×2.7 (Birenheide, 1969a).——Fig. 185,*4d,e*. *P. rectum* (Walther), Frasn., Ger., Deilinghofen and Warrenbeck; *d,e*, transv., long. secs., ×2.7 (Schouppé, 1958).——Fig. 185,*4f,g*. *P. gallica* (Lang & Smith), Frasn., probably from F_{2e} sh. behind Boussu Cemetery, Belg.; *f,g*, transv., long. sec., ×2.0, ×2.7 (Hill, n; UQF12794); see Fig. 8 for an enlarged view of *g*.

Thamnophyllum Penecke, 1894, p. 593 [**T. stachei*; SD Lang & Smith, 1935, p. 564; †886, UG, Graz; lectotype by Flügel, 1958, p. 625] [?=*Phacellophyllum* Gürich, 1909, which see]. Dendroid or phaceloid, with axial increase; septa so dilated in dissepimentarium that only loculi are those enclosed by median series of small horseshoe dissepiments; septal trabeculae ?rhiphidacanths; in tabularium septa are attenuate and do not reach axis; tabulae typically transverse, flat or slightly domed or saucered, mostly complete and commonly widely spaced. *L.Dev.*, Australia(Vict.); *M. Dev. (Eifel.)*, Eu. (Aus.-?France)-Asia (Urals).——Fig. 185,*3a-d*. **T. stachei*, M.Dev., Barrandei beds, Aus.; *a,b*, transv., long. secs., ×2.7, ×1.3 (Lang & Smith, 1935), *c,d*, transv., long. secs., ×3.9, ×4.5 (Hill, n; BM(NH) R30991, R30994).

Vestigiphyllum Sytova in Sytova & Ulitina, 1970, p. 117 [**Thamnophyllum tabulatum* Bulvanker, 1958, p. 79; OD; †99 and slide 720a, coll. 7761, TsGM, Leningrad] [?=*Phacellophyllum* Gürich, 1909, which see, stability of aulos in *Vestigiphyllum* uncertain, no aulos in *Phacellophyllum; Thamnosyringaxon* Ivanovskiy, 1973b, p. 116, *nom. null.* (type, *Thamnophyllum tabulatum* Bulvanker, see above); *Neopetrozium* Jia in Jia *et al.*, 1977, p. 151 (type, *N. zhongguoense*, OD; †IV37034, HPRIGS, Yichang; L.Dev., Gui Xian, Guangxi [Kwangsi])]. Branching, corallites long, cylindrical, increase lateral; major septa withdrawn somewhat from axis to upper edges of mesa-shaped axial tabellae which may be based one upon another thus forming ?impersistent tabular aulos or may have their edges declined to dissepimentarium; adaxially declined or flat periaxial tabellae may occur; minor septa very short; septa somewhat thickened in narrow dissepimentarium which consists of longitudinal series of small horseshoe dissepiments separated from outer wall by very narrow flat or slightly convex dissepiments declined toward outer wall. *L.Dev.*, Asia(Kwangsi); *M. Dev. (Eifel.)*, Asia (Kuzbas-Transcauc.).——Fig. 185,*2a,b*. **V. tabulatum* (Bulvanker), holotype, Shandin beds, Kuzbas, Mt. Krest, SW. of Ashkurek; *a,b*, transv., long. secs., ×2.7 (Bulvanker, 1958).

