of shell dissimilar; skeleton composed of opaline silica. *Cam.-Rec.*

MORPHOLOGICAL FEATURES

The Nassellina differ essentially from other suborders in the structure of the central capsule and of the skeleton. The thin-walled single membrane encloses a more or less egg-shaped central capsule with a truncated base. The convex part is completely devoid of pores, but the flat part, closed off by a thick **operculum,** is pierced by numerous tiny pores. Inside the central capsule, resting its base upon the operculum, is a stout obtuse cone termed the **podoconus.** Fine canals from the operculum pass

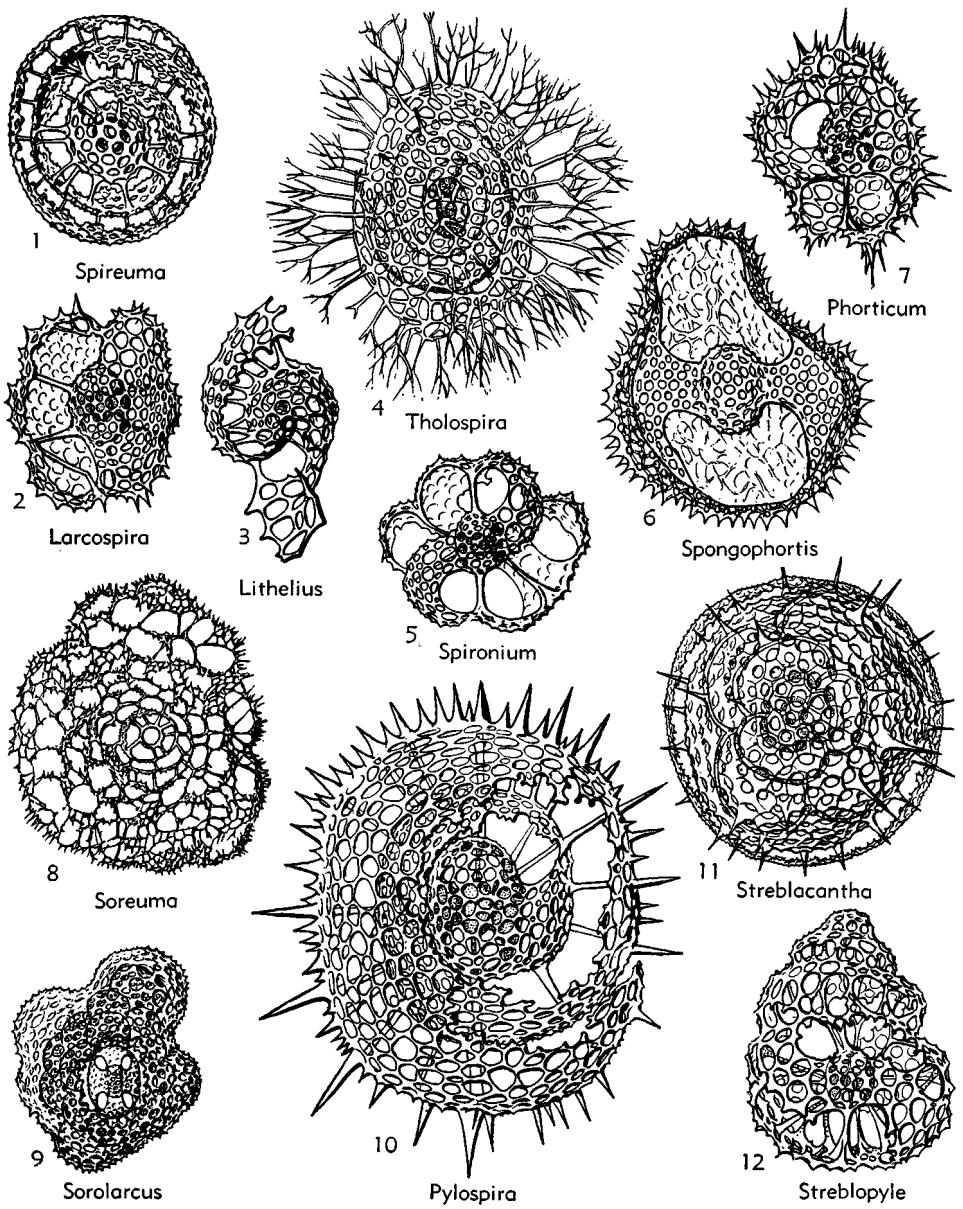

FIG. 49. Litheliidae, Strebloniidae, Phorticidae, Soreumatidae (p. D99, D100).

through the podoconus to the apex and thus allow communication between the extracapsular and intracapsular cytoplasm. The simple genus *Cystidium* of the Nassellina may be compared with *Procyttarium* of the Spumellina, from which it differs almost exclusively in the shape of the central capsule and in presence of a podoconus. These two genera represent probable ancestors of their respective suborders.

The peripherally generated nasselline skeleton is siliceous (opal), like that of the spumelline shell and unlike that found in the other 2 suborders. Three fundamental skeletal elements are found in this type of skeleton: (a) the **tripod** formed by divergent rods united at a common center and oriented in such a way that one leg is posterior and the other 2 are right and left antero-lateral; (b) the commonly conical or helmet-shaped **lattice shell,** fixed at the common center of the tripod; and (c) the great circle or **sagittal ring** which reinforces the latticed wall in the medial sagittal plane. Especially in Nasselina having a segmented lattice shell, the first division (nearest the center) is called the **cephalis.**

Great difficulty is presented by the fact that the 3 structural types mentioned are not constantly united, but each alone may constitute the skeleton by itself. In this respect there are 7 possible arrangements: (1) The skeleton is formed by the basal tripod alone, as in some Stephaniicae. (2) The skeleton is composed of a basal tripod alone *(Acanthometra)* or a tripod with a vertical apical spine rising from its center *(Plagoniscus),* and commonly with an irregular framework rising from the rods of the tripod but without trace of a latticed cephalis or sagittal ring, as in the Plagoniicae. (3) The skeleton is composed only of a latticed cephalis or single chamber and is without trace of sagittal ring or basal tripod, as in the Archicorythidae, some Cannobotrydicae, and many other Cyrtellari. (4) The skeleton is composed of a sagittal ring and basal tripod without a latticed cephalis, as in some Stephaniicae. (5) The skeleton is formed by a sagittal ring and latticed cephalis without a basal tripod, as among Cyrtellari, especially in some Triospyrididae, many Cannobotrydicae, and some complex Adelocyrtidinae, Theocorythidae, and Stichocorythidae. (6) The shell is composed of a basal tripod and latticed cephalis which may bear an apical cupola or dome but lacks any trace of sagittal ring, as among many Cyrtellari. (7) The shell is composed of a sagittal ring, basal tripod, and latticed cephalis, as in most Triospyridicae and Archipiliicae.

Among the Archipiliicae, subdivisions may be distinguished according to 3 different criteria: number of **joints** into which the shell is divided by transverse strictures; number of radial apophyses rising from the shell; and character of the basal shell mouth, which is open in most but closed off or **fenestrated** in some. The number of **segments into which the shell** is divided by transverse strictures serves to discriminate 4 subsuperfamilies—Archipiliilae (1 joint, no stricture), Sethopiliilae (2 joints, 1 stricture), Theopiliilae (3 joints, 2 strictures), and Triacartilae (4 or more joints, 3 or more strictures). The first 3 joints generally are very different from those which follow, so that the first is distinguished as the cephalis, the second as the **thorax,** and the third as the **abdomen.** Joints which may follow the abdomen are termed collectively **postabdomina.**

The radial appendages may consist of either solid or fenestrated **feet** projecting from the ultimate joint, or **wings** extending from the sides of the shell, but solid or latticed ribs may take the place of wings. Most shells have 3 radial appendages, although some have many more and others none.

The cephalis of the Archipiliicae is probably similar to that of the Triospyridicae and differs from it in the reduction of the sagittal stricture, so that the chamber is single instead of double. That of the Cannobotrydicae is lobulated into several, commonly irregular chambers, and appears to have arisen secondarily from the single-chamber cephalis of the Archipiliicae. The thorax of shells belonging to the Sethopiliilae, Theopiliilae, and Tricartilae is equivalent to that found in the Phormospyrididae, Androspyrididae, Pylobotrydidae, being developed from apophyses which arise from the base of the cephalis and become united by transverse branches to form a latticed cylinder, truncate cone, or pyramid. The thorax may be closed by a convex or flat fenestrated plate at its lower end. The abdomen, absent in the Archipiliicae

and most Triospyridicae, occurs in most other Cyrtellari.

The horizontal plate at the base of the cephalis has basal or **collar pores** in the Triospyridicae, and some other Cyrtellari. They resemble those at the point of attachment of the ring and tripod in the Semantididae. **Strictures** between successive shell joints of the Cyrtellari generally are marked by a latticed girdle projecting into the shell cavity like a diaphragm; this diaphragm has the form of a solid horizontal annulus in many shells.

The lattice structure exhibits extraordinary variety and the different shell joints commonly are distinguished by modifications displayed by this lattice. The pores of the meshwork of the different joints are also varied in many ways and may serve to differentiate these joints externally.

The closing of the mouth by a transverse plate has different significance in the Archiperinae from that found in the many multijointed basally fenestrated genera. In the Archiperinae this plate is the original one formed by the cephalis of the Triospyridicae and developed from the beams which bound the regularly disposed collar pores of these forms. In multijointed genera, on the other hand, the plate originates by the central union of the convergent edges of the shell margin which grew inward toward the center; a central vertical spine, as in *Artoperina,* may project downward from this center, but in most basally fenestrated genera it is lacking. The basal plate may be flat, convex, or even inverted conical. The pores which occur in it are generally like those of the next superior joint.

The radial apophyses may be derived from the tripod found among the Plectellari, especially of the Stephaniicae and most Triospyridicae. The apical spine, or **apical horn,** is particularly important and bears relationship to the odd or posterior foot. An **internal columella** arises in many forms within the cephalis, or an ascending rib following the convex surface of the cephalis on the dorsal wall may develop in its place. This rib connects the base of the apical horn with the origin of the posterior foot; the columella or rib seems to be a remaining part of the sagittal ring found in some Plectellari. Accessory apical horns, either free or less commonly anastomosed, may be developed. In some hornless genera, the columella connecting with the posterior foot is preserved.

The characters of the Cyrtellari are such that all structures described above in connection with this division are combined with each other to produce the many genera and families. This group contains more than 1,000 species, and the majority of the fossil Nassellina are included in it. In many genera the number of species is large, but species belonging to the more complex genera are few.

The best account of the biology and ecology of the Nassellina may be found in HAECKEL (12).

Division PLECTELLARI Haeckel, 1887

[as Plectellaria; emend. CAMPBELL, herein]

Without complete skeleton. *Ord.-Rec.*

Superfamily CYSTIDIICAE Haeckel, 1883

[*ex* Cystidina; emend. CAMPBELL, herein]
[=Nassoidea HKL., 1887]

Lacking skeleton. *Rec.*

Family CYSTIDIIDAE Haeckel, 1883

[as Cystidina; emend. CAMPBELL, herein]
[=Nassellida HKL., 1887]

Naked cells only. *Rec.*

Cystidium HERTWIG, 1879 [**C. inerme*]. Calymma hyaline, without alveoles.——FIG. 50,*1. C. princeps* HKL., Rec., ×200 (42).

Nassella HKL., 1887 [**N. thalassicola;* SD herein]. Calymma foamy, with large alveoles.

Superfamily PLAGONIICAE Haeckel, 1882

[*ex* Plagonida; emend. CAMPBELL, herein]
[=Plegmida HKL., 1878; Plagiacanthida HERTWIG, 1879 *(partim);* Plectida HKL., 1882; Plectoidea HKL., 1887]

Skeleton consists only of basal tripod. *Ord.-Rec.*

Family PLAGONIIDAE Haeckel, 1882

[as Plagonida; emend. CAMPBELL, herein]

Skeleton formed of radial spines united at a common center; without wickerwork. *Ord.-Rec.*

Subfamily PLAGONIINAE Haeckel, 1882

[as Plagonida *(partim);* emend. CAMPBELL, herein]
[=Hexaplagida HKL., 1887]

Six radial spines. *Ord.-Rec.*

Plagonium HKL., 1882 [**P. sphaerozoum* HKL., 1887]. Spines in 2 opposite groups from poles of common center. *Ord.-Rec.*——FIG. 50,*6*. **P. sphaerozoum*, Rec., ×100 (42).

Hexaplagia HKL., 1882 [**H. arctica* HKL., 1887] [=*Hexaplagidium* HKL., 1882]. Spines arise from one common center. *Rec.*

Subfamily TRIPLAGIINAE Haeckel, 1882

[as Triplagida; emend. CAMPBELL, herein]

Three radial spines. *Dev.-Rec.*

Triplagia HKL., 1882 [**T. primordialis* HKL., 1887]. Spines in one horizontal plane. *Rec.*——FIG. 50,*3*. **T. primordialis*, Rec., ×82 (42).

Acanthometra MÜLLER, 1855 [**A. arachnoides* CLAPARÈDE, 1855] [=*Plagiacantha* CLAPARÈDE, 1856 (obj.); *Triplagiacantha* SCHRÖDER, 1914]. Spines corresponding to edges of flat pyramid. *Dev.-Rec.*——FIG. 50,*2*. *A. australis* (HINDE), 2 spines and basal part of a third one, Dev., Austral., ×150 (44).

Subfamily TETRAPLAGIINAE Haeckel, 1887

[as Tetraplagida; emend. CAMPBELL, herein] [=Tetraplectida HKL., 1882]

Four radial spines. *Ord.-Rec.*

Tetraplagia HKL., 1882 [**T. geometrica* HKL., 1887]. Equal spines arise from common center. *Rec.*——FIG. 50,*5*. *T. phaenaxonia* HKL., Rec., ×100 (42).

Plagiocarpa HKL., 1882 [**P. procortina* HKL., 1887]. Spines arise in 2 pairs from poles of common central rod; one apical spine opposed to 3 basal spines. *Rec.*——FIG. 50,*4*. **P. procortina*, Rec., ×100 (42).

Plagonidium HKL., 1882 [**P. bigeminum* HKL., 1887]. Like *Plagiocarpa* but all spines equal. *Rec.*

Plagoniscus HKL., 1887 [**P. tripodiscus*; SD herein]. Like *Tetraplagia* but spines unequal. *Ord.-Rec.*——FIG. 50,*7*. *P. cristatus* HINDE, Dev., Austral., ×150 (44).

Subfamily ENNEAPLAGIINAE Campbell, nov.

Radial spines 7 to 9 or more. *Rec.*

Enneaplagia HKL., 1882 [**Polyplagia septenaria* HKL., 1887] [=*Enneaplagidium* HKL., 1882; *Polyplagia* HKL., 1887 (obj.)]. Spines arise from common central rod and lie in different planes.

Family PLECTANIIDAE Haeckel, 1882

[as Plectanida; emend. CAMPBELL, herein]

Skeleton formed of the united branches of radial spines. *Rec.*

Subfamily PLECTANIINAE Haeckel, 1882

[as Plectanida *(partim)*; emend. CAMPBELL, herein] [=Polyplectida HKL., 1882 *(partim)*]

Six radial spines. *Rec.*

Plectanium HKL., 1882 [**P. trigeminum* HKL., 1887]. Spines arise in 2 opposite groups from poles of common central rod.——FIG. 50,*12*. **P. trigeminum*, Rec., ×200 (42).

Hexaplegma HKL., 1882 [**Hexaplecta triaxonia* HKL., 1887] [=*Hexaplecta* HKL., 1887 (obj.)]. Spines arise from one common central point.

Verticellata POP., 1913 [**V. hexacantha*]. Spines surrounded by lattice.——FIG. 50,*13*. **V. hexacantha*, Rec., ×275 (48).

Subfamily TRIPLECTINAE Haeckel, 1882

[as Triplectida; emend. CAMPBELL, herein]

Three radial spines. *Rec.*

Triplecta HKL., 1882 [**T. triangulum* HKL., 1887]. Spines lie in one horizontal plane.——FIG. 50,*10*. *T. triactus* HKL., Rec., ×100 (42).

Campylacantha JÖRG., 1905 [**C. cladophora*]. Vertical spine simple, others basally forked with 3 free tips at ends.——FIG. 50,*8*. **C. cladophora*, Rec., ×300 (46).

Plectacantha JÖRG., 1905 [**P. oikiskos*]. Each spine has 2 paired forked branches.——FIG. 50,*9*. **P. oikiskos*, Rec., ×250 (46).

Plectophora HKL., 1882 [**P. triomma* HKL., 1887]. Spines correspond to edges of flat pyramid.

Protoscenium JÖRG., 1905 [**Plectanium simplex* CLEVE, 1899]. Each primary spine forked 4 times; primary spines connected by arches.——FIG. 50,*11*. **P. simplex* (CLEVE), Rec., ×400 (46).

Subfamily TETRAPLECTINAE Haeckel, 1882

[as Tetraplectida; emend. CAMPBELL, herein]

Four radial spines. *Rec.*

Tetraplecta HKL., 1882 [**T. tetrahedra* HKL., 1887] [=*Amphiplecta* HKL., 1882]. Equal spines correspond to 4 axes of a tetrahedron.

Dumetium POP., 1909 [**D. rectum*]. Axial spine opposed to 2 basal spines one of which is terminally forked; repeated lateral anastomosed branches on spines.——FIG. 51,*2*. **D. rectum*, Rec., ×200 (48).

Gonosphaera JÖRG., 1905 [**G. primordialis*]. Two regular pentagons with a common side, long oblique spines at 4 corners and a connecting 3-jointed arch at 5th.——FIG. 51,*4*. **G. primordialis*, Rec., ×250 (46).

Obeliscus POP., 1913 [**O. pseudocuboïdes*]. Strong spines extend from ring united by arched beams; above ring a pyramidal spiny lattice.——FIG. 51,*1*. **O. pseudocuboïdes*, Rec., ×400 (48).

Periplecta HKL., 1882 [**P. cortina* HKL., 1887]. Spines in 2 pairs; one apical spine differs from 3 basal spines.——FIG. 51,*3*. **P. cortina*, Rec., ×100 (42).

Phormacantha JÖRG., 1905 [**Peridium hystrix* CLEVE, 1899]. Primary spines with 3 arches and a strong ventral sagittal spine.——FIG. 51,*7*. **P. hystrix* (CLEVE), Rec., ×300 (46).

Plectaniscus HKL., 1887 [**P. cortiniscus*]. Spines arise from common central point; apical spine

differs from 3 basal spines.——Fig. 51,5. **P. cortiniscus,* Rec., ×100 (42).

Subfamily ENNEAPLEGMATINAE Campbell, nov.

Radial spines 7 to 9 or more. *Rec.*

Enneaplegma Hkl., 1882 [**Polyplecta heptacantha* Hkl., 1887 (=*Heptaplegma heptacantha* Hkl., 1887)] [=*Pentaplegma* (obj.), *Plegmatium* (obj.) Hkl., 1882; *Polyplecta* (obj.), *Heptaplegma* (obj.) Hkl., 1887]. Seven to 9 or more spines arise from central point and lie in different planes.——Fig. 51,6. **E. heptacantha* (Hkl.), Rec., ×150 (42).

Superfamily STEPHANIICAE Haeckel, 1887

[*ex* Stephanida; emend. Campbell, herein]
[=Stephida Hkl., 1882 *(partim)*; Stephoidea Hkl., 1887; Orboidea Pop., 1913 *(partim)*]

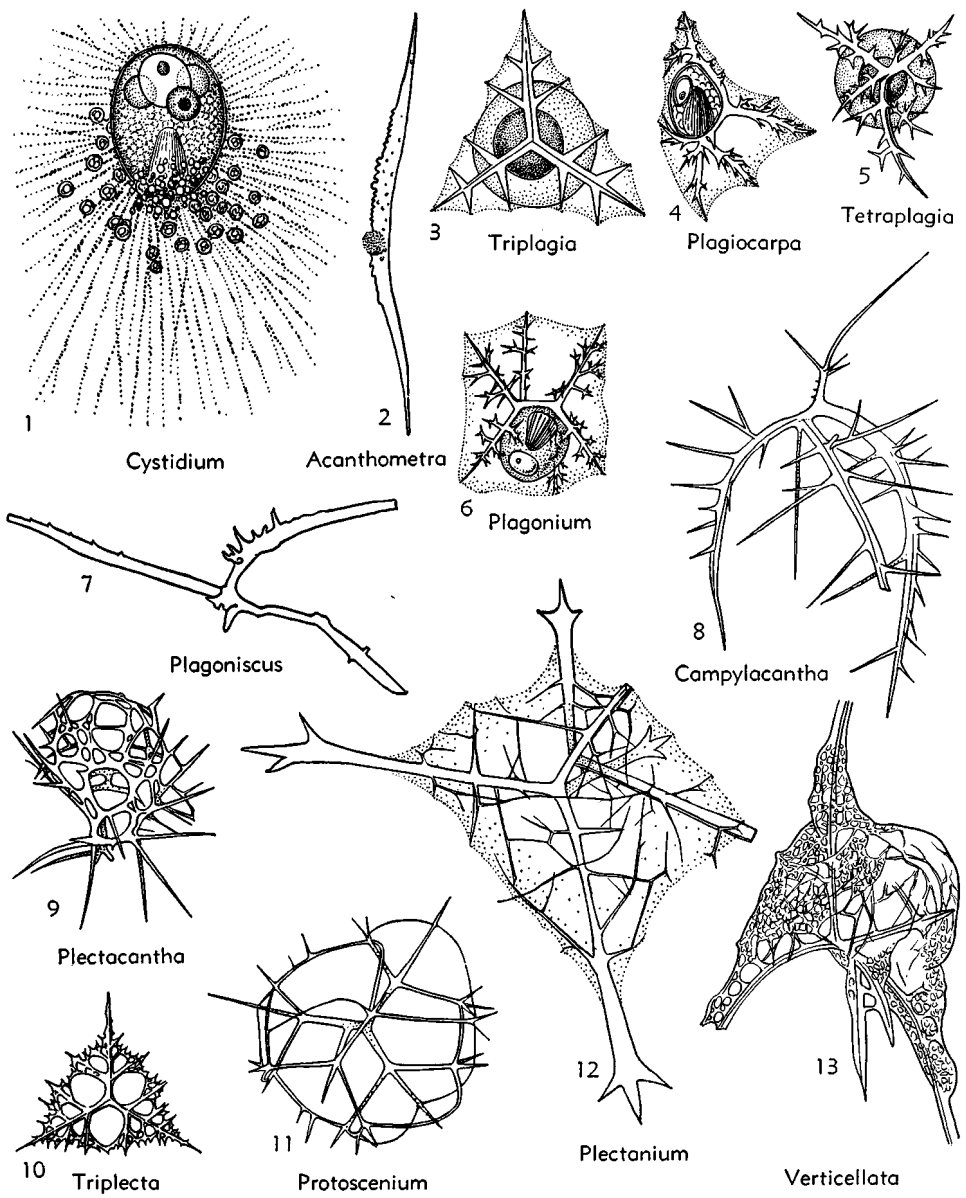

Fig. 50. Cystidiidae, Plagoniidae, Plectaniidae (p. D103, D104).

Skeleton formed of sagittal ring with or without basal tripod. *Trias.-Rec.*

Family STEPHANIIDAE Haeckel, 1887

[as Stephanida; emend. CAMPBELL, herein] [=Monostephida HKL., 1882 *(partim)*]

Skeleton composed of simple vertical sagittal ring, without secondary rings. *Trias.-Rec.*

Subfamily STEPHANIINAE Haeckel, 1887

[as Stephanida *(partim)*; emend. CAMPBELL, herein] [=Cortinida HKL., 1887]

Basal feet present. *Eoc.-Rec.*

Stephanium HKL., 1887 [**S. quadrupes*; SD herein]. Four basal feet. *Eoc.-Rec.*——FIG. 51,*8*. **S. quadrupes*, Rec., ×150 (42).

Cortina HKL., 1887 [**C. typus*]. Three basal feet. *Eoc.-Rec.*——FIG. 51,*12*. **C. typus*, Rec., ×100 (42).

Subfamily LITHOCIRCINAE Haeckel, 1887

[as Lithocircida; emend. CAMPBELL, herein]

Without typical basal feet. *Trias.-Rec.*

Lithocircus MÜLLER, 1856 [**L. annularis* MÜLLER, 1858]. Dorsal and ventral bows of ring similar; armed with branched spines. *Cret.-Rec.*——FIG. 51,*14*. *L. quadricornis* HKL., Rec., ×200 (42).

Acanthocircus SQUIN., 1903 [**A. irregularis*; SD herein]. Ring mostly elliptical; incomplete internal spine on each side of middle; thorns or spines simple. *Cret.*——FIG. 51,*9*. **A. irregularis*, Cret., Italy, ×60 (52).

Dendrocircus HKL., 1882 [**D. quadrangulus* HKL., 1887]. Dorsal and ventral bows of ring different, otherwise as *Lithocircus*. *Eoc.-Rec.*——FIG. 51,*11*. *D. arborescens* HKL., Rec., ×200 (42).

Monostephus HKL., 1882 [**Archicircus monostephus* HKL., 1887] Like *Lithocircus* but ring has no branched thorns or spines. *Trias.-Rec.*

M. (Monostephus). Ring without prominent corners. *Trias.-Rec.*——FIG. 51,*13b*. **M. (M.) monostephus*, Rec., ×300 (42).

M. (Archicircus) HKL., 1887 [**Archicircus primordialis* HKL., 1887] [=*Archistephus* HKL., 1887 (obj.)]. Ring polygonal. *Rec.*——FIG. 51, *13a*. **M. (A.) primordialis*, Rec., ×200 (42).

Zygocircus BÜTSCHLI, 1882 [**Lithocircus productus* HERTWIG, 1879]. Like *Dendrocircus* but spines branched. *Cret.-Rec.*——FIG. 51,*10*. **Z. pentagonus* HKL., Rec., ×200 (42).

Family CYRTOSTEPHANIDAE Popofsky, 1913

Sagittal ring latticed, or netlike fan of repeated anastomosed spines. *Rec.*

Cyrtostephanus POP., 1913 [**C. globus*; SD herein]. Ring incomplete.——FIG. 52,*1*. **C. globus*, Rec., ×400 (48).

Family SEMANTIDIDAE Haeckel, 1887

[as Semantida; emend. CAMPBELL, herein]

Skeleton composed of a vertical sagittal and a horizontal basal ring. *Jur.-Rec.*

Subfamily SEMANTIDINAE Haeckel, 1887

[as Semantida *(partim)*; emend. CAMPBELL, herein] [=Semantiscida HKL., 1887]

Lacking typical basal feet. *Jur.-Rec.*

Semantis HKL., 1887 [**S. biforis*; SD herein]. Two basal pores. *Jur.-Rec.*——FIG. 52,*4*. *S. triangularis* CL.-C., U.Eoc., Calif., ×870 (39).

Clathrocircus HKL., 1882 [**C. hexaporus* HKL., 1887] [=*Sphaerocircus* HKL., 1882]. Like *Semantis* but has dorsal and ventral pores along whole ring. *Rec.*——FIG. 52,*5*. *S. stapedius* HKL., Rec., ×200 (42).

Dictyocircus JÖRG., 1905 [**D. clathratus*]. Sagittal ring with 6 spines; 2 opposite lateral rings each with 2 short spines. *Rec.*——FIG. 52,*2*. **D. clathratus*, Rec., ×300 (46).

Neosemantis POP., 1913 [**N. distephanus*; SD herein]. Three fused rings united at 2 places. *Rec.*——FIG. 52,*3*. *N. distephanus*, Rec., ×400 (48).

Semantidium HKL., 1887 [**S. hexastoma*; SD herein]. Six basal pores, otherwise as *Semantis*. *Rec.*——FIG. 52,*6*. *S. signatorum* HKL., Rec., ×200 (42).

Semantrum HKL., 1887 [**S. quadrifore*; SD herein]. Four basal pores, otherwise as *Semantis*. *Eoc.-Rec.*——FIG. 52,*7*. **S. quadrifore*, Eoc., Barbados, ×200 (42).

Subfamily CORTINISCINAE Haeckel, 1887

[as Cortiniscida; emend. CAMPBELL, herein]

Basal ring with regularly disposed feet. *Eoc.-Rec.*

Cortiniscus HKL., 1887 [**C. typicus*]. One odd or caudal foot and 2 paired lateral feet. *Eoc.-Rec.* ——FIG. 52,*8*. **C. typicus*, Rec., ×150 (42).

Semantiscus HKL., 1887 [**S. hexapylus*; SD herein]. Six basal feet. *Rec.*——FIG. 52,*10*. **S. hexapylus*, Rec., ×200 (42).

Stephaniscus HKL., 1887 [**S. quadrifurcus*; SD herein]. Like *Cortiniscus* but has 4 feet. *Eoc.-Rec.*——FIG. 52,*9*. **S. quadrifurcus*, Rec., ×150 (42).

Family ACANTHODESMIIDAE Hertwig, 1879

[as Acanthodesmida; emend. CAMPBELL, herein] [=Coronida HKL., 1887]

Skeleton formed by 2 crossed vertical meridional rings and commonly a horizontal basal ring. *Jur.-Rec.*

Subfamily ACANTHODESMIINAE Haeckel, 1882

[as Acanthodesmida *(partim)*; emend. CAMPBELL, herein]

Five large gates or openings between rings. *Rec.*

Acanthodesmia MÜLLER, 1858 [**Lithocircus vinculatus* MÜLLER, 1856]. Like *Coronidium* but gates partly latticed.——FIG. 52,*13*. *A. coronata* HKL., Rec., ×200 (42).

Coronidium HKL., 1882 [**C. dyostephanus* HKL., 1887]. Four open lateral gates.——FIG. 52,*15*. **C. dyostephanus*, Rec., ×200 (42).

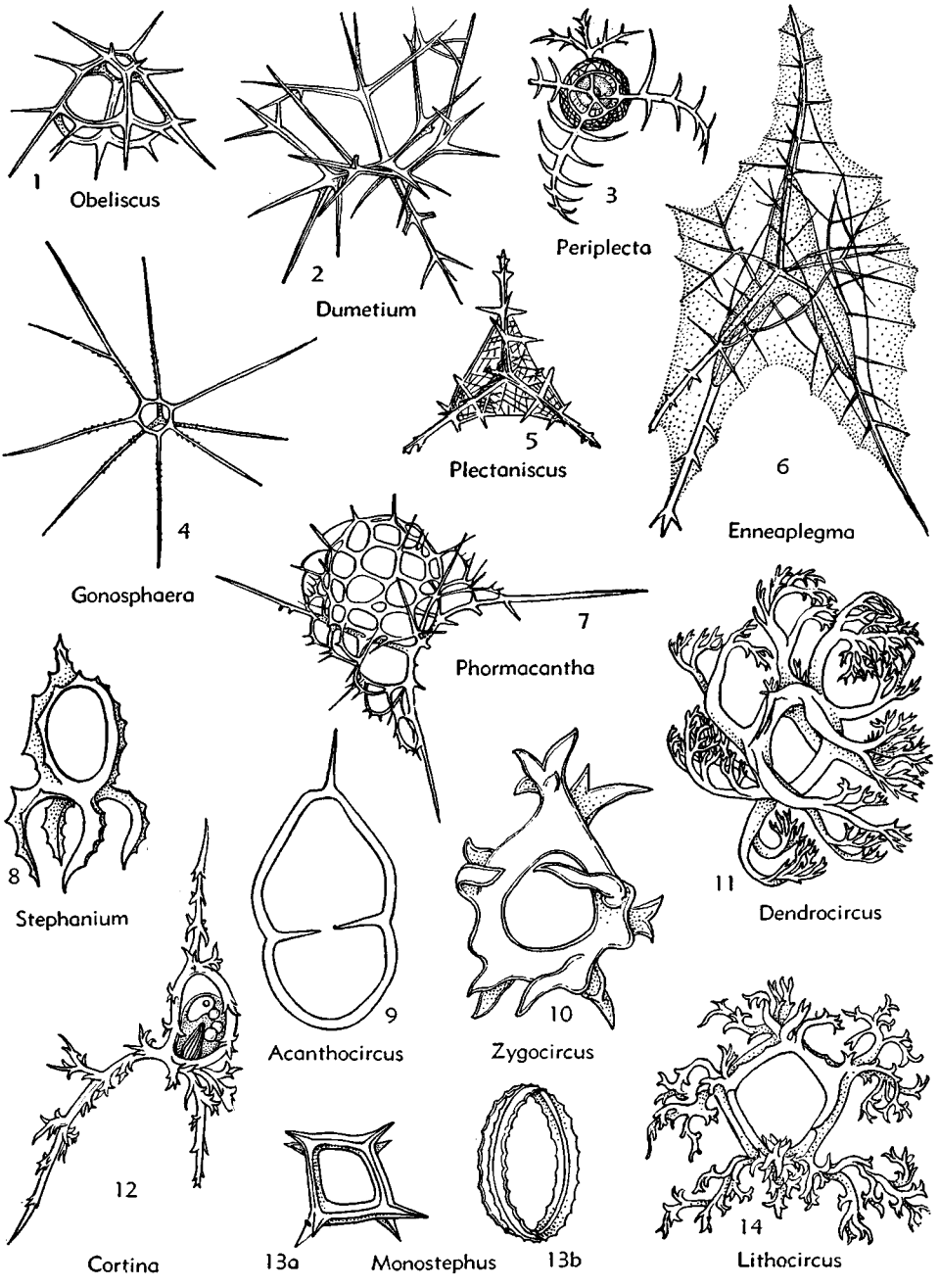

FIG. 51. Plectaniidae, Stephaniidae (p. D104-D106).

Subfamily ZYGOSTEPHANINAE Haeckel, 1882
[as Zygostephanida; emend. CAMPBELL, herein]

Four lateral gates. *Jur.-Rec.*

Zygostephanus HKL., 1862 [**Z. mülleri*]. Gates simple. *Jur.-Rec.*

Z. (Zygostephanus) [=*Zygostephus* HKL., 1882 (obj.)]. Vertical ring without sagittal constriction. *Jur.-Rec.*——FIG. 52,*11*. *Z. (Z.) dissocircus* HKL., Rec., ×200 (42).

Z. (Zygostephaniscus) HKL., 1882 [**Z. reniformis* HKL., 1887]. Sagittal constrictions present. *Rec.*

Zygostephanium HKL., 1882 [**Z. dizonium* HKL., 1887 (=*Tympaniscus dizonius* HKL., 1887)]. Gates partly latticed. *Rec.*——FIG. 52,*12*. *Z. paradictyum* HKL., Rec., ×200 (42).

Subfamily EUCORONIDINAE Haeckel, 1882
[as Eucoronida; emend. CAMPBELL, herein]

Six large gates. *Eoc.-Rec.*

Eucoronis HKL., 1882 [**E. perspicillum* HKL., 1887]. Lacking large basal feet; gates simple. *Rec.*

E. (Eucoronis) [=*Acrocoronis* HKL., 1882 (obj.)]. Armed with short thorns.——FIG. 52,*14*. **E. (E.) perspicillum*, Rec., ×200 (42).

E. (Lithocoronis) HKL., 1882 [**E. crevicornis* HKL., 1887]. Armed with arborescent spines.

Plectocoronis HKL., 1882 [**P. anacantha* HKL., 1887]. Like *Eucoronis* but gates partly latticed. *Rec.*——FIG. 52,*19*. **P. pentacantha* HKL., Rec., ×150 (42).

Podocoronis HKL., 1882 [**P. dipodiscus* HKL., 1887]. Large regularly disposed basal feet and simple gates. *Eoc.-Rec.*

P. (Podocoronis) [=*Dipocoronis* HKL., 1882 (obj.)]. A right and left lateral foot. *Eoc.-Rec.*——FIG. 52,*18*. *P. (P.) toxarium* HKL., Rec., ×200 (42).

P. (Hexacoronis) HKL., 1887 [**P. hexapodiscus*]. Six basal feet. *Rec.*

P. (Stylocoronis) HKL., 1887 [**P. petalospyris;* SD herein]. Eight to 12 or more basal feet. *Eoc.-Rec.*

P. (Tetracoronis) HKL., 1882 [**P. tetrapodiscus* HKL., 1887]. Four basal feet. *Rec.*

P. (Tripocoronis) HKL., 1882 [**P. cortiniscus* HKL., 1887]. Three basal feet. *Eoc.-Rec.*

Subfamily TRISSOCYCLINAE Haeckel, 1882
[as Trissocyclida; emend. CAMPBELL, herein]

Eight large gates. *Rec.*

Trissocyclus HKL., 1882 [**T. stauroporus* HKL., 1887]. Gates all similar, partly latticed.

T. (Trissocyclus) [=*Tricyclarium* HKL., 1887 (obj.)]. Sagittal ring smaller than others.

T. (Tricyclonium) HKL., 1887 [**T. sphaeridium*]. All rings similar.——FIG. 52,*20*. **T. (T.) sphaeridium*, Rec., ×200 (42).

Tricyclidium HKL., 1882 [**T. dictyospyris* HKL., 1887]. Four upper gates larger than others; gates partly latticed.——FIG. 52,*16*. **T. dictyospyris*, Rec., ×150 (42).

Trissocircus HKL., 1882 [**T. lentellipsis* HKL., 1887]. Like *Trissocyclus* but gates all simple.

T. (Trissocircus) [=*Tricircarium* HKL., 1887 (obj.)]. Sagittal ring smaller than others.——FIG. 52,*17*. **T. (T.) lentellipsis*, Rec., ×200 (42).

T. (Tricirconium) HKL., 1887 [**T. globus;* SD herein]. Rings all alike.

Tristephanium HKL., 1882 [**T. dimensivum* HKL., 1887]. Like *Tricyclidium* but gates all simple.

T. (Tristephanium) [=*Triostephus* HKL., 1882 (obj.)]. Sagittal and frontal rings of different size and form.——FIG. 52,*21*. **T. (T.) dimensivum*, Rec., ×200 (42).

T. (Tristephaniscus) HKL., 1882 [**T. quadricorne* HKL., 1887]. Sagittal and frontal rings alike.

Family PARATYMPANIDAE Haeckel, 1882

[as Paratympanida; emend. CAMPBELL, herein]
[=Parastephida HKL., 1882; Tympanida HKL., 1887]

Skeleton composed of 2 parallel horizontal rings conected by vertical sagittal ring. *Jur.-Rec.*

Subfamily PROTYMPANIINAE Haeckel, 1887
[as Protympanida; emend. CAMPBELL, herein]

Horizontal rings bisected by complete sagittal ring. *Cret.-Rec.*

Protympanium HKL., 1882 [**P. primordiale* HKL., 1887]. Horizontal rings connected by 2 columellae; one complete sagittal ring. *Rec.*——FIG. 53, *13*. *P. amphipodium* HKL., Rec., ×200 (42).

Acrocubus HKL., 1882 [**A. octopylus* HKL., 1887]. Like *Microcubus* but without equatorial ring or galear (upper) and thoracal bows. *Rec.*

A. (Acrocubus) [=*Apocubus* HKL., 1887 (obj.)]. Basal ring without feet.——FIG. 53,*8*. **A. (A.) octopylus*, Rec., ×200 (42).

