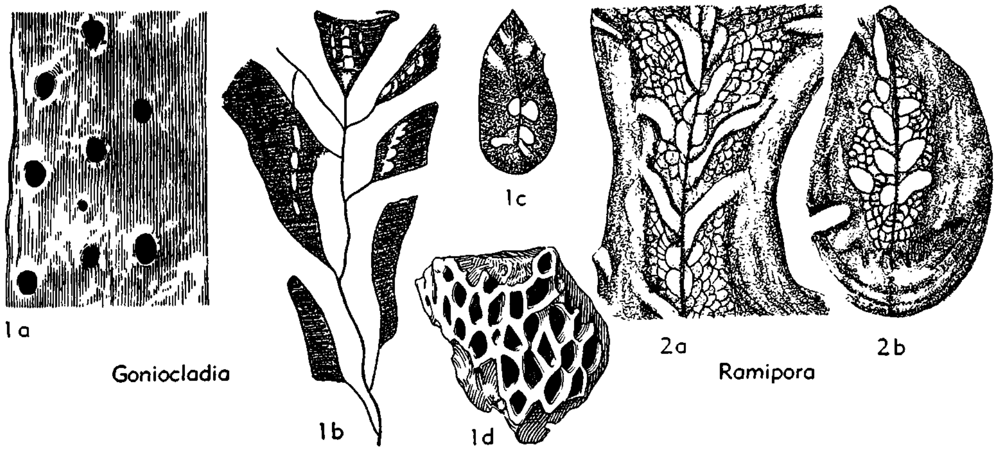

FIG. 54. Goniocladiidae (p. G89, G90).

the branch and projects as a keel on the front and a flat area on the back; fenestrules polygonal. *Miss.-Perm.*——FIG. 54,*1*. **G. cellulifera* (ETH.), Perm., Eng.; *1a,* surface, ×20; *1b,* long. sec., ×20; *1c,* transv. sec., ×10; *1d,* zoarium, ×1 (131).

Ramipora TOULA, 1875 [**R. hochstetteri*]. Like *Goniocladia* but zoarium dendroid, branches extended or short, ending bluntly. *Carb.-Permocarb.,* Spitz.

R. (Ramipora) Irregularly pinnate zoaria.

R. (Ramiporidra) NIKIF., 1938. *Permocarb.*——FIG. 54,*2*. **R. (R.) uralica* (STUCK.), *Permocarb.,* Russ.; *2a,b,* secs., ×10 (198).

R. (Ramiporalia) SHULGA, 1933 [**Ramiporalia dichotoma*]. *Carb.,* Russ.

R. (Aetomacladia) BRETNALL, 1926 [**A. ambrosioides*]. Zooecia in 3 or 4 rows on each side of mesotheca. *Carb.,* Austral.

R. (Ramiporella) SHULGA, 1933 [**Ramiporella asymmetrica*]. *Carb.,* Russ.

Volgia STUCK., 1905 [**Coscinium arborescens*] [=*Ramiporina* SHULGA, 1933]. Zoarium arborescent composed of primary branches giving off secondary branches in verticels and these bearing branches of third order. *Perm.,* Russ.

Order TREPOSTOMATA Ulrich, 1882

[=Stenolaemata BORG, 1926 *(partim)*]

Zoaria mostly massive, lamellate, or stemlike, comprising typical so-called stony bryozoans. Zooecia consist of long calcareous tubes, generally intersected by many partitions (diaphragms), each tube being divisible into an immature region in the axial part of the zoarium characterized by thin walls, wide spacing of diaphragms, and contact with other zooecia on all sides, and a mature region near the zoarial surface characterized by thickened walls, close spacing of diaphragms, and intervention of special cells (mesopores, acanthopores) between zooecia. Monticules or maculae, comprising regularly spaced clusters of cells smaller or larger than average, commonly well defined on zoarial surface (1,5,6,7,8). *Ord.-Perm., ?Trias.*

MORPHOLOGICAL FEATURES

This order seemingly is limited to the Paleozoic era, when it flourished in an abundance of species forming stony colonies and even coral-like reefs which contributed largely to the building of many formations. These colonies are invariably calcareous, consisting generally of solid masses which may attain considerable size (diameter and thickness exceeding 50 cm.), or branching growths composed of long, coherent, prismatic, or cylindrical tubes with terminal apertures. Each tube is composed of an inner axial **(immature)** region and an outer, peripheral **(mature)** region. This change in the character of the tubes, which is basis for the name of the order (*trepos,* change), is accompanied by development in the mature zone of additional features known as mesopores, acanthopores, cystiphragms, hemiphragms, and heterophragms, as well as more numerous diaphragms.

The Trepostomata include the greater portion of the so-called monticuliporoids, which for a long time were regarded as corals described mainly as species of *Chaetetes* or *Monticulipora*. MILNE-EDWARDS & HAIME regarded them as anthozoan corals, whereas NICHOLSON assigned them to the Octocoralla because the "corallites" seem to agree with those of *Heliolites* in microscopic structure and supposed increase by intermural gemmation or fission. Their bryozoan nature was long insisted on by ULRICH, who in establishing the order published many proofs of their affinities with undoubted Bryozoa. This relationship was confirmed by CUMINGS (6), who discovered that the budding plan of at least 6 Ordovician trepostome genera was precisely the same as in typical Recent bryozoans; that is, the free-swimming larva upon becoming sedentary gave rise to (1) the **protoecium,** an attached circular disc, followed by (2) the **ancestrula,** a tubular zooid seen also in the Cyclostomata and other orders, and then (3) several **primary individuals** developed by budding from the ancestrula. These primitive structures are separated from the rest of the colony by a considerable thickening of their posterior walls. Among corals, development from the larva is direct the moment it becomes sedentary, and therefore the presence of the protoecium alone is practically conclusive as to the systematic position of the Trepostomata as bryozoans.

Some trepostomes are incrusting and consist of one or many superposed layers, but most either build ramose twiglike stems, flat or undulating fronds, thin bifoliate expansions, or hemispherical to rounded masses as much as 2 feet (60 cm.) in diameter. Such massive zoaria arise from the manner in which the trepostome zooecia **(autopores)** develop directly superposed on one another so as to form long tubes by continued terminal budding of the same zooid or repeated addition of new zooids in positions of old ones. The tubes are intersected by straight or nearly straight partitions **(diaphragms)** or strongly curved ones **(cystiphragms, heterophragms)**, which seemingly represent the covers and floors of successive zooecial layers. The diaphragms may be incomplete **(semidiaphragms, hemiphragms)** or provided with a central opening **(perforate diaphragms).** Generally few or wanting in the immature zone, they become numerous and commonly crowded in the outer mature zone, where also the zooecia of many genera are separated by more or less closely tabulated slender angular tubes **(mesopores)** and spiniform tubules **(acanthopores).** Zooecial covers with a small subcentral opening may occur. The hemiphragms are diaphragms covering only half the zooecial diameter; heterophragms are small cystlike semidiaphragms of laminated tissue continuous with the walls.

One characteristic of the Trepostomata, shared with Cryptostomata and some Cyclostomata (Fistuliporidae), is the presence at regular intervals over the zoarial surface of elevated clusters of cells **(monticules),** that differ in size from the average, or flat to gently depressed areas **(maculae)** of such cells. The size, shape, elevation, and distance apart of the monticules or maculae are usually specific characters. Monticules vary from small sharp tubercles through rounded nodes to elevated rings completely encircling slender branches. The maculae are inconspicuous in some zoaria but prominent in others; in one family (Constellariidae), they form distinctive star-shaped regions. The significance of monticules and maculae is unknown.

The spinelike projections on the zoarial surface formed by acanthopores are visible in thin sections as slender tubules included in the wall substance, but with a definite cone-in-cone structure of their own, pierced by a minute central opening which may be interrupted by crowded transverse diaphragms. The acanthopores commonly traverse the mature region and undoubtedly represent zooids with some definite function, possibly like the avicularia or vibracula of the Cheilostomata; **megacanthopores** and **micracanthopores** are large and small forms of acanthopores which are well developed in definite positions in some trepostomes, as in the cryptostomes.

For many years, identification of the Trepostomata was based on external features such as zoarial form, size and shape of zooecial apertures, and surface characters of tubercles or maculae. This led to so much confusion that members of the order were considered to have little value in identifying stratigraphic horizons. Experience has shown that the internal structure of these bryozoans gives the true specific characters, and so the preparation of thin sections for study under the microscope becomes indispensable in their study. When a species once has been thoroughly studied in this manner, so as to correlate internal and external characters, generally it can be identified without preparation of thin sections. Etching smoothed surfaces with acid brings out structural details quite clearly under a hand lens.

CLASSIFICATION

Two main divisions of the Trepostomata are defined by minute structure of the walls between adjoining zooids (1). Among the 10 famiiles now recognized in the order, 6 are composed of genera in which the calcareous substance of adjoining zooecial tubes is amalgamated together so that one wall cannot be distinguished from its neighbor (Amalgamata). In the other 4 families (Integrata), the walls retain their identity, so that where the zooecia adjoin, their boundaries are marked by a dark line representing probably remains of animal matter which filled this space during life of the organisms. The narrow area may be occupied by light-colored tissue, in which case the outer boundaries of the wall of each zooecium can be seen clearly. In certain

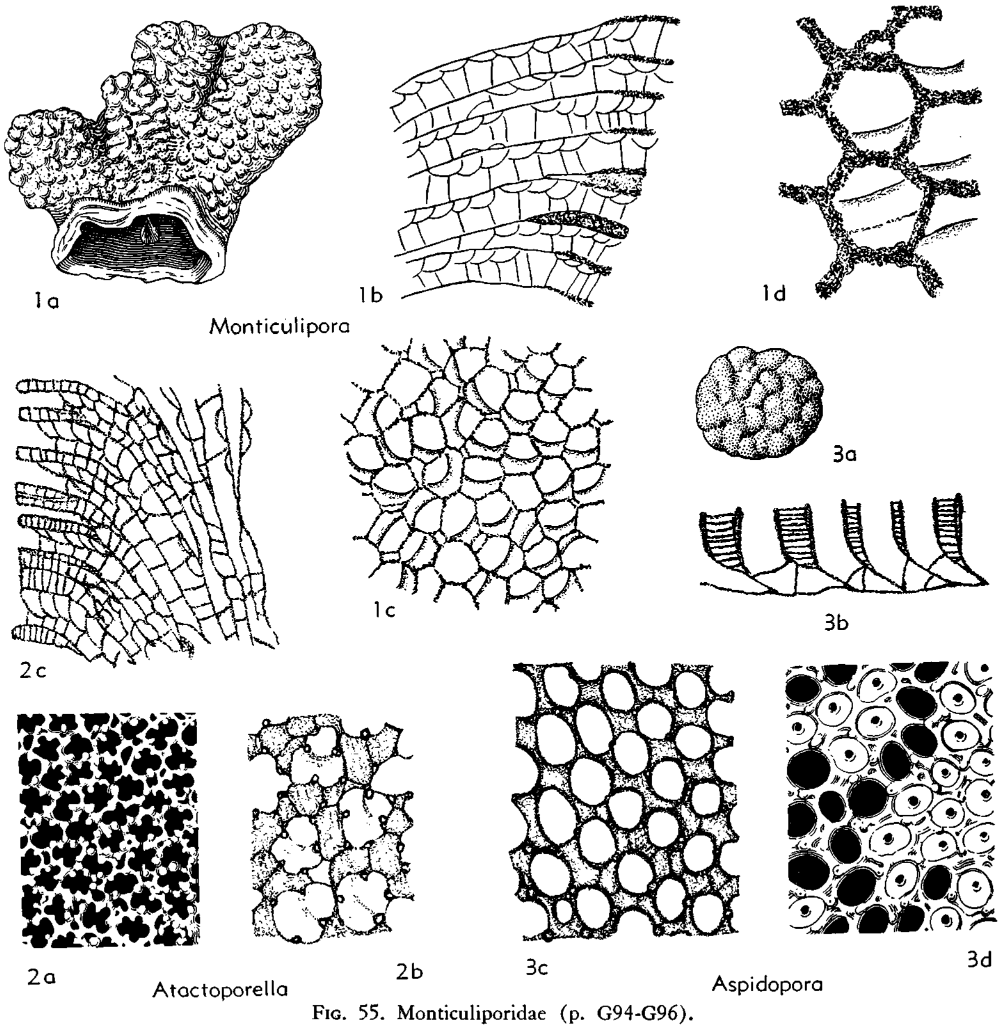

Fig. 55. Monticuliporidae (p. G94-G96).

genera, the amalgamation or distinctness of the walls is difficult to determine, especially if mesopores are numerous. Compared with most other orders, the Trepostomata seem to be poorly represented in described genera and species, but it should be pointed out that many areas and formations known to contain these fossils remain for study. Even such classic regions as the Trentonian of New York have received comparatively little attention for more than a century and abundant species in Blackriveran formations of the Appalachian Valley are largely undescribed.

Bryozoans of the post-Paleozoic suborder Cerioporina of the Cyclostomata, commonly known as the heteroporoids, so much resemble trepostomes exteriorly that they were classified erroneously as Trepostomata by J. W. Gregory in 1909. In consequence, Borg (9,11) included the Trepostomata with Cyclostomata under the new name Stenolaemata, ignoring the fact that highly characteristic features of the Cyclostomata, such as ovicell and wall structure with pseudopores, are totally absent in true Trepostomata. Species of so-called Trepostomata of Triassic age described by Vinassa (12) need restudy; probably they will prove to belong to the Cerioporina.

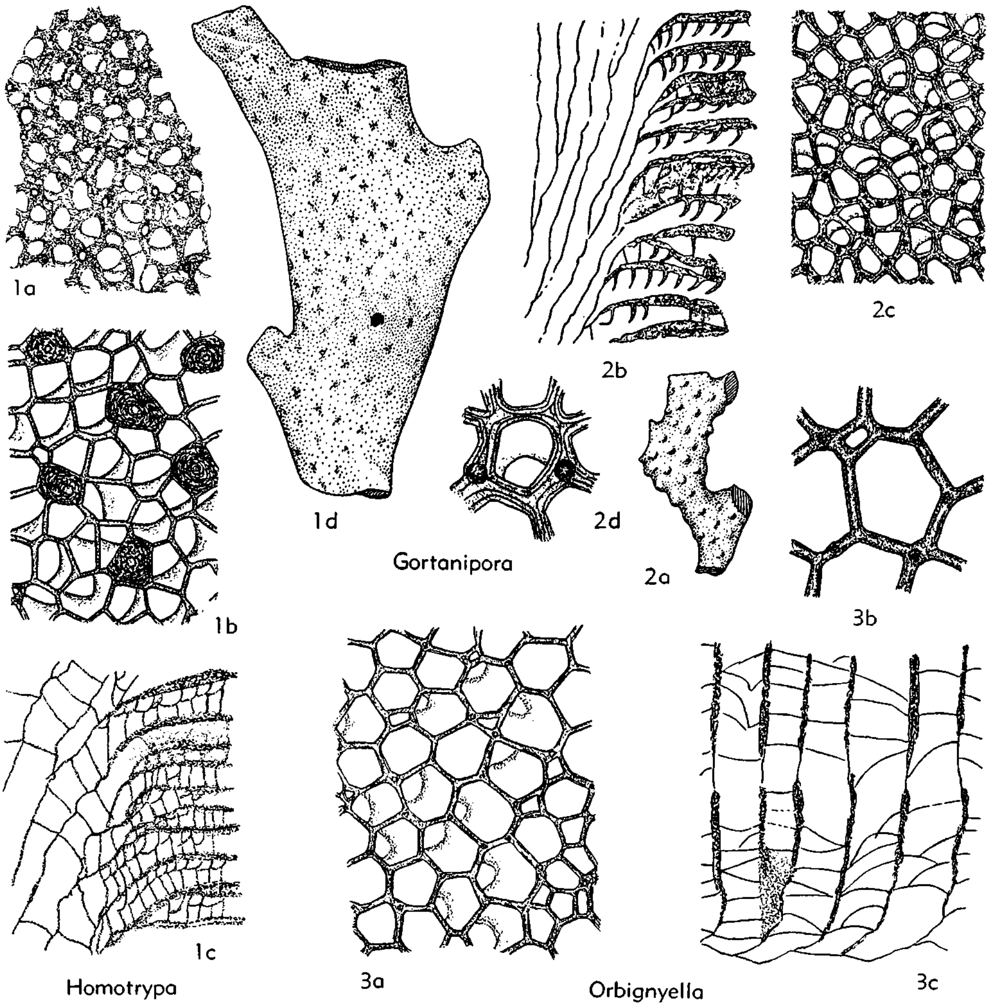

Fig. 56. Monticuliporidae (p. G96).

Suborder AMALGAMATA Ulrich & Bassler, 1904

Trepostomata with boundaries of adjacent zooecia obscured by more or less complete coalescence of their walls. *Ord.-Perm.*

Family MONTICULIPORIDAE Nicholson, 1881

[=Prasoporidae SIMPSON, 1897]

Zoarium incrusting, ramose, frondescent, bifoliate, or massive; generally with regularly spaced monticules. Zooecial tubes characterized by presence of incomplete curved partitions (cystiphragms) in addition to straight diaphragms; apertures polygonal. Acanthopores and angular mesopores with numerous diaphragms commonly present (3,112,115; NICKLES-B., 1900). *Ord.-Dev.*

Monticulipora D'ORB., 1850 [*nom. conserv.*, ICZN pend. (*non* D'ORB., 1849)]. [**M. mammulata* D'ORB., 1850] [=*Monticuliporella* BASSLER, 1935]. Typically massive, but also incrusting to fron-

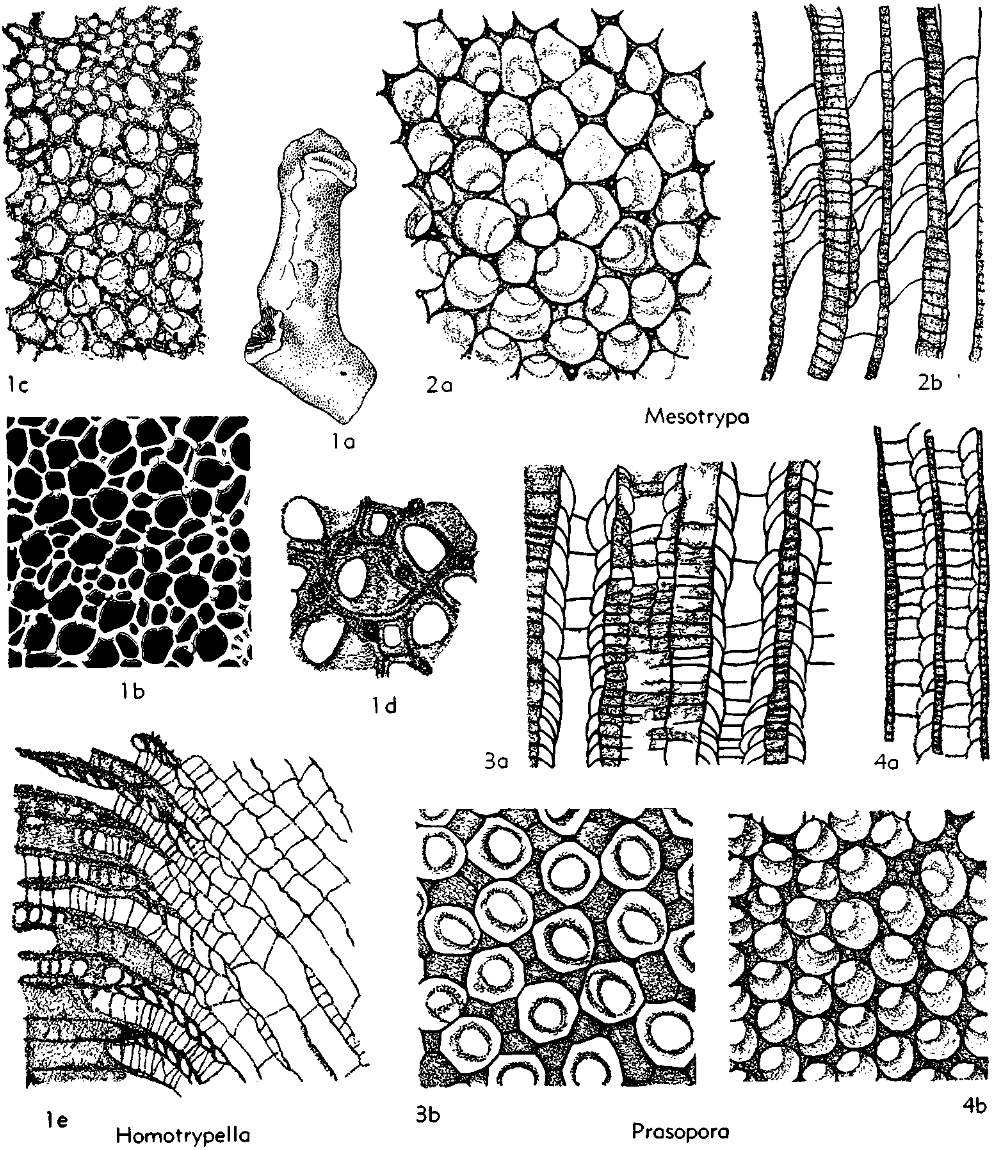

FIG. 57. Monticuliporidae (p. G96).

dose. Zooecia thin-walled, polygonal, with cystiphragms and diaphragms in both immature and mature regions. Small acanthopores with granulose walls common; mesopores few, with diaphragms. *Ord.*——FIG. 55,*1*. **M. mammulata,* Ord.(Maysv.), Ohio; *1a,* massive zoarium (chosen as type by M.EDW.-H., 1851), ×1; *1b,* long. sec., ×25; *1c,d,* tang. sec., ×25, ×50; (*1b-d* from frondose type described as *M. molesta* NICH., 1881, but figured as D'ORBIGNY's type of *M. mammulata* by BOULE, 1906) (*1a,* 131; *1b-d,* 223).

Aspidopora ULR., 1882 [**A. areolata* ULR., 1883]. Thin free epithecate expansions with few cystiphragms, small acanthopores, and closely tabulate large mesopores. *Ord.-Sil.*——FIG. 55,*3*. **A. areolata,* Ord.(Eden.), Ohio; *3a,* zoarium, ×1; *3b,c,* secs., ×20; *3d,* surface showing zooecial closures, ×20 (222).

Atactoporella ULR., 1883 [**A. typicalis*]. Incrusting, but also ramose to massive. Zooecia thin-walled, lined by cystiphragms and diaphragms, with apertures indented by so many small acanthopores as to become petaloid; large tabulate mesopores. *Ord.*——FIG. 55,*2*. **A. typicalis,* Ord.(Eden.),

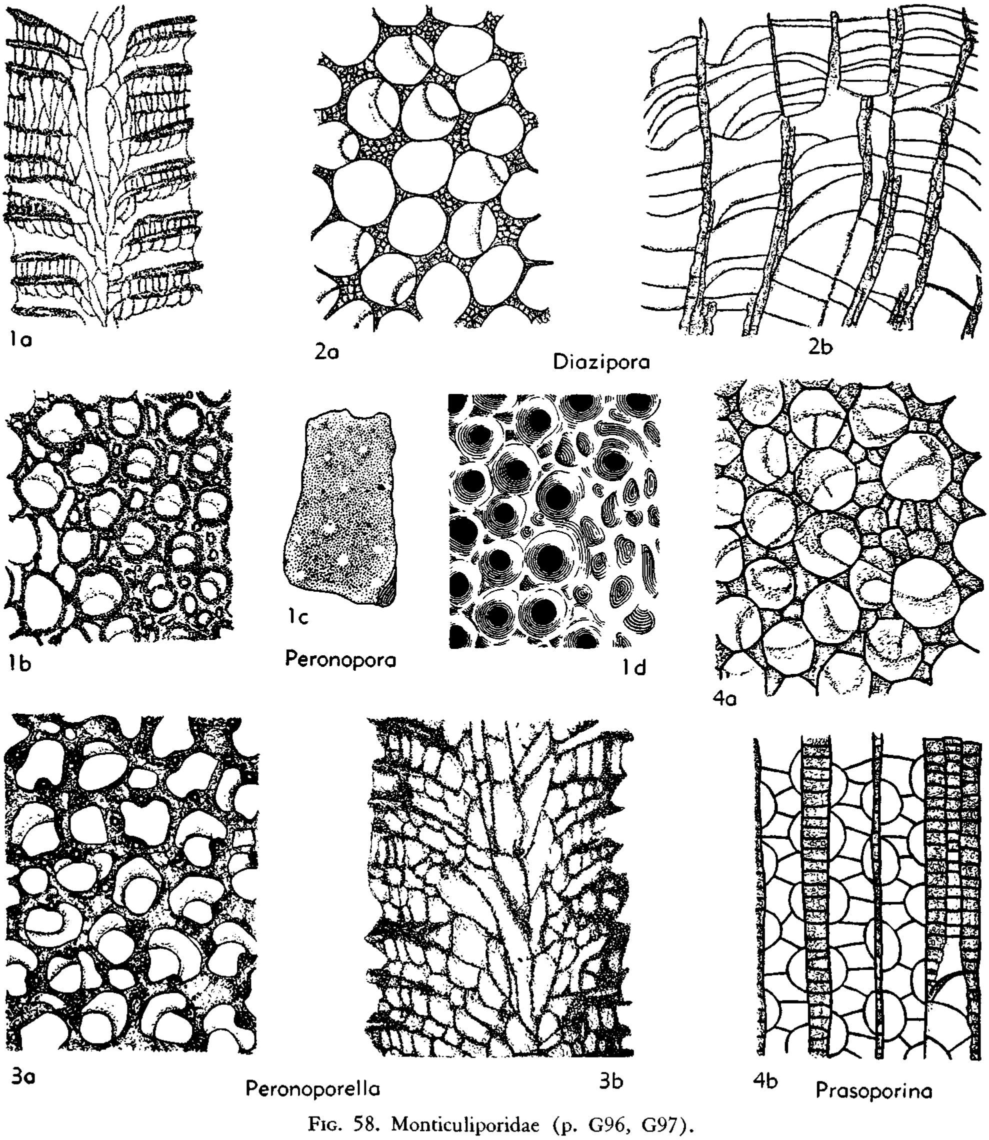

FIG. 58. Monticuliporidae (p. G96, G97).

Ky.; *2a,* surface, ×20; *2b,c,* tang. and long. secs., ×50, ×20 (222).

Diazipora VINASSA, 1920 [**Mesotrypa milleporacea* BASSLER, 1911]. Lamellate. Zooecia thin-walled, with many gently curved diaphragms; mesopores very minute, grouped, tabulate. *M.Ord.*——FIG. 58,*2*. **D. milleporacea* (BASSLER), M.Ord., Est.; *2a,b,* secs., ×20 (225).

Gortanipora VINASSA, 1920 [**Homotrypa bassleri* NICKLES, 1902] [=*Gorgantipora* BASSLER, 1935]. Like *Homotrypa* but with well-developed isolated cystiphragms, restricted to mature zone; diaphragms absent. *Ord.*——FIG. 56,*2*. **G. bassleri* (NICKLES), Richmond., Ohio; *2a,* zoarium, ×1; *2b,* long. sec., ×20; *2c,d,* tang. secs., ×20, ×50 (225).

Homotrypa ULR., 1882 [**H. curvata*] [=*Canavaripora, Cadornipora* VINASSA, 1920]. Frondescent to ramose. Cystiphragms with diaphragms restricted to mature zone; mesopores only in clusters. *Ord.-Sil.*——FIG. 56,*1*. **H. curvata,* Ord.(Maysv.), Ohio; *1a,b,* tang. secs., large acanthopores in *1b,* ×20, ×25; *1c,* long. sec., ×20; *1d,* zoarium, ×1 (222).

Homotrypella ULR., 1886 [**H. instabilis*]. Like *Homotrypa* but has numerous tabulate mesopores and cystiphragms in early part of zooecial mature zone. *Ord.*——FIG. 57,*1*. **H. instabilis,* Blkriv., Minn.; *1a,* zoarium, ×1; *1b,* surface, ×20; *1c,d,* tang. secs., ×20, ×50; *1e,* long. sec., ×20 (222).

Mesotrypa ULR., 1893 [**Diplotrypa infida* ULR., 1886]. Small discoidal or conical free masses with basal epitheca. Zooecia with obliquely curved diaphragms crowded in mature zone, with acanthopores and closely tabulate mesopores. *Ord.*——FIG. 57,*2*. **M. infida* (ULR.), Blkriv., Minn.; *2a,b,* tang. and long. secs., ×20 (222).

Orbignyella ULR.-B., 1904 [**O. sublamellosa*]. Lamellate. Zooecia angular, with sharply defined walls and curved diaphragms. Acanthopores well developed but mesopores lacking. *Ord.*——FIG. 56,*3*. **O. sublamellosa,* Blkriv., Tenn.; *3a,b,* tang. secs., ×25, ×50; *3c,* long. sec., ×25 (223).

Peronopora NICH., 1881 [**Chaetetes frondosus* NICH., 1874 (*non* D'ORB., 1854)(=*Chaetetes decipiens* ROM., 1866)]. Bifoliate convolute growth. *Ord.*——FIG. 58,*1*. **P. decipiens* (ROM.), Richmond., Ind.; *1a,b,* secs., ×20; *1c,* fragment, ×1; *1d,* surface, ×20 (222).

Peronoporella CUMINGS-G., 1913 [**P. dubia*]. Like *Homotrypella* but immature region very short. *Ord.*——FIG. 58,*3*. **P. dubia,* Richmond., Ind.; *3a,b,* secs., ×50 (144).

Prasopora NICH.-E., 1877 [**P. grayae*] [=*Prasoporella* VINASSA, 1920]. Free discoid to hemispherical masses. Zooecia lined by overlapping cystiphragms connected by diaphragms. Mesopores small, angular, closely tabulate. *Ord.*——FIG. 57,*3*. **P. grayae,*

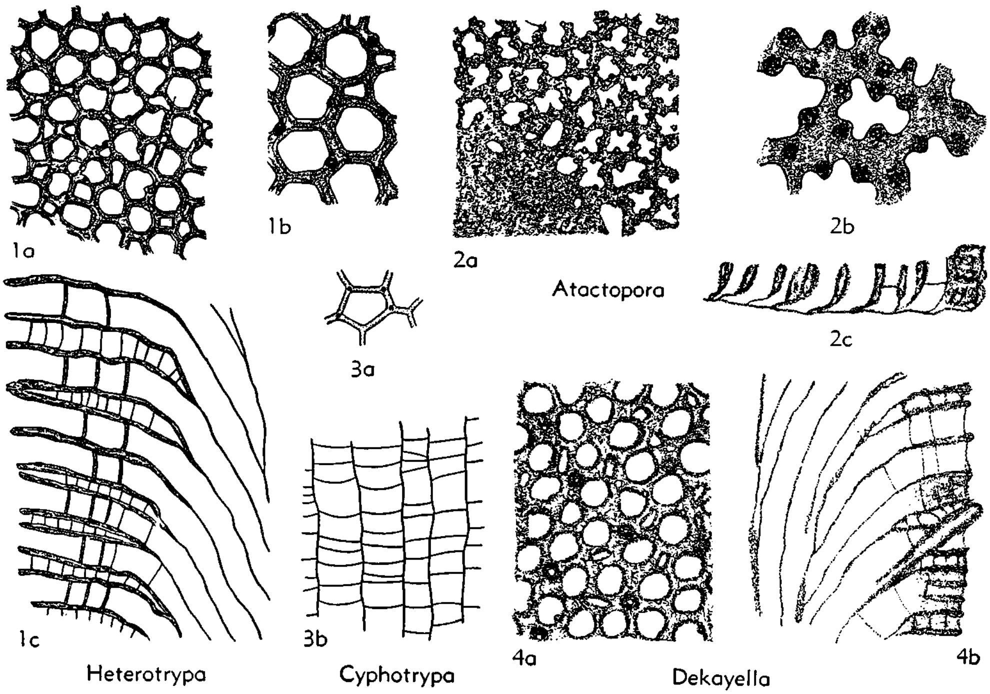

FIG. 59. Heterotrypidae (p. G97, G98).

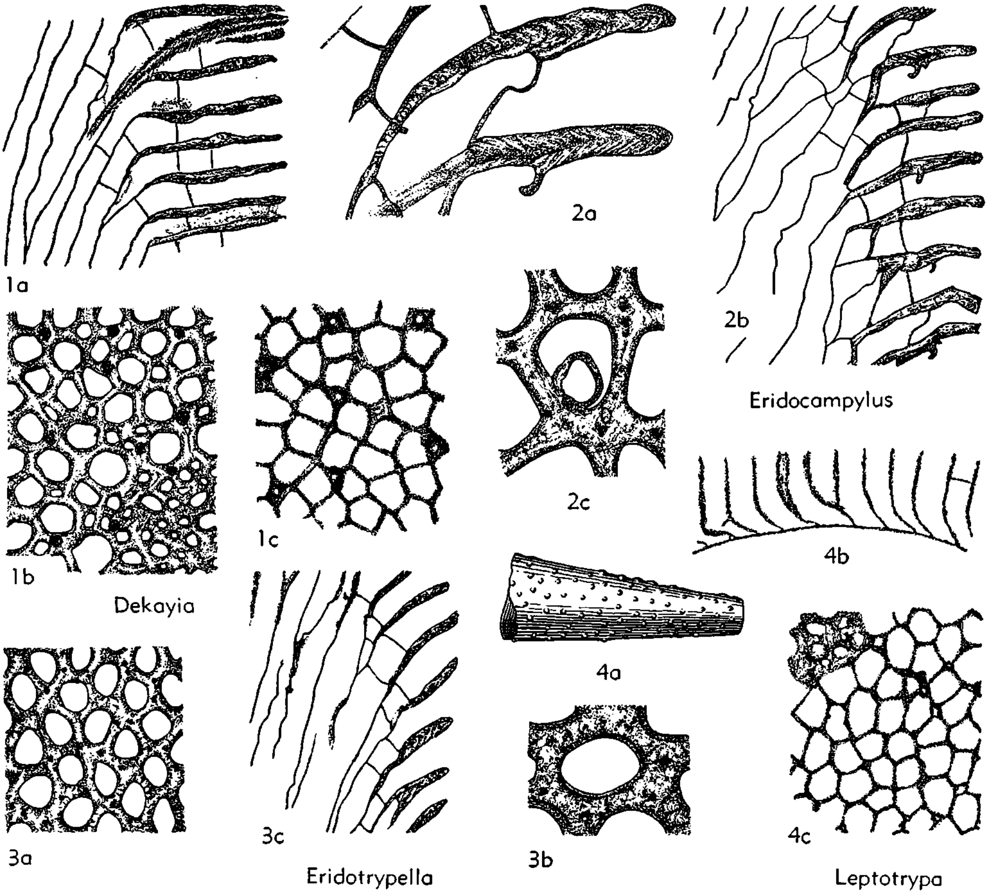

FIG. 60. Heterotrypidae (p. G98).

Caradoc., Scot.; *3a,b,* secs., ×25 (131).——FIG. 57,*4*. *P. simulatrix* ULR., L.Trenton., Ky.; *4a,b,* secs., ×20 (222).

Prasoporina BASSLER, 1952 [**Monticulipora selwynii* NICH., 1881]. Like *Prasopora* but cystiphragms are isolated subglobular structures connected with opposite wall by a few diaphragms. *Ord.*——FIG. 58,*4*. **P. selwynii* (NICH.), Trenton., Ont.; *4a,b,* secs., ×20 (222).

Family HETEROTRYPIDAE Ulrich, 1890

Zoarium typically erect flabellate but also incrusting to massive. Zooecia angular, with straight diaphragms and no cystiphragms; walls fused but retaining light-colored dotted or lined central band. Mesopores few; acanthopores well defined, commonly large (3,54,112,114,115; NICKLES-B., 1900). *Ord.-Dev.*

Heterotrypa NICH., 1879 [**Monticulipora frondosa* D'ORB., 1850]. Frondescent. Mesopores closely tabulate; acanthopores of one kind only. *Ord.*——FIG. 59,*1*. **H. frondosa* (D'ORB.), Maysv., Ohio; *1a,b,* tang. secs., ×20, ×25; *1c,* long. sec., ×20 (223).