GROUP 4

Peneckiella Soshkina, 1939, p. 23 [**Diphyphyllum minus* Roemer, 1855, p. 29; OD; †117, BA, Clausthal-Zellerfeld] [=*Penenckiella* Stumm, 1949, p. 37, *nom. null.*; see also under *Phacellophyllum* Gürich, 1909; *?Sudetia* Rozkowska, 1960, which see]. Phaceloid; septa noncarinate but thickened especially at inner edge of dissepimentarium, which is narrow and commonly of one series of globose plates flattened above, each with its inner edge curved down in three-fourths hemisphere to meet plate next below and its outer edge abutting wall at level higher than base of inner edge (peneckielloid) [these have been interpreted by Flügel, 1956b, p. 356, and Schouppé, 1958, p. 229, as horseshoe plates with their outer ends amalgamate with wall]; rarely one or a few horseshoe dissepiments are found; septal trabecular fans may occur with zone of divergence at axis of curvature of upper surface of dissepiments; trabeculae rhipidacanths; tabulae commonly in one series and complete, may be flat-topped domes; peripheral tabellae declined adaxially may occur [Hill & Jell, 1970b, p. 30; Scrutton, 1968, p. 271]. *?L.Dev.(Ems.)*, Australia(New S.Wales); *?M.Dev.(Givet.)*, W.Australia-N.Am.(Wash.); *U. Dev. (Frasn.)*, Eu. (Ger.-U.K.-Pol.)-W. Australia.——Fig. 186,*2a,b*. **P. minor* (Roemer), holotype, Frasn., Iberg Ls., Ger., Winterburg near Bad Grund; *a,b*, oblique transv., long. secs., ×3, ×6 (Scrutton, 1968).

Sudetia Rozkowska, 1960, p. 35 [**S. lateseptata*; OD; †Rozkowska figs. 30-33, PZI, Poznan] [?=*Peneckiella* Soshkina, 1939, which see, *fide* Scrutton, 1968, p. 273]. Dendroid; increase lateral, from connecting process, offset thamnophylloid or aseptate; corallites with slender stereozone at boundary between tabularium and dissepimentarium, major septa short, scarcely extending beyond stereozone; minor septa shorter, not always projecting beyond wall; one series of peneckielloid dissepiments; trabecular fans asymmetrical, with axis of divergence near wall, resting on distal end of peneckielloid dissepiment; trabeculae thick; tabulae mostly complete, concave or horizontal. *U.Dev.(Frasn.)*, Eu.(Pol.-Urals).——Fig. 186,*1a-d*. **S. lateseptata*, holotype, Pol., Mokrzeszow (formerly Oberkunzendorf); *a*, transv. sec., ×7.4; *b-d*, long. secs., ×5.0, ×5.2, ×3.2 (Rozkowska, 1960).

Suborder CYATHOPHYLLINA Nicholson, 1889

[*nom. correct.* Hill, herein, *ex* "Order Zoantharia, Section II Madreporaria Rugosa (Tetracoralla) Section I Cyathophylloidea" Nicholson in Nicholson & Lydekker, 1889, p. 284. It is assumed from this citation that Nicholson's taxon is of ordinal rank; he included Cyathophyllidae Dana, 1846b, Heliophyllidae Nicholson, 1889 (=Zaphrentidae Milne-Edwards & Haime, 1850), and Clisiophyllidae Nicholson in Nicholson & Lydekker, 1889, p. 291.] [=Zaphrentina Nicholson, 1889, *nom. correct.* Weyer, 1972c, p. 448, *pro* Zaphrentoidea Nicholson in Nicholson & Lydekker, 1889, p. 293. Nicholson, not knowing that dissepiments are commonly developed distally in *Zaphrentis*, used the name Zaphrentoidea for those Rugosa without dissepimentarium.]

Solitary or compound Stauriida with dissepimentarium of small, normal dissepiments; in late stages septa attenuate; septa commonly long, carinate or otherwise complexly structured in dissepimentarium; major septa deflected to form aulos in Eridophyllinae; tabular floors variable: flat or low domes that may be axially depressed, or slightly arched axially and bent down at margins; tabulae complete or incomplete. *Sil.-Dev.; L.Carb.*

Family ERIDOPHYLLIDAE de Fromentel, 1861

[*nom. correct.* STUMM, 1949, p. 32, in translated form as Eridophyllinae DE FROMENTEL, 1861, p. 301, *pro* Eridophylliens DE FROMENTEL, 1861, p. 301] [=Craspedophyllidae DYBOWSKI, 1873c, p. 339; Crepidophyllidae YÜ, 1934, p. 88, as Crepidophyllidae GRABAU MS]