A. (Dipocubus) HKL., 1887 [**A. arcuatus;* SD herein]. Two feet.

A. (Tetracubus) HKL., 1887 [**A. tetrapodius;* SD herein]. Four feet.

A. (Tripocubus) HKL., 1887 [**A. cortina;* SD herein]. Three feet.

Microcubus HKL., 1882 [**M. dodecastoma* HKL., 1887]. Four columellae; complete equatorial ring. *Eoc.-Rec.*——FIG. 53.*5*. **M. dodecastoma*, Rec., ×150 (42).

Octotympanum HKL., 1887 [**O. octonarium;* SD herein]. Like *Microcubus* but equatorial ring incomplete. *Eoc.-Rec.*——FIG. 53,*10*. **O. octonarium*, Rec., ×200 (42).

Toxarium HKL., 1887 [**T. circospyris;* SD herein]. Like *Acrocubus* but has galear and thoracal bows. *Rec.*

T. (Toxarium) [=*Toxellium* HKL., 1887 (obj.)]. Bows simple.——FIG. 53,*11a*. **T. (T.) circospyris*, Rec., ×200 (42).

T. (Toxidium) HKL., 1887 [**T. cordatum;* SD herein]. Thoracal bow forked.

T. (Toxonium) HKL., 1887 [**T. bifurcum;* SD herein]. Like *Tympanidium* but has 6 columellae. *Eoc.-Rec.*——FIG. 53,*11b*. **T. dipodiscus,* Rec., ×200 (42).

Tympanidium HKL., 1882 [**T. foliosum* HKL., 1887]. Horizontal rings connected by 8 columellae or rods. *Cret.-Rec.*

T. (Tympanidium) [=*Tympanura* HKL., 1887 (obj.)]. Gates 12. *Cret.-Rec.*——FIG. 53,*15*. **T. (T.) foliosum,* Rec., ×150 (42).

T. (Tympanomma) HKL., 1887 [**T. binoctonum* HKL., 1887; SD herein]. Gates 16. *Rec.*

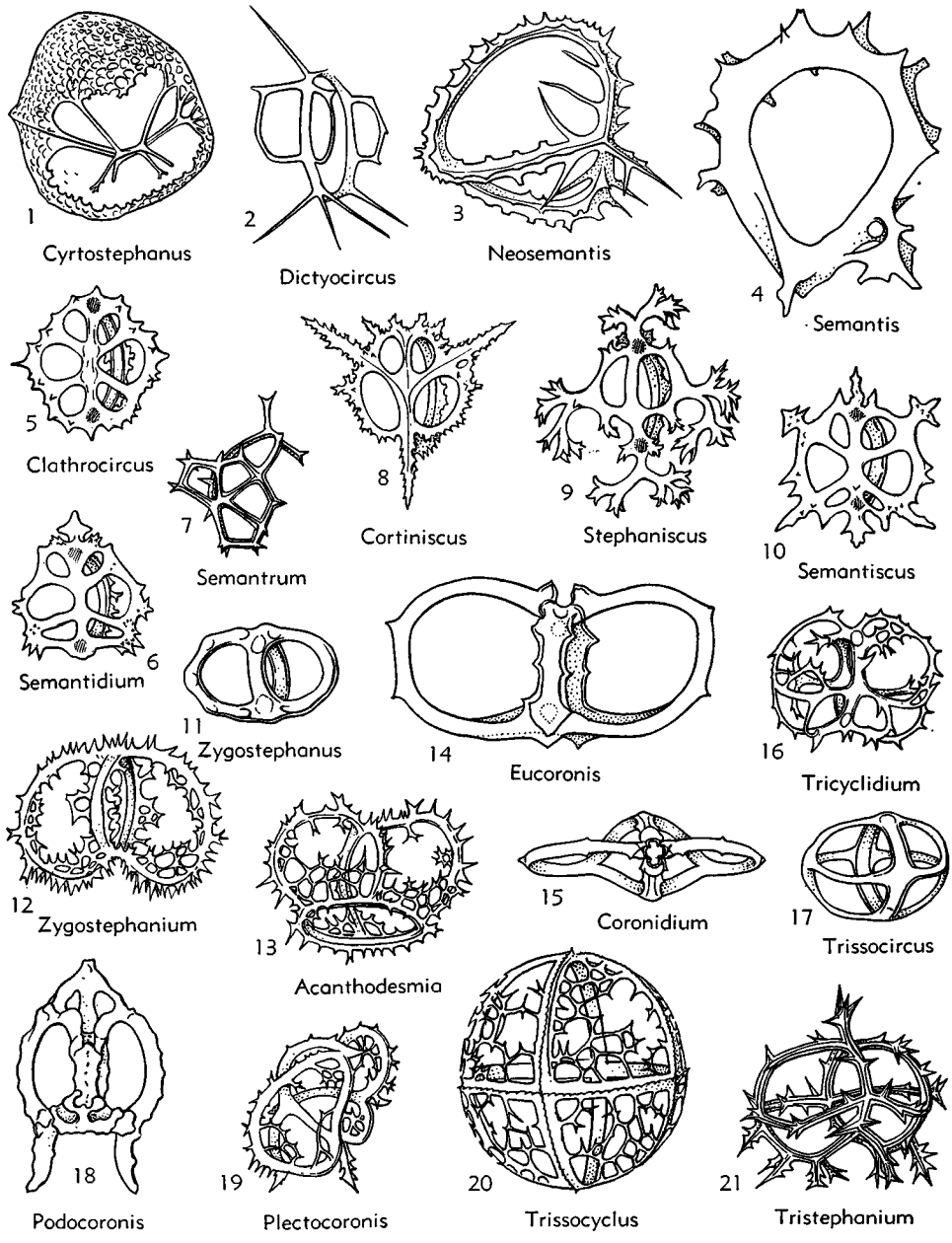

FIG. 52. Cyrtostephanidae, Semantididae, Acanthodesmiidae (p. D106-D108).

Subfamily PARATYMPANINAE Haeckel, 1882
[as Paratympanida *(partim)*; emend. CAMPBELL, herein]

Two horizontal fenestrated rings. *Rec.*

Paratympanum HKL., 1882 [**P. hexastylum* HKL., 1887]. Two horizontal rings unequal.——FIG. 53,*6*. *P. octostylum* HKL., Rec., ×200 (42).

Lithotympanum HKL., 1882 [**L. tuberosum* HKL., 1887]. Rings unequal.——FIG. 53,*14*. **L. tuberosum*, Rec., ×300 (42).

Subfamily DYSTYMPANIINAE Haeckel, 1887
[as Dystympanida; emend. CAMPBELL, herein]

Mitral or upper ring fenestrated, basal ring simple. *Jur.-Rec.*

Dystympanium HKL., 1887 [**D. dictyocha;* SD herein]. With characters of subfamily.——FIG. 53,*7*. **D. dictyocha*, Rec., ×200 (42).

Subfamily EUTYMPANIINAE Haeckel, 1887
[as Eutympanida; emend. CAMPBELL, herein]

Two simple horizontal rings; apical and basal parts of sagittal ring absent. *Jur.-Rec.*

Eutympanium HKL., 1882 [**E. musicantum* HKL., 1887]. Horizontal rings connected by 6 to 8 or more columellae; rings equal. *Rec.*——FIG. 53,*1*. **E. musicantum*, Rec., ×300 (42).

Circotympanum HKL., 1887 [**C. hexagonium;* SD herein]. Like *Eutympanium* but rings unequal. *Rec.*——FIG. 53,*9*. *C. octogonium* HKL., Rec., ×200 (42).

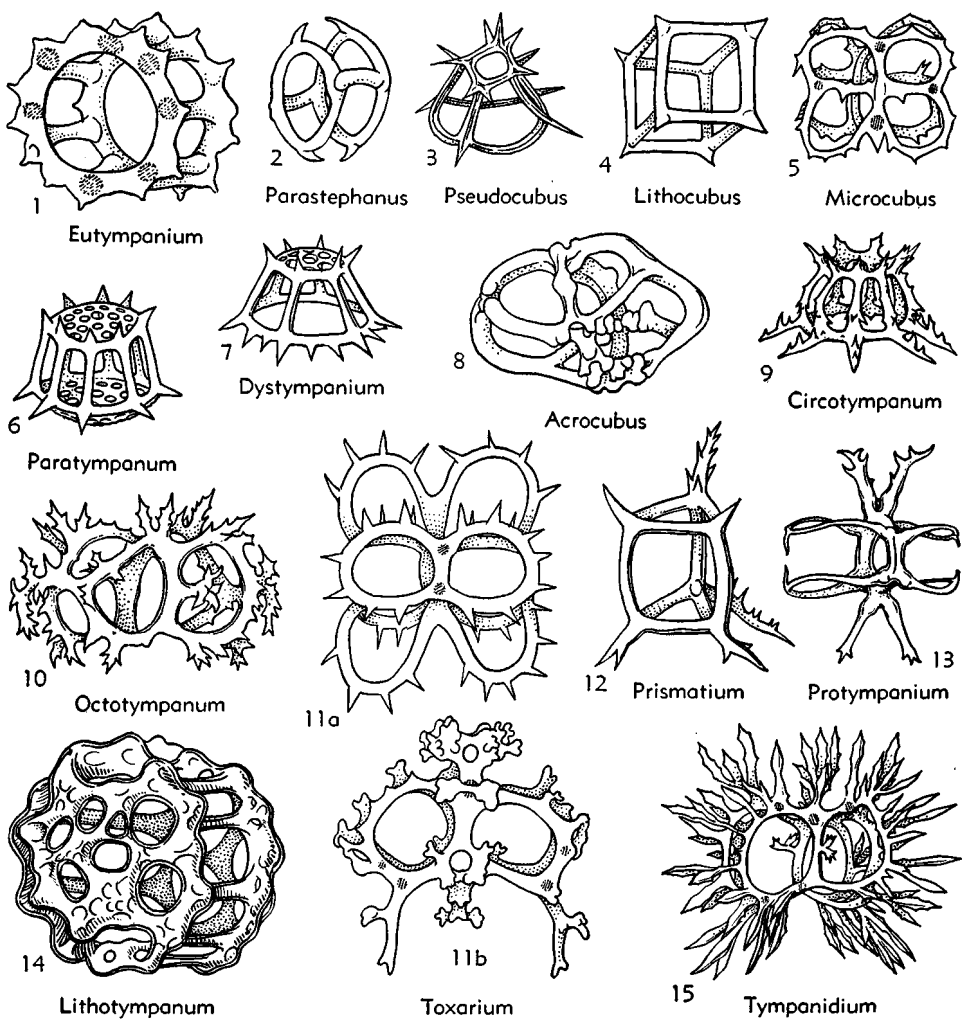

FIG. 53. Paratympanidae (p. D108-D111).

Lithocubus HKL., 1882 [**L. geometricus* HKL., 1887]. Four columellae; rings equal. *Rec.*——53,*4*. **L. geometricus,* Rec., ×200 (42).

Parastephanus HKL., 1882 [**P. circularis* HKL., 1887]. Two columellae. *Rec.*——FIG. 53,*2*. *P. quadrispinus* HKL., Rec., ×200 (42).

Prismatium HKL., 1882 [**Acanthodesmia prismatium* HKL., 1860]. Three columellae. *Jur.-Rec.*——FIG. 53,*12*. *P. tripodium* HKL., Rec., ×200 (42).

Pseudocubus HKL., 1887 [**P. obeliscus;* SD herein]. Like *Lithocubus* but rings unequal. *Rec.*——FIG. 53,*3*. **P. obeliscus,* Rec., ×300 (42).

Division CYRTELLARI Haeckel, 1882

[as Cyrtellaria; emend. CAMPBELL, herein]

Lattice shell complete. *Cam.-Rec.*

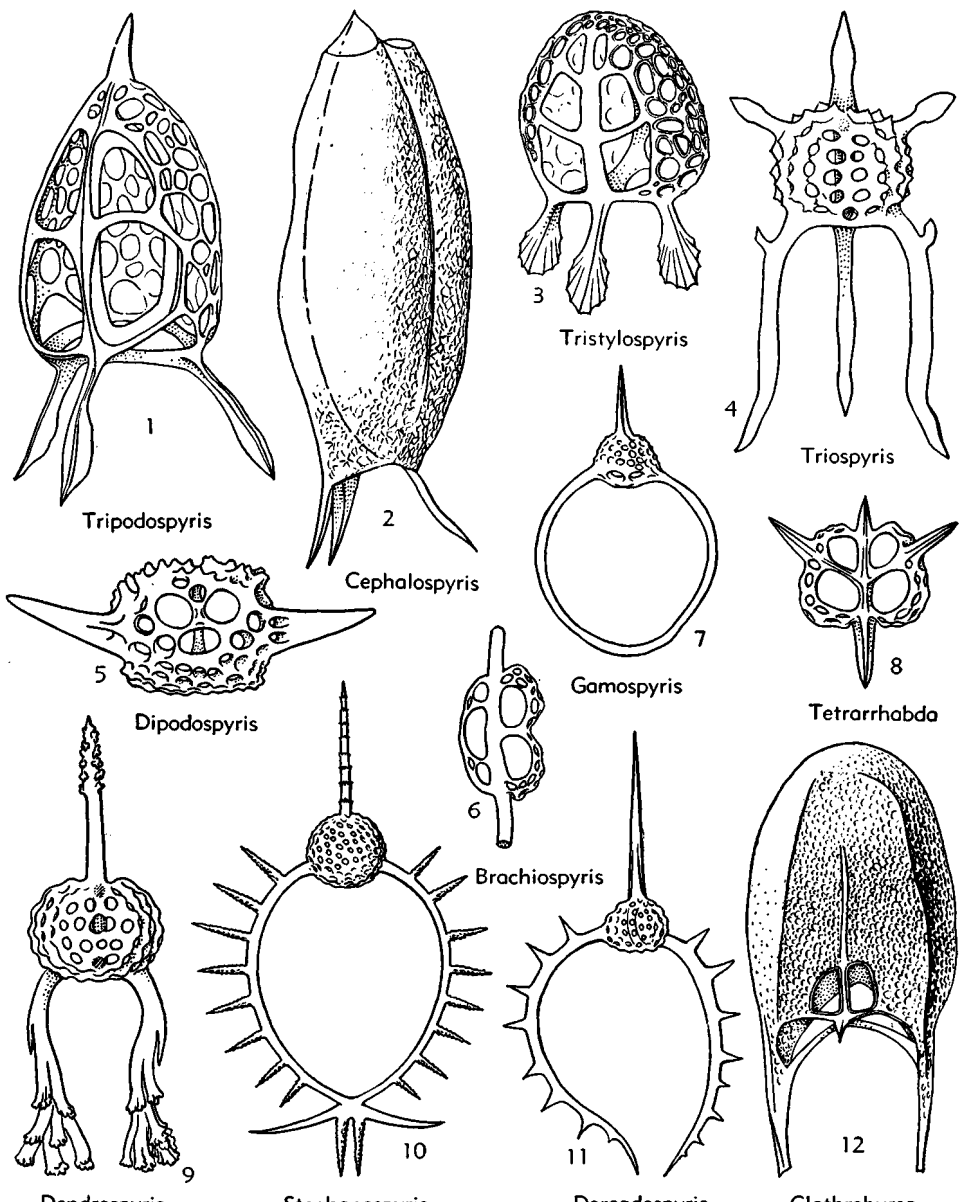

FIG. 54. Triospyrididae (p. D112).

Superfamily TRIOSPYRIDICAE Haeckel, 1882

[*ex* Triospyrida; emend. CAMPBELL, herein]
[=Spyridina EHR., 1847 *(partim)*; Zygocyrtida HKL., 1862; Spyrida HKL., 1882; Orboidea POP., 1913 *(partim)*]

Bilocular cephalis with sagittal constriction. *Jur.-Rec.*

Family TRIOSPYRIDIDAE Haeckel, 1882

[as Triospyrida; emend. CAMPBELL, herein]
[=Zygospyrida HKL., 1887]

Shell composed of cephalis and its apophyses; without apical cupola or dome or thorax. *Jur.-Rec.*

Subfamily TRIOSPYRIDINAE Haeckel, 1882

[as Triospyrida *(partim)*; emend. CAMPBELL, herein]
[=Tripospyrida HKL., 1887]

Three basal feet. *Eoc.-Rec.*

Triospyris HKL., 1882 [**Triceraspyris tripodiscus* HKL., 1887][=*Triceraspyris* HKL., 1887 (obj.)]. Apex has 3 horns. *Rec.*

T. (Triospyris). Horns and feet unbranched.

T. (Triospyrium) HKL., 1887 [**Ceratospyris furcata* EHR., 1875; SD herein]. Horns simple; feet forked or branched.——FIG. 54,*4*. *T. (T.) giraffa* HKL., Rec., ×200 (42).

T. (Triospyridium) HKL., 1887 [**Triceraspyris damaecornis* HKL., 1887; SD herein]. Horns and feet forked or branched.

Cephalospyris HKL., 1882 [**C. cancellata* HKL., 1887]. Apex with a right and left apical hole; no horn. *Rec.*——FIG. 54,*2*. **C. cancellata,* Rec., ×200 (42).

Tripodospyris HKL., 1882 [**Tripospyris cortina* HKL., 1887][=*Tripospyris* HKL., 1887 (obj.)]. Apex with a single horn. *Eoc.-Rec.*

T. (Tripodospyris) [=*Tripospyrantha* HKL., 1887 (obj.)]. Basal plate with 2 large collar pores. *Rec.*——FIG. 54,*1*. *T. (T.) cortiniscus* HKL., Rec., ×300 (42).

T. (Tripospyrella) HKL., 1887 [**Tripospyris conifer* HKL., 1887; SD herein]. Basal plate with 3 large collar pores.

T. (Tripospyrissa) HKL., 1887 [**Tripospyris semantrum* HKL., 1887; SD herein]. Basal plate with 2 pairs of collar pores. *Eoc.-Rec.*

T. (Tripospyromma) HKL., 1887 [**Tripospyris hexomma* HKL., 1887; SD herein]. Basal plate with 6 or more collar pores. *Eoc.-Rec.*

Tristylospyris HKL., 1887 [**T. palmipes* HKL., 1887]. Apex without horn; no apical holes. *Eoc.-Rec.*

T. (Tristylospyris) [=*Tristylospyrula* HKL., 1887 (obj.)]. Feet unbranched. *Eoc.-Rec.*——FIG. 54,*3*. **T. (T.) palmipes,* Rec., ×200 (42).

T. (Tristylospyrium) HKL., 1887 [**T. ramosa;* SD herein]. Feet branched or forked. *Rec.*

Subfamily DIPODOSPYRIDINAE Haeckel, 1882

[as Dipodospyrida; emend. CAMPBELL, herein]
[=Brachiospyrida HKL., 1882; Dipospyrida HKL., 1887]

Two lateral basal feet. *Eoc.-Rec.*

Dipodospyris HKL., 1882 [**Dipospyris bipes* HKL., 1887][=*Dipospyris* HKL., 1887 (obj.)]. Feet unbranched, with lateral spines; single apical horn. *Eoc.-Rec.*——FIG. 54,*5*. *D. cubus* HKL., Rec., ×200 (42).

Brachiospyris HKL., 1882 [**Ceratospyris ocellata* EHR., 1875]. Like *Dipodospyris* but without apical horn. *Paleoc.-Rec.*——FIG. 54,*6*. *B. diacantha* (EHR.), Rec., ×200 (42).

Dendrospyris HKL., 1882 [**Ceratospyris stylophora* EHR., 1875]. Feet branched like a tree; single apical horn. *Eoc.-Rec.*——FIG. 54,*9*. *D. arborescens* HKL., Rec., ×200 (42).

Dorcadospyris HKL., 1882 [**D. dentata* HKL., 1887]. Feet with lateral spines; single apical horn. *Mio.-Rec.*——FIG. 54,*11*. **D. dentata,* Rec., ×100 (42).

Gamospyris HKL., 1882 [**G. circulus* HKL., 1887]. Two unbranched feet grown together forming a ring; apex with single horn. *Rec.*——FIG. 54,*7*. **G. circulus,* Rec., ×100 (42).

Stephanospyris HKL., 1882 [**S. cordata* HKL., 1887]. Like *Gamospyris* but feet have lateral spines. *Rec.*——FIG. 54,*10*. *S. excellens* HKL., Rec., ×100 (42).

Subfamily TETRARRHABDINAE Campbell, nom. nov.

[*pro* Tetraspyrida HKL., 1887]

Two lateral and 2 sagittal feet. *Eoc.-Rec.*

Tetrarrhabda HKL., 1882 [**Tetraspyris stephanium* HKL., 1887][=*Tetraspyris* HKL., 1887 (obj.)]. With single apical horn. *Eoc.-Rec.*

T. (Tetrarrhabda). Feet unbranched. *Eoc.-Rec.*——FIG. 54,*8*. **T. (T.) stephanium,* Rec., ×150 (42).

T. (Tetracorethra) HKL., 1882 [**Tetraspyris tetracorethra* HKL., 1887 (=*Tetracorethra tetracorethra* HKL., 1887)]. Feet branched or forked. *Rec.*

Clathrobursa HKL., 1882 [**Tessarospyris clathrobursa* HKL., 1887 (=*Clathrobursa dictyopus* HKL., 1887, obj.)][=*Tessarospyris* HKL., 1887 (obj.)]. Without apical horn. *Rec.*——FIG. 54, *12*. **C. clathrobursa,* Rec., ×200 (42).

Subfamily PENTASPYRIDINAE Haeckel, 1882

[as Pentaspyrida; emend. CAMPBELL, herein]

Five basal feet. *Eoc.-Rec.*

Pentaspyris HKL., 1882 [**P. pentacantha* HKL., 1887]. Apex without horn. *Eoc.-Rec.*——FIG. 55,*8*. **P. pentacantha,* Rec., ×200 (42).

Aegospyris HKL., 1882 [**A. aequispina* HKL., 1887]. Apex with 3 horns. *Eoc.-Rec.*——FIG. 55,*1*. *A. aegoceras* HKL., Rec., ×200 (42).

Clathrospyris Hkl., 1882 [**C. camelopardalis* Hkl., 1887]. Apex with single horn. *Eoc.-Rec.*——Fig. 55,*4*. *C. pyramidalis* Hkl., Rec., ×200 (42).

Subfamily HEXASPYRIDINAE Haeckel, 1887
[as Hexaspyrida; emend. Campbell, herein]

Six basal feet. *Eoc.-Rec.*

Hexaspyris Hkl., 1887 [**H. alterna;* SD herein]. Apex with single horn. *Eoc.-Rec.*

H. (Hexaspyris) [=*Hexaspyridium* Hkl., 1887 (obj.)]. Feet unbranched. *Eoc.-Rec.*

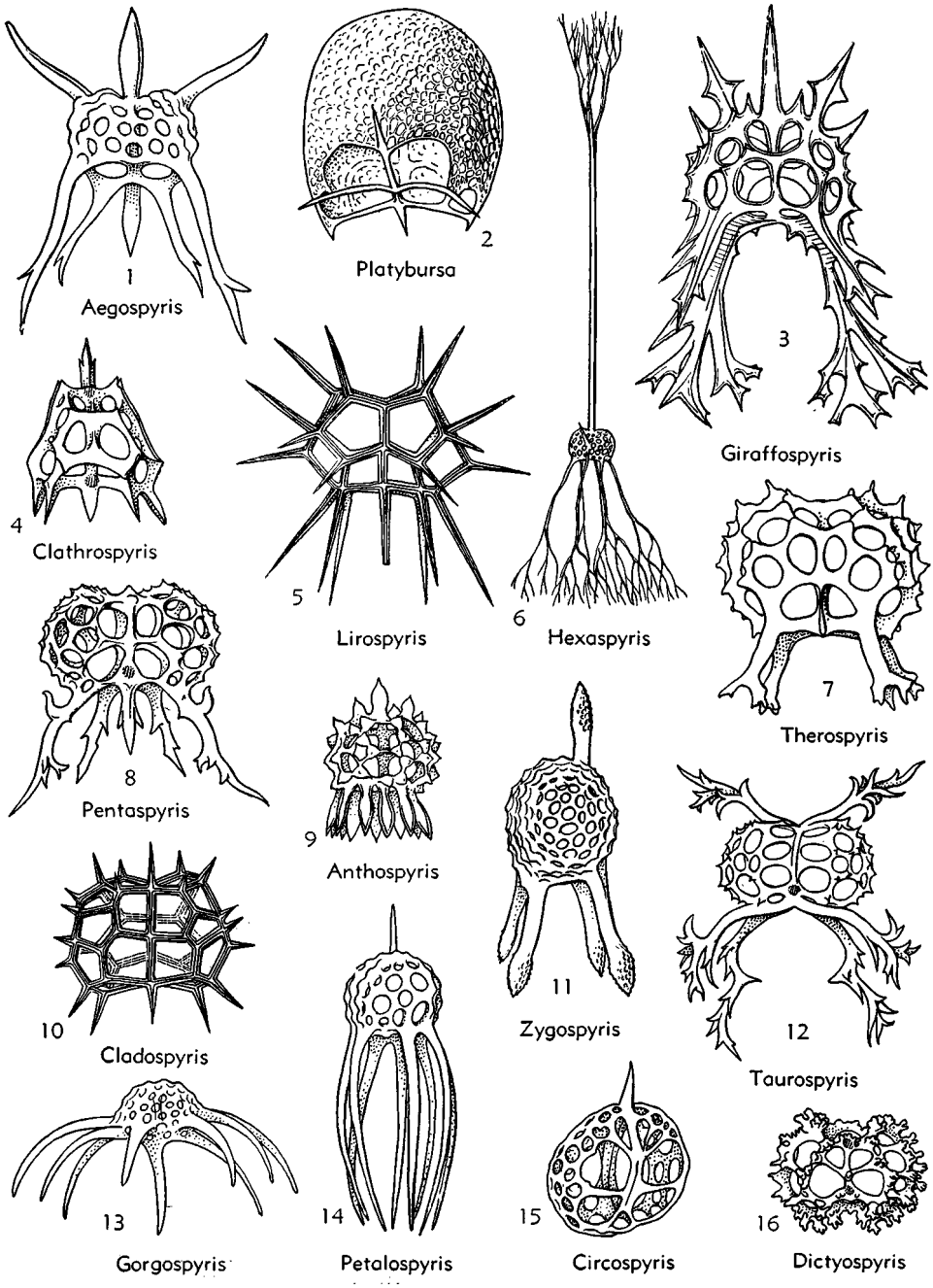

Fig. 55. Triospyrididae (p. D113, D114).

H. (Hexacorethra) HKL., 1887 [**H. hexacorethra;* SD herein (=*Hexacorethra magica* HKL., 1887; obj.)]. Feet forked or branched *Eoc.-Rec.*——FIG. 55,*6*. **H. (H.) hexacorethra,* Rec., ×100 (42).

Lirospyris HKL., 1882 [**L. hexapoda* HKL., 1887]. Three apical horns. *Eoc.-Rec.*——FIG. 55,*5*. **L. hexapoda,* Rec., ×200 (42).

Platybursa HKL., 1882 [**Cantharospyris platybursa* HKL., 1887 (=*Platybursa compressa* HKL., 1887, obj.)][=*Cantharospyris* HKL., 1887 (obj.)]. Lacks apical horn. *Eoc.-Rec.*——FIG. 55,*2*. **P. platybursa,* Rec., ×200 (42).

Subfamily THEROSPYRIDINAE Haeckel, 1882

[as Therospyrida; emend. CAMPBELL, herein]

Four paired lateral basal feet. *Cret.-Rec.*

Therospyris HKL., 1882 [**T. canis* HKL., 1887]. Apex without apical horn. *Eoc.-Rec.*——FIG. 55, *7*. *T. felis* HKL., Rec., ×200 (42).

Giraffospyris HKL., 1882 [**Ceratospyris heptaceros* EHR., 1875][=*Elaphospyris* HKL., 1882 (obj.)]. Three apical horns. *Eoc.-Rec.*

G. (Giraffospyris). Feet unbranched. *Eoc.-Rec.*

G. (Corythospyris) HKL., 1882 [**Elaphospyris damaecornis* HKL., 1887]. Feet branched or forked. *Rec.*——FIG. 55,*3*. *G. (C.) crevicornis* HKL., Rec., ×200 (42).

Taurospyris HKL., 1882 [**T. cervina* HKL., 1887]. Two lateral or frontal apical horns. *Rec.*——FIG. 55,*12*. **T. cervina,* Rec., ×200 (42).

Zygospyris HKL., 1882 [**Z quadrupes* HKL., 1887]. Apex with a single horn. *Cret.* (Calif.)-*Rec.*——FIG. 55,*11*. *Z. equis* HKL., Rec., ×200 (42).

Subfamily PETALOSPYRIDINAE Campbell, nov.

Basal feet 7 to 12 or more. *Jur.-Rec.*

Petalospyris EHR., 1847 [**D. foveolata* EHR., 1854]. Single apical horn. *Jur.-Rec.*

P. (Petalospyris) [=*Petalospyrantha* HKL., 1887 (obj.)]. Basal plate with 2 large collar pores. *Jur.-Rec.*

P. (Petalospyrella) HKL., 1887 [**P. platyacantha* EHR., 1875; SD herein]. Basal plate with 3 large collar pores. *Eoc.-Rec.*

P. (Petalospyrissa) HKL., 1887 [**P. octopus;* SD herein]. Basal plate with 4 large collar pores. *Eoc.-Rec.*——FIG. 55,*14*. **P. (P.) octopus,* Rec., ×200 (42).

P. (Petalospyromma) HKL., 1887 [**P. dictyocubus;* SD herein]. Basal plate with 6 or more large collar pores. *Eoc.-Rec.*

Anthospyris HKL., 1882 [**A. mammillata* HKL., 1887]. Three apical horns. *Eoc.-Rec.*——FIG. 55,*9*. **A. mammillata,* Rec., ×200 (42).

Cladospyris EHR., 1847 [**C. ramosa*][=*Ceratospyris* EHR., 1847 (obj.)]. Apex with numerous horns. *Eoc.-Rec.*

C. (Cladospyris). Spines forked or branched; meshes rounded or polygonal. *Eoc.-Rec.*

C. (Lophospyris) HKL., 1882 [*non* HKL., 1887] [**Ceratospyris polygona* HKL., 1887]. Spines unbranched; meshes polygonal or within polygonal frames. *Eoc.-Rec.*——FIG. 55,*10*. *C. (L.) allmersii* HKL., Rec., ×200 (42).

Gorgospyris HKL., 1882 [**G. medusa* HKL., 1887]. Lacks apical horns. *Eoc.-Rec.*

G. (Gorgospyris) [=*Gorgospyrium* HKL., 1887 (obj.)]. Feet unbranched. *Eoc.-Rec.*——FIG. 55, *13*. **G. (G.) medusa,* Rec., ×150 (42).

G. (Thamnospyris) HKL., 1882 [**G. schizopodia* HKL., 1887]. Feet divided or branched. *Rec.*

Subfamily CIRCOSPYRIDINAE Haeckel, 1882

[as Circospyrida; emend. CAMPBELL, herein]

Basal feet lacking. *Jur.-Rec.*

Circospyris HKL., 1882 [**C. nucula* HKL., 1887]. Single apical horn. *Rec.*——FIG. 55,*15*. **C. nucula,* Rec., ×200 (42).

Dictyospyris EHR., 1847 [**D. ceratospyris*]. Lacks apical horn. *Jur.-Rec.*

D. (Dictyospyris) [=*Dictyospyrantha* HKL., 1887 (obj.)]. Basal plate with 2 large collar pores. *Jur.-Rec.*——FIG. 55,*16*. *D. (D.) stalactites* HKL., Rec., ×200 (42).

D. (Dictyospyrella) HKL., 1887 [**D. triastoma* EHR., 1875; SD herein]. Basal plate with 3 large collar pores. *Eoc.-Rec.*

D. (Dictyospyrissa) HKL., 1887 [**D. fenestrata* EHR., 1875; SD herein]. Basal plate with 4 large collar pores. *Eoc.-Rec.*

D. (Dictyospyromma) HKL., 1887 [**D. hexastoma;* SD herein]. Basal plate with 6 or more large pores. *Eoc.-Rec.*

Family THOLOSPYRIDIDAE Haeckel, 1887

[as Tholospyrida; emend. CAMPBELL, herein]

Cephalis with an apical cupola; without thorax. *Mio.-Rec.*

Subfamily THOLOSPYRIDINAE Haeckel, 1887

[as Tholospyrida *(partim)*; emend. CAMPBELL, herein] [=Lophospyrida HKL., 1887]

Basal feet 2 or 3; cupola with apical horn. *Mio.-Rec.*

Tholospyris HKL., 1882 [**T. tripodiscus* HKL., 1887]. Basal feet 3. *Mio.-Rec.*

T. (Tholospyris) [=*Tholospyrium* HKL., 1887 (obj.)]. Feet unbranched. *Mio.-Rec.*——FIG. 56,*1*. *T. (T.) fenestrata* HKL., Rec., ×200 (42).

T. (Tholospyridium) HKL., 1887 [**T. ramosa;* SD herein]. Feet forked or branched. *Rec.*

Eulophospyris CAMPBELL, 1951 [*pro Lophospyris* HKL., 1887 (*non* 1882)][**Lophospyris diplodiscus* HKL., 1887]. Two paired feet. *Rec.*——FIG. 56,*2*. **E. diplodiscus* (HKL.), Rec., ×200 (42).

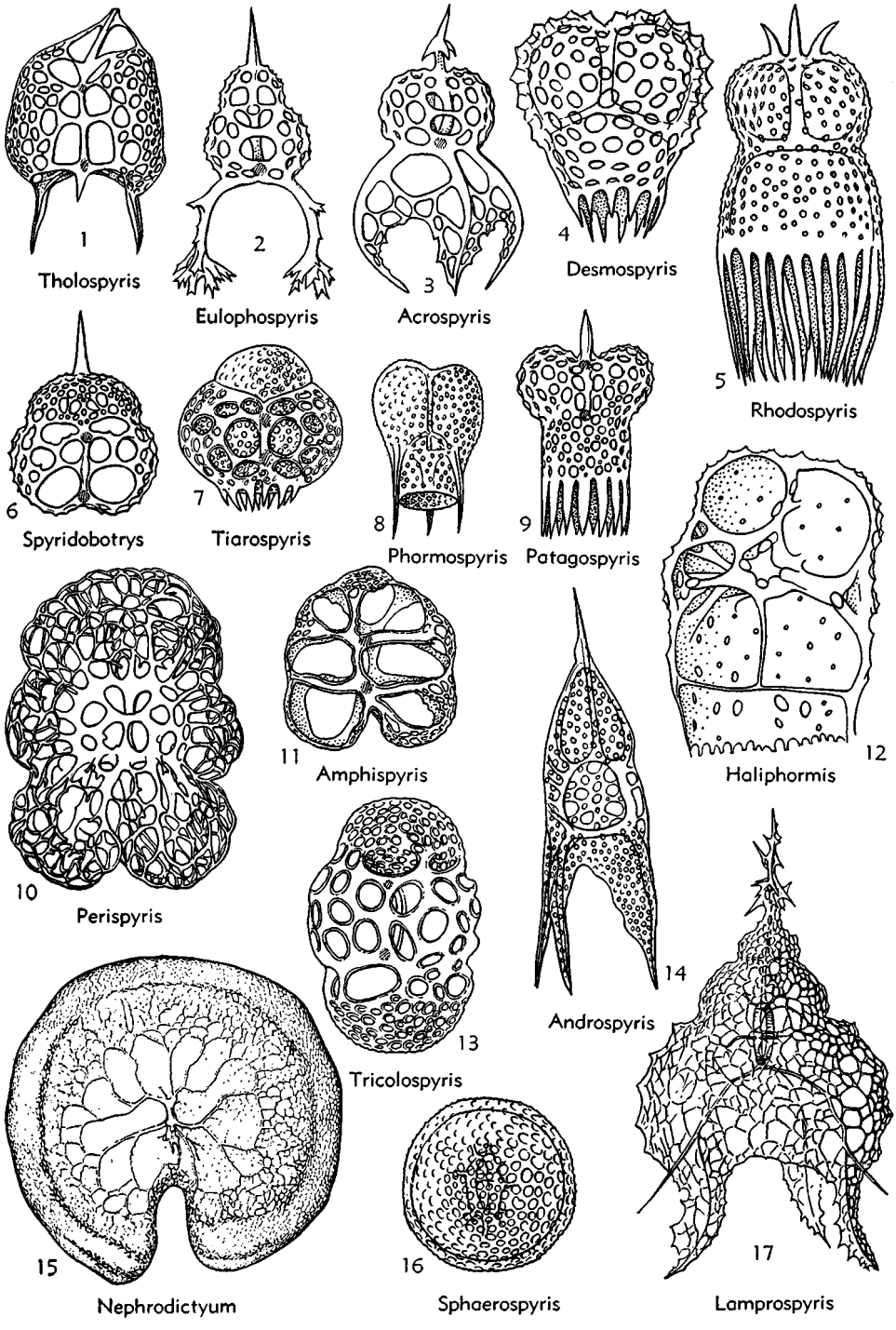

FIG. 56. Tholospyrididae, Phormospyrididae, Androspyrididae (p. D114, D116).

Subfamily TIAROSPYRIDINAE Haeckel, 1887
[as Tiarospyrida; emend. CAMPBELL, herein]

Basal feet 6 to 9 or more. *Rec.*

Tiarospyris HKL., 1882 [**T. pervia* HKL., 1887]. Lacking apical horn.——FIG. 56,*7*. *T. mitra* HKL., Rec., ×200 (42).

Sepalospyris HKL., 1882 [**S. platyphylla* HKL., 1887]. With apical horn.

Subfamily SPYRIDOBOTRYDINAE Campbell, nom. nov.
[*pro* Pylospyrida HKL., 1887]

Basal feet lacking. *Rec.*

Spyridobotrys HKL., 1862 [**S. trinacria*] [=*Pylospyris* HKL., 1882 (obj.)]. Cupola with apical horn.——FIG. 56,*6*. *S. canariensis* HKL., Rec., ×200.

Family PHORMOSPYRIDIDAE Haeckel, 1882

[as Phormospyrida; emend. CAMPBELL, herein]

Shell with thorax; without apical cupola. *Eoc.-Rec.*

Subfamily PHORMOSPYRIDINAE Haeckel, 1882
[as Phormospyrida *(partim)*; emend. CAMPBELL, herein] [=Acrospyrida HKL., 1882]

Basal feet 3. *Eoc.-Rec.*

Phormospyris HKL., 1882 [**P. tricostata* HKL., 1887]. Lacks apical horn. *Rec.*——FIG. 56,*8*. *P. tridentata* HKL., Rec., ×200 (42).

Acrospyris HKL., 1882 [**A. clathrocanium* HKL., 1887]. Single apical horn. *Eoc.-Rec.*——FIG. 56, *3*. **A. clathrocanium*, Rec., ×150 (42).

Subfamily RHODOSPYRIDINAE Haeckel, 1887
[as Rhodospyrida; emend. CAMPBELL, herein]

Basal feet 9 to 12 or more. *Eoc.-Rec.*

Rhodospyris HKL., 1882 [**R. tricornis* HKL., 1887]. Three apical horns. *Rec.*——FIG. 56,*5*. **R. tricornis*, Rec., ×300 (42).

