphyllum* but with septa discontinuous peripherally in a partly lonsdaleoid dissepimentarium (52). *L.M.Dev.*, Queensl.——FIG. 207,*4*. **A. cyathophylloides* (ETH.); *4a,b,* transv. and long. secs., ×2 (85).

Neostringophyllum WEDEKIND, 1922 [**N. ultimum*]. Like *Acanthophyllum* but with septa withdrawn from the axis in a wide tabularium (52). *U.M.Dev.*, Ger.——FIG. 208,*2*. **N. ultimum; 2a,b,* transv. and long. secs., ×1 (137).

Dohmophyllum WEDEKIND, 1923 [**D. involutum*] [=*Trematophyllum* WDKD., 1923; *Sparganophyllum, Pseudoptenophyllum* WDKD., 1925]. Solitary or rarely cerioid, corallites large; septa irregularly carinate or with lateral cystose dissepiments, twisted and united in the tabularium, causing the close tabulae to be irregularly domed, not funnel-shaped 52). *M.Dev.*, Eu.-E.Austral.——FIG. 208,*3a*. **D. involutum;* transv. sec., ×2 (137).——FIG. 208, *3b. D. helianthoides* (GOLDFUSS); Ger.(Eifel); long. sec., ×2 (85n).

Pseudochonophyllum SOSHKINA, 1937 [**Chonophyllum pseudohelianthoides* SHERZER, 1892]. Solitary; like *Acanthophyllum* but septa naotic, with very narrow dissepimental alleys (52). *L.Dev.*, Eu.——FIG. 209,*1*. **P. pseudohelianthoides* (SHERZER), Boh.; *1a,b,* transv. and long. secs., ×1 (108).

Family STRINGOPHYLLIDAE Wedekind, 1921

[*nom. transl.* WDKD., 1925 (*ex* Stringophyllinae WDKD., 1921)]

Corallum solitary or phaceloid; septa rather thick, each consisting of a single series of very large monocanths 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 (22). *L.Dev.-M.Dev.*

Stringophyllum WEDEKIND, 1922 [**S. normale;* SD WDKD., 1925] [=*Neospongophyllum* WDKD., 1922; *Loipophyllum, Schizophyllum* WDKD., 1925 (*non* VERHOEFF, 1895); *Loepophyllum* LANG-S.-T., 1940 *(nom. van.); Vollbrechtophyllum* TAYLOR, 1951 (=*Schizophyllum* WDKD., 1925, obj.); *Sunophyllum* WANG, 1948]. *Up.M.Dev.*, Eu.-E.Austral. ——FIG. 209,*3a,b*. **S. normale,* Eu.; *3a,* transv. sec., ×2; *3b,* long. sec., ×1 (137).——FIG. 209, *3c,d. S. variabile* (WDKD.) (type species of *Neospongophyllum*), U.M.Dev., Eu.; *3c,d,* transv. and long. secs., ×2 (137).

Family LONSDALEIIDAE Chapman, 1893

[*nom. correct.* CHI, 1931 (*pro* Lonsdalidae CHAPMAN, 1893)] [=Lonsdaliens DE FROMENTEL, 1861 (invalid vernacular name); Lonsdaleidae GRABAU, 1927]

Compound or rarely solitary Rugosa with an axial structure containing a columella or medial plate and axial tabellae; with lonsdaleoid dissepiments peripherally and with conical tabular floors upturned at margins. *Carb.-Perm.*

Subfamily LONSDALEIINAE Chapman, 1893

[*nom. transl.* HILL, herein (*ex* Lonsdaleiidae, *nom. correct. pro* Lonsdalidae CHAPMAN, 1893)] [=?Axophyllinae M.EDW.-H., 1851; ?Axophylliens DE FROMENTEL, 1861 (invalid vernacular name); ?Axophyllidae (*nom. transl.* DYBOWSKI, 1873); ?Axaphyllidae DYB., 1873 (misprint); Carcinophyllinae HUDSON, 1942; Lithostrotionellidae SHROCK & TWENHOFEL, 1953]

Lonsdaleoid dissepiments predominant; only 2 orders of septa present. *Carb.-L.Perm. (Artinsk.).*

Lonsdaleia M'COY, 1849 [**Erismatolithus Madreporites (duplicatus)* MARTIN, 1809, ICZN pend.] [=*Actinocyathus* D'ORBIGNY, 1849 (*non* KENT, 1882); *?Chonaxis* M.EDW.-H., 1851; *Stylidophyllum* DE FROMENTEL, 1861; *Protolonsdalia* LISSITZIN, 1925; *Protolonsdaleia* LANG-S.-T., 1940 *(nom. van.)*]. Fasciculate or cerioid; corallites with an axial structure of septal lamellae, medial plate, or columella, and conically arranged, shallowly curved tabellae (18). *L.Carb.-M.Carb.*, Eu.-Asia, *L.Carb.*, E.Austral.-N.Am.——FIG. 210,*4*. **L. duplicata* (MARTIN), L.Carb., Eu.; *4a,b,* transv. and long. secs., ×2 (117).

Thysanophyllum NICHOLSON & THOMSON, 1876 [**T. orientale;* SD GREGORY, 1917] [=*?Sublonsdalia* LISSITZIN, 1925; *Sublonsdaleia* LANG-S.-T., 1940 *(nom. van.)*]. Fasciculate or cerioid, with wide lonsdaleoid dissepimentarium; septa withdrawn from axis except for counter septum which may be very long, particularly in young stages; tabulae complete, cones or flat-topped domes (18). *L.Carb.*, Eu.-Asia.——FIG. 210,*3a,b*. **T. orientale,* Scot.; *3a,b,* transv. and long. secs., ×1 (85).——FIG. 210,*3c,d. T. ? intermedia* (LISSITZIN) (type species of *Sublonsdalia*), Asia; *3c,d,* transv. and long. secs., ×1 (101).

Lithostrotionella YABE & HAYASAKA, 1915 [**L.*

unica] [=?*Acrocyathus* D'ORBIGNY, 1849]. Like *Thysanophyllum* but with columella a persistent vertical lath, in some corallites continuous with counter and cardinal septa (57). *Carb.*, N.Am.; *L.Perm.(Artinsk.)*, China.——FIG. 210,*1a*. *L. floriformis* (ORB.), Carb., N.Am.; upper surface, ×0.5 (106).——FIG. 210,*1b,c*. **L. unica*, Artinsk., Yunnan; *1b,c*, transv. and long. secs., ×1 (140).

Sciophyllum HARKER & MCLAREN, 1950 [**S. lambarti*]. Cerioid, without septa and axial structure; dissepimentarium a single series of lonsdaleoid plates; tabulae complete, flat. *Carb.*, Can.

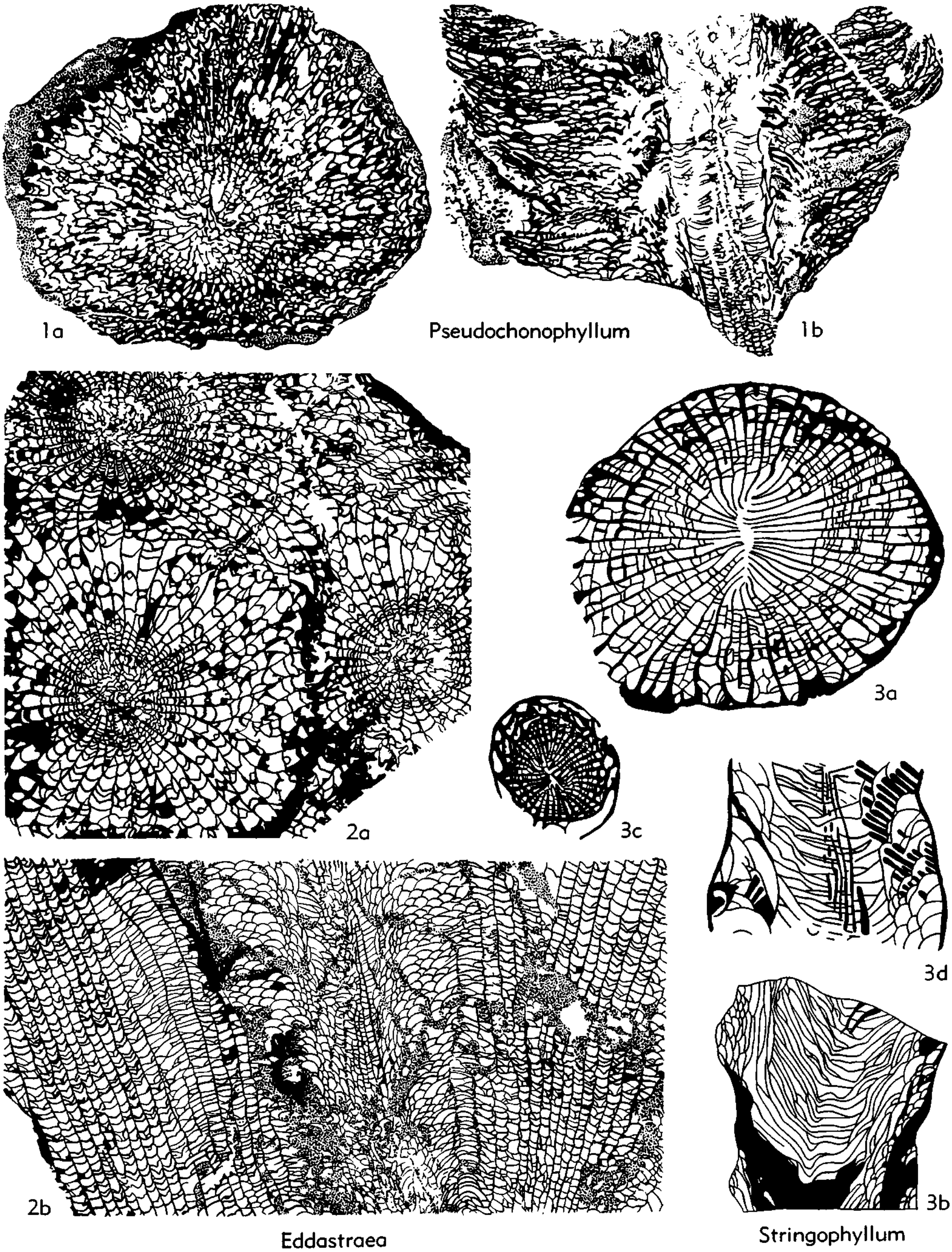

FIG. 209. Columnariina: Ptenophyllidae, Stringophyllidae (p. F306).