?Solitary, fasciculate or massive; septa attenuate, of fine, close monacanthine trabeculae and with zigzag to yardarm carinae parallel to curvature of trabeculae; major septa deflected to form aulos in Eridophyllinae and long or short in others; dissepimentarium of one to several rows of globose normal dissepiments; tabular floors variable, commonly flat or slightly arched axially and downbent at margins of tabularium; tabulae complete or incomplete [OLIVER, 1974, p. 166]. *U.Sil.-M.Dev.*

Subfamily ERIDOPHYLLINAE de Fromentel, 1861

[*nom. transl. et correct.* STUMM, 1949, p. 32, *ex* Eridophylliens DE FROMENTEL, 1861, p. 301] [=Craspedophyllinae DYBOWSKI, 1873c, *nom. transl.* OLIVER, 1974, p. 170, *ex* Craspedophyllidae DYBOWSKI, 1873c, p. 339; Crepidophyllinae YÜ, 1934, *nom. transl.* OLIVER, 1975a, p. 153, *ex* Crepidophyllidae YÜ, 1934, p. 88, as Crepidophyllidae GRABAU MS]

?Solitary, fasciculate or alternately phaceloid and cerioid eridophyllids; major septa deflected in tabularium to form perfect or imperfect aulos; septa thin and strongly carinate and major septa may or may not enter aulos [OLIVER, 1974, p. 170]. *U.Sil.-M.Dev.*

Eridophyllum MILNE-EDWARDS & HAIME, 1850, p. lxxi [**E. seriale*; OD; †in DE VERNEUIL Coll., EM, Paris; lectotype by SMITH, 1933, p. 515] [=*Craspedophyllum* DYBOWSKI, 1873c, p. 339, generic name and diagnosis only; 1873b, p. 155 (type, *C. americanum,* M; †not traced; M.Dev., Columbus, Ohio); *Crepidophyllum* NICHOLSON & THOMSON, 1876, p. 149 (type, *Diphyphyllum Archiaci* BILLINGS, 1860, p. 260, SD MILLER, 1889-1897, p. 180; †not found in GSC, Ottawa; Hamilton Sh., Bosanquet, Ont.); *Schistotoechelasma* STEWART, 1938, p. 45 (type, *S. typicalis,* OD; †2172, OSU, Columbus; M.Dev., Columbus Ls., Columbus, Ohio); *Schistotoechelasma* LANG, SMITH, & THOMAS, 1940, p. 117, *nom. van.*]. Phaceloid, with connecting processes; septa but slightly dilated, commonly carinate with yardarm carinae; marginarium a wide dissepimentarium with small, mostly globose, equal plates in several series; a thin aulos, breached at the cardinal fossula in some, separating an axial series of horizontal tabellae from a periaxial series of tabellae declined outward [see OLIVER, 1976a, p. 96]. *M. Dev.,* N. Am. (Ohio-Ind.-Mich.-Ont.)-N. Afr. (Moroc.).——FIG. 187,*2a,b.* **E. seriale,* Columbus Ls., Ohio, Sandusky; *a,b,* transv., long. secs., ×2 (Stewart, 1938).

Capnophyllum SUTHERLAND, 1965, p. 28 [**C. hedlundi*; OD; †5474, OU, Norman]. Solitary, or with impersistent peripheral increase; major septa subequal, withdrawn somewhat from axis, and in places with their axial ends united to form aulos that may be impersistent in late stages; minor septa long; both orders carinate, carinae in half fans, from zigzag to yardarm in type; cardinal fossula not apparent; dissepimentarium wide, of small, globose and subglobose dissepiments; tabular floors flat; periaxial tabellae outside aulos when present are mostly declined like dissepiments toward aulos. *U.Sil.(Ludlov.),* N.Am.(Okla.).——FIG. 188,*2a,b.* **C. hedlundi,* holotype, Henryhouse F., Lawrence uplift, Okla.; *a,b,* transv., long. secs., ×4 (Sutherland, 1965).