Desmospyris HKL., 1882 [**D. mammillata* HKL., 1887]. Lacks apical horn. *Eoc.-Rec.*——FIG. 56, *4*. **D. mammillata*, Rec., ×300 (42).

Haliphormis EHR., 1847 [*non* HKL., 1887 (=*Haliphormartidium* CAMPBELL, 1951)] [**H. calva* EHR., 1854] [=*Saccospyris* HAECKER, 1908]. Lacks apical horn; has corona of minute serrations around basal shell mouth. *Rec.*——FIG. 56,*12*. *H. antarctica* (HAECKER), Rec., ×400 (43).

Patagospyris HKL., 1882 [**Petalospyris confluens* EHR., 1875]. Has apical horn. *Eoc.-Rec.*——FIG. 56,*9*. *P. anthocyrtis* HKL., Rec., ×200 (42).

Family ANDROSPYRIDIDAE Haeckel, 1887

[as Androspyrida; emend. CAMPBELL, herein]

Has thorax and cephalis with apical cupola. *Eoc.-Rec.*

Subfamily ANDROSPYRIDINAE Haeckel, 1887
[as Androspyrida *(partim)*; emend. CAMPBELL, herein] [=Lamprospyrida HKL., 1887]

Basal feet 3. *Rec.*

Androspyris HKL., 1887 [**A. pithicus*; SD herein]. Lattice simple; apical horn usually not fenestrated.——FIG. 56,*14*. **A. pithicus*, Rec., ×300 (42).

Lamprospyris HKL., 1882 [**L. darwinii* HKL., 1887]. Shell wholly or partly spongy; apical horn always fenestrated.——FIG. 56,*17*. **L. darwinii*, Rec., ×150 (42).

Subfamily PERISPYRIDINAE Haeckel, 1882
[as Perispyrida; emend. CAMPBELL, herein]

Shell 3-jointed; without basal feet. *Rec.*

Perispyris HKL., 1882 [**P. bicincta* HKL., 1887]. Shell with 2 transverse strictures; lattice double or spongy.——FIG. 56,*10*. **P. bicincta*, Rec., ×200 (42).

Amphispyris HKL., 1882 [**A. thorax* HKL., 1887]. Like *Perispyris* but lattice complete only in frontal ring.

A. (Amphispyris) [=*Amphispyrium* HKL., 1887 (obj.)]. On each side of ring-plane 3 pairs of large annular meshes.——FIG. 56,*11*. **A. (A.) thorax*, Rec., ×150 (42).

A. (Amphispyridium) HKL., 1887 [**A. sternalis*; SD herein]. On each side of ring-plane 4 pairs of large meshes.

Tricolospyris HKL., 1882 [**T. ḳantiana* HKL., 1887]. Lattice complete on all sides, otherwise like *Perispyris*.——FIG. 56,*13*. **T. ḳantiana*, Rec., ×300 (42).

Subfamily PARADICTYINAE Haeckel, 1882
[as Paradictyida; emend. CAMPBELL, herein] [=Nephrospyrida HKL., 1887]

Shell discoidal or spherical; without basal feet. *Eoc.-Rec.*

Nephrodictyum HKL., [**Nephrospyris renilla* HKL., 1887] [=*Nephrospyris* HKL., 1887 (obj.)]. Shell discoidal, subcircular or bean-shaped. *Rec.*

N. (Nephrodictyum). Simple network.

N. (Paradictyum) HKL., 1882 [**Nephrospyris paradictyum* HKL., 1887 (=*Paradictyum paradoxum* HKL., 1887, obj.)]. Double network, space between filled with weblike meshes.——FIG. 56,*15*. **N. (P.) paradictyum*, Rec., ×100 (42).

Sphaerospyris HKL., 1887 [**Dictyospyris sphaera* BÜTSCHLI, 1882]. Shell spherical. *Eoc.-Rec.*——FIG. 56,*16*. *S. globosa* HKL., Rec., ×200 (42).

Superfamily ARCHIPILIICAE Haeckel, 1882

[*ex* Archipilida; emend. CAMPBELL, herein] [=Cyrtida HKL., 1862; Cyrtoidea HKL., 1887]

Cephalis neither bilocular nor lobate. *Cam.-Rec.*

Subsuperfamily ARCHIPILIILAE Haeckel, 1882

[*ex* Archipilida; emend. CAMPBELL, herein] [=Monocyrtida HKL., 1862]

Shell lacking joints or strictures. *Cam.-Rec.*

Family ARCHIPILIIDAE Haeckel, 1882

[as Archipilida; emend. CAMPBELL, herein] [Tripocalpida HKL., 1887]

Three radial apophyses. *Cam.-Rec.*

Subfamily ARCHIPILIINAE Haeckel, 1882

[as Archipilida *(partim)*; emend. CAMPBELL, herein]

Basal shell mouth open. *Cam.-Rec.*

Archipilium HKL., 1882 [**A. orthopterum* HKL., 1887]. Without feet or apical horn. *Rec.*——FIG. 57,*2*. **A. orthopterum*, Rec., ×200 (42).

Tripocalpis HKL., 1882 [**T. plectaniscus* HKL., 1887]. Three unbranched solid feet; with apical horn. *Cam.-Rec.*——FIG. 57,*1*. *T. cortinaris* HKL., Rec., ×200 (42).

Bisphaerocephalus POP., 1909 [**B. minutus*]. Cephalis incompletely divided by stricture. *Rec.*——FIG. 57,*9*. **B. minutus*, Rec., ×500 (48).

Tripodictyopus HERTWIG, 1879 [**T. elegans*]. Three shovel-shaped latticed feet; with apical horn. *Rec.*——FIG. 57,*11*. *T. vatillum* HKL., Rec., ×200 (42).

Tripilidium HKL., 1882 [**T. nanum* RÜST, 1885]. Like *Tripodiscium* but lacks apical horn. *Cam.-Rec.*

T. (Tripilidium) [=*Tristylocorys* HKL., 1887 (obj.)]. Feet unbranched. *Cam.-Rec.*——FIG. 57,*10*. *T. (T.) costatum* HKL., Rec., ×200 (42).

T. (Tripodocorys) HKL., 1882 [**T. fischeri* RÜST, 1885]. Feet forked or branched. *Jur.-Rec.*

Tripodiscium HKL., 1882 [**T. tristylospyris* HKL., 1887]. Like *Tripocalpis* but has 3 lateral ribs in wall, and lacks apical horn. *Cam.-Rec.*

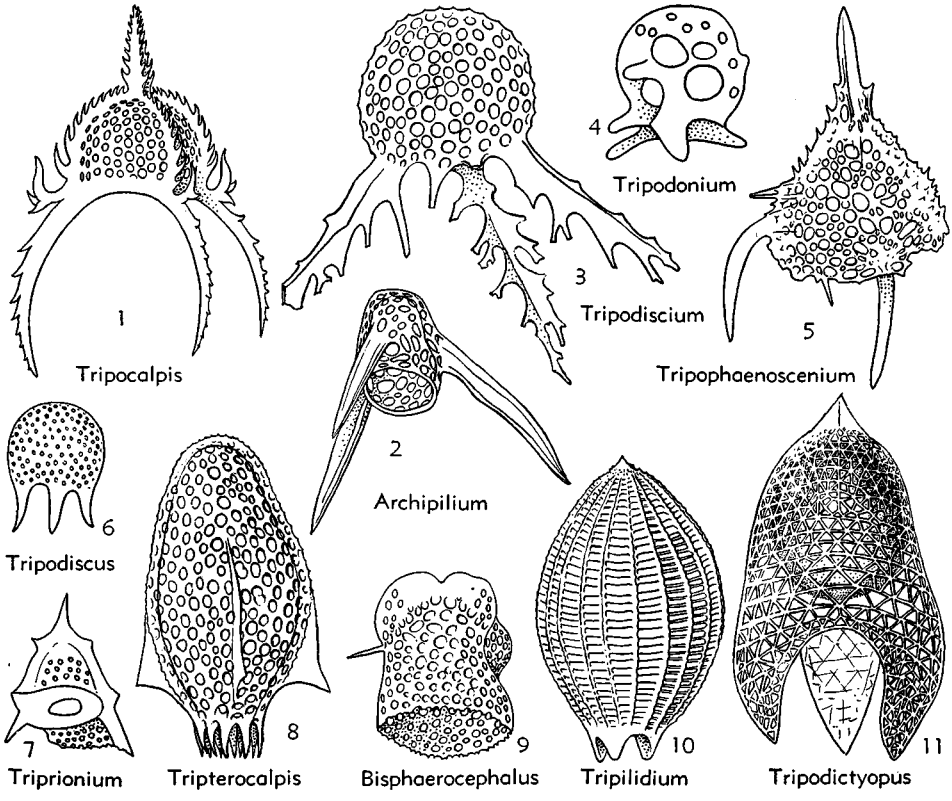

FIG. 57. Archipiliidae (p. D117, D118).

T. (Tripodiscium) [=*Tripodiscinus* HKL., 1887 (obj.)]. Feet unbranched. *Cam.-Rec.*

T. (Tripodisculus) HKL., 1887 [**T. sphaerocephalum;* SD herein]. Feet branched or forked. *Rec.*——FIG. 57,*3*. **T. (T.) sphaerocephalum,* Rec., ×300 (42).

Tripodiscus HKL., 1882 [**T. modestus* RÜST, 1885]. Shell globular; 3 short stout feet. *Jur.*——FIG. 57,*6*. **T. modestus,* Jur., Ger., ×150 (51).

Tripodonium HKL., 1882 [**T. campanulatum* HKL., 1887]. Like *Tripocalpis* but lacks apical horn. *Mio.-Rec.*——FIG. 57,*4*. *T. caputmortis* VINASSA, Mio., Italy, ×400 (55).

Tripophaenoscenium C.-CL. [**T. laimingi*]. Three unbranched feet; 3 lateral subapical spikes; internal columella. *Mio.*——FIG. 57,*5*. **T. laimingi,* Mio., Calif., ×120 (35).

Triprionium HKL., 1882 [**T. montisrigi* RÜST, 1885]. Three forked feet; with apical horn; lateral ribs in wall. *Jur.*——FIG. 57,*7*. **T. montisrigi,* Jur., Ger., ×75 (51).

Tripterocalpis HKL., 1882 [**T. phylloptera* HKL., 1887]. Six to 9 terminal feet; without apical horn; 3 lateral wings. *Rec.*——FIG. 57,*8*. **T. phylloptera,* Rec., ×200 (42).

Trissopilium HKL., 1882 [**T. tetraplecta* HKL., 1887]. Like *Archipilium* but has apical horn. *Plio.-Rec.*

Subfamily ARCHIPERINAE Haeckel, 1882

[as Archiperida; emend. CAMPBELL, herein]

Basal shell mouth fenestrated. *Rec.*

Archipera HKL., 1882 [**A. cortiniscus* HKL., 1887]. Without internal columella; 3 basal feet; 2 or more apical horns.——FIG. 58,*1*. **A. cortiniscus,* Rec., ×200 (42).

Archibursa HKL., 1882 [**A. tripodiscus* HKL., 1887]. Like *Archipera* but lacks apical horn.——FIG. 58,*3*. **A. tripodiscus,* Rec., ×200 (42).

Archiscenium HKL., 1882 [**A. quadrispinum* HKL., 1887]. Unbranched internal columella; 3 latticed wings connecting feet and horn.—— FIG. 58,*5*. **A. quadrispinum,* Rec., ×300 (42).

Cladoscenium HKL., 1882 [**C. fulcratum* HKL., 1887]. Three free feet; no latticed wings; branched columella.——FIG. 58,*6*. *C. ancoratum* HKL., Rec., ×300 (42).

Euscenium HKL., 1887 [**E. plectaniscus;* SD herein]. Like *Cladoscenium* but columella unbranched.

E. (Euscenium) [=*Euscenarium* HKL., 1887 (obj.)]. Feet unbranched.——FIG. 58,*4*. *E. (E.) tricolpium* HKL., Rec., ×300 (42).

E. (Euscenidium) HKL., 1887 [**E. furcatum;* SD herein]. Feet branched or forked.

Peridium HKL., 1882 [**P. lasanum* HKL., 1887]. Like *Archipera* but has only single horn.

P. (Peridium) [=*Peridarium* HKL., 1887 (obj.)]. Feet unbranched.

P. (Archiperidium) HKL., 1887 [**P. spinipes;* SD herein]. Feet spiny or branched.——FIG. 58,*2*. **P. (P.) spinipes,* Rec., ×300 (42).

Pteroscenium HKL., 1882 [**P. arcuatum* HKL., 1887]. Like *Archiscenium* but has branched columella.——FIG. 58,*7*. *P. pinatum* HKL., Rec., ×300 (42).

Family ARCHIPHORMIDIDAE Haeckel, 1882

[as Archiphormida; emend. CAMPBELL, herein]
[=Phaenocalpida HKL., 1887]

Radial apophyses 4 to 9 or more. *Ord.-Rec.*

Subfamily ARCHIPHORMIDINAE Haeckel, 1882

[as Archiphormida *(partim);* emend. CAMPBELL, herein]
[=Acropyramida HKL., 1882]

Basal shell mouth open. *Ord.-Rec.*

Archiphormis HKL., 1882 [**Halicalyptra cancellata* EHR., 1854]. Bell-shaped or urnlike shell with radial ribs; mouth with corona of spines; without apical horn. *Rec.*——FIG. 59,*1*. *A. urceolata* HKL., Rec., ×150 (42).

Arachnocalpis HKL., 1882 [**A. ellipsoides,* HKL., 1887]. Without radial ribs; free terminal feet; double shell with external mantle; without apical horn. *Rec.*——FIG. 59,*11*. **A. ellipsoides,* Rec., ×150 (42).

Bathrocalpis CL.-C., 1942 [**B. campanula*]. Without radial feet; internal columella. *Eoc.*——FIG. 59,*4*. **B. campanula,* U.Eoc., Calif., ×150 (39).

Bathropyramis HKL., 1882 [**B. acephala* HKL., 1887]. Pyramidal shell with simple lattice; without apical horn. *Cret.-Rec.*

B. (Bathropyramis) [=*Acropyramis* HKL., 1882 (obj.)]. Without surface spines. *Cret.-Rec.*—— FIG. 59,*3b*. *B. (B.) quadrata,* HKL., Rec., ×200 (42).

B. (Cladopyramis) HKL., 1882 [**B. spinosa* HKL., 1887]. With prominent unbranched or branched spines on surface. *Mio.-Rec.*——FIG. 59,*3a*. *B. (C.) ramosa* HKL., Rec., ×150 (42).

Cinclopyramis HKL., 1882 [**C. cribellum* HKL., 1887]. Like *Bathropyramis* but has double network. *Eoc.-Rec.*——FIG. 59,*12*. *C. infundibulum* HKL., Rec., ×150 (42).

Cladarachnium HKL., 1882 [**C. ramosum* HKL., 1887]. Bell-shaped shell with branched radial ribs. *Rec.*——FIG. 59,*7*. **C. ramosum,* Rec., ×100 (42).

Cystophormis HKL., 1887 [**C. pila;* SD herein]. Shell with radial ribs; ovate or urn-shaped to bell-shaped shell; mouth constricted; without radial feet or apical horn. *Rec.*——FIG. 59,*8*. **C. pila,* Rec., ×200 (42).

Halicalyptra EHR., 1847 [**H. virginica* EHR., 1854]. Like *Lithocarpium* but has apical horn. *Ord.-Rec.*

H. (Halicalyptra) [=*Acrocalpis* HKL., 1882 (obj.)]. Surface without spines or thorns. *Ord.-Rec.*——FIG. 59,*9*. *H. (H.) petalospyris* HKL., Rec., ×200 (42).

H. (Echinocalpis) HKL., 1882 [**H. spinosa* HKL., 1887]. Surface spiny or thorny. *Rec.*

Haliphormartidium CAMPBELL, 1951 [*pro Haliphormis* HKL., 1887 (*non* EHR., 1847)][**Haliphormis lagena* HKL., 1887]. Like *Archiphormis* but has apical horn. *Rec.*——FIG. 59,*10*. **H. lagena* (HKL.), Rec., ×100 (42).

Lithocarpium STÖHR, 1880 [**L. pyriforme*] [=*Carpocanistrum* HKL., 1887 (obj.)]. Without radial ribs; with corona of free feet; without mantle or apical horn. *Eoc.-Rec.*——FIG. 59,*5*. *L. flosculum* (HKL.), Rec., ×300 (42).

Litharachnium HKL., 1860 [**L. arachnoides* HKL., 1862; SD herein]. Like *Cladarachnium* but has unbranched radial ribs. *Rec.*

L. (Litharachnium) [=*Litharachnidium* HKL., 1887 (obj.)]. Apex with 3 pores.——FIG. 59,*6*. *L. araneosum* HKL., Rec., ×150 (42).

L. (Litharachnoma) HKL., 1887 [**L. pilidium*; SD herein]. Apex with 4 pores.

Peripyramis HKL., 1882 [**P. circumtexta* HKL., 1887]. Like *Bathropyramis* but has outer mantle. *Rec.*——FIG. 59,*2*. **P. circumtexta*, Rec., ×150 (42).

Subfamily ARCHIPHATNINAE Haeckel, 1882

[as Archiphatnida *(partim)*; emend. CAMPBELL, herein]

Basal shell mouth fenestrated. *Jur.-Rec.*

Archiphatna HKL., 1882 [**Archiphaena gorgospyris* HKL., 1887][=*Archiphaena* HKL., 1887 (obj.)]. Without columella or apical horn. *Rec.*

A. (Archiphatna) [=*Coronophatna* HKL., 1882 (obj.); *Coronophaena* HKL., 1887 (obj.)]. Feet unbranched.——FIG. 60,*7*. **A. (A.) gorgospyris*, Rec., ×200 (42).

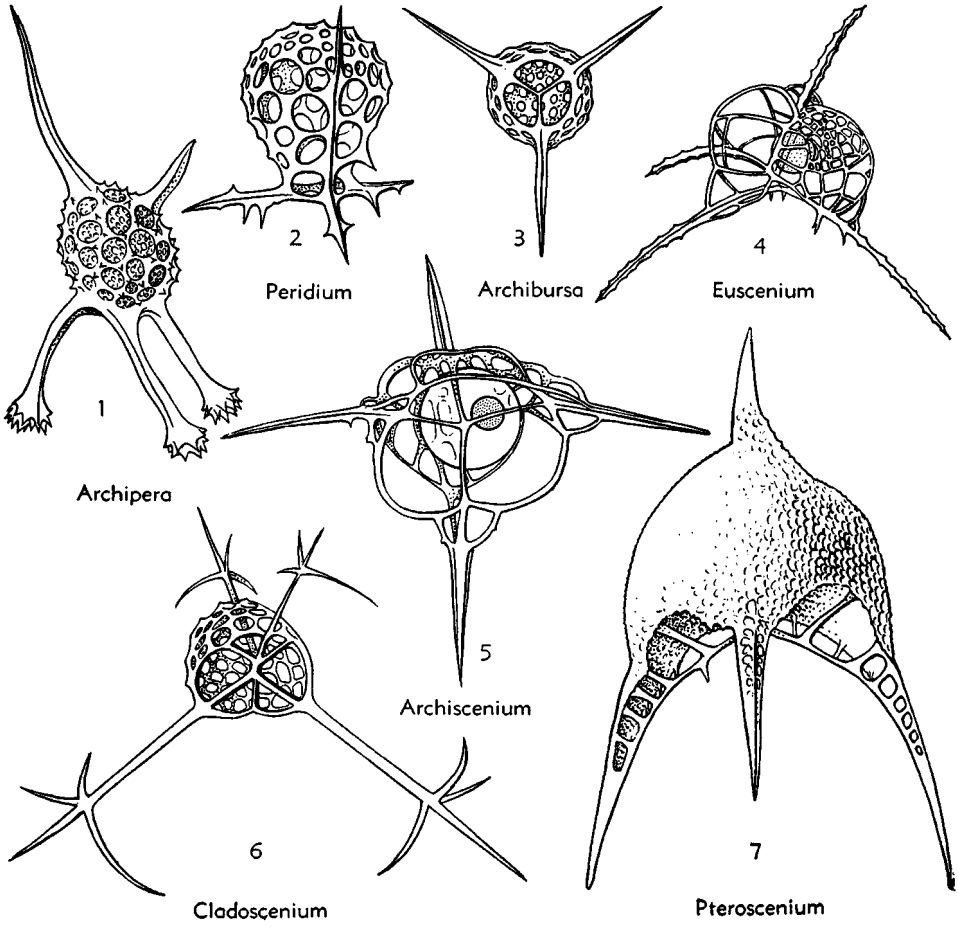

FIG. 58. Archipiliidae (p. D118).

A. (Stephanophatna) HKL., 1882 [**Archiphaena stephanoma* HKL., 1887][=*Stephanophaena* HKL., 1887 (obj.)]. Feet branched or forked.

Acrocorona HKL., 1882 [**Calopophaena tetrarrhabda* HKL., 1887][=*Tetrapteroma* HKL., 1882; *Calopophaena* HKL., 1887 (obj.)]. Like *Archiphatna* but has apical horn. *Rec.*

A. (Acrocorona). Unbranched feet.——FIG. 60,*8*. *A. (A.) hexarrhabda* HKL., Rec., ×200 (42).

A. (Cladocorona) HKL., 1882 [**Calopophaena tetracorethra* HKL., 1887]. Feet branched or forked.

Phaenocalpis HKL., 1887 [**P. petalospyris;* SD herein]. Unbranched free columella. *Eoc.-Rec.*——FIG. 60,*11*. **P. petalospyris,* Rec., ×200 (42).

Phaenoscenium HKL., 1887 [**P. hexapodium;* SD herein]. Like *Phaenocalpis* but has branched columella. *Jur.-Rec.*——FIG. 60,*12*. **P. hexapodium,* Rec., ×150 (42).

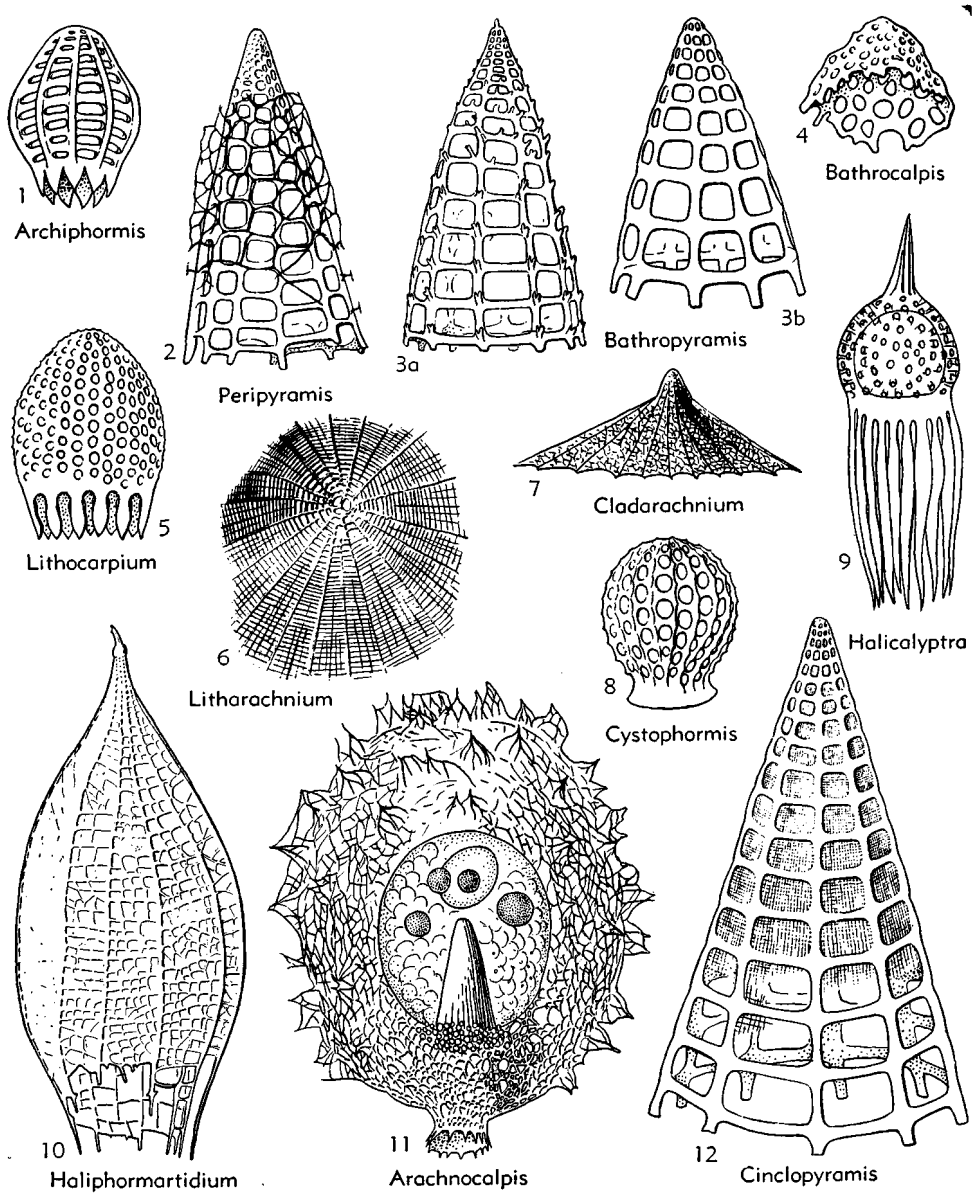

FIG. 59. Archiphormididae (p. D118, D119).

Family ARCHICORYTHIDAE Haeckel, 1887

[as Archicorida; emend. CAMPBELL, herein]
[=Cyrtocalpida HKL., 1887]

Without radial apophyses. *Cam.-Rec.*

Subfamily ARCHICORYTHINAE Haeckel, 1882

[as Archicorida *(partim)*; emend. CAMPBELL, herein]

Basal shell mouth open. *Cam.-Rec.*

Archicorys HKL., 1882 [**A. galea* HKL., 1887]. Like *Cyrtocalpis* but has apical horn. *Cam.-Rec.* ——FIG. 60,*1*. *A. ovata* HKL., Rec., ×200 (42).

Cornutanna HKL., 1882 [**C. orthoconus* HKL., 1887]. Conical shell with simple lattice; without apical horn. *Jur.-Rec.*

C. (Cornutanna) [=*Orthocornutanna* CL.-C., 1945 (obj.)]. Shell axis straight. *Jur.-Rec.*—— FIG. 60,*5*. *C. (C.) charlestownensis* CL.-C., U.Eoc., Calif., ×200 (39).

C. (Heterocornutanna) CL.-C., 1945 [**C. cyrtoconus* HKL., 1887]. Shell axis curved. *Jur.-Rec.*

Cornutella EHR., 1838 [**C. clathrata* EHR., 1884]. Like *Cornutanna* but has distinct apical horn. *Jur.-Rec.*

C. (Cornutella) [=*Cornutissa* HKL., 1882 (obj.)]. Shell axis straight; pores round and without polygonal frames. *Eoc.-Rec.*——FIG. 60,*3a*. *C. (C.) paloverdensis* CL.-C., Mio., Calif. (common), ×150 (39).

C. (Cornutellium) HKL., 1882 [*non* 1887][**C. limbatum* RÜST, 1885]. Shell axis straight; pores polygonal or within polygonal frames. *Jur.-Rec.* ——FIG. 60,*3b*. *C. (C.) hexagona* HKL., Rec., ×400 (42).

C. (Cornutosa) HKL., 1882 [**C. curvata* HKL., 1887] [=*Cornutura* HKL., 1882]. Shell axis curved; pores circular. *Eoc.-Rec.*

Cyrtocalpis HKL., 1860 [**C. amphora* HKL., 1862; SD herein][=*Cyrtolepis* RÜST, 1885 (obj.)]. Ovate or urn-shaped shell with simple lattice; constricted mouth; without apical horn. *Cam.-Rec.*——FIG. 60,*6*. *C. urceolatus* HKL., Rec., ×200 (42).

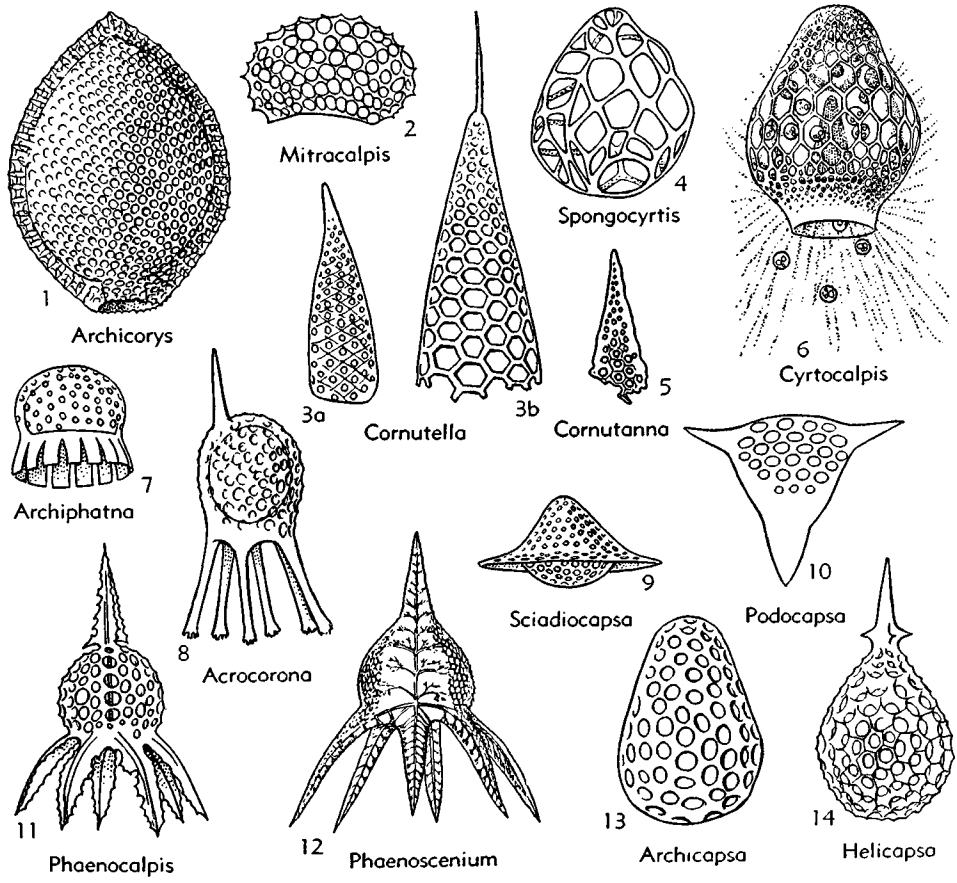

FIG. 60. Archiphormididae, Archicorythidae (p. D119-D122).

Mitracalpis HKL., 1882 [**M. palliata* HKL., 1887]. Ovate shell with outer mantle. *Cret.-Rec.*——FIG. 60,*2*. *M. depressa* RÜST, Cret., C.Eur., ×300 (51).

Spongocyrtis DUNIKOWSKI, 1882 [**S. montisovis*]. Like *Mitracalpis* but has spongy lattice. *Carb.-Jur.*——FIG. 60,*4*. *S. eurydictyum* RÜST, Carb., Harz Mts., ×100 (51).

Subfamily ARCHICAPSINAE Haeckel, 1882

[as Archicapsida; emend. CAMPBELL, herein]

Basal shell mouth fenestrated. *Perm.-Rec.*

Archicapsa HKL., 1882 [**A. pyriformis* RÜST, 1885]. Lacks apical horn. *Perm.-Rec.*——FIG. 60,*13*. *A. triforis* HKL., Rec., ×300 (42).

Halicapsa HKL., 1882 [**H. pulex* RÜST, 1885]. Like *Archicapsa* but has apical horn. *Cret.-Rec.*

H. (Halicapsa) [=*Calpocapsa* HKL., 1887 (obj.)]. Surface not spiny. *Cret.-Rec.*——FIG. 60,*14*. *H. (H.) trigochin* HKL., Rec., ×200 (42).

H. (Echinocapsa) HKL., 1882 [**H. papillata* HKL., 1887]. Surface spiny, thorny, or papillate. *Cret.-Rec.*

Podocapsa RÜST, 1885 [**P. guembelii*]. Three or more fenestrated appendages. *Jur.*——FIG. 60,*10*. **P. guembelii,* Jur., Switz., ×150 (51).

Sciadiocapsa SQUIN., 1904 [**S. euganea*]. Peripheral flange surrounds fenestrate mouth plate of lenslike shell; without apical spine. *Cret.*——FIG. 60,*9*. **S. euganea,* Cret., Italy, ×150 (52).

Subsuperfamily SETHOPILIILAE Haeckel, 1882

[*ex* Sethopilida; emend. CAMPBELL, herein]
[=Dicyrtida HKL., 1862]

Shell divided by transverse stricture into cephalis and thorax. *Cam.-Rec.*

Family SETHOPILIIDAE Haeckel, 1882

[as Sethopilida; emend. CAMPBELL, herein]
[=Tripocyrtida HKL., 1887]

Shell bears 3 radial apophyses. *Jur.-Rec.*

Subfamily SETHOPILIINAE Haeckel, 1882

[as Sethopilida *(partim)*; emend. CAMPBELL, herein]

Basal shell mouth open. *Jur.-Rec.*

Sethopilium HKL., 1882 [**S. orthopus* HKL., 1887]. Like *Dictyophimus* but without cephalic horn and lacks septum between shell joints. *Eoc.-Rec.*——FIG. 61,*7*. *S. macropus* HKL., Rec., ×150 (42).

Acerocanium VINASSA, 1900 [**A. globosum*]. Thorax without radial ribs; solid straight feet; lacks apical horn. *Mio.*——FIG. 61,*15*. **A. globosum,* Mio., Italy, ×200 (55).

Amphiplecta HKL., 1882 [**A. amphistoma* HKL., 1887][=*Amphicryphalus* HKL., 1887 (obj.); *Trisulcus* POP., 1913]. Like *Eucecryphalus* but ribs inside thorax; cephalis with large apical hole. *Rec.*——FIG. 61,*14*. *A. acrostoma* HKL., Rec., ×200 (42).

Callimitra HKL., 1882 [**C. carolatae* HKL., 1887]. Thorax completely latticed; thoracic ribs connected by latticed vertical wings to cephalis; with 4 cephalic spines. *Rec.*——FIG. 61,*9*. **C. carolatae,* Rec., ×300 (42).

Clathrocanium EHR., 1860 [**C. squarrosum* EHR., 1872; SD herein]. Three prominent lateral ribs in thorax; without latticed wings; ribs alternated with 3 large thoracic holes; with apical horn. *Rec.*

C. (Clathrocanium) [=*Clathrocanidium* HKL., 1887 (obj.)]. Apical horn not fenestrated; basal shell mouth smooth.——FIG. 61,*11*. *C. (C.) sphaerocephalum* HKL., Rec., ×300 (42).

C. (Clathrocorona) HKL., 1882 [**C. diadema* HKL., 1887]. Apical horn fenestrated; basal shell mouth with spiny corona.

Clathrocorys HKL., 1882 [**C. murrayi* HKL., 1887]. Three prominent lateral thoracic ribs alternated with 3 large thoracic holes; ribs connected with apical horn by latticed wings. *Rec.*——FIG. 61,*4*. **C. murrayi,* Rec., ×300 (42).

Clathromitra HKL., 1882 [**C. pterophormis* HKL., 1887]. Like *Callimitra* but has 5 cephalic spines. *Rec.*——FIG. 61,*6*. **C. pterophormis,* Rec., X200 (42).

Dictyophimus EHR., 1847 [**D. lucerna* EHR., 1854; SD herein]. Three complete thoracic ribs prolonged as solid divergent feet; cephalis with apical horn; without latticed wings. *Jur.-Rec.*

D. (Dictyophimus) [=*Dictyophimium* HKL., 1887 (obj.)]. Without prominent spines on edges of ribs. *Jur.-Rec.*——FIG. 61,*12*. *D. (D.) babylonis* CL.-C., U.Eoc., Calif., ×150 (39).

D. (Lamprotripus) HKL., 1882 [**D. triserratus* HKL., 1887]. Prominent spines on edge of thoracic ribs. *Rec.*

Eucecryphalus HKL., 1860 [*E. gegenbauri* HKL., 1862]. Three free wings or solid spines outside thorax; without apical hole; with apical spine. *Eoc.-Rec.*

E. (Eucecryphalus) [=*Eucecryphalium* HKL., 1887 (obj.)]. Shell mouth with corona of spines. *Eoc.-Rec.*

E. (Eucyrtomphalus) HKL., 1882 [**E. corocalyptra* HKL., 1887]. Shell mouth devoid of spines. *Rec.*——FIG. 61,*8*. *E. (E.) campanella* (EHR.), Rec., ×200 (42).

Lamprodiscus EHR., 1860 [**L. monoceros* EHR., 1872; SD herein]. Three divergent lateral ribs in wall of flat, conical, discoidal or pyramidal thorax; with apical horn; shell mouth devoid of spines. *Rec.*

Lampromitra HKL., 1882 [**L. coronata* HKL., 1887]. Like *Lamprodiscus* but mouth has prominent spiny corona. *Rec.*——FIG. 61,*13*. *L. huxleyi* HKL., Rec., ×200 (42).