Atactopora ULR., 1879 [**A. hirsuta*]. Thin incrustations with conspicuous solid elevations (monticules), generally found on cephalopod shells. Zooecial apertures floriform, strongly indented by acanthopores. Mesopores lacking. *Ord.*——FIG. 59,2. **A. hirsuta,* Eden., Ky.; *2a,b,* tang. secs., ×20, ×50; *2c,* long. sec., ×20 (*2a,c,* 222; *2b,* 131).

Cyphotrypa ULR.-B., 1904 [**Leptotrypa acervulosa* ULR., 1893]. Massive, attaining width of 25 cm. Zooecia thin-walled, with diaphragms in recurrent mature zones. Mesopores absent; acanthopores well developed. *Ord.-Dev.*——FIG. 59,*3*. **C. acervulosa* (ULR.), Trenton., Iowa; *3a,b,* secs., ×25, ×20 (223).

Dekayella ULR., 1882 [**D. obscura* ULR., 1883]. Like *Dekayia* but has many mesopores; sets of large and small acanthopores. *Ord.*——Fig. 59,*4*. **D. obscura* Ulr., Eden., Ohio; *4a,b,* secs., ×20 (222).

Dekayia M.Edw.-H., 1851 [**D. aspera*]. Ramose. Mesopores and diaphragms practically absent; acanthopores large. *Ord.*——Fig. 60,*1*. **D. aspera,* Maysv., Ohio; *1a,* long. sec.; *1b,* tang. sec. near surface; *1c,* tang. sec. well below surface; all ×20 (*1a,c,* 131; *1b,* 222).

Eridocampylus Duncan, 1939 [**E. ulrichi*]. Ramose. Zooecia with amalgamate walls, modified curved diaphragms (heterophragms), and small cystoid structures of thick laminated tissue projecting from walls. *M.Dev.*——Fig. 60,*2*. **E. ulrichi,* Traverse, Mich.; *2a,b,* long. secs. showing heterophragms, ×50, ×20; *2c,* tang. sec., ×50 (147).

Eridotrypella Duncan, 1939 [**Batostomella obliqua* Ulr., 1890]. Ramose. Like *Eridotrypa* but has heterotrypoid wall structure; zooecia with thick transversely dotted bands. Mesopores absent. *M.Dev.*——Fig. 60,*3*. **E. obliqua* (Ulr.), Traverse, Mich.; *3a,b,* tang. secs., ×20, ×50; *3c,* long. sec., ×20 (147).

Leptotrypa Ulr., 1883 [**L. minima*]. Incrusting, with sharp monticules. Zooecial walls thin, diaphragms nearly wanting. Mesopores rare; acanthopores few. *Ord.*——Fig. 60,*4*. **L. minima,* Maysv., Ohio; *4a,* zoarium, ×1; *4b,c,* secs., ×20 (222).

Leptotrypella Vinassa, 1920 [**Chaetetes barrandei* Nich., 1874]. Like *Eridotrypella* but has well-developed laminated acanthopores. *M.Dev.*——Fig. 61,*2*. **L. barrandei* (Nich.), Hamilton, Ont.; *2a,* zoarium, ×1; *2b,* surface, ×20; *2c,d,* tang. secs., ×20, ×50; *2e,* long. sec., ×20 (225).

Petigopora Ulr., 1882 [**P. gregaria* Ulr., 1883]. Small circular incrusting patches with structure of *Dekayia*. *Ord.*——Fig. 61,*3*. **P. gregaria* Ulr., Maysv., Ohio; *3a,* zoaria, ×1; *3b,c,* secs., ×20 (222).

Stigmatella Ulr.-B., 1904 [**S. crenulata*] [=*D'Annunziopora, D'Annunzioporina* Vinassa, 1920]. Typically ramose, also incrusting to massive. Zooe-

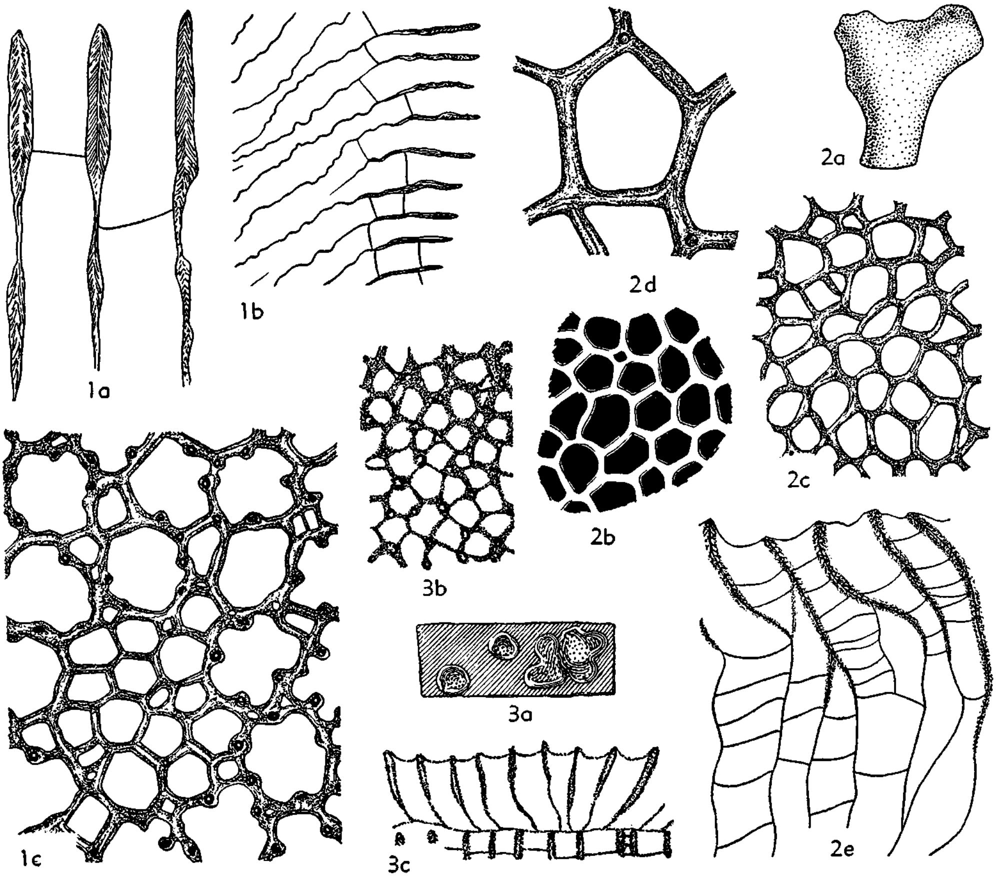

Fig. 61. Heterotrypidae (p. G98, G99).

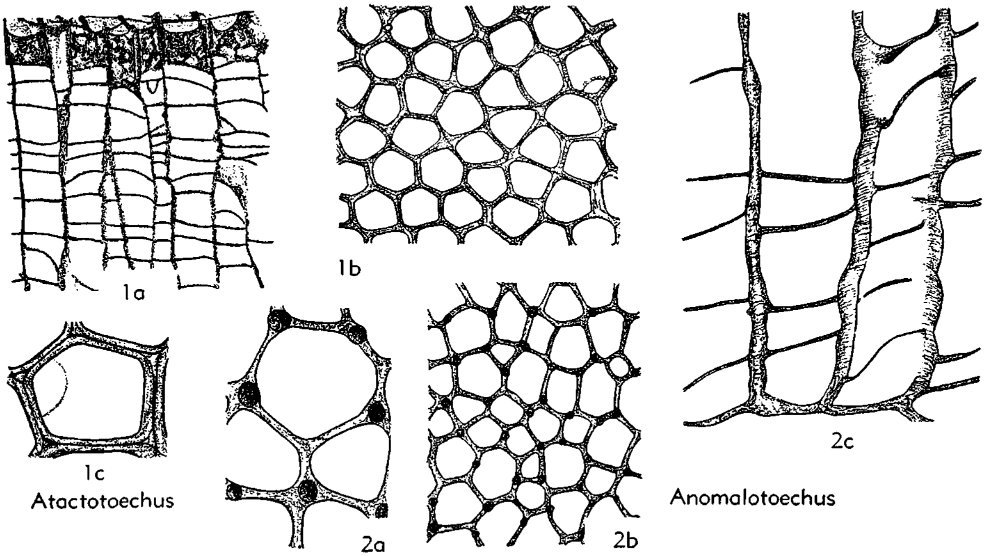

FIG. 62. Atactotoechidae (p. G99).

cial tubes crenulated. Acanthopores in periodically developed mature zones. *Ord.*——FIG. 61,*1*. **S. crenulata; 1a,b,* secs., ×50, ×20; *1c,* tang. sec. showing acanthopores, ×50 (223).

Family ATACTOTOECHIDAE Duncan, 1939

Zoaria ramose to massive. Zooecia angular, with laminated amalgamate walls which are granular only in early mature region; straight diaphragms or gently curved cystiphragms. Mesopores absent; acanthopores of nongranular laminated tissue (54). *Dev.*

Atactotoechus DUNCAN, 1939 [**A. typicus*]. Cystiphragms in mature zone resemble slightly curved diaphragms. Acanthopores few. *Dev.*——FIG. 62,*1*. **A. typicus,* Traverse, Mich.; *1a,* long. sec., ×20; *1b,c,* tang. secs., ×20, ×50 (147).

Anomalotoechus DUNCAN, 1939 [**A. typicus*]. Differs from *Atactotoechus* in having many acanthopores and lacking bands of crowded gently curved diaphragms and zones of thickened walls. *M.Dev.* ——FIG. 62,*3*. **A. typicus,* Traverse, Mich.; *3a,b,* tang. secs., ×50, ×20; *3c,* long. sec., ×50 (147).

Family BATOSTOMELLIDAE Miller, 1889

[=Bythoporidae MILLER, 1889]

Zoaria generally slender, ramose. Zooecia with thick walls more or less fused in mature region; diaphragms straight. Mesopores and acanthopores commonly present (3,54, 114; NICKLES-B., 1900). *Ord.-Dev.*

Batostomella ULR., 1882 [**Chaetetes gracilis* NICH., 1874][=*Bythopora* ULR., 1890 (*non* MILLER & DYER, 1878); *Leptotrypellina* VINASSA, 1920]. Slender to thick smooth branches. *Ord.*——FIG. 63,*1*. **B. gracilis* (NICH.), Maysv., Ohio; *1a,b,* secs., ×50, ×20; *1c,* zoarium, ×1; *1d,* surface, ×25 (222).

Batostomellina VINASSA, 1920 [**Trematopora granulifera* HALL, 1852]. Slender solid branches. Zooecia with oval apertures, no diaphragms. Acanthopores so numerous as to obscure mesopores. *Sil.* ——FIG. 63,*2*. **B. granulifera* (HALL), Clint., N.Y.; *2a,b,* secs., ×25 (162).

Bythopora MILLER & DYER, 1878 [**B. fruticosa* (=*Helopora dendrina* JAMES, 1878)]. Very slender branching stems. Zooecia with thin mature region, oblique apertures, thick channeled interspaces. *Ord. (Maysv.),* Ohio.

Callotrypa HALL-S., 1887 [**Callopora macropora* HALL, 1874]. Apertures oval, with equally elevated peristomes; internal structure unknown. *L.Dev.* ——FIG. 63,*4*. **C. macropora* (HALL), Held., N.Y.; *4a,* zoarium, ×1; *4b,* surface, ×5 (162).

Canutrypa BASSLER, 1952 [**C. francqana*]. Ramose. Zooecia polygonal, thick-walled in mature zone, mostly with large cystiphragms which may be spherical, suggesting ovicells. Mesopores closely tabulate. *Dev.*——FIG. 63,*3*. **C. francqana,* Ferques, Fr.; *3a,b,* secs., ×20 (131).

Eridotrypa ULR., 1893 [**E. mutabilis*][=*Badoglioporа, Badoglioporina, Diplotrypella, Eridotrypina* VINASSA, 1920]. Bifurcating branches. Zooecia thick-walled, oblique, with diaphragms. *Ord.*——FIG. 63,*5*. **E. mutabilis,* Blkriv., Minn.; *5a,* zoarium, ×1; *5b,* surface, ×20; *5c,d,* tang. secs., ×50, ×20; *5e,* long. sec., ×20 (222).

Esthoniopora Bassler, 1911 [**E. communis*]. Zoarium hemispherical, with basal epitheca. Zooecia thin-walled, polygonal, with semidiaphragms. Mesopores and acanthopores lacking. *Ord.*——Fig. 64,*1*. **E. communis,* Est.; *1a,b,* zoarium, ×1; *1c,d,* secs., ×20 (131).

Geinitzella Waag.-W., 1886 [**Coralliolites columnaris* Schloth., 1813]. Unrecognizable until types restudied. *Perm.,* Ger.

Orbipora Eichw., 1856 [*pro Orbitulites* Eichw., 1829 (*non* Lamarck, 1801)][**Orbitulites distinctus* Eichw., 1829]. Zoarium massive, hemispherical, with basal epitheca. Zooecia lack diaphragms. Acanthopores large and numerous; mesopores absent. *Ord.*——Fig. 64,*2*. **O. distincta* (Eichw.), Est.; *2a,b,* zoarium, ×1; *2c,d,* secs., ×20., ×5 (131).

Trematella Hall, 1886 [**Trematopora glomerata* Hall, 1883]. Slender branches. Zooecia angular, thick-walled; internal structure little known. *Dev.* ——Fig. 64,*3*. **T glomerata* (Hall), Onond.

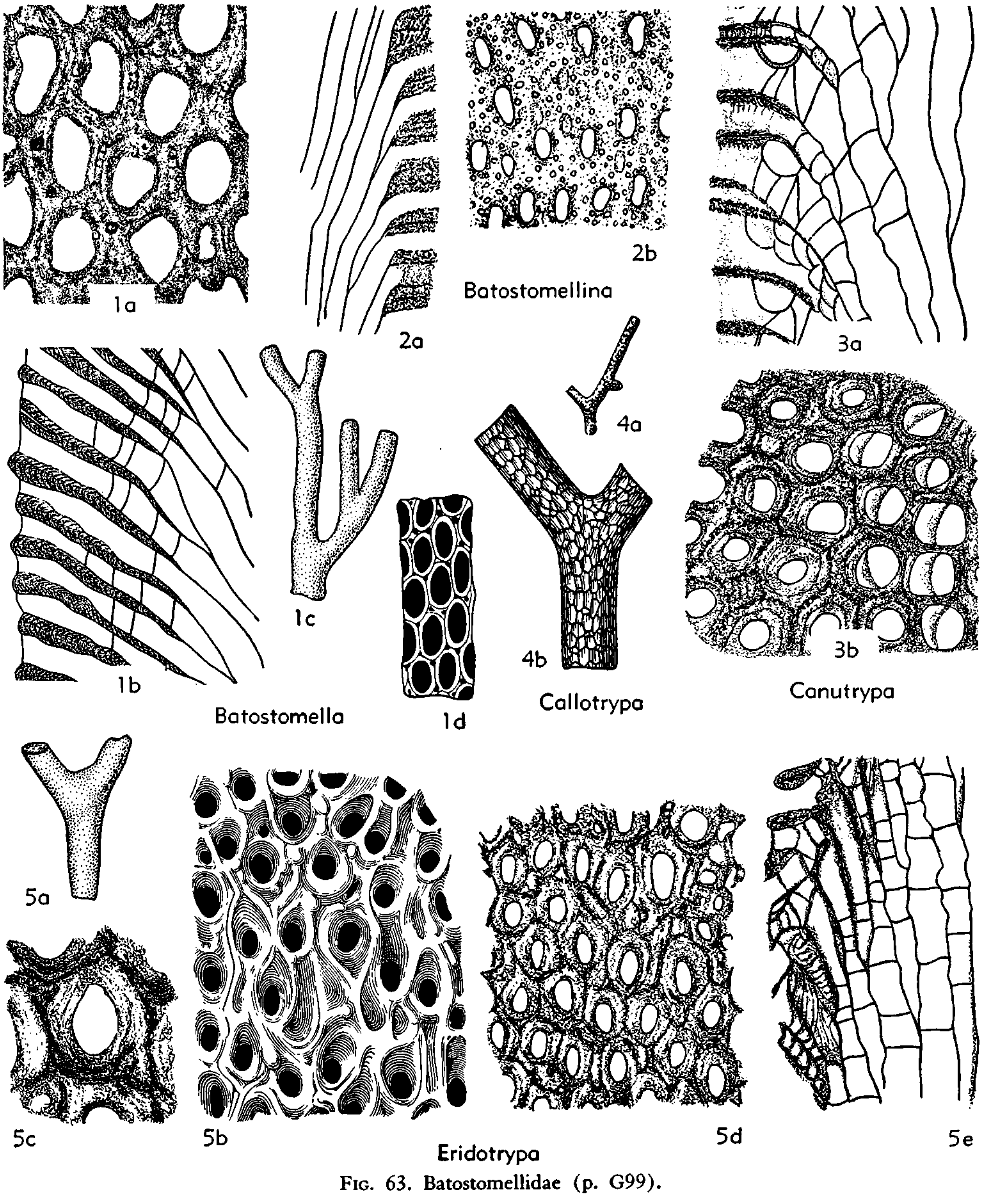

Fig. 63. Batostomellidae (p. G99).

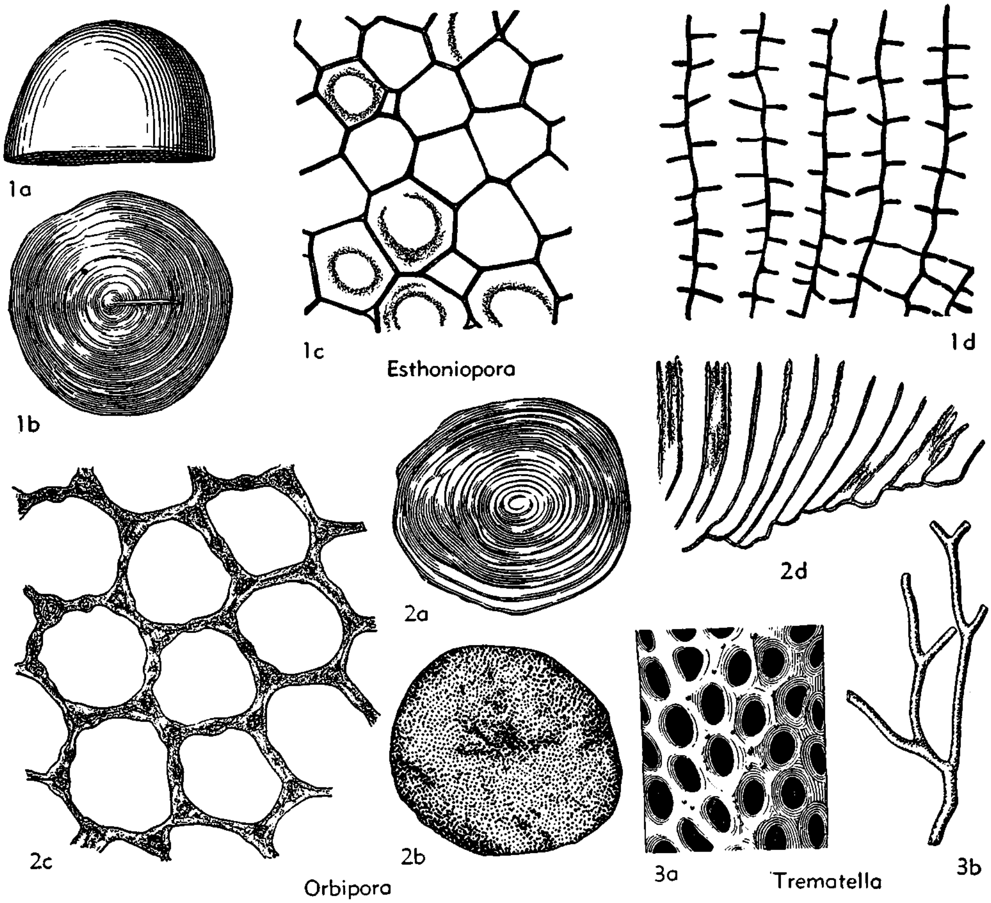

FIG. 64. Batostomellidae (p. G100).

Falls, Ohio; *3a,* surface, ×20; *3b,* zoarium, ×1 (162).

Family STENOPORIDAE Waagen & Wentzel, 1886

[as Stenoporinae]

Zoarium incrusting, ramose frondescent, massive, or bifoliate. Zooecia angular, with laminate amalgamate walls thickened intermittently in simple forms but distinctly beaded (moniliform) in typical genera; diaphragms generally present, complete in primitive forms but in others centrally perforated, or extending part way across tubes (hemiphragms, heterophragms), or lacking entirely. Acanthopores mostly well developed, including large (megacanthopores) and small (micracanthopores); mesopores may occur (8,54). *Sil.-Perm.*

Stenopora LONSD., 1844 [**S. tasmaniensis*] [=*Tubuliclidea* LONSD., 1844 (obj.); *Ulrichotrypa* BASSLER, 1929]. Ramose or massive. Zooecia thick-walled, with well-developed monilae; without diaphragms. A megacanthopore on distal side of each zooecial tube and many micracanthopores between tubes, mostly at zooecial angles; mesopores lacking (8). *Miss.-Perm.*——FIG. 65,*1*. **S. tasmaniensis,* Perm., Tasm.; *1a,b,* secs., ×20 (142).

Amphiporella GIRTY, 1911 [**A. maculosa*]. Broad flat fronds. Like *Tabulipora* but mesopores more numerous (8). *Miss.*——FIG. 65,*4*. **A. maculosa,* Chest., Ark.; *4a,b,* secs., ×20 (131).

Anisotrypa ULR., 1883 [**A. symmetrica*]. Hollow or solid branches. Zooecial walls with indistinct monilae. Acanthopores and mesopores absent. *Miss.*——FIG. 65,*2*. **A. symmetrica,* Chest., Ky.; *2a,b,* zoarium, ×1; *2c,d,* secs., ×20; *2e,* surface, ×20 (131).

Calacanthopora DUNCAN, 1939 [**C. prima*]. Incrusting. Zooecial walls completely amalgamate;

without diaphragms. Megacanthopores abundant; mesopores absent. *M.Dev.*——Fig. 65,*3*. **C. prima*, Traverse, Mich.; *3a,b*, secs., ×25, ×50 (147).

Callocladia Girty, 1911 [**C. elegans*]. Hollow branches as in *Anisotrypa* but mesopores, acanthopores, and perforate diaphragms present (8). *Miss.*——Fig. 65,*5*. **C. elegans*, Chest., Ark.; *5a,b*, secs., ×20 (131).

Chondraulus Duncan, 1939 [**C. granosus*]. Massive. Zooecia with wall structure obscured by granules and minute tubules; thin complete diaphragms. Mesopores and acanthopores absent. *M.Dev.*——Fig. 66,*2*. **C. granosus*, Traverse, Mich.; *2a,b*, tang. secs., ×50, ×20; *2c*, long. sec., ×20 (147).

Coeloclemis Girty, 1911 [**C. tumida*]. Hollow epithecate stems. Like *Anisotrypa* but lacks diaphragms and has acanthopores (8). *Miss.*——Fig. 66,*1*. **C. tumida*, Chest., Ark.; *1a*, tang. sec., ×20; *1b,c*, long. secs., ×20, ×5 (131).

Diplostenopora Ulr.-B., 1912 [**Escharopora siluriana* Weller, 1903]. Bifoliate. Zooecia with walls not beaded; diaphragms centrally perforate. Acanthopores few. *Dev.*——Fig. 66,*3*. **D. siluriana* (Weller), Held., N.J.; *3a,b*, secs., ×25, ×20 (223).

Dyoidophragma Duncan, 1939 [**D. typicalis*]. Incrusting layers. Zooecia thick-walled, with thin complete diaphragms and irregular thick hemiphragms. Megacanthopores prominent. *M.Dev.*——Fig. 67,*4*. **D. typicalis*, Traverse, Mich.; *4a,b*, tang. secs., ×20, ×50; *4c,d*, long. secs., ×50, ×20 (147).

Dyscritella Girty, 1911 [**D. robusta*]. Like ramose *Leioclema* but zooecia thick-walled, lacking diaphragms (8). *Miss.*——Fig. 66,*4*. **D. robusta*, Chest., Ark.; *4a-c*, secs., ×20, ×25, ×20 (131).

Eostenopora Duncan, 1939 [**E. picta*]. Laminar. Zooecial walls intermittently thickened. Micracanthopores crowded, granular; mesopores absent. *M. Dev.*——Fig. 67,*2*. **E. picta*, Traverse, Mich.; *2a-c*, secs., ×50, ×20, ×50 (147).

Koninckopora Lee, 1912 [**Calamopora inflata* De-

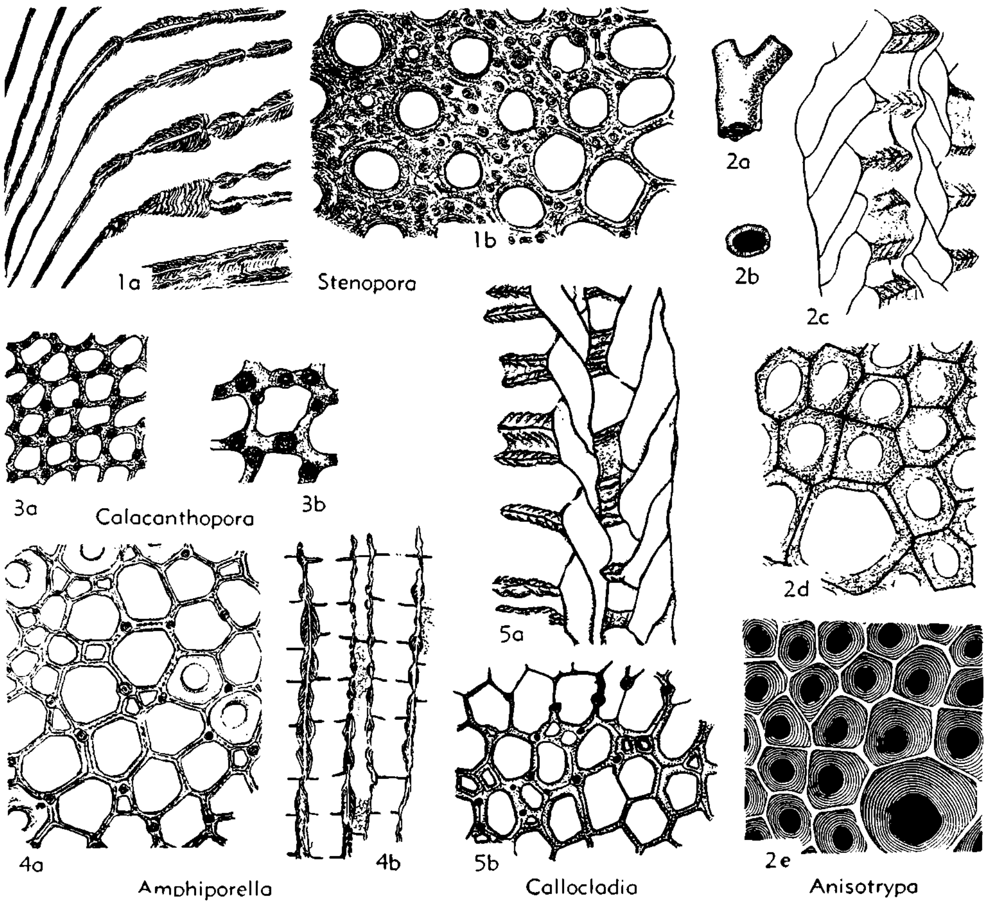

Fig. 65. Stenoporidae (p. G101, G102).

KON., 1842]. ?Green alga (WOOD, 1943). *Carb.*, Belg.

Leeporina VINASSA, 1920 [**Discrytella nana* LEE, 1912]. Slender solid stems. Zooecia with centrally perforate diaphragms but confined to immature region. Mesopores lack tubulae. *Carb.*——FIG. 66,*5*. **L. nana* (LEE), Eng.; *5a,b*, secs., ×20 (176).

Leioclema ULR., 1882 [**Callopora punctata* HALL, 1858] [=*Thallostigma* HALL, 1883; *Lioclema* VINASSA, 1920]. Incrusting, ramose, or massive. Zooecia without beaded walls; apertures petaloid; diaphragms complete. Mesopores tabulate; megacanthopores common. *Ord.-Perm.*——FIG. 67,*3*. **L. punctata* (HALL), Miss.(Warsaw), Iowa; *3a,b*, secs., ×20, ×50 (223).

Lioclemella FOERSTE, 1895 [**Callopora ohioensis* FOERSTE, 1887]. Like *Leioclema* but zoarium cylindrical, pointed at base for attachment. *Ord.-Sil.*——FIG. 67,*1*. **L. ohioensis* (FOERSTE), Sil.(Medin.), Ohio; *1a,b*, secs., ×20, ×25; *1c*, zoarium, ×1 (223).

Lioporidra BASSLER, 1952 [*pro Liopora* GIRTY, 1915 (*non* NICH.-E., 1878)] [**Liopora subnodosa* GIRTY, 1915]. Thin lamellate. Zooecia without diaphragms but bearing spinelike projections from walls. Mesopores numerous. *M.Penn.*——FIG. 68,*1*. **L. subnodosa* (GIRTY), Desmoin., Mo.; *1a,b*, secs., ×20 (156).

Microcampylus DUNCAN, 1939 [**M. typicus*]. Like *Stenoporella* but mesopores numerous, acanthopores large, granules in zooecial walls. *M.Dev.*——FIG. 68,*3*. **M. typicus*, Traverse, Mich.; *3a,b*, long. secs., ×20, ×50; *3c,d*, tang. secs., ×20, ×50 (147).

Pycnopora GIRTY, 1911 [**P. regularis*]. Thin lamellar expansions. Like *Leioclema* but zooecia have undulating walls and semidiaphragms; mesopores lack tubulae (8). *Miss.*——FIG. 68,*2*. **P. regularis*, Chest., Ark.; *2a,b*, secs., ×20 (131).

Rhombotrypella NIKIF., 1933 [**R. astragaloides*]. Solid cylindrical branches. Zooecia thick-walled in mature zone, with monilae, thin-walled and with

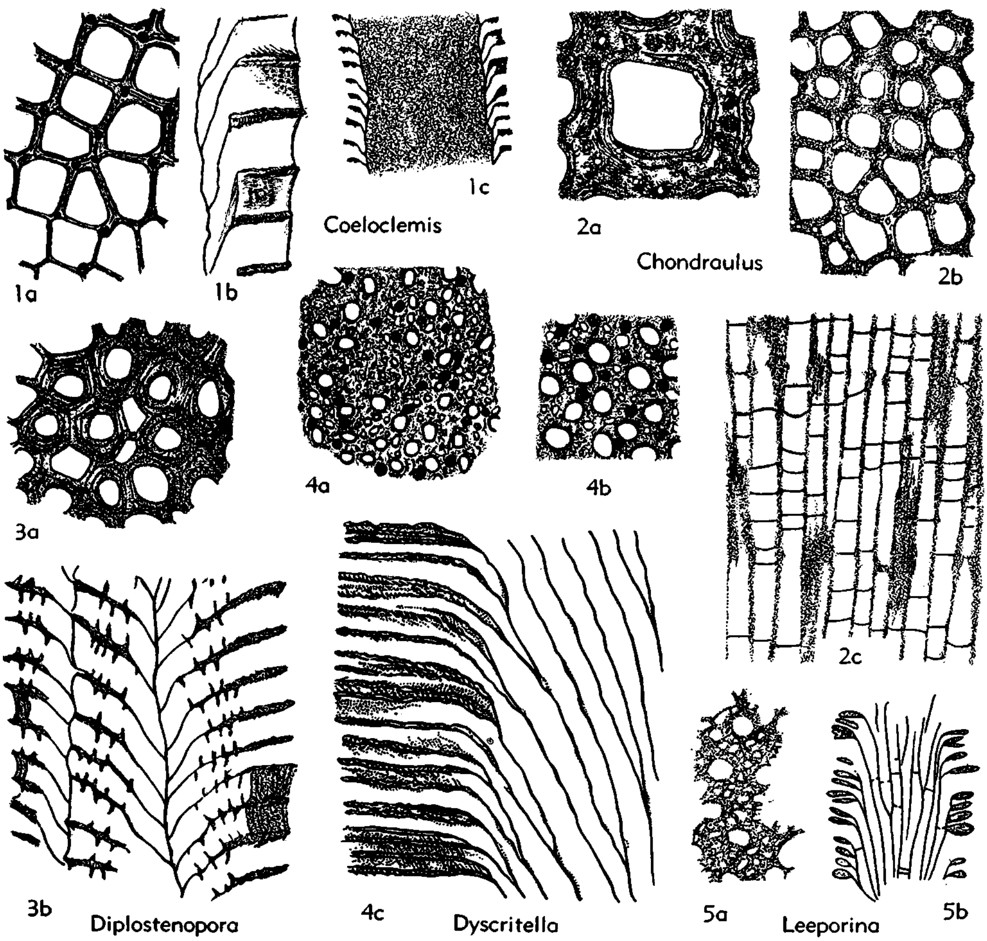

FIG. 66. Stenoporidae (p. G102, G103).

quadrate cross section in axial region. Megacanthopores and micracanthopores present. *Carb.*——Fig. 69,*3*. **R. astragaloides*, M.Carb., Russ.; *3a-c*, secs. long., transv., tang., ×20 (198).

Stenocladia Girty, 1911 [**S. frondosa*]. Like *Leioclema* but bifoliate, zooecia and mesopores without tabulae (8). *Miss.*——Fig. 69,*1*. **S. frondosa*, Chest., Ark.; *1a,b*, secs., ×20 (131).

Stenodiscus Crockford, 1945 [**S. moniliformis*]. Like *Tabulipora* but has thin nonperforate diaphragms. *Perm.*——Fig. 68,*4*. **S. moniliformis*, Tasm.; *4a,b*, secs., ×10 (142).

Stenophragmidium Bassler, 1952 [*pro Stenophragma* Munro, 1912 (*non* Skuse, 1890)] [**Stenophragma lobatum* Munro, 1912]. Like *Stenopora* but has hemiphragms projecting from one side of zooecial walls only. *Carb.*——Fig. 69,*4*. **S. lobatum* (Munro), Eng.; *4a,b*, secs., ×20 (131).