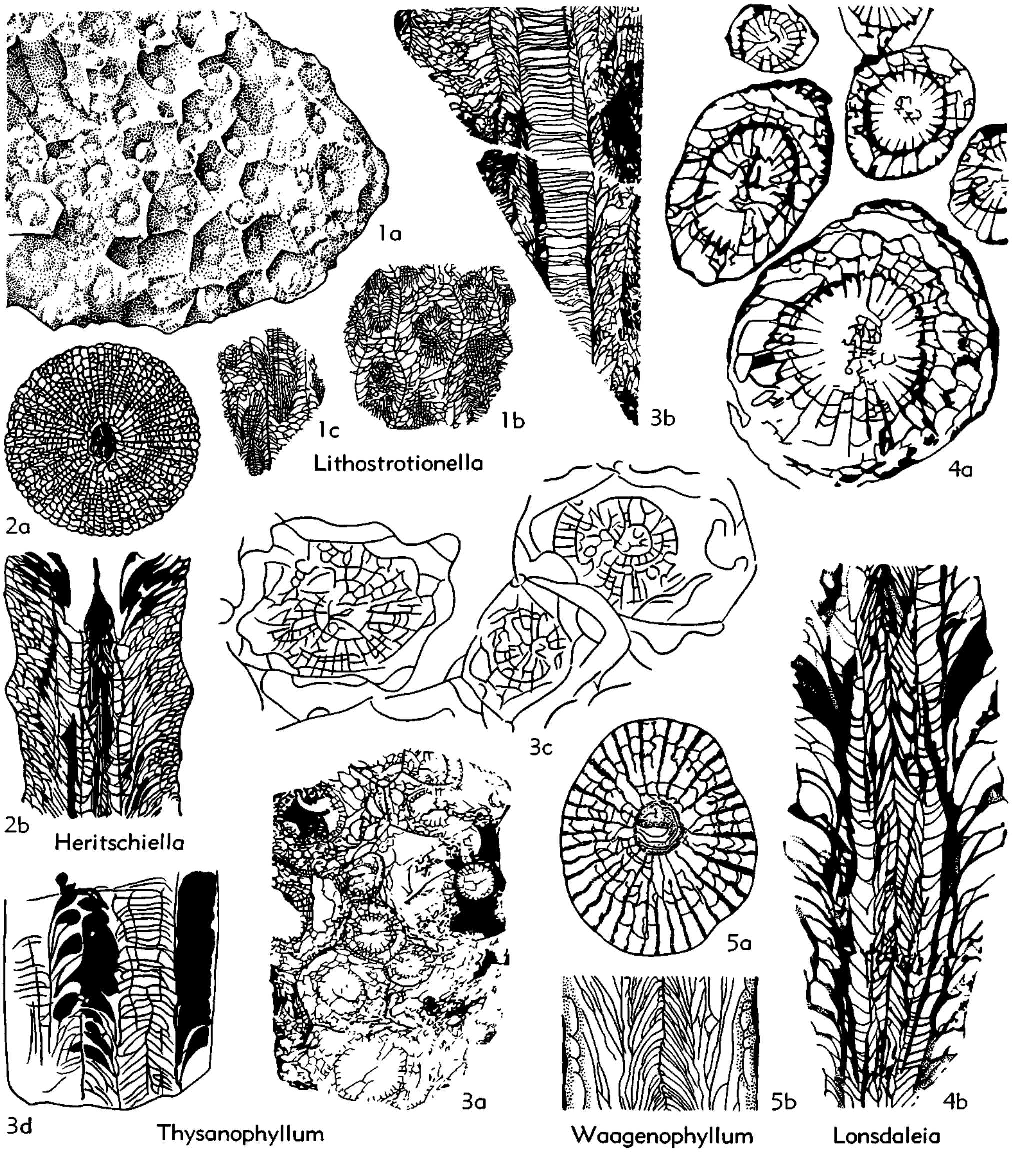

FIG. 210. Columnariina: Lonsdaleiidae (p. F306-F310).

Carcinophyllum THOMSON & NICHOLSON, 1876 [**C. kirsopianum* THOMSON, 1880; SD THOMSON, 1880] [=?*Axophyllum* M.EDW.-H., 1850 (type specimens require restudy); *Agassizia* THOMSON, 1883 (*non* BEHR, 1870; *nec* VETTER, 1881) (*non Agassisia* VALENCIENNES, 1846)]. Solitary; axial structure of irregular anastomosing dilated lamellae, with a median plate; marginarium a peripheral stereozone interrupted by lonsdaleoid dissepiments; tabulae flat or sagging periaxially, conical in the axial structure (18). *L.Carb.*, Eu.——FIG. 211,*4*. **C. kirsopianum* Scot.; *4a,b,* transv. and long. secs., ×1 (85).

Ivanovia DOBROLYUBOVA, 1935 [**I. podolskiensis*] [=*Cystophora* YABE & HAYASAKA, 1916 (*non* NILSSON, 1820); *Cystiphora* LANG-S.-T., 1940 (*nom. van.*) (*non* KIEFFER, 1892)]. Aphroid, with some traces of wall, septa long, dilated in tabularium; axial structure compact, thickened, with a few tabellae arranged in cones; periaxial tabulae sagging (57). *M.Carb.*, USSR; *?L.Perm.*, Manch.——FIG. 211,*3a,b*. *I. manchurica* DOBR. (type species of *Cystophora*), ?Artinsk., Manch.; *3a,b,* transv. and long. secs., ×2 (85n).——FIG. 211, *3c,d*. **I. podolskiensis,* M.Carb., USSR; *3c,d,* transv. and long. secs., ×1.5 (68).

Subfamily WAAGENOPHYLLINAE Wang, 1950

Dissepimentarium of small interseptal plates; lonsdaleoid dissepiments rare except in *Polythecalis,* third-order septa commonly developed. *L.Perm.*

Iranophyllum Douglas, 1936 [**I. splendens*] Solitary; axial structure of medial plate, septal lamellae, and tented tabellae, surrounded by flat tabulae in the narrow space left free of septa and just outside this by elongate tabellae which slope downward and inward; dissepimentarium not lonsdaleoid, wide, with tertiary as well as minor septa (8). *L.Perm.(?Artinsk.),* Iran-?China.——Fig. 211,*2*. **I. splendens,* Iran; *2a,b,* transv. and long. secs., ×2 (69).

Waagenophyllum Hayasaka, 1924 [*pro Waagenella* Yabe & Hayasaka, 1915 as *Warganella*) (*non Waagenella* de Koninck, 1883)] [**Lonsdaleia indica* Waagen & Wentzel, 1886; SD Grabau, 1931]. Fasciculate, corallites slender, like *Iranophyllum* internally but without tertiary septa (8). *L.Perm.(Artinsk.),* USSR-Asia-N.Z.——Fig. 210, *5*. **W. indica* (Waag.-W.), India; *5a,b,* transv. and long. secs., ×10 (134).

Wentzelella Grabau in Huang, 1932 [**Lonsdaleia salinaria* Waagen & Wentzel, 1886]. Like *Waagenophyllum* but massive (8). *L.Perm. (?Artinsk.),* Asia.

W. (Wentzelella). Cerioid (8). *?Artinsk.,* Asia-N.Z.——Fig. 211,*1*. **W. (W.) salinaria* (Waagen & Wentzel), India; *1a,* transv. sec., ×4; *1b,* long. sec., ×20 (134).

W. (Wentzelloides) Yabe & Minato, 1944 [**W. (W.) maiyaensis*]. Like *W. (Wentzelella)* but with incomplete fission, so that the corallum is partially meandroid. *Artinsk.,* Japan.——Fig. 212, *3*. **W. (W.) maiyaensis; 3a,b,* transv. and long. secs., ×4 (141).

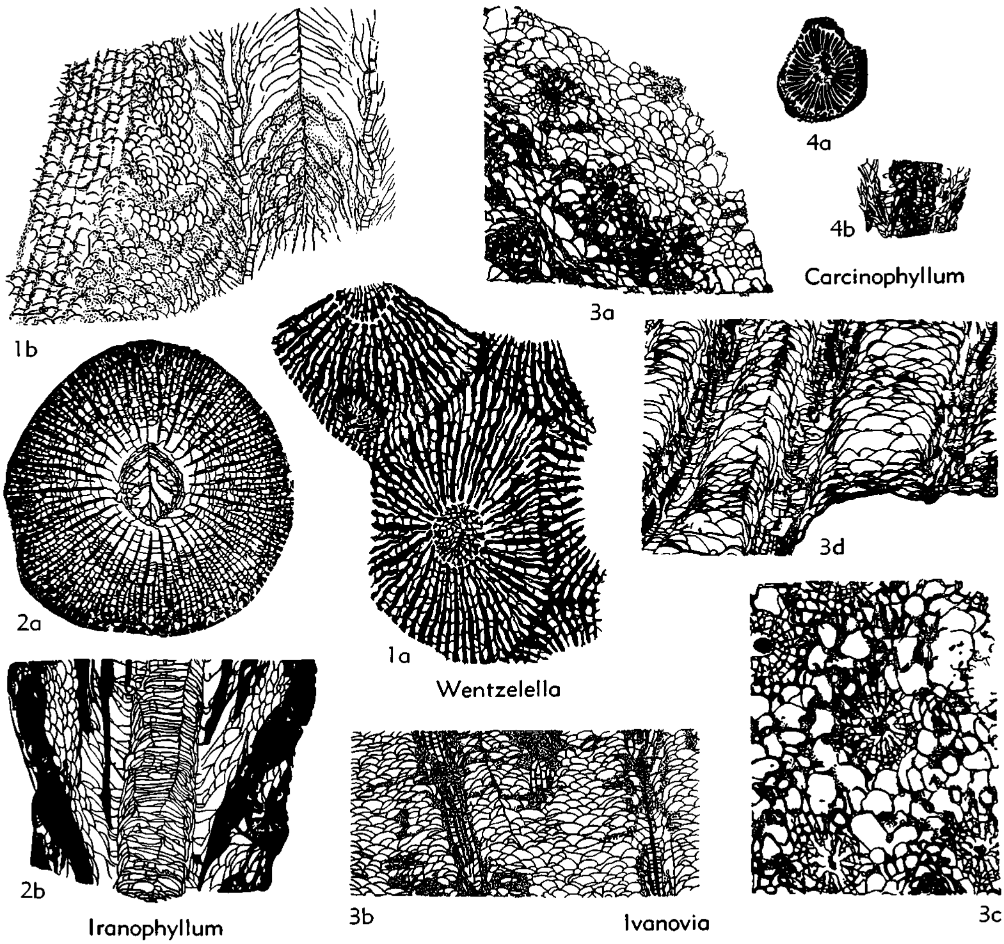

Fig. 211. Columnariina: Lonsdaleiidae (p. F307-F309).

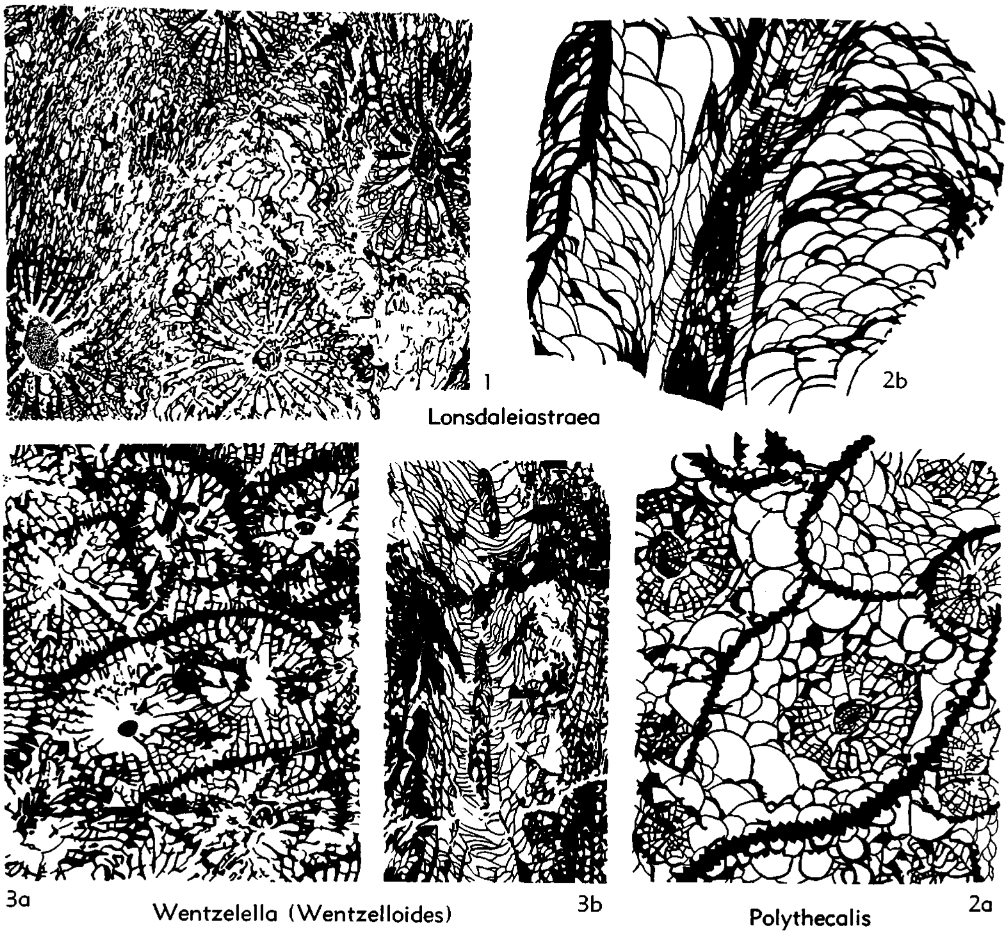

FIG. 212. Columnariina: Lonsdaleiidae (p. F309-F310).