Grewgiphyllum OLIVER, 1974, p. 170 [**Heliophyllum colligatum* BILLINGS, 1859b, p. 126; OD; †31158, GSC, Ottawa; lectotype by OLIVER, 1974, p. 172] [?=*Craspedophyllum* DYBOWSKI, 1873c, p. 339, see *Eridophyllum*]. Like *Eridophyllum* but alternately phaceloid and cerioid and with imperfect aulos commonly penetrated by major septa [see OLIVER, 1976a, p. 108]. *L.Dev.(Ems.)-M.Dev.(Eifel.),* N.Am.(Ont.).——FIG. 188,*1a,b.* **G. colligatum* (BILLINGS), lectotype, L.Dev., Bois Blanc F., Ont., Walpole; *a,b,* transv., long. secs., ×1.0, ×2.5 (Oliver, 1974; photographs courtesy W. A. Oliver).

Tipheophyllum HILL, 1956a, p. 9 [**Eridophyllum bartrumi* ALLAN, 1935, p. 4; OD; †in VU coll., Auckland, but part =R25545, BM(NH), London]. Phaceloid or partly cerioid; corallites with wide dissepimentarium and carinate septa, major septa withdrawn from axis but with their axial edges irregularly carinate, spinose, bent so as to divide tabularium into two regions but not to form persistent aulos; septal trabeculae broad, simple monacanths, carinae of yardarm type or from zigzags; axial tabellae subhorizontal and periaxial tabellae declined adaxially [see also PEDDER, JACKSON, & PHILIP, 1970, p. 230]. *L.Dev.,* N.Z.-Australia (New S.Wales).——FIG. 187,*1a,b.* **T. bartrumi* (ALLAN), Reefton Ls., N.Z., road cutting, Reefton-Springs Junction road, 3.5 mi. S. of Reefton; *a,b,* transv., long. secs., ×2 (Hill, n; UQF54940).