Lithomelissa EHR., 1847 [**L. tartari* EHR., 1854]. Thoracic ribs prolonged as lateral wings or spines; thorax latticed; without terminal feet; with one or more apical horns. *Eoc.-Rec.*

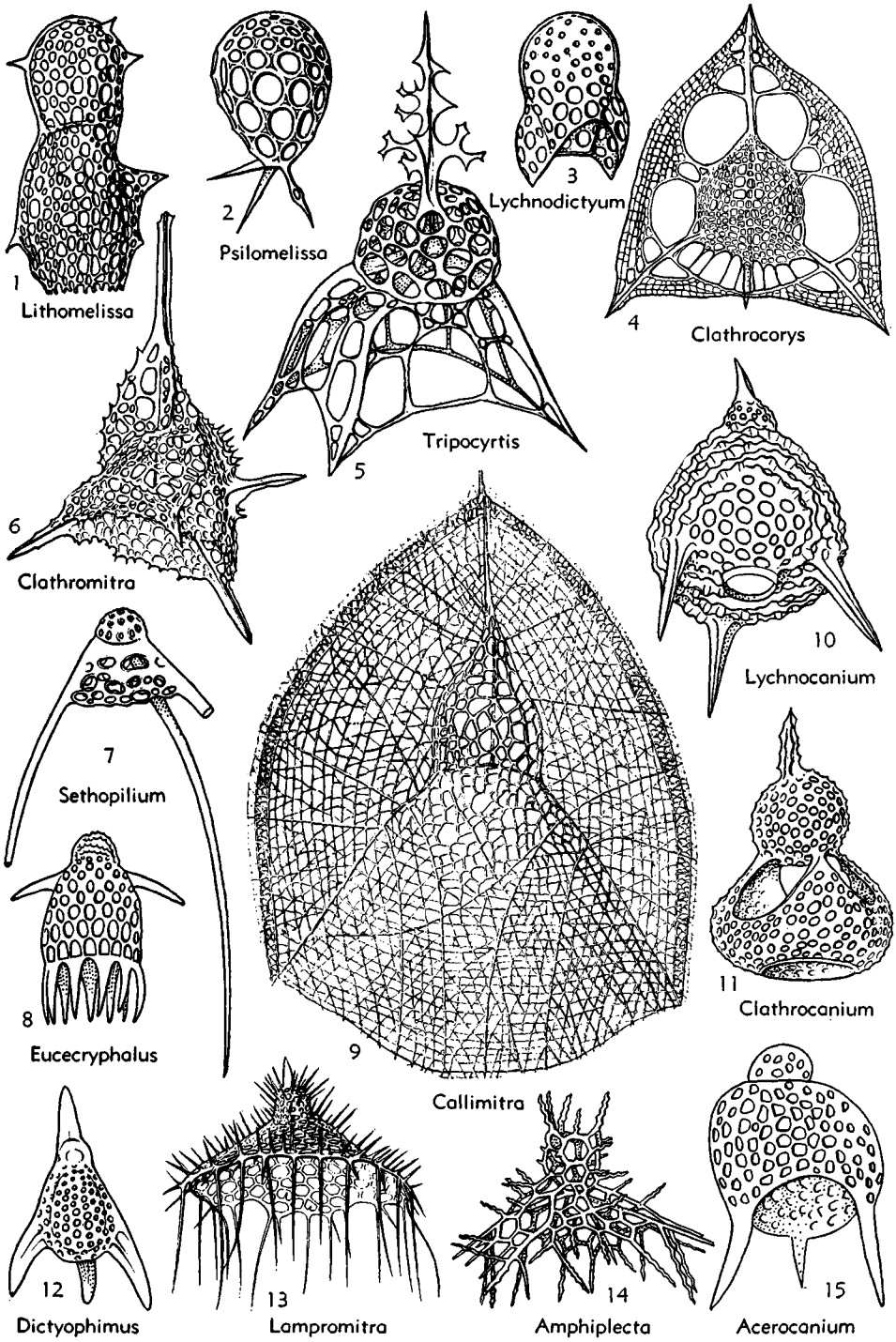

FIG. 61. Sethopiliidae (p. D122-D124).

L. (Lithomelissa) [=*Acromelissa* HKL., 1882 (obj.)]. Single occipital horn. *Eoc.-Rec.*

L. (Corythomelissa) CAMPBELL, 1951 [*pro Sethomelissa* HKL., 1887 (12, p. 1207; *non* p. 1237)] [**L. corythium* EHR., 1875]. Three or more horns. *Eoc.-Rec.*

L. (Dimelissa) CAMPBELL, 1951 [*pro Micromelissa* HKL., 1882 (12, p. 1205; *non* p. 1235)] [**L. thoracites* HKL., 1862]. Two divergent apical horns. *Rec.*——FIG. 61,*1. L. (D.) bütschlii* HKL., Rec., ×300 (42).

Lychnocanium EHR., 1847 [**L. falciferum* EHR., 1854; SD herein] [=*Lichnocanium* VINASSA, 1900 (obj.); *Fenestracantha* BERTOLINI, 1935]. Three solid terminal feet on shell mouth; without thoracic ribs. *Cret.-Rec.*

L. (Lychnocanium) [=*Lychnocanissa* HKL., 1887 (obj.)]. Feet divergent, more or less curved. *Cret.-Rec.*

L. (Lychnocanella) HKL., 1887 [**L. lanterna;* SD herein]. Feet divergent, more or less straight. *Eoc.-Rec.*——FIG. 61,*10. L. (L.) pyriforme* HKL., Rec., ×200 (42).

L. (Lychnocanoma) HKL., 1887 [**L. clavigerum;* SD herein]. Feet parallel, straight or curved. *Eoc.-Rec.*

Lychnodictyum HKL., 1882 [**Dictyophimus challengeri* HKL., 1878]. Like *Lychnocanium* but feet latticed. *Mio.-Rec.*——FIG. 61,*3. L. scaphopodium* HKL., Rec., ×300 (42).

Psilomelissa HKL., 1882 [**Dictyocephalus galeatus* EHR., 1872]. Like *Lithomelissa* but without apical horn. *Rec.*——FIG. 61,*2. P. calvata* HKL., Rec., ×300 (42).

Spongomelissa HKL., 1887 [**Lithomelissa spongiosa* BÜTSCHLI, 1882]. Like *Lithomelissa* but has spongy shell. *Eoc.*

Tripocyrtis HKL., 1887 [**T. plagoniscus;* SD herein]. Three radial ribs in thorax prolonged into solid feet; without latticed wings; with apical horn. *Eoc.-Rec.*——FIG. 61,*5. *T. plagoniscus,* Rec., ×300 (42).

Subfamily SETHOPERINAE Haeckel, 1882

[as Sethoperida; emend. CAMPBELL, herein]

Basal shell mouth fenestrated. *Jur.-Rec.*

Sethopera HKL., 1882 [**S. tricostata* HKL., 1887]. Three ribs enclosed in latticed thorax; with apical horn. *Jur.-Rec.*——FIG. 62,*4. *S. tricostata,* Rec., ×200 (42).

Acerahedrina VINASSA, 1900 [**A. hirta*]. Like *Sethopera* but lacks apical horn. *Mio.*——FIG. 62, *9. *A. hirta,* Mio. Italy, ×150 (55).

Clathrolychnus HKL., 1882 [**C. araneosus* HKL., 1887]. Three free latticed feet; with weblike mantle. *Rec.*——FIG. 62,*2. *C. araneosus,* Rec., ×300 (42).

Helotholus JÖRG., 1905 [**H. histricola*]. Without apical horn; shell spiny. *Eoc.* (Ger.)-*Rec.*——FIG. 62,*8. *H. histricola,* Rec., ×300 (46).

Lithopera EHR., 1847 [**L. bacca* EHR., 1872]. Like *Sethopera* but has 3 internal rods in thorax. *Rec.*——FIG. 62,*7. L. ananassa* HKL., Rec., ×300 (42).

Micromelissa HKL., 1882 [*non* HKL., 1887] [**M. bombus* HKL., 1887]. Three solid divergent lateral spines; wtih apical horn. *Cret.-Rec.*——FIG. 62,*5. *M. bombus,* Rec., ×200 (42).

Peromelissa HKL., 1882 [**P. phalacra* HKL., 1887]. Like *Micromelissa* but lacks apical horn. *Plio.-Rec.*——FIG. 62,*1. P. calva* HKL., Rec., ×300 (42).

Sethochytris HKL., 1882 [**S. triconiscus* HKL., 1887]. Three latticed feet; with apical horn. *Eoc.-Rec.*——FIG. 62,*3. *S. triconiscus,* Rec., ×200 (42).

Sethomelissa HKL., 1882 [*non* HKL., 1887] [**S. hymenoptera* HKL., 1887]. Like *Micromelissa* but has latticed wings and a horn or bunch of horns. *Rec.*

Tetrahedrina HKL., 1882 [**T. pyramidalis* HKL., 1887]. Like *Sethomelissa* but has 3 solid feet. *Cret.-Rec.*——FIG. 62,*6. T. megapora* RÜST, Cret., Zilli., ×60 (51).

Family SETHOPHORMIDIDAE Haeckel, 1882

[as Sethophormida; emend. CAMPBELL, herein] [=Anthocyrtida HKL., 1887; Plectopyramididae *(partim);* Sethophormidae FRIZZELL, 1951]

Radial apophyses 4 to 9 or more. *Cam.-Rec.*

Subfamily SETHOPHORMIDINAE Haeckel, 1887

[as Sethophormida *(partim);* emend. CAMPBELL, herein] [=Sethophorminae FRIZZELL, 1951]

Basal shell mouth open. *Cam.-Rec.*

Tetraphormis HKL., 1882 [**Sethophormis cruciata* HKL., 1887] [=*Sethophormis* HKL., 1887]. Numerous radial ribs in flat and broad bell-shaped or nearly discoidal thorax; cap-shaped cephalis lacks apical horn. *Cret.-Rec.*

T. (Tetraphormis). Thorax with 4 radial ribs. *Cret.-Rec.*

T. (Astrophormis) HKL., 1887 [**Sethophormis aurelia* HKL., 1887 (=*Leptarachnium aurelia* HKL., 1887)] [=*Leptarachnium* HKL., 1887 (obj.)]. Radial ribs 12 to 20 or more. *Rec.*——FIG. 63,*1c. T. (A.) dodecaster* HKL., Rec., ×200 (42).

T. (Enneaphormis) HKL., 1882 [**Sethophormis rotula* HKL., 1887 (=*Enneaphormis rotula* HKL., 1887)] [=*Craspedilium* HKL., 1887 (obj.)]. Thorax with 9 radial ribs. *Rec.*——FIG. 63,*1b. *T. (E.) rotula,* Rec., ×200 (42).

T. (Hexaphormis) HKL., 1882 [**Sethophormis hexalactis* HKL., 1887 (=*Heptaphormis hexalactis* HKL., 1887)] [=*Heptaphormis* HKL., 1887 (obj.)]. Thorax with 6 radial ribs. *Rec.*——FIG. 63,*1a. *T. (H.) hexalactis,* Rec., ×200 (42).

T. (Octophormis) HKL., 1887 [**Sethophormis octalactis*]. Thorax with 8 radial ribs. *Rec.*

T. (Pentaphormis) HKL., 1882 [**Sethophormis pentalactis* HKL., 1887]. Thorax with 5 radial ribs. *Rec.*——FIG. 63,*1d*. **T. (P.) pentalactis*, Rec., ×200 (42).

Acanthocorys HKL., 1882 [**A. hexapodia* HKL., 1887]. Numerous radial ribs in wall of pyramidal thorax prolonged into divergent feet; simple network; cephalis often has apical horns. *Cret.-Rec.*

A. (Acanthocorys) [=*Acanthocorallium* HKL., 1887 (obj.)]. Thorax with 6 ribs. *Cret.-Rec.*

A. (Acanthocoronium) HKL., 1887 [**Arachnocorys umbellifera* HKL., 1862]. Thorax with 9 ribs. *Rec.* ——FIG. 63,*6*. *A. (A.) macroceras* HKL., Rec., ×100 (42).

A. (Acanthocorythium) HKL., 1887 [**A. dodecaster;* SD herein]. Thorax with 20 or more ribs. *Rec.*

Anthocyrtidium HKL., 1882 [**A. cineraria* HKL., 1887]. Like *Anthocyrtis* but feet are outside of constricted mouth. *Eoc.-Rec.*——FIG. 63,*4*. **A. cineraria*, Rec., ×200 (42).

Anthocyrtium HKL., 1887 [**A. chrysanthemum;* SD herein]. Like *Anthocyrtis* but has 12 or more feet. *Eoc.-Rec.*

A. (Anthocyrtium) [=*Anthocyrtarium* HKL., 1887 (obj.)]. Feet divergent. *Eoc.-Rec.*——FIG. 63,*2*. *A. (A.) adonis* HKL., Rec., ×300.

A. (Anthocyrtonium) HKL., 1887 [**A. campanula;* SD herein]. Feet parallel. *Eoc.-Rec.*

A. (Anthocyrturium) HKL., 1887 [**A. pyrum;* SD herein]. Feet convergent. *Eoc.-Rec.*

Anthocyrtoma HKL., 1887 [**Anthocyrtis serrulata* EHR., 1875; SD FRIZZELL, 1951]. Without thoracic ribs; 9 feet; free cephalis with apical horn. *Paleoc.-Rec.*

Anthocyrtis EHR., 1847 [**A. mespilus* EHR., 1854; SD herein]. Like *Anthocyrtoma* but has only 6 feet; feet inside mouth unlike *Anthocyrtidium*. *Cam.-Rec.*

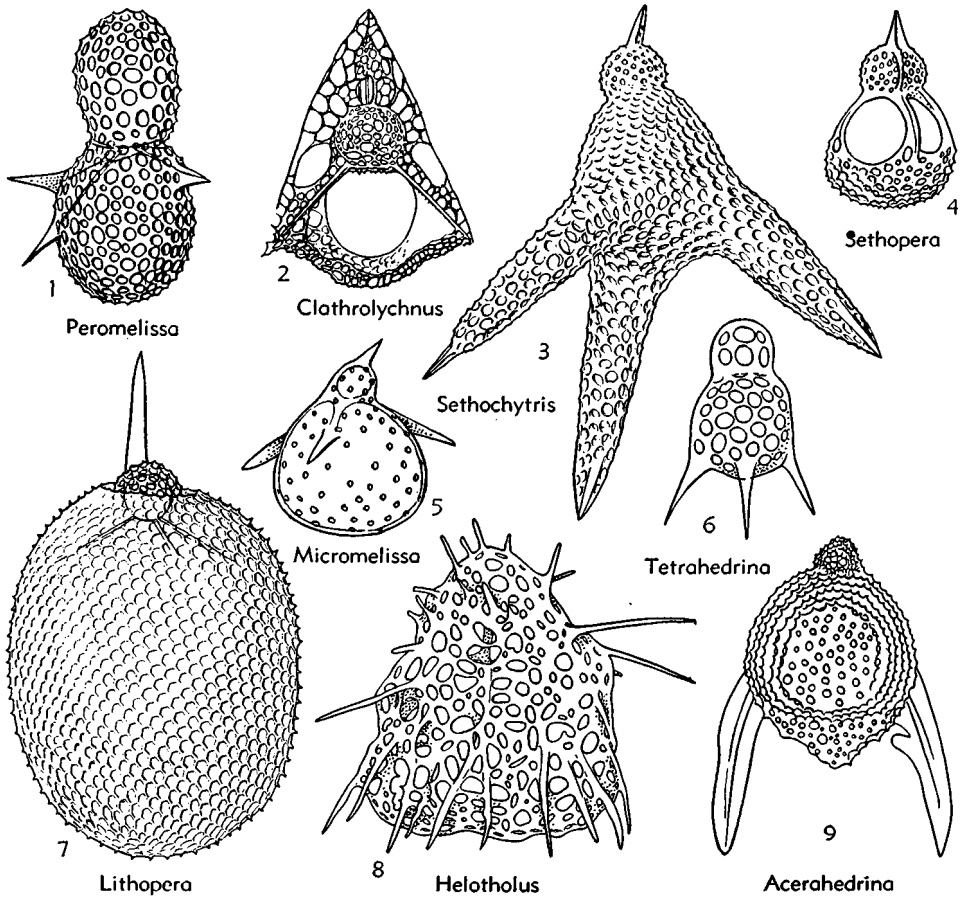

FIG. 62. Sethopiliidae (p. D124).

A. (Anthocyrtis) [=*Anthocyrtella* HKL., 1887 (obj.)]. Feet divergent. *Cam.-Rec.*

A. (Anthocyrtissa) HKL., 1887 [**A. ophirensis* EHR., 1872; SD herein]. Feet parallel. *Rec.*

A. (Anthocyrtura) HKL., 1887 [**A. ovata* HKL., 1887]. Feet convergent. *Rec.*——FIG. 63,*3*. **A. (A.) ovata,* Rec., ×200 (42).

Arachnocorys HKL., 1860 [**A. circumtextum* HKL., 1862]. Like *Acanthocorys* but shell enveloped by weblike network. *Rec.*

A. (Arachnocorys) [=*Arachnocoronium* HKL., 1887 (obj.)]. Thorax with 9 ribs.——FIG. 63,*7*. **A. (A.) araneosa* HKL., Rec., ×200 (42).

A. (Arachnocorallium) HKL., 1887 [**A. hexaptera;* SD herein]. Thorax with 6 ribs.

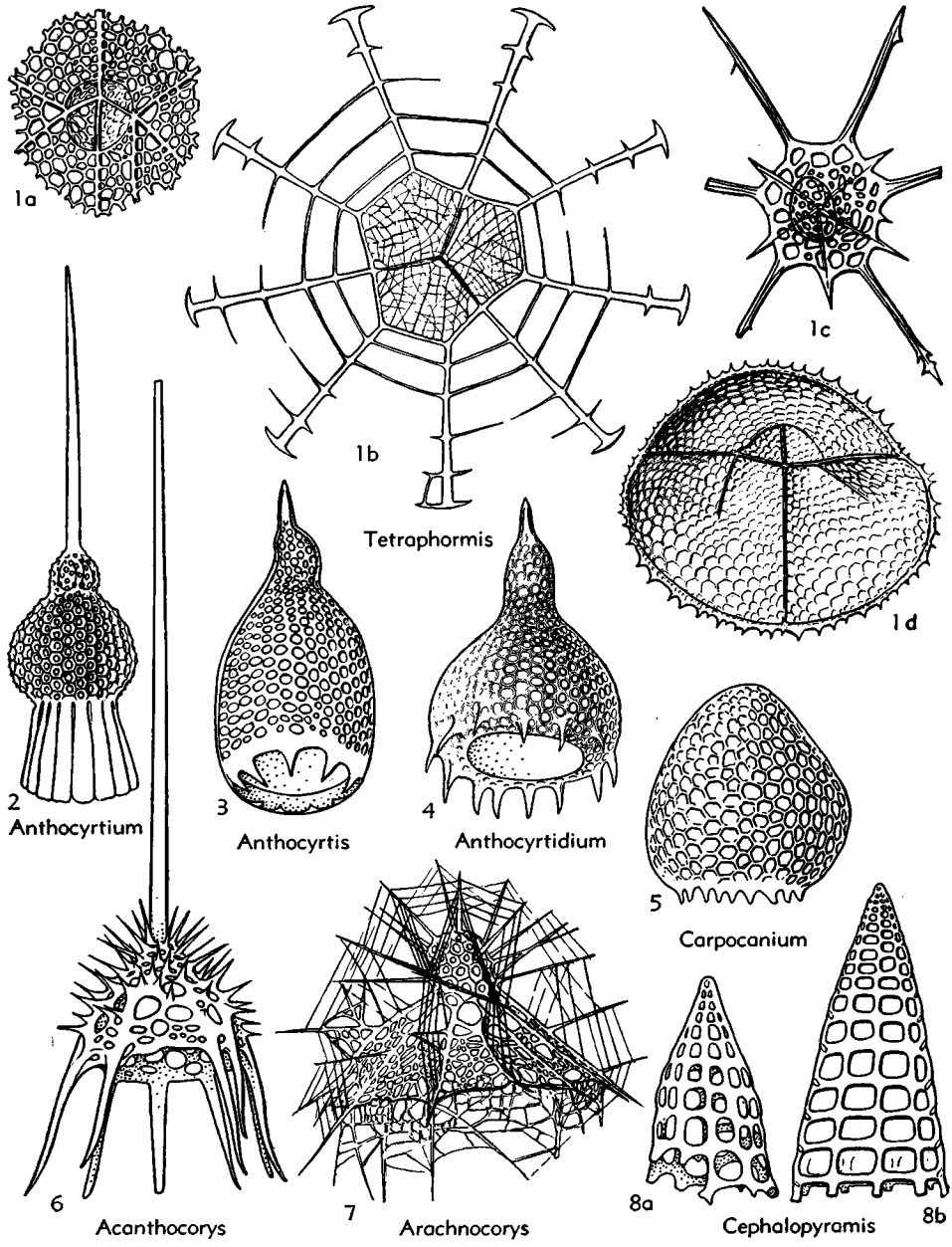

FIG. 63. Sethophormididae (p. D124-D127).

A. (Arachnocorythium) HKL., 1887 [**A. polyptera*]. Thorax with 12 to 20 or more ribs.

Carpocanium EHR., 1847 [**Lithocampe solitaria* EHR., 1874]. Without thoracic ribs; with 6 to 12 or more feet; hornless cephalis hidden within thorax. *Eoc.-Rec.*

C. (Carpocanium) [=*Carpocanidium* HKL., 1887 (obj.)]. With corona of 9 feet. *Eoc.-Rec.*

C. (Carpocanarium) HKL., 1887 [**C. calycodes* STÖHR, 1880]. With corona of 6 feet. *Eoc.-Rec.*

C. (Carpocanobium) HKL., 1887 [**C. trepanium;* SD herein]. With corona of 12 or more feet. *Rec.*——FIG. 63,*5. C. (C.) hexagonale* HKL., Rec., ×300 (42).

Cephalopyramis HKL., 1882 [**Sethopyramis enneactis* HKL., 1887][=*Sethopyramis* HKL., 1882 (obj.); *Sethophormis (Enneaphormis) eupilium* HKL., 1887 =*Craspedelium eupilium* HKL., 1887 (12, p. 1247) (obj.)]. Pyramidal shell with straight ribs and simple fenestration. *Eoc.-Rec.*

C. (Cephalopyramis). Nine radial ribs in thorax. *Eoc.-Rec.*——FIG. 63,*8a. C. (C.) magnifica* (CL.-C.), U.Eoc., Calif., ×200 (39).

C. (Actinopyramis) HKL., 1887 [**Sethopyramis dodecalactis;* SD herein]. Twelve or more radial ribs in thorax. *Rec.*

C. (Sestropyramis) HKL., 1882 [**Cornutella scalaris* EHR., 1875]. Six radial ribs in thorax. *Eoc.-Rec.*——FIG. 63,*8b. C. (S.) quadrata* HKL., Rec., ×200 (42).

Craterocyclas HAECKER, 1908 [**C. robusta*]. Crater-like shell without ribs; with toothed corona. *Rec.*——FIG. 64,*1. *C. robusta,* Rec., ×200 (43).

Cryptocephalus HKL., 1882 [**C. exiguus* RÜST, 1885][=*Sethamphora* HKL., 1887 (obj.)]. Like *Tetraphormis* but has ovate shell and constricted mouth. *Jur.-Rec.*

C. (Cryptocephalus). Cephalis hidden within thorax. *Jur.-Rec.*——FIG. 64,*4. C. (C.) favosa* HKL., Rec., ×300 (42).

C. (Dictyoprora) HKL., 1882 [**Sethamphora hexapleura* HKL., 1887]. Cephalis free. *Eoc.-Rec.*

Dicorys POP., 1913 [**D. architypus*]. Shell open at both ends; 4 or more thoracic ribs extended as feet; commonly with 2 apical horns. *Rec.*——FIG. 64,*2. *D. architypus,* Rec., ×400 (48).

Platycryphalus HKL., 1882 [**P. pumilus* RÜST,

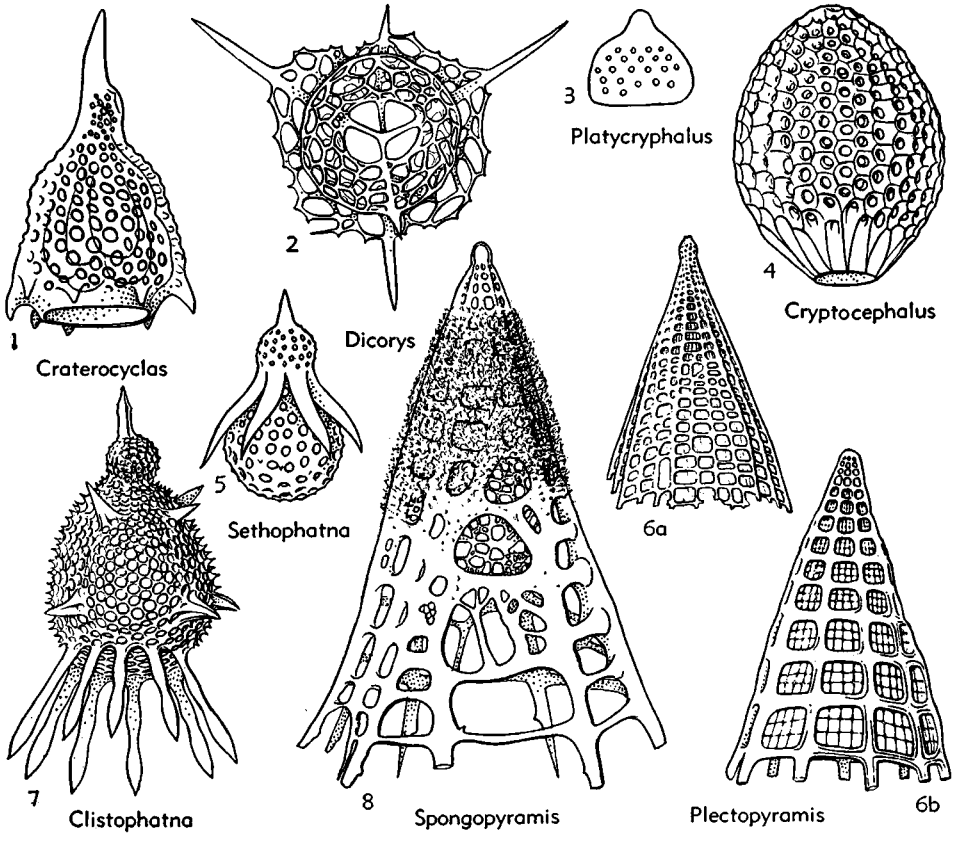

FIG. 64. Sethophormididae (p. D127, D128).

1885][=*Sethocephalus* HKL., 1887 (obj.)]. Large cephalis without apical horn; flat expanded discoidal thorax. *Jur.-Rec.*——FIG. 64,*3*. **P. pumilus,* Jur., Rigi, ×150 (51).

Plectopyramis HKL., 1882 [**P. magnifica* HKL., 1887 (=*Polycystina magnifica* HKL., 1887 (12, p. 1257)][=*Pyramis* (obj.), *Polycystina* (obj.) HKL., 1887]. Slender pyramidal shell with straight ribs, meshes fenestrated by secondary lattice. *Eoc.-Rec.*

P. (Plectopyramis) [=*Hexapleuris* HKL., 1887 (obj.)]. Six (5-7) main radial beams. *Eoc.-Rec.*

P. (Enneapleuris) HKL., 1887 [**P. dodecomma* HKL., 1887; SD herein]. Nine (8-10) radial beams. *Eoc.-Rec.*——FIG. 64,*6b*. **P. (E.) dodecomma,* Rec., ×200 (42).

P. (Polypleuris) HKL., 1887 [**P. polypleura;* SD herein]. Twelve (12-20) or more radial beams. *Rec.*——FIG. 64,*6a*. **P. (P.) polypleura,* Rec., ×200 (42).

Spongopyramis HKL., 1887 [**S. spongiosa;* SD herein (=*Plectopyramis spongiosa* HKL., 1887)]. Like *Plectopyramis* but meshes closed by spongy framework. *Rec.*——FIG. 64,*8*. **S. spongiosa,* Rec., ×200 (42).

Velicucullus RIEDEL & CAMPBELL, 1952 [**Soreuma magnificum* CL.-C., 1942]. Spongy or platelike velum on oral surface of broadly bell-shaped or discoidal thorax; cephalis with several lobes. *Eoc.*, Calif., core samples off New York.

Subfamily SETHOPHATNINAE Haeckel, 1882

[as Sethophatnida; emend. CAMPBELL, herein] [=Sethophaenida HKL., 1887]

Basal shell mouth fenestrated. *Rec.*

Sethophatna HKL., 1882 [**Sethophaena tetraptera* HKL., 1887] [=*Sethophaena* HKL., 1887 (*non* 1882) (obj.)]. Apophyses lateral; cephalis without horn.——FIG. 64,*5*. *S. hexaptera* (HKL.), Rec., ×200 (42).

Clistophatna HKL., 1882 [**Clistophaena rüstiana* HKL., 1887][=*Clistophaena* HKL., 1887 (*non* 1882) (obj.)]. Apophyses terminal; with apical horn.——FIG. 64,*7*. *C. armata* HKL., Rec., ×150 (42).

Family LOPHOPHAENIDAE Haeckel, 1882

[as Lophophaenida; emend. CAMPBELL, herein] [=Sethocorida HKL., 1882 *(partim);* Sethocyrtida HKL., 1887]

Without radial apophyses. *Cam.-Rec.*

Subfamily LOPHOPHAENINAE Haeckel, 1882

[as Lophophaenida *(partim);* emend. CAMPBELL, herein]

Basal shell mouth open. *Cam.-Rec.*

Lophophaena EHR., 1847 [**L. galea* EHR., 1854]. Like *Dictyocephalus* but has a bunch of large cephalic horns. *Eoc.-Rec.*

L. (Lophophaena) [=*Lophophaenula* HKL., 1887 (obj.)]. Horns without anastomosis. *Eoc.-Rec.*——FIG. 65,*2*. *L. (L.) auriculaleporis* CL.-C., U.Eoc., Calif., ×200 (39).

L. (Lophophaenoma) HKL., 1887 [**L. circumtexta*]. Horns anastomosed. *Eoc.-Rec.*

Asecta POP., 1913 [**A. prunoides*]. Thorax ovate, without constricted throat; cephalis hidden within thorax; without apical spine. *Rec.* ——FIG. 65,*8*. **A. prunoides,* Rec., ×400 (48).

Conarachnium HKL., 1882 [**Eucyrtidium trochus* EHR., 1872][=*Sethoconus* HKL., 1887 (*non* 1882) (obj.)]. Conical or bell-shaped thorax; wide open mouth; with one or more apical horns. *Cret.-Rec.*

C. (Conarachnium) [=*Ceratocyrtis* BÜTSCHLI, 1882 (obj.)]. Large cephalis; distinct collar septum; thorax smooth. *Cret.-Rec.*

C. (Ceratarachnium) HKL., 1887 [*pro Cornuellium* HKL., 1882 (*non* 1887)][**Sethoconus hexagonalis* HKL., 1887]. Small cephalis; feeble collar septum; thorax smooth. *Eoc.-Rec.*

C. (Phlebarachnium) HKL., 1882 [**Sethoconus facetus* HKL., 1887] [=*Cladarachnium* HKL., 1882 (obj.)]. Small cephalis; internal collar septum; spiny or thorny thorax. *Rec.*——FIG. 65,*3*. **C. (P.) facetus* (HKL.), Rec., ×200 (42).

Dictyocephalus EHR., 1860 [**D. obtusus* EHR., 1860; SD herein]. Like *Sethocyrtis* but mouth may be simply truncated or with collar; apical horn lacking. *Cam.-Rec.*

D. (Dictyocephalus) [=*Dictyocryphalus* HKL., 1882 (obj.)]. Mouth without collar. *Cam.-Rec.*

D. (Streptodelus) CAMPBELL, 1953 [*pro Dictyoprora* HKL., 1887 (*non* HKL., 1882][**D. amphora* HKL., 1887]. Mouth with collar. *Cret.-Rec.*——FIG. 65,*12*. *D. (S.) obesus* CL.-C., U.Eoc., Calif., ×200 (39).

Lithocampana CL.-C., 1942 [**L. lithoconella*]. Bell-shaped, without apical horn or lateral appendages. *Eoc.*——FIG. 65,*4*. **L. lithoconella,* U.Eoc., Calif., ×200 (39).

Periarachnium HKL., 1882 [**P. periplectum* HKL., 1887]. Like *Conarachnium* but has webbed mantle. *Rec.*——FIG. 65,*13*. **P. periplectum,* Rec., ×300 (42).

Sethocorys HKL., 1882 [**S. achillus* HKL., 1887]. Like *Sethocyrtis* but has tubular collar. *Jur.-Rec.* ——FIG. 65,*14*. **S. achillus,* Rec., ×300 (42).

Sethocyrtis HKL., 1887 [**S. oxycephalus;* SD herein]. Thorax ovate or cylindrical; constricted mouth without collar; single apical horn. *Jur.-Rec.*——FIG. 65,*11*. **S. oxycephalus,* Rec., ×300 (42).

Sethodiscus HKL., 1882 [*non* HKL., 1887][**S. tholus* RÜST, 1885]. Small cephalis with minute apical spine; smooth inflated thorax. *Jur.*—— FIG. 65,*1*. **S. tholus,* RÜST, Jur., Rigi, ×150 (51).

Subfamily ADELOCYRTIDINAE Campbell, nom. nov.

[*pro* Sethocapsida Hkl., 1882]

Basal shell mouth fenestrated. *Cam.-Rec.*

Adelocyrtis Pantanelli, 1880 [**A. pala;* SD herein][=*Sethocapsa* Hkl., 1882 (obj.)]. Greatly inflated thorax; single apical horn. *Cam.-Rec.*——Fig. 65,*5*. *A. pyriformis* (Hkl.), Rec., ×300 (42).

Cryptocapsa Hkl., 1882 [**C. tricyclia* Rüst, 1885]. Cephalis hidden within thorax; without apical horn. *Jur.-Rec.*——Fig. 65,*10*. **C. tricyclia* Rüst, Jur., Switz., ×150 (51).

Diacanthocapsa Squin., 1903 [**D. eugenea*]. Cephalis with 2 horns. *Cret.*——Fig. 65,*15*. **D. eugenea,* Cret., Italy, ×150 (52).

Dicolocapsa Hkl., 1882 [**D. murina* Rüst, 1885]. Cephalis without apical horn. *Cam.-Rec.*——Fig. 65,*6*. *D. microcephalia* Hkl., Rec., ×300 (42).

Salpingocapsa Rüst, 1885 [**S. mira*]. Cephalis with single horn; thorax fenestrated only in basal part. *Jur.*——Fig. 65,*9*. **S. mira,* Jur., Rigi, ×100 (51).

Stylocapsa Principi, 1909 [**S. exagonata*]. Small globular cephalis with strong horn partly hidden within swollen, ovate thorax. *Mio.-Plio.,* Rotti.——Fig. 65,*7*. **S. exogonata,* Mio., Italy, ×230 (49).

Subsuperfamily THEOPILIILAE Haeckel, 1882

[*ex* Theopilida; emend. Campbell, herein] [=Tricyrtida Hkl., 1882]

Shell divided by 2 transverse strictures into cephalis, thorax and abdomen. *Cam.-Rec.*

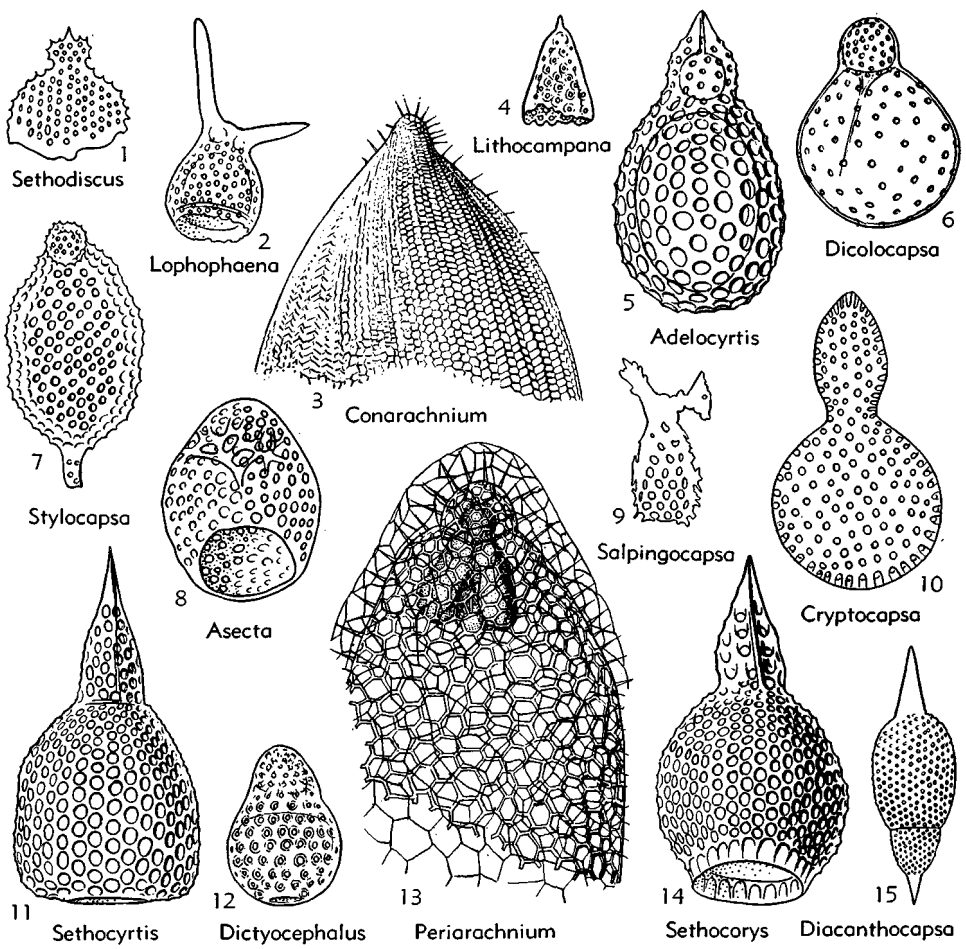

Fig. 65. Lophophaenidae (p. D128, D129).

Family THEOPILIIDAE Haeckel, 1882

[as Theopilida; emend. CAMPBELL, herein]
[=Podocyrtida HKL., 1887]

Three radial apophyses. *Jur.-Rec.*

Subfamily THEOPILIINAE Haeckel, 1882

[as Theopilida *(partim)*; emend. CAMPBELL, herein]

Basal shell mouth open. *Jur.-Rec.*

Theopilium HKL., 1882 [**T. tricostatum* HKL., 1887]. Without wings or feet; 3 lateral ribs enclosed in thorax. *Rec.*——FIG. 66,*1*. **T. tricostatum*, Rec., ×200 (42).

Corocalyptra HKL., 1887 [**C. agnesae*; SD herein]. Hat-shaped shell with 3 solid free thoracic wings arising from collar stricture. *Cret.-Rec.*——FIG. 66,*2*. **C. agnesae*, Rec., ×200 (42).

Dictyoceras HKL., 1862 [**Lithornithium dictyoceras* HKL., 1860]. Three latticed thoracic wings not extended into cephalis; without terminal feet. *Rec.*——FIG. 66,*3*. *D. insectum* HKL., Rec., ×300 (42).

Dictyocodon HKL., 1882 [**D. annasethe* HKL., 1887]. Three free latticed wings; numerous terminal feet. *Rec.*

D. (Dictyocodon) [=*Dictyocodella* HKL., 1887 (obj.)]. Latticed wings arise from thorax alone. ——FIG. 66,*4*. **D. (D.) annasethe*, Rec., ×300 (42).

D. (Dictyocodoma) HKL., 1887 [**D. pallidius*; SD herein]. Latticed wings prolonged to abdomen.

Dictyopodium EHR., 1847 [**D. eurylophus* EHR., 1875]. Like *Podocyrtis* but has 3 latticed terminal feet. *Eoc.-Rec.*——FIG. 66,*7*. *D. scaphopodium* HKL., Rec., ×200 (42).

Lithopilium POP., 1913 [**L. macroceras*; SD herein]. Three ribs extended from thorax as free feet connected internally with apical horn and with transverse collar beams. *Rec.*——FIG. 66,*5*. **L. macroceras*, Rec., ×400 (48).

Pleuropodium HKL., 1882 [**Podocyrtis charybdea* MÜLLER, 1856]. Abdomen with 3 ribs and 3 simple feet; no thoracic ribs. *Rec.*

Podocyrtis EHR., 1847 [**P. papalis* EHR., 1854]. Solid unbranched abdominal feet; abdomen without ribs. *Cret.-Rec.*

P. (Podocyrtis) [=*Podocyrtidium* HKL., 1887 (obj.)]. Feet convergent; thoracic and abdominal pores nearly similar. *Cret.-Rec.*——FIG. 66, *8a*. *P. (P.) fasciata* CL.-C., U.Eoc., Calif., ×150 (39).