Stenoporella Bassler, 1936 [**S. romingeri*]. Like *Tabulipora* but beaded structure of zooecial walls

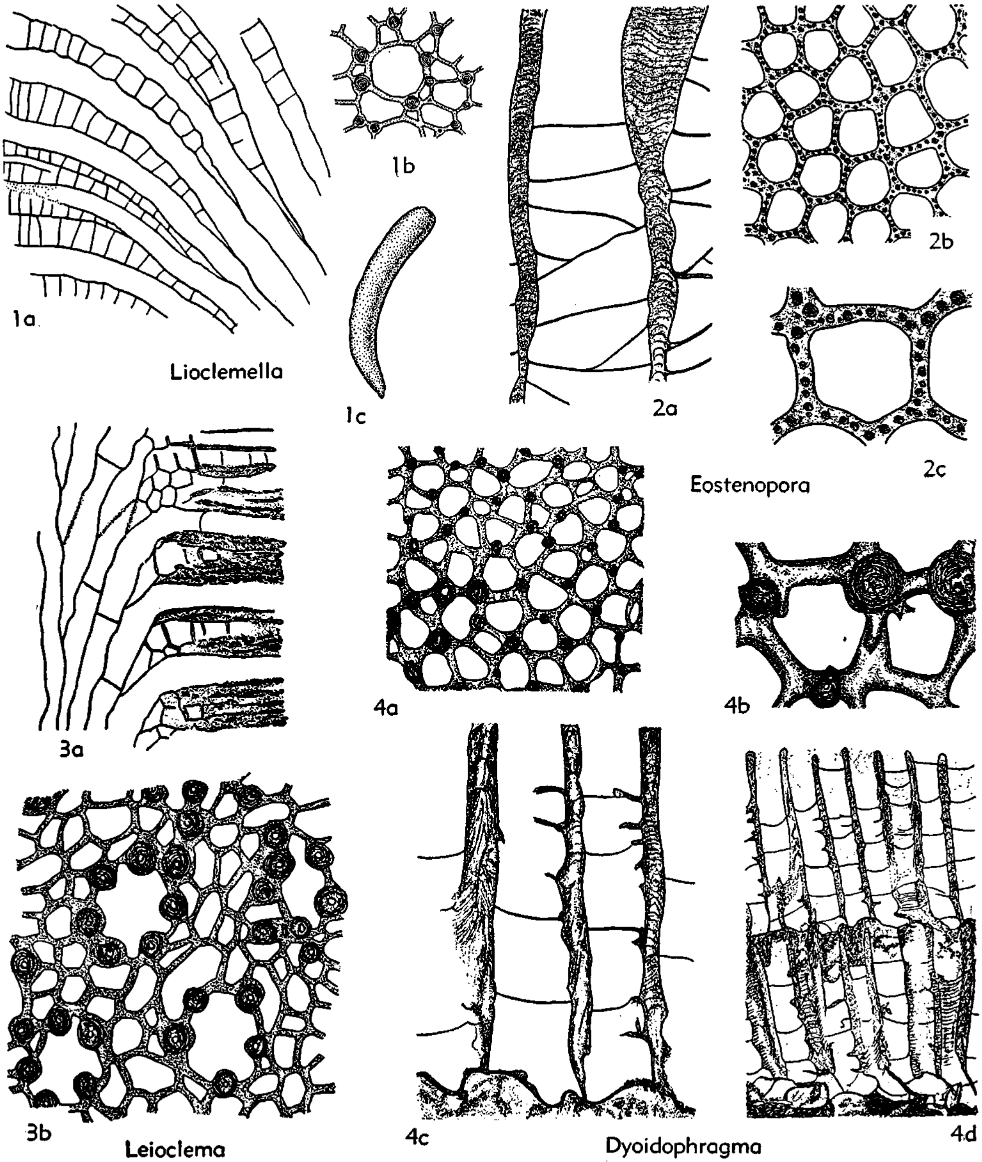

Fig. 67. Stenoporidae (p. G102, G103).

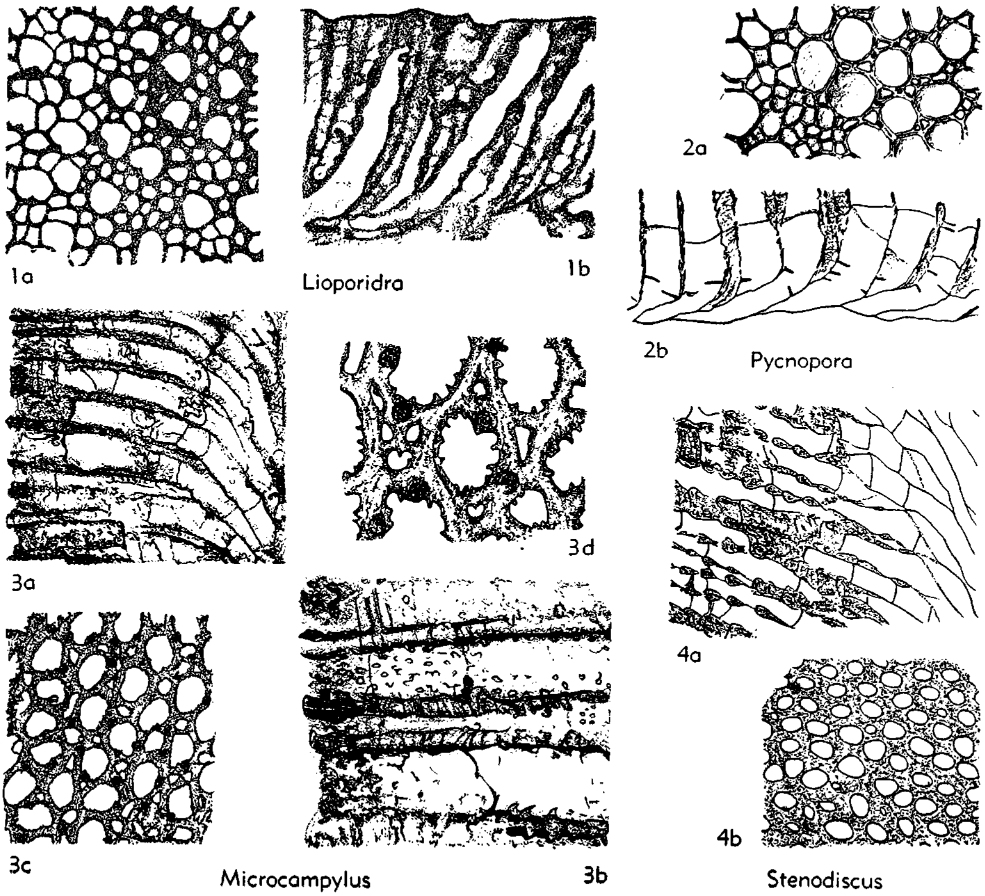

FIG. 68. Stenoporidae (p. G103, G104).

nearly obsolete and hemiphragms occur as blunt spines. *Miss.*——FIG. 69,*2*. **S. romingeri,* Chest., Ark.; *2a,b,* tang. secs., ×25, ×20; *2c,* long. sec., ×20 (131).

Stereotoechus DUNCAN, 1939 [**S. typicus*]. Laminar. Zooecia with slightly beaded walls and complete diaphragms. Acanthopores distinct; mesopores absent. *M.Dev.*——FIG. 70,*4*. **S. typicus,* Traverse, Mich.; *4a,b,* tang. secs., ×20, ×50; *4c,* long. sec., ×20 (147).

Tabulipora YOUNG, 1883 [**T. scotica* LEE, 1912 (=*Stenopora urei* YOUNG, *partim*)]. Like *Stenopora* but has centrally perforate diaphragms. *Carb.* ——FIG. 70,*1*. **T. scotica* LEE, SCOT.; *1a,b,* secs., ×20 (176).

Tabuliporella NIKIF., 1933 [**T. nalivkini*]. Ramose. Zooecia thick-walled, with eccentrically perforate diaphragms. Mesopores nontabulate; acanthopores absent. *Carb.*——FIG. 70,*2*. **T. nalivkini,* L.Carb., Turkestan; *2a,b,* secs., ×20 (198).

Trachytoechus DUNCAN, 1939 [**T. typicus*]. Massive. Zooecia with laminate wall tissue, few nearly straight diaphragms, and curved heterophragms which appear fringed on proximal side. Mesopores and acanthopores absent. *M.Dev.*——FIG. 70,*3*. **T. typicus,* Traverse, Mich.; *3a-c,* tang. secs., ×20, ×50, ×50; *3d,e,* long. secs. showing heterophragms, ×20, ×50 (147).

Family CONSTELLARIIDAE Ulrich, 1890

Zoarium incrusting, laminar, frondescent, to massive. Stellate clusters of mesopores closed at the surface and abundant hollow spines or granules that replace true acanthopores generally isolate the zooecia; straight complete diaphragms in zooecia and mesopores (3,112,114; NICKLES-B., 1900). *Ord.-Sil.*

Constellaria DANA, 1846 [**Ceriopora constellata* VAN CLEVE, in DANA, 1846]. Erect fronds with surface marked by depressed stellate clusters of mesopores. *Ord.*——FIG. 71,*1*. **C. constellata* (VAN CLEVE), Maysv., Ohio; *1b*, zoarium, ×1; *1a,c,d*, tang. secs., *(a)* cluster, ×20, *(c)* normal zooecia, ×50, *(d)*, immature region, ×20; *1e*, long. sec., ×20 (222).

Dianulites EICHW., 1829 [**D. fastigiatus*] [=*Hexaporites* PANDER, 1830]. Zoarium massive, erect. Zooecia angular, thin-walled; mesopores large; both with minute granular structure and few diaphragms. *Ord.*——FIG. 71,*3*. **D. fastigiatus*, M.Ord., Est.; *3a,b*, zoarium, top and side, ×1; *3c*, long. sec. with wide-spaced diaphragms in mesopores, ×10; *3d,e*, tang. secs., ×20, ×50 (131).

Hennigopora BASSLER, 1952 [**Callopora florida* HALL, 1852]. Like *Nicholsonella* but with numerous acanthopores indenting zooecia and interspaces with polygonal vesicles. *Sil.*——FIG. 71,*2*. **H. florida* (HALL), Clint., N.Y.; *2a,b*, secs., ×20; *2c,d*, zoarium, ×1, ×5 (131).

Idiotrypa ULR., 1883 [**I. parasitica*]. Incrusting to lamellate. Zooecia and mesopores with closely spaced minutely perforate diaphragms; walls traversed by tubuli. *Sil.*——FIG. 71,*4*. **I. parasitica*, Clint., N.Y.; *4a,b*, secs., ×20; *4c*, surface, ×20 (222).

Nicholsonella ULR., 1889 [**N. ponderosa* ULR., 1890]. Ramose to frondescent. Zooecia separated by tabulate mesopores filled by calcareous **deposits.** *Ord.*——FIG. 72,*4*. **N. ponderosa* ULR., Blkriv., Ill.; *4a,b*, secs., ×20; *4c*, surface, ×20 (222).——

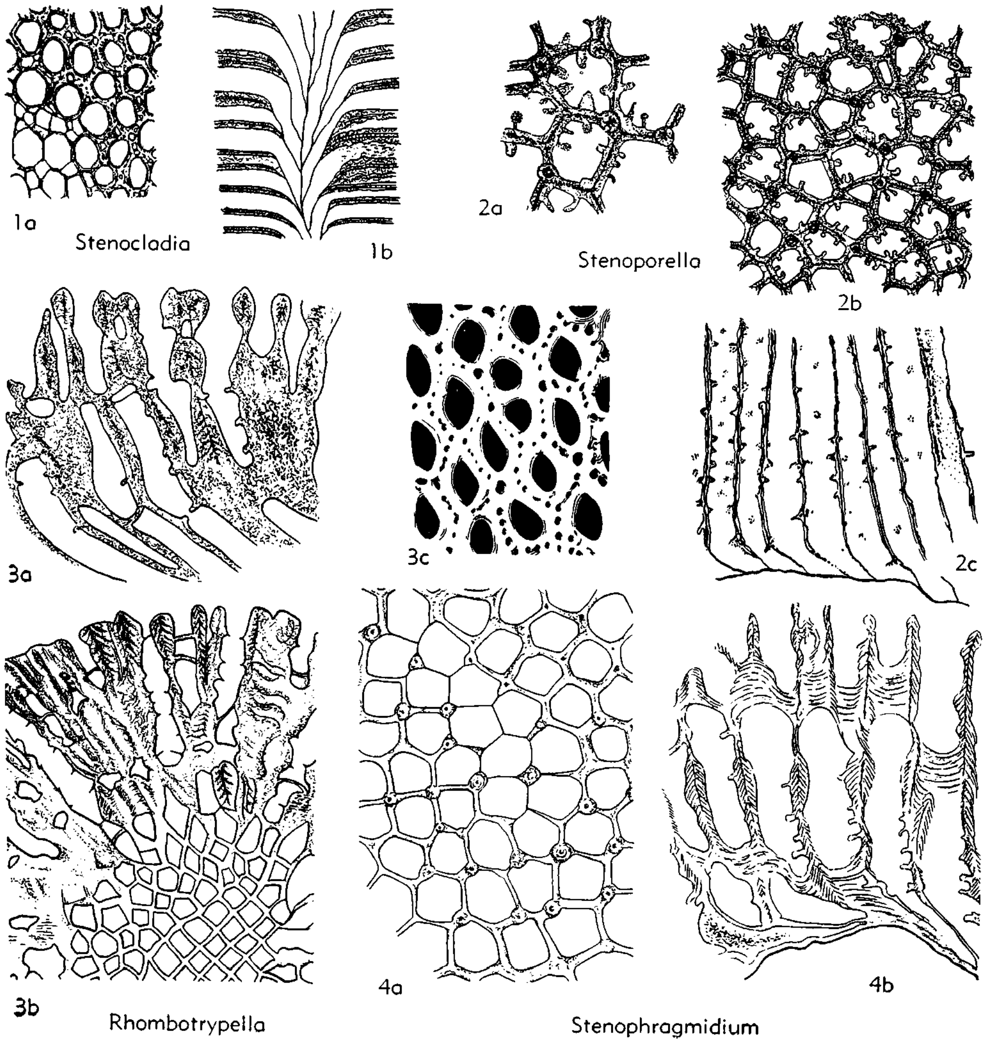

FIG. 69. Stenoporidae (p. G103, G104).

FIG. 72,*5*. *N. pulchra* ULR., Blkriv., Tenn.; *5a,* zoarium, ×1; *5b,* long. sec., ×20; *5c,* surface, ×10 (222).

Revalotrypa BASSLER, 1952 [**Nicholsonella gibbosa* BASSLER, 1911]. Like *Nicholsonella* but diaphragms nearly absent in zooecia and mesopores. Granular wall structure as in *Dianulites*. *Ord.*——FIG. 72,*1*. **R. gibbosa* (BASSLER), Est.; *1a,* long. sec., ×10; *1b,c,* tang. secs., ×20, ×50; *1d,e,* zoarium from side and base, ×1 (131).

Stellipora HALL, 1847 [*non* HAG., 1951] [**S. antheloidea*] [=*Revalopora* VINASSA, 1920]. Like *Constellaria* but has lamellate incrusting growth and mesopores are restricted to monticules. *Ord.*——FIG. 72,*2*. **S. antheloidea,* Trenton., N.Y.; *2a,* zoarium, ×1; *2b,c,* secs., ×20; *2d,* surface, ×5 (131).——FIG. 72,*3*. *S. apsendesoides* BASSLER, Est.; a single star, ×5 (131).

Suborder INTEGRATA Ulrich & Bassler, 1904

Walls of adjacent zooecial tubes not coalesced but separated by a dark divisional

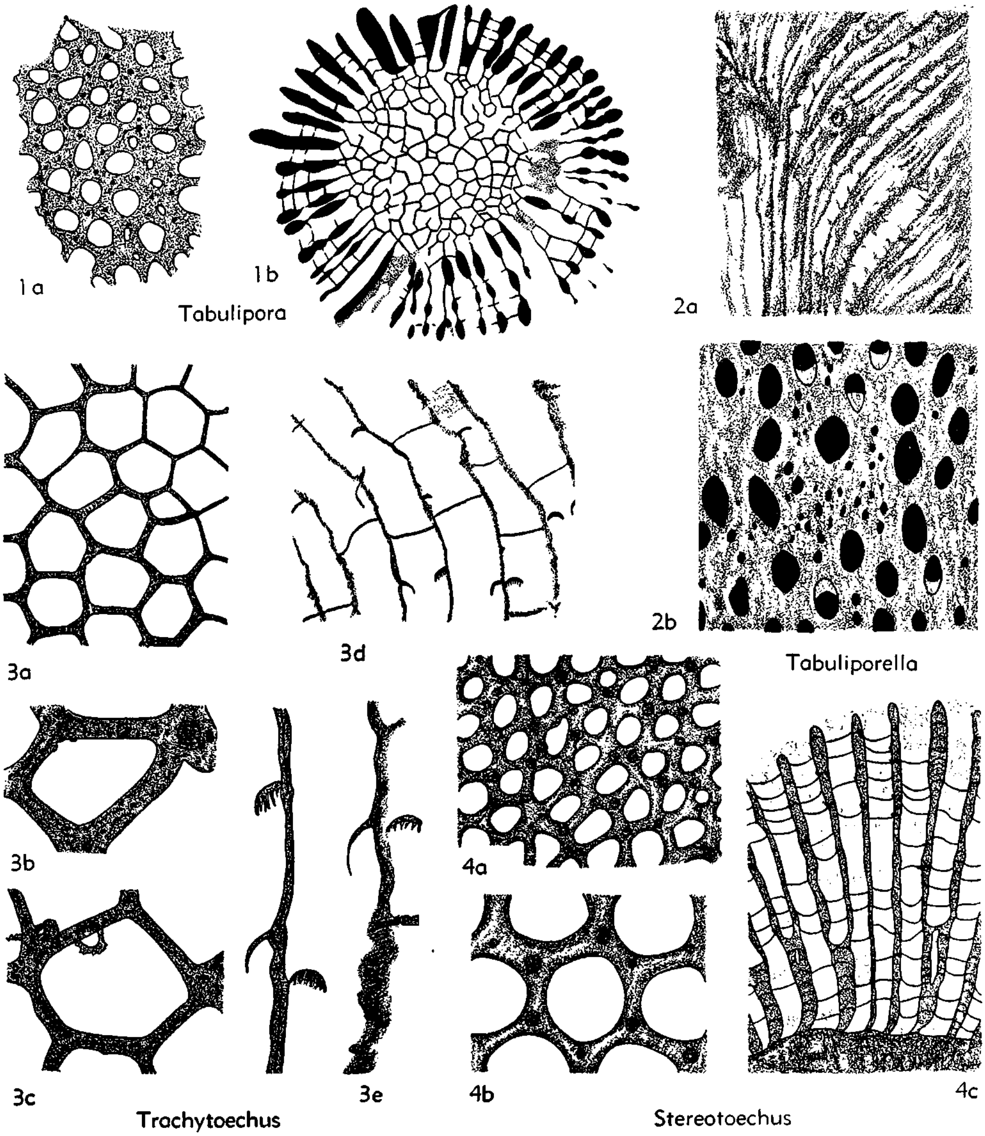

FIG. 70. Stenoporidae (p. G105).

line or by light-colored tissue, with individual wall boundaries distinctly visible. *Ord.-Perm., ?Trias.*

Family AMPLEXOPORIDAE Miller, 1889

Zoarium ramose to bifoliate. Zooecia comparatively simple prismatic tubes. Acanthopores commonly abundant; mesopores absent (112,114; Nickles-B., 1900). *Ord.-Dev.*

Amplexopora Ulr., 1882 [**A. cingulata*]. Ramose. Zooecia with complete diaphragms. Acanthopores numerous. *Ord.*——Fig. 73,*1*. **A. cingulata,* Maysv., Ky.; *1a,* long. sec., ×20; *1b,* surface ×20; *1c,d,* tang. secs., ×20, ×50 (222).

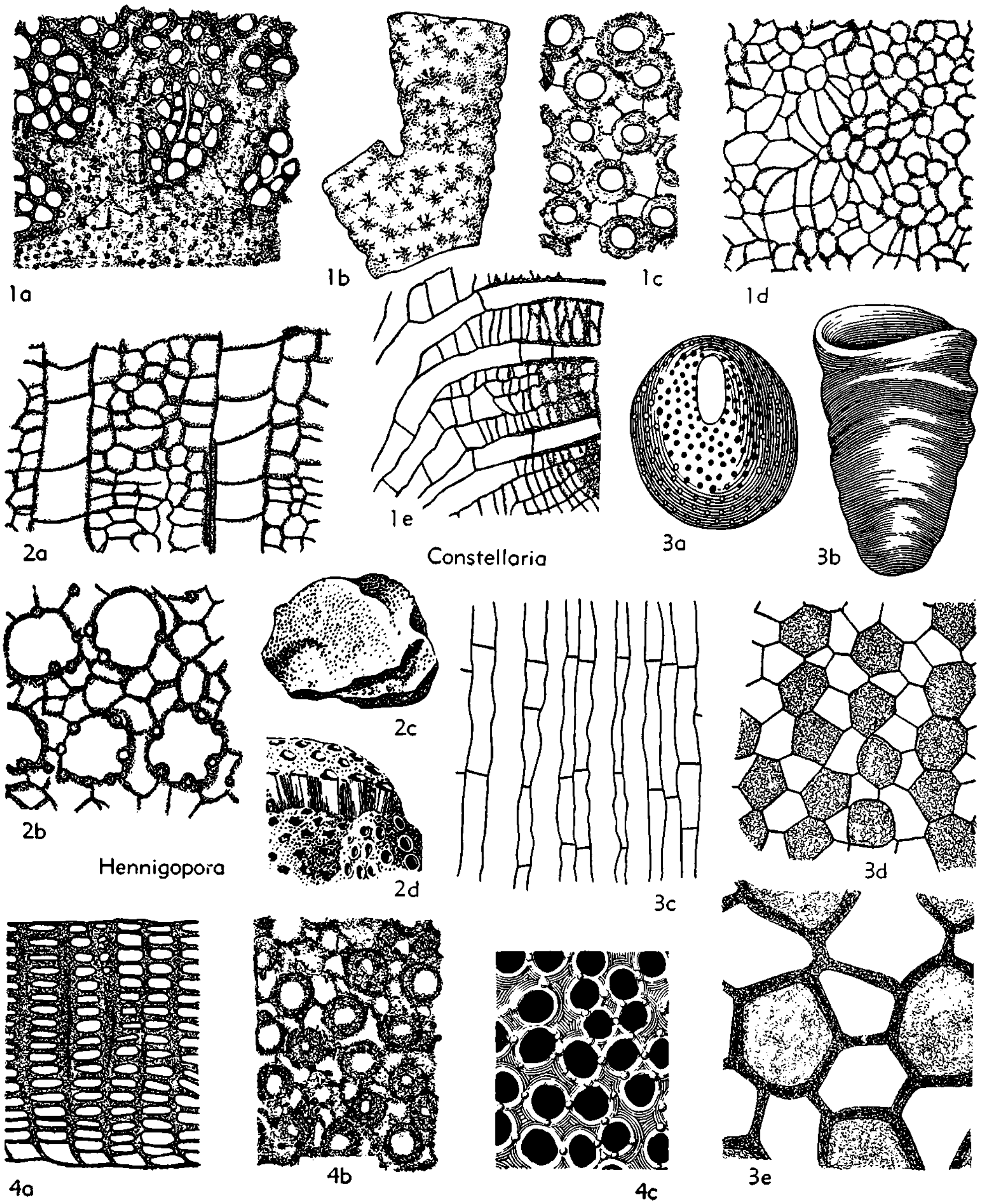

Fig. 71. Constellariidae (p. G105, G106).

Discotrypa ULR., 1882 [**Chaetetes elegans* ULR., 1879]. Free or incrusting expansions. Zooecia thin-walled, apertures rhomboidal. Acanthopores lacking. *Ord.-Dev.*——FIG. 73,*4*. **D. elegans* (ULR.), Ord.(Maysv.), Ohio; *4a*, long. sec.; *4b*, surface; *4c*, tang. sec.; all ×20 (222).

Monotrypella ULR., 1882 [**M. aequalis*]. Lacks acanthopores. *Ord.*——FIG. 73,*3*. **M. aequalis*, Edén., Ky.; *3a*, surface, ×20; *3b,c*, secs., ×20 (222).

Petalotrypa ULR., 1889 [**P. compressa* ULR., 1890]. Leaflike, bifoliate. Zooecia with polygonal apertures separated by some mesopore-like interspaces (not true mesopores). Acanthopores small. *Sil.-Carb.*——FIG. 73,*2*. **P. compressa* ULR., M.Dev., Iowa; *2a,b*, secs., ×20; *2c*, zoarium, ×1 (222).

Rhombotrypa ULR.-B., 1904 [**Chaetetes quadratus* ROM., 1866] [=*Acanthotrypina* VINASSA, 1920]. Zooecia of axial region quadrate in section. *Ord.-Dev.*——FIG. 73,*5*. **R. quadratus* (ROM.),

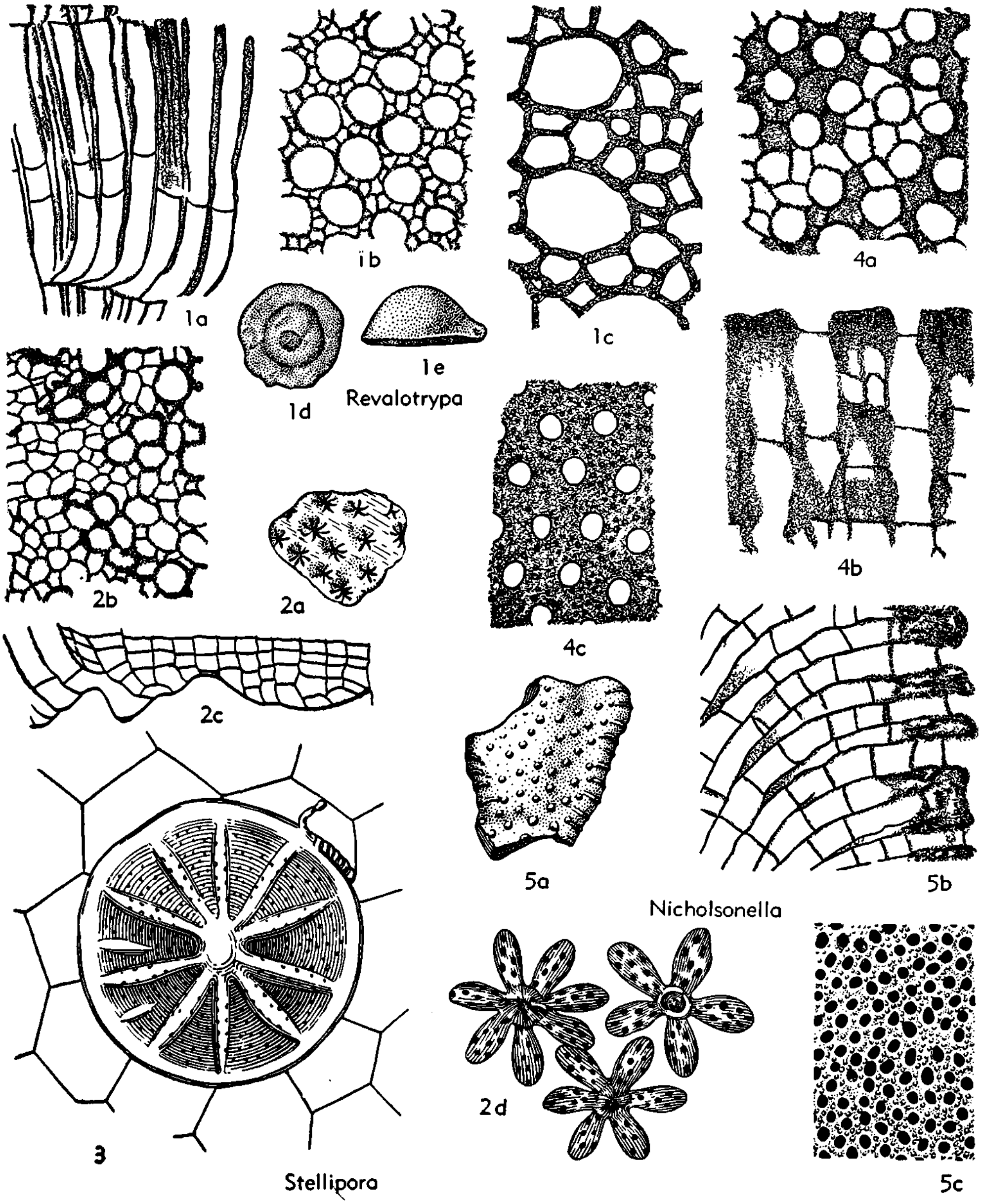

FIG. 72. Constellariidae (p. G106, G107).

Ord.(Richmond.), Ohio; *5a*, transv. sec., ×5; *5b,c*, tang. secs., ×20, ×50; *5d*, long. sec., ×20; *5e*, zoarium, ×1 (*5a,c,d*, 197; *5b,e*, 131).

Family HALLOPORIDAE Bassler, 1911

[=emend. Calloporidae Ulr., 1890]

Generally ramose. Zooecial tubes subcir-

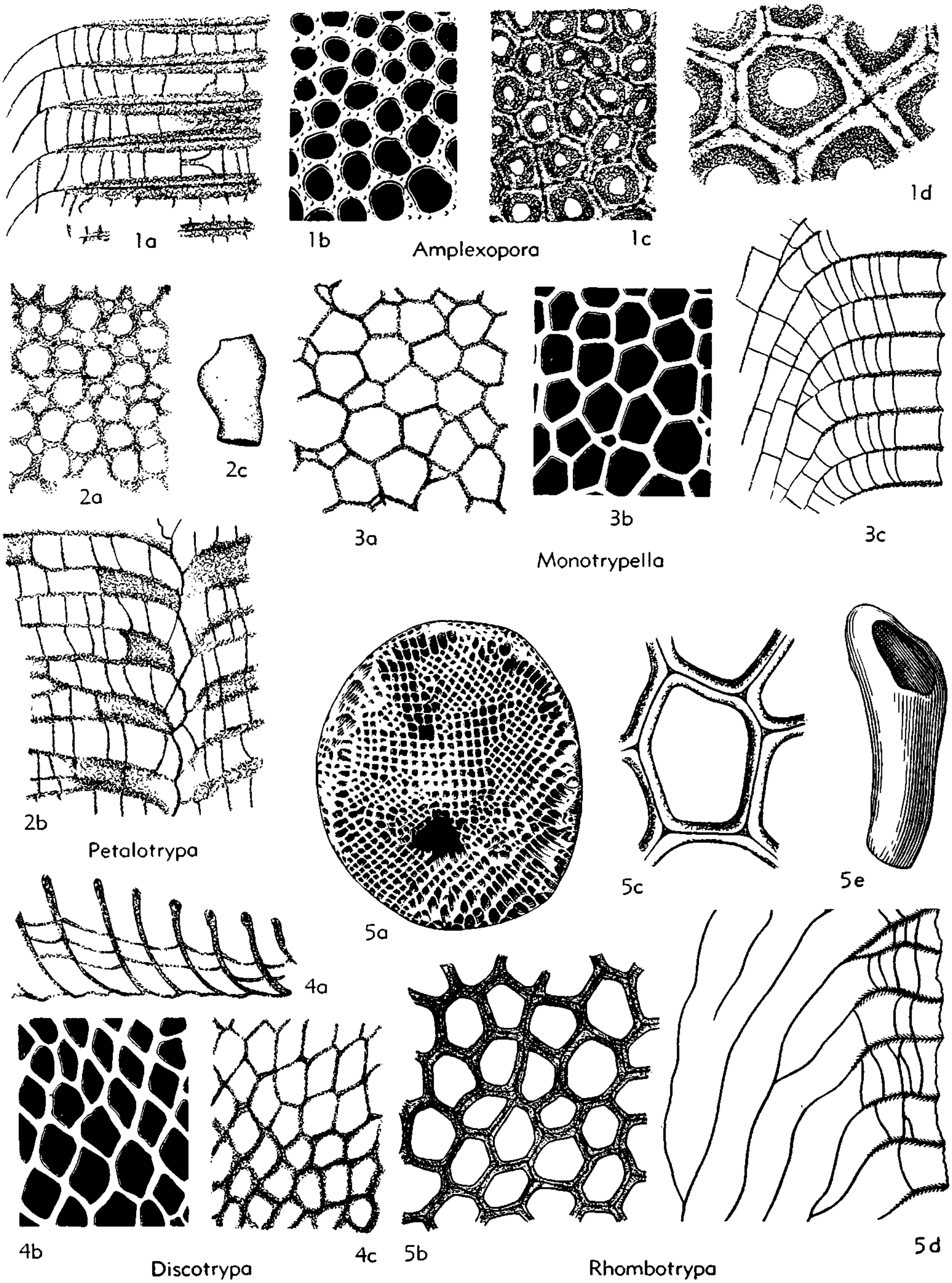

Fig. 73. Amplexoporidae (p. G108-G110).

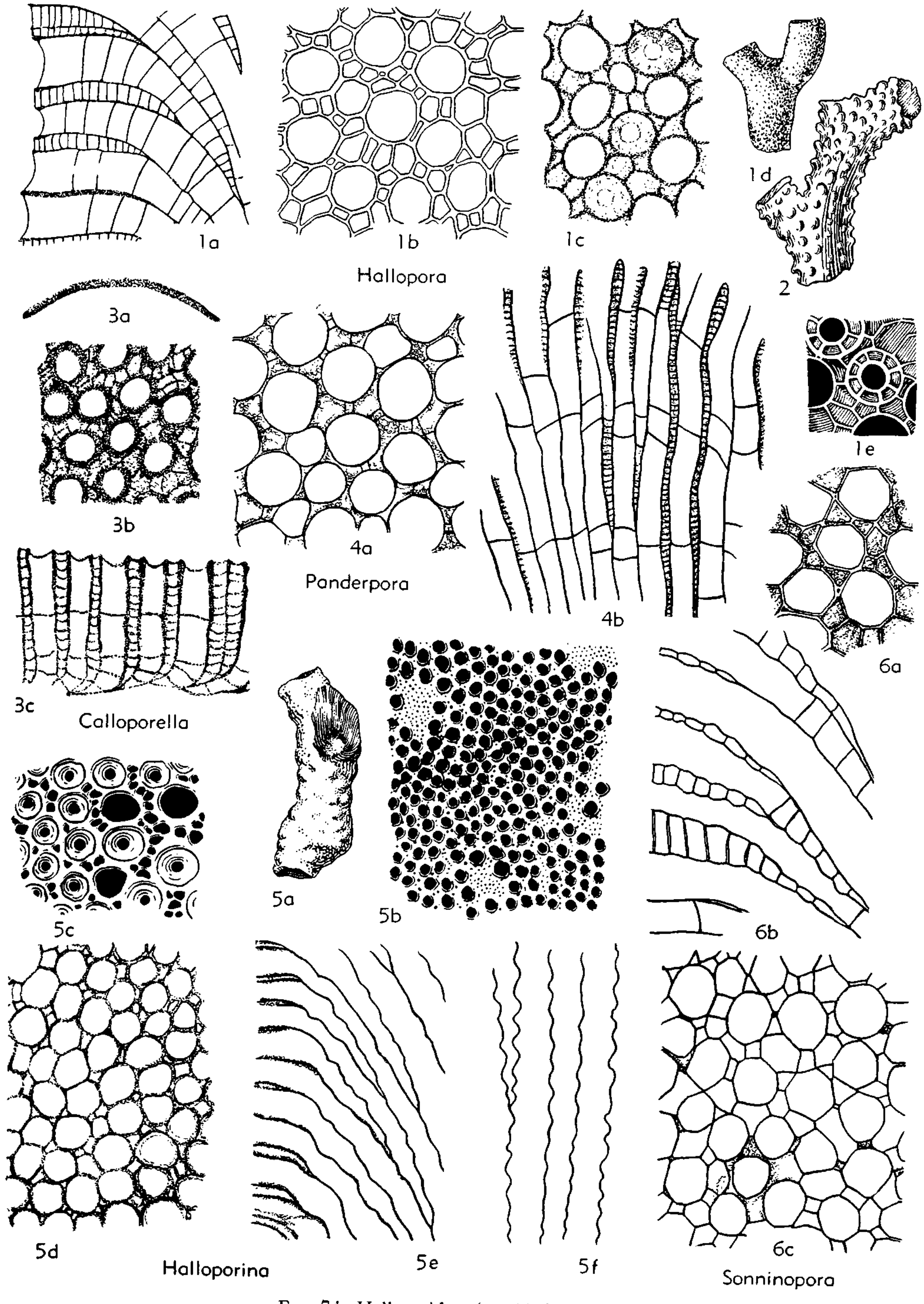

FIG. 74. Halloporidae (p. G112, G113).

cular, generally with diaphragms, which may be more numerous and closely spaced in the immature region than the mature. Mesopores common, closely tabulate; acanthopores virtually lacking (3,114,115; NICKLES-B., 1900). *Ord.-Dev.*

Hallopora BASSLER, 1911 [*pro Callopora* HALL, 1851 (*non* GRAY, 1848)] [**Callopora elegantula* HALL, 1852]. Ramose; intertwined branches may form clumps 30 cm. wide. Zooecial apertures commonly closed by ornamented perforate covers which become diaphragms when left behind during growth. *Ord.-Dev.*——FIG. 74,*1*. **H. elegantula* (HALL), Sil.(Clint.), N.Y.; *1a-c*, secs., ×20; *1d*, fragment, ×1; *1e*, surface, ×25 (*1a,c*, 222; *1b,d,e*, 131).——FIG. 74,*2*. *H. ramosa* D'ORB., Ord.(Maysv.), Ohio; zoarium with monticules, ×1 (222).