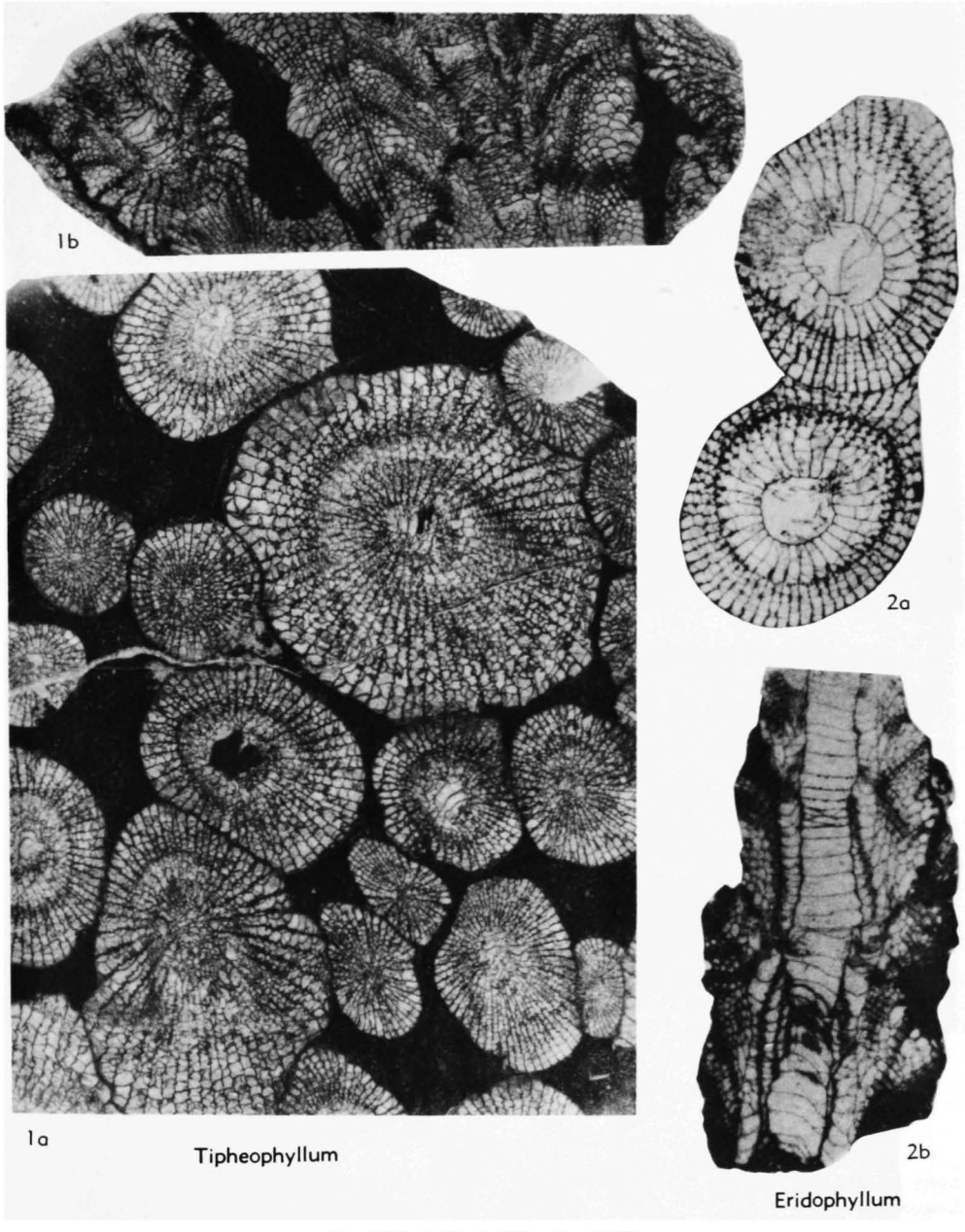


FIG. 187. Eridophyllidae (p. *F*290).

Subfamily CYLINDROPHYLLINAE Oliver, 1974

[Cylindrophyllinae OLIVER, 1974, p. 166] [=Billingsastraeinae JELL, 1969, p. 68, *nom. inval.*, being based on *Billingsastraea* GRABAU, 1917b, p. 957, invalid name, *fide* OLIVER, 1974, p. 167, based on probably Silurian coral unrelated to forms on which concept *Billingsastraea* AUCTT. has been based]

Eridophyllids lacking aulos. *L.Dev.-M. Dev.*

Cylindrophyllum SIMPSON, 1900, p. 217, *non Cylindrophyllum* YABE & HAYASAKA, 1915, p. 90, a Devonian rugose coral renamed *Fletcherina* LANG, SMITH, & THOMAS, 1955, p. 261 [**C. elongatum*; OD; †246, NYSM, Albany] [?=*Cylindrohelium* GRABAU, 1910, p. 102 (type, *C. profundum*, OD; †13085, UMMP, Ann Arbor, lectotype by OLIVER, 1976a, p. 68; L.Dev., Lucas Dol., Silica Quarry,