P. (Podocyrtarium) HKL., 1887 [**P. tripodiscus*; SD herein]. Feet divergent; thoracic and abdominal pores nearly similar. *Eoc.-Rec.*——FIG. 66, *8b*. **P. (P.) tripodiscus*, Rec., ×200 (42).

P. (Podocyrtecium) HKL., 1887 [**P. prismatica*; SD herein]. Feet divergent; thoracic and abdominal pores dissimilar. *Eoc.-Rec.*——FIG. 66,*8d*. **P. (P.) prismatica*, Rec., ×200 (42).

P. (Podocyrtonium) HKL., 1887 [**P. pedicellaria*; SD herein]. Feet convergent; thoracic and abdominal pores dissimilar. *Eoc.-Rec.*——FIG. 66,*8c*. **P. (P.) pedicellaria*. Rec., ×150 (42).

Pterocanium EHR., 1847 [**P. proserpinae* EHR., 1858]. Three latticed ribs prolonged into latticed feet, otherwise like *Theopodium*. *Jur.-Rec.*

P. (Pterocanium) [=*Pterocanarium* HKL., 1887 (obj.)]. Abdominal edges concave. *Jur.-Rec.*——FIG. 66,*6*. *P. (P.) gravidum* HKL., Rec., ×200 (42).

P. (Pterocanidium) HKL., 1887 [**P. eucolpum*; SD herein (=*Dictyopodium eucolpum* HKL., 1887)]. Basal abdominal edges convex. *Rec.*

Pterocodon EHR., 1847 [**P. campana* EHR., 1854] [=*Androcyclas* JÖRG., 1905]. Like *Pterocorys* but has numerous terminal feet. *Eoc.-Rec.*——FIG. 67,*11*. *P. ornatus* HKL., Rec., ×200 (42).

Pterocorys HKL., 1882 [**P. campanula* HKL., 1887]. Three solid thoracic wings; without terminal feet. *Eoc.-Rec.*

P. (Pterocorys) [=*Pterocyrtidium* BÜTSCHLI, 1882 (obj.)]. Single apical horn; abdomen not prolonged as a tube. *Eoc.-Rec.*——FIG. 67,*10a*. **P. (P.) campanula*, Rec., ×300 (42).

P. (Pterosyringium) HKL., 1887 [**Pterosyringium tubulosum* HKL., 1887; SD herein]. Single apical horn; abdomen prolonged into a tube. *Rec.*——FIG. 67,*10b*. **P. (P.) tubulosa*, Rec., ×200 (42).

P. (Pterocorythium) HKL., 1887 [**P. rhinoceras*; SD herein]. Two or more apical horns; abdomen not prolonged into tube. *Eoc.-Rec.*

Pteropilium HKL., 1882 [**P. stratiodes* HKL., 1887]. Like *Dictyoceras* but wings not prolonged into cephalis. *Rec.*

P. (Pteropilium) [=*Clathropilium* HKL., 1882 (obj.)]. Thorax completely latticed.——FIG. 67, *9*. **P. (P.) stratiodes*, Rec., ×200 (42).

P. (Arachnopilium) HKL., 1882 [**P. clathrocanium* HKL., 1887]. Thorax with 3 large lateral holes between latticed wings.

Rhopalosyringium C.-CL., 1944 [**R. magnificum*]. Terminal spine at open end of abdomen longer than apical horn. *Cret.*——FIG. 67,*2*. **R. magnificum*, Cret., Calif., ×150 (35).

Theopodium HKL., 1882 [**T. macropus* RÜST, 1885]. Like *Pterocanium* but ribs and feet solid. *Jur.-Rec.*——FIG. 67,*5*. **T. macropus* RÜST, Rec., ×200 (42).

Thyrsocyrtis EHR., 1847 [**T. rhizodon* EHR., 1875]. Like *Podocyrtis* but has branched solid feet. *Eoc.-Rec.*——FIG. 67,*7*. *T. arborescens* HKL., Rec., ×300 (42).

Subfamily THEOPERINAE Haeckel, 1882

[as Theoperida; emend. CAMPBELL, herein]

Basal shell mouth fenestrated. *Jur.-Rec.*

Theopera HKL., 1882 [**Rhopalocanium prismaticum* HKL., 1887]. Three lateral thoracic wings

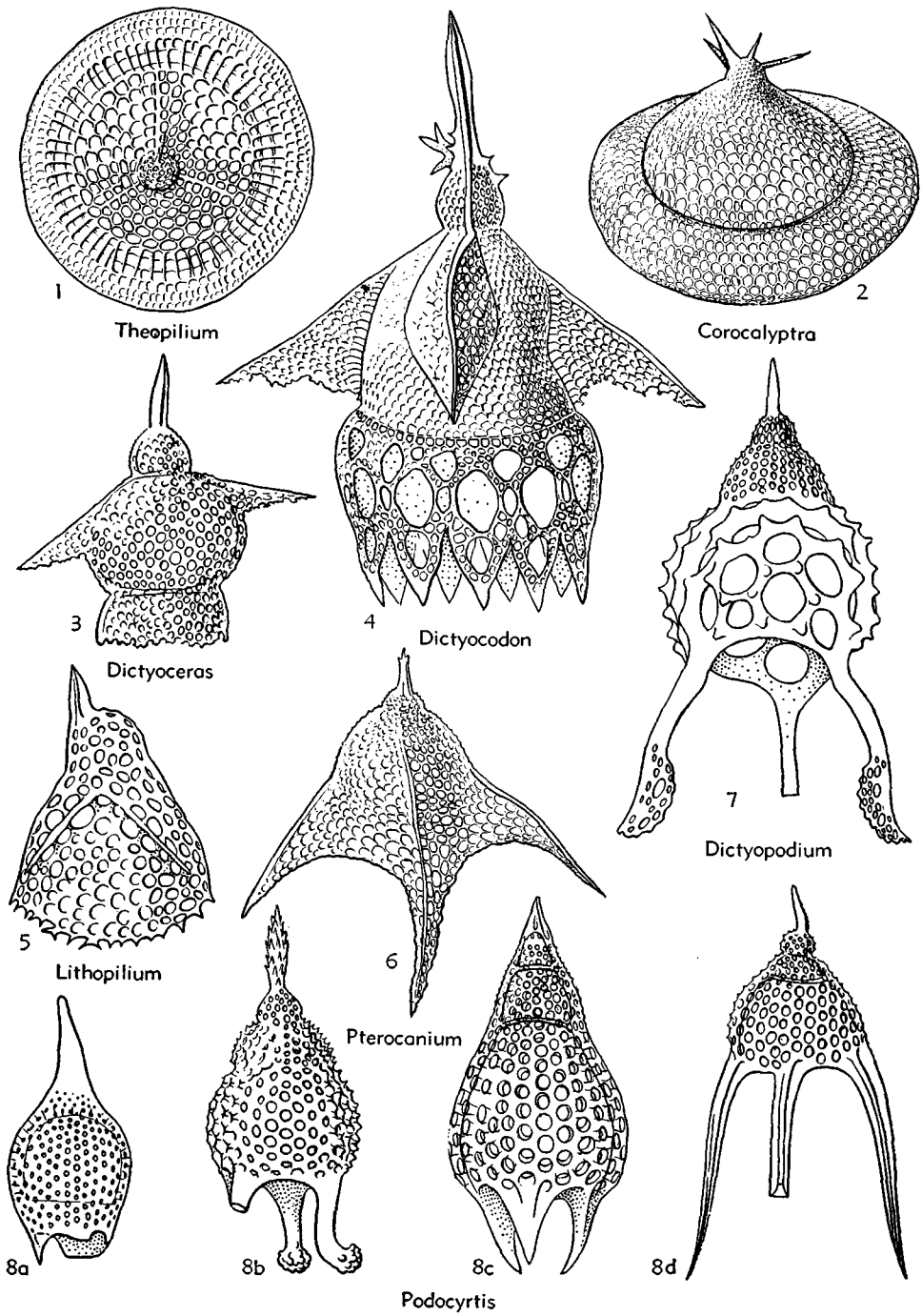

FIG. 66. Theopiliidae (p. D130).

prolonged into abdomen. *Eoc.-Rec.*——Fig. 67,*8*. **T. prismatica* (Hkl.), Rec., ×300 (42).

Lithochytris Ehr., 1847 [**L. vespertilio* Ehr., 1875]. Stout regular tetrahedral shell with external apophysis at each of 3 basal corners; with apical horn. *Jur.-Rec.*

L. (Lithochytris) [=*Lithochytridium* Hkl., 1887 (obj.)]. Apophyses latticed. *Eoc.-Rec.*——Fig. 67,*3b*. *L. (L.) cheopsis* Cl.-C., U.Eoc., Calif., ×150 (39).

L. (Lithochytrodes) Hkl., 1887 [**L. pyriformis;* SD herein]. Apophyses solid. *Jur.-Rec.*——Fig. 67,*3a*. **L. (L.) pyriformis,* Rec., ×300 (42).

Lithornithium Ehr., 1847 [**Lithocampe hirundo* Ehr., 1844]. Three solid lateral wings on thorax. *Jur.-Rec.*——Fig. 67,*1*. *L. falco* Hkl., Rec., ×300 (42).

Rhopalatractus Hkl., 1882 [**R. pentacanthus* Hkl., 1887][=*Dictyatractus* Hkl., 1882 (obj.)]. Fenestrated basal pole of shell with spine, otherwise like *Rhopalocanium*. *Rec.*——Fig. 67,*6*. *R. fenestratus* Hkl., Rec., ×150 (42).

Rhopalocanium Ehr., 1847 [**R. ornatum* Ehr., 1854]. Three lateral wings on conical abdomen; without basal spine. *Eoc.-Rec.*——Fig. 67,*4*. *R. lasanum* Hkl., Rec., ×200 (42).

Sethornithium Hkl., 1882 [**S. dictyopterum* Hkl., 1887]. Like *Lithornithium* but has latticed wings. *Rec.*

Family THEOPHORMIDIDAE Haeckel, 1887

[as Theophormida; emend. Campbell, herein] [=Phormocyrtida Hkl., 1887; Lamprocycladidae Haecker, 1908 *(partim)*]

Four to 9 or more radial apophyses. *Jur.-Rec.*

Subfamily THEOPHORMIDINAE Haeckel, 1882

[as Theophormida *(partim)*; emend. Campbell, herein]

Basal shell mouth open. *Jur.-Rec.*

Theophormis Hkl., 1882 [**T. callipilium* Hkl., 1887]. Flat dilated abdomen with wide open mouth and numerous radial ribs. *Cret.-Rec.*——Fig. 68,*2*. **T. callipilium,* Rec., ×150 (42).

Calocyclas Ehr., 1847 [**C. turris* Ehr., 1875]. Like *Clathrocyclas* but has cylindrical or ovate, not dilated abdomen. *Cret.-Rec.*

C. (Calocyclas) [=*Calocyclissa* Hkl., 1887 (obj.)]. Thorax spiny or thorny; abdomen smooth. *Cret.-Rec.*——Fig. 68,*1b*. *C. (C.) advena* Cl.-C., U.Eoc., Calif., ×150 (39).

C. (Calocycletta) Hkl., 1887 [**C. veneris;* SD herein]. Thorax and abdomen smooth. *Eoc.-Rec.*——Fig. 68,*1c*. *C. (C.) semipolita* Cl.-C., U.Eoc., Calif., ×150 (39).

C. (Calocycloma) Hkl., 1887 [**C. casta;* SD herein]. Thorax smooth; abdomen spiny or thorny. *Rec.*——Fig. 68,*1a*. **C. (C.) casta,* Rec., ×200 (42).

C. (Calocyclura) Hkl., 1887 [**C. monumentum;* SD herein][=*Calocycloma* Hkl., 1887 (obj.); *Calompterium* Cl.-C., 1942 (obj.)]. Thorax and abdomen spiny or thorny. *Eoc.-Rec.*——Fig. 68, *1d*. **C. (C.) monumentum,* Rec., ×200 (42).

Clathrocyclas Hkl., 1882 [**C. principessa* Hkl., 1887]. Lacks radial ribs; single terminal corona of feet; abdomen dilated, truncate, conical or discoidal. *Jur.-Rec.*

C. (Clathrocyclas) [=*Clathrocyclia* Hkl., 1887 (obj.)]. Conical shell with single apical horn. *Jur.-Rec.*

C. (Clathrocycloma) Hkl., 1887 [**C. alcmenae;* SD herein]. Flattened shell; cephalis with 2 or more horns. *Mio.-Rec.*——Fig. 68,*3*. *C. (C.) cabrilloensis* C.-Cl., Mio., Calif., ×150 (35).

Cryptoprora Ehr., 1860 [**C. fundicola*][=*Alacorys* Hkl., 1887 (obj.)]. Ribs limited to abdomen but continued as free feet. *Eoc.-Rec.*

C. (Cryptoprora) [=*Polyalacorys* Hkl., 1887 (obj.)]. Feet 10 to 20 or more. *Eoc.-Rec.*

C. (Ennealacorys) Hkl., 1887 [**Alacorys enneacantha;* SD herein]. Nine feet. *Eoc.-Rec.*

C. (Hexalacorys) Hkl., 1882 [**Alacorys friderici* Hkl., 1887]. Six feet. *Eoc.-Rec.*——Fig. 68,*7*. **C. (H.) friderici* (Hkl.), Rec., ×200 (42).

C. (Octalacorys) Hkl., 1887 [**Podocyrtis aculeata* Ehr., 1875]. Eight feet. *Eoc.-Rec.*

C. (Pentalacorys) Hkl., 1882 [**Podocyrtis pentacantha* Ehr., 1875]. Five feet. *Eoc.-Rec.*

C. (Tetralacorys) Hkl., 1882 [**Alacorys lutheri* Hkl., 1887]. Four feet. *Eoc.-Rec.*

Cycladophora Ehr., 1847 [**C. stiligera* Ehr., 1875] [=*Lanterna* Hkl., 1887 (obj.)]. Like *Cryptoprora* but lacks terminal feet. *Eoc.-Rec.*

C. (Cycladophora) [=*Cyclamptidium* Hkl., 1887 (obj.)]. Abdomen nearly cylindrical or prismatic; 10 to 20 strong straight, vertical, parallel ribs; mouth wide open. *Eoc.-Rec.*

C. (Cyclampterium) Hkl., 1887 [**C. pantheon;* SD herein]. Abdomen bell-shaped with 10 to 20 or more ribs and wide open mouth. *Eoc.-Rec.*

C. (Lampterium) Hkl., 1882 [**C. goetheana* Hkl., 1887]. Abdomen with 4 ribs, opposite in 2 pairs. *Rec.*——Fig. 68,*8*. **C. (L.) goetheana,* Rec., ×200 (42).

C. (Lamptidium) Hkl., 1887 [**C. hexapleura;* SD herein]. Abdomen with 6 ribs. *Eoc.-Rec.*

C. (Lamptonium) Hkl., 1887 [**C. enneapleura;* SD herein]. Abdomen with 9 ribs. *Rec.*

Diplocyclas Hkl., 1882 [**D. bicorona* Hkl., 1887]. Has one corona of teeth between thorax and abdomen and a second corona around mouth of abdomen. *Rec.*——Fig. 68,*6*. **D. bicorona,* Rec., ×300 (42).

Lamprocyclas Hkl., 1882 [**L. nuptialis* Hkl., 1887]. Like *Diplocyclas* but both coronas of teeth are terminal. *Rec.*

L. (Lamprocyclas) [=*Lamprocyclia* Hkl., 1887 (obj.)]. Feet of both coronas unbranched.——

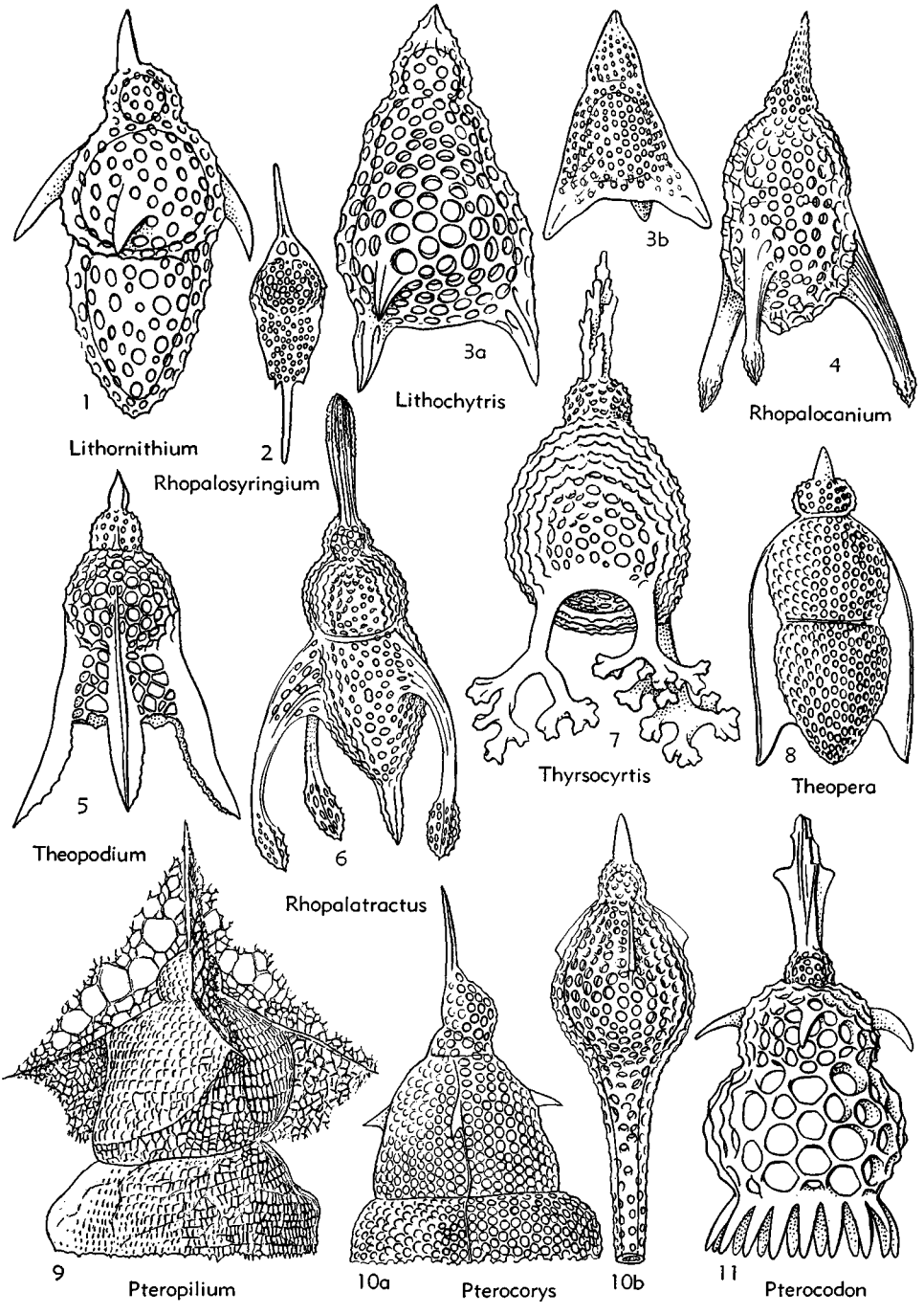

FIG. 67. Theopiliidae (p. D130-D132).

FIG. 68,*4*. **L. (L.) nuptialis*, Rec., ×200 (42).

L. (Lamprocycloma) HKL., 1887 [**L. bajaderae*]. Feet branched or forked.

Phormocyrtis HKL., 1887 [**Theocorys longicornis* HKL., 1887; SD herein]. Like *Theophormis* but has ovate or cylindrical abdomen and constricted mouth. *Jur.-Rec.*——FIG. 68,*5*. **P. longicornis* (HKL.), Rec., ×200 (42).

Subfamily THEOPHATNINAE Haeckel, 1882

[as Theophatnida; emend. CAMPBELL, herein]
[=Theophaenida HKL., 1887]

Basal shell mouth fenestrated. *Rec.*

Theophatna HKL., 1882 [**Theophaena corona* HKL., 1887][=*Theophaena* HKL., 1887 (obj.), *non* HKL., 1882]. Nine lateral abdominal wings. ——FIG. 69,*1*. **T. corona* (HKL.), Rec., ×150 (42).

Hexalodus HAECKER, 1908 [**H. dendrophorus*]. Six teeth on abdomen.——FIG. 69,*3*. **H. dendrophorus*]. Six teeth on abdomen.——FIG. 69,*3*. **H. dendrophorus*, Rec., ×200 (43).

Theophaena HKL., 1882 [*non* HKL., 1887][**Hexalatractus sexalatus* HKL., 1887][=*Hexalatractus* HKL., 1887 (obj.)]. Six lateral abdominal wings. ——FIG. 69,*2*. *T. fusiformis* (HKL.), Rec., ×200 (42).

Family THEOCORYTHIDAE Haeckel, 1882

[as Theocorida; emend. CAMPBELL, herein]
[=Theocyrtida HKL., 1887; Theocoridae FRIZZELL, 1951]

Without basal apophyses. *Cam.-Rec.*

Subfamily THEOCORYTHINAE Haeckel, 1882

[as Theocorida *(partim)*; emend. CAMPBELL, herein]

Basal shell mouth open. *Cam.-Rec.*

Theocorys HKL., 1882 [**T. morchellula* RÜST, 1885]. Swollen abdomen ovate; mouth constricted; cephalis with single apical horn. *Cret.-Rec.*

T. (Theocorys) [=*Theocoronium* HKL., 1887 (obj.)]. Thoracic and abdominal pores similar. *Cret.-Rec.*——FIG. 69,*5*. *T. (T.) adamsi* CL.-C., Mio., Calif., ×200 (39).

T. (Theocorythium) HKL., 1887 [**T. dianae*; SD herein]. Thoracic and abdominal pores dissimilar. *Eoc.-Rec.*

Axocorys HKL., 1882 [**A. macroceros* HKL., 1887]. Like *Theocorys* but has internal axial columella. *Jur.-Rec.*——FIG. 69,*17*. **A. macroceros*, Rec., ×200 (42).

Cecryphalium HKL., 1882 [**C. lamprodiscus* HKL., 1887]. Like *Theocalyptra* but lacks apical horn. *Perm.-Rec.*——FIG. 69,*16*. **C. lamprodiscus*, Rec., ×200 (42).

Lophoconus HKL., 1887 [**Eucyrtidium antilope* EHR., 1872; SD FRIZZELL, 1951]. Abdomen conical; with 2 or more apical horns. *Paleoc.-Rec.*——FIG. 69,*4*. *L. titanothericeraos* CL.-C., U.Eoc., Calif., ×200 (39).

Lophocorys HKL., 1882 [**L. cribosa* RÜST, 1885]. Like *Theocorys* but has 2 apical horns or a bunch of horns. *Jur.-Rec.*——FIG. 69,*11*. *L. astrocephalia* HKL., Rec., ×200 (42).

Lophocyrtis HKL., 1887 [**Eucyrtidium stephanophorum* EHR., 1875; SD herein]. Like *Theocyrtis* but has 2 apical horns, or a bunch of cephalic horns. *Jur.-Rec.*

Theocalyptra HKL., 1882 [**T. veneris* HKL., 1887]. Abdomen discoidal; with one or 2 apical horns. *Cret.-Rec.*

Theocampe HKL., 1887 [**Dictyomitra ehrenbergii* ZITTEL, 1876; SD herein]. Like *Theocorys* but without apical horn. *Cam.-Rec.*

T. (Theocampe) [=*Theocampula* HKL., 1887 (obj.)]. Thoracic and abdominal pores similar. *Cam.-Rec.*——FIG. 69,*6*. *T. (T.) stenostoma* HKL., Rec., ×200 (42).

T. (Theocamptra) HKL., 1887 [**T. collaris*; SD herein]. Thoracic and abdominal pores dissimilar. *Eoc.-Rec.*

Theoconus HKL., 1887 [**Eucyrtidium zancleum* MÜLLER, 1858; SD herein]. Like *Lophocorys* but has single apical horn. *Cret.-Rec.*

T. (Theoconus) [=*Theocorax* HKL., 1887 (obj.)]. Thoracic and abdominal pores similar. *Cret.-Rec.*

T. (Theocorbis) HKL., 1887 [**T. jovis*; SD herein]. Thoracic and abdominal pores dissimilar. *Eoc.-Rec.*——FIG. 69,*10*. **T. (T.) jovis*, Rec., ×200 (42).

Theocyrtis HKL., 1887 [**Eucyrtidium barbadense* EHR., 1875; SD herein]. Cylindrical abdomen; thorax and abdomen of nearly similar breadth; with single apical horn. *Cret.-Rec.*

T. (Theocyrtis) [=*Theocorypha* HKL., 1887 (obj.)]. Thoracic and abdominal pores similar. *Cret.-Rec.*

T. (Theocorusa) HKL., 1887 [**T. macroceros*; SD herein]. Thoracic and abdominal pores dissimilar. *Eoc.-Rec.*——FIG. 69,*15*. **T. (T.) macroceros*, Rec., ×200 (42).

Tricolocampe HKL., 1882 [**T. clypsydra* RÜST, 1885]. Abdomen cylindrical; without apical horn. *Jur.-Rec.*

T. (Tricolocampe) [=*Tricolocampium* HKL., 1887 (obj.)]. Thoracic and abdominal pores similar. *Jur.-Rec.*——FIG. 69,*7*. *T. (T.) cylindrica* HKL., Rec., ×200 (42).

T. (Tricolocamptra) HKL., 1887 [**T. urnula*; SD herein]. Thoracic and abdominal pores dissimilar. *Eoc.-Rec.*

Urocyrtis PANTANELLI, 1880 [**U. amaliae*; SD herein] [=*Theosyringium* HKL., 1882 (obj.)]. Slender tubular abdomen; inflated thorax; with single apical horn. *Jur.-Rec.*——FIG. 69,*9*. *U. tibia* (HKL.), Rec., ×200 (42).

Subfamily THEOCAPSINAE Haeckel, 1882
[as Theocapsida; emend. Campbell, herein]

Basal shell mouth fenestrated. *Dev.-Rec.*

Theocapsa Hkl., 1882 [**T. gratiosa* Rüst, 1885]. Without latticed septum between thorax and abdomen; with single apical horn. *Dev.-Rec.*

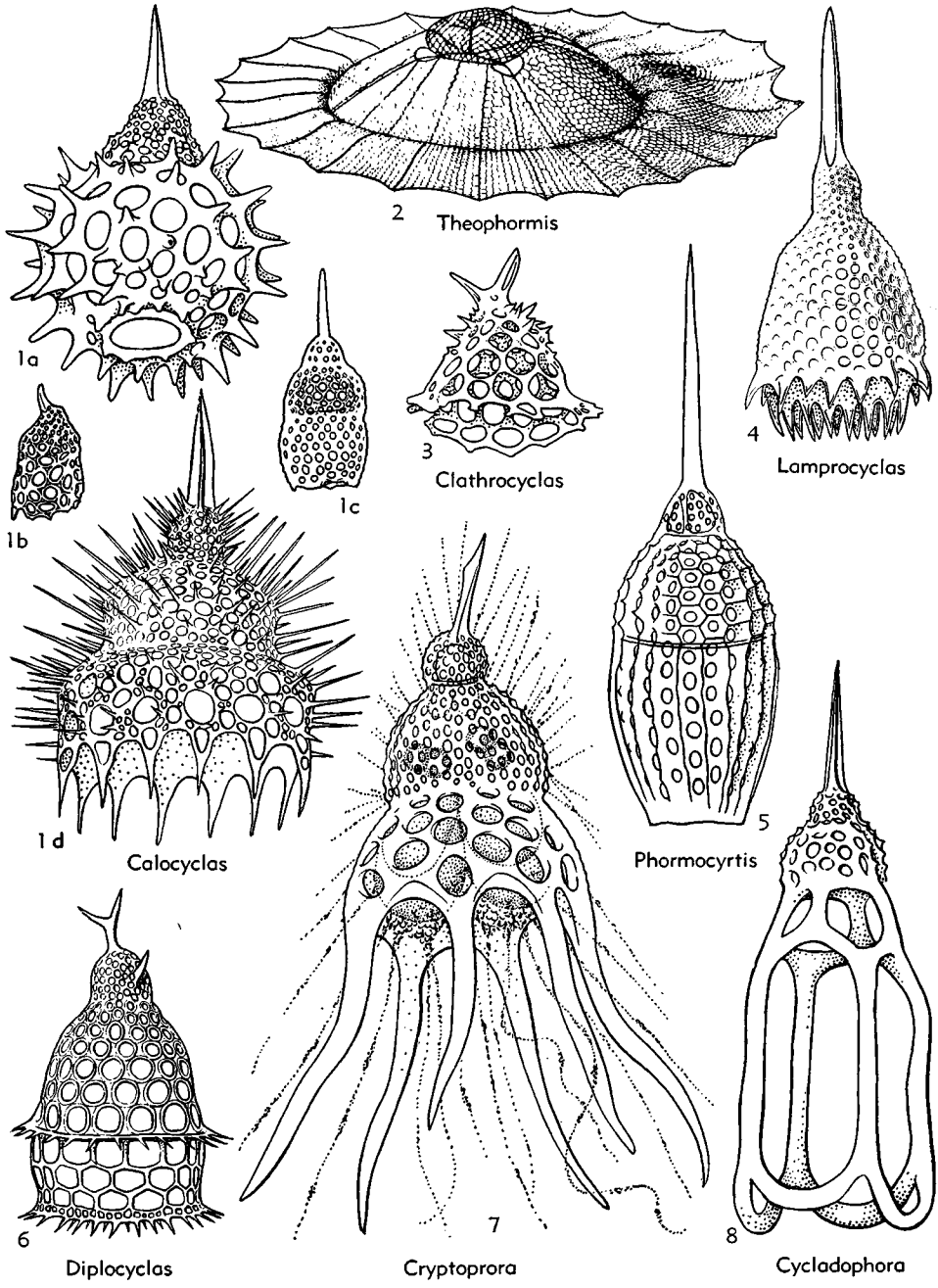

Fig. 68. Theophormididae (p. D132-D134).

T. (Theocapsa) [=*Theocapsetta* HKL., 1887 (obj.)]. Thorax and abdomen of nearly the same size; thoracic and abdominal pores similar. *Jur.-Rec.*——FIG. 69,*18*. *T. (T.) aristotelis* HKL., Rec., ×200 (42).

T. (Theocapsilla) HKL., 1887 [**T. wottonis;* SD herein]. Thorax and abdomen of about the same size; thoracic and abdominal pores dissimilar. *Rec.*

T. (Theocapsomma) HKL., 1887 [**T. linnaei;* SD herein]. Thorax much smaller than abdomen; thoracic and abdominal pores similar. *Rec.*

T. (Theocapsura) HKL., 1887 [**T. lamarckii;* SD herein]. Thorax much smaller than abdomen; thoracic and abdominal pores dissimilar. *Eoc.-Rec.*

Distylocapsa SQUIN., 1904 [**D. nova;* SD herein]. Single abdominal spine and 2 unequal apical horns. *Cret.*——FIG. 69,*13*. **D. nova,* Cret., Italy, ×133 (52).

Hemicryptocapsa TAN, 1927 [**H. capita*]. Cephalis hidden within thorax; with single apical horn. *Pre-Cret.*——FIG. 69,*12*. *H. pilula* (HINDE) Tan, Pre-Cret., Borneo, ×200 (43).

Holocryptocapsa TAN, 1927 [**H. fallax*]. Like *Hemicryptocapsa* but without apical horn. *Trias.-Plio.*

Phrenocodon HKL., 1887 [**P. clathrostomium;* SD herein]. Like *Theocapsa* but has lattice plate between thorax and abdomen. *Rec.*——FIG. 69,*8*. **P. clathrostomium,* Rec., ×300 (42).

Stylocryptocapsa TAN, 1927 [**S. verbeeki*]. Both cephalis and thorax hidden within abdomen; with apical horn. *U.Cret.-Plio.,* E.Indies.

Tricolocapsa HKL., 1887 [**T. theophrasti;* SD herein]. Like *Theocapsa* but lacks apical horn. *Jur.-Rec.*

T. (Tricolocapsa) [=*Tricolocapsula* HKL., 1887 (obj.)]. Thorax as large as abdomen or larger. *Jur.-Rec.*

T. (Tricolocapsium) HKL., 1887 [**T. schleidenii;* SD herein]. Thorax much smaller than abdomen. *Cret.-Rec.*——FIG. 69,*14*. *T. (T.) granti* C.-CL., Cret., Calif., ×150 (35).

Subsuperfamily TRIACARTILAE Campbell, nom. nov.

[*pro* Stichopilida HKL., 1882]
[=Tetracyrtida, Stichocyrtida, HKL., 1882]

Shell divided by 3 or more strictures into cephalis, thorax, abdomen, and post-abdominal segments. *Ord.-Rec.*

Family TRIACARTIDAE Campbell, nom. nov.

[*pro* Stichopilida HKL., 1882]
[=Podocampida HKL., 1887; Stichopiliidae FRIZZELL, 1951]

Three radial apophyses. *Perm.-Rec.*

Subfamily TRIACARTINAE Campbell, nom. nov.

[*pro* Stichopilida HKL., 1882 *(partim)*]
[=Stichopiliinae FRIZZELL, 1851]

Basal shell mouth open. *Perm.-Rec.*

Triacartus HKL., 1882 [**Stichopilium cortina* HKL., 1887][=*Stichopilium* HKL., 1882 (obj.)]. Three solid lateral ribs or wings; without basal feet; with apical horn. *Cret.-Rec.*

T. (Triacartus). Shell with 2 annular strictures. *Eoc.-Rec.*——FIG. 70,*1a*. *T. (T.) bicornis* HKL., Rec., ×300 (42).

T. (Stichopilidium) HKL., 1887 [**Stichopilium macropterum* HKL., 1887; SD herein (=*Rhopalocanium varietas* HKL., 1887, obj.)]. Shell with 4 or more annular strictures. *Cret.-Rec.*——FIG. 70,*1b*, *T. (S.) teslaensis* C.-CL., U.-Cret., Calif., ×120 (35).

Podocampe HKL., 1882 [**P. tripodiscus* HKL., 1887]. Three solid basal feet; without lateral ribs or wings; with apical horn. *Rec.*——FIG. 70,*2*. *P. trictenota* HKL., Rec., ×200 (42).

Pteropilium HKL., 1887 [**Pterocanium sphinx* EHR., 1875]. Like *Triacartus* but lacks apical horn. *Rec.*

Stichocampe HKL., 1882 [**S. divergens* HKL., 1887]. Three solid radial ribs or wings prolonged as solid basal feet; with apical horn. *Rec.*

Stichopodium HKL., 1882 [**S. dictyopodium* HKL., 1887]. Like *Podocampe* but has 3 latticed basal feet. *Rec.*——FIG. 70,*3*. **S. dictyopodium,* Rec., ×300 (42).

Stichopterium HKL., 1882 [**S. pterocanium* HKL., 1887]. Like *Stichocampe* has 3 latticed feet. *Rec.*

Trictenartus HKL., 1882 [**Artopilium elegans* HKL., 1887][=*Artopilium* (obj.), *Pterocorythium* (obj.) HKL., 1882]. Like *Triacartus* but has latticed lateral ribs or wings. *Rec.*

T. (Trictenartus). Shell with 3 annular strictures. ——FIG. 70,*4b*. *T. (T.) longicornis* HKL., Rec., ×300 (42).

T. (Stichopterygium) HKL., 1882 [**Artopilium trifenestra* HKL., 1887 (=*Clathropyrgus trifenestra* HKL., 1887)][=*Clathropyrgus* HKL., 1882 (obj.)]. Shell with 4 or more annular strictures. ——FIG. 70,*4a*. **T. (S.) trifenestra,* Rec., ×300 (42).

Subfamily STICHOPERINAE Haeckel, 1882

[as Stichoperida; emend. CAMPBELL, herein]

Basal shell mouth fenestrated. *Perm.-Rec.*

Stichopera HKL., 1882 [**S. ovata* HKL., 1887]. Three solid lateral ribs or 3 lateral rows of spiny combs; with apical horn. *Perm.-Rec.*

S. (Stichopera) [=*Stichoperina* HKL., 1887 (obj.)]. Three solid lateral ribs or longitudinal rows of dentate crests. *Perm.-Rec.*

S. (Sticholagena) HKL., 1887 [**S. pectinata;* SD herein]. Three radial spiny combs or longitud-

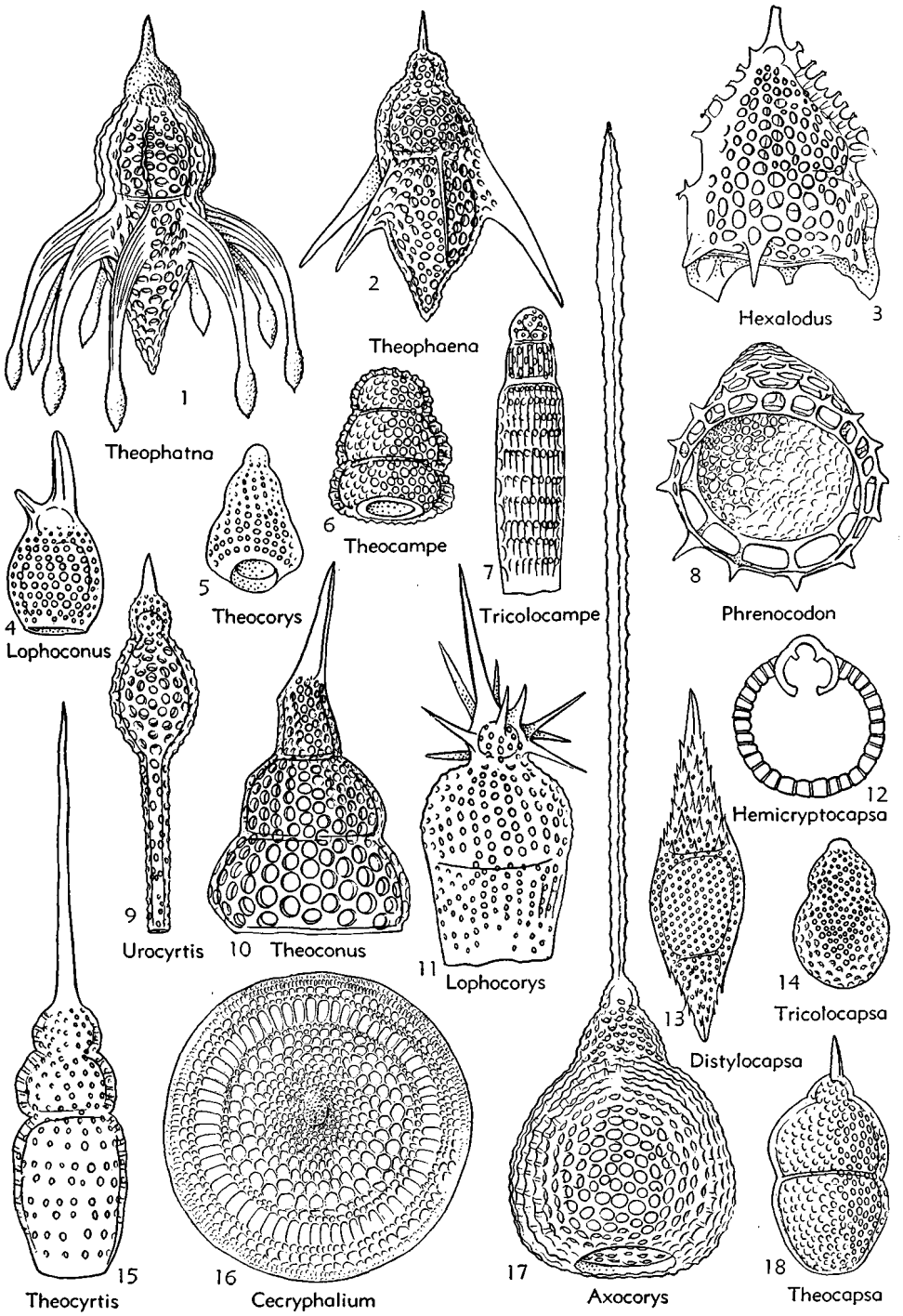

FIG. 69. Theophormididae, Theocorythidae (p. D134-D136).

inal rows of isolated spines. *Rec.*——Fig. 70,6. **S. (S.) pectinata,* Rec., ×300 (42).