Calloporella ULR., 1882 [**C. harrisi* ULR., 1883 (=*Monticulipora (Heterotrypa) circularis* JAMES, 1862)] [=*Halloporella* VINASSA, 1920 (obj.)]. Zoarium thin, discoid, convex. Mesopores angular, closely tabulate. *Ord.*——FIG. 74,*3*. **C. circularis* (JAMES), Richmond., Ohio; *3a*, edge view of zoarium, ×1; *3b,c*, secs., ×25, ×20 (222).

Halloporina BASSLER, 1913 [*pro Calloporina* ULR.-B., 1904 (*non* NEVIANI, 1895)] [**Callopora crenulata* ULR., 1893]. Like *Hallopora* but zooecia have strongly crenulate walls and lack diaphragms. *Ord.*——FIG. 74,*5*. **H. crenulata* (ULR.), Blkriv., Minn.; *5a*, zoarium, ×1; *5b*, surface with maculae, ×10; *5c*, surface showing perforate zooecial covers (diaphragms), ×20; *5d-f*, secs., ×20 (222).

Panderpora BASSLER, 1952 [**Hallopora dybowskii* BASSLER, 1911]. Hemispherical. Zooecia with wide-spaced curved diaphragms. Mesopores narrow, closely tabulate. *Ord.*——FIG. 74,*4*. **P. dybowskii* (BASSLER), Est.; *4a,b*, secs., ×20, ×10 (131).

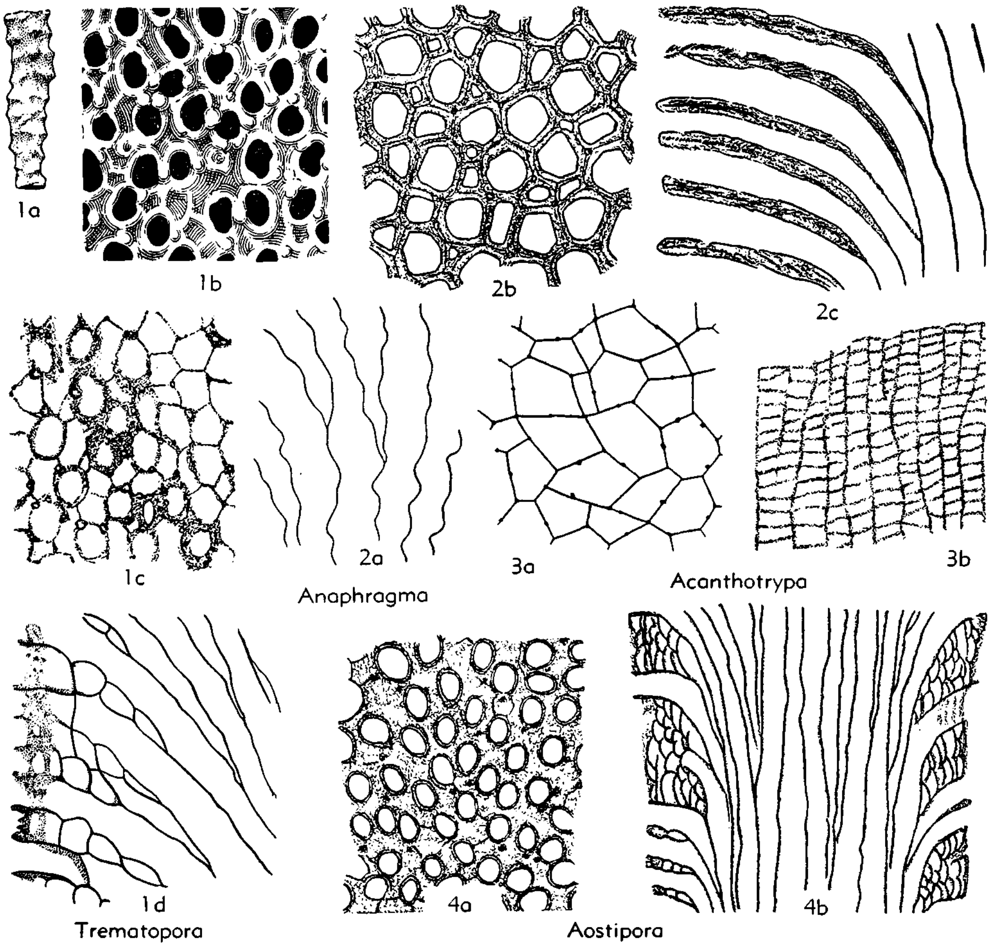

FIG. 75. Trematoporidae (p. G113).

Sonninopora VINASSA, 1920 [**Hallopora tenuispinosa* BASSLER, 1911]. Like *Hallopora* but peripheral mature region has minute acanthopores. *M.Ord.*——FIG. 74,*6*. **S. tenuispinosa* (BASSLER), Est.; *6a-c*, secs., ×25, ×20, ×20 (131).

Family TREMATOPORIDAE Miller, 1889

[=Diplotrypidae ULRICH, 1890]

Zoaria ramose, hemispherical, or massive; characterized by general looseness and obscurity of structure unlike other trepostomes. Distinguished from Halloporidae chiefly by presence of acanthopores and closed mesopores (3,114,115; NICKLES-B., 1900). *Ord.-Dev., ?Trias.*

Trematopora HALL, 1851 [**T. tuberculosa*]. Ramose, with prominent monticules. Zooecial apertures circular, with peristomes. Solid interspaces contain small acanthopores and distinctly moniliform granular mesopores. *Ord.-Sil.*——FIG. 75,*1*. **T. tuberculosa*, Sil.(Clint.), N.Y.; *1a*, zoarium, ×1; *1b*, surface, ×20; *1c,d*, secs., ×20 (131).

Acanthotrypa VINASSA, 1915 [**Monticulipora (Monotrypa) carnica*]. Massive. Like *Monotrypa* but zooecia have many regularly spaced diaphragms and minute acanthopores. *Ord.*——FIG. 75,*3*. **A. carnica* (VINASSA), NE.Italy (Carnic Alps); *3a,b*, secs., ×10, ×5 (225).

Anaphragma ULR.-B., 1904 [**A. mirabile*]. Like *Batostoma* but diaphragms entirely absent and walls crenulate in immature region. *Ord.*——FIG. 75,*2*. **A. mirabilis*, Richmond., Ill.; *2a-c*, secs., ×20 (223).

Aostipora VINASSA, 1920 [**Trematopora cystata* BASSLER, 1911]. Smooth slender cylindrical stems. Zooecia without diaphragms. Interspaces of mature region filled with cystose vesicles. *M.Ord.*——FIG. 75,*4*. **A. cystata* (BASSLER), Est.; *4a,b*, secs., ×20 (131).

Batostoma ULR., 1882 [**Monticulipora (Heterotrypa) implicata* NICH., 1881] [=*Acanthotrypella* VINASSA, 1920]. Irregular branches rising

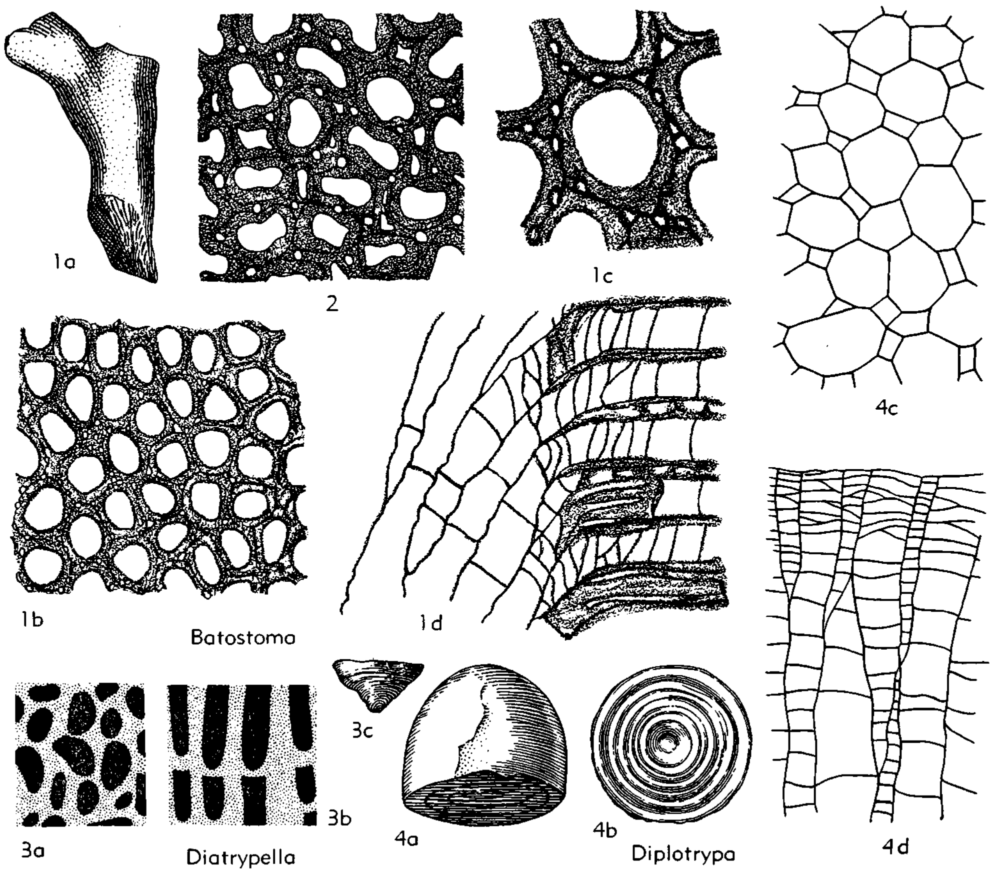

FIG. 76. Trematoporidae (p. G113, G114).

from large basal expansion. Zooecia thick-walled in mature region, somewhat uneven diaphragms numerous. Mesopores common, irregular; large acanthopores abundant. *Ord.*——Fig. 76, *1. B. minnesotense* Ulr., Blkriv., Minn.; *1a,* zoarium, ×1; *1b,c,* tang. secs., ×20, ×50; *1d,* long. sec., ×20 (222).——Fig. 76,*2.* **B. implicatum* (Nich.), Eden., Ohio; tang. sec., ×25 (222).

Diatrypella Vinassa, 1911 [**Monotrypa (Diatrypella) baconica*]. *Trias.,* Italy.——Fig. 76,*3.* **D. baconica; 3a,b,* secs., ×10; *3c,* zoarium, from side, ×1 (225).

Diplotrypa Nich., 1879 [**Favosites petropolitanus* Pander, 1830] [=*Diplotrypina* Vinassa, 1920]. Like *Monotrypa* but has mesopores. *Ord.*——Fig. 76,*4.* **D. petropolitanus* (Pander), Est.; *4a,b,* zoarium from side and base, ×1; *4c,d,* secs., ×20 (131).

Dittopora Dybowski, 1877 [**D. clavaeformis*]. Club-shaped. Like *Hemiphragma* but has a pair of large acanthopores with each zooecium and numerous other small ones. *M.Ord.*——Fig. 77,*1.* **D. clavaeformis,* Est.; *1a,b,* secs., ×20; *1c,* zoarium, ×1 (131).

Hemiphragma Ulr., 1893 [**Batostoma irrasum* Ulr., 1886] [=*Balticopora, Balticoporella* Vinassa, 1920]. Like *Batostoma* but diaphragms incomplete (hemiphragms) in mature region. *Ord.*——

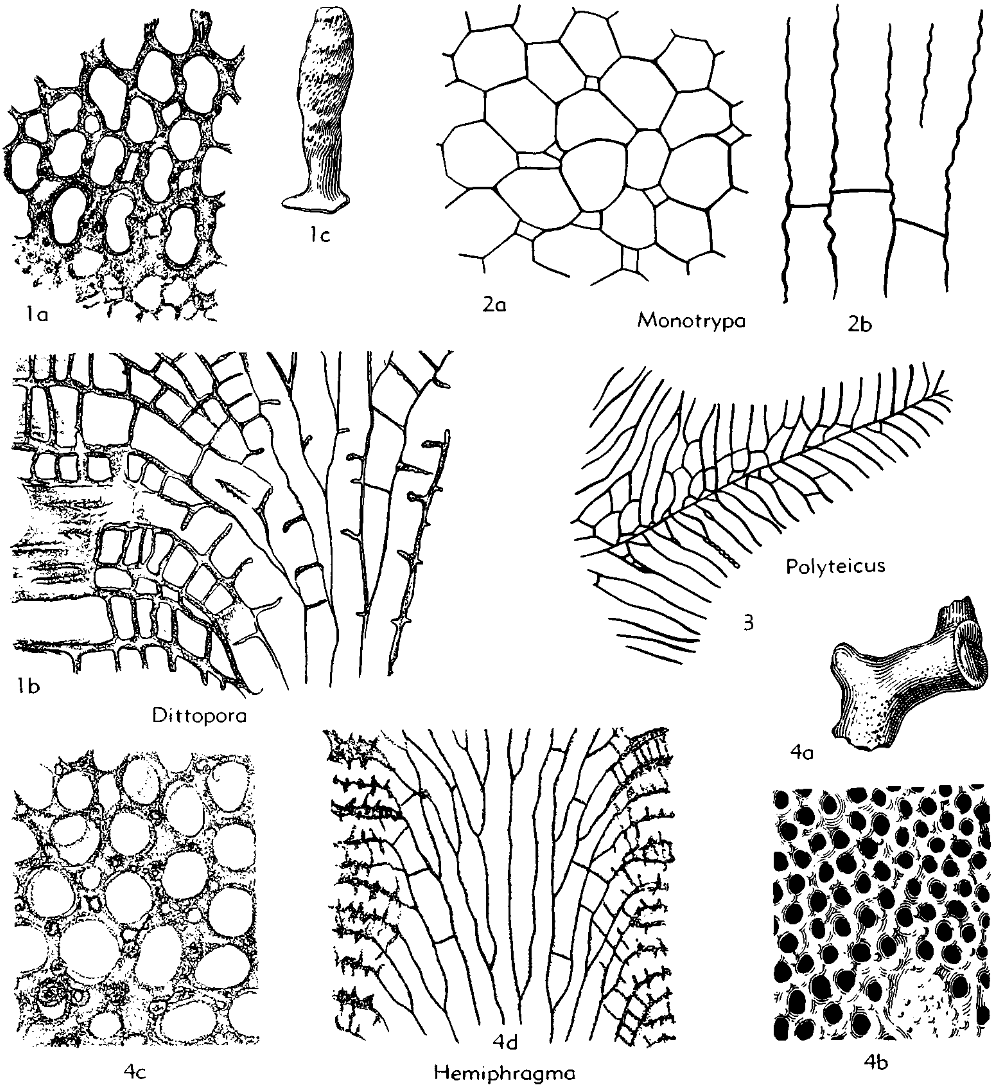

Fig. 77. Trematoporidae (p. G114, G115).

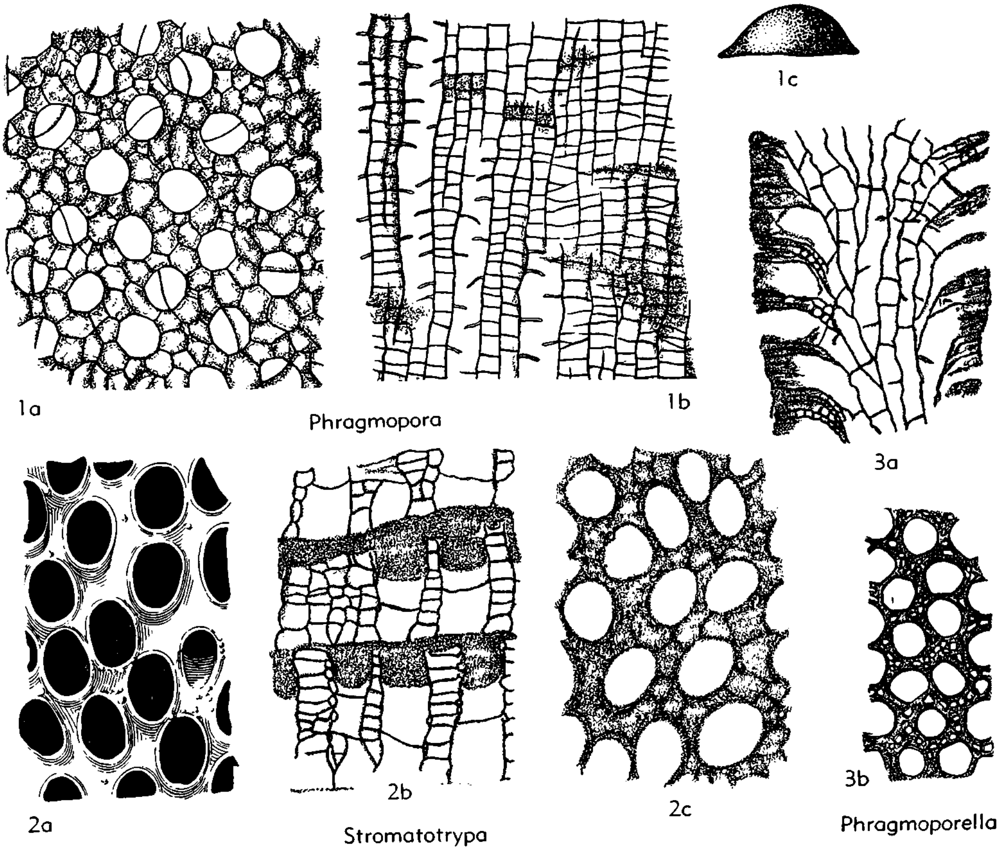

Fig. 78. Trematoporidae (p. G115).

Fig. 77,*4*. *H. irrasum* (Ulr.), Blriv., Minn.; *4a*, zoarium, ×1; *4b*, surface, ×10; *4c,d*, secs., ×20, ×10 (222).

Monotrypa Nich., 1879 [**Chaetetes undulatus* Nich., 1875] [=*Pachytheca* Schlüter, 1885; *Ptychonema* Hall-S., 1887]. Massive. Zooecia angular, with undulating thin walls. Mesopores absent. *Ord.-Dev.*——Fig. 77,*2*. **M. undulata* (Nich.), Ord.(Trenton.), Ont.; *2a,b*, secs., ×20 (197).

Phragmopora Vinassa, 1920 [**Hemiphragma multiporatum* Bassler, 1911]. Dome-shaped. Like *Hemiphragma* but zooecia thin-walled, with hemiphragms throughout, and mesopores numerous, closely tabulate. Acanthopores absent. *M.Ord.*——Fig. 78,*1*. **P. multiporata* (Bassler), Est.; *1a,b*, secs., ×20; *1c*, zoarium, ×1 (131).

Phragmoporella Vinassa 1920 [**Hemiphragma maculatum* Bassler, 1911]. Slender cylindrical branches with conspicuous maculae. Zooecia with wide-spaced hemiphragms. Mesopores minute, closely tabulate; acanthopores absent. *M.Ord.*——Fig. 78,*3*. **P. maculata* (Bassler), Est.; *3a,b*, secs., ×20 (131).

Polyteicus Počta, 1902 [**Monotrypa novaki* Perner, 1900]. Like *Monotrypa* but surface bears one or more bifoliate lamellae with apertures. *Ord.*——Fig. 77,*3*. **P. novaki* (Perner), Czech.; sec., ×5 (205).

Stromatotrypa Ulr., 1893 [**S. ovata*]. Superposed lamellae. Zooecia oval; papillose interspaces at surface denote mesopores. *Ord.*——Fig. 78,*2*. **S. ovata*, Blkriv., Minn.; *2a*, surface, ×20; *2b,c*, secs., ×20 (222).

Family PHYLLOPORINIDAE Ulrich, 1890

[=Subreteporidae Miller, 1889; Chainodictyonidae Nickles-B., 1900]

Zoaria composed of anastomosing or reticulating slender branches attached at base, with 2 to 8 rows of apertures on front (celluliferous) side and none on the other (back), which is longitudinally striate. Zooecia comprise gently curved tubes with long immature region; diaphragms widely spaced or lacking and no hemisepta; apertures generally without peristome. Mesopores with closely spaced diaphragms and acanthopores, surficially marked by spines, may be present in the mature region. The assemblage is intermediate between Cryptostomata, which it resembles in zoarial form, and Trepostomata, which it matches in internal structure. Assignment of the family to the Trepostomata is based on lack of proved diagnostic cryptostome structures (46,49,114,115; NICKLES-B., 1900; BASSLER, 1952). *Ord.-Perm.*

Phylloporina ULR., 1887 [**Retepora trentonensis* NICH., 1871 (=*R. fenestrata* HALL, 1850)]. Anastomosing branches with 4 to 8 rows of apertures. Elongate angular zooecial tubes separated by closely tabulate mesopores. *Ord.*——FIG. 79,*4*. **P. fenestrata* (HALL); *4a,b,* secs., ×20, Trenton., Ont.; *4c,d,* back, front, ×10, Trenton., N.Y.——FIG. 79,*5*. *P. sublaxa* ULR., Blkriv., Minn.; *5a,b,* back, front, ×10 (222).

Bashkiriella NIKIF., 1939 [**B. ornata*]. Zoarium like *Subretepora* but zooecia converge toward middle of branch; acanthopores stellate. *Carb.*——FIG. 79, *3*. **B. ornata,* Fenestellidae ser., Russ.; sec., ×20 (198).

Carinophylloporina BASSLER, 1952 [**C. typica*]. Like *Phylloporina* but fenestrules hexagonal, with sharp keel dividing 4 to 6 longitudinal rows of apertures in 2 sets. *Ord.*——FIG. 80,*1*. **C. typica,* Blkriv.(Edinburg), Va.; *1a,b,* frontal side, ×10, ×20; *1c,* back, ×10 (131).

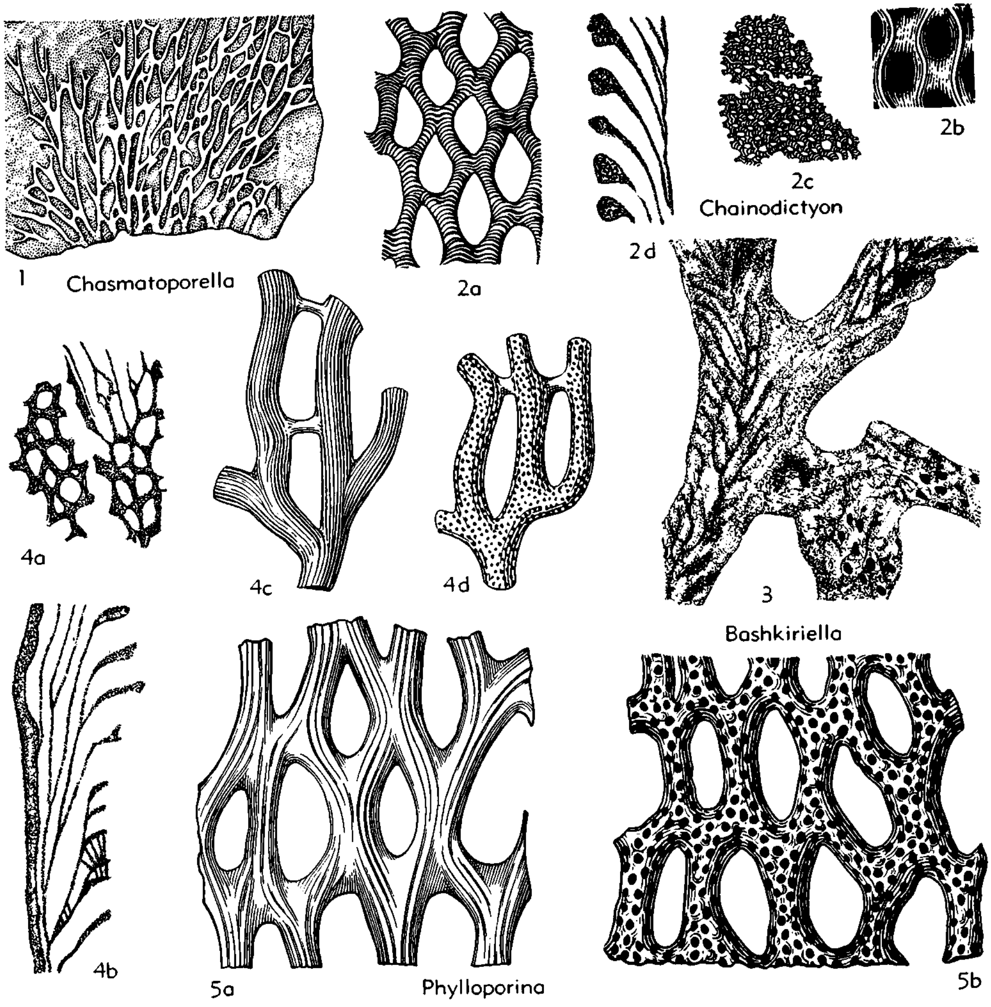

FIG. 79. Phylloporinidae (p. G116, G117).

Chainodictyon Foerste, 1887 [**C. laxum*]. Like *Phylloporina* but zooecia shorter and without diaphragms; mesopores absent; back concentrically undulated. *Penn.-Perm.*——Fig. 79,*2*. **C. laxum*, Penn., Ohio; *2a,b*, back and front, ×5, ×15; *2c*, zoarium, ×1; *2d*, long. sec., ×10 (222).

Chasmatoporella Nekh., 1936 [**C. metzi*]. Dichotomously branching, with 2 rows of zooecia separated by keel and uniting at 4 or more diameters apart. *Ord.*——Fig. 79,*1*. **C. metzi*, NE.Italy (Carnic Alps); zoarium, ×1 (195).

Moorephylloporina Bassler, 1952 [**M. typica*]. Like *Phylloporina* but fenestrules polygonal, small; frontal with 2 rows of well-spaced circular apertures divided by threadlike keel bearing minute perforated nodes (?acanthopores) at regular intervals. *M.Ord.*——Fig. 80,*2*. **M. typica*, Blkriv. (Edinburg), Va.; *2a,b*, back, front, ×20 (131).

Oeciophylloporina Bassler, 1952 [**O. typicalis*]. Like *Subretepora* but branches bear 3 or 4 rows of circular apertures, fenestrules elongate; ovicell-like structures on frontal; granular longitudinal striae on back. *M.Ord.*——Fig. 80,*3*. **O. typicalis*, Blkriv.(Edinburg), Va.; *3a,b*, front, back, ×20 (131).

Pseudohornera Roemer, 1876 [**Retepora diffusa* Hall, 1852][=*Drymotrypa* Ulr., 1890 (obj.); *Thamnocella* Simpson, 1897]. Branches bifurcating but not anastomosing, with zooecia rising from a thin double plate. *Ord.-Sil.*——Fig. 81,*2*. **P. diffusa* (Hall), Sil.(Clint.), N.Y.; *2a*, zoarium, ×1; *2b,c*, back, front, ×5; *2d-f*, secs., ×20 (131).

Sardesonina Bassler, 1952 [**Phylloporina corticosa* Ulr., 1886]. Branches broad, closely reticulate, with 4 to 6 rows of apertures on frontal side traversed by strongly undulating carinae. *Ord.*——Fig. 81,*4*. **S. corticosa* (Ulr.), Blkriv., Minn.; *4a*, zoarium, ×1; *4b,c*, secs., ×20, ×10; *4d,e*, back, front, ×10 (222).

Subretepora d'Orb., 1849 [**Intricaria reticulata* Hall, 1847][=*Chasmatopora* Eichw., 1860]. Characters relatively ill known. Reticulate branches with 2 or more rows of short-tubed granular zooe-

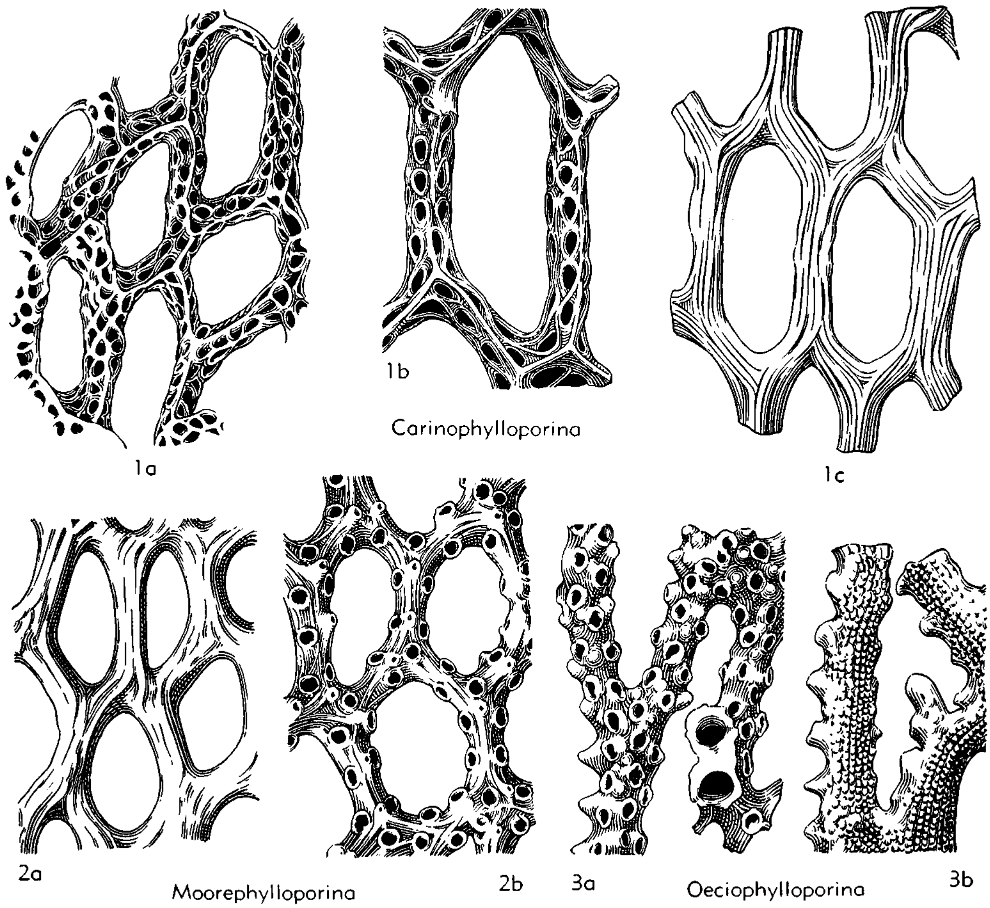

Fig. 80. Phylloporinidae (p. G116, G117).

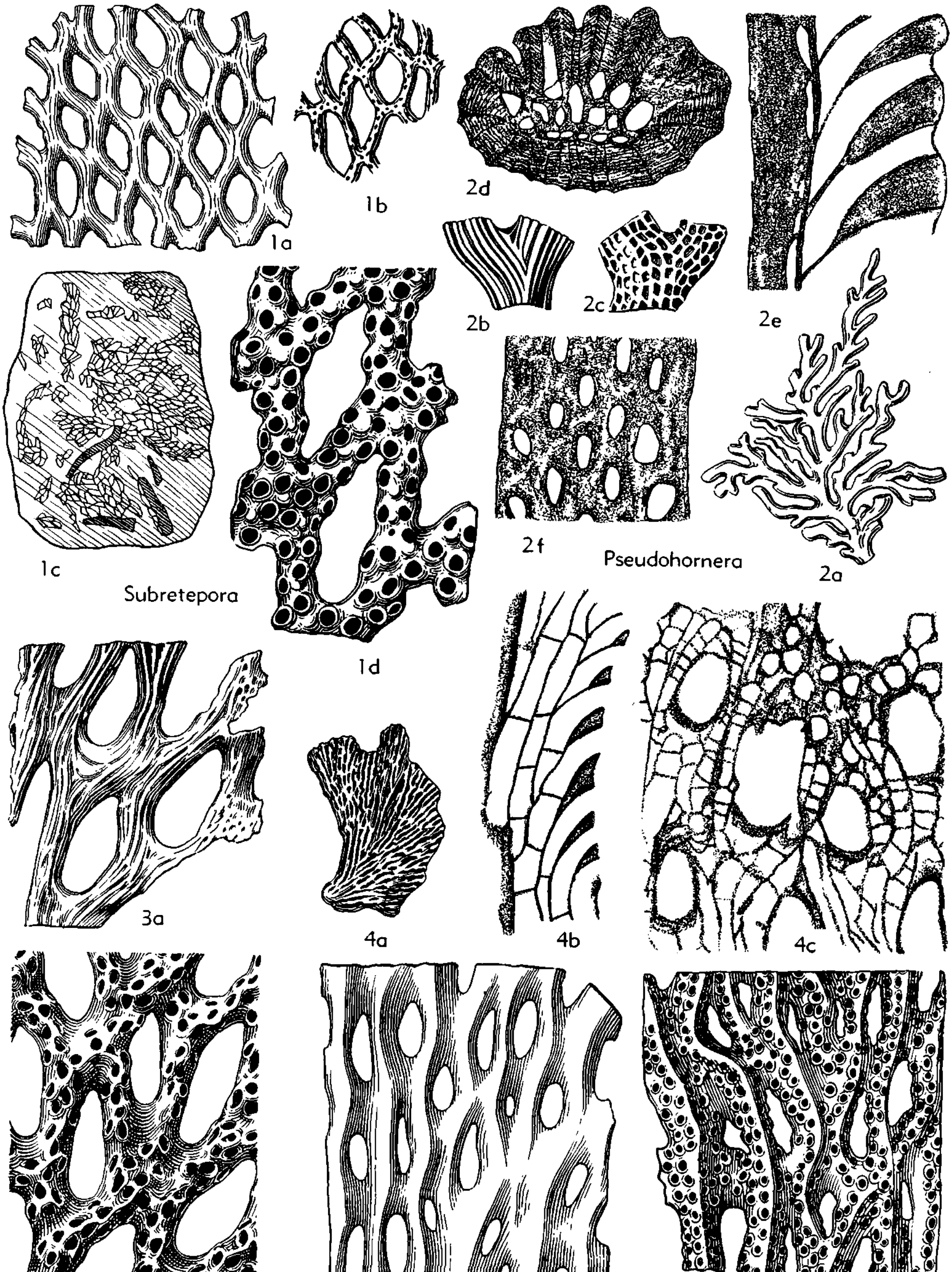

FIG. 81. Phylloporinidae (p. G117-G119).

cia with diaphragms, apertures separated by irregularly placed nodes (acanthopores); back with delicate striations; mesopores absent. *Ord.-Sil.*——FIG. 81,*1*. **S. reticulata* (HALL), Ord.(Trenton.), N.Y.; *1a,b*, back, front, ×10; *1c*, zoarium, ×1; *1d*, front, ×20 (*1a,c*, 149; *1b,d*, 222).

Trepostomina BASSLER, 1952 [**T. crassa*]. Reticulate branches, elongate fenestrules; front with 3 to 5 rows of elliptical to angular zooecial apertures; back closely striate. *M.Ord.*——FIG. 81,*3*. **T. crassa*, Blkriv.(Edinburg), Va.; *3a,b*, back, front, ×10 (131).

Order CRYPTOSTOMATA Vine, 1883

Zoaria mostly delicate reticulate fronds or slender branching stems of cylindrical or ribbon-like form, all calcareous. Zooecia as in Trepostomata, with well-marked differentiation of immature and mature regions, but the boundary between them more abrupt and the tubes much shorter; the distal part of each zooecial tube is a vestibule that extends from the aperture at the surface to the position of the orifice near the inner boundary of the mature zone, defined in many forms by shelflike hemisepta projecting from the walls. Interspaces between adjacent vestibules commonly filled by vesiculose coenosteum or solid stereom, which may be traversed by acanthopores. *Ord.-Perm.*

MORPHOLOGICAL FEATURES

This order is characterized by relative shortness of the zooecial tubes and concealment of their orifice (*cryptos*, hidden) at the bottom of a tubular shaft or vestibule which is surrounded by solid, laminated, or vesicular calcareous tissue. The primitive zooecium is regularly pyriform to oblong, quadrate or hexagonal in shape, with the orifice at its distal extremity. Since this is a prevailing character of the Cheilostomata, it is possible the Cryptostomata are really Paleozoic cheilostomes. The cryptostomes differ from typical cheilostomes, however, (1) in the absence of ovicells and avicularia; (2) in the much greater deposit of calcareous material on the zooecial front; (3) in the common development of successive layers of zooids one directly over another so as to form a continuous zooecial tube; and (4) in the presence of regularly spaced maculae or monticules composed of specialized cells in expanded lamellate zoaria. The 2 last-cited distinctions are suggestive of the Trepostomata, but the Cryptostomata differ from them in having a much shorter immature region (primitive cell), a more abrupt passage to the mature region, and a vestibule.