Lonsdaleiastraea GERTH, 1921 [*L. *vinassai*]. Thamnasterioid or partly aphroid; like *Iranophyllum* internally, but with some lonsdaleoid dissepiments (12). *L.Perm.(Artinsk.)*, Asia.——FIG. 212, *1*. **L. vinassai*, Timor; transv. sec., ×2 (79).

Polythecalis YABE & HAYASAKA, 1916 [*P. *confluens*]. Cerioid or in part aphroid; like *Iranophyllum* internally but with lonsdaleoid dissepimentarium (25). *L.Perm.(Artinsk.)*, Asia.——FIG. 212,*2*. **P. confluens*; *2a,b*, transv. and long. secs., ×4 (88).

Heritschiella MOORE & JEFFORDS, *nom. nov.* [*pro Heritschia* MOORE-J., 1941 (Kans. Geol. Survey Bull. 38, p. 94) (*non* TEPPNER, 1922)] [**Heritschia girtyi* MOORE-J., 1941]. Fasciculate; like *Waagenophyllum* but with thin, numerous septa; tertiary septa present; periaxial zone of tabulae wide, with tabulae flat or outwardly and upwardly inclined. *L.Perm.*, N.Am.-Eu.-Asia.——FIG. 210,*2*. **H. girtyi* (MOORE-J.), Kans.; *2a,b*, transv. and long. secs., ×2 (104).

Suborder CYSTIPHYLLINA Nicholson in Nicholson & Lydekker, 1889

[*nom. correct.* HILL, herein (*pro* Cystiphylloidea NICH., in NICH.-L., 1889)] [=Lythophyllacea WEDEKIND, 1925; Cystiphyllida, Cystiphyllacea WDKD., 1927; Calceolacea WDKD., 1937; Cystiphylalacea WANG, 1948 (misprint); includes Tryplasmacea LECOMPTE, 1952 (superfam.)]

Solitary or compound Rugosa; septal trabeculae large; marginarium either a stereozone in which cores of trabeculae appear set in a mass of lamellate sclerenchyme, or a dissepimentarium of small globose dissepiments, typically with septa represented by separate trabeculae based on upper surfaces of the dissepiments; tabulae flat and complete, or inversely conical and incomplete. *Ord.-Dev.*

Family TRYPLASMATIDAE Etheridge, 1907

[*nom. correct.* HILL, herein (*pro* Tryplasmidae ETHERIDGE, 1907)] [=?Palaeocyclidae DYBOWSKI, 1873; ?Palaeocyclinae (*nom. transl.* ZITTEL, 1876); ?Cyclinidae CHAPMAN, 1893 (invalid); Pholidophyllidae, Pholidophyllida WEDEKIND, 1927; Acanthocyclidae HILL, 1936; ?Paleocyclidae BASSLER, 1937; Rhabdocyclidae HILL, 1940; ?Porpitidae MOORE & JEFFORDS, 1945)]

Solitary and compound Rugosa with complete, horizontal or inversely conical tabulae, rarely with a narrow median notch; typically without dissepiments, marginarium a stereozone with very numerous septa, each represented by a vertical series of trabeculae bound together by lamellate sclerenchyme but free at their inner ends; major septa may be continued toward axis as small spines on upper surfaces only of tabulae; trabeculae rhabdacanthine or holacanthine. *Ord.-Dev.*

Rhabdocyclus LANG & SMITH, 1939 [*pro Acanthocyclus* DYBOWSKI, 1873 (*non* LUCAS, 1844)] [**Palaeocyclus fletcheri* M.EDW.-H., 1851]. Discoid or patellate, with cone of attachment excentric; without tabulae or dissepiments, with stereozone of rhabdacanthine septa (17). *Sil.*, Eu.-N. Am.——FIG. 213,*1*. **R. fletcheri* M.EDW.-H., M. Sil., Eu.; *1a,b*, calice, long. sec., ×2 (98).

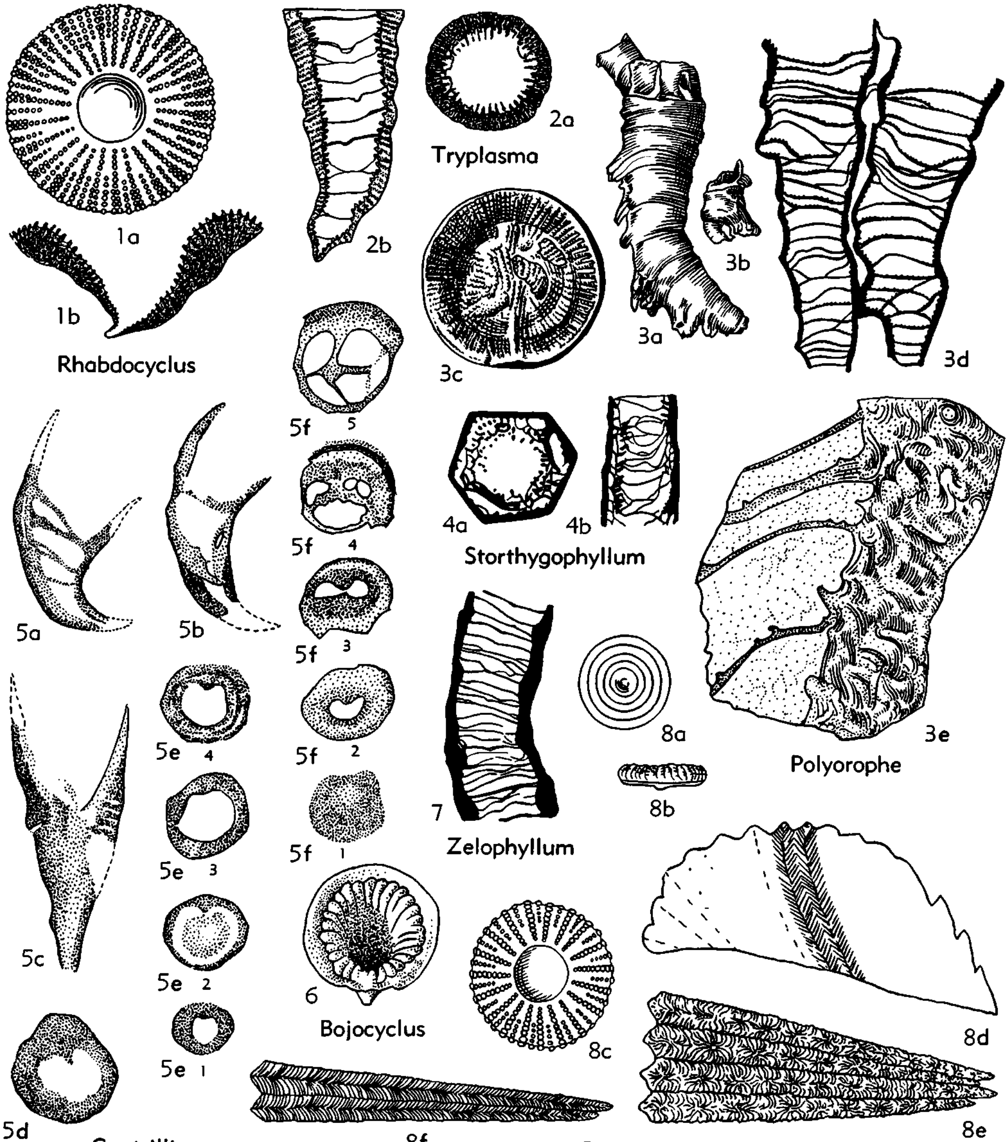

FIG. 213. Cystiphyllina: Tryplasmatidae (p. F311-F312).

Tryplasma LONSDALE, 1845 [**T. aequabile;* SD ETHERIDGE, 1907] [=*Pholidophyllum* LINDSTRÖM, 1871, *Pholadophyllum* LANG-S.-T., 1940 *(nom. van.); Spiniferina* PENECKE, 1894 *(pro Acanthodes* DYBOWSKI, 1873; *non* AGASSIZ, 1833; *nec* DE HAAN, 1833; *nec* BALY, 1864); *Aphyllostylus* WHITEAVES, 1904; *?Tyrrellia* PARKS, 1913 *(non* KOENIKE, 1895); *Stortophyllum* WEDEKIND, 1927; *?Aphyllum* SOSHKINA, 1937 *(non Aphylum* BERGROTH, 1906)]. Solitary, with marked rejuvenescence rims, or fasciculate; minor septal grooves on epitheca weaker than major septal grooves (17). *Sil.-L.Dev.,* Eu.-Asia-N.Am.-Austral.——FIG. 213, *2. T. loveni* (M.EDW.-H.), M.Sil., Eu; *2a,b,* transv. and long. secs., ×1 (85).

Storthygophyllum WEISSERMEL, 1894 [**S. megalocystis (partim)*] [=*Xiphelasma* SMITH & LANG, 1931]. Like *Tryplasma* but cerioid, and with a narrow zone of lonsdaleoid dissepiments. *Sil.,* Gotl. ——FIG. 213,*4. S. tubulatum* (SCHLOTHEIM) (type species of *Xiphelasma*), *4a,b,* transv. and long. secs., ×3 (118).

Cantrillia SMITH, 1930 [**C. prisca*]. Like *Tryplasma* but with infold of peripheral stereozone, and tabulae invested with lamellate sclerenchyme continuous with that of the stereozone (17). *L.Sil.,* Br.I. ——FIG. 213,*5. *C. prisca,* U.Llandov., Br.I.; *5a-c,* long. secs., ×3; *5d-g,* transv. secs. (incl. 2 ontogenetic series), ×3 (117).

Polyorophe LINDSTRÖM, 1882 [**P. glabra*]. Like solitary *Tryplasma* but with remarkable development of epithecal outgrowths of attachment (36). *L.Sil.-M.Sil.,* Gotl.——FIG. 213,*3. *P. glabra, 3a,b,* side view of corallites, ×0.5; *3c,* calice, ×1; *3d,e,* long. secs., ×1, ×5 (100).

Zelophyllum WEDEKIND, 1927 [**Z. intermedium*]. Fasciculate, with no free ends of trabeculae projecting beyond narrow peripheral stereozone (55). *M.Sil.,* Gotl.——FIG. 213,*7. *Z. intermedium;* long. sec., ×1 (137).

?Porpites SCHLOTHEIM, 1820 [*non* GUETTARD, 1770 (*non* Linnean)] [**P. haemisphericus;* (=*Madrepora porpita* LINNÉ, 1767 *partim;* SD LANG-S.-T., 1940] [=*Palaeocyclus* M.EDW.-H., 1849]. Discoid, with central cone of attachment; stereozone of monacanthine septa, no tabulae and no dissepiments (17). *L.Sil.-M.Sil.,* Eu.-N.Am.——FIG. 213,*8. *P. porpita* (LINNÉ), L.Sil. (U.Llandov.), Eng.; *8a,b,* base, side, ×1; *8c,* top, ×2; *8d-f,* transv. and long. secs. of septa showing trabeculae, enlarged (85).

Kitakamiphyllum HILL, *nom. nov.* [*pro Maia* SUGIYAMA, 1940 (Sci. Rept. Tôhoku Imp. Univ., ser. 2, v. 21, p. 122) (*non* BRISSON, 1760; *nec* LAMARCK, 1801; *nec* REICHENBACH, 1850; *nec* FREDERICKS, 1924)] [**Maia cylindrica* SUGIYAMA, 1940]. Like *Tryplasma* but without trace of septa. *M.Sil.,* Japan.

?Bojocyclus PRANTL, 1939 [**B. bohemicus*]. Discoid with cone of attachment excentric; calice with smooth, aseptate outer border; septa strongly crenulate (52). *M.Dev.,* Czech.——FIG. 213,*6. *B. bohemicus;* calice, ×2 (109).