Artoperina Campbell, 1951 [*pro Artopera* Hkl., 1887 (*non* 1882)][**Lithornithium loxia* Ehr., 1854]. Like *Stichopera* but has vertical spine on abdomen. *Eoc.-Rec.*——Fig. 70,7. **A. loxia* (Ehr.), U.Eoc., Barbados, ×200 (41).

Cytopera Hkl., 1882 [**C. thoracoptera* Hkl., 1887]. Like *Stichopera* but has latticed ribs or wings. *Rec.*

C. (Cyrtopera) [=*Artopera* Hkl., 1882 (*non* 1887)]. Three annular strictures.——Fig. 70,5. **C. (C.) thoracoptera,* Rec., ×200 (42).

C. (Cyrtolagena) Hkl., 1887 [*non* 1879] [**C. laguncula* Hkl., 1887]. Four or more annular strictures.

Family ARTOPHORMIDIDAE Haeckel, 1882

[as Artophormida; emend. Campbell, herein] [=Artophaenida Hkl., 1882; Phormocampida Hkl., 1887]

Four to 9 or more radial apophyses. *Jur.-Rec.*

Subfamily ARTOPHORMIDINAE Haeckel, 1882

[as Artophormida *(partim);* emend. Campbell, herein] [=Stichophormida Hkl., 1882]

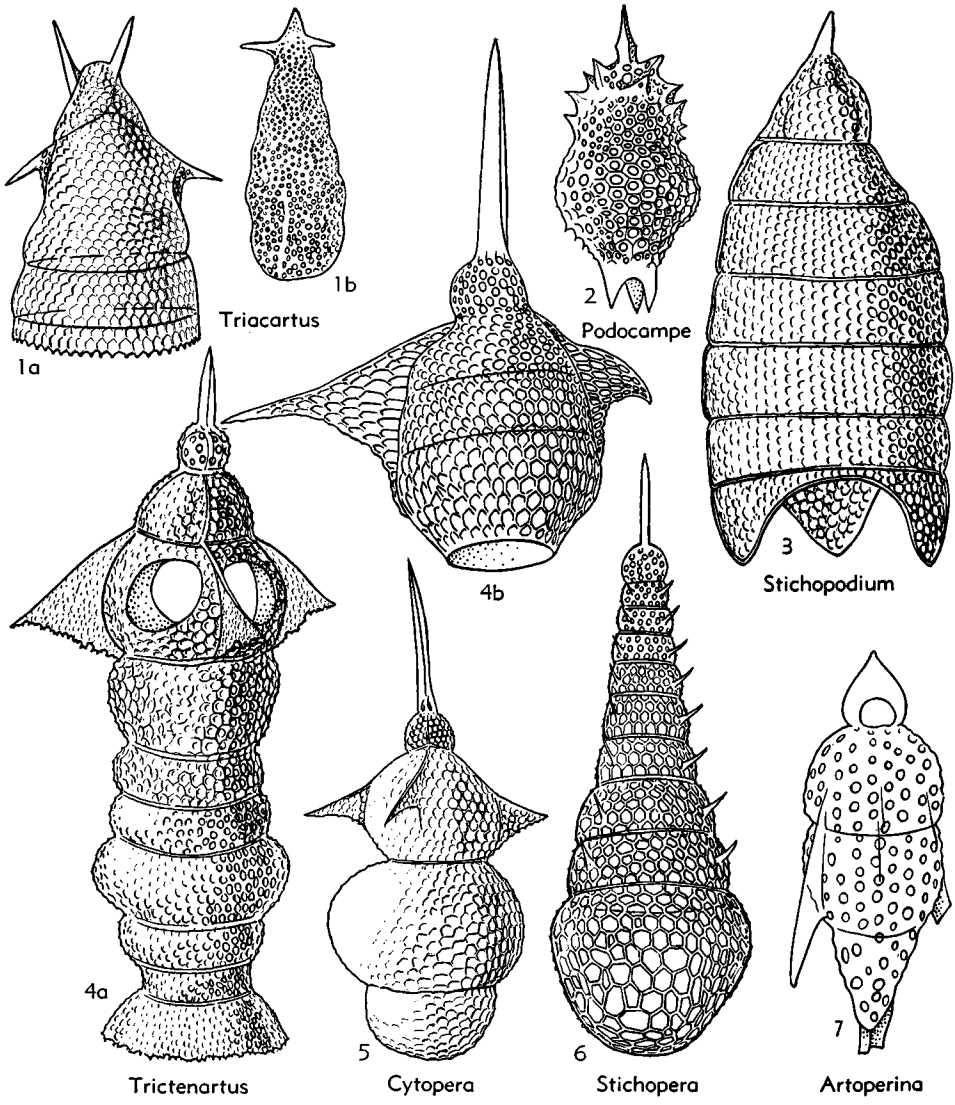

Fig. 70. Triacartidae (p. D136-D138).

Basal shell mouth open. *Jur.-Rec.*

Artophormis HKL., 1882 [**A. horrida* HKL., 1887]. Oval or spindle-shaped shell; radial ribs prolonged into feet; mouth constricted. *Rec.*——FIG. 71,*1*. **A. horrida*, Rec., ×200 (42).

Anthocorys HKL., 1882 [**A. regularis* RÜST, 1885] [=*Phormocampe* HKL., 1887 (obj.)]. Conical or pyramidal shell; without lateral ribs; with corona of feet. *Jur.-Rec.*

A. (Anthocorys). Three annular strictures. *Jur.-Rec.*——FIG. 71,*3*. *A. (A.) campanula*, Rec., ×300 (42).

A. (Cyrtocorys) HKL., 1882 [**Phormocampe mitra* HKL., 1887]. Four or more annular strictures. *Rec.*

Cyrtophormis HKL., 1887 [*non Cystophormis* HKL., 1887][**C. armata*; SD herein]. Like *Artophormis* but lacks lateral ribs. *Cret.-Rec.*

C. (Cyrtophormis) [=*Cyrtophormium* HKL., 1887 (obj.)]. Six (5 to 7) feet. *Cret.-Rec.*——FIG. 71,*7a*. **C. (C.) armata*, Rec. ×300 (42).

C. (Cyrtophormiscus) HKL., 1887 [**C. cingulata*, SD herein]. Nine (8 to 10) feet. *Eoc.-Rec.*——FIG. 71,*7b*. **C. (C.) cingulata*, Rec., ×300 (42).

C. (Phormostichoartus) CAMPBELL, 1951 [*pro Acanthocyrtis* HKL., 1887 (*non* 1882)][**C. cylindrica* HKL., 1887]. Feet 12 to 20 or more. *Cret.-Rec.*——FIG. 71,*7c*. *C. (P.) grandis* C.-CL., Cret., Calif., ×100 (35).

Stichophormis HKL., 1882 [**S. pyramidalis* HKL.,

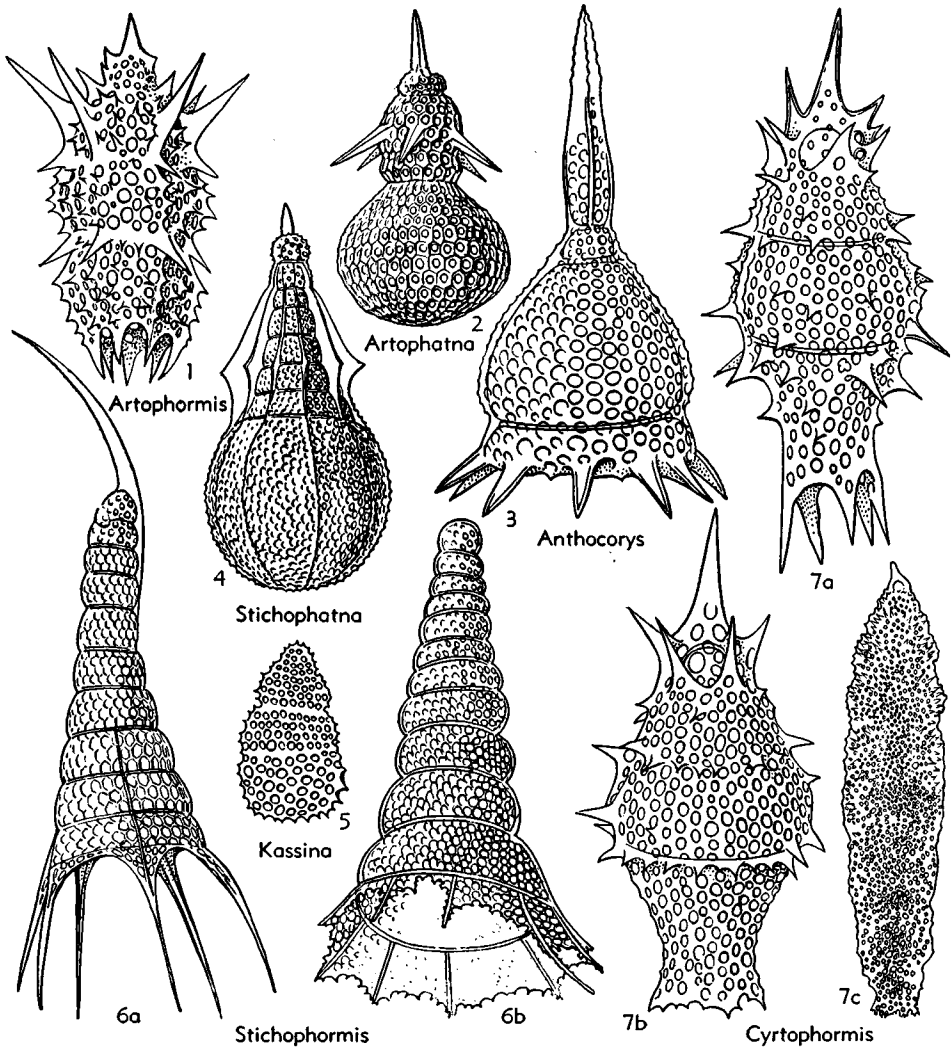

FIG. 71. Artophormididae (p. D139, D140).

1887]. Like *Anthocorys* but lateral ribs are prolonged into feet. *Jur.-Rec.*

S. (Stichophormis) [=*Stichophormium* HKL., 1887 (obj.)]. Six prominent ribs. *Jur.-Rec.*——FIG. 71,*6a. S. (S.) cornutella* HKL., Rec., ×300 (42).

S. (Stichophormiscus) HKL., 1887 [**S. novena*; SD herein]. Nine prominent ribs. *Rec.*——FIG. 71, *6b. *S. (S.) novena,* Rec., ×300 (42).

Subfamily STICHOPHATNINAE Haeckel, 1882

[as Stichophatnida; emend. CAMPBELL, herein] [=Stichophaenida HKL., 1887]

Basal shell mouth fenestrated. *Cret.-Rec.*

Stichophatna HKL., 1882 [**Stichophaena ritteriana* HKL., 1887][=*Stichophaena* HKL., 1887 (obj.)]. Nine prominent ribs or wings. *Rec.*

S. (Stichophatna) [=*Stichophaenidium* HKL., 1887 (obj.)]. Last joint rounded; without basal spine.——FIG. 71,*4. *S. (S.) ritteriana,* Rec., ×200 (42).

S. (Stichophaenoma) HKL., 1887 [**Stichophaena nonaria;* SD herein]. Last joint pointed; with basal spine.

Artophatna HKL., 1882 [**Arthophaena aerostatica* HKL., 1887][=*Artophaena* HKL., 1887 (obj.)]. Six radial ribs or wings. *Rec.*——FIG. 71,*2. *A. aerostatica,* Rec., ×200 (42).

Kassina CHABAKOV, 1937 [**K. kassini*]. Tower-shaped shell; with 3 to 5 or more chambers. *Cret.*——FIG. 71,*5. *K. kassini,* Cret., Russ., ×130 (38).

Tetracapsa HKL., 1882 [**T. pilula* RÜST, 1885]. Three lateral ribs. *Jur.*

Family STICHOCORYTHIDAE Haeckel, 1882

[as Stichocorida; emend. CAMPBELL, herein] [=Lithocampida HKL., 1887; Stichocoridae FRIZZELL, 1951]

With radial apophyses. *Ord.-Rec.*

Subfamily STICHOCORYTHINAE Haeckel, 1882

[as Stichocorida *(partim);* emend. CAMPBELL, herein] [=Artocorida HKL., 1882; Stichocorinae FRIZZELL, 1951]

Basal shell mouth open. *Ord.-Rec.*

Stichocorys HKL., 1882 [**S. wolffi* HKL., 1887]. Shell constricted in middle; upper 0.5 conical, lower 0.5 cylindrical; mouth truncate; cephalis with apical horn. *Trias.-Rec.*——FIG. 72,*1. *S. wolffi,* Rec., ×300 (42).

Acotripus HKL., 1882 [**A. urceolus* RÜST, 1885]. Small superior joints annular; without apical horn; 3 prolongations of last joint. *Jur.*

Artostrobus HKL., 1887 [**Cornutella annulata* BAILEY, 1856]. Shell cylindrical; rounded cephalis with apical horn; mouth truncated. *Eoc.-Rec.*

A. (Artostrobus) [=*Artostrobulus* HKL., 1887 (obj.)]. Single transverse row of small round pores on each joint. *Eoc.-Rec.*

A. (Artostrobium) HKL., 1887 [**A. auritus;* SD herein]. Several rows of small pores on each joint. *Eoc.-Rec.*——FIG. 72,*3. A. (A.) articulatus* HKL., Rec., ×300 (42).

Dictyomitra ZITTEL, 1876 [**D. multicostata;* SD herein][=*Polysticha* PANTANELLI, 1880 (obj.); *Stichomitra* CAYEUX, 1897; *Poramphora* JÖRG., 1905; *Lithocorys* ICHIKAWA, 1950]. Shell conical; without apical horn. *Dev.-Rec.*

D. (Dictyomitra) [=*Dictyomitroma* HKL., 1887 (obj.)]. Shell with longitudinal ribs and furrows; joints of dissimilar length. *Dev.-Rec.*——FIG. 72,*2. *D. (D.) multicostata,* U.Cret., Calif., ×150 (35).

D. (Dictyomitrella) HKL., 1887 [**Eucyrtidium articulatum* EHR., 1875; SD herein]. Smooth shell; joints of nearly similar length. *Eoc.-Rec.*

D. (Dictyomitrissa) HKL., 1887 [**D. polypora* ZITTEL, 1876; SD herein]. Shell smooth; joints of dissimilar length. *Cret.-Rec.*

Diplostrobus SQUIN., 1903 [**D. crassispina*]. Tubular post-abdomen has narrow mouth; 5 chambers form upper conical part of shell; with apical horn. *Cret.*——FIG. 72,*5. *D. crassispina,* Cret., Italy, ×80 (52).

Eucyrtidium EHR., 1847 [**Lithocampe acuminata* EHR., 1844; SD FRIZZELL, 1951]. Like *Lithocampe* but has solid apical horn. *Jur.-Rec.*

E. (Eucyrtidium) [=*Eucyrtis* HKL., 1882 (obj.)]. All joints of nearly similar length. *Jur.-Rec.*——FIG. 72,*7a. E. (E.) hexagonatum* HKL., Rec. ×300 (42).

E. (Acanthocyrtis) HKL., 1882 [*non* 1887][**E. tricinctum* HKL., 1887]. Joints of dissimilar length; surface spiny. *Rec.*——FIG. 72,*7b. E. (A.) armatum* HKL., Rec., ×200 (42).

E. (Artocyrtis) HKL., 1887 [**E. profundissimum* EHR., 1872; SD herein]. Joints of dissimilar length; surface smooth. *Paleoc.-Rec.*——FIG. 72, *7c. E. (A.) hertwigi* HKL., Rec., ×300 (42).

E. (Stichocyrtis) HKL., 1882 [**E. spinosum* HKL., 1887]. Joints of nearly similar length; surface spiny. *Rec.*

Eusyringium HKL., 1882 [**E. conosiphon* HKL., 1887]. Like *Eucyrtidium* but last shell joint is a long narrow cylinder. *Trias.-Rec.*

E. (Eusyringium) [=*Eusyringartus* HKL., 1887 (obj.)]. Shell with 3 strictures. *Trias.-Rec.*——72,*8a. E. (E.) conosiphon,* Rec., ×200 (42).

E. (Eusyringoma) HKL., 1887 [**E. lagenoides* STÖHR, 1880; SD FRIZZELL, 1951]. Shell has 4 or more strictures. *Paleoc.-Rec.*——FIG. 72,*8b. E. (E.) siphonostoma* HKL., Rec., ×300 (42).

Lithamphora POP., 1909 [**L. furcaspiculata*]. Internal radial beams connect apical horn but are not extended as apophyses; mouth open (?). *Rec.*——FIG. 72,*4. *L. furcaspiculata,* Rec., ×300 (48).

Lithocampe EHR., 1838 [**L. radicula;* SD herein]. Ovate or spindle-shaped shell; with constricted but not tubular mouth; cephalis without apical horn. *Ord.-Rec.*

L. (Lithocampe) [=*Lithocampula* HKL., 1887 (obj.)]. All shell joints nearly of similar length. *Ord.-Rec.*

L. (Lithocampium) HKL., 1882 [**L. stabile* RÜST, 1885]. Shell joints of dissimilar length. *Eoc.-Rec.*——FIG. 73,*1*. *L. (L.) diploconus* HKL., Rec., ×350 (42).

Lithomitra BÜTSCHLI, 1882 [**Eucyrtidium pachyderma* EHR., 1875; SD herein]. Like *Artostrobus* but lacks apical horn. *Trias.-Rec.*

L. (Lithomitra) [=*Lithomitrella* HKL., 1887 (obj.)]. Single row of small round pores on each joint. *Trias.-Rec.*——FIG. 72,*6*. *L. (L.) nodosaria* HKL., Rec., ×400 (42).

L. (Lithomitrissa) HKL., 1887 [**L. infundibulum;* SD herein]. Several rows of pores on each joint. *Eoc.-Rec.*

Lithostrobus BÜTSCHLI, 1882 [**Eucyrtidium argus* EHR., 1875; SD herein]. Like *Dictyomitra* but has apical horn. *Perm.-Rec.*

L. (Lithostrobus) [=*Cyrtostrobus* HKL., 1887 (obj.)]. Conical shell with straight axis; dissimilar joints. *Perm.-Rec.*——FIG. 73,*4*. *L. (L.) conulus* HKL., Rec., ×300 (42).

L. (Botryostrobus) HKL., 1887 [**L. botryocyrtis;* SD herein]. Cephalis lobulate. *Rec.*

L. (Conostrobus) HKL., 1887 [**L. hexastichus;* SD herein]. Conical shell with straight axis; similar joints. *Rec.*

L. (Cornustrobus) HKL., 1887 [**L. caloceras;* SD herein]. Horn-shaped shell; similar joints. *Rec.*

Siphocampium HKL., 1882 [**S. accrescens* RÜST, 1885][=*Siphocampe* HKL., 1887 (obj.)]. Like *Eucyrtidium* but has hollow cylindrical cephalic tube in place of a solid apical horn. *Jur.-Rec.*

S. (Siphocampium). Shell joints of dissimilar length. *Jur.-Rec.*——FIG. 73,*9b*. *S. (S.) spiralis* HKL., Rec., ×300 (42).

S. (Siphocampula) HKL., 1887 [**Siphocampe tubulosa;* SD herein]. Joints of nearly similar

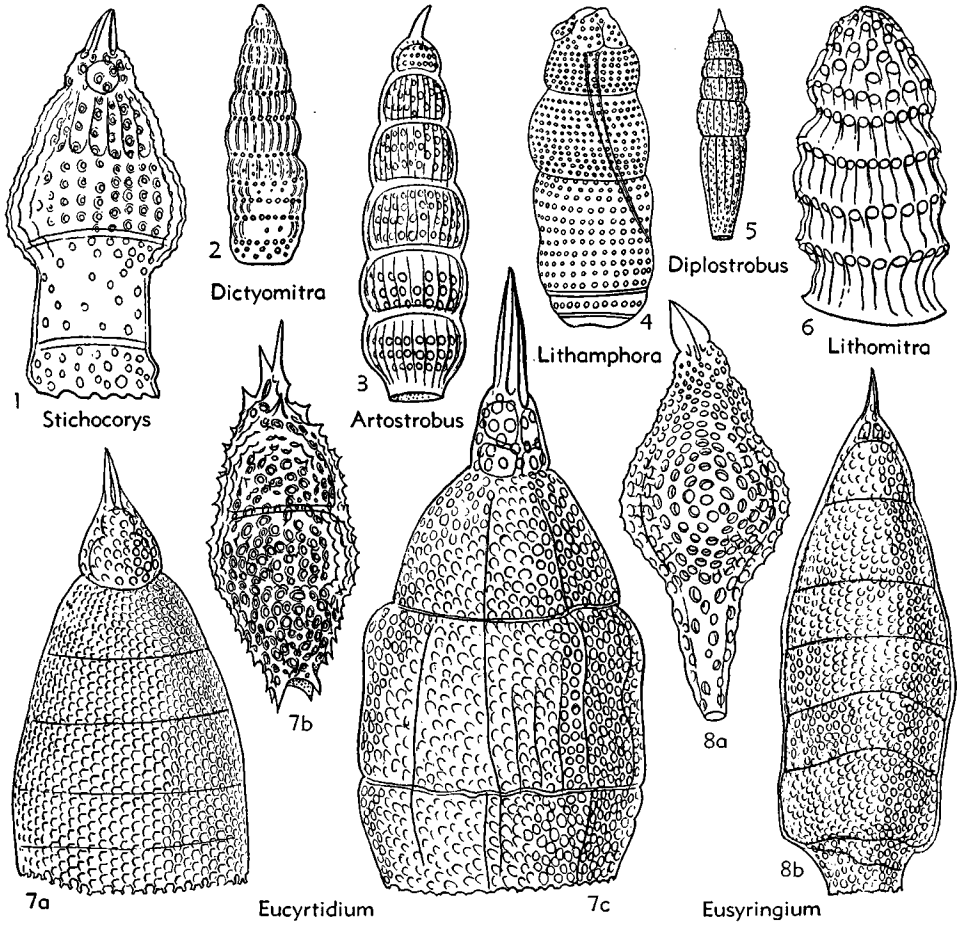

FIG. 72. Stichocorythidae (p. D140, D141).

length. *Rec.*——Fig. 73,*9a*. *S. (S.) annulosa* Hkl., Rec., ×300 (42).

Spirocampe Hkl., 1882 [**S. callispira* Hkl., 1887]. Strictures spirally disposed; without apical horn. *Mio.*,Calif.-*Rec.*——Fig. 73,*3*. **S. callispira,* Rec., ×300 (42).

Spirocyrtis Hkl., 1882 [**S. scalaris* Hkl., 1887]. Like *Spirocampe* but has apical horn. *Cret.-Rec.*

S. (Spirocyrtis) [=*Spirocyrtidium* Hkl., 1887 (obj.)]. Shell conical. *Cret.-Rec.*——Fig. 73,*10*. **S. scalaris,* Rec., ×350 (42).

S. (Spirocyrtoma) Hkl., 1887 [**S. holospira;* SD herein]. Ovate shell, some spindle-shaped. *Rec.*

Syringium Principi, 1909 [**S. vinassai*]. Like *Eusyringium* but cephalis hidden within thorax. *Mio.-Plio.*——Fig. 73,*5*. **S. vinassai,* Mio., Italy, ×230 (49).

Trisyringium Vinassa 1900 [**T. capellinii*]. Three gradually dilated joints; without apical horn. *Cret.*——Fig. 73,*2*. **T. capellinii,* Cret., Karpathos., ×200 (55).

Subfamily STICHOCAPSINAE Haeckel, 1882

[as Stichocapsida; emend. Campbell, herein] [=Artocapsida, Hkl., 1882]

Basal shell mouth fenestrated. *Dev.-Rec.*

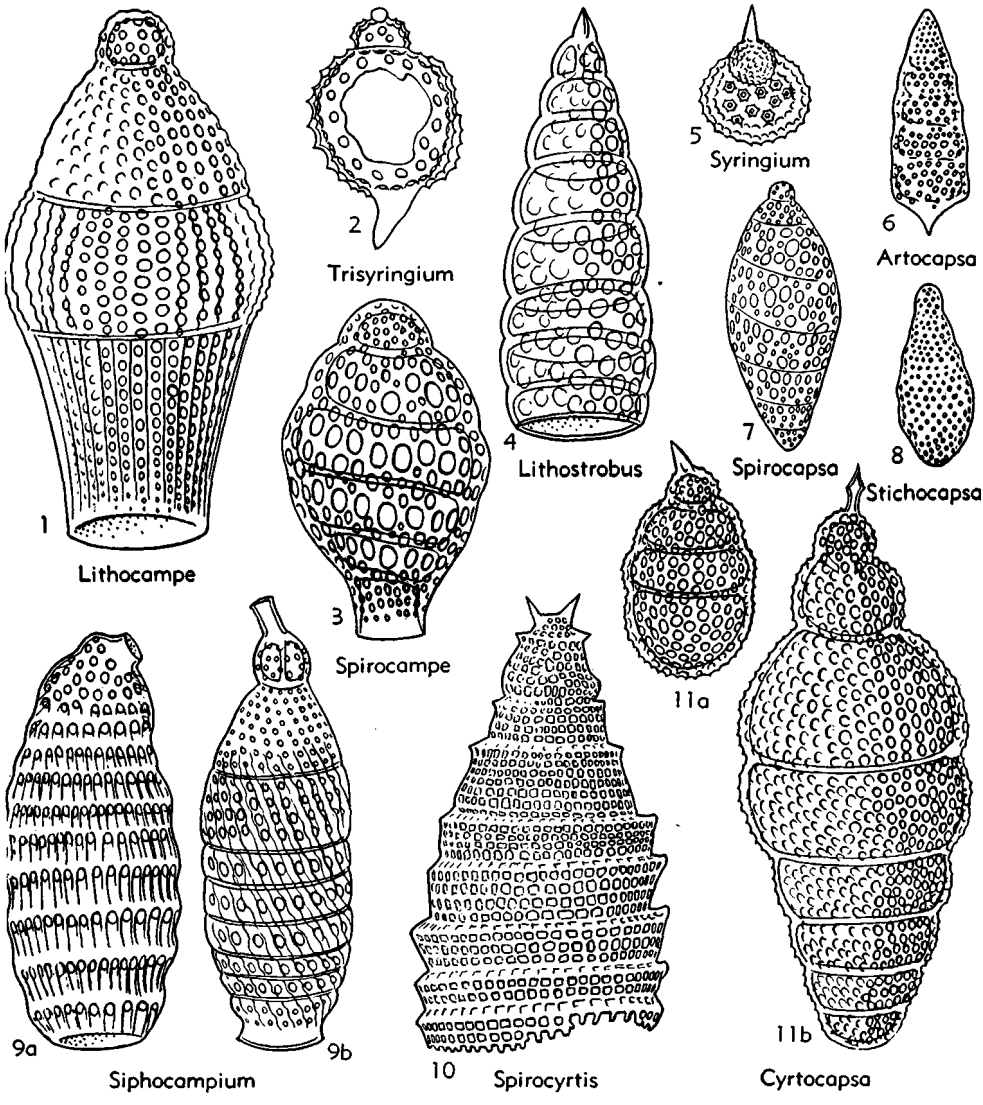

Fig. 73. Stichocorythidae (p. D141-D143).

Stichocapsa HKL., 1882 [**S. jaspidea* RÜST, 1885]. Last joint rounded but without basal spine or apical horn. *Dev.-Rec.*——FIG. 73,*8*. *S. megalocephalia* C.-CL., U.Cret., Calif., ×150 (35).

Artocapsa HKL., 1882 [**A. fusiformis* HKL., 1887]. Last joint pointed, conical, with basal spine and apical horn. *Cret.-Rec.*——FIG. 73,*6*. *A. livermorensis* C.-CL., U.Cret., Calif., ×150 (35).

Cyrtocapsa HKL., 1882 [**C. ovalis* RÜST, 1885]. Like *Stichocapsa* but has apical horn. *Jur.-Rec.*

C. (Cyrtocapsa) [=*Cyrtocapsoma* HKL., 1887 (obj.)]. Four or more annular strictures. *Jur.-Rec.*——FIG. 73,*11a*. *C. (C.) tetracapsa* HKL., Rec., ×200 (42).

C. (Cyrtocapsella) HKL., 1887 [**C. tetrapera;* SD herein]. Three annular strictures. *Rec.*——FIG. 73,*11b*. *C. (C.) chrysalidium* HKL., Rec., ×300 (42).

Spirocapsa RÜST, 1892 [**S. singularis*]. Shell composed of spiral lamina with 8 or more turns; with apical horn. *Jur.*——FIG. 73,*7*. **S. singularis,* Jur., Sicily, ×150 (51).

Superfamily CANNOBOTRYDICAE Haeckel, 1882

[*ex* Cannobotryida; emend. CAMPBELL, herein]
[=Botryodea HKL., 1882]

Cephalis lobulated. *Jur.-Rec.*

Family CANNOBOTRYDIDAE Haeckel, 1882

[as Cannobotryida; emend. CAMPBELL, herein]

Shell formed of a single chamber. *Jur.-Rec.*

Cannobotrys HKL., 1882 [**C. monacanna* HKL., 1887]. Has tubules. *Jur.-Rec.*——FIG. 74,*2*. *C. tricanna* HKL., Rec., ×200 (42).

Acanthobotrys POP., 1913 [**A. multispina*]. Two lobes; surface spiny. *Rec.*——FIG. 74,*1*. **A. multispina,* Rec., ×300 (48).

Lithobotrys EHR., 1844 [**L. quadriloba*][=*Lithocorythium* EHR., 1873; *Botryopera* HKL., 1887 (obj.)]. Lacks tubules. *Eoc.,*(Va.)*-Rec.*——FIG. 74,*3*. *L. cyrtoloba* (HKL.), Rec., ×300 (42).

Family GLYCOBOTRYDIDAE Campbell, nov.

[=emend. Lithobotryida HKL., 1887]
[=Neobotrydidae POP., 1913]

Shell formed of cephalis and thorax. *Eoc.-Rec.*

Glycobotrys CAMPBELL, 1951 [*pro Lithobotrys* HKL., 1887 (*non* EHR., 1844)]. [**Lithobotrys*

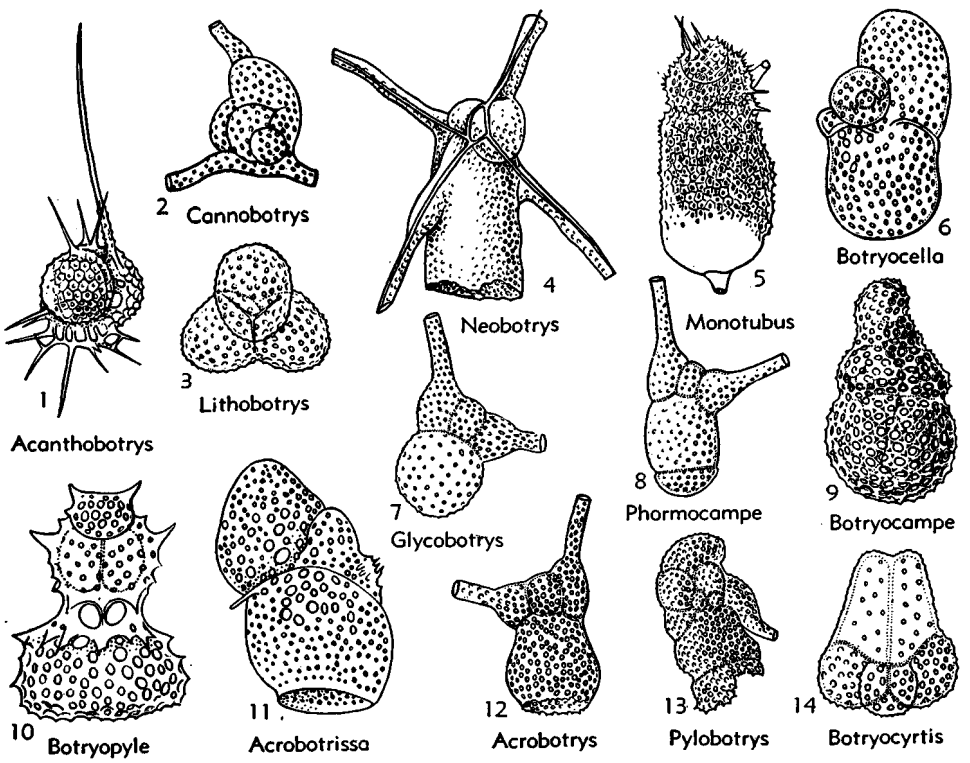

FIG. 74. Cannobotrydidae, Glycobotrydidae, Pylobotrydidae (p. D143, D144).

geminata EHR., 1875]. Cephalis has tubules; thorax fenestrated. *Eoc.-Rec.*——FIG. 74,*7*. *G. sphaerothorax* (HKL.), Rec., ×200 (42).

Acrobotrissa POP., 1913 [**A. cribosa*]. Lacks tubules and surface spines. *Rec.*——FIG. 74,*11*. **A. cribosa,* Rec., ×400 (48).

Acrobotrys HKL., 1882 [**A. monosolenia* HKL., 1887]. Has cephalic tubules; thorax open. *Rec.*——FIG. 74,*12*. *A. disolenia* HKL., Rec., ×200 (42).

Botryocella HKL., 1882 [**Lithobotrys nucula* EHR., 1875]. Lacks cephalic tubules; thorax fenestrated. *Eoc.-Rec.*——FIG. 74,*6*. *B. multicellularis* HKL., Rec., ×300 (42).

Botryopyle HKL., 1882 [**B. sethocorys* HKL., 1887]. Lacks cephalic tubules; thorax open. *Eoc.-Rec.*——74,*10*. **B. sethocorys,* ×300 (42).

Monotubus POP., 1913. [**M. microporus*]. Single vertical-lateral cephalic tubule. *Rec.*——FIG. 74, *5*. **M. microporus,* Rec., ×400 (48).

Neobotrys POP., 1913 [**N. quadrituberosa*]. Has inner trellis consisting of sagittal ring and appended spines. *Rec.*——FIG. 74,*4*. **N. quadrituberosa,* Rec., ×400 (48).

Family PYLOBOTRYDIDAE Haeckel, 1882

[as Pylobotryida; emend CAMPBELL, herein]

Shell formed of cephalis, thorax, and abdomen. *Eoc.-Rec.*

Subfamily PYLOBOTRYDINAE Haeckel, 1882

[as Pylobotryida *(partim)*; emend. CAMPBELL, herein] [=Botryocyrtida HKL., 1887]

Basal shell mouth open. *Rec.*

Pylobotrys HKL., 1882 [**P. putealis* HKL., 1887]. Cephalis has variable number of tubules.——FIG. 74,*13*. **P. putealis,* Rec., ×200 (42).

Botryocyrtis EHR., 1860 [**B. serpentis* EHR., 1872; SD herein]. Cephalis without tubules.——FIG. 74,*14*. *B. cerebellum* HKL., Rec., ×300 (42).

Subfamily BOTRYOCAMPINAE Haeckel, 1887

[as Botryocampida; emend. CAMPBELL, herein]

Basal shell mouth fenestrated. *Eoc.-Rec.*

Botryocampe EHR., 1860 [**Lithobotrys inflata* BAILEY, 1856]. Lacks cephalic tubules. *Eoc.-Rec.*——FIG. 74,*9*. *B. camerata* HKL., Rec., ×200 (42).

Phormocampe HKL., 1882 [**P. trithalmia* HKL., 1887]. Has cephalic tubules. *Rec.*——FIG. 74,*8*. *P. cannothalmia* HKL., Rec., ×200 (42).

Suborder PHAEODARINA Haeckel, 1879

[as Phaeodaria; emend. CAMPBELL, herein] [=Pansolenia HKL., 1878; Tripylea HERTWIG, 1879; Cannopylea HKL., 1882]

Central capsule with double membrane, bearing at one pole a tubular main opening **(astropyle)** in the center of a conical radiate operculum. Accessory openings common on opposite pole of the main axis; extracapsular cytoplasm with voluminous aggregate or dark pigmented bodies (phaeodium); skeleton composed of silica-carbonate in the form of hollow or solid tubules or rods or a lattice. *Cret.-Rec.*

MORPHOLOGICAL FEATURES

The Phaeodarina differ from other suborders of the Radiolaria in structure of the central capsule, presence of cytoplasmic inclusions and nature of the skeleton. The capsule generally is very large and oblately spherical, being depressed in the direction of the main axis. The main axis is vertical and distinctly marked by the commonly ventral position of the inverted conical **astropyle**. It has a double membrane, unlike the capsule of other suborders. These membranes differ in thickness, the outer one being thicker than the delicate inner one. In the living animal these membranes are in contact with each other. The walls of the capsule are continuous and devoid of the many pores which distinguish the capsular wall of Acantharina and Spumellina. The astropyle is a single aperture invariably placed at the oral end of the main axis, forming an inverted conical or caplike elevation, the center of which extends into a short cylindrical tube. This tube is termed the **proboscis**, and the conical part forms the **operculum**, but this operculum does not resemble the similarly termed plate of the oral pole of the central capsule of the Nassellina. In the Phaeodarina it is radially ribbed and no podoconus exists. Accessory apertures **(parapylae)** are variable in number and position, but generally there are 2 of them.

The **phaeodium**, composed of dark pigmented globules, is a unique possession in the cytoplasm of the Phaeodarina and is the structure from which the group derives its name. Invariable features of the phaeodium are its excentric location in the oral part of the calymma, its relation to the astropyle, constant volume (generally larger than the central capsule), and similar physical and chemical appearance. The most striking character is its position. The granules **(phaeodellae)** may be symbiotic algae, comparable to the zooanthellae of

other Radiolaria; pigmented eye-spots comparable to those found in many flagellates; metabolic agents of a special sort.