Some ramose Cryptostomata have relatively long thin-walled prismatic tubes in the axial region, with or without diaphragms, precisely as in ramose trepostomes and cyclostomes. They are distinguished from both these orders, however, by presence of semidiaphragms called hemisepta, one of which (superior hemiseptum) may extend downward and forward from the posterior (proximal) side of the base of the vestibule into the primitive cell, and the other (inferior hemiseptum) rising from the bottom of the cell (distal wall). The purpose of the hemisepta is unknown, although possibly they served as supports for a movable operculum. Acanthopores are common, as in the Trepostomata; in many zoaria they include very large ones (megacanthopores), generally located at the distal end of a zooecium, and small ones (micracanthopores) surrounding the aperture.

Relationship of the Cryptostomata to Cheilostomata is suggested by similarity of zoarial forms and markings of zooecial surfaces. In many typical Cryptostomata, the zoarium consists of 2 thin layers of zooecia growing back to back into erect sword-shaped, ramose, ribbon-like or fan-shaped expansions (Ptilodictyidae, Stictoporellidae, Rhinidictyidae, Sulcoreteporidae). In other Cryptostomata, the zoaria are lacelike expansions (Fenestellidae, Acanthocladiidae) consisting of only a single layer of cells with the back side covered by a dense layer of striated or minutely granulose tissue. In another prolific section, the zoaria are ramose, with zooecia arising from a real or imaginary axis and opening on all sides of narrow cylindrical stems (Rhabdomesidae, Arthrostylidae). Mostly these zoaria are continuous, but in some delicate, erect forms they are regularly divided into segments, articulating with each other or only at the base.

Most cryptostome bryozoans can be identified from surface characters of the zooecia and zoarium, but in some, particularly the bifoliate and solid ramose species, thin sections are as essential for study as in the Trepostomata.

DISTRIBUTION

The order first appears in Ordovician rocks, reaches greatest development in Devonian and Mississippian deposits, and disappears in the Upper Permian. Many Ordovician genera and species have been described and illustrated by ULRICH (5,8) and BASSLER (13), Silurian by BASSLER (14), Devonian by HALL & SIMPSON (15), Carboniferous by ULRICH (5), and Permian by BASSLER (16).

Family FENESTELLIDAE King, 1850

[=Enalloporidae, Sphragioporidae, Thamniscidae MILLER, 1889; Fenestrellinidae BASSLER, 1935]

Zoaria forming reticulate expansions composed of rigid branches, laterally joined by regularly spaced nonporiferous crossbars (dissepiments) or by coalescence at opposed sinuous bends so as to leave open spaces (fenestrules) of circular, elliptical, or quadrangular form extending through the zoarium; branches rarely free, not laterally connected. Zooecia consisting of short recumbent tubes embedded in minutely porous calcareous tissue which is progressively modified by secretion of fine-grained dense laminae (sclerenchyme); proximal part of zooecia commonly delimited by a superior hemiseptum forming a semi-closed chamber which appears rounded, quadrate, or polygonal in longitudinal sections; primary orifice anterior (distal), semielliptical in outline, truncate behind; external apertures rounded, rimmed by a peristome, opening invariably on the side of branches that is termed front (obverse), but in exceptionally well-preserved specimens closed by a centrally perforate lid; the reverse side of branches, termed back, opposite the zooecial mouths, may be smooth, longitudinally striate, granulose, or nodose. Mesopores lacking but acanthopores represented by spines on the front side of branches, generally regularly spaced along a keel, may occur (68,111,114; NICKLES-B., 1900). *Ord-Perm.*

The zoarial characters of fenestellid bryozoans are quite constant and of great systematic importance. The nature of zooecial cavities closely resembles that observed in the Ptilodictyidae and Rhinidictyidae, and the same is true of the primary and external orifices.

The ability of bryozoans to deposit fine-grained calcareous tissue, lamina on lamina, whenever and wherever needed for support of the zoarium, probably is best exemplified in the Fenestellidae. By localized secretion of sclerenchyme, the relatively simple fronds of *Fenestella* type were built into unusual structures such as distinguish *Archimedes, Lyropora, Lyroporella,* and other unique genera. Similarly, specialized skeletal extension of acanthopore spines produced strange, delicate superstructures on the front side of zoarial fronds, as in *Hemitrypa, Isotrypa, Cervella,* and *Unitrypa.*

The terms front and back, for the celluliferous (obverse) and noncelluliferous (reverse) sides of the fenestellid frond, are adopted because of their simplicity.

Fenestella LONSD., 1839 [*nom. conserv.,* ICZN pend. (*non* BOLTON, 1798)] [**Fenestella antiqua* LONSD., 1839 (*nom. conserv.,* ICZN pend.)(*non Gorgonia antiqua* GOLDF., 1826 = *Fenestella antiqua* (GOLDF.) = *Fenestrella subantiqua* D'ORB., 1849 = *Fenestella subantiqua* D'ORB.)(*nom. conserv.,* ICZN pend.)] [=*Fenestrella* D'ORB., 1850]. Zoarium funnel- or fan-shaped. Zooecia in 2 rows on each branch with 2 to 8 apertures in a single row adjoining one fenestrule. Front of branches with or without median keel and acanthopore spines present or absent. *Ord.-Perm.*——FIG. 82,*1*. **F. antiqua* LONSD., Sil.(Wenlock.), Eng.; front, ×10 (179).

Anastomopora SIMPSON, 1897 [*pro Reteporella* SIMPSON, 1895 (*non* BUSK, 1884)] [**Fenestella cinctuta* HALL, 1884] [=*Reteporidra* NICKLES-B., 1900]. Thin fan-shaped fronds with thick lateral margins of lamellose tissue; branches anastomosing, fenestrules oval. Zooecial apertures in 3 to 7 rows on each branch. *Dev.*——FIG. 82,*2*. **A. cinctuta* (HALL), M.Dev., N.Y.; *2a,b,* front and back, ×5 (163).

Archimedes OWEN, 1838 [**Fenestella (Archimedes) wortheni* HALL, ?1856; SD MILLER, 1889] [=*Archimedipora* D'ORB., 1849]. Zoarial network like *Fenestella,* with 2 rows of apertures along branches, supported by a screwlike axis of laminated tissue that encloses proximal edge of the spirally twisted frond. *Miss.-Perm.*——FIG. 82,*5*. **A. wortheni* HALL, L.Miss.(Warsaw), Ill.; *5a,b,* spiral axis, long. sec. and surface., ×1 (222).——FIG. 82,*6*. *A. communis* ULR., U.Miss.(Chest.), Ky.; long. sec. of axis showing zooecial layers coated by lamellar tissue, ×25 (131).——Fig. 82,*7*. *A. proutana* Ulr., U.Miss.(Chest.), Ky.; spiral axis, ×1.——Fig. 82,*8*. *A. sublaxa* Ulr., U.Miss.(Chest.), Ill.; axis and part of fronds, ×1 (222).

Bicorbis Condra-E., 1945 [*pro Bicorbula* Condra-E., 1945 (*non* Fischer, 1887)] [**Bicorbula arizonica* Condra-E., 1945]. Zoarium double-layered, basket-like, with upper meshwork like *Polypora* and lower one of dense laminated tissue. *Perm.*——Fig. 82,*4*. **B. arizonica* (Condra-E.), M.Perm., Ariz.; long. sec., ×20 (141).

Cervella Chronic, 1949 [**C. cervoidea*]. *Fenestella*-type frond with superstructure of stellate processes developed from acanthopore-like spines along midline of branch fronts. *Perm.*——Fig. 82,*3*. **C. cervoidea*, L.Perm., Peru; *3a,b*, back and front, ×5, ×10 (139).

Enallopora d'Orb., 1849 [**Gorgonia perantiqua* Hall, 1847] [=*Protocrisina* Ulr., 1889]. Narrow bifurcating branches not laterally joined; a row of front-facing apertures along each margin of branch and irregularly placed additional ones between on front; back with small pores. *Ord.*——Fig. 83,*4*. **E. perantiqua* (Hall), Trenton., N.Y.; *4a,b*, front and back, ×10 (162).

Fenestepora Frederiks, 1915 [**Fenestella jabensis* Waagen & Pichl, 1886]. Like *Fenestella* but with row of small cells along carina. *U.Carb.*, Russ.

Fenestralia Prout, 1858 [**F. sanctiludovici*]. Like *Fenestella* but with 2 rows of apertures on each

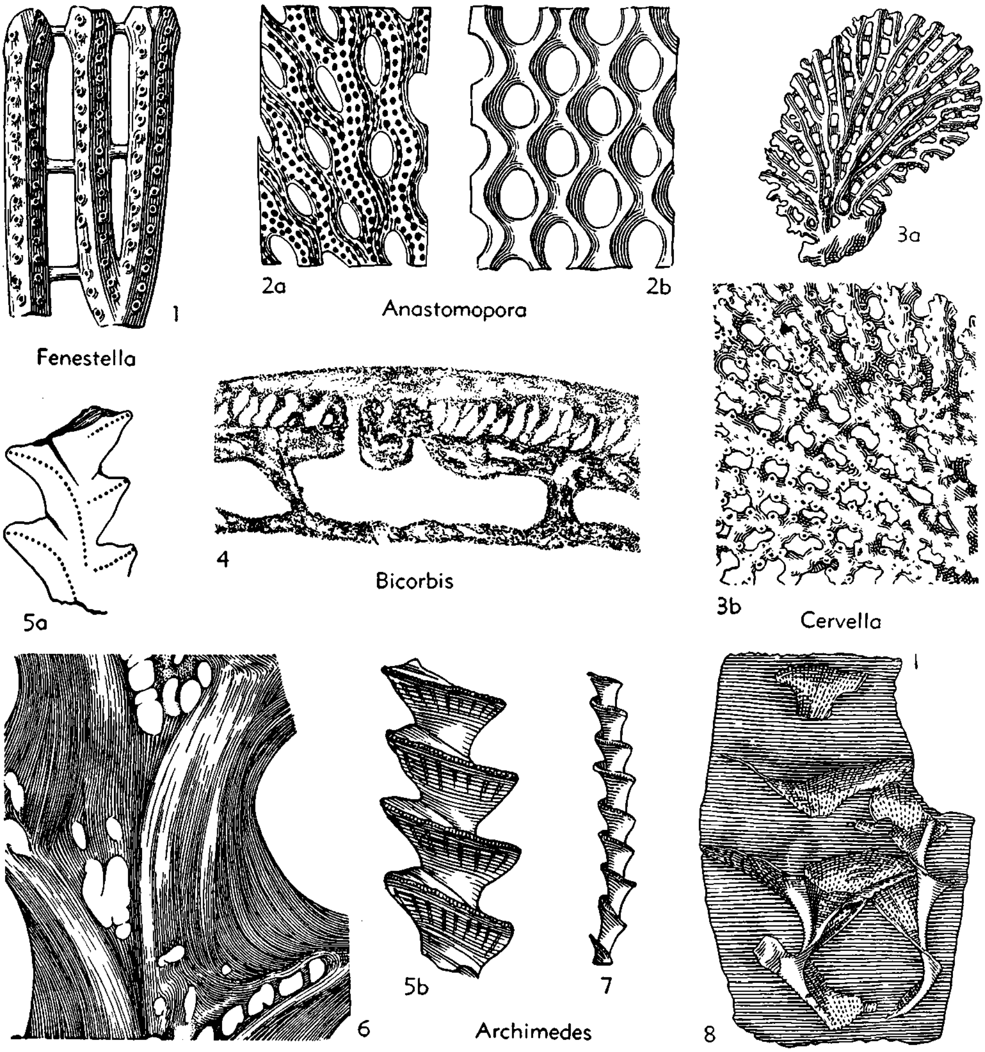

Fig. 82. **Fenestellidae (p. G120, G121).**

side of median keel. *Miss.*——FIG. 83,7. **F. sanctiludovici*, Meramec., Mo.; *7a*, front, ×5; *7b*, back, ×1 (217).

Fenestrapora HALL, 1885 [**F. biperforata*]. Like *Fenestella* but back and wide keel summits on front bear pores or pits. *Dev.*——FIG. 83,8. **F. biperforata*, M.Dev., N.Y.; *8a,b*, back, front, ×20 (162).

Fenestrellina D'ORB., 1849 [**Fenestella crassa* McCOY, 1844] [=*Actinostoma* Y.-Y., 1874; *Flabelliporina* SIMPSON, 1895]. Dissepiments widely separated and fenestrules very long, as in *Thamniscus;*

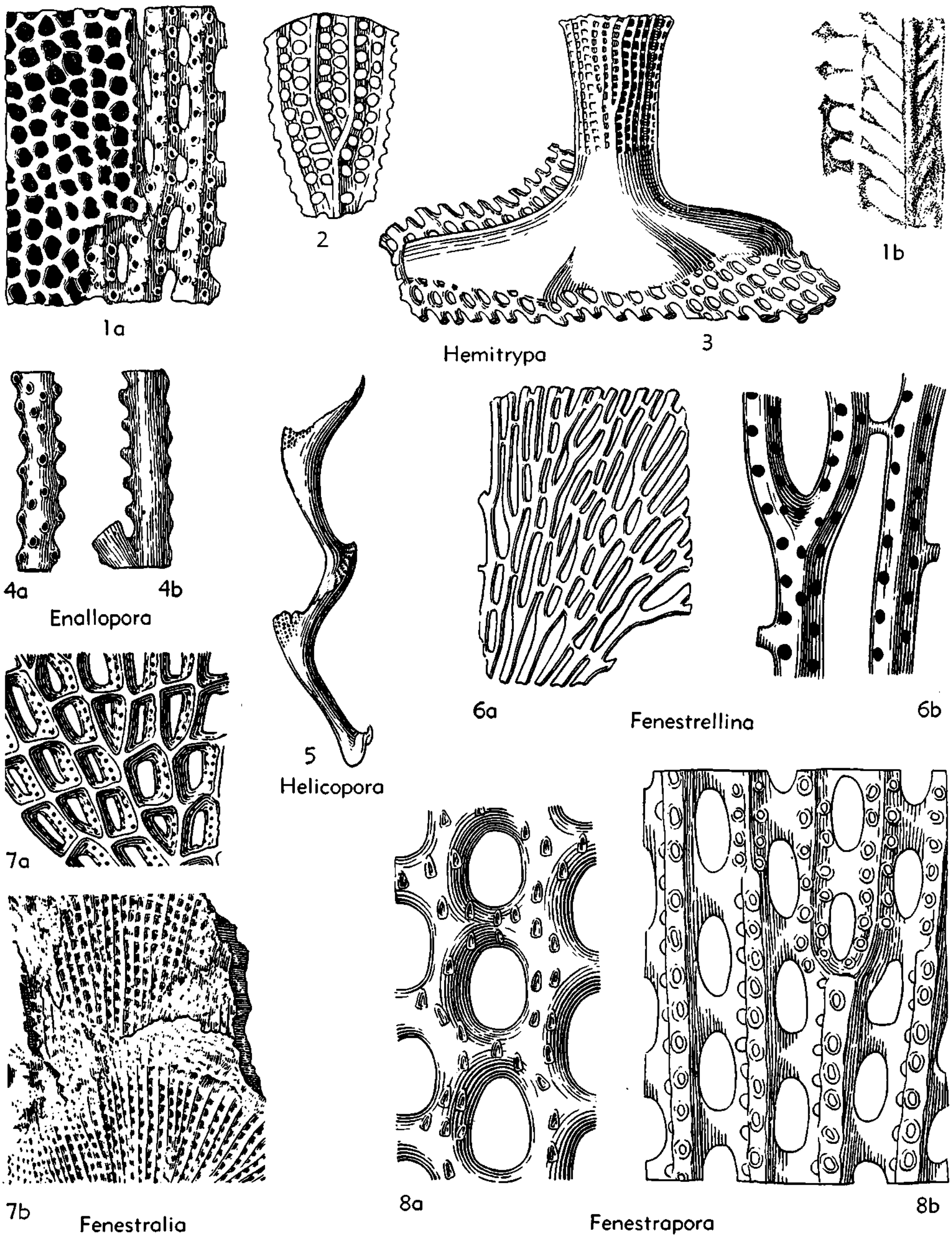

FIG. 83. Fenestellidae (p. G121-G123).

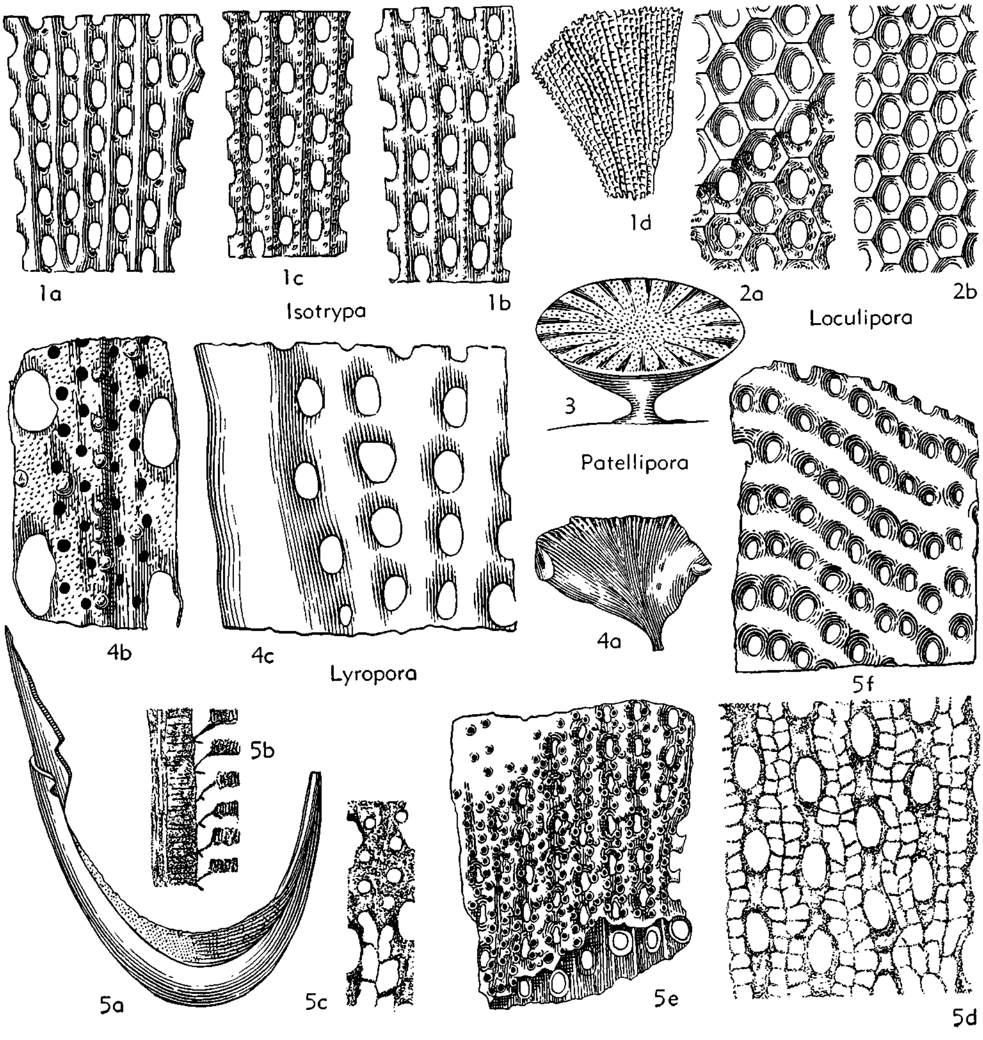

FIG. 84. Fenestellidae (p. G123-G125).

front with keel and 2 rows of apertures, as in *Fenestella. Carb.-Perm.*——FIG. 83,*6.* **F. crassa* (McCoy), L.Carb., Ire.; *6a,* back, ×1; *6b,* front, ×10 (180).

Helicopora CLAYPOLE, 1881 [**H. latispiralis*]. Network of *Fenestella* type twisted in loose spire around flexuous solid axis of laminated sclerenchyme. *Sil.-Dev.*——FIG. 83,*5.* **H. latispiralis,* Sil.(Niag.), Ohio; axis, ×1 (140).

Hemitrypa PHILLIPS, 1841 [**H. oculata*]. Like *Fenestella* but with reticulate superstructure borne by regularly spaced spines along keels of front side, meshes of upper network corresponding in number and position to zooecial apertures beneath. *Sil.-Perm.*——FIG. 83,*1. H. proutana* ULR., Miss. (Warsaw), Ill.; *1a,* front, showing superstructure partly removed, ×15; *1b,* long. sec., showing solid floor of branch (right), obliquely disposed zooecia (middle), and superstructure (left), ×20 (222).——Fig. 83,*2.* **H. oculata,* Dev., Eng.; front, showing superstructure, ×10 (206).——FIG. 83,*3. H. cribrosa* HALL, M.Dev., Falls Ohio, Ky.-Ind.; base of zoarium attached to a fenestellid, ×5 (162).

Isotrypa HALL, 1885 [**Fenestella (Hemitrypa) conjunctiva* HALL, 1883] [=*Amorphotrypa* WHIDBOURNE, 1897; *Tectuliporella* SIMPSON, 1895]. Like *Fenestella* but with superstructure formed by strongly elevated keels connected laterally by cross-bars, so that front and back of zoarium appear almost identical. *Dev.*——Fig. 84,*1*. **I. conjunctiva* (Hall), Onond., Ont.; *1a,b,* back, with pore at edge of each dissepiment, ×5; *1c,* front, with superstructure removed, ×5; *1d,* front, with superstructure in place, ×1 (162).

Loculipora Hall, 1885 [**Fenestella perforata* Hall, 1884] [=*Tectulipora* Hall, 1885; *Entopora* Maurer, 1885]. Dissepiments greatly reduced, carinae of branches and dissepiments so expanded and coalesced that front and back of zoarium are closely similar. *Sil.-Dev.*——Fig. 84,*2*. **L. perforata* (Hall), M.Dev.(Hamilton), N.Y.; *2a,b,* front, back, ×5 (162).

Lyropora Hall, 1857 [**Fenestella (Lyropora) subquadrans*] [=*Lyroporidra* Simpson, 1897 (obj.); *Dictyoretmon* Whitf., 1909]. Fenestrate zoarium with branches bearing 3 to 5 rows of zooecia, lateral borders of fan-shaped frond consisting of noncelluliferous thick deposit of laminated sclerenchyme; front of branches may bear keel with nodes. *Miss.-Perm.*——Fig. 84,*4*. **L. subquadrans* Hall, U.Miss.(Chest.), Ill.; *4a,* zoarium, ×1; *4b,* front, ×20; *4c,* back, showing a thickened edge, ×10 (222).

Lyroporella Simpson, 1895 [**Fenestella (Lyropora) quincuncialis* Hall, 1857] [=*Lyroporina* Simpson, 1897]. Like *Lyropora* but branches have only 2 rows of zooecia. *Miss.*——Fig. 84,*5*. **L. quincuncialis* (Hall), Chest., Ill.; *5a,* zoarium, network incomplete, ×1; *5b-d,* secs., ×20; *5e-f,* front and back, ×10 (222).

Minilya Crockford, 1944 [**M. duplaria*]. Like *Fenestella* but nodes along keel disposed zigzag, their number and position corresponding to arrangement of interlocked alternating zooecia of the 2 rows on each branch. *Penn.-Perm.*——Fig. 85,*1*. **M. duplaria,* Perm., W.Austral.; *1a,* tang. sec., ×10; *1b,* front, ×10 (142).

Patellipora Rom., 1887 [**P. stellata*]. Zoarium saucer-shaped, stalked; upper surface with radiat-

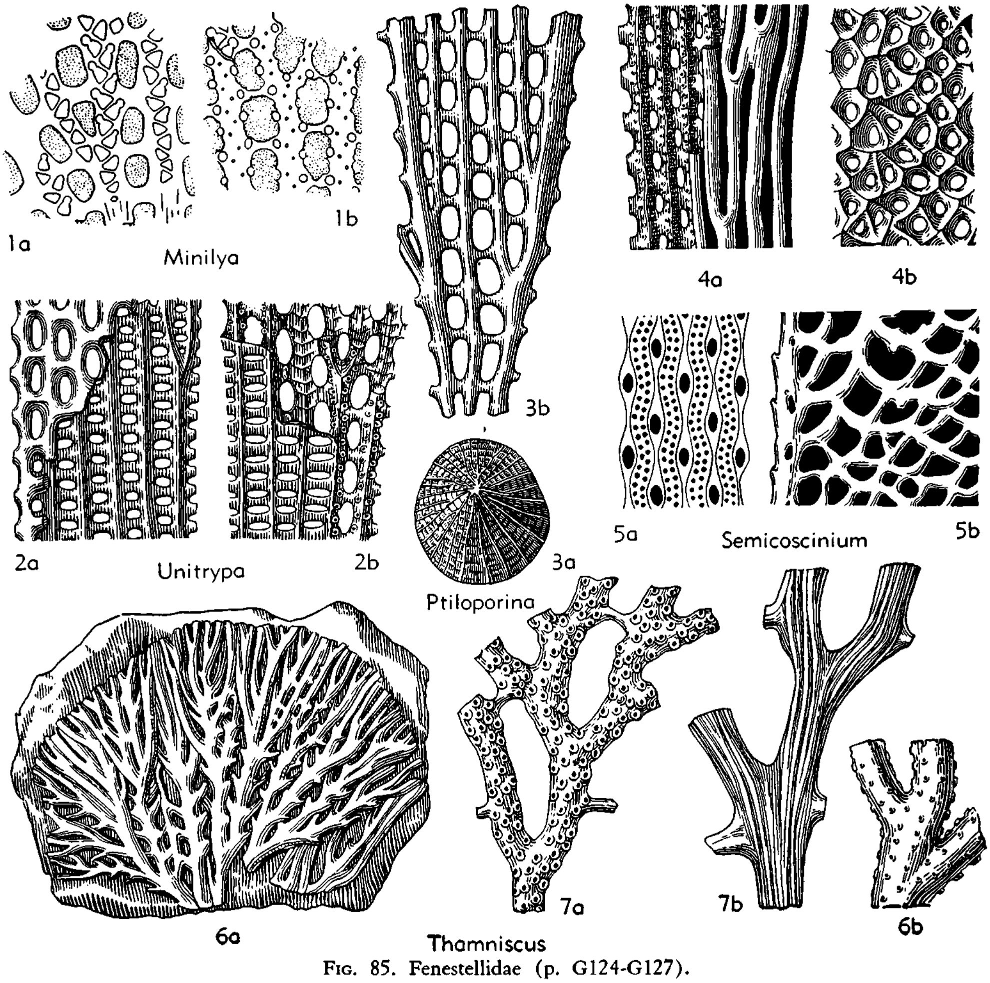

Fig. 85. Fenestellidae (p. G124-G127).

ing branches which bear rows of zooecia. *Dev.* ——FIG. 84,*3*. **P. stellata*, erratic in drift, Mich.; zoarium, ×1 (212).

Polypora McCOY, 1844 [**P. dendroides*] [=*Flabelliporella, Polyporella* SIMPSON, 1895; *Polyporina* FREDERIKS, 1920]. Like *Fenestella* but has 3 to 8 rows of zooecia on each branch; median keel absent but may be represented by row of nodes. *Ord.-Perm.*——FIG. 86,*7*. **P. dendroides*, L.Carb., Ire.; *7a,b*, front, ×1, ×5 (180).

Protoretepora DEKON., 1876 [**Fenestella ampla* LONSD., 1844] [=*Phyllopora* KING, 1849 (*non* EHR., 1834)]. Like *Polypora* but zooecial apertures occur on dissepiments. *Carb.-Perm.*——FIG. 86,*2*. **P. ampla* (LONSD.), Carb., N.S.W.; front, ×20 (179).——FIG. 86,*1*. **P. ehrenbergi* (GEINITZ), Perm., Ger.; *1a*, curved conical zoarium, ×1; *1b*, front, ×10 (155).

Pseudoisotrypa PRANTL, 1932 [**P. bohemica*]. Like *Isotrypa* but branches and superstructure flexuous, resembling anastomosis. *Dev.*, Czech.

Pseudounitrypa NEKH., 1926 [**P. sibirica*]. Spines along keels produced laterally at summit as inclined concave scales which may join to form superstructure. *Carb.*——FIG. 86,*4*. **P. sibirica*, L. Carb., Russ.; oblique tang. sec. intersecting branches (below), spines (middle), and superstructure (top), ×0.67 (195).

Ptiloporella HALL, 1885 [**Fenestella (Ptiloporella) laticrescens* HALL-S., 1887] [=*Pinnaporella* SIMPSON, 1897 (*non* SIMPSON, 1895)]. Like *Fenestella* but normal branches diverge pinnately from con-

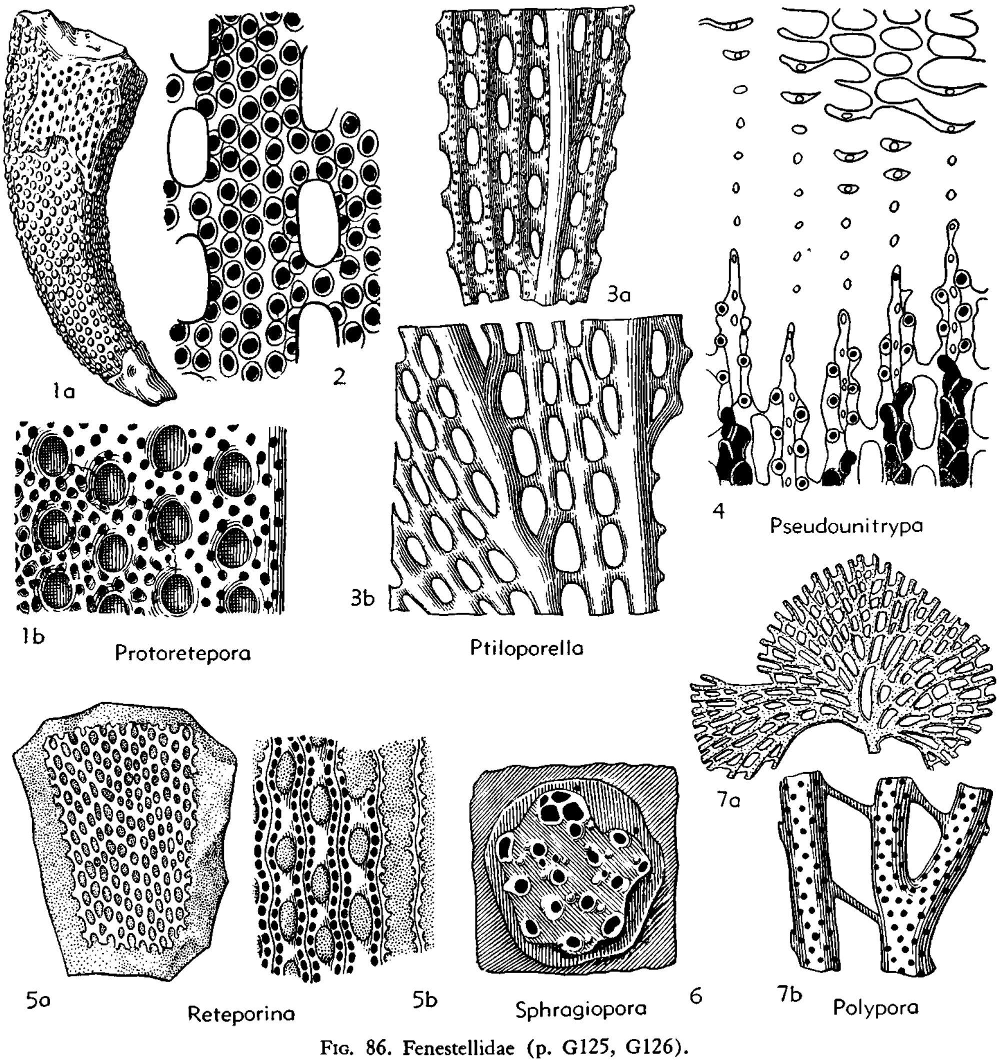

FIG. 86. Fenestellidae (p. G125, G126).

siderably thickened main branches. *Sil.-Dev.*——Fig. 86,*3*. **P. laticrescens* Hall-S., Dev.(Onond.), Ont.; *3a,b,* front and back, ×5 (162).

Ptiloporina Hall, 1885 [**Fenestella (Ptiloporina) conica* Hall-S., 1887] [=*Pinnaporella* (*non* Simpson, 1897), *Pinnaporina* Simpson, 1895]. Like *Ptiloporella* but branches have 3 or more rows of zooecia and no carina. *Dev.*——Fig. 85,*3*. **P. conica* Hall-S., Onond., Ont.; *3a,* zoarium, ×1; *3b,* back, ×5 (162).

Reteporina d'Orb., 1849 [**Retepora prisca* Goldf., 1826] [=*Heteroprisca* Nekh., 1929 (obj.)]. Poorly known; may be senior synonym of *Semicoscinium*. *Dev.*——Fig. 86,*5*. **R. prisca* (Goldf.), M. Dev., Ger.; *5a,* back, ×1; *5b,* front, ×5 (157).

Semicoscinium Prout, 1859 [**S. rhomboideum*] [=*Carinopora, Cryptopora* Nich., 1874; *Cycloporina* Simpson, 1895; ?*Cyclopelta* Borneman, 1884]. Zoarium funnel-shaped, celluliferous on outer side, fenestrules subrhomboidal on back, branches with 2 rows of zooecia and high median keel expanded at top. *Sil.-Dev.*——Fig. 85,*4*. *S. interruptum* Hall-S., M.Dev., Falls Ohio, Ky.-Ind.; *4a,* front, with expanded keels removed at left, ×5 (163).——Fig. 85,*5*. **S. rhomboideum,* M.Dev., Falls Ohio, Ky.-Ind.; *5a,* front, weathered, ×5; *5b,* back, ×5 (208).

Seriopora Počta, 1894 [**S. petala*]. Dissepiments reduced to minimum. *Dev.,* Czech.

Sphragiopora Ulr., 1889 [**S. parasitica* Ulr., 1890]. Minute incrusting patches; ?juvenile stage of fenestellid. *Miss.-Perm.*——Fig. 86,*6*. **S. parasitica* Ulr., U.Miss.(Chest.), Ill.; front, ×20 (222).

Thamniscus King, 1849 [**Keratophytes dubius* Schloth., 1820] [=*Thamniscides* King, 1849]. Like *Polypora* but dissepiments far apart or nearly absent. *Sil.-Perm.*——Fig. 85,*6*. **T. dubius* (Schloth.), Perm., Ger.; *6a,* back, ×1; *6b,* front, ×5 (170).——Fig. 85,*7*. *T. ramulosus* Ulr., U. Miss. (Chest.), Ill.; *7a,b,* front, back, ×10 (222).