Family CYSTIPHYLLIDAE Milne-Edwards & Haime, 1850

[=Cystiphyllinae (*nom. transl.* M'COY, 1851); Araeopomatidae LINDSTRÖM, 1883; Cystiphyllacea WEDEKIND, 1927 (suborder); Holmophyllinae WANG, 1947]

Solitary or fasciculate; septa very numerous, each represented by a vertical series of discrete, typically holacanthine trabeculae commonly set in lamellar sclerenchyme which coats the horizontal skeletal elements; tabulae sagging to inversely conical, incomplete; dissepimentarium wide, dissepiments usually smaller than tabellae. *Sil.*

Cystiphyllum LONSDALE, 1839 [**C. siluriense;* SD M.EDW.-H., 1850] [=*Conophyllum* HALL, 1851]. Solitary; with long septa, each represented only by distant, separate trabeculae developed only on upper surfaces of successive globose dissepiments and tabellae; minor septa very long, dissepimentarium very wide; calicular floor inversely conical, inclination of dissepiments and tabellae being similar (31). *Sil.,* Eu.-Asia-Austral.-N.Y.——FIG. 214,*1. C. cylindricum* LONSD., M.Sil., Eu.; *1a,b,* secs., ×1 (98).

Hedstroemophyllum WEDEKIND, 1927 [*nom. correct.* HILL, herein (*pro Hedströmophyllum* WDKD., 1927)] [**H. articulatum*]. Like *Cystiphyllum* but corallites slender, with trabeculae long enough to pierce several successive dissepimental floors (55). *M.Sil.,* Gotl.——FIG. 214,*3. *H. articulatum; 3a,* transv. sec., ×3; *3b,* long. sec., ×2 (137).

Holmophyllum WEDEKIND, 1927 [**H. holmi*]. Like *Cystiphyllum* but trabeculae extending from epitheca into tabularium; tabulae complete and flat or sagging (55). *U.Sil.,* Gotl.-Austral.——FIG. 214, *6. *H. holmi,* Gotl.; *6a,b,* transv. and long. secs., ×3 (137).

Gyalophyllum WEDEKIND, 1927 [**G. angelini*]. Like *Cystiphyllum* but with lamellar sclerenchyme forming a dense zone as wide as the minor septa are long and broken only by dissepiments developed on distant calical floors (55). *U.Sil.,* Gotl. ——FIG. 214,*7. *G. angelini; 7a,* transv. sec., ×1; *7b,* long. sec., ×2 (137).

Araeopoma LINDSTRÖM, 1883 [**A. prismaticum* (=*Cystiphyllum prismaticum* LIND., 1868)]. Like *Cystiphyllum* but square in section in the erect part of corallum (36). *L.Sil.(U.Llandov.)-M.Sil.,* Gotl. ——FIG. 214,*4. *A. prismaticum* (LIND.); side view, ×1 (100).

Microplasma DYBOWSKI, 1873 [**M. gotlandicum;* SD WEDEKIND, 1927]. Like *Cystiphyllum* but fasciculate, corallites slender; trabeculae confined to extremely narrow peripheral stereozone; horizontal skeletal elements large, not distinctly divisible into dissepiments and tabellae (9). *M.Sil.-U.Sil.,* Eu.——Fig. 214,2. **M. gotlandicum; 2a,b,* long. secs., ×1; *2c,* transv. sec., ×2 (71).

?**Nipponophyllum** Sugiyama, 1940 [**N. giganteum*] [=*Baeophyllum* Hill, 1940]. Fasciculate, corallites slender, with connecting processes formed by outgrowths of dissepimentarium; septa represented by separate trabeculae or by segments in which 2 or 3 trabeculae are in contact; dissepiments large, in 1 or 2 series, inner edges steeply sloping; tabulae concave, complete or supplemented by wide tabellae (20). *M.Sil.,* Japan-E.Austral.——Fig. 214,5. **N. giganteum,* Japan; *5a,* transv. sec., ×1; *5b,c,* long. secs., ×1 (128).

Family GONIOPHYLLIDAE Dybowski, 1873

[=Goniophyllinae (*nom. transl.* Zittel, 1876); Calceolidae Lindström, 1883 (also Calceolidae Roemer, 1883); Calceolacea Wedekind, 1937]

Corallites semicircular (calceoloid) or square in transverse section; calice with an operculum of 1 or 4 plates of dense sclerenchyme; corallites either with wide dissepimentarium and incomplete, inversely conical tabulae or completely filled with dense sclerenchyme; septa may be confined to a few short plates on flat side of corallum or developed as short plates so thick as almost to preclude dissepiments, and with little difference between major and minor septa. *Sil.-Dev.*

Goniophyllum M.Edw.-H., 1850 [**Turbinolia pyramidalis* Hisinger, 1831]. Solitary, square in section, with operculum of 4 triangular plates; septa

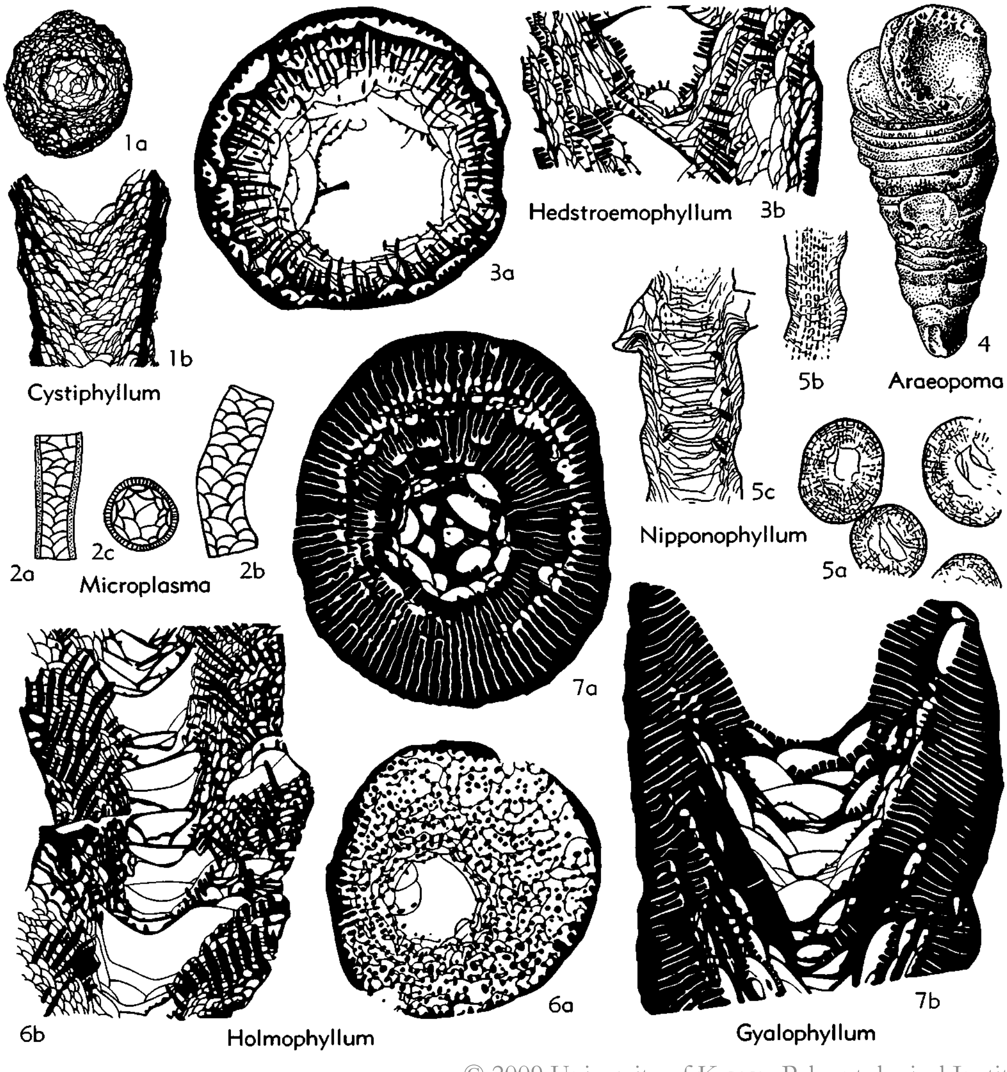

Fig. 214. Cystiphyllina: Cystiphyllidae (p. F312-F313).

thick, mostly contiguous, as long as the dissepimentarium is wide; dissepiments and tabellae numerous, commonly thickened (36). *L.Sil.-M.Sil.*, Eu.——FIG. 215,*2*. **G. pyramidale* (HISINGER); *2a*, corallite, ×1; *2b,c*, secs., ×1, ×2 (100).

Rhizophyllum LINDSTRÖM, 1866 [**Calceola gotlandica* F. A. ROEMER, 1856]. Calceoloid; dissepiments and tabulae little thickened or not at all; septa developed only along flattened side as short plates not distinguishable into major and minor cycles (36). *M.Sil.-L.Dev.*, Eu.-Asia-N.Am.-Austral. ——FIG. 215,*3*. **R. gotlandicum* (ROEMER), U.Sil., Gotl.; *3a,b*, side view, long. sec., ×1 (100).

Teratophyllum LANG-S.-T., 1940 [*pro Platyphyllum* LINDSTRÖM, 1883 (*non* AUDINET-SERVILLE, 1831)] [**Platyphyllum sinense* LIND., 1883]. Calceoloid; septa numerous; dissepiments and tabulae as in *Goniophyllum* (36). *M.Sil.*, China; *L.Dev.*, USSR. ——FIG. 215,*1*. **T. sinense* (LIND.), M.Sil., China; *1a,b*, secs., ×1, enlarged (100).

Rhytidophyllum LINDSTRÖM, 1883 [**R. pusillum*]. Minute, operculate and calceoloid, with faint septa; ?cystiphylloid structure (36). *U.Sil.*, Gotl.——FIG. 215,*5*. **R. pusillum;* side view, ×4 (100).

Calceola LAMARCK, 1799 [*non* SWAINSON, 1840] [**Anomia sandalium* GMELIN, in LINNÉ, 1791 (=*Anomia sandalinum* LINNÉ, 1771)] [=*Calceolina* RAFINESQUE, 1815 (*non* ADAMS, 1863)]. Corallites semicircular in section, with semicircular operculum; completely filled with dense sclerenchyme (36). *L.Dev.(Ems.)-M.Dev.*, Eu.-Asia; *M.Dev.*, Afr.-Austral.-Calif.——FIG. 215,*4*. **C. sandalina* (LINNÉ); *4a*, convex side; *4b,c*, convex side and interior of another specimen; *4d,e,g*, exterior, interior, side of operculum; *4f*, diagram of septal arrangement in calice and interior of operculum (C, cardinal septum; K, counter septum); all ×1 (129).

?Protaeropoma TING, 1937 [**P. wedekindi*] [=*Protaraeopoma* LANG-S.-T., 1940 *(nom. van.)*]. *Sil.*, Gotl.

Family DIGONOPHYLLIDAE Wedekind, 1923

[=?Plasmophyllidae, ?Plasmocystidae DYBOWSKI, 1873; ?Plasmophyllinae (*nom. transl.* ZITTEL, 1876); Lythophyllidae, Lythophyllacea WDKD., 1925; Arcophyllidae MARCOV, 1926; Lytophyllidae, Lytophyllinae, Cosmophyllinae WDKD. & VOLLBRECHT, 1931 (invalid); Glossophyllidae KETTNEROVA, 1932; Cystiphylloidae, Cystiphylloinae, Arcophyllinae STUMM, 1949 (=Cystiphylloididae, *nom. correct.* HILL, herein, *ex Cystiphylloides*)]

Solitary coralla with inversely conical calicular floors, wide dissepimentarium merging into tabularium; in some, septal tissue is developed only in successive inverse cones of thickening (septal cones of WEDEKIND), in which individual large trabeculae may be distinguished, or septa may be developed in short, thick, contiguous laminar segments or in part as discrete trabeculae; in others, septa are developed as contiguous laminae, and in these a minor septum near the counter septum is elongated into the axial region. *Dev.*

In this family, if WEDEKIND's (54) analysis is correct, laminar septa are built up from discrete trabeculae and from discontinuous laminar septal segments in which the trabeculae are contiguous and may be indistinguishable. The family thus may have been derived from the earlier family Cystiphyllidae with discrete trabeculae, in which some genera (*Gyalophyllum*) show extreme dilatation affecting tissue in successive inversely conical calicular floors ("septal cones"), just as in the Digonophyllidae. It is possible, however, to regard the "septal cones" as rejuvenescent returns to earlier stages of ontogeny in which the septa were of thick, contiguous laminae, and in this view ancestors of the Digonophyllidae may be outside the Cystiphyllina altogether, though at present no satisfactory ancestor for such an origin can be suggested for them. Therefore, they are herein referred to the Cystiphyllina and placed close to the Cystiphyllidae.