The siliceous bars which compose the peripherally generated skeleton of the Phaeodarina are mostly hollow tubules filled with living cytoplasm. These cylindrical structures may be simple spicules in the Cannorrhaphididae and Aulacanthidae or articulated legs or spines containing regularly placed transverse septa in the Medusettidae and Atlanticellidae. The transverse plates somewhat resemble the septa of *Nautilus* and, like them, are pierced by a median aperture. In the Aulosphaeridae, Cannosphaeridae, Circoporidae, and Tuscadoridae, the tubules have a delicate wire-like thread of silica in the main axis which connects by horizontal branches to the inner wall of the tubule. Although hollow bars are most common, solid rods occur among the Sagosphaeridae, Castanellidae, and Conchariidae.

The substance of the shell of most Phaeodarina is homogeneous, but the Challengeriidae have a tracery of extremely fine, regular hexagonal meshes, which closely resembles the similar structure of the diatom frustule. The Tuscadoridae and Circoporidae possess porcelaneous texture, the walls being composed of silica cement and numerous fine needles enclosed in the matrix. In the Caementellidae and *Miracella* of the Atlanticellidae, the skeleton is formed of siliceous cement to which foreign particles are attached. These radiolarians are analogous to the arenaceous Foraminifera. Tabulate, paneled, or dimpled shells composed of polygonal plates or without plates, occur in the Circoporidae. These structures resemble similar ones found in complex Acantharina.

The meshwork of the lattice shell of some Castanellidae exhibits **rosettes** or flower-shaped buttons within hexagonal frames, especially located near the radial spines.

Among the families of Phaeodarina, the Phaeodinidae differ mostly from *Cystidium* (Nassellina) and *Procyttarium* (Spumellina) in the character of the central capsule and presence of the phaeodium. Other members of the Phaeodinicae have skeletal elements in the form of spicules or of incrusted foreign matter. The **spicules** are mostly cylindrical or spindle-shaped, and less commonly hemispheres or cap-shaped bodies. They may be unbranched or branched in different ways; many have terminal or lateral teeth (denticles). HAECKEL (20) associated these spiculate forms with those lacking skeletal structures, and called them Phaeocystina. The remaining Phaeodarina, with lattice shells, were included in a section termed Phaeocoscina. These last differ among themselves with respect to the shape of the shell and in other characters.

The Aulosphaericae include Phaeodarina with 1 or 2 spherical **lattice shells**, which may have pyramidal elevations or tents on the surface and **radial spines** projecting from the surface. The pyramidal elevations may have an axial rod running lengthwise of the pyramid and this rod bears lateral branches. Spongy spherical shells also occur among the Aulosphaericae. Some Cannosphaeridae have solid internal shells with closed pore frames on the surface.

The Challengeriicae, none of which have a bivalved form, are mostly characterized by shells with a prominent mouth at the free end of a projecting collar at one pole of the main axis. The mouth commonly is provided with **oral teeth**. In the Pharyngellinae an internal tube **(pharynx)** occurs inside the shell. Many genera of the Challengeriidae have marginal spines on the sharp edge of the shell or are provided with **apical horns.** These structures vary in number, position, and development in different genera and subgenera. The Medusettidae and Atlanticellidae have articulated legs or spines, described as ascending or descending, according to curvature of the spines upward toward the apex or downward around the mouth. Some Medusettidae, Castanellidae, and Tuscadoridae superficially resemble various Nassellina in manner well illustrating evolutionary convergence.

The Conchariicae have a bivalved shell composed of 2 completely separate thick hemispherical, cap- or boat-shaped dorsal and ventral valves, thus bearing likeness to brachiopods. These valves may be smooth or have dentate edges. A few bear a sagittal keel or median vertical superstructure. The valves may be unequal in size and may bear horns in various positions.

The Coelodendricae have a thin, delicate bivalved shell with a conical process **(galea)** which may bear branched tubes attached to each valve.

The 2 families included in this superfamily differ in presence or absence of structures termed **rhinocanna** and **frenulum.** The rhinocanna (nasal tube) is a curved cylinder or 3-sided prismatic tube which embraces the central capsule on one side and the galea on the other. It lies in the sagittal plane of the valve with its open end directed toward the proboscis of the central capsule. The frenulum (nasal suspensorium) is a small cylinder which connects the nasal mouth with the internal part of the nasal tube of the style near its base on the galea. **Styles** are long, generally dichotomously branched tubes which extend outside the shell margin. They anastomose with each other in some genera so as to form an outer lattice shell mantle. Commonly they have lateral and terminal branches. Numerous **dendrites (brushes)** may arise from the galea. Structures having importance in determination of the species of Coelodendricae are illustrated in Fig. 75.

The majority of the Phaeodarina are inhabitants of deep seas, mainly in the southern hemisphere; they are so common in some places that thousands of well-preserved individuals have been obtained in a single sample. A smaller number is found near the surface of the sea, widely distributed in most oceans. Most Phaeodarina have a diameter of 1 or 2 mm. They are thus 10 to 20 times the size of other Radiolaria. A few gigantic forms are 20 to 30

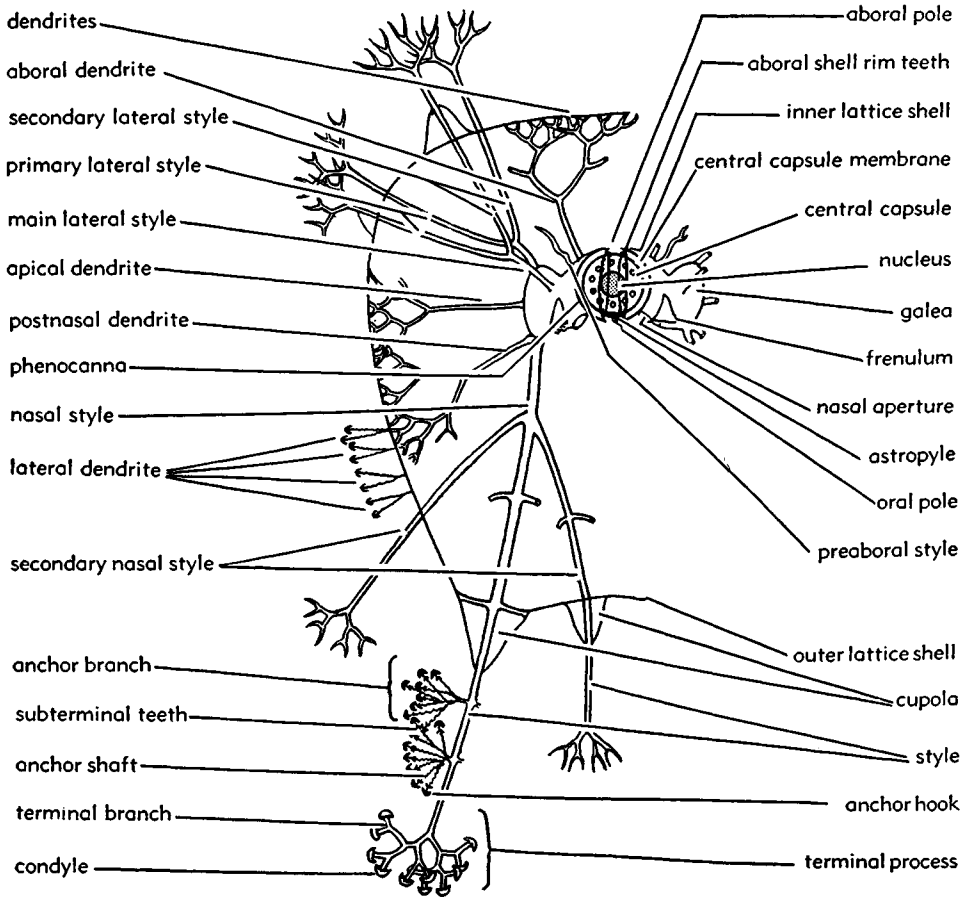

FIG. 75. Morphological features of phaeodarine radiolarians belonging to the superfamily Coelodendricae.

mm. in diameter, but a very few *(Cadium)* are extremely tiny.

Important accounts of the biology, reproduction, and ecology of the Phaeodarina are given by HAECKEL (12), HAECKER (13), and POPOFSKY (20). HAECKER, especially, gives an elaborate description of the reproduction and ecology of the members of this suborder found by the "Valdivia" in the central and south Atlantic, the Antarctic, and the Indian oceans.

Superfamily PHAEODINICAE Haeckel, 1879

[*ex* Phaeodinida; emend. CAMPBELL, herein] [=Phaeocystida HKL., 1879]

Lacking lattice shell; either naked cells or with isolated cytoplasmic spicules. *Rec.*

Family PHAEODINIDAE Haeckel, 1879

[as Phaeodinida; emend. CAMPBELL, herein]

Naked cells without spicules. *Rec.*

Phaeodina HKL., 1879 [**P. tripylea* HKL., 1887]. Central capsule with 3 openings.

Phaecolla HKL., 1879 [**P. primordialis* HKL., 1887]. Central capsule with single opening.——FIG. 76,*1*. **P. primordialis*, Rec., ×200 (42).

Family CAEMENTELLIDAE Borgert, 1909

Skeleton formed of incrusted siliceous foreign matter. *Rec.*

Caementella BORGERT, 1909 [**C. loricata*]. Central capsule with 3 openings.

Family CANNORRHAPHIDIDAE Haeckel, 1879

[as Cannorrhaphida; emend. CAMPBELL, herein]

Skeleton composed of scattered spicules. *Rec.*

Subfamily CANNORRHAPHIDINAE Haeckel, 1879

[as Cannorrhaphida *(partim)*; emend. CAMPBELL, herein] [=Cannobelida HKL., 1887]

Hollow tangential spicules cylindrical or spindle-shaped. *Rec.*

Cannorrhaphis HKL., 1879 [**C. spinulosa* HKL., 1887]. Tubules spiny or branched.——FIG. 76,*3*. **C. spinulosa*, Rec., ×50 (42).

Thalassoplancta HKL., 1862 [*non* HKL., 1887 (=*Thalassorrhaphis* CAMPBELL, 1951)] [**Thalassicolla calvispicula* HKL., 1860] [=*Cannobelos* HKL., 1887 (obj.)]. Smooth unbranched tubules.

Subfamily CATINULINAE Haeckel, 1887

[as Catinulida; emend. CAMPBELL, herein]

Spicules hemispherical or caplike. *Rec.*

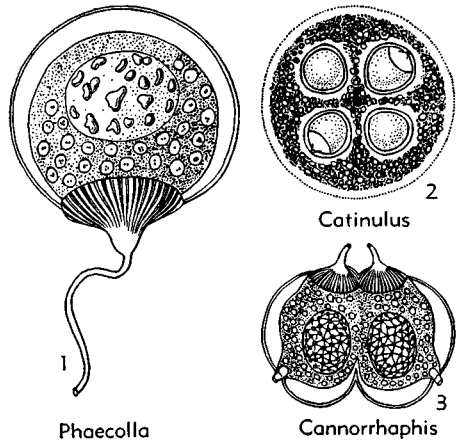

FIG. 76. Phaeodinidae, Cannorrhaphididae (p. D147).

Catinulus HKL., 1887 [**C. quadrifidus;* SD herein]. Spicules with radiate margins and circular openings.——FIG. 76,*2*. **C. quadrifidus*, Rec., ×200 (42).

Family AULACANTHIDAE Haeckel, 1862

[as Aulacanthida; emend. CAMPBELL, herein]

Skeleton formed of numerous hollow radial tubules the proximal ends of which touch the surface of the central capsule. *Rec.*

Subfamily AULACANTHINAE Haeckel, 1862

[as Aulacanthida *(partim)*; emend. CAMPBELL, herein] [=Aulographida HKL., 1887]

External veil of interwoven, numerous, thin and hollow tangential needles entirely covering surface of calymma. *Rec.*

Aulacantha HKL., 1860 [**A. scolymantha* HKL., 1862]. Unbranched radial tubules.

Auloceros HKL., 1887 [**A. furcosus;* SD herein]. Like *Aulographis* but terminal branches of radial tubules are forked and again ramified.

A. (Auloceros) [=*Auloceraea* HKL., 1887 (obj.)]. Terminal branches without corona of radiate denticles.——FIG. 77,*2*. *A. (A.) elegans* HKL., Rec., ×40 (42).

A. (Auloceratium) HKL., 1887 [**A. dicranaster;* SD herein]. Distal ends of terminal branches with small coronas of recurved radiate teeth.

Aulodendron HKL., 1887 [**A. pacificum;* SD herein]. Lateral and terminal branches irregularly scattered along length of radial tubules.——FIG. 77,*4*. *A. indicum* HKL., Rec., ×75 (42).

Aulographis HKL., 1879 [**A. pandora* HKL., 1887] [=*Aulographium*, *Aulancora* HKL., 1879]. Radial tubules with distal verticels of simple terminal branches.

A. (Aulographis) [=*Aulographantha* HKL., 1887 (obj.)]. No lateral teeth on tubules.

A. (Aulocoryne) FOWLER, 1898 [**A. zetesios*]. Terminal branches swollen, knoblike, with 100 to 150 or more threadlike branches and small coronas of radiate denticles.

A. (Aulographella) HKL., 1887 [**A. flosculus;* SD herein]. [=*Aulokleptes* IMMERMANN, 1904]. Without coronas of radiate denticles; lateral teeth or secondary spines commonly stout and club-shaped.

A. (Aulographidium) HKL., 1887 [**A. tetrancistra;* SD herein]. Terminal branches armed with whorls of small radial teeth; without lateral denticles.

A. (Aulographonium) HKL., 1887 [**A. candelabrum;* SD herein]. Terminal branches armed with lateral teeth and terminal whorls of small radial teeth.——FIG. 77,*1. A. (A.) candelabrum,* Rec., ×40 (42).

A. (Aulophyton) IMMERMANN, 1904 [**A. tetronyx*]. Terminal branches with 4 distal branches ending in recurved hooks.

Aulopetasus HAECKER, 1908 [**A. charoides*]. Terminal tubules with 4 to 5 lateral branches which have secondary terminal branches and minute coronas of radiate teeth.

Aulospathis HKL., 1887 [**A. bifurca;* SD herein]. Radial tubules bear a distal and proximal verticel of lateral branches.

A. (Aulospathis) [=*Aulospathessa* HKL., 1887 (obj.)]. Radial tubules distally inflated.——FIG. 77,*5. *A. (A.) bifurca,* Rec., ×20 (42).

A. (Aulospathilla) HKL., 1887 [**A. triodon;* SD herein]. Radial tubules not inflated.

Subfamily AULACTINIINAE Haeckel, 1887

[as Aulactinida; emend. CAMPBELL, herein]

Lacking external veil of needles. *Rec.*

Aulactinium HKL., 1887 [**A. actinastrum;* SD herein]. Surface of calymma naked.——FIG. 77, *3a. A. spinosum* HKL., distal end of a tubule, ×100 (42).——FIG. 77,*3b. *A. actinastrum,* Rec., ×50 (42).

Family ASTRACANTHIDAE Haecker, 1908

Distal ends of hollow radial tubules variously developed; proximal ends touch hollow central sphere. *Rec.*

Astracantha HAECKER, 1908 [**A. paradoxa;* SD herein].——FIG. 78,*2. A. umbellifera* HAECKER, Rec., ×25 (43).

Superfamily AULOSPHAERICAE Haeckel, 1862

[*ex* Aulosphaerida; emend. CAMPBELL, herein] [=Phaeosphaeria HKL., 1879 *(partim)*]

Single or double, usually spherical lattice shell; without mouth and not bivalved. *Cret.-Rec.*

Family SAGOSPHAERIDAE Haeckel, 1887

[as Sagosphaerida; emend. CAMPBELL, herein]

Delicate network of subregular triangular meshes and thin filiform solid rods. *Rec.*

Subfamily SAGOSPHAERINAE Haeckel, 1887

[as Sagosphaerida *(partim);* emend. CAMPBELL, herein] [=Sagenida HKL., 1887]

Simple lattice sphere with or without pyramidal elevations or tents. *Rec.*

Sagosphaera HKL., 1887 [**S. penicella; SD herein*]. Like *Sagena* but with radial spines at nodal points of meshes.——FIG. 78,*1. *S. penicella,* a nodal point and its radial spines. Rec., ×150 (42).

Sagena HKL., 1887 [**S. ternaria;* SD herein]. Surface smooth, without pyramidal elevations or radial spines.——FIG. 78,*4. *S. ternaria,* Rec., ×100 (42).

Sagenoarium BORGERT, 1891 [**S. chuni*]. Double lattice shell; numerous pyramidal elevations without axial rods and with radial spines.

Sagenoscena HKL., 1887 [**S. stellata;* SD herein]. Like *Sagoscena* but pyramids have internal axial rods.——FIG. 78,*6. *S. stellata,* top and axial rod of a pyramidal tent prolonged into a crowned radial spine, Rec., ×100 (42).

Sagoscena HKL., 1887 [**S. castra;* SD herein]. Pyramidal tents or elevations without internal axial rods.——FIG. 78,*5. *S. castra,* Rec., ×25 (42).

Subfamily SAGMARIINAE Haeckel, 1887

[as Sagmarida; emend. CAMPBELL, herein]

Thick shell composed of spongy wickerwork. *Rec.*

Sagmarium HKL., 1887 [**S. spongodictyum;* SD herein]. Smooth surface.——FIG. 78,*7. *S. spongodictyum,* Rec., ×25 (42).

Sagmidium HKL., 1887 [**S. crucicorne;* SD herein]. Spiny surface.——FIG. 78,*3. *S. crucicorne,* single nodal point with 3 radial spines, Rec., ×150 (42).

Sagoplegma HKL., 1887 [**S. scenophora;* SD herein]. Like *Sagmidium* but has numerous pyramidal elevations.——FIG. 78,*8. *S. scenophora,* tops of 3 pyramids, ×150 (42).

Family AULOSPHAERIDAE Haeckel, 1862

[as Aulosphaerida; emend. CAMPBELL, herein]

Single shell composed of hollow tangential cylindrical tubules separated by starlike (astral) septa in nodal points. *Rec.*

Subfamily AULOSPHAERINAE Haeckel, 1862
[as Aulosphaerida *(partim)*; emend. CAMPBELL, herein]
[=Aularida HKL., 1887]

Triangular meshwork. *Rec.*

Aulosphaera HKL., 1860 [**A. trigonopa* HKL., 1862]. Spherical shell with simple network; without radial tubules.

A. (Aulosphaera) [=*Aulosphaerantha* HKL., 1887

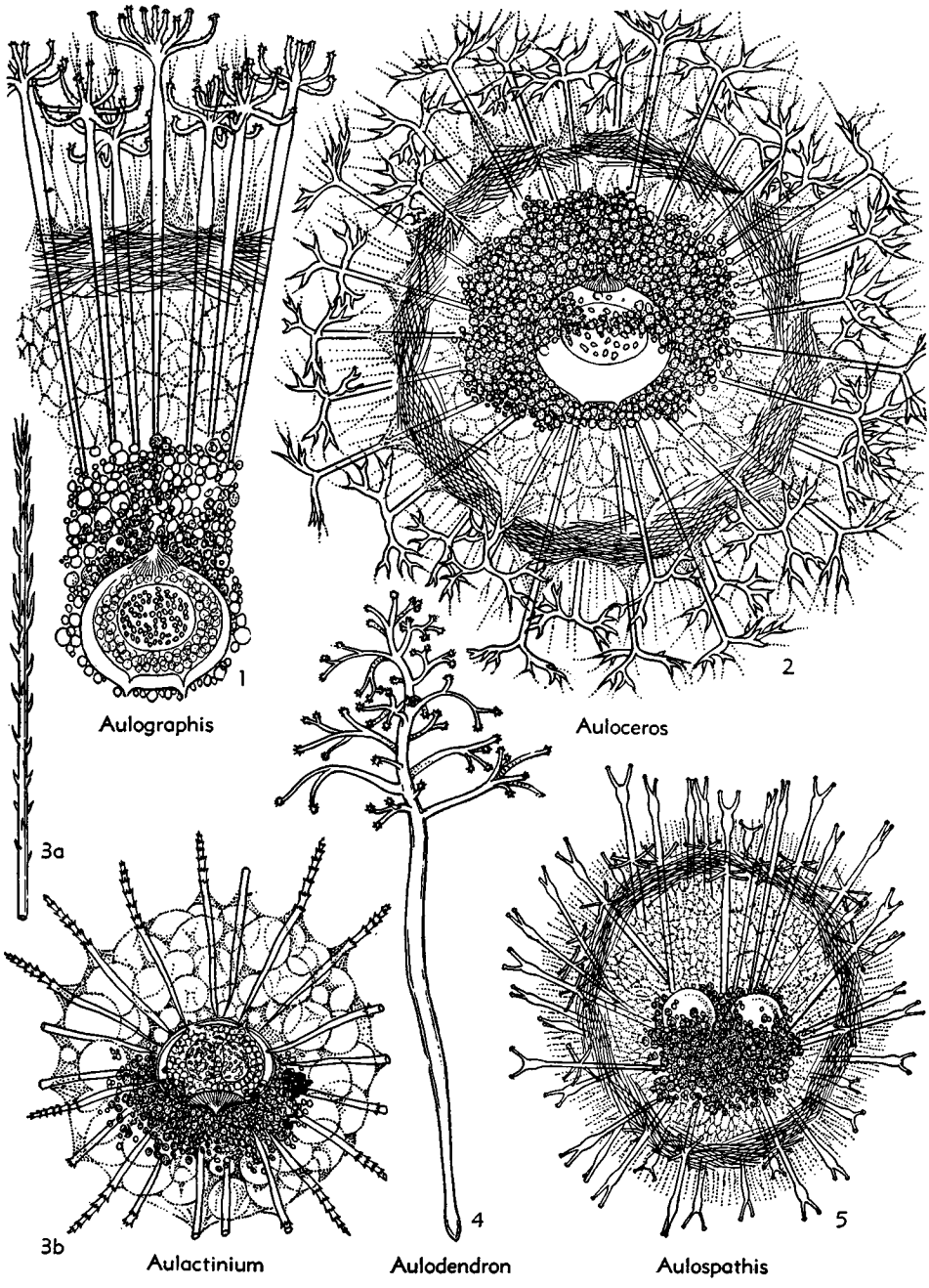

FIG. 77. Aulacanthidae (p. D147, D148).

(obj.)]. Radial tubules smooth; without teeth.

A. (Aulosphaerella) HKL., 1887 [**A. triodon;* SD herein]. Radial tubules smooth; armed with a verticel of distal teeth.

A. (Aulosphaerissa) HKL., 1887 [**A. spathillata;* SD herein]. Radial tubules with variable number of regular verticels of lateral branches.——FIG. 79,*2*. *A. (A.) dendrophora* HKL., Rec., ×25 (42).

A. (Aulosphaeromma) HKL., 1887 [**A. trifurca;* SD herein]. Radial tubules spiny or thorny; irregular lateral branches.

Aularia HKL., 1887 [**A. ternaria;* SD herein]. Like *Aulosphaera* but lacks radial tubules.——FIG. 79,*6*. **A. ternaria,* group of 6 triangular meshes with 7 nodal points of tubules, ×150 (42).

Aulatractus HKL., 1887 [**A. fusiformis;* SD herein]. Single shell spindle-shaped; radial tubules at nodal points.——FIG. 79,*1*. **A. fusiformis,* Rec., ×5 (42).

Aulophacus HKL., 1887 [**A. amphidiscus;* SD herein]. Like *Aulatractus* but shell lenticular.——FIG. 79,*3*. *A. lenticularis* HKL., single radial spine, ×150 (42).

Auloplegma HKL., 1879 [**A. perplexum* HKL., 1887]. Spongy spherical shell with radial tubules.——FIG. 79,*5*. **A. perplexum,* Rec., ×20 (42).

Auloscena HKL., 1887 [**A. mirabilis;* SD herein]. Spherical shell with pyramidal elevations or tents with radial tubule on top.

A. (Auloscena) [=*Auloscenium* HKL., 1887 (obj.)]. Radial tubules smooth.——FIG. 79,*9*. **A. (A.) mirabilis,* Rec., ×20 (42).

A. (Auloscenidium) HKL., 1887 [**A. tentorium;* SD herein]. Radial tubules spiny or thorny.

Subfamily AULONIINAE Haeckel, 1887

[as Aulonida; emend. CAMPBELL, herein]

Polygonal meshes. *Rec.*

Aulonia HKL., 1887 [**A. hexagonia;* SD herein]. Spherical shell with simple network; without radial tubules.——FIG. 79,*7*. **A. hexagonia,* Rec., ×20 (42).

Aulastrum HKL., 1887 [**A. dendroceros;* SD herein]. Like *Aulonia* but has radial tubules in nodes of network.——FIG. 79,*8*. **A. dendroceros,* 3 radial spines, ×150 (42).

Aulodictyum HKL., 1879 [**A. hydrodictyum* HKL., 1887]. Spongy spherical shell without radial tubules.

Family CANNOSPHAERIDAE Haeckel, 1879

[as Cannosphaerida; emend. CAMPBELL, herein]

Two concentric shells. *Cret.-Rec.*

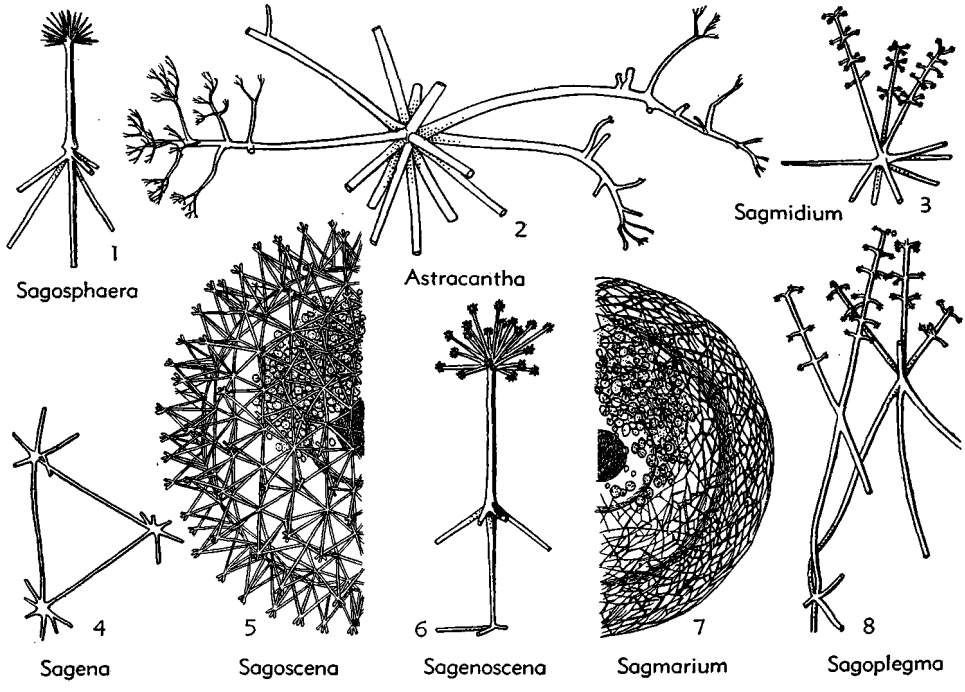

FIG. 78. Astracanthidae, Sagosphaeridae (p. D148).

Cannosphaera HKL., 1879 [**C. atlantica* HKL., 1887]. Internal shell without open pores. *Rec.*—FIG. 79,*4*. *C. antarctia* HKL., Rec., ×20 (42).

Cannosphaeropsis WETZEL, 1933 [**C. utinensis*]. Like *Cannosphaera* but external shell has polygonal meshwork. *Cret.*, C.Eur.

Coelacantha HERTWIG, 1879 [**C. ancorata*]. Internal shell latticed. *Rec.*

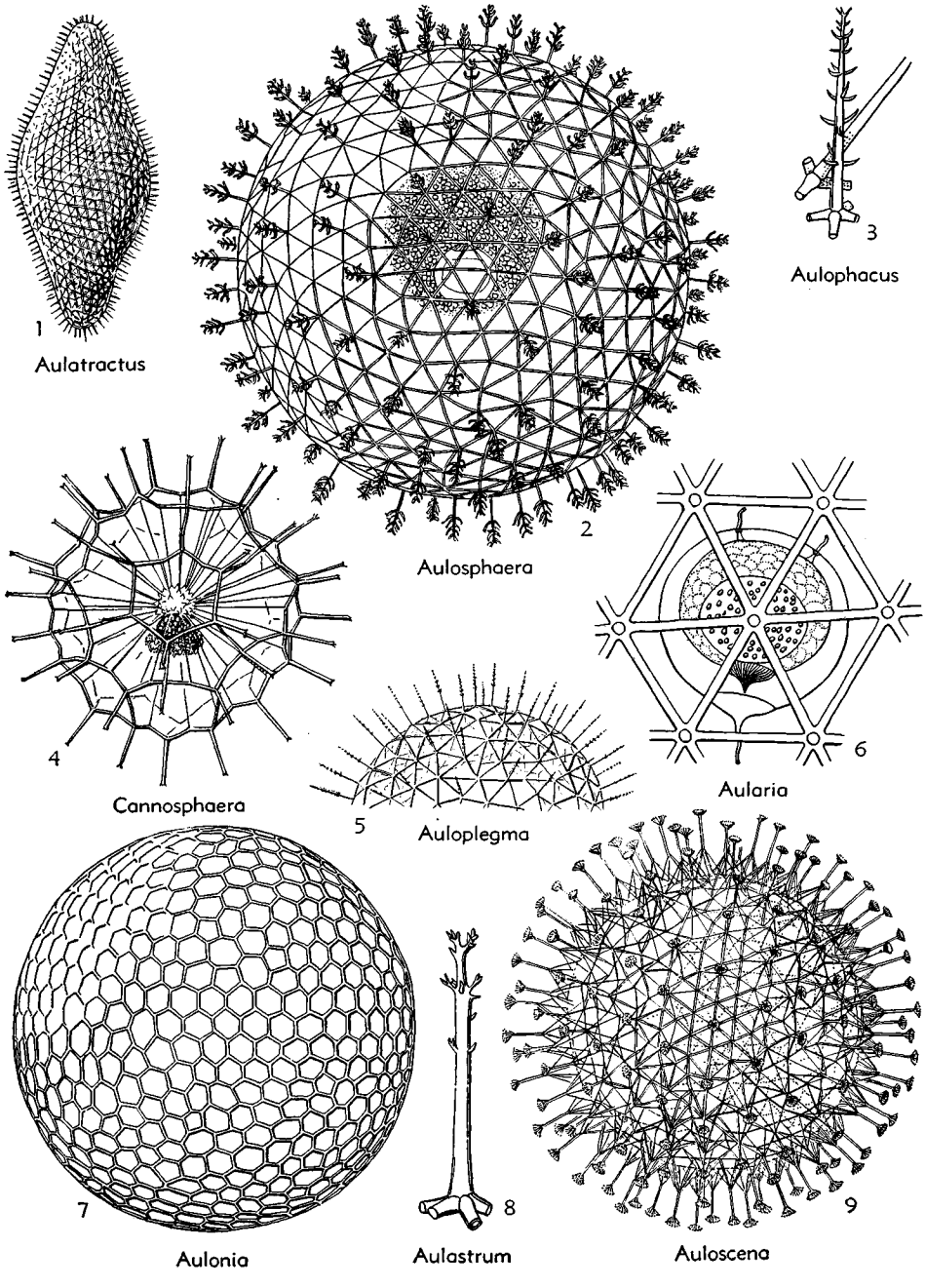

FIG. 79. Aulosphaeridae, Cannosphaeridae (p. D150, D151).

Superfamily CHALLENGERIICAE Murray, 1876

[*ex* Challengerida; emend. CAMPBELL, herein] [=Phaeogromia HKL., 1879]

Shell provided with mouth; not bivalved. *Rec.*

Family CHALLENGERIIDAE Murray, 1876

[as Challengerida; emend. CAMPBELL, herein]

Ovate or lens-shaped shell with fine regular hexagonal mesh (diatom-structure); with open mouth and commonly teeth; without articulated legs. *Rec.*

Subfamily CHALLENGERIINAE Murray, 1876

[as Challengerida *(partim)*; emend. CAMPBELL, herein] [=Lithogromida HKL., 1887]

Mouth simple. *Rec.*

Challengeria MURRAY, 1876 [**C. naresii*]. Shell with oral teeth, without marginal spines.

C. (Challengeria) [=*Challengerantha* HKL., 1887 (obj.)]. Single undivided tooth.——FIG. 80,*5*. *C. (C.) tritonis* HKL., Rec., ×100 (42).

C. (Challengeretta) HKL., 1887 [**C. slogettii*; SD herein]. Forked or bifid tooth, or 2 parallel teeth.

C. (Challengerilla) HKL., 1887 [**C. trifida*; SD herein]. Three teeth separate, or single tooth trifid.

C. (Challengeromma) HKL., 1887 [**C. bromleyi*; SD herein]. Four to 6 or more teeth.

Challengeron MURRAY, 1879 [**C. bethelli*; SD herein]. Like *Challengeria* but has spines on sharp marginal edge of shell.

C. (Challengeron) [=*Challengerosium* HKL., 1887 (obj.)]. Margin dentate or serrate in continuous series.——FIG. 80,*1*. *C. (C.) wyvillei* HKL., Rec., ×150 (42).

C. (Challengeranium) HKL., 1887 [**Challengeria swirei* MURRAY, 1879]. Single apical spine.

C. (Challengerebium) HKL., 1887 [**C. richardsii*; SD herein]. Two widely distant marginal spines.

C. (Challengeridium) HKL., 1887 [**C. crosbiei*; SD herein]. Large spines 3 to 5 or more, or a bunch of spines on shell margin; middle spine larger than others.

C. (Heliochallengeron) HAECKER, 1908 [**C. channeri* MURRAY, 1879]. Shell margin with 20 or more elongated spines in a single series.

Lithogromia HKL., 1879 [**L. silicea* HKL., 1879]. Like *Challengeria* but has smooth shell without either marginal spines or oral teeth.——FIG. 80,*2*. **L. silicea*, Rec., ×75 (42).

Protocystis WALLICH, 1869 [**P. aurita*]. Like *Lithogromia* but has one or more oral teeth.

Subfamily PHARYNGELLINAE Haeckel, 1887

[as Pharyngellida; emend. CAMPBELL, herein]

Shell has prominent inner tube or pharynx. *Rec.*

Pharyngella HKL., 1887 [**P. gastrula*; SD herein]. Shell has oral teeth but lacks marginal spines.——FIG. 80,*4*. **P. gastrula*, Rec., ×150 (42).

Entocannula HKL., 1879 [**E. circularis* HKL., 1887] [=*Trichogromia* HKL., 1887 (obj.)]. Shell without marginal spines and oral teeth.——FIG. 80,*6*. *E. infundibulum* HKL., Rec., ×75 (42).

Porcupinia HKL., 1879 [**P. aculeata* HKL., 1887]. Shell with oral teeth and marginal spines.——FIG. 80,*3*. *P. cordiformis* HKL., Rec., ×100 (42).

Family CADIIDAE Borgert, 1901

Minute, ovoidal, elliptical, lemon- or melon-shaped shell with bent neck and subterminal opening; surface with longitudinal striae; apex with or without apical spine, or with an elliptical ring connecting apex and lower part of aperture. *Rec.*

Cadium BAILEY, 1856 [**C. marinum*] [=*Beroetta* CLEVE, 1899; *Cadimella* STAND, 1928].——FIG. 80,*12*. *C. inauris* BORGERT, Rec., ×1,000 (34).

Family MEDUSETTIDAE Haeckel, 1887

[as Medusettida; emend. CAMPBELL, herein]

Ovate, hemispherical or caplike shell of alveolated texture; hollow articulated legs surround wide open mouth. *Rec.*

Subfamily MEDUSETTINAE Haeckel, 1887

[as Medusettida *(partim)*; emend. CAMPBELL, herein] [=Euphysettida HKL., 1887]

Three or 4 legs; apex usually with horn. *Rec.*

Medusetta HKL., 1887 [**M. codonium*; SD herein]. Four equal legs.——FIG. 80,*9*. *M. quadrigata* HKL., Rec., ×200 (42).

Cortinetta HKL., 1887 [**C. tripodiscus*; SD herein]. Three equal legs.——FIG. 80,*7*. **C. tripodiscus*, Rec., ×150 (42).

Euphysetta HKL., 1887 [**E. staurocodon*; SD herein]. One large and 3 small legs.——FIG. 80, *10*. *E. amphicodon* HKL., Rec., ×150 (42).

Subfamily GAZELLETTINAE Haeckel, 1887

[as Gazellettida; emend. CAMPBELL, herein]

Six to 12 or more legs; apex usually without horn. *Rec.*

Gazelletta HKL., 1887 [*non* MURRAY, 1876 MSS] [**G. hexanema*; SD herein]. Six descending legs.

G. (Gazelletta) [=*Gazellarium* HKL., 1887 (obj.)]. Smooth unbranched legs.——FIG. 80,*8*. **G. (G.) hexanema*, Rec., ×200 (42).

G. (Gazellettidium) HKL., 1887 [**G. bifurca*; SD herein]. Legs distally branched or with a bunch of terminal spines.

G. (Gazellonium) HKL., 1887 [**G. studeri;* SD herein]. Legs with unbranched or branched lateral spines.

G. (Gazellusium) HKL., 1887 [**G. dendronema;* SD herein]. Spiny legs armed with large terminal branches.

Gorgonetta HKL., 1887 [**G. mirabilis;* SD herein]. Six descending and 6 ascending legs.——FIG. 80, *11. *G. mirabilis,* Rec., ×40 (42).

Nationaletta BORGERT, 1905 [**Gazelletta fragilis* BORGERT, 1902]. Spindle-, cudgel-, or bag-shaped shell with 10 to 13 chambered radial spines around mouth, each with terminal spines.

Planktonetta BORGERT, 1902 [**Gazelletta atlantica* BORGERT, 1901]. Like *Nationaletta* but has 8 to 10 distally branched descending legs.

Polypetta HKL., 1887 [**P. polynema;* SD herein]. Ten to 20 or more descending legs.