Unitrypa Hall, 1885 [**Fenestella (Hemitrypa) lata* Hall, 1883]. Like *Fenestella* but has reticulate superstructure on front consisting of imbricate lamellae (scalae) which correspond in num-

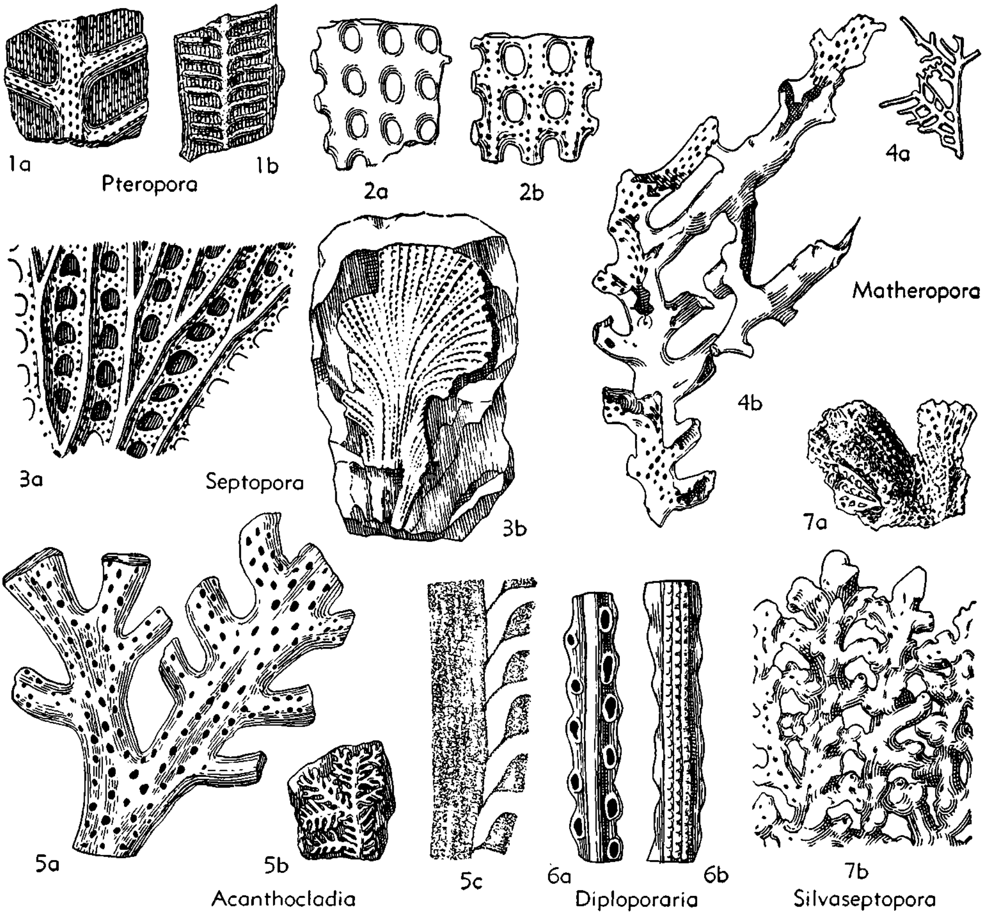

Fig. 87. Acanthocladiidae (p. G127, G128).

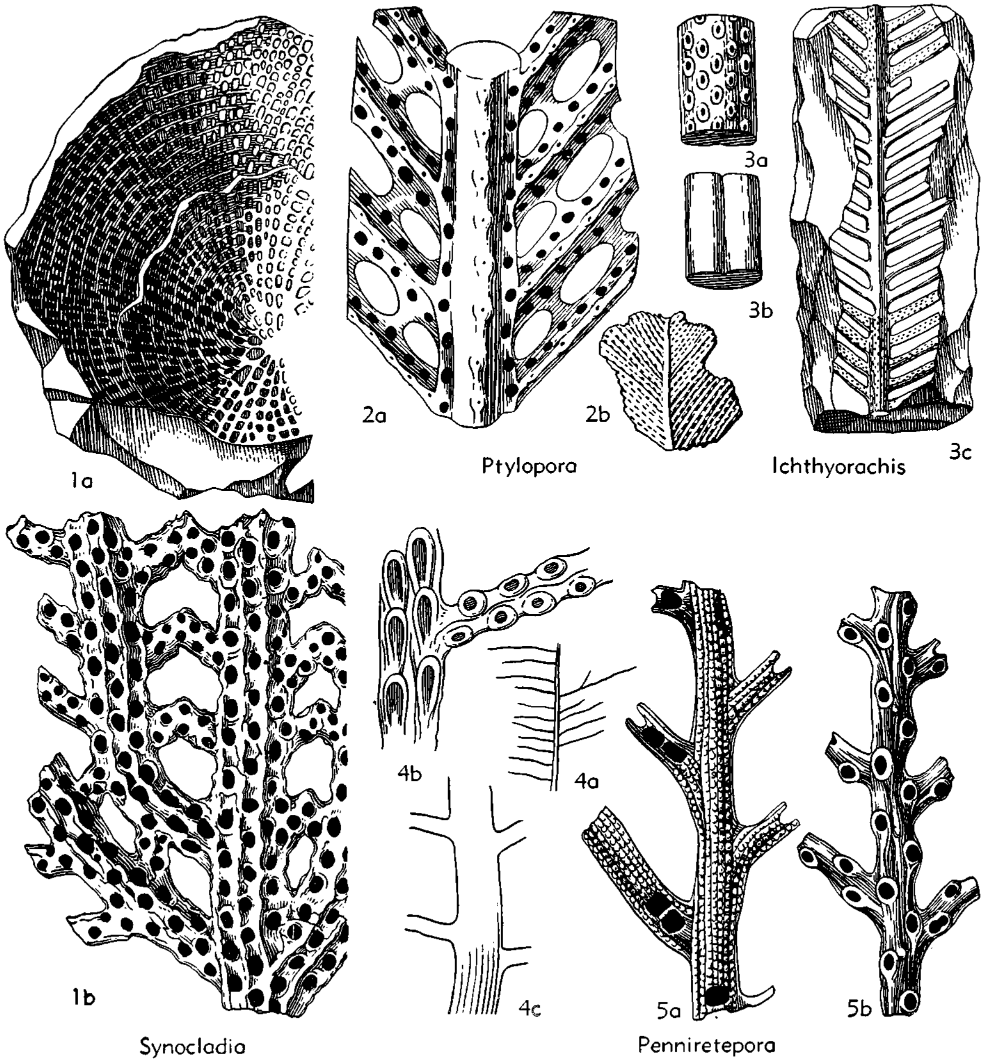

FIG. 88. Acanthocladiidae (p. G128).

ber to zooecia, the whole borne by projections of keels on the branches. *Sil.-Dev.*——FIG. 85,2. **U. lata* (HALL), M.Dev.(Onond.), Ont.; *2a,* back, mostly showing underside of superstructure, ×5; *2b,* front, with superstructure in place at left, ×5 (162).

Utropora POČTA, 1894 [**U. nobilis*]. Zooecial apertures on sides of branches, distinction between front and back lost. *Dev.,* Czech.

Family ACANTHOCLADIIDAE Zittel, 1880

Zoarium composed of strong stems with branches generally diverging obliquely and remaining free or uniting with adjacent branches, the side branches with or without connecting crossbars (dissepiments) which may bear zooecia (111,114; NICKLES-B., 1900). *Sil.-Perm.*

Acanthocladia KING, 1849 [**Keratophytes anceps* SCHLOTH., 1820]. Coarse stipes with 3 or more rows of zooecia; short oblique side branches closely and regularly spaced, commonly without dissepiments. *Penn.-Perm.*——FIG. 87,5. **A. anceps* (SCHLOTH.), *Perm.,* Ger.; *5a,* front, ×10; *5b,* zoarium, ×1; *5c,* long. sec., ×20 (170).

Diploporaria NICKLES-B., 1900 [*pro Diplopora* Y.-Y., 1875 (*non* GÜMBEL, 1866)] [**Glauconome* *marginalis* Y.-Y., 1875]. Like *Penniretepora* but side branches very few. *Carb.-Perm.*——FIG. 87,6. **D. marginalis* (Y.-Y.), L.Carb., Scot.; *6a,b,* front, back, ×20 (233).

Filites POČTA, 1894 [**F. cribrosus*. Resembles *Penniretepora. Dev.*, Czech.

Ichthyorachis McCOY, 1844 [**I. newenhami*] [=*Ichthyorhachis* AGASSIZ, 1845). Like *Ptylopora* but main stem bears 5 or more rows of zooecia and side branches generally 3 rows; dissepiments lacking. *Dev.-Carb.*——FIG. 88,3. **I. newenhami,* L.Carb., Ire.; *3a,b,* fragment of main stem, front and back, ×10; *3c,* front, ×1 (180).

Lyrocladia SHULGA, 1931 [**L. permica*]. *Perm.,* Russ.

Matheropora BASSLER, *nom. nov.* [*pro Dictyocladia* MATHER, 1915[1] (*non* POMEL, 1872)] [**Dictyocladia triseriata* MATHER, 1915]. Like *Acanthocladia* but main stems have 4 or 5 rows of zooecia and side branches partly joined by dissepiments. *Penn.-Perm.*——FIG. 87,4. **M. triseriata* (MATHER), L. Penn.(Morrow.), Ark.; *4a,* zoarium, ×1; *4b,* front, ×5 (187).

Penniretepora D'ORB., 1849 [**Retepora pluma* PHILLIPS, 1836] [=*Acanthopora* Y.-Y., 1875; *Pinnatopora* VINE, 1883; *Glauconome* auctt. (*non* GOLDF., 1826)]. Slender main stem and short, regularly spaced, oblique side branches without dissepiments; 2 rows of zooecia on stem and branches. *Dev.-Perm.*——FIG. 88,4. **P. pluma* (PHILLIPS), L.Carb., Eng. (Yorks.); *4a,* zoarium, ×1; *4b,c,* front and back, ×20 (206).——FIG. 88,5. *P. bellula* (ULR.), L. Penn., Ill.; *5a,b,* back, front, ×20 (222).

Pteropora EICHW., 1855 (*non* HALL, 1883) [**P. pennula*]. Like *Ichthyorachis* but side branches connected by celluliferous tissue. *Ord.*——FIG. 87,1. **P. pennula,* M.Ord., Est.; *1a,b,* front, ×5, ×1 (149).

Ptylopora McCOY, 1844 [**P. pluma*] [=*Ptilopora* AGASSIZ, 1846; *Dendricopora* DEKON., 1876]. Zoarium pinnate, with strong main stem and long oblique side branches connected by dissepiments generally non-celluliferous but in some with apertures; 2 rows of zooecia divided by node-bearing keel on stem and side branches. *Dev.-Perm.*——FIG. 88,2. **P. pluma,* L.Carb., Ire.; *2a,* front, ×10; *2b,* zoarium, ×1 (180).

Samaria STUCK., 1888 (*non* RAGANOF, 1893) [**S. volgensis*]. *L.Carb.,* Russ.

Septopora PROUT, 1859 [**S. cestriensis*] [=*Loculiporella* FREDERIKS, 1920]. Primary and secondary branches numerous, the latter joined to adjacent primaries; 2 rows of zooecia on all branches; back with scattered pores; union of secondaries (pinnae) may form dissepiment-like structures with apertures. *Miss.-Perm.*——FIG. 87,2. *S. laevis* EICHW., Carb., Russ.; *2a,b,* back, front, ×5 (149).——FIG. 87,3. **S. cestriensis,* U.Miss.(Chest.), Ill.; *3a,* front, ×5; *3b,* zoarium, ×1 (208).

[1] MATHER, K. F., 1915, Denison Univ. Bull. Sci. Lab., vol. 18, p. 131.

Silvaseptopora CHRONIC, 1949 [**S. incaica*]. Like *Septopora* but front bears prominent spines along keels, largest with treelike branching. *Perm.*——FIG. 87,7. **S. incaica,* Peru; *7a,* zoarium, ×1; *7b,* front, ×5 (139).

Synocladia KING, 1849 [**Retepora virgulacea* PHILLIPS, 1829]. Like *Septopora* but branches coarser and bearing 3 or more rows of zooecia. *Miss.-Perm.*——FIG. 88,1. **S. virgulacea* (PHILLIPS), Perm., Eng.; *1a,* back, ×1; *1b,* front, ×10 (170).

Syncladiopsis GREGORIO, 1930 [**S. elegans*]. *Perm.,* Sicily.

Family ARTHROSTYLIDAE Ulrich, 1888

Zoaria composed of numerous subcylindrical articulated segments forming small pinnate or bushy growth or continuous dichotomously dividing branches. Zooecia radially arranged about a central axis, opening on all sides of the segments or only on one side, the other being longitudinally striate and lacking apertures (3,114,115; NICKLES-B., 1900). *Ord.-Dev.*

Arthrostylus ULR., 1888 [*pro Arthronema* ULR., 1882 (*non* ESCHSCHOLTZ, 1825)] [**Helopora tenuis* JAMES, 1878]. Very delicate subquadrate segments articulating terminally to form bushy zoaria, with zooecia in 3 rows between longitudinal ridges, the 4th face with striae only. *Ord.*——FIG. 89,1. *A. obliquus* ULR., Blkriv., Minn.; *1a,b,* side and back, ×20 (222).——FIG. 89,2. **A. tenuis* (JAMES), Eden., Ohio; *2a,* zoarium, ×1; *2b-d,* front and 2 back views, ×25 (222).

Arthroclema BILL., 1862 [**A. pulchellum*]. Segments celluliferous on all sides, articulated terminally and laterally to form a pinnate zoarium. *Ord.*——FIG. 89,3. **A. pulchellum,* Trenton., Ont.; *3a,* zoarium, ×1; *3b,c,* segments, one showing lateral socket, ×20 (222).

Arthrostyloecia BASSLER, 1952 [**A. nitida*]. Differs from *Arthrostylus* in having distinct oval peristomes around apertures, some enlarged as cup-shaped structures resembling ovicells. *Ord.*——FIG. 89,7. **A. nitida,* Blkriv., Va.; *7a,* front; *7b,c,* back of segment with basal joint and front; all ×20 (131).

Glauconomella BASSLER, 1952 [**Glauconome disticha* GOLDF., 1836]. Zoarium continuous, pinnate, with short side branches joined obliquely to stem, lacking apertures on back; basal articulation not observed. *Ord.-Sil.*——FIG. 89,4. *G. plumula* (WIMAN), Ord.(from drift), Gotl.; *4a,b,* front, back, ×10 (232).——FIG. 89,5. **G. disticha* (GOLDF.), Sil. (Wenlock.), Eng.; *5a,* front, ×10; *5b,* zoarium, ×1 (157).

Helopora HALL, 1851 [**H. fragilis*]. Like *Arthrostylus* but segments larger, apertures on all sides, and acanthopores present. *Ord.-Sil.*——FIG. 90,*1*. **H. fragilis,* Sil. (Medin.), N.Y.; *1a-d,* secs., ×20 (222).

Heminematopora [**H. virginiana*]. Differs from *Nematopora* in having longitudinally striate back lacking apertures. *Ord.*——FIG. 89,*8*. **H. virginiana,* Blkriv., Va.; *8a,b,* front, back, ×20; *8c,* front of branch with broken basal point, ×20 (131).

Hemulrichostylus BASSLER, 1952 [**H. lineata*]. Like *Ulrichostylus* but jointed only at base and has broad striate back. *Ord.*——FIG. 89,*6*. **H. lineata,* Blkriv., Va.; *6a,b,* front, back, ×20 (131).

Nematopora ULR., 1888 (*non* DUV., 1920) [**Trematopora minuta* HALL, 1876]. Zoarium dichotomously branched, continuous, articulated only at base; apertures on all sides. *Ord.-Sil.*——FIG. 90,*5*. **N. minuta* (HALL), Sil.(Clinton.), N.Y.; *5a,* surface, ×10; *5b,c,* secs., ×20 (131).——FIG. 90,*6*. *N. delicatula* ULR., Ord.(Trenton.), Ill.; branch with basal joint, ×20 (131).——FIG. 90,*7*. *N. ovalis* ULR., Ord.(Trenton.), Minn.; surface, ×20 (222).

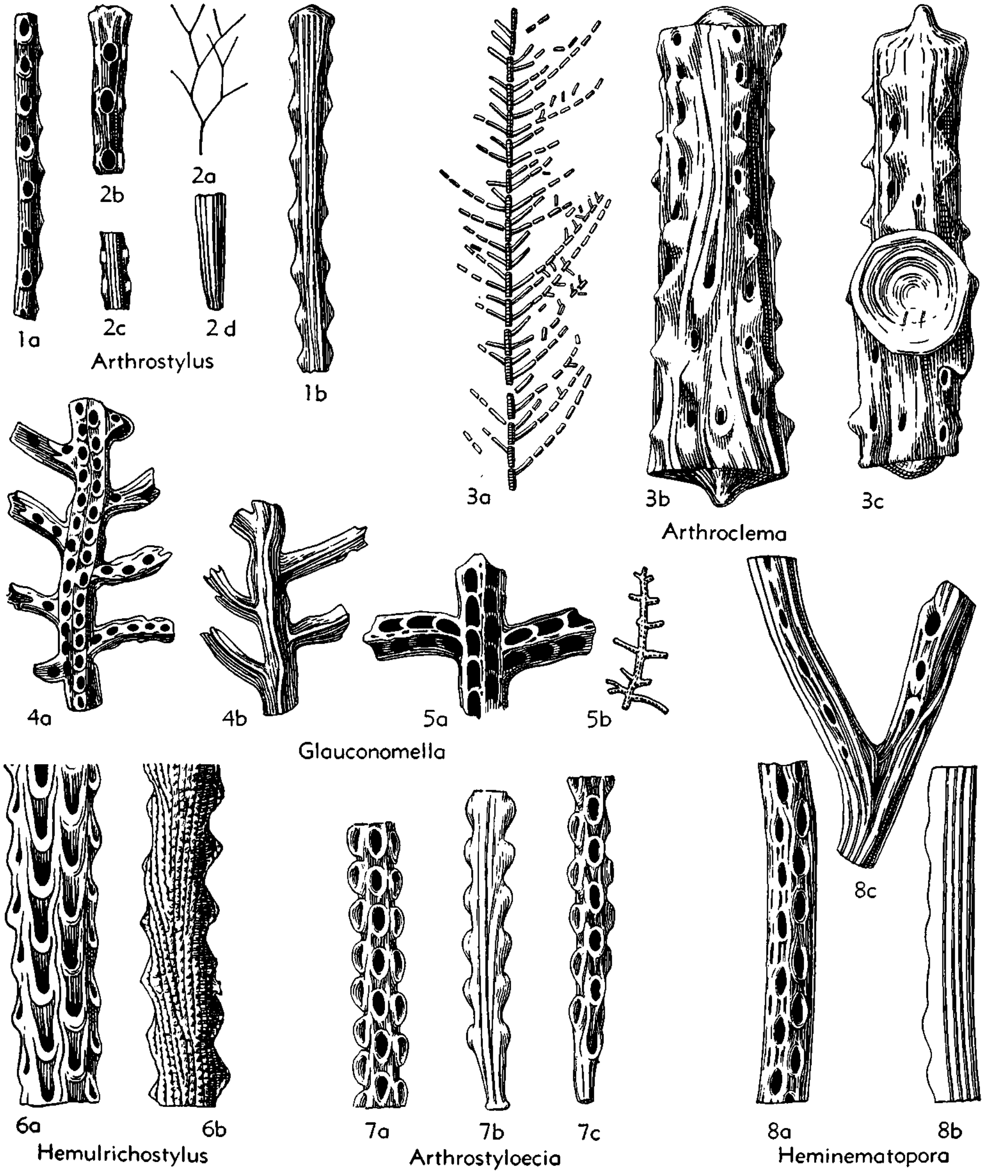

FIG. 89. Arthrostylidae (p. G128, G129).

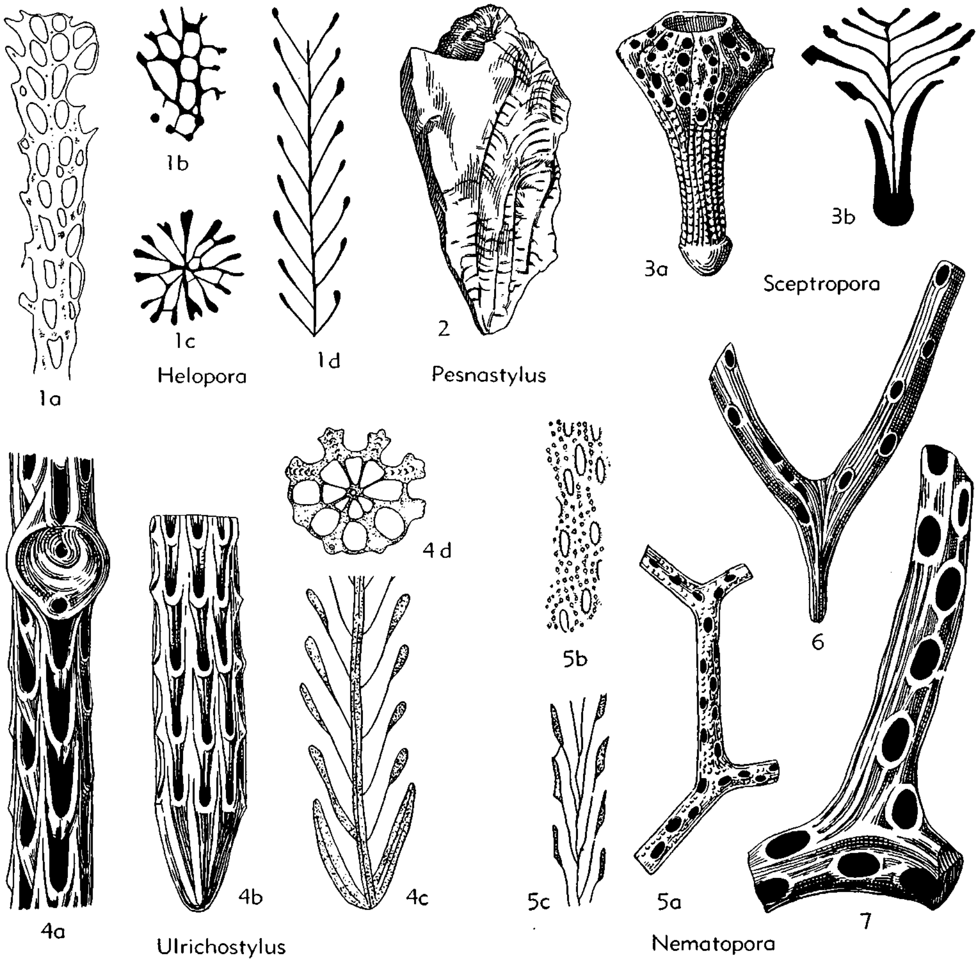

FIG. 90. Arthrostylidae (p. G128-G130).

Pesnastylus CROCKFORD, 1941 [**P. humei*]. Zoarium pinnate, probably articulated at base. *Sil.*——FIG. 90,*2*. **P. humei,* N.S.W.; zoarium, ×1 (142).

Sceptropora ULR., 1888 [**S. facula*]. Segments proximally slender and striate all around, distally much expanded and bearing apertures in several linear series. *Ord.*——FIG. 90,*3*. **S. facula,* Richmond., Minn.; *3a,* segment, ×20; *3b,* long. sec., ×20 (222).

Ulrichostylus BASSLER, 1952 [**Helopora divaricatus* ULR., 1893]. Slender cylindrical stems, with 8 or more longitudinal rows of apertures; articular faces at base and one side. *Ord.*——FIG. 90,*4*. **U. divaricatus* (ULR.), Blkriv., Minn.; *4a,* stem with lateral socket; *4b,* basal part of segment; *4c,d,* secs.; all ×20 (*4a,* 131; *4b-d,* 222).

Family RHABDOMESIDAE Vine, 1883

[as Rhabdomesontidae]
[=Rhomboporidae SIMPSON, 1895; Bactroporidae SIMPSON, 1897]

Zoaria slender cylindrical, unarticulated, branched or unbranched, generally solid stems with an immature axial region of thin-walled tubes and strongly differentiated cortex-like mature zone of thickened structure. Zooecial tubes typically curved or abruptly bent toward surface, with or without diaphragms in immature region and commonly bearing hemisepta near inner edge of mature region; apertures mostly elliptical, within a more or less defined sloping vestibule which may be rhombic hexagonal in form. Acanthopores abundant in most genera, including notably enlarged ones (megacanthopores) and small ones (micracanthopores); mesopores commonly absent (114; NICKLES-B., 1900; BASSLER, 1952). *Sil.-Perm.*

Rhabdomeson Y.-Y., 1874 [**Millepora gracilis* PHILLIPS, 1841]. Differs from *Rhombopora* in having a hollow axial epithecate tube from which zooecia extend obliquely outward. *Miss.-Perm.*——FIG. 91,*1*. **R. gracile* (PHILLIPS), L.Carb., Eng.; *1a*, surface, ×20; *1b,c*, secs., ×20 (131).

Acanthoclema HALL, 1886 [**Trematopora alternata* HALL, 1883]. Zoarium with filiform axis; apertures in longitudinal series defined by ridges, with a megacanthopore between each pair of apertures. *Dev.-Miss.*——FIG. 91,*3*. **A. alternata* (HALL), M.Dev.(Onond.), N.Y.; *3a*, zoarium, ×1; *3b,c*, surface, ×5, ×20 (162).

Ascopora TRAUTSCHOLD, 1876 [**Millepora rhombifera* PHILLIPS, 1836]. Like *Rhabdomeson* but axis comprises a bundle of parallel immature tubes. *Carb.-Perm.*——FIG. 91,*5*. **A. rhombifera* (PHIL-

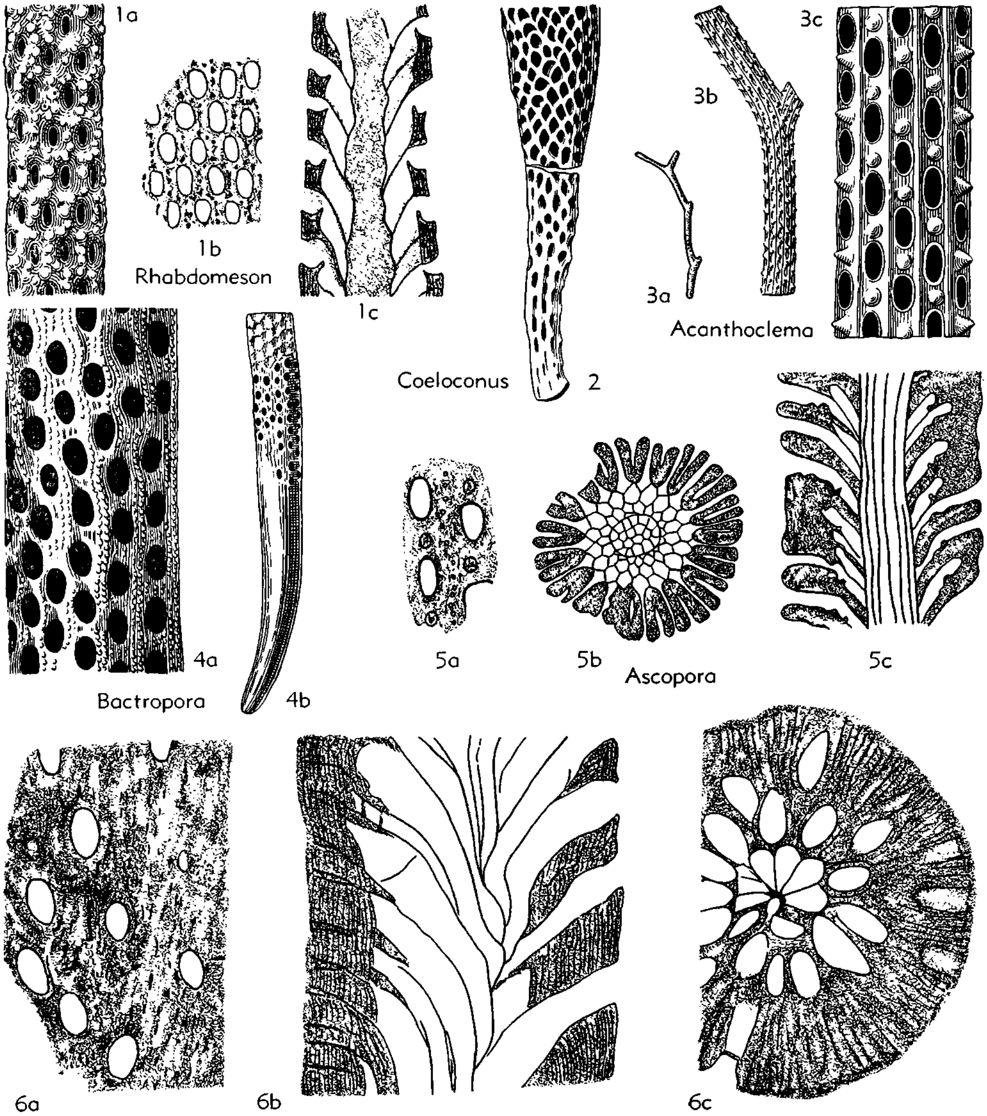

FIG. 91. Rhabdomesidae (p. G131, G132).

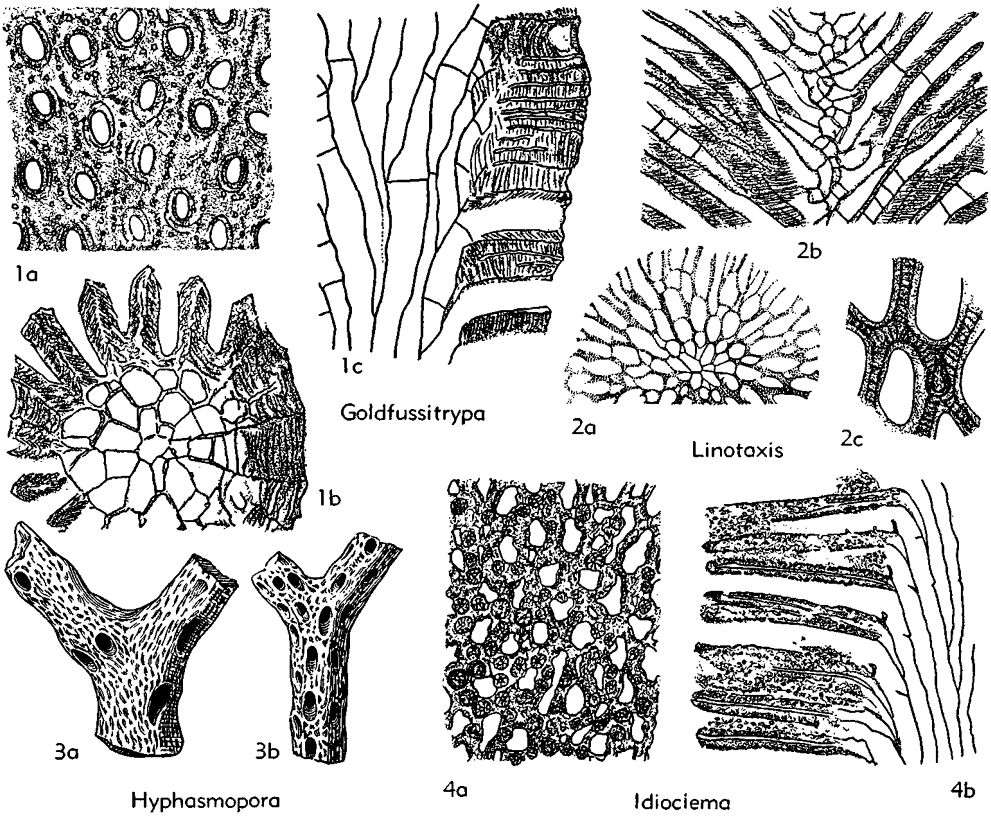

FIG. 92. Rhabdomesidae (p. G132).

LIPS), L.Carb., Eng.; *5a-c,* secs., tang. (×25), transv. (×10), long. (×10) (198).

Bactropora HALL-S., 1887 [**Trematopora? granistriata* HALL, 1883]. Resembles *Rhombopora;* proximal extremity pointed. *Dev.-Miss.*——FIG. 91,*4.* **B. granistriata* (HALL), M.Dev.(Hamilton), N.Y.; *4a,b,* surface, ×20, ×5 (162).

Clausotrypa BASSLER, 1929 [**C. separata*]. Like *Streblotrypa* but zooecia arise from axial line in ascending spirals; mesopores closed by laminated tissue. *Miss.-Perm.*——FIG. 91,*6.* **C. separata,* Perm., Timor; *6a-c,* secs., tang., long., transv., ×20 (131).

Coeloconus ULR., 1889 [**C. rhombicus* ULR., 1890]. Like *Rhabdomeson* but axial hollow expands distally like whole zoarium. *Miss.*——FIG. 91,*2.* **C. rhombicus* ULR., Warsaw, Ill.; surface, ×10 (222).

Goldfussitrypa BASSLER, 1952 [**Rhombopora esthonia* BASSLER, 1911]. Zooecia with diaphragms in immature region, no hemisepta, thick-walled mature zone with abundant micracanthopores. *Ord.*——FIG. 92,*1.* **G. esthonia* (BASSLER), M.Ord., Est.; *1a-c,* secs., tang., transv., long., ×20 (131).

Hyalotoechus MCNAIR, 1942 [**H. duncani*]. Like *Rhombopora* but has heterophragms projecting from thickened walls of mature region, no diaphragms. *Dev.*——FIG. 93,*1.* *H. subannulata* (ULR.), M.Dev., Iowa; *1a,b,* secs., ×20; *1c,* surface, ×10; *1d,* zoarium, ×1 (222).——FIG. 93,*2.* **H. duncani,* Chemung., N.Y.; *2a,b,* secs., ×20 (182).

Hyphasmopora ETH., 1875 [**H. buskii*]. Like *Streblotrypa* but one side nearly all occupied by minute pits representing mesopores. *Carb.-Perm.*——FIG. 92,*3.* **H. buskii,* L.Carb., Scot.; *3a,b,* back, front, ×15 (151).

Idioclema GIRTY, 1911 [**I. insigne*]. Like *Rhombopora* but lacks diaphragms, megacanthopores as large as zooecia. *Miss.*——FIG. 92,*4.* **I. insigne,* Chest., Ark.; *4a,b,* secs., ×25 (131).

Linotaxis BASSLER, 1952 [**Orthopora? magna* MCNAIR, 1942]. Like *Rhombopora* but zooecia develop from linear axis, without hemisepta; single large megacanthopore at distal edge of each aperture. *U.Dev.*——FIG. 92,*2.* **L. magna* (MCNAIR), ?Chemung., N.Y.; *2a-c,* secs., transv. (×25), long. (×25), tang. (×50) (131).

Megacanthopora Moore, 1929 [**M. fallacis*]. Megacanthopores unusually large, containing diaphragms, commonly oriented oblique to surface; may be synonym of *Rhombopora*. *Penn.*——Fig. 95,*7*. **M. fallacis*, U.Penn., Tex.; *7a,b*, secs., ×25 (131).

Nemataxis Hall, 1886 [**N. fibrosus*]. Thick stems annulated by low transverse monticules. Zooecia developed from a filiform axis, without diaphragms but bearing inferior and superior hemisepta, thick-walled in mature zone, with oval apertures. Micracanthopores numerous. *Dev.*——Fig. 93,*3*. **N. fibrosus*, M.Dev.(Onond.), Ont.; *3a,b*, secs., ×20; *3c*, surface, ×5 (*3a*, 162; *3b,c*, 131).

Nemataxidra Bassler, 1952 [**N. piercensis*]. Like *Nemataxis* internally but lacks hemisepta and mature zone not sharply differentiated. *Ord.*——Fig. 93,*4*. **N. piercensis*, Blkriv., Tenn.; *4a-c*, secs., ×25 (131).

Nematotrypa Bassler, 1911 [**N. gracilis*]. Slender solid branches. Zooecia very small, developed from filiform axis, containing hemisepta. Minute open tabulate mesopores with micracanthopores at their angles fill interspaces. *Ord.*——Fig. 94,*1*. **N. gracilis*, Est.; *1a,c*, secs., tang. (×50), transv. (×25), long. (×25) (131).

Nicklesopora Bassler, 1952 [**Rhombopora elegantula* Ulr., 1884]. Like *Rhombopora* but lacking diaphragms, hemisepta, and megacanthopores; a single row of micracanthopores around each aperture. *Miss.*——Fig. 94,*2*. **N. elegantula* (Ulr.), L.Miss.(Osag.), Ky.; *2a*, zoarium, ×1; *2b,c*, secs., ×20 (222).