Subfamily ZONOPHYLLINAE Wedekind, 1924

[=?Plasmophyllidae, ?Plasmocystidae DYB., 1873; Lythophyllidae WDKD., 1925; Lytophyllidae, Lytophyllinae WDKD. & VOLLBRECHT, 1931 (invalid); Zonophyllidae (*nom. transl.* WDKD., 1937)]

Solitary or rarely fasciculate coralla with inversely conical calicular floors of globose tabellae and smaller, less globose dissepiments; septa discontinuous, of monacanthine trabeculae (separate in some) developed only in successive zones (calicular floors, "septal cones") of skeletal dilatation; the separate trabeculae do not pierce successive dissepiments; there is no trace of any long counter minor septum, nor of crossbar carinae. *L.Dev.-M.Dev.*

Zonophyllum WEDEKIND, 1924 [**Z. duplicatum;* SD LANG-S.-T., 1940] [=?*Coleophyllum* HALL, 1883; *Legnophyllum, Pseudozonophyllum* WDKD., 1924; *Lythophyllum, Nardophyllum, Paralythophyllum* WDKD., 1925; *Plagiophyllum* WDKD. & VOLLBRECHT, 1931; *Lithophyllum (nom. van. pro Lythophyllum), Paralithophyllum (nom. van. pro Paralythophyllum)* LANG.-S.-T., 1940 (*non Lithophyllum* MÜLLER, 1859); *Wedekindophyllum* STUMM, 1949 *(nom. van. pro Lythophyllum)*]. Solitary, conical or cylindrical; calicular floors erect or oblique inverse cones (54). *L.Dev.-M.Dev.*, Eu.-Asia-N.Am.——FIG. 216-*1a-c*. **Z. duplicatum*, Ger.; *1a-c,* transv. secs., ×2 (137).——FIG. 216, *1d,e. Z. marginatum* WDKD. (type species of *Lythophyllum* WDKD. and *Wedekindophyllum* STUMM), U.M.Dev., Ger.; *1d,e,* transv. and long. secs., ×1 (137).——FIG. 216,*1f,g. Z. pseudoseptatum* (SCHULZ), U.M.Dev., Ger.; *1f,g,* transv. and long. secs., ×1 (138).——FIG. 270,*1h,i. Z.? romingeri* (HALL) (type species of *Coleophyllum*), L.Dev., N.Am.; *1h,i,* side and calical views of corallite, ×0.5 (83).

Cayugaea LAMBE, 1901 [**C. whiteavesiana*]. Subcylindrical without trace of septa; tabulae large, saucer-shaped, complete, distinctly demarcated from dissepimentarium formed of rather steeply sloping plates (52). *L.Dev.,* N.Am.——FIG. 216,2. **C. whiteavesiana,* Can.; *2a,b,* transv. and long. secs., ×0.5 (96).

Skoliophyllum WEDEKIND, 1937 [**Cyathophyllum lamellosum* GOLDFUSS, 1826; SD LANG-S.-T., 1940] [=*Scoliophyllum* LANG-S.-T., 1940 *(nom. van.)*]. Solitary, with flat calicular floors and repeated rejuvenescence, giving a series of laminae en echelon; practically filled by skeletal dilatation (52). Uppermost *L.M.Dev.,* Ger.——FIG. 216,*3*. **S. lamellosum* (GOLDF.); side view, ×1 (137).

?**Bucanophyllum** ULRICH, 1886 [**B. gracile*]. Small, solitary, slender at first, then rapidly expanding. *L.Dev.,* N.Am.

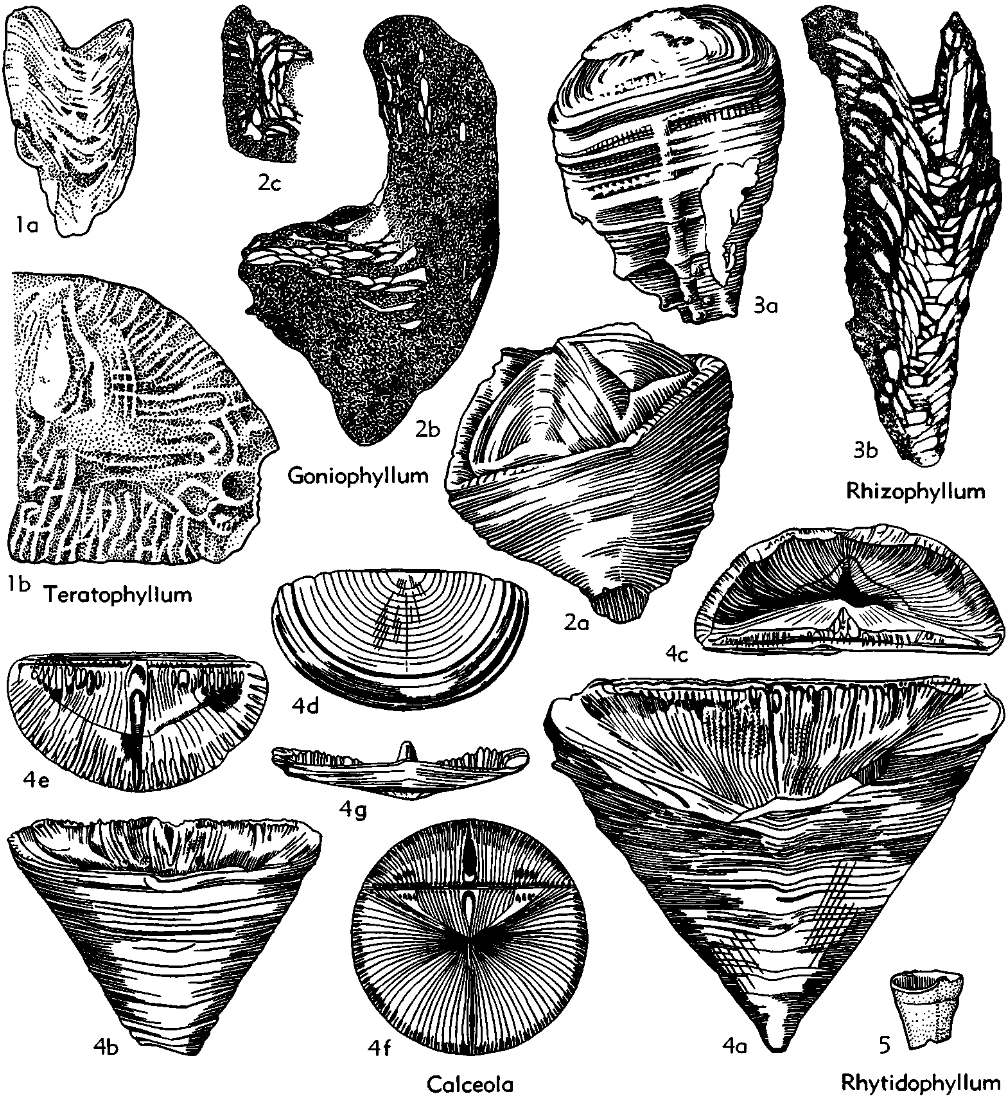

FIG. 215. Cystiphyllina: Goniophyllidae (p. F314).

?**Plasmophyllum** Dybowski, 1873 [**Cyathophyllum goldfussi* M.Edw.-H., 1851] [=*Stereophyllum* Schlüter, 1889 (*non* Grabau, 1917; *nec* Soshkina, 1937)]. Small, curved, conical; typically filled with skeletal dilating tissue except at calical periphery, where lonsdaleoid dissepiments develop (52). *M.Dev.*, Ger.——Fig. 216,6. **P. goldfussi* (M.Edw.-H.); *6a*, calice, ×1; *6b,c*, transv. and long. secs., ×1 (114).

?**Diplochone** Frech, 1886 [**D. striata*]. Solitary;

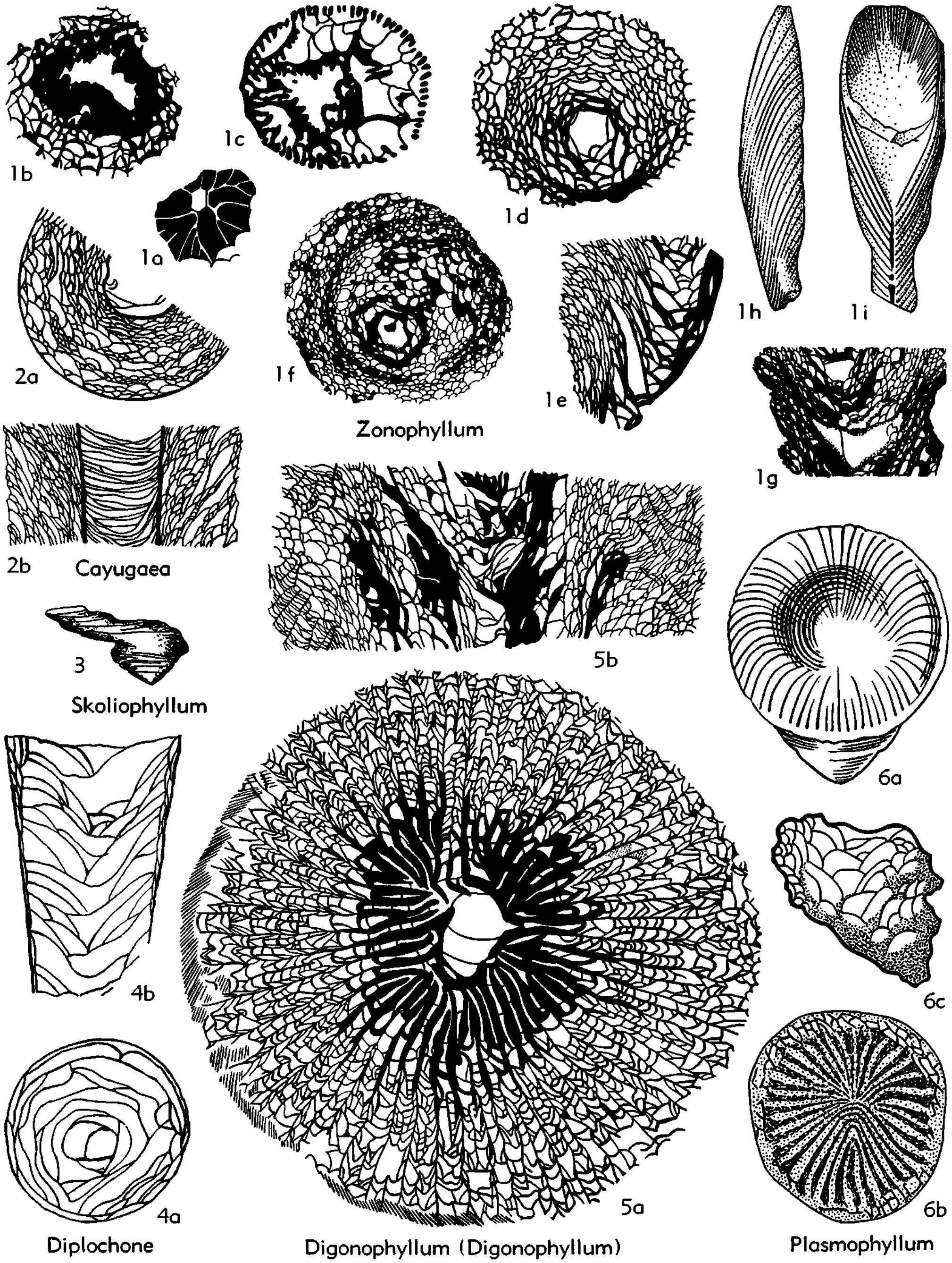

Fig. 216. Cystiphyllina: Digonophyllidae (p. F314-F318).