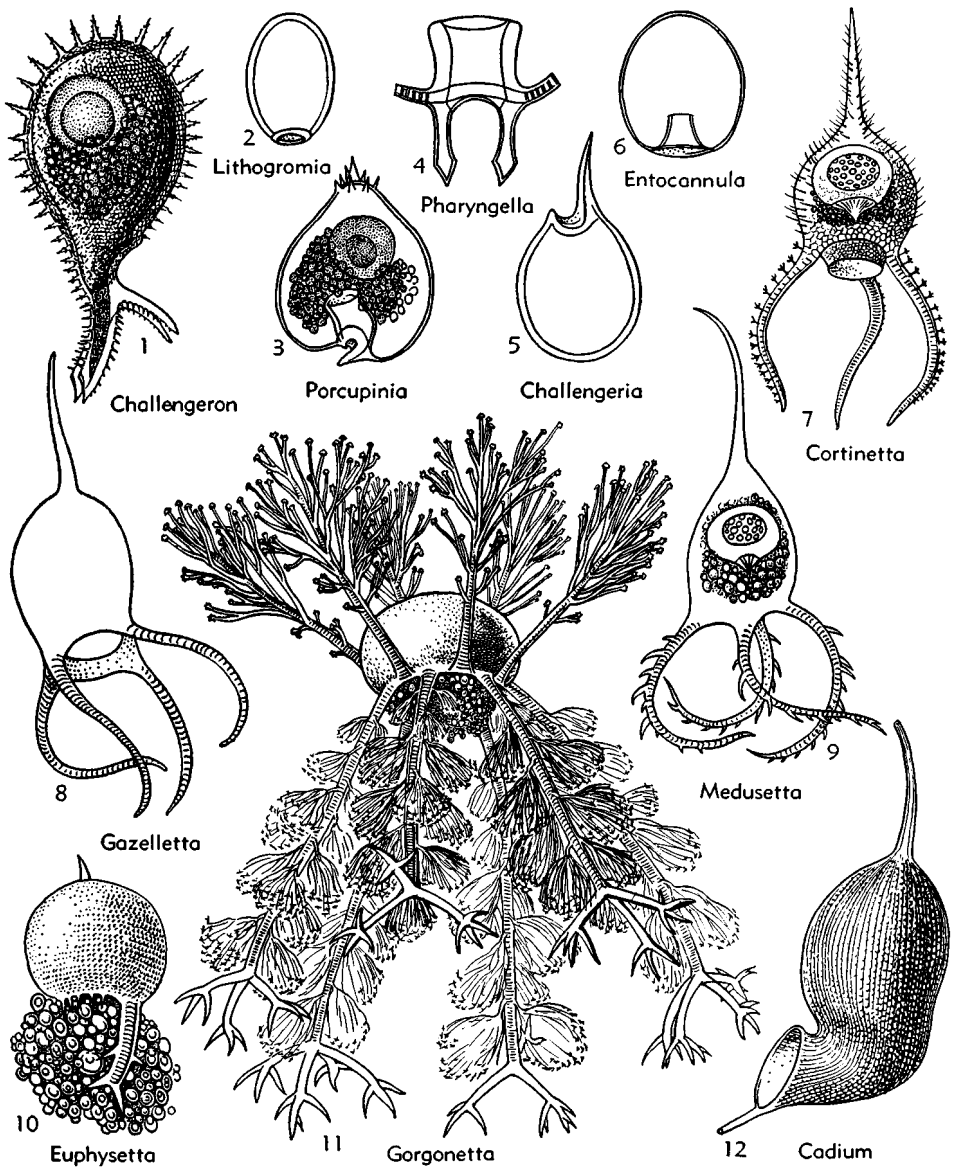

FIG. 80. Challengeriidae, Cadiidae, Medusettidae (p. D152, D153).

Family POROSPATHIDIDAE Borgert, 1901

[as Porospathida; emend. CAMPBELL, herein]

Shell covered by paneled or tabulated surface or covered by trizonal meshwork; radial spines on all sides. *Rec.*

Porospathis HKL., 1879 [**P. tabulata;* SD herein]. ——FIG. 81,*9*. **P. tabulata,* Rec., ×250 (42).

Family ATLANTICELLIDAE Borgert, 1906

Without skeleton or with skeleton appended to bladder-like central capsule forming a ring with 4 paired hollow articulated vertical descending divergent spines from each of which arise greatly elongated recurved ascending branches. *Rec.*

Atlanticella BORGERT, 1906 [**A. planktonica;* SD herein]. Central capsule tomato-shaped; usually with skeleton.——FIG. 81,*8*. *A. bicornis* HAECKER, Rec., ×70 (42).

Cornucella BORGERT, 1907 [**C. maya*]. Central capsule with cylindrical arms.

Globicella BORGERT, 1907 [**G. pila*]. Central capsule globular.

Halocella BORGERT, 1907 [**H. gemma*]. Skeleton formed of spongy basket-like piece and 2 small winglike rods.

Lobocella BORGERT, 1907 [**L. proteus*]. Saccular central capsule with finger-like processes.

Miracella BORGERT, 1911 [**M. ovulum*]. Skeleton formed of adherent foreign matter.

Family CASTANELLIDAE Haeckel, 1879

[as Castanellida; emend. CAMPBELL, herein]

Generally spherical shell with ordinary lattice and round pores; radial spines lacking circles of basal pores; large mouth armed with teeth. *Rec.*

Subfamily CASTANELLINAE Haeckel, 1879

[as Castanellida *(partim);* emend. CAMPBELL, herein] [=Eucastanellinae HAECKER, 1908]

Pores without rosettes around main radial spines. *Rec.*

Castanella HKL., 1879 [**C. wyvillei* HKL., 1887]. Dentate mouth; without main radial spines.—— FIG. 81,*5*. **C. wyvillei,* Rec., ×40 (42).

Castanarium HKL., 1879 [**C. darwini* HKL., 1887]. Like *Castanella* but has smooth mouth.

Castanea HAECKER, 1906 [**C. amphora*]. Large solid shell; feeble main radial spines; small smooth mouth.——FIG. 81,*4*. **C. amphora,* Rec., ×75 (43).

Castanidium HKL., 1879 [**C. willemoesi* HKL., 1887]. Large unbranched radial main spines scattered between short bristles; smooth mouth. ——FIG. 81,*2*. *C. murrayi* HKL., Rec., ×40 (42).

Castanissa HKL., 1879 [**C. challengeri* HKL., 1887]. Like *Castanidium* but has dentate mouth. ——FIG. 81,*1*. **C. challengeri,* Rec., ×40 (42).

Castanopsis HKL., 1879 [**C. naresi* HKL., 1887]. Main radial spines branched.——FIG. 81,*3*. **C. naresi,* Rec., ×40 (42).

Castanura HKL., 1879 [**C. tizardi* HKL., 1887]. Like *Castanopsis* but has dentate mouth.——FIG. 81,*7*. **C. tizardi,* Rec., ×40 (42).

Subfamily CIRCOCASTANEINAE Haecker, 1908

Pore frames near bases of main radial spines solid; with rosettes within them. *Rec.*

Circocastanea HAECKER, 1906 [**C. margarita*]. Mouth toothed; with corona of 4 to 7 (5 to 8) rosettes.——FIG. 81,*6*. **C. margarita,* Rec., ×75 (43).

Family CIRCOPORIDAE Haeckel, 1879

[as Circoporida; emend. CAMPBELL, herein]

Spherical or polyhedral shell exhibiting solid porcelaneous structure and tabulate, paneled or dimpled surface; stellate circle of radial pores around base of hollow radial spines. *Rec.*

Subfamily CIRCOPORINAE Haeckel, 1879

[as Circoporida *(partim);* emend. CAMPBELL, herein] [=Circogonida HKL., 1887]

Paneled shell composed of polygonal plates; radial spines branched. *Rec.*

Circoporus HKL., 1879 [**C. sexfurcus* HKL., 1887]. Spherical shell with 6 radial spines.——FIG. 82,*3*. **C. sexfurcus,* Rec., ×40 (42).

Circogonia HKL., 1887 [**C. icosahedra;* SD herein]. Icosahedral shell with 12 radial spines. ——FIG. 82,*5*. **C. icosahedra,* Rec., ×40 (42).

Circoporetta HAECKER, 1908 [**Circoporus octahedrus* HKL., 1887]. Octahedral shell with trigonal plates; star-shaped pylome.——FIG. 82,*6*. **C. octahedrus* (HKL.), Rec., ×150 (42).

Circospathis HKL., 1879 [**C. furcata* HKL., 1887]. Tetradecahedral shell with 9 radial spines.——FIG. 82,*4*. **C. furcata,* Rec., ×40 (42).

Circostephanus HKL., 1879 [**C. coronarius* HKL., 1887]. Polyhedral shell with 24 to 40 or more radial spines.——FIG. 82,*2*. **C. coronarius,* Rec., ×50 (42).

Circorrhegma HKL., 1887 [**C. dodecahedra*]. Dodecahedral shell with 20 radial spines.——FIG. 82,*7*. **C. dodecahedra,* Rec., ×40 (42).

Subfamily HAECKELIANINAE Campbell, nov.

[=Haeckelinida HKL., 1887]

Dimpled spherical shell without polygonal plates; unbranched radial spines. *Rec.*

Haeckeliana HKL., 1887 [*non* MURRAY MSS, 1879] [*non Haeckeliania* GIARULT, 1912, *nec Haeckelina* BESSELS, 1875] [**H. porcellana;* SD herein]. Radial spines variable in number.——FIG. 82,*1. H. darwiniana* HKL., Rec., ×100 (42).

Family TUSCADORIDAE Haeckel, 1887

[as Tuscarorida; emend. CAMPBELL, herein]

Ovate or spindle-shaped smooth or spiny shell with solid porcelaneous texture; not

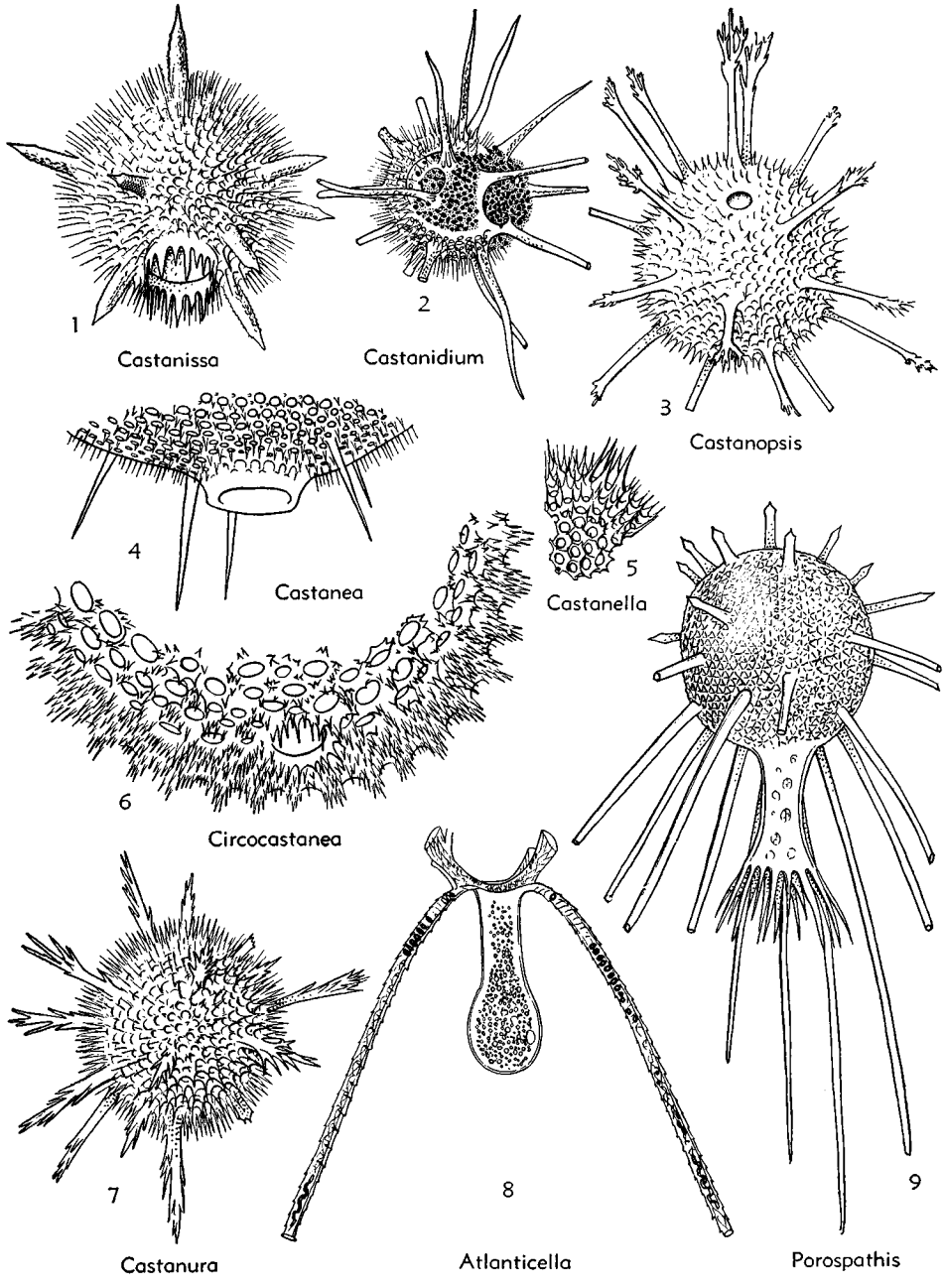

FIG. 81. Porospathididae, Atlanticellidae, Castanellidae (p. D154).

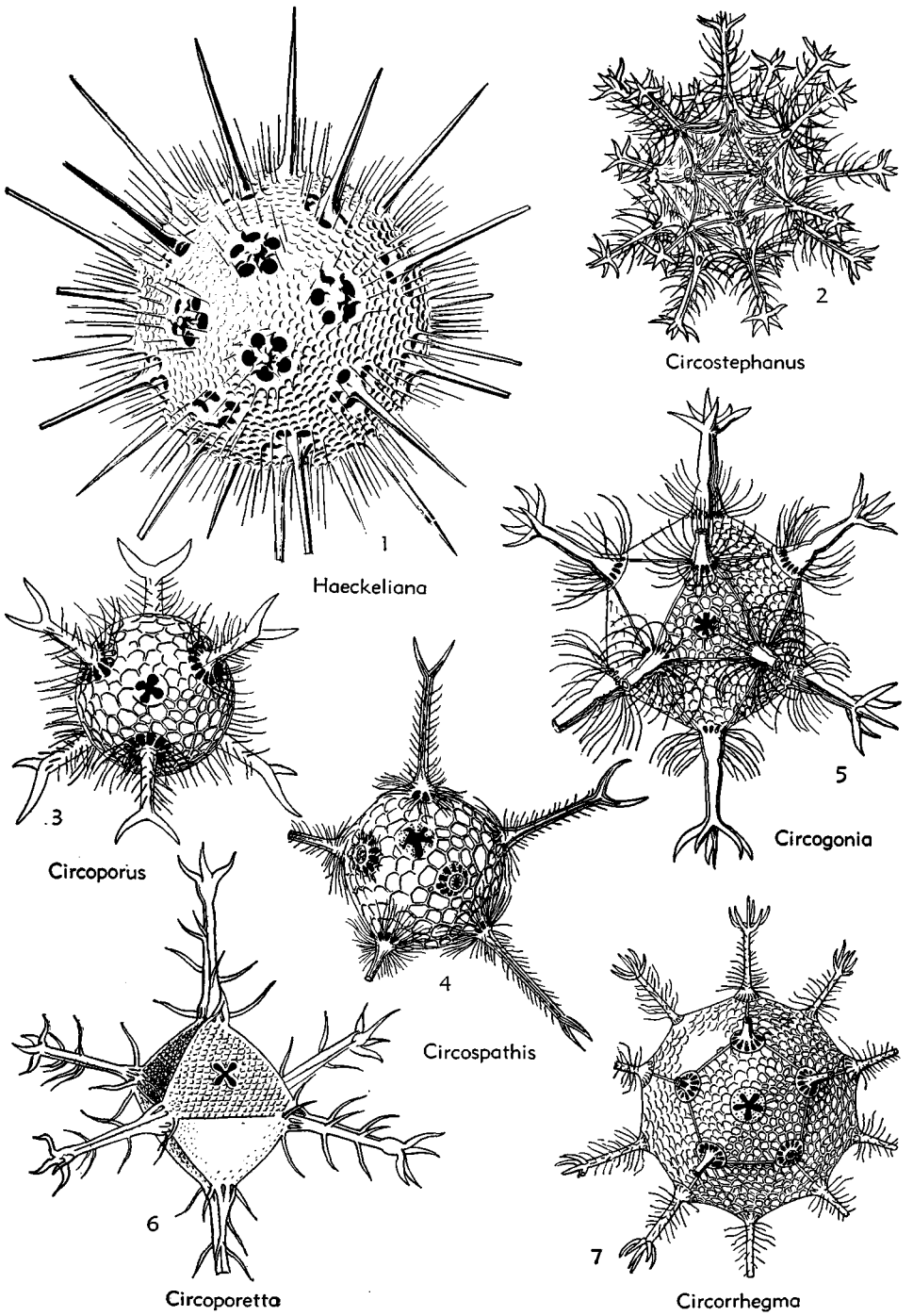

FIG. 82. Circoporidae (p. D154, D155).

paneled or tabulate; few pores around hollow radial legs. *Rec.*

Tuscadora HKL., 1879 [**Tuscarora bisternaris* MURRAY, 1879][=*Tuscarora* HKL., 1882]. Three equidistant radial legs.

T. (Tuscadora) [=*Tuscarantha* HKL., 1887 (obj.)]. Three oral teeth.——FIG. 83,*10*. *T. (T.) murrayi* (HKL.), Rec., ×10 (42).

T. (Tuscaretta) HKL., 1887 [**Tuscarora tubulosa* MURRAY, 1879; SD herein]. Two oral teeth.

T. (Tuscarilla) HKL., 1887 [**Tuscarora bellknapii* MURRAY, 1879]. Four crossed teeth.

Tuscaridium HKL., 1887 [**T. lithornithium;* SD herein]. Only one single leg.——FIG. 83,*11*. **T. lithornithium*, Rec., ×10 (42).

Tuscarusa HKL., 1887 [**T. medusa*]. Four legs. ——FIG. 83,*9*. **T. medusa*, Rec., ×10 (42).

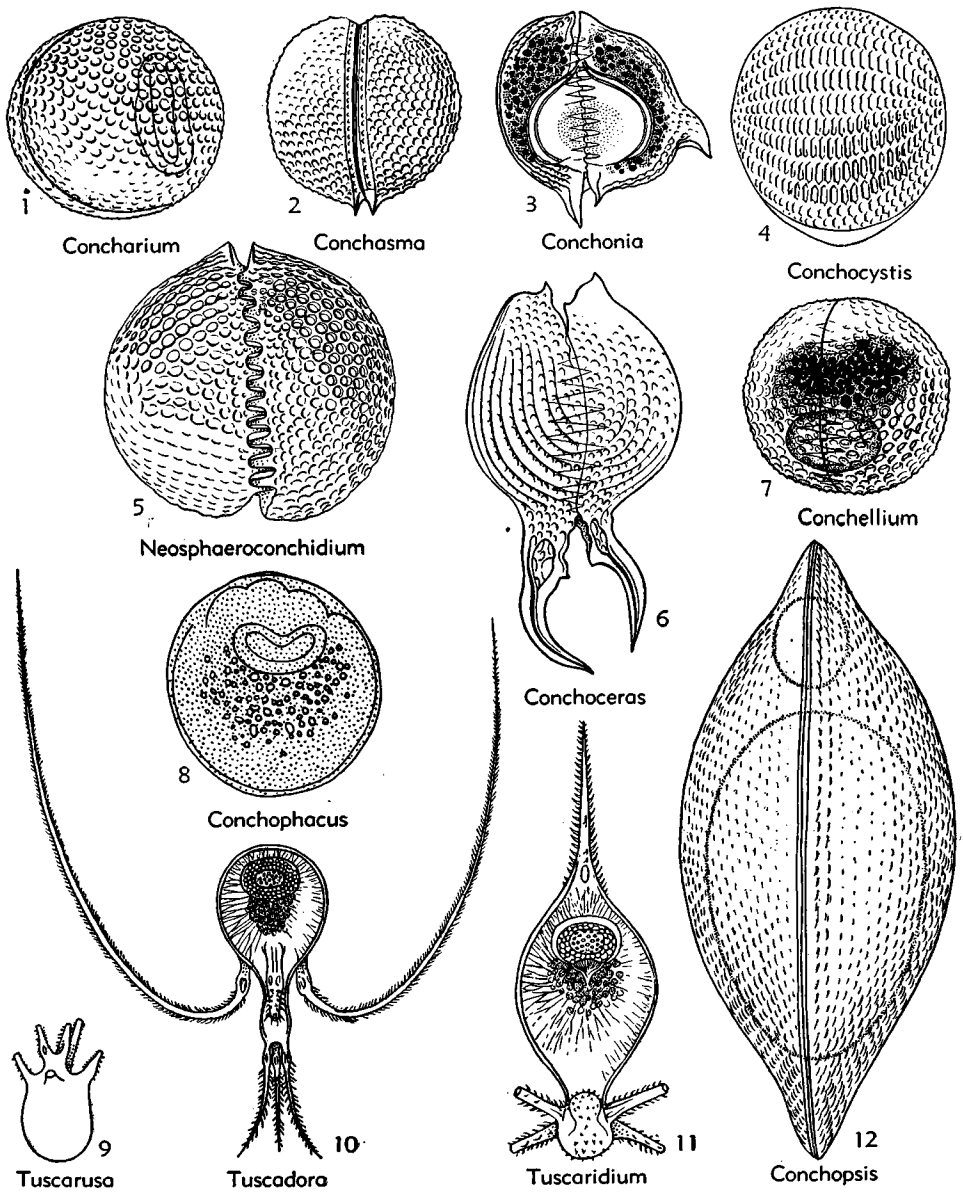

FIG. 83. Tuscadoridae, Conchariidae (p. D157, D158).

Superfamily CONCHARIICAE Haeckel, 1879

[*ex* Concharida; emend. CAMPBELL, herein] [=Phaeoconchia HKL., 1879 *(partim)*]

Two thick-walled valves perforated by rounded or slitlike pores. *Rec.*

Family CONCHARIIDAE Haeckel, 1879

[as Concharida; emend. CAMPBELL, herein]

Valves equal or unequal; boat-shaped. *Rec.*

Subfamily CONCHARIINAE Haeckel, 1879

[as Concharida *(partim)*; emend. CAMPBELL, herein] [=Conchasmida HKL., 1887]

Lateral edges of valves smooth. *Rec.*

Concharium HKL., 1879 [**C. bivalvum* HKL., 1887]. Aboral hinge lacks horn.——FIG. 83,*1*. **C. bivalvum*, Rec., ×75 (42).

Conchasma HKL., 1887 [**C. radiolites*; SD herein]. Aboral hinge with single horn.——FIG. 83,*2*. *C. sphaerulites* HKL., Rec., ×150 (42).

Subfamily NEOSPHAEROCONCHIDIINAE Campbell, nov.

[=emend. Conchidiinae HAECKER, 1908]

Lateral margin of valves dentate. *Rec.*

Neosphaeroconchidium CAMPBELL, 1952 [*pro Conchidium* HKL., 1879 (*non* LINNÉ, 1768, *nec* HISINGER, 1799)][**Conchidium terebratula* HKL., 1887]. Valves with 2 aboral horns on hinge; without apical horn.——FIG. 83,*5*. **N. terebratula* (HKL.), Rec., ×200 (42).

Conchellium HKL., 1887 [**C. tridacna*; SD herein]. Like *Neosphaeroconchidium* but lacks aboral horns. ——FIG. 83,*7*. **C. tridacna*, Rec., ×75 (42).

Conchocystis HAECKER, 1908 [**Conchellium lenticula* BORGERT, 1904]. Lens-shaped; diatom-like texture.——FIG. 83,*4*. **C. lenticula* (BORGERT), Rec., ×150 (43).

Conchonia HKL., 1887 [**C. diodon*; SD herein] [=*Conchura* HKL., 1887 (obj.)]. Apical horn on poles of sagittal axis; 2 caudal horns on hinge.——FIG. 83,*3*. **C. diodon*, Rec., ×100 (42).

Conchophacus HAECKER, 1908 [**Concharium diatomeum* HKL., 1887]. Like *Conchocystis* but pores are slitlike.——FIG. 83,*8*. **C. diatomeus* (HKL.), Rec., ×150 (43).

Subfamily CONCHOPSIDINAE Haeckel, 1887

[as Conchopsida; emend. CAMPBELL, herein] [=Conchidiinae HAECKER, 1908]

Shell compressed; with sharp sagittal keel. *Rec.*

Conchopsis HKL., 1879 [**C. orbicularis* HKL., 1887]. Aboral hinge without horns.——FIG. 83, *12*. *C. compressa* HKL., Rec., ×100 (42).

Conchoceras HKL., 1879 [**C. caudatum* HKL., 1887]. One horn on each valve.——FIG. 83,*6*. *C. cornutum* HKL., Rec., ×100 (42).

Superfamily COELODENDRICAE Haeckel, 1862

[*ex* Coelodendrida; emend. CAMPBELL, herein] [=Phaeoconchia HKL., 1879; Phaeodendria HAECKER, 1908]

Two thin-walled valves each with a conical process (galea) from which divergent branched tubes originate. *Rec.*

Family COELODENDRIDAE Haeckel, 1862

[as Coelodendrida; emend. CAMPBELL, herein]

Rhinocanna and frenula lacking. *Rec.*

Subfamily COELODENDRINAE Haeckel, 1862

[as Coelodendrida *(partim)*; emend. CAMPBELL, herein] [=Coelodorida HKL., 1887]

Without external mantle. *Rec.*

Coelodendrum HKL., 1860 [**C. ramosissimum* HERTWIG, 1879]. Forked or dichotomous nasal tubes.

C. (Coelodendrum) [=*Coelodendridium* HKL., 1887 (obj.)]. Terminal ramules of last branches equal.——FIG. 84,*1*. *C. furcatissimum* HKL., Rec., ×20 (42).

C. (Coelodendronium) HKL., 1887 [**C. cervicorne*; SD herein]. Terminal ramules of last branches unequal.

Coelodoras HKL., 1887 [**C. hexagraphis*; SD herein]. Nasal tubes unbranched.

Subfamily COELODRYMINAE Haeckel, 1887

[as Coelodrymida; emend. CAMPBELL, herein]

External bivalved mantle produced by anastomoses of branched hollow tubes. *Rec.*

Coelodrymus HKL., 1879 [**C. ancoratus* HKL., 1887]. Lattice mantle not spongy.——FIG. 84,*2*. **C. ancoratus*, Rec., ×20 (42).

Coelodasea HKL., 1887 [**C. spongiosa*; SD herein]. Mantle spongy.

Family COELOGRAPHIDIDAE Haeckel, 1887

[as Coelographida; emend. CAMPBELL, herein] [=Coelodendridae HAECKER, 1908]

Rhinocanna and single or double frenulum present. *Rec.*

Subfamily COELOGRAPHIDINAE Haeckel, 1887

[as Coelographida *(partim)*; emend. CAMPBELL, herein] [=Coeloplegmida HKL., 1887; Coeloplegminae, HAECKER, 1908]

Rhinocanna of each valve with odd sagittal frenulum; with external mantle. *Rec.*

Coelographis HKL., 1887 [**C. regina*; SD herein]. Styles 6.——FIG. 84,*3*. **C. regina*, Rec., ×10 (42).

Coelathemum HAECKER, 1907 [**C. auloceroides*]. Styles 28.——FIG. 84,*5*. **C. auloceroides*, Rec., ×40 (43).

Coelodecas HKL., 1887 [**C. sagittaria*; SD herein]. Styles 10.——FIG. 85,*4*. **C. sagittaria*, Rec., ×10 (42).

Coelogalma HKL., 1887 [**C. mirabile*]. Styles 16.——FIG. 85,*6*. **C. mirabile*, Rec., ×10 (42).

Coeloplegma HKL., 1887 [**C. murrayanum*; SD herein]. Styles 14.——FIG. 85,*1*. **C. murrayanum*, Rec., ×20 (42).

Coelospathis HKL., 1887 [**C. ancorata*; *SD* herein]. Styles 8.——FIG. 84,*4*. **C. ancorata*, Rec., ×20 (42).

Coelostylus HKL., 1887 [**C. bisenarius*; SD herein]. Styles 12.——FIG. 85,*3*. **C. bisenarius*, Rec., ×10 (42).

Subfamily COELOTHYRINAE Haecker, 1908

Without nasal styles. *Rec.*

Coelothyrus HAECKER, 1907 [**C. cypripedium*]. Without lattice mantle.——FIG. 85,*5*. **C. cypripedium*, Rec., ×15 (43).

Coelopodium POP., 1926 [**C. borgerti*]. Mantle present.——FIG. 85,*2*. **C. borgerti*, anchor branches and side branches, ×80 (48).

Subfamily COELOTETRACERADINAE Campbell, nov.

Galea exaggerated. *Rec.*

Coelotetraceras HAECKER, 1907 [**C. xanthacanthium*]. Galea with high wide nasal opening.——FIG. 86,*4*. **C. xanthacanthium*, nasal side and 2 main spines, ×20 (43).

Coelechinus HAECKER, 1904 [**C. wapiticornis*]. Tubes and dendrites similar.——FIG. 86,*5*. **C. wapiticornis*, Rec., ×50 (43).

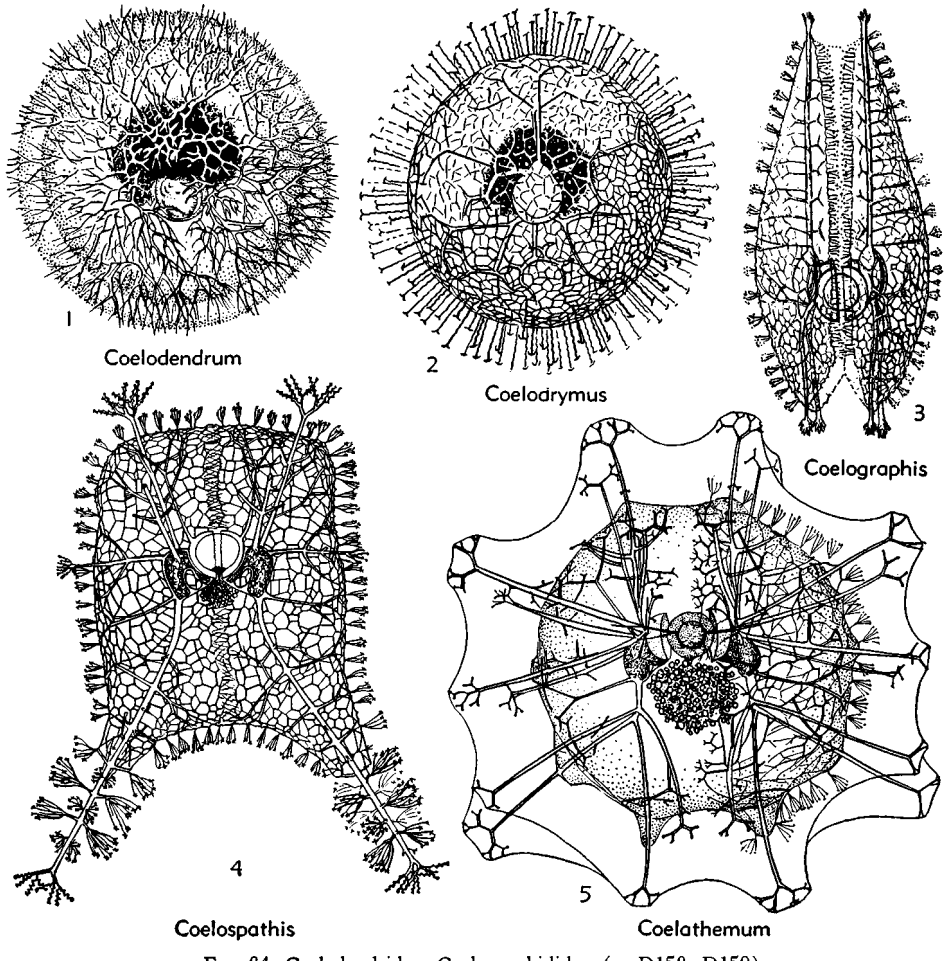

FIG. 84. Coelodendridae, Coelographididae (p. D158, D159).

Coelodiceras HAECKER, 1907 [**C. macropylum*]. Nasal tubes developed like styles.——FIG. 86,*6*. *C. spinosum* HAECKER, Rec., ×50 (43).

Subfamily COELOTHOLINAE Haeckel, 1887

[as Coelotholida; emend. CAMPBELL, herein]

Two paired lateral frenula on each galea; without lattice mantle. *Rec.*

Coelotholus HKL., 1887 [**C. octonus;* SD herein]. Paired styles 8.——FIG. 86,*2*. **C. octonus*, Rec., ×10 (42).

Coelothauma HKL., 1879 [**C. duodenum* HKL., 1887]. Paired styles 12.——FIG. 86,*1*. **C. duodenum*, Rec., ×10 (42).

Coelothamnus HKL., 1879 [**C. davidoffi* BÜTSCHLI, 1882]. Paired styles 16.——FIG. 86,*3*. *C. bivalvis*, Rec., ×10 (42).

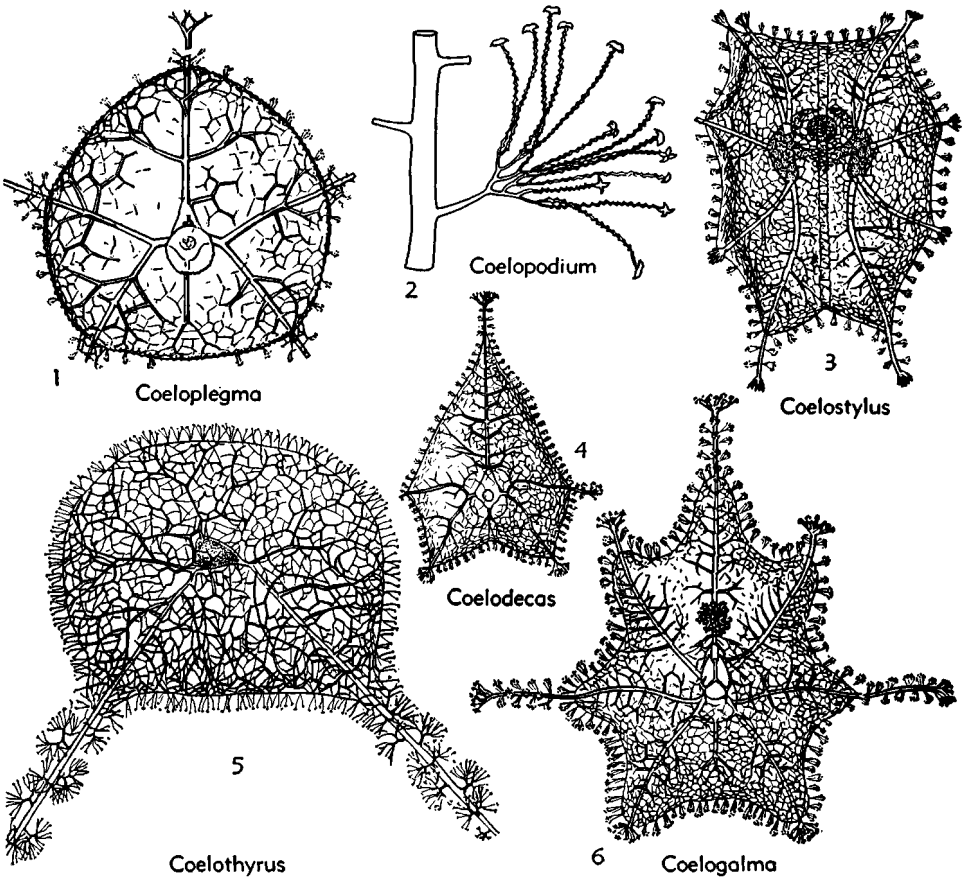

FIG. 85. Coelographididae (p. D159).

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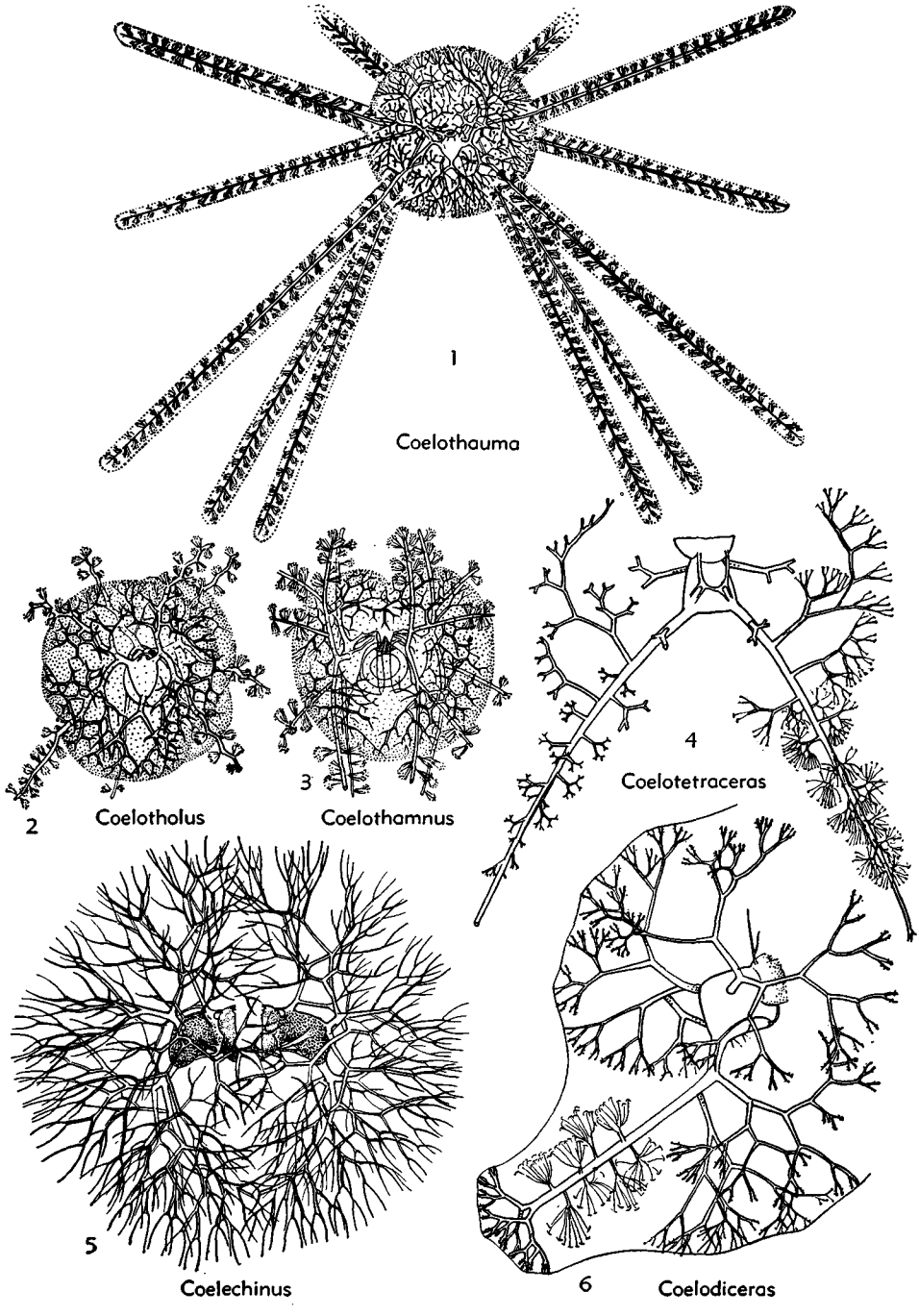

FIG. 86. Coelographididae (p. D159, D160).

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