Orthopora Hall, 1886 [**Trematopora regularis* Hall, 1874]. Differs from *Rhombopora* in prominence of longitudinal rows of apertures separated by nodose ridges. *Sil.-Dev.*——Fig. 94,*4*. *R. rhombifera* (Hall), L.Dev., W.Va.; *4a,b*, secs., ×20

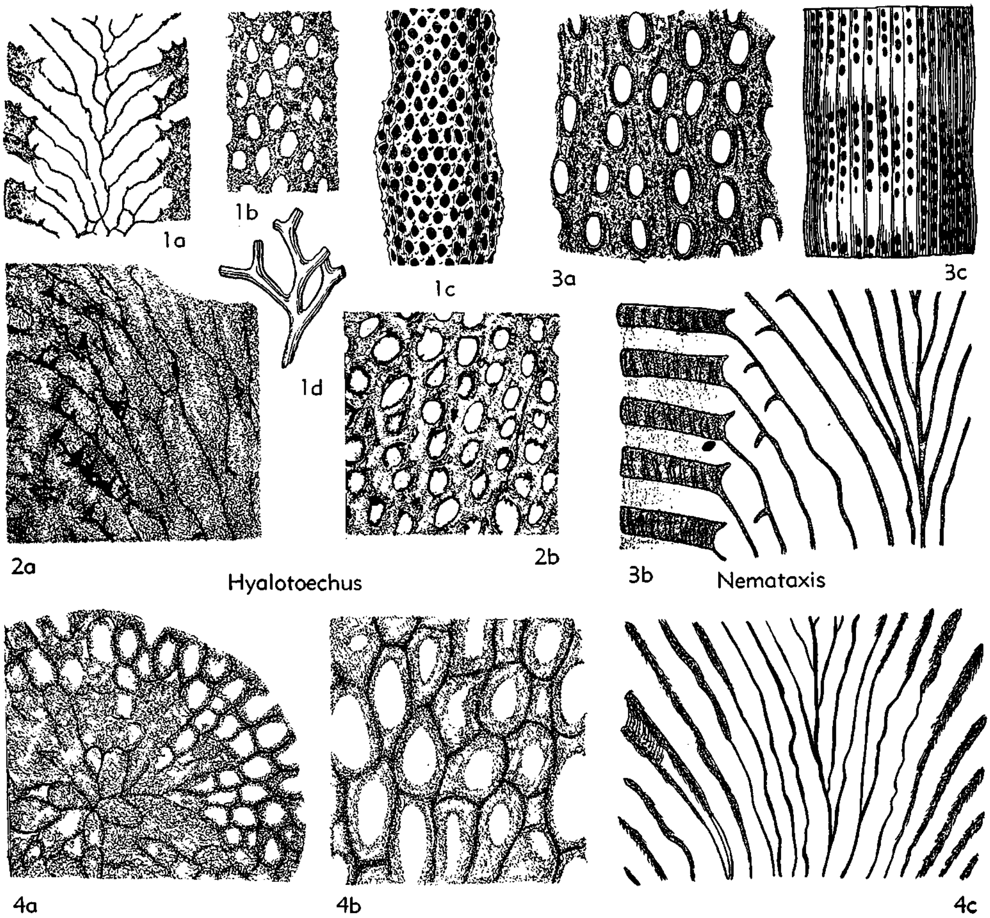

Fig. 93. Rhabdomesidae (p. G132, G133).

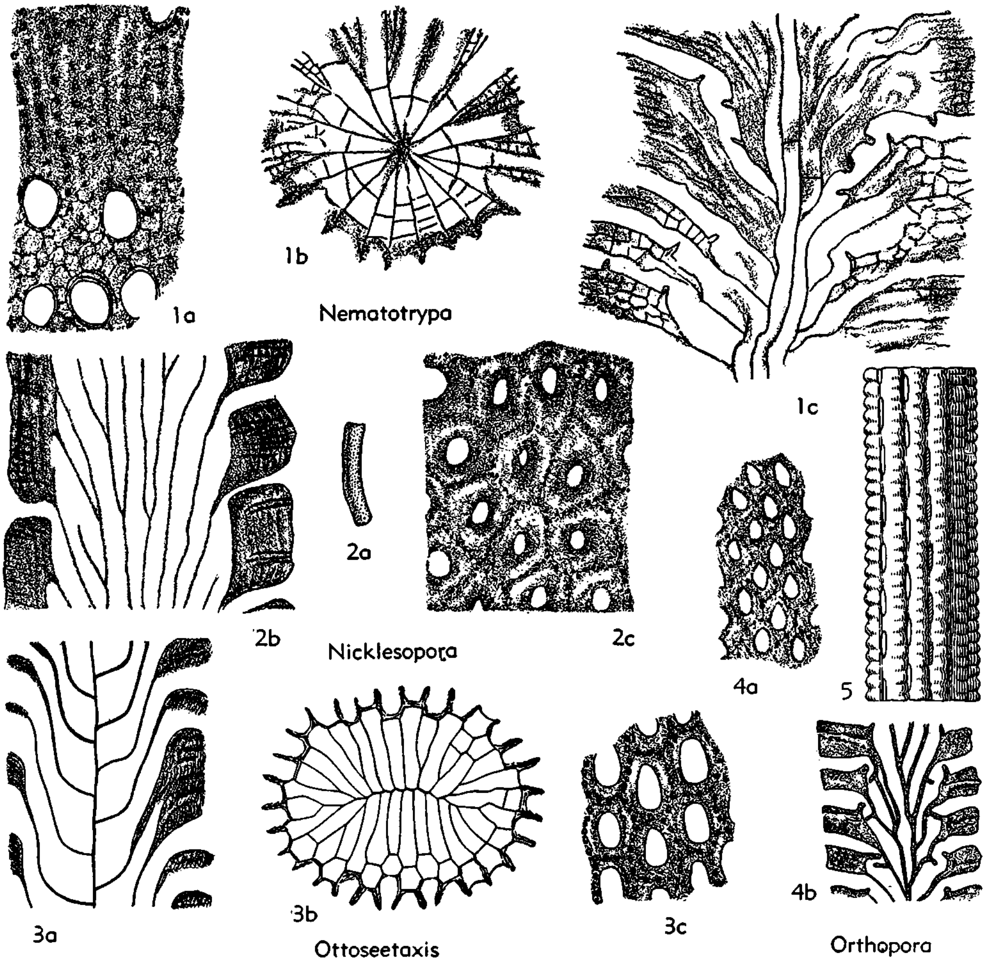

FIG. 94. Rhabdomesidae (p. G133, G134).

(223).——FIG. 94,*5*. **O. regularis* (HALL), L.Dev. (Held.), N.Y.; surface, ×20 (162).

Ottoseetaxis BASSLER, 1952 [**O. bipartitus*]. Slender bifoliate stems lacking external indication of mesotheca; broad immature but narrow mature zone. Zooecia lack diaphragms and hemisepta. Micracanthopores in single row around apertures; no mesopores. *Ord.*——FIG. 94,*3*. **O. bipartitus,* Blkriv., Tenn.; *3a-c,* secs., ×25 (131).

Petaloporella PRANTL, 1935 [**P. bohemica*]. Like *Streblotrypa* but without hemisepta. *Dev.*——FIG. 95,*1*. **P. bohemica,* Czech.; *1a,b,* secs., ×10 (207).

Rhombocladia ROGERS, 1900 [**R. delicata*]. Like *Rhombopora* but lens-shaped transversely, apertures restricted to front, back smooth. *Penn.-Perm.* ——FIG. 95,*3*. **R. delicata,* U.Penn., Kans.; *3a,b,* secs., ×20 (192).

Rhombopora MEEK, 1872 [**R. lepidodendroides*]. Solid slender branching stems, thick-walled in mature region. Zooecia with few diaphragms, no hemisepta; oval apertures within sloping hexagonal vestibules aligned in regular oblique rows. Micracanthopores around each aperture and a megacanthopore at distal edge of each; mesopores lacking. *Dev.-Perm.*——FIG. 95,*4*. **R. lepidodendroides,* L. Perm., Nebr.; *4a-c,* secs., tang., transv., long., ×20 (222).

Rhomboporella BASSLER, 1936 [**R. typica*]. Like *Rhombopora* but zooecial tubes rhombic or quadrate in transverse sections. *Carb.-Perm.*——FIG. 96,*3*. **R. typica,* Carb., Bol.; *3a-c,* secs., ×20; **3*d*,** zoarium, ×1 (131).

Saffordotaxis BASSLER, 1952 [**Rhombopora incrassata* ULR., 1888]. Like *Rhombopora* but a row of megacanthopores surrounds each aperture. *Miss.* ——FIG. 95,*5*. **S. incrassata* (ULR.), L.Miss. (Osag.), Ky.; *5a,* surface, ×10; *5b,c,* secs., ×20 (222).

Spirillopora GÜRICH, 1896 [*S. anguillata]. Twisted stems with zooecia in spiral rows. *L.Dev.*, Pol.

Streblascopora BASSLER, 1952 [**Streblotrypa fasciculata* BASSLER, 1929]. Like *Streblotrypa* but has axial bundle of parallel tubes. *Perm.*——FIG. 96,*1*. **S. fasciculata* (BASSLER), Timor; *1a-c*, secs., ×20 (131).

Streblocladia CROCKFORD, 1944 [**S. excavata*]. Like *Rhombocladia* but lacks acanthopores. *Perm.*——FIG. 96,*2*. **S. excavata*, W.Austral.; *2a,b*, front, back, ×20 (142).

Streblotrypa VINE, 1885 [**S. nicklesi*]. Like *Rhombopora* but apertures in longitudinal rows with several mesopores between each pair of apertures. *Dev.-Perm.*——FIG. 95,*6*. **S. nicklesi*, U.Miss. (Chest.), Ill.; *6a*, zoarium, ×1; *6b*, surface, ×20; *6c*, long. sec., ×20 (222).

Syringoclemis GIRTY, 1911 [**S. biserialis*]. Hollow cylindrical stem; zooecia, mesopores, and acanthopores as in *Leioclema* but structure seen in long. secs. cryptostomatous. *Miss.*——FIG. 96,*4*. **S. biserialis*, Chest., Ark.; *4a-c*, secs., ×20 (131).

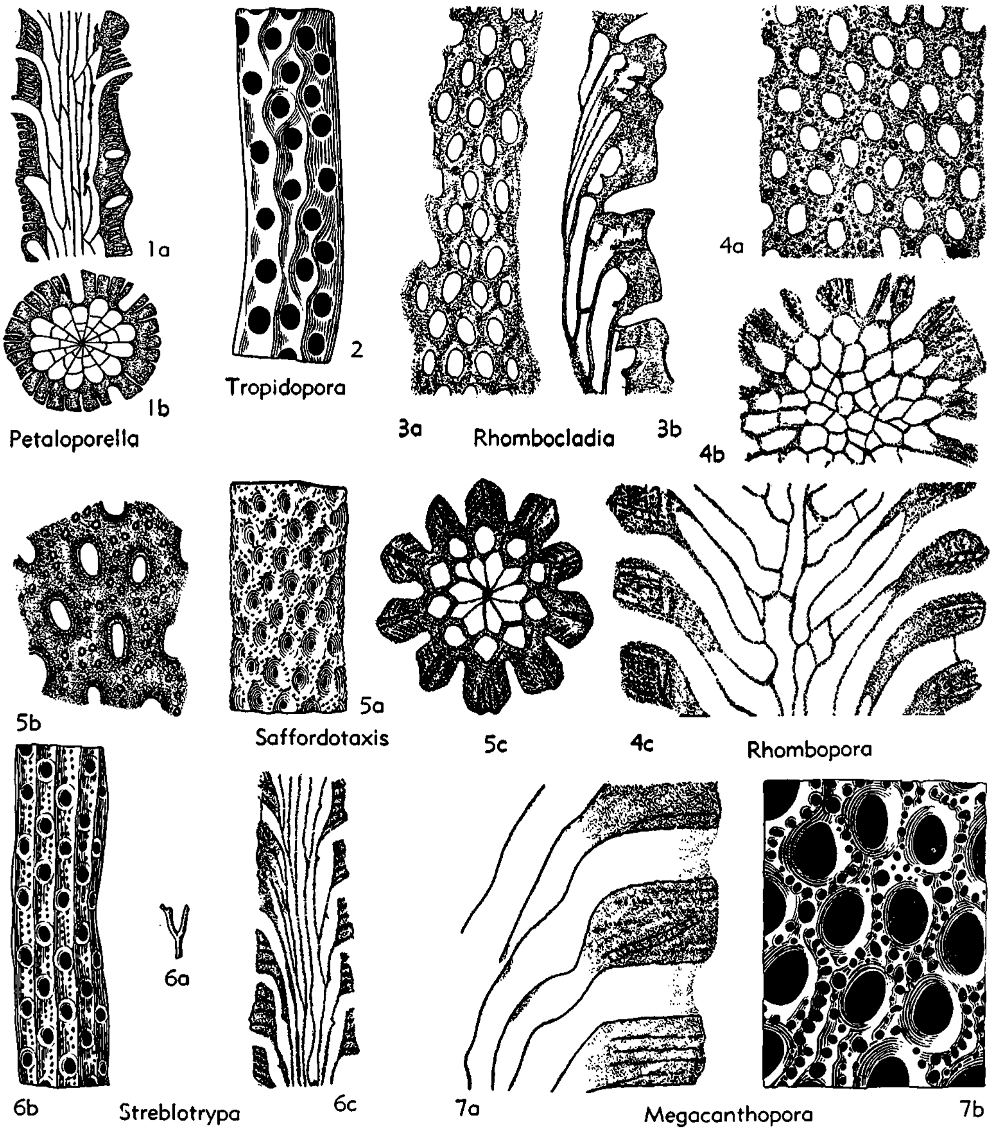

FIG. 95. Rhabdomesidae (p. G133-G136).

Tropidopora Hall, 1886 [**T. nana*]. Apertures in irregular longitudinal rows separated by sinuous ridges. *Dev.*——Fig. 95,*2*. **T. nana,* Onond., N.Y.; surface, ×20 (162).

Family PTILODICTYIDAE Zittel, 1880

[as Ptilodictyonidae]
[=Clathroporidae Simpson, 1897]

Zoaria bifoliate, with monticules or maculae in broad forms, articulating proximally with a basal expansion. Zooecia developed from median lamina (mesotheca), forming 2 layers that grow back to back, without median tubuli; hemisepta common. Mesopores rare (3,114; Nickles-B., 1900). *Ord.-Dev.*

Ptilodictya Lonsd., 1839 [**Flustra lanceolata* Goldf., 1826] [=*Heterodictya* Nich., 1875]. Falciform to broad fronds with longitudinally arranged oblong zooecia. *Ord.-Dev.*——Fig. 97,*1*. *P. expansa* Hall, L.Sil.(Brassfield), Ohio; *1a,b,* secs., tang., long., ×20 (222).——Fig. 97,*2*. *P. nebulosa* (Hall), L.Dev.(Held.), N.Y.; *2a,* surface with monticules, ×5; *2b,* zoarium, ×1 (162).——Fig. 97,*3*. **P. lanceolata* (Goldf.), Sil.(Wenlock.), Eng.; zoarium, ×1 (157).

Arthropora Ulr., 1882 [**Stictopora (Ptilodictya) shafferi* Meek, 1872] [=*Crateripora* Ulr., 1879]. Numerous small equal articulated segments in one plane, attached to socket on an expanded base (*Crateripora erecta* Ulr.). *Ord.*——Fig. 98,*1*. **A. shafferi* (Meek), Maysv., Ohio; *1a,* zoarium, ×1; *1b,* part of base, ×10; *1c,* surface, ×20; *1d,* long. sec., ×20 (222).

Clathropora Hall, 1852 [**C. frondosa* Hall, 1892]. Like *Ptilodictya* but with articulating base and forming a network of oval fenestrules. *Sil.-Dev.*——Fig. 97,*7*. **C. frondosa,* Sil.(Clint.), N.Y.; *7a,b,* zoarium, ×1, ×5; *7c,d,* secs., tang., long., ×20 (131).

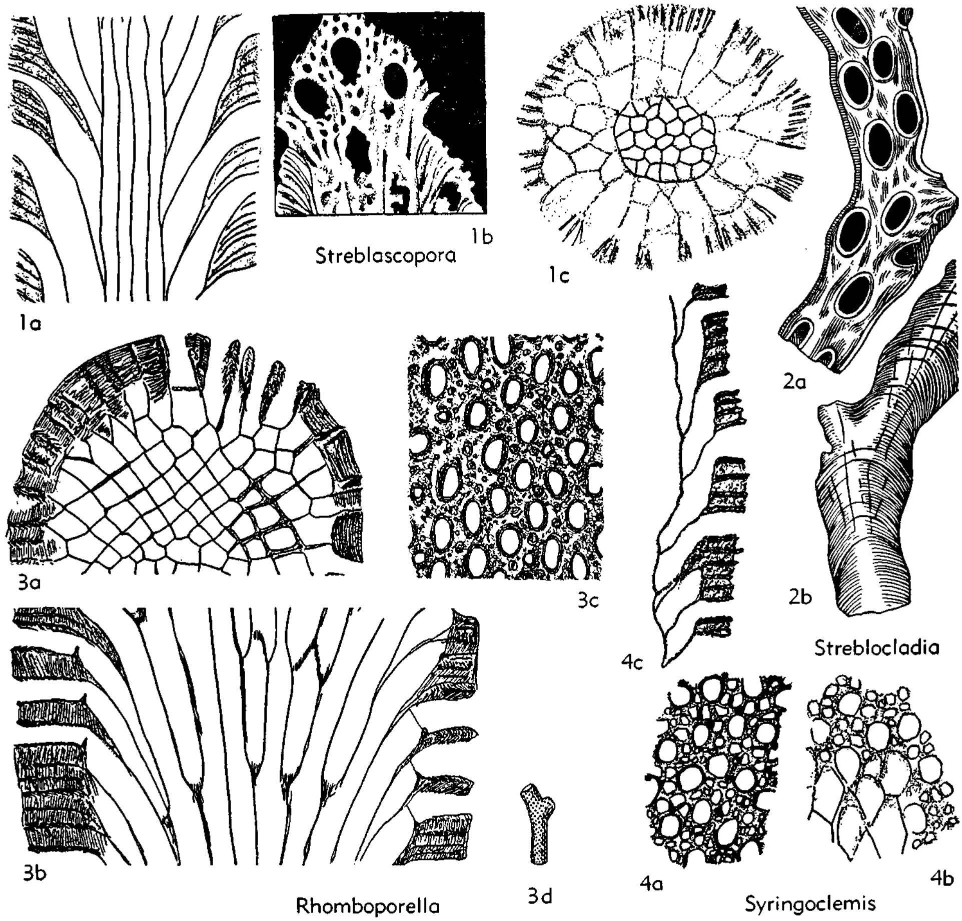

Fig. 96. Rhabdomesidae (p. G134, G135).

Escharopora Hall, 1847 [**E. recta*][=*Nicholsonia* Waag.-W., 1886]. Like *Ptilodictya* but apertures arranged in intersecting series; articulating with a basal expansion. *Ord.*——Fig. 98,*4*. **E. recta*, Trenton., N.Y.; *4a,* basal expansion, ×10; *4b,* zoarium, ×1; *4c,* surface, ×20 (162).——Fig. 98,*5*. *E. angularis* Ulr., Blkriv., Minn.; zoarium, ×10 (222).

Graptodictya Ulr., 1882 [**Ptilodictya perelegans* Ulr., 1878][=*Graptopora* Ulr., 1882 (*nom. nud.*)(*non* Salter, 1858)]. Like *Arthropora* but zoarium is a single or inosculating frond jointed only at base. *Ord.*——Fig. 98,*3*. **G. perelegans* (Ulr.), Richmond., Ohio; *3a,* zoarium, ×1; *3b,* surface, ×20; *3c,* long. sec., ×25 (*3a,b,* 222; *3c,* 131).

Phaenopora Hall, 1851 [**P. explanata* Hall, 1852]. Like *Ptilodictya* but mesopores in interspaces between ends of apertures. *Ord.-Dev.*——Fig. 97,*4*. *P. lirata* Hall, L.Dev., N.Y.; *4a,* zoarium, ×5; *4b,* surface, ×20 (162).——Fig. 97,*5*. **P. explanata* Hall, Sil.(Medin.), Ont.; *5a,* zoarium, ×1; *5b,* surface, ×20 (162).——Fig. 97,*6*. *P. constellata* Hall, Sil.(Clint.), N.Y.; *6a,b,* secs., tang., long., ×20 (222).

Stictoporina Hall-S., 1887 [**Trematopora claviformis* Hall, 1883]. Branching segments with articulating base and intersecting apertures. *Dev.*——Fig. 98,*2*. **S. claviformis* (Hall), Hamilton, N.Y.; zoarium, ×5 (162).

Family STICTOPORELLIDAE Nickles & Bassler, 1900

[=Heliotrypidae, ?Stictoporidae Miller, 1889; Intraporidae Simpson, 1897]

Like Ptilodictyidae but zoarium without articulation between upper part and ex-

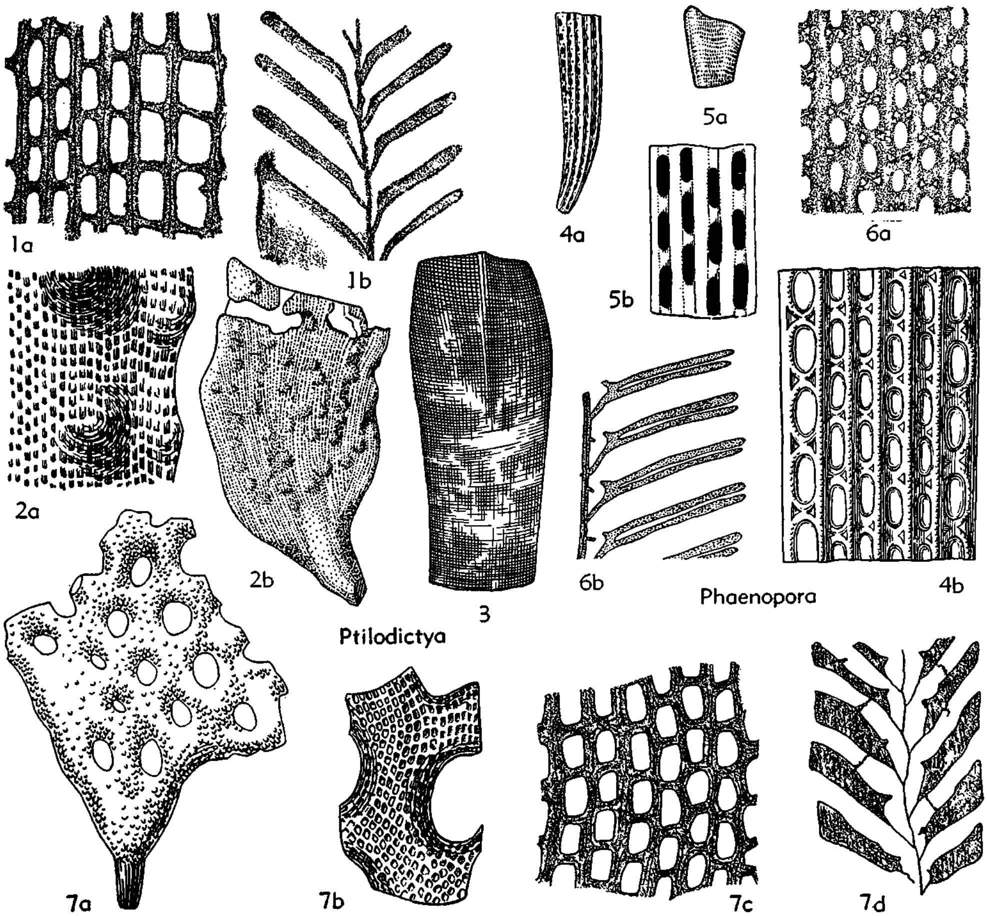

Fig. 97. Ptilodictyidae (p. G136, G137).

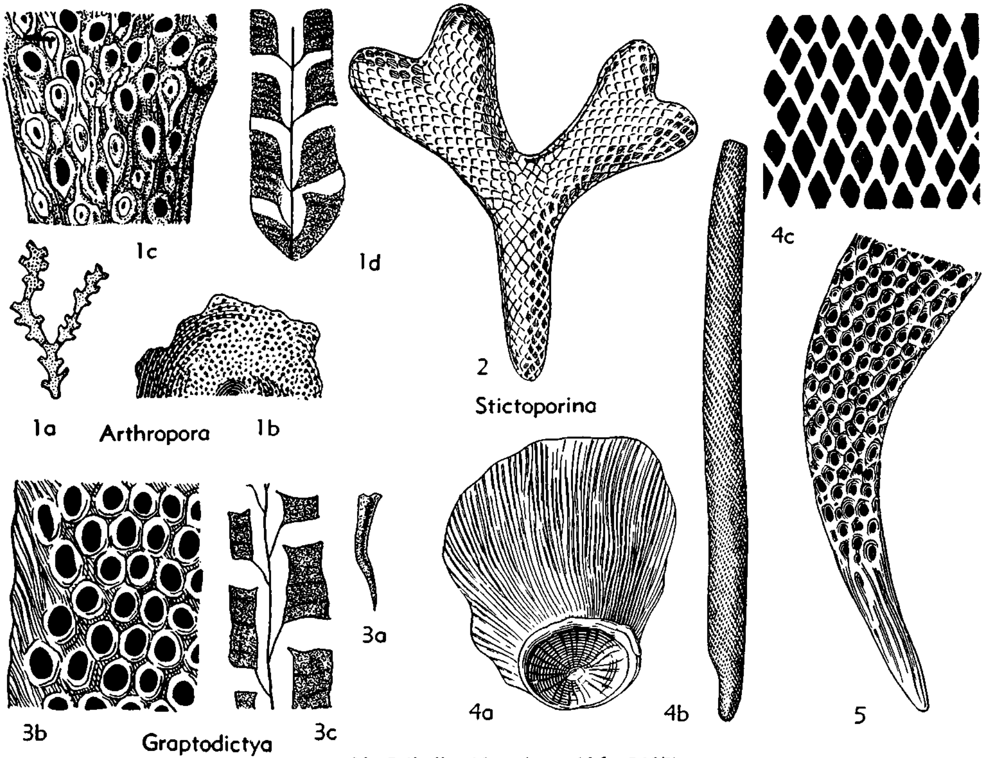

FIG. 98. Ptilodictyidae (p. G136, G137).

panded base, and mesopores present commonly (NICKLES-B., 1900). *Ord.-Miss.*

Stictoporella ULR., 1882 [**S. interstincta* (=*Ptilodictya flexuosa* JAMES, 1878)] [=*Micropora* EICHW., 1855 (*non* GRAY, 1848); *Lemmatopora* POČTA, 1894]. Zoaria narrow cribrose or leaflike, with elliptical apertures at bottom of a sloping area; thick-walled nontabulate mesopores between apertures and lining zoarial margins. *Ord.*——FIG. 99,*1*. **S. flexuosa* (JAMES), Eden., Ohio; *1a,b*, secs., long., tang., ×25 (222).——FIG. 99,*2*. *S. cribrosa* ULR., Blkriv., Minn.; *2a*, zoarium, ×1; *2b*, surface, ×20 (222).

Coscinella HALL-S., 1887 [**C. elegantula*]. Explanate frond of anastomosing branches. Zooecia tubular, resting on mesotheca with direct vestibules; apertures circular, irregularly disposed. Tabulate mesopores opening at surface as minute angular pits occupy spaces between vestibules and margins of fenestrules. *Dev.*——FIG. 99,*5*. **C. elegantula*, Hamilton, Ont.; *5a*, zoarium, ×1; *5b,c*, secs., tang., long., ×20 (163).

Heliotrypa ULR., 1883 [**H. bifolia*]. Zoarium with maculae. Zooecia subtubular, prostrate on mesotheca, with superior hemiseptum; thick-walled vestibules traversed obliquely by tubuli, apertures circular. Mesopores common. *Miss.*——FIG. 99,*4*. **H. bifolia*, Chest.(Glen Dean), Ky.; *4a*, surface with macula, ×20; *4b,c*, secs., tang., long., ×50, ×20 (222).

Intrapora HALL, 1883 [**I. puteolata*]. Like *Taeniodictya* but tabulate mesopores numerous. *Dev.*——FIG. 99,*8*. **I. puteolata*, Onond., Falls Ohio, Ky.-Ind.; *8a*, zoarium, ×1; *8b*, surface, ×20 (162).

Ptilotrypa ULR., 1890 [**P. obliquata*]. Zoarium compressed or frondescent; surface with irregular longitudinally channeled areas resembling maculae. Zooecia long, oblique tubes with few diaphragms; apertures ovate, some with accessory pore at extremity. *Ord.*——FIG. 99,*7*. **P. obliquata*, Richmond., Ill.; *7a,b*, secs., ×20; *7c*, surface, ×10 (222).

?**Stictopora** HALL, 1847 [**S. elegantula*] [?=*Stictotrypa* ULR., 1890]. Slender ribbon-like bifoliate branches. Zooecial tubes long, without hemisepta: apertures with distinct peristomes; interspaces wide, without mesopores (may belong in Rhinoporidae). *Ord.*——FIG. 99,*6*. **S. elegantula*, Trenton., N.Y.; *6a*, zoarium, ×1; *6b*, surface, ×20 (162).

Taeniodictya ULR., 1888 [**T. interpolata*]. Branches compressed. Zooecia short, tubular, oblong, both hemisepta present; apertures subcircular in sloping vestibule; interspaces ridgelike. *Sil.-Miss.*——FIG. 99,*3*. **T. interpolata*, Waverlian, Ohio; *3a*, surface, ×20; *3b*, zoarium, ×1 (222).

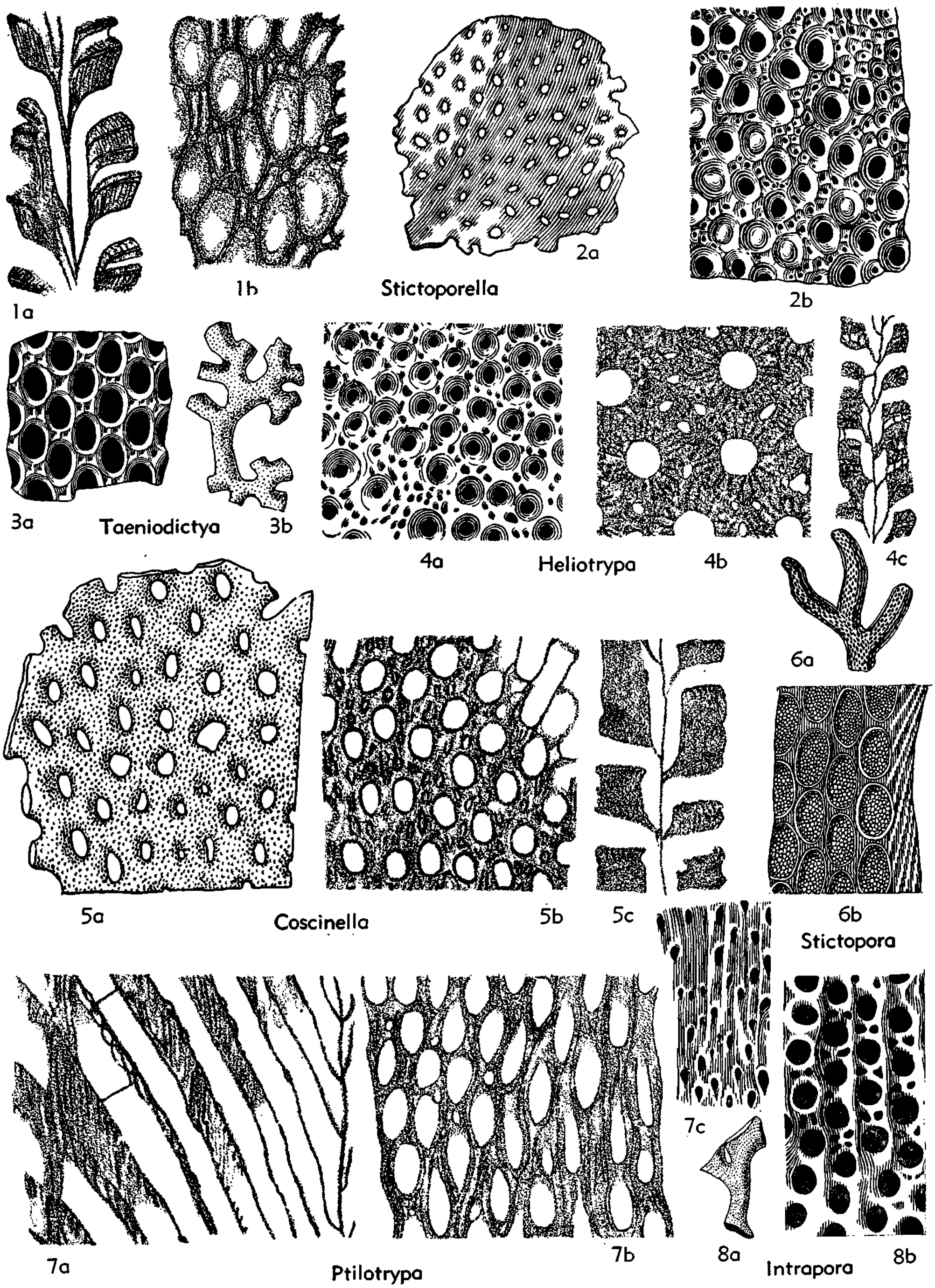

FIG. 99. Stictoporellidae (p. G138).

Family RHINIDICTYIDAE Ulrich, 1895

[as Rhinidictyonidae]

Zoarium bifoliate or rarely trifoliate, continuous or jointed compressed branches or erect expansions. Zooecia subquadrate proximally, arranged longitudinally, apertures elliptical to subcircular; inferior hemiseptum and lunarium absent. Median tubuli between laminae of the mesotheca and between rows of zooecia. Mesopores absent, but vesicular tissue common (3,114,115; NICKLES-B., 1900). *Ord.-Carb.*

Rhinidictya ULR., 1882 [**R. nicholsoni*] [=*Stictopora* ULR., 1882 (*non* HALL, 1847)]. Narrow, compressed, dichotomously dividing, straight-edged bifoliate branches, attached by a continuous expanded base. Apertures in longitudinal series between slightly flexuous ridges which bear a crowded row of small blunt spines; median tubuli in mesotheca. *Ord.*——FIG. 100,*1*. **R. nicholsoni,* Blkriv., Ky.; *1a,b,* secs., ×20; *1c,* zoarium, ×5; *1d,* surface, ×20 (222).

Dicranopora ULR., 1882 [**Ptilodictya internodia* MILLER & DYER, 1878]. Like *Rhinidictya* but zoarium jointed; segments straplike, rarely simple, commonly bifurcating; extremities thickened. *Ord.-Dev.*——FIG. 100,*4*. **D. internodia* (MILLER & DYER), Maysv., Ohio; *4a,* zoarium, ×1; *4b,* proximal part of segment, ×20; *4c,d,* secs., ×25 (222).