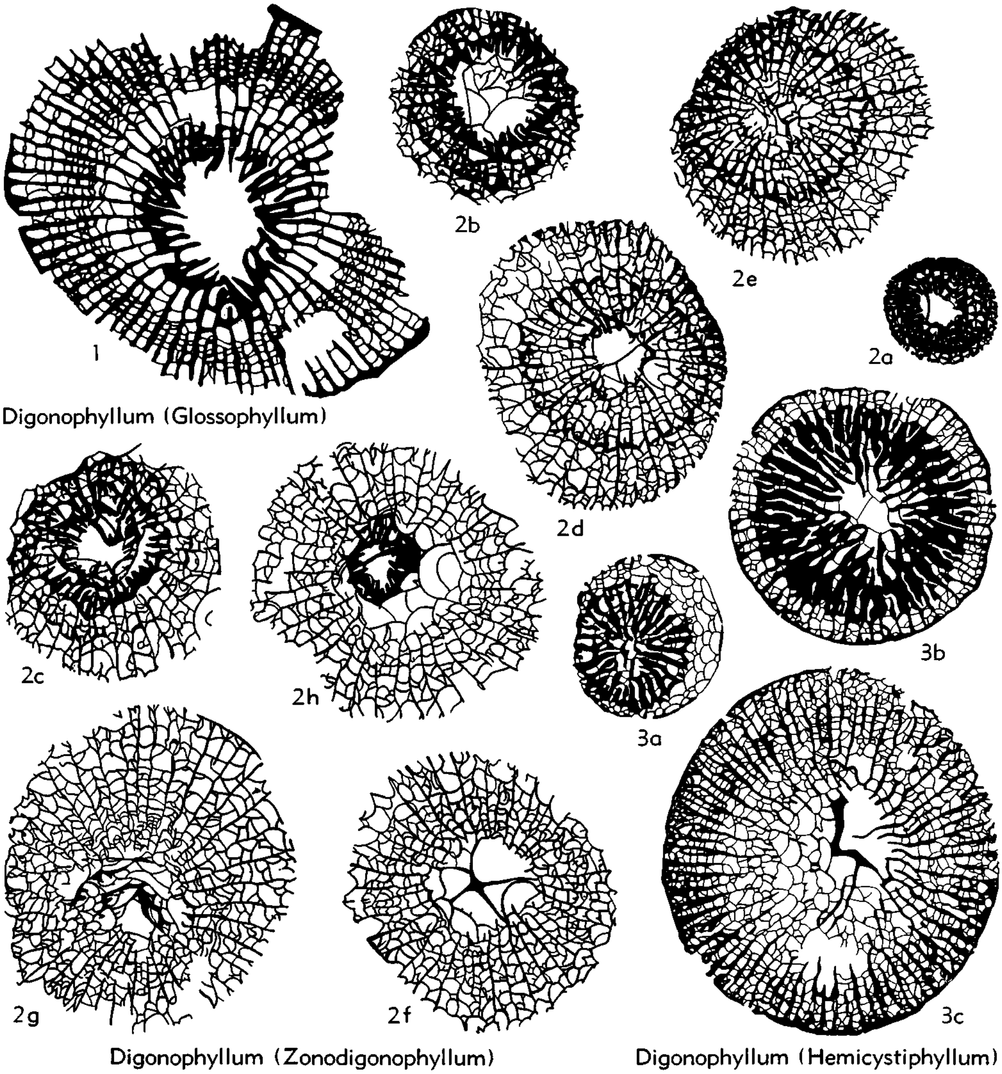

FIG. 217. Cystiphyllina: Digonophyllidae (p. F318).

septa developed only as very low ridges (not spinose) on upper surfaces of tabulae and on inner side of wall, but numerous and rather long; dissepimentarium very narrow, of 1 or 2 series of elongate, highly inclined plates; tabulae complete or incomplete, funnel-shaped (52). *Up.M.Dev.*, Ger.——FIG. 216,*4*. **D. striata; 4a,b,* transv. and long. secs., ×1 (77).

Subfamily DIGONOPHYLLINAE Wedekind, 1923

[=Arcophyllidae MARKOV, 1926; Cosmophyllinae WEDEKIND & VOLLBRECHT, 1931; Glossophyllidae KETTNEROVA, 1932; Cystiphylloidae STUMM, 1949 (*errore pro* Cystiphylloididae); Atelophyllinae, Mochlophyllinae TAYLOR, 1951]

Large solitary Rugosa with inversely conical calicular floors of globose tabellae and small, less globose dissepiments; septa are continuous vertical plates thinnest near periphery, or are represented in dissepimentarium or throughout by septal crests, by separate crossbar carinae, or they are quite absent (especially minor septa); they may be lined by lateral dissepiments; usually one minor septum near counter septum is very long; arrangement of septa in tabularium characteristic; fossula like a keyhole in transverse section, being outlined in cardinal part of tabularium by deepening of the calical floor, by parallelism of the short axial ends of 2 major septa nearest to the short cardinal septum, and by sudden inward expansion of this trough into a circular space left by axial ends of septa in cardinal quadrants. *M.Dev.*

Digonophyllum WEDEKIND, 1923 [**D. schulzi*]. Large; septa typically continuous laminae, but minor septa may be represented by sparse crests only (22). *M.Dev.*, Eu.-Austral.

D. (Digonophyllum). Very large; minor septa continuous vertical plates except near periphery; major septa thick in tabularium, the thickening dying away in inner parts of dissepimentarium; lateral dissepiments line the septa, and crossbar carinae may develop at periphery (22). *L.M.Dev.*, Ger.——FIG. 216,*5*. **D. (D) schulzi; 5a,b,* transv. and long. secs., ×0.25 (133).

D. (Glossophyllum) WEDEKIND, 1924 [**G. dohmi;* SD LANG-S.-T., 1940]. Like *D. (Digonophyllum)* but with well-developed minor septa (54). *L.M. Dev.*, Ger.——FIG. 217,*1*. **D. (G.) dohmi;* transv. sec., ×2 (137).

D. (Zonodigonophyllum) VOLLBRECHT, 1926 [**Z. primum;* SD LANG-S.-T., 1940]. Minor septa represented by rare crests only; major septa typically continuous plates, septa withdrawn from axis; rejuvenescent cones of septal thickening marked (52). *L.M.Dev.*, Ger.——FIG. 217,*2*. **D. (Z.) primum; 2a-h,* series of transv. secs. showing growth changes, ×1 (133).

D. (Hemicystiphyllum) WEDEKIND, 1925 [**H. frechi*]. Minor septa commonly continuous; major septa in adult stage withdrawn from tabularium or represented there by crests (52). *U.M.Dev.*, Ger.——FIG. 217,*3*. **D. (H.) frechi; 3a-c,* transv. secs., ×2 (137).

D. (Mochlophyllum) WEDEKIND, 1923 [**Actinocystis maximus* SCHLÜTER, 1882 (=*Mesophyllum maximum* SCHLÜTER, 1889] [=*Pseudocosmophyllum* WEDEKIND & VOLLBRECHT, 1931]. Exceptionally large; major and minor septa continuous plates except near periphery where they are replaced by separate crossbar carinae; lateral dissepiments line septa; septal ends in tabularium dilated, unequal, not straight, shorter ones impinging on longer; one counter minor septum very long, extending into tabularium; keyhole fossula may be obscured (52). *U.M.Dev.*, Ger.-Austral.——FIG. 218,*1c*. **D. (M.) maximum* (SCHLÜTER), Ger.; transv. sec., ×0.25 (133).——FIG. 218,*1a,b*. *D. (M.) geigeri* WDKD. & VOLLBRECHT (type species of *Pseudocosmophyllum*), Ger.; *1a,b,* transv. and long. secs., ×1 (138).

D. (Enteleiophyllum) WALTHER, 1928 [**E. sundwigense;* SD LANG-S.-T., 1940]. Septa continuous plates except near periphery, with slight dilatation, without crossbar carinae; major septa unequal, not straight in tabularium rarely leaving a rounded axial space at inner end of the fossula (52). *U.M.Dev.*, Ger.——FIG. 218,*2*. **D. (E.) sundwigense;* transv. sec., ×1 (135).

D. (Uralophyllum) SOSHKINA, 1936 [**U. unicum*]. Like *D. (Mochlophyllum)* but with septa dilated only in tabularium, and thread-thin in the inner parts of dissepimentarium (52). *U.M.Dev.*, USSR. ——FIG. 218,*3*. **D. (U.) unicum,* Urals; *3a,b,* transv. and long. secs., ×1 (122).

Mesophyllum SCHLÜTER, 1889 [*non* HAHN, 1911] [**M. defectum* SCHLÜTER, 1889 (=*Actinocystis defecta* SCHLÜTER, 1882); SD WDKD., 1925]. Septa represented in dissepimentarium or throughout by septal crests, by separate yardarm carinae, or by rare traces, especially the minor septa; commonly one counter minor septum very long; keyhole fossula characteristic (22). *M.Dev.*, Eu.-Asia-Austral.

M. (Mesophyllum). Septa withdrawn from axis, leaving an axial space, pear-shaped in transverse section, with cardinal fossula at the edge of tabularium; septa unthickened, represented peripherally by discrete yardarm carinae and axially by narrow laminar segments (22). *U.M.Dev.*, Ger.-Austral.-Asia.—FIG. 219,*5*. **M. (M.) defectum* (SCHLÜTER), Ger.; transv. sec., ×2 (137).

M. (Dialytophyllum) AMANSHAUSER in WEDEKIND, 1925 [**D. complicatum*] [=*Bothriophyllum* VOLLBRECHT, 1926]. Like *M. (Mesophyllum)* but with major septa dilated, continuous but partly replaced by lateral dissepiments, and without discrete yardarm carinae peripherally (22). *U.M. Dev.*, Ger.-Austral.——FIG. 219,*4*. **M. (D.) complicatum,* Ger.; transv. sec., ×1 (137).

M. (Hemicosmophyllum) WEDEKIND & VOLLBRECHT, 1931 [**H. limbatum*]. Like *M. (Mesophyllum)* but septa may be dilated in inner parts of dissepimentarium, major septa proceeding as continuous dilated vertical plates to axis, with shorter ones impinging on longer, keyhole fossula obscure (52). Lowermost *U.M.Dev.*, Ger. ——FIG. 219,*3*. **M. (H.) limbatum; 3a-c,* transv. secs., ×1 (138).

M. (Lekanophyllum) WEDEKIND, 1923 [**L. punctatum;* SD LANG-S.-T., 1940] [=*Lecanophyllum* LANG-S.-T., 1940]. Like *M. (Mesophyllum)* but with septa represented in young stages by sparse monacanthine trabeculae and in adult by more or less continuous, moderately thick plates (52). Lowermost *U.M.Dev.*, Ger.——FIG. 219,*2a-c*. **M. (L.) punctatum; 2a-c,* ×2 (54).

M. (Arcophyllum) MARKOV, 1926 [**A. typus*] [=*Cosmophyllum* VOLLBRECHT, 1922 (*non* BLANCHARD, 1851)]. Like *M. (Mesophyllum)* but with greater continuity in septa in inner parts of dissepimentarium (52). *U.M.Dev.*, Eu.——FIG. 219,*1*. **M. (A.) typus,* Ger.; enlarged (133).

M. (Atelophyllum) WEDEKIND, 1925 [**A. emsti*]. Like *M. (Arcophyllum)* but with peripheral discrete crossbar carinae rare or absent (52). *U.M. Dev.*, Eu.-Asia.——FIG. 218,*4a,b*. **M. (A.) emsti, 4a,b,* ×1 (137).

M. (Cystiphylloides) CHAPMAN, 1893 [**Cystiphyllum aggregatum* BILLINGS, 1859] [=*Cystiphylloides* YOH, 1937; ?*Cystiplasma* TAYLOR, 1951]. Solitary or weakly aggregate, with septa represented only by radiating striae in calice (52). *U.M.Dev.*, Eu.-N.Am.-Asia.——FIG. 219,6. **M. (C.) aggregatum* (BILL.), Can.; ×1 (BILLINGS).