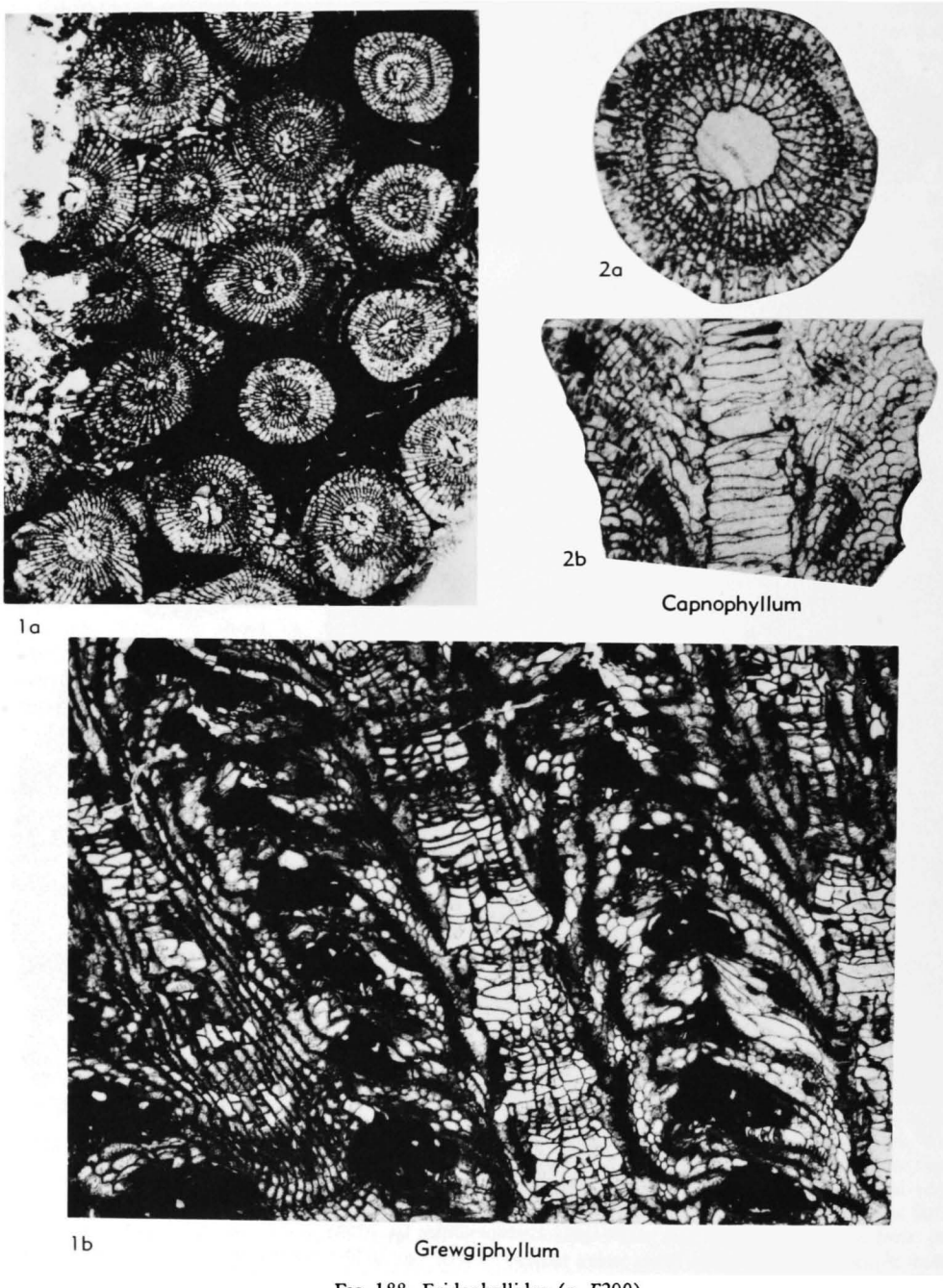


FIG. 188. Eridophyllidae (p. *F290*).

near Sylvania, Ohio; calical molds, unrecognizable)]. Phaceloid; cylindrical corallites connected by slender lateral processes; major and minor septa attenuate, with weak or strong development of zigzag or subyardarm carinae; major septa not extending to axis; minor septa not long; tabulae commonly complete and subhorizontal, or concave with supplementary tabellae peripherally; dissepiments in few series, small, subglobose [see OLIVER, 1976a, p. 68]. *L.Dev.(Ems.)-M.Dev.(Givet.)*, N. Am.(N.Y.-Ont.-Ind.-Ohio-Ky.); *M.Dev.*, S.Am. (Venez.)-?Asia(Viet Nam).——FIG. 189,*2a,b*. **C.*