Eurydictya ULR., 1889 [**E. montifera* ULR., 1890]. Like *Rhinidictya* but zoarium a broad, simple or irregularly divided bifoliate expansion, with sur-

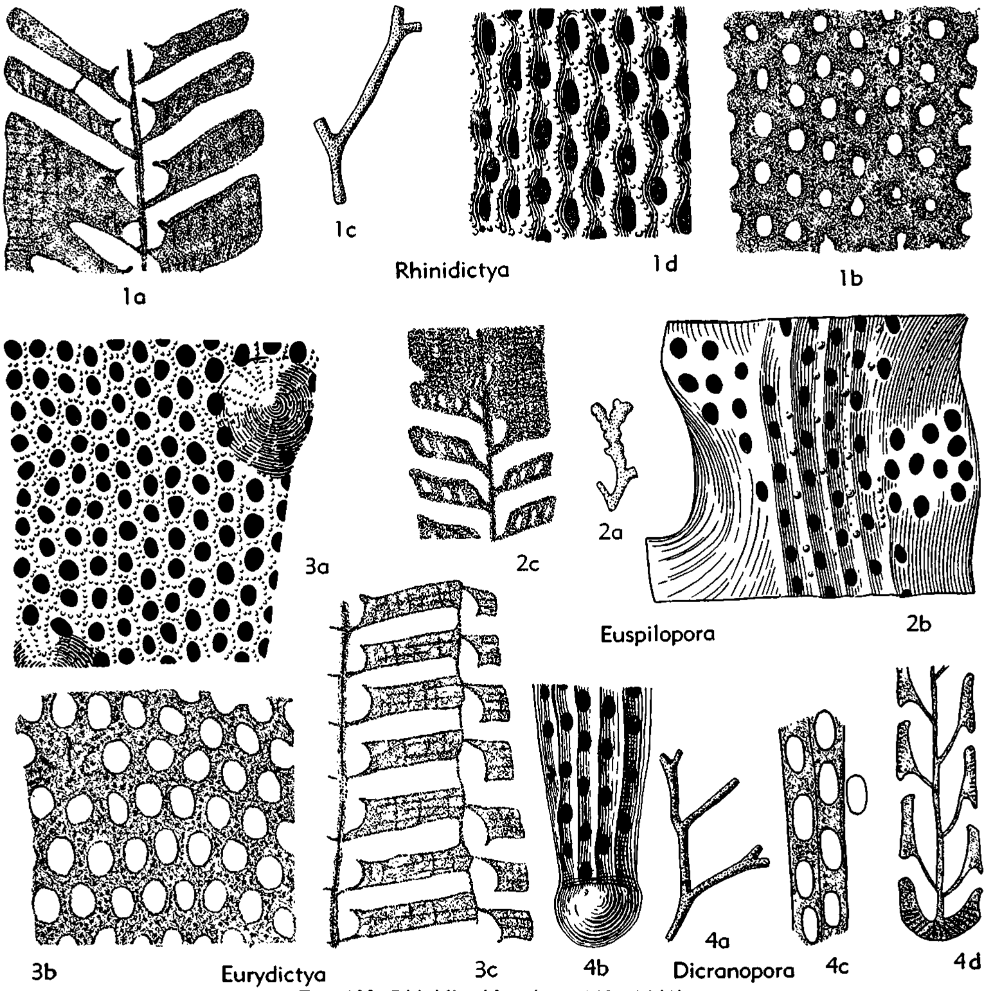

FIG. 100. Rhinidictyidae (p. G140, G141).

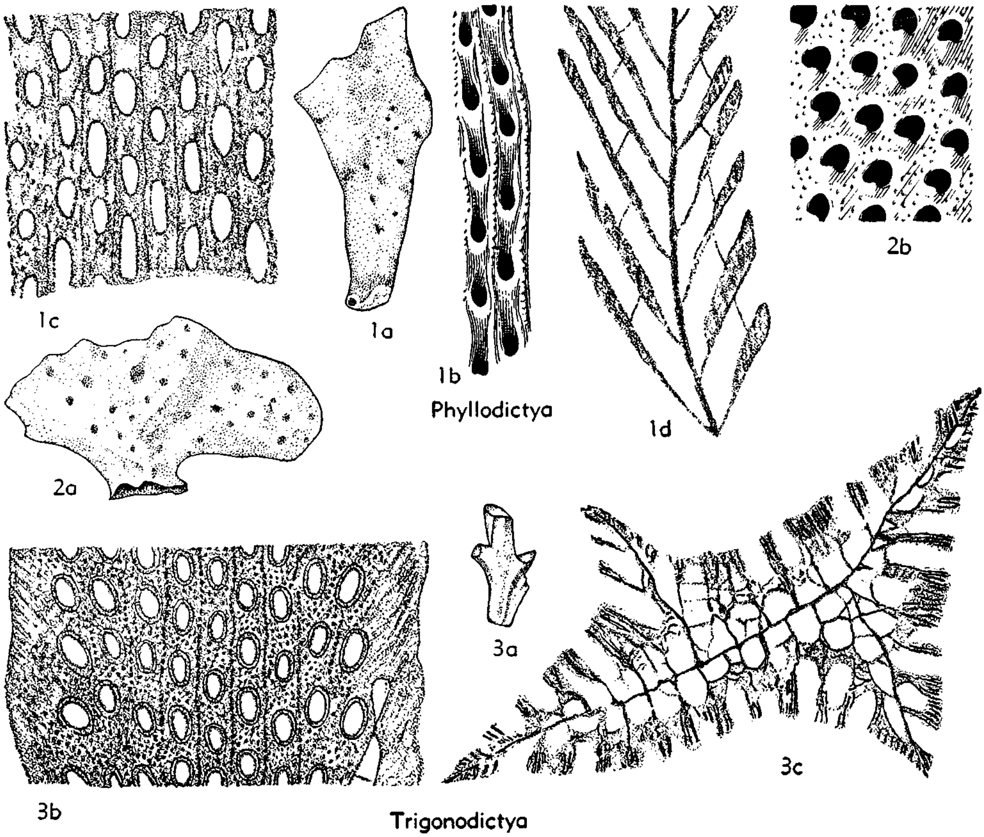

FIG. 101. Rhinidictyidae (p. G141, G142).

face bearing more or less conspicuous, small solid maculae or monticules. *Ord.*——FIG. 100,*3*. **E. montifera* ULR., Richmond., Ill.; *3a*, surface; *3b*, tang. sec.; *3c*, long. sec. showing normal zooecia on one side of mesotheca (left) and superposed thin layer of secondary, oppositely oriented zooecia (right); all ×20 (222).

Euspilopora ULR., 1889 [**E. serrata* ULR., 1890]. Small, irregularly divided branches with wavy edges. Zooecia erect, without hemisepta; oval apertures in 4 or more longitudinal rows between node-bearing ridges along middle of branches and in clusters on either side of these rows. Vesicles between zooecia and tubuli normal to surface in interspaces between zooecial clusters. *Dev.*——FIG. 100,2. *E. serrata* ULR., M.Dev., Iowa; *2a*, zoarium, ×1; *2b*, surface, ×20; *2c*, long. sec., ×20 (222).

Goniotrypa ULR., 1889 [**G. bilateralis*]. Like *Dicranopora* but with prominent median ridge on both sides of segments. *Ord.*——FIG. 102,*4*. **G. bilateralis*, Richmond., Manitoba; surface, ×20 (222).

Hemidictya CORYELL, 1921 [**H. lebanonensis*]. Like *Pachydictya* but has hemisepta. *Ord.* Blkriv., Tenn.

Pachydictya ULR., 1882 [**P. robusta*]. Broad bifoliate fronds with maculae (or monticules); less commonly narrow bifurcating stipes. Zooecia erect, with well-spaced diaphragms but no hemisepta; apertures oval, crowded. Vesicles between zooecia, filled by calcareous tissue near surface and traversed by tubuli. *Ord.-Sil.*——FIG. 102,*2*. **P. robusta*, Blkriv., Tenn.; *2a*, zoarium, ×1; *2b*, tang. sec., ×20; *2c*, surface, ×20 (222).——FIG. 102,*3*. *P. foliata* ULR., Blkriv., Minn.; long. sec., ×20 (222).

Phyllodictya ULR., 1882 [**P. frondosa*]. Broad bifoliate frond with expanded base. Zooecial tubes straight, oblique to mesotheca, with few diaphragms, no hemisepta; apertures strongly oblique. Interspaces filled with vesicles, traversed by tubuli, which appear as papillae at surface. *Ord.*——FIG. 101,*1*. *P. varia* ULR., Blkriv., Minn.; *1a*, zoarium, ×1; *1b*, surface, ×20; *1c,d*, secs., ×20 (222).——FIG. 101,*2*. **P. frondosa*, Blkriv., Ky.; *2a*, zoarium, ×1; *2b*, surface, ×20 (222).

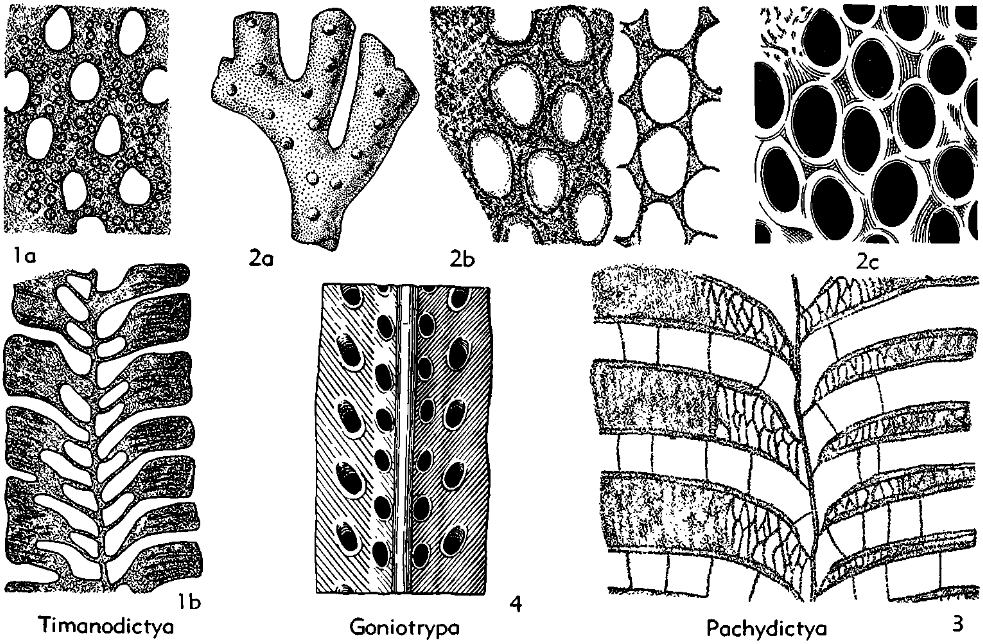

FIG. 102. Rhinidictyidae (p. G141, G142).

Timanodictya NIKIF., 1938 [**Coscinium dichotoma* STUCK., 1887]. Bifoliate dichotomous ribbon-like branches. Zooecial apertures in diagonally intersecting rows. Noncelluliferous maculae with stellate acanthopores at regular intervals; interzooecial spaces with acanthopores, no vesicles. *Carb.-Perm.*——FIG. 102,*1*. **T. dichotoma* (STUCK.), Carb., Russ.; *1a,b*, secs., ×25, ×10 (198).

Timanotrypa NIKIF., 1938 [**T. foliata*]. Like *Timanodictya* but zoarium a symmetrical expansion. *Carb.*, Russ.

Trigonodictya ULR., 1893 [**Pachydictya conciliatrix* ULR., 1886]. Differs from *Pachydictya* in triangular cross section of zoarium. *Ord.-Sil.*——FIG. 101,*3*. **T. conciliatrix* (ULR.), Blkriv., Minn.; *3a*, zoarium, ×1; *3b,c*, secs., tang., transv., ×20 (222).

Family SULCORETEPORIDAE Bassler, 1935

[=emend. Cystodictyonidae ULR., 1884]
[=Acrogeniidae, Thamnotrypidae SIMPSON, 1897]

Zoaria bifoliate, ribbon-like or frondose, branching in plane of mesotheca. Zooecia normally arranged in longitudinal series enclosed by double walls, without diaphragms but with hemisepta in some genera, vestibules tubular; apertures with peristome and more or less well-developed lunarium. Vesicles in interzooecial spaces, commonly filled by calcareous deposits near surface (68,114; NICKLES-B., 1900). *Sil.-Perm.*

Sulcoretepora D'ORB., 1849 [**Flustra parallela* PHILLIPS, 1836] [=*Cystodictya* ULR., 1882; *Arcanopora* VINE, 1883 (obj.); *Stictocella* SIMPSON, 1897]. Narrow ribbon-like branches with subparallel, nonporiferous margins. Zooecia prostrate proximally, erect distally, with more or less distinct hemisepta and generally prominent lunarium. Interspaces on surface smooth, granulose, or finely striate, but in worn specimens may appear pitted, showing vesicles. *Dev.-Perm.*——FIG. 103,*1*. **S. parallela* (PHILLIPS), L.Carb., Eng.; surface, lunaria lacking, ×10 (206).——FIG. 103,*2*. *S. gilberti* (MEEK), M.Dev.(Onond.), Falls Ohio, Ky.-Ind.; *2a*, surface, lunaria prominent, ×20; *2b*, proximal part of zoarium, ×5; *2c,d*, secs., long., tang., ×20 (222).

Acrogenia HALL, 1883 [**A. prolifera*]. Narrow articulated segments dichotomously branching at each joint; cylindrical rootlets at base. *Dev.*——FIG. 103,*3*. **A. prolifera*, M.Dev.(Hamilton, N.Y.; *3a*, proximal part of segment, ×5; *3b*, transversely cut segment showing surface, mesotheca, and rhombic cross section, ×10; *3c*, zoarium, ×1 (162).

Ceramella HALL-S., 1887 [**C. scidacea*]. Thin broad erect expansions with oval to circular apertures on

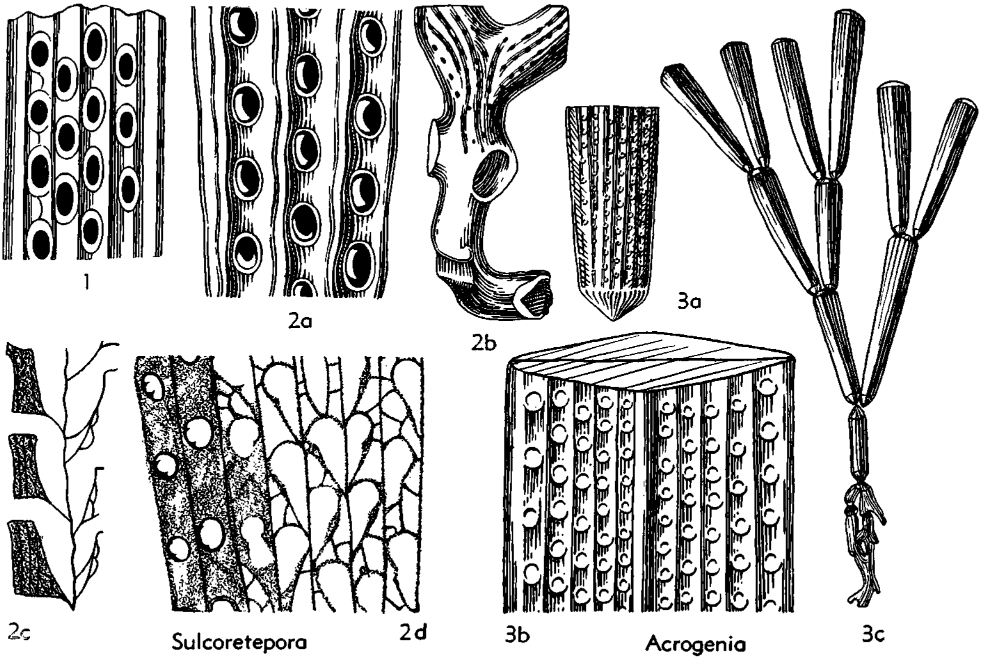

FIG. 103. Sulcoreteporidae (p. G142).

each face; surface marked by elongate maculae. *Dev.*——FIG. 104,*5*. **C. scidacea*, Hamilton, N.Y.; *5a*, surface with macula, ×5; *5b*, fragment, ×1 (162).

Dichotrypa ULR., 1889 [**D. foliata* ULR., 1890]. Like *Sulcoretepora* but zoarium a broad, thin expansion with maculae. Lunaria weak. *Dev.-Miss.* ——FIG. 104,*6*. **D. foliata* ULR., M.Dev., Iowa; *6a,b*, secs., long., tang., ×20 (222).——FIG. 104, *7*. *D. flabellum* ROM., Miss.(Meramec.), Ind.; *7a*, basal part of zoarium, ×1; *7b*, surface with macula, ×10 (222).

Ptilocella SIMPSON, 1897 [**Ptilodictya parallela* HALL-S., 1887]. Ensiform, with pointed, striate base, margins striate, noncelluliferous. Apertures circular in longitudinal rows separated by ridges. *Dev.*——FIG. 104,*3*. **P. parallela* (HALL-S.), Hamilton, N.Y.; *3a*, zoarium, ×1; *3b*, surface, ×10 (163).

Semiopora HALL, 1883 [**S. bistigmata*]. Like *Sulcoretepora* but lunaria absent and 2 small adjoined mesopores between pairs of zooecia. *Dev.*——FIG. 104,*4*. **S. bistigmata*, Hamilton, Ont.; *4a*, surface, ×10; *4b*, zoarium, ×1 (163).

Taeniopora NICH., 1874 [**T. exigua*] [=*Pteropora* HALL, 1883 (*non* EICHW., 1860); *Stictoporidra* SIMPSON, 1897]. Distinguished from *Sulcoretepora* by a longitudinal ridge or keel dividing each face into equal parts. *Dev.*——FIG. 104,*2*. **T. exigua*, Hamilton, Ont.; *2a*, surface, ×5; *2b*, zoarium, ×1 (162).

Thamnotrypa HALL-S., 1887 [*pro Thamnopora* HALL, 1883 (*non* STEININGER, 1831)] [**Thamnopora divaricata* HALL, 1883]. Very narrow stipe of rectangularly lateral branches with 2 (rarely 3) longitudinal rows of apertures separated by a prominent ridge on each face. *Dev.*——FIG. 104,*1*. **T. divaricata* (HALL), Onond., N.Y.; *1a*, surface, ×5; *1b*, zoarium, ×1 (162).

Family RHINOPORIDAE Miller, 1889

Zoaria variable, unilaminar or bifoliate, ramose or sheetlike. Zooecia simple, oblong or rhomboidal, prone along basal membrane; diaphragms and hemisepta absent; vestibules direct, apertures rounded to angular. Mesopores and acanthopores lacking; interzooecial areas generally solid or containing vesicles (2,114; NICKLES-B., 1900). *Sil.*

Rhinopora HALL, 1852 [**R. verrucosa*]. Large, undulating bifoliate expansions; surface commonly smooth, rarely with solid monticules and traversed by slender rounded bifurcating ridges which appear as shallow grooves when surface is worn. Apertures nearly circular, on prominent papillae.

Median tubuli in mesotheca. *Sil.*——Fig. 105,*1*. **R. verrucosa*, Medin., Ont.; *1a*, surface, ×1; *1b*, worn surface showing shallow grooves, ×2 (162).

Diamesopora Hall, 1852 [**D. dichotoma*]. Ramose, hollow stems lined internally by an epitheca. Zooecia simple, hexagonal or rhomboidal, with oval orifice at bottom of tubular vestibule; apertures with peristomes equally elevated or highest posteriorly. Interzooecial spaces compact or horizontally laminated. *Sil.*——Fig. 105,*4*. **D. dichotoma*, Clint., N.Y.; *4a,b*, secs., ×20; *4c*, zoarium, one side broken away below, ×1 (131).

Lichenalia Hall, 1852 [**L. concentrica*]. Like *Rhinopora* but zoarium a thin subcircular unilaminar expansion with concentric basal epitheca, surface traversed by slender bifurcating ridges (canals). Zooecia prostrate, elongate subrhomboidal, with erect subtubular vestibules; apertures rounded, with peristome much elevated on posterior side; interspaces depressed. *Sil.*——Fig. 105,*3*. **L. concentrica*, Clint., N.Y.; *3a*, part of epithecate base, ×1; *3b*, celluliferous side with canals, ×5; *3c*, long. sec., ×20 (131).

Stictotrypa Ulr., 1890 [**Stictopora similis* Hall, 1876] [?=*Stictopora* Hall, 1847]. Narrow ramose bifoliate stems, pointed at base. Apertures circular or elliptical with distinct, evenly elevated peristomes. Interspaces flat or concave, composed of horizontally laminated solid tissue. *Sil.*——Fig. 105,*2*. **S. similis* (Hall), Niag., Ind.; *2a*, fragment, ×5; *2b,c*, secs., ×20 (*2a*, 162; *2b,c*, 222).

Family CYCLOPORIDAE Ulrich, 1890

Zoaria variable in form and structure; includes genera of doubtful affinities, some

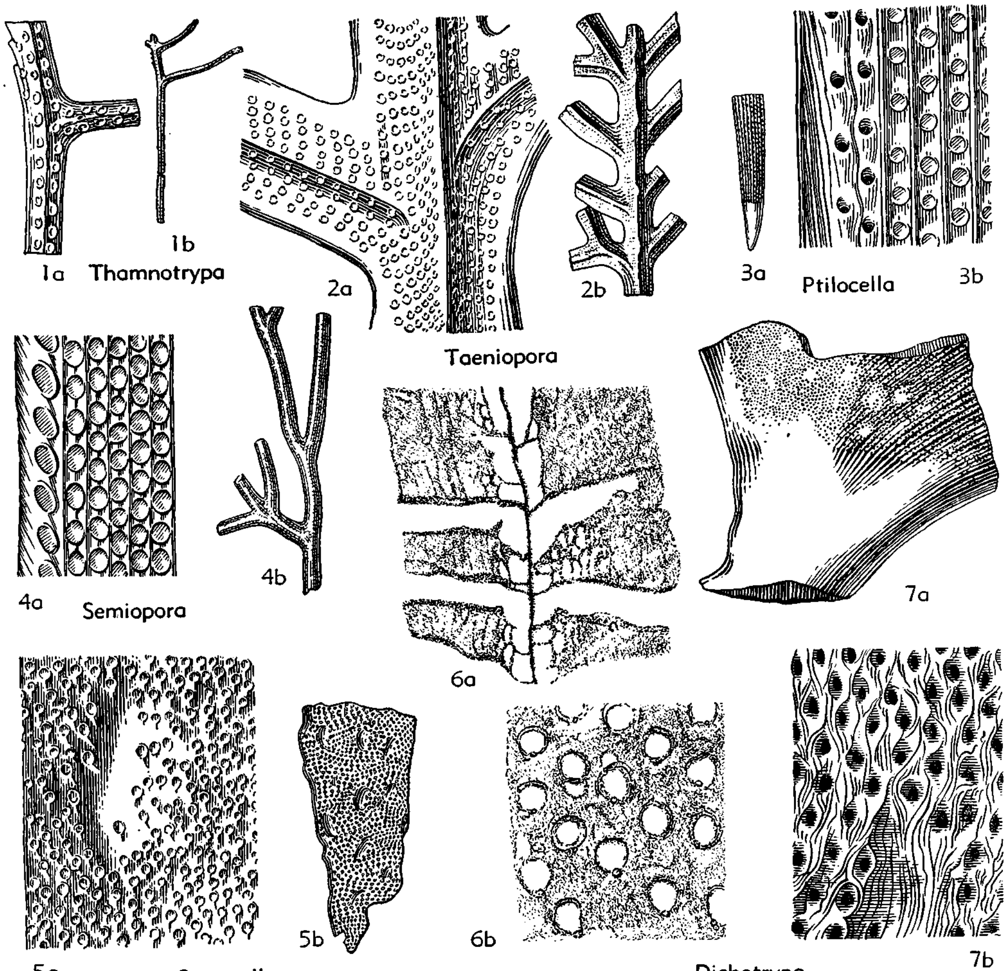

Fig. 104. Sulcoreteporidae (p. G143, G144).

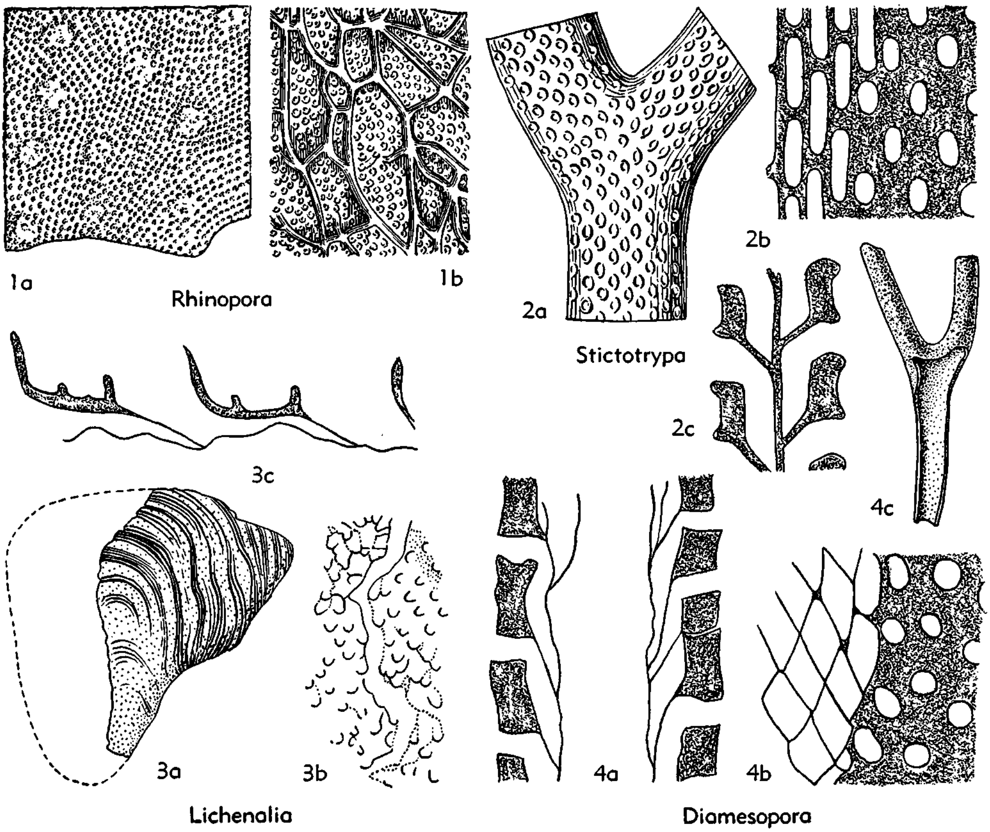

FIG. 105. Rhinoporidae (p. G143, G144).

of which may belong among Cheilostomata (114). *Miss.*

Cyclopora PROUT, 1860 (*non* JULLIEN & CALVET, 1903) [**C. fungia*]. Unilaminar, parasitic or free. Zooecia subtubular, without hemisepta; vestibules rather thick-walled, apertures subcircular, with smooth or granulose peristome. Mesopores open at surface, with thick diaphragms which commonly are centrally perforate; acanthopores may be present. *Dev.-Miss.*——FIG. 106,*1*. **C. fungia,* Miss., Mo.-Ill.; *1a,b,* secs., ×25 (222).

Cycloporella ULR., 1889 [**C. spinifera* ULR., 1890]. Zoarium thin, discoidal. Zooecia subtubular; vestibules with successive superior hemisepta. Irregular mesopores abundant; acanthopores numerous, large. *Miss.*——FIG. 106,*2*. **C. spinifera,* ULR., Osag. (Keokuk), Ill.; *2a,* epithecate base, ×1; *2b,c,* secs., ×25, ×20 (222).

Proutella ULR., 1889 [**Cyclopora discoidea* PROUT, 1860]. Zoarium thin discoid, free; basal concentrically wrinkled epitheca. Zoecia subtubular, thin-walled, with broad, elliptical aperture, surrounded by a narrow hexagonal sloping area; in well-preserved forms apertures have a depressed calcareous plate covering about ⅔ of the opening. With age, the vestibules become elongate and are intersected by incomplete diaphragms. *Miss.*——FIG. 106,*3*. **P. discoidea* (PROUT), Osag. (Keokuk), Ill.; *3a,b,* surface, tang. sec., ×20 (222).

Family ACTINOTRYPIDAE Ulrich, 1890

Thin bifoliate expansions. Apertures indented by projecting ends of 8 to 10 septa-like ridges along sides of vestibules nearly or quite to orifice. Interzooecial spaces filled with layers of vesicles (114). *Miss.-Perm.*

Actinotrypa ULR., 1889 [**Fistulipora peculiaris* ROM., 1866]. May belong among cheilostomes. *Miss.-Perm.*——FIG. 106,*4*. **A. peculiaris* (ROM.), Osag.(Keokuk), Mo.; *4a,* surface, ×20; *4b,c,* secs., showing vesicles ×20 (222).

Family WORTHENOPORIDAE Ulrich, 1893

Bifoliate, branching or palmate. Zooecia very regularly arranged, elongate, rhomboidal; apertures semielliptical, truncated posterior margin somewhat raised; line of junction between zooecia marked on surface by an elevated ridge; elongate triangular space below apertures plain (115). *Miss.*

Worthenopora Ulr., 1889 [**Flustra spatulata* Prout, 1859]. May belong among cheilostomes. *Miss.*——Fig. 106,*6*. *W. spinosa* Ulr., Osag.(Keokuk), Ill.; *6a*, fragment, ×10; *6b*, zooecia, ×25

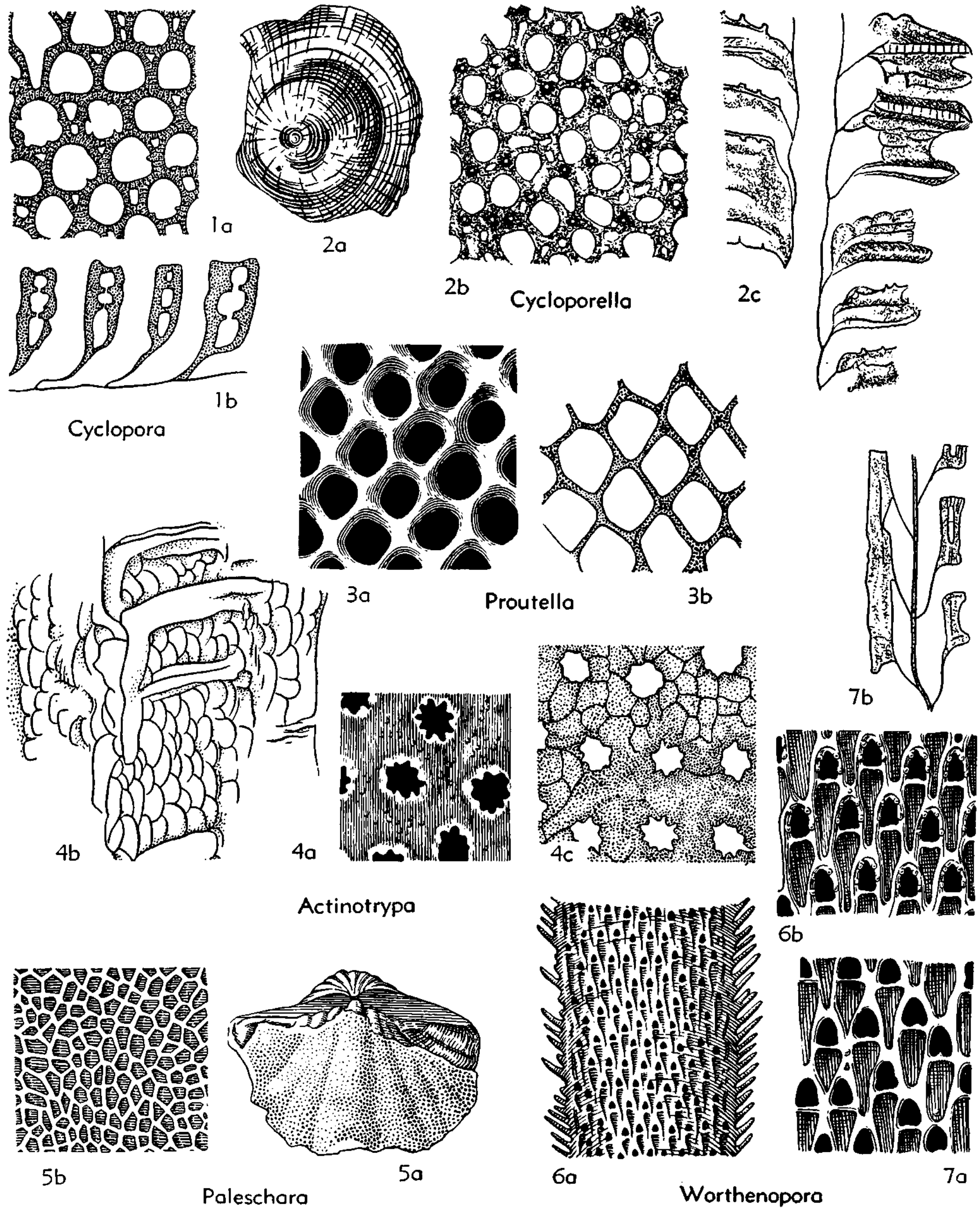

Fig. 106. Cycloporidae, Actinotrypidae, Worthenoporidae, Palescharidae (p. G145-G147).

(222).——Fig. 106,7. **W. spatulata* (Prout), Warsaw, Ill.; *7a*, surface, ×25; *7b*, long. sec., ×25 (222).

Family PALESCHARIDAE Miller, 1889

Thin parasitic expansions upon other fossils, especially cephalopod shells. Zooecial tubes thin, very short, without diaphragms or other structures; apertures direct, angular oblong, with groups of larger ones at regular intervals (114). *Ord.-Dev.*

Paleschara Hall, 1874 [**P. incrustans*]. May belong among cheilostomes. *Ord.-Dev.*——Fig. 106,5. **P. incrustans*, Dev.(Held.), N.Y.; *5a*, incrusting zoarium, ×1; *5b*, surface, ×10 (163).

Order CHEILOSTOMATA Busk, 1852

[=Cheiloctenostomata Silen, 1942 *(partim)*]

Zoaria mostly calcareous but in some families corneous or membranous, generally delicate and highly variable in form; most common are incrusting or free lamellate expansions, slender branching stems, and reticulate fronds. Zooecia almost exclusively short, rounded or angular chambers, arranged serially and in general side by side; orifice distal, smaller in diameter than the zooecium, closed by a hinged operculum, surrounded in many genera by a rim (peristome) that may be extended as a tube (peristomie) with aperture distinct from the operculum-covered orifice, thus resembling cryptostomes. Eggs matured in several sorts of ovicells. Specialized zooids (avicularia, vibracula) common. *?M.Jur., Cret.-Rec.*

MORPHOLOGICAL FEATURES

The Cheilostomata, the dominant group among Cenozoic and Recent Bryozoa, are characterized by closure of the aperture with an **operculum,** hinged chitinous lip *(cheilos),* when the polypide is retracted. The order includes many beautiful sorts of zoarial growth, for the zooecial **frontal wall,** when calcified, commonly exhibits varied patterns of great delicacy. Formerly, differences in these patterns were relied on alone for the discrimination of genera and species and as a result, an unnatural classification prevailed. The calcification of the frontal wall is only one of the bryozoan functions and a natural classification should be based upon all important features.

The Cheilostomata also exhibit the highest type of development in the Bryozoa and for that reason the description of the various animal functions has been reserved for this place. Study of living bryozoans shows that in order of importance these are (1) those concerned with reproduction, including passage of the eggs and escape of the larvae, which calls to attention relations between the zooecial operculum and ovicell; (2) the hydrostatic system, which controls extrusion and retraction of the polypide; and (3) calcification and chitinization, or the nature of skeletal parts. The least important of these formerly was considered alone almost invariably. The characters mentioned are not difficult to determine in Recent forms, but in fossil species, where only the calcareous skeleton remains, often it seems impossible to discover all of them. Fortunately, the form of the zooecial aperture indicates the hydrostatic function and the occurrence of **cardelles** (projections on the orifice edge for hingement of the operculum) reveals the presence and nature of movements of the operculum. The function of reproduction is illustrated by the character and location of the ovicell.

Reproduction.—A classification of the Bryozoa that finally may be judged acceptable is impossible at present, because probably each family should be characterized essentially by the larval form of its constituents; unfortunately, this is known at present for comparatively few families. The fertilized eggs of cheilostomatous Bryozoa are transformed into embryos as in the Cyclostomata and these develop into larvae within special cavities of incubation, which, when visible, are called **ovicells.** The larva called *Cyphonautes,* belonging to the widely distributed *Membranipora pilosa,* is a curious pelagic form with a pair of shell-like covers protecting its sides. Some cheilostome species reveal no ovicells; nothing on the exterior shows their mode of reproduction. Some are oviparous and expel their eggs by an intertentacular organ, but most have some visible ovicell, which is a globular swelling surmounting the zooecial orifice and not a direct modification of the zooe-