RUGOSA Incertae Sedis

Akiyosiphyllum YABE & SUGIYAMA, 1942 [**A. stylo-*

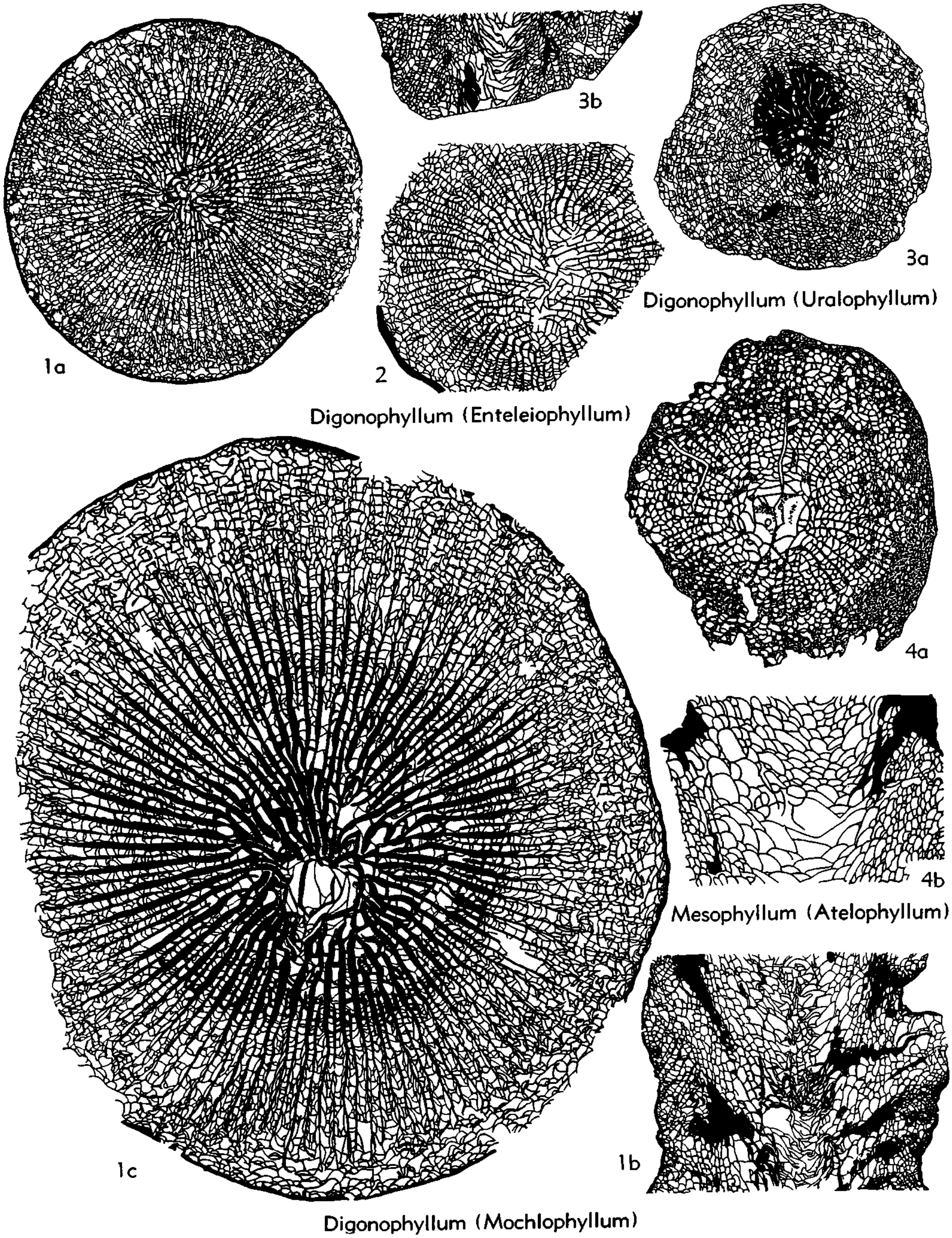

FIG. 218. Cystiphyllina: Digonophyllidae (p. F318).

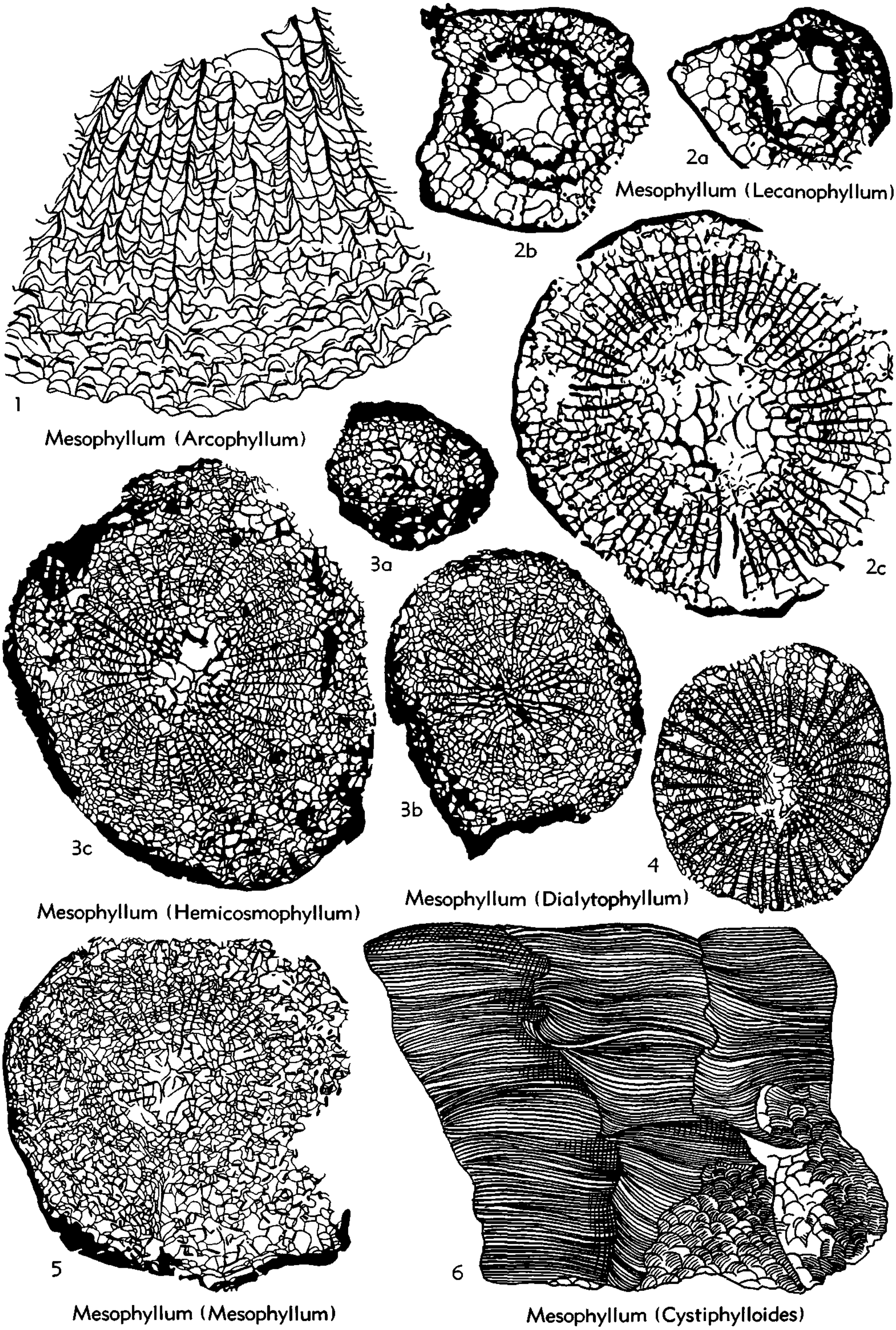

FIG. 219. Cystiphyllina: Digonophyllidae (p. F318-F319) (For *Lecanophyllum* read *Lekanophyllum*).

phorum]. *Perm.*, Japan [not seen].
Astraeophyllum NICHOLSON & HINDE, 1874 [**A. gracile*]. *Sil.*, Can. [types missing].
Axinura CASTELNAU, 1843 [**A. canadensis*]. Drift, *ex Dev.*, N.Am. [holotype lost (=*?Eridophyllum*)].
Barbouria LANG-S.-T., 1940 [*pro Craterophyllum* BARBOUR, 1911; *non* FOERSTE, 1909; *nec* TOLMACHEV, 1931] [**Craterophyllum verticillatum* BARBOUR, 1911]. *Penn.*, Nebr.
Brochiphyllum WEDEKIND, 1923 [*genus caelebs*]. *M.Dev.*, Ger.
Campsactis RAFINESQUE & CLIFFORD, 1820 [**C. canaliculata;* SD LANG-S.-T., 1940]. *Dev.*, Ky. [types lost].
Chusenophyllum TSENG, 1948 [**C. palonoidea*]. *Perm.*, China [not seen].
Cyathaxonella STUCKENBERG, 1895 [**C. gracilis*]. *L.Carb.*, USSR [?Cyathaxoniidae or ?Timorphyllidae].
Cystostylus WHITFIELD, 1880 [**C. typicus*] [=*Cystistylus* LANG-S.-T., 1940 *(nom. van.)*]. *M. Sil.*, USA.
Duncania DE KONINCK, 1872 [**D. simplex*]. *L. Carb.*, Belg.
Edaphophyllum SIMPSON, 1900 [**Cystiphyllum bipartitum* HALL, 1882]. *L.Dev.(Onond.)*, N.Am. [cf. *Coleophyllum;* types lost].
Elasmophyllum HALL, 1882 [**E. attenuatum*]. *L. Dev.(Onond.)*, N.Am. [types lost].
Exostega RAFINESQUE & CLIFFORD, 1820 [**E. tecta;* SD LANG-S.-T., 1940]. *Dev.*, Ky. [types lost].
Gangamophyllum GORSKY, 1938 [**G. boreale*]. *Carb.*, N.Zem.
Huangophyllum TSENG, 1948 [**H. symmetricum*]. *Perm.*, China [not seen].
Kenophyllum DYBOWSKI, 1873 [**K. subcylindricum*] [=*Cenophyllum* RYE, 1875]. *Ord.* (Z_2), Est.
Omphyma RAFINESQUE & CLIFFORD, 1820 [**O. verrucosum*]. *?Miss.*, Ky. [types lost].
Peripaedium EHRENBERG, 1834 [**Cyathophyllum turbinatum* GOLDF., 1826]. M.Dev., Ger.
Polydilasma HALL, 1851 [**P. turbinatum*] [=*Polydiselasma* LANG-S.-T., 1940 *(nom. van.)*]. *M.Sil.*, N.Y. [types missing].
?Prisciturben KUNTH, 1870 [**P. densitextum*]. *Sil.*, Swed. (*See* p. F133.)
Pterorrhiza EHRENBERG, 1834 [**Cyathophyllum marginatum* GOLDF., 1826; SD LANG-S.-T., 1940]. *M.Dev.*, Ger. [type missing].
Rhipidophyllum SANDBERGER, 1889 [**R. vulgare*]. *L.Dev.*, Ger. [not seen].
Sphaerophyllum WEDEKIND, 1923 [*genus caelebs*]. *L.M.Dev.*, Ger.
Stegophyllum SCHEFFEN, 1933 [**S densum*]. *U. Ord.*, Norway.
Sugiyamaella YABE & MINATO, 1944 [**S. carbonarium*]. *Perm.*, Japan [not seen].

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HETEROCORALLIA

By Dorothy Hill

MORPHOLOGY

The heterocorals are a small, short-lived (Carboniferous) order of very elongate solitary corals. They possess **septa** (longitudinal radial plates) and **tabulae** (transverse plates) but may lack an external sheath (**epitheca**) and their narrow wall is formed by thickening and apposition of the steeply sloping edges of their tabulae. The method of insertion of their septa is characteristic. Material so far collected consists of fragments only, which show little change in diameter from one end to another. There are but rare indications of branching and the corallites may be slightly twisted, or may show sudden changes in direction of growth.

The skeleton is a framework of radial longitudinal and transverse skeletal elements; each consisting of fibers of $CaCO_3$ at right angles to the growth lamellation, which is weakly apparent. An external sheath or epitheca is absent, according to Schindewolf (41), but Hill (18) thought it to be present in one species (*Heterophyllia phillipsi*).

The only radial skeletal elements are the septa, plates in which the fibers are arranged approximately at right angles to the median plane. The outer edges of septa typically project, so that the corallum is fluted rather than cylindrical, and they may have a linear series of denticulations which may be hooked. The inner edges of septa are scarcely anywhere free, but each typically abuts on to another septum, the abutted septum commonly diverging outwardly from its radial course at the point of contratingency, so as to give an appearance of forking. This attachment of inner edges of the septa is one of the distinctive features of the order. The septa are flexuous, and serial sections show that the roles of apparent abutter and abutted may be interchangeable.