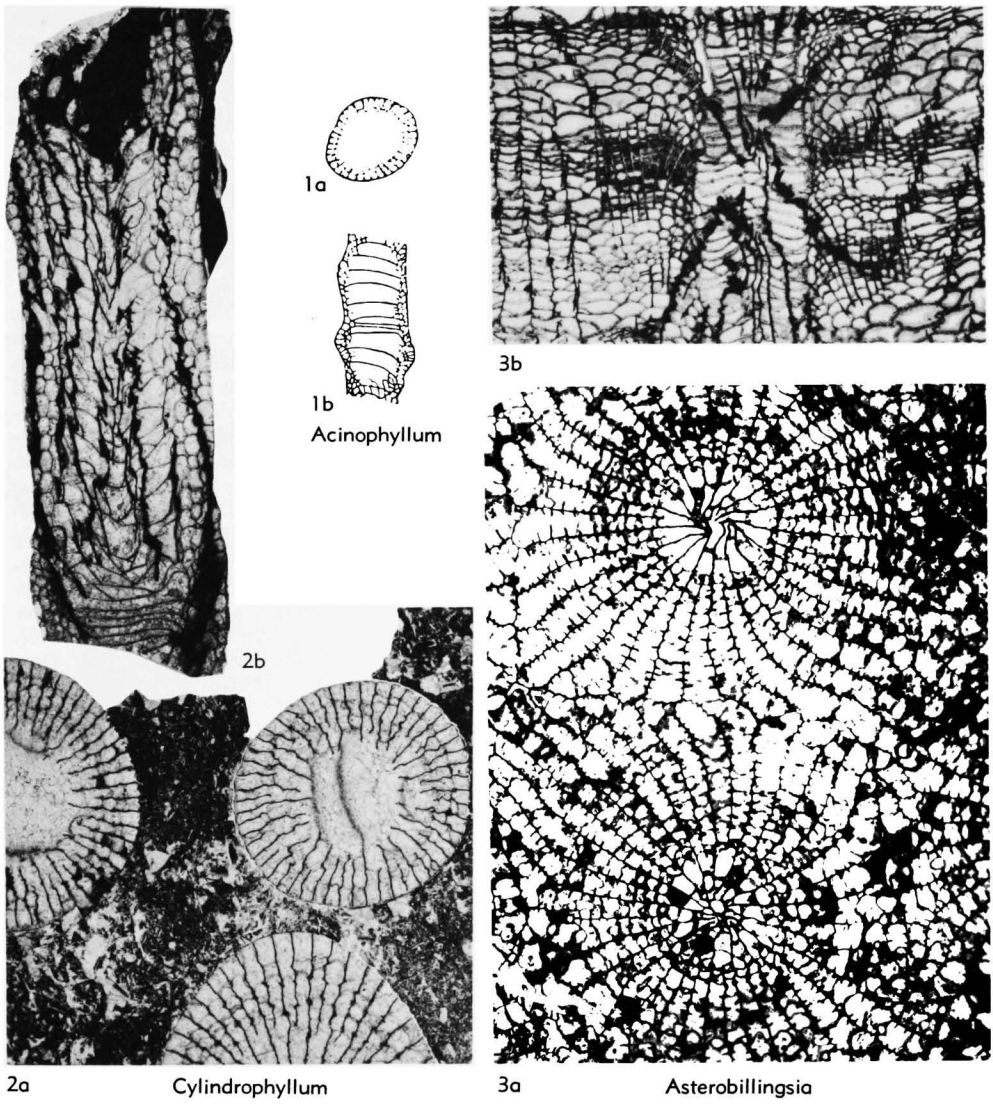
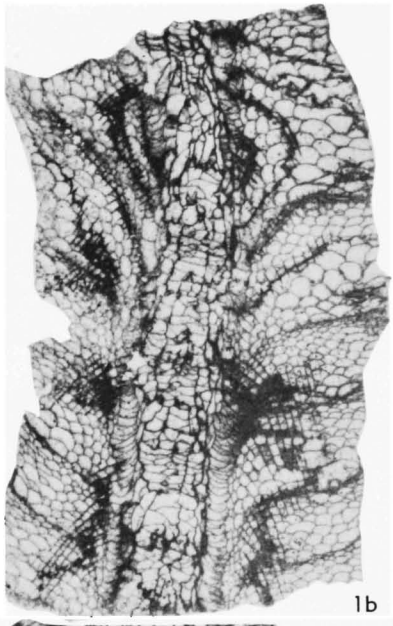