Owing to the fragmentary nature of the material, and the very slow change in diameter with consequently slow rate of appear-

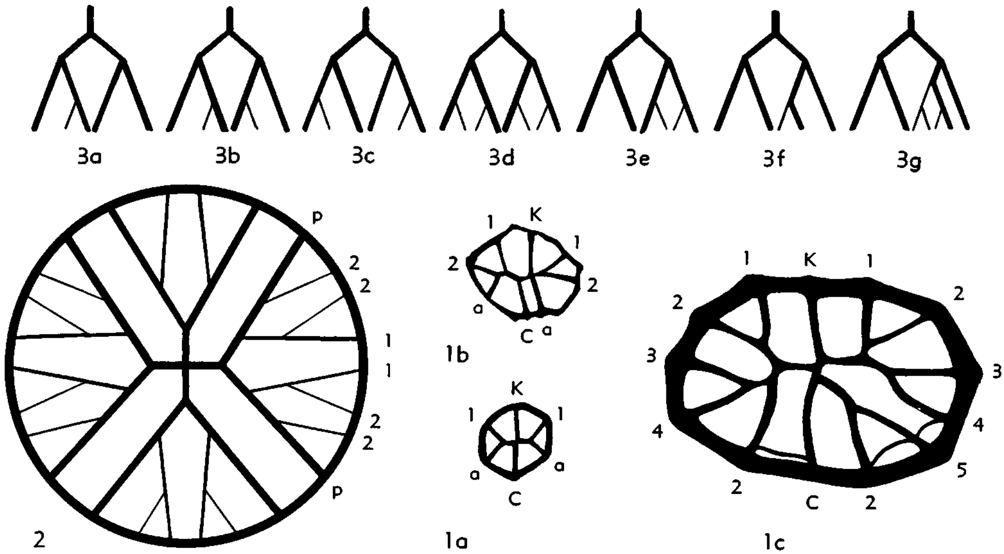

FIG. 220. Arrangement of septa in Heterocorallia. *1*, Development of septa in *Heterophyllia kitakamiensis* YABE & SUGIYAMA, L.Carb., Japan, shown by transverse sections of juvenile part of corallite *(1a,b)* and ephebic part *(1c)*, ×15; C, cardinal septum; K, counter septum; a, accessory (alar) septa; p, protoseptum; 1-5, metasepta in order of appearance (140). *2*, Diagram of septal arrangement in *Heterophyllia;* p, protoseptum; 1, 2, metasepta in order of appearance (113). *3*, Diagrams showing insertion of 2nd-order metasepta (light-weight lines) in a quadrant as illustrated by various heterocorals, heavy lines indicating protosepta and 1st-order metasepta; the ideal regular plan *(3d)* is commonly not realized (113).

ance of new septa, the **insertion of septa** has been the subject of deductive rather than inductive studies. Thus, YABE & SUGIYAMA (1940) consider that 6 protosepta were present, as in Rugosa and Scleractinia, and that new septa (metasepta) were thereafter pinnately inserted, as in Rugosa, not cyclically as in Scleractinia, but that this pinnate insertion occurred only in 2 positions, as against 4 positions in Rugosa (Fig. 220,*1a-c*).

SCHINDEWOLF (1941), however, included in his studies serial sections from fragmentary coralla, and his strikingly different conclusions may be outlined as follows. There are 4 original septa **(protosepta)**. Each of these may split into 2 near the periphery; new septa are inserted only in the 4 spaces formed between the 2 split portions of each such septum, thus in "quadrants," and do not arise in the original 4 spaces ("fossulae") between the protosepta (Fig. 220,*2*). Of these 4 insertion spaces, 2 opposing ones, regarded as lateral, show far more newly formed septa than the remaining 2, of which one, the "upper" (oriented in SCHINDEWOLF's drawings in the position he usually assigns to the cardinal septum) is more backward than the other. The new septa develop in groups of 8 irregularly, appearing neither pinnately nor cyclically, the various possible arrangements being as indicated in Fig. 220,*3*. There may be 16 in the group derived from "splitting" of each lateral septum, as against 2 from the cardinal, and 4 from the counter septum. In SCHINDEWOLF's view, the new septa are inserted in the original endocoeles, leaving the original 4 exocoeles undivided.

The only transverse skeletal elements are **tabulae.** These are domed (or in SCHINDEWOLF's opinion saucered) floors with steeply sloping edges. Each is formed of fibrous $CaCO_3$, the fibers growing on one surface only, which in HILL's view is the upper surface. Each floor consists of a series of segments developed in the loculi between septa, the segments being discontinuous through the septa, but on the same level in neighboring loculi. Each segment is curved both from axis of corallite to periphery, and from one septum to its neighbor. In HILL's view, the latter curve is concave on the growing side, as in similar tabulae or dissepimental segments in Rugosa; but according to inter-

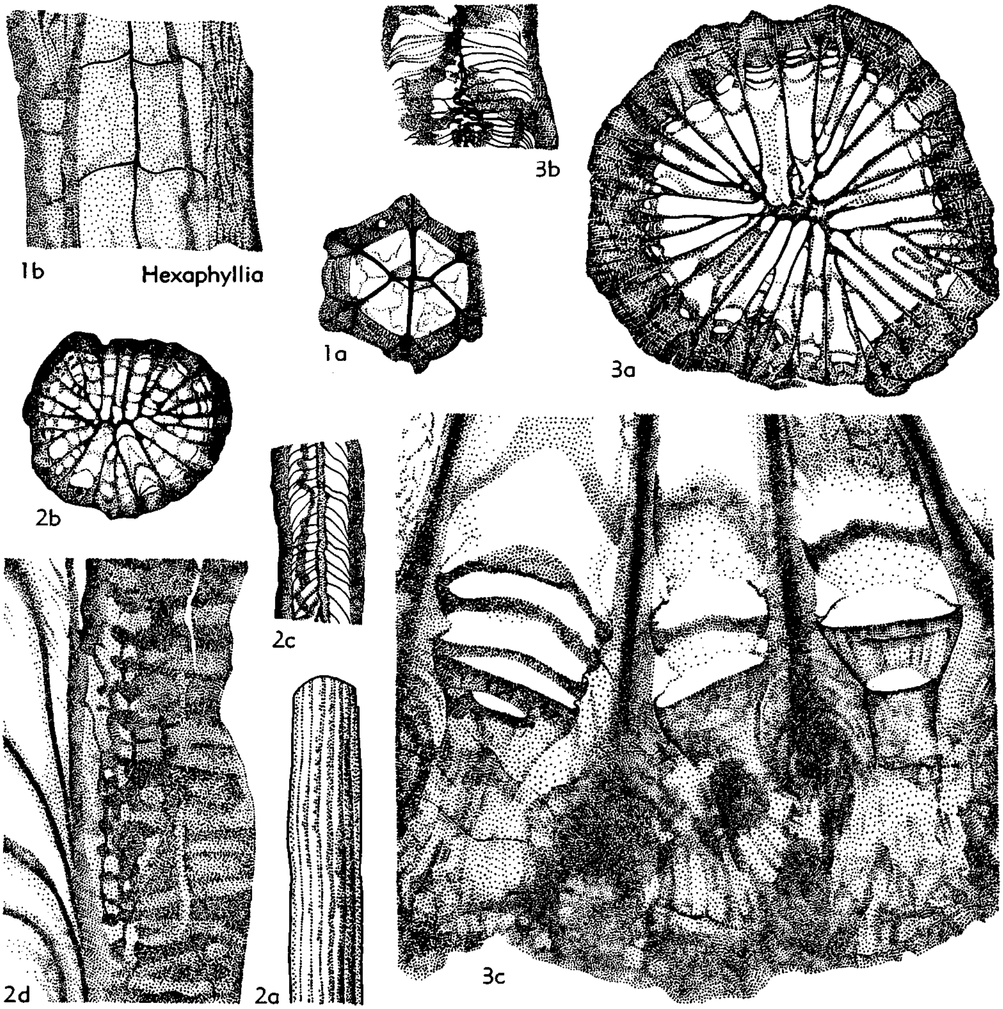

FIG. 221. Heterophylliidae (p. F327).

pretation of the tabulae as saucered, not domed, the curve from septum to septum is domed, not saucered, and is thus the opposite of the condition in all other corals. Scattered incomplete tabulae developed in one or only a few interseptal loculi indicate by their manner of adhesion that the tabulae are domes, not saucers.

In their steeply sloping edges, the tabulae, thickened by outward growth of their fibers, are in contact in a zone of dense tissue; the septa also become thickened at their peripheral edges in this zone, and the combined result is a **stereozone,** called "heterotheca" by SCHINDEWOLF. In this stereozone, trabeculae may develop from the tendency for fibers to grow grouped about straight or curved axes perpendicular to the outer surface of the corallum. This is the only type of marginal zone developed in the Heterocorallia; dissepiments are observed nowhere (Fig. 221,*3*).

CLASSIFICATION

The classification of the Heterocorallia as Zoantharia seems justified by their possession of septa and tabulae of fibrous $CaCO_3$; but the grouping, contratingency, and flexuousness of the septa, and their manner of septal insertion as known at present, clearly distinguishes them from Tabulata, Rugosa, and Scleractinia. They consist of one small family only, divisible into 2 genera.

DISTRIBUTION

Their stratigraphic distribution is limited, both in time and space, for they are known only in the Visean and Namurian divisions of the Carboniferous system in Europe and Asia. At most localities, both genera occur together, and in view of the fragmentary nature of the material, KUNTH's suggestion that the more primitive genus, *Hexaphyllia,* may be merely the young stage of *Heterophyllia,* is not unreasonable. Because of their fragmentary nature, also, we have direct knowledge only of later parts of their ontogeny. It is not possible at present to indicate ancestry for the order, which seems to have left no descendants in post-Namurian time.

They are found in calcareous shales and in pure limestones, and SCHINDEWOLF (41) suggests that their elongate nature, and the hooks on outer septal edges of some, indicate a pseudo-planktonic existence attached to seaweeds.

SYSTEMATIC DESCRIPTIONS

Order HETEROCORALLIA Schindewolf, 1941

[as suborder; =Dicoelia YABE & SUGIYAMA, 1940 (subdivision of Tetracoralla)]

Elongate coralla originally with 4 septa conjoined axially and with new septa formed in attachment to these so that the 4 original interseptal loculi remain undivided; marginarium a narrow trabeculate stereozone; tabulae complete, domes with steeply sloping to vertical edges. *Carb.*

Family HETEROPHYLLIIDAE Dybowski, 1873

[*nom. transl.* HILL, 1940 (*ex* Heterophyllinae DYBOWSKI, 1873); Heterophyllidae YABE & SUGIYAMA, 1940]

Hexaphyllia STUCKENBERG, 1904 [**H. prismatica*]. Slender, with only 6 septa (41). *Carb.(Visé.-Namur.)* Eu.-Asia.——FIG. 221,*1*. *H. mirabilis* (DUNCAN), Eu.; *1a,b,* transv. and long. secs., ×10 (113).

Heterophyllia M'COY, 1849 [*non* D'ORBIGNY, 1849] [**H. grandis;* SD M.EDW.-H., 1850]. With numerous septa. *Carb.(Visé.-Namur.),* Eu.-Asia.

H. (Heterophyllia). With all 4 original interseptal loculi separated by new septa (41). *Carb.(Visé.-Namur.),* Eu.-Asia.——FIG. 221,*3*. **H. (H.) grandis* (M'COY), Eu.; *3a,c,* transv. secs., ×4, ×20; *3b,* long. sec., ×2 (113).

H. (Heterophylloides) SCHINDEWOLF, 1941 [**H. (H.) reducta*]. With 2 of the original interseptal loculi not separated by new septa or separated by but one new septum (41). *Carb.(Visé.-Namur.),* Eu.——FIG. 221,*2*. **H. (H.) reducta; 2a,* exterior of corallite, ×1.5; *2b,* transv. sec., ×4; *2c,d,* long. secs., ×2, ×20 (113).

REFERENCES AND SOURCES OF ILLUSTRATIONS

See preceding section on Rugosa (p. F321, F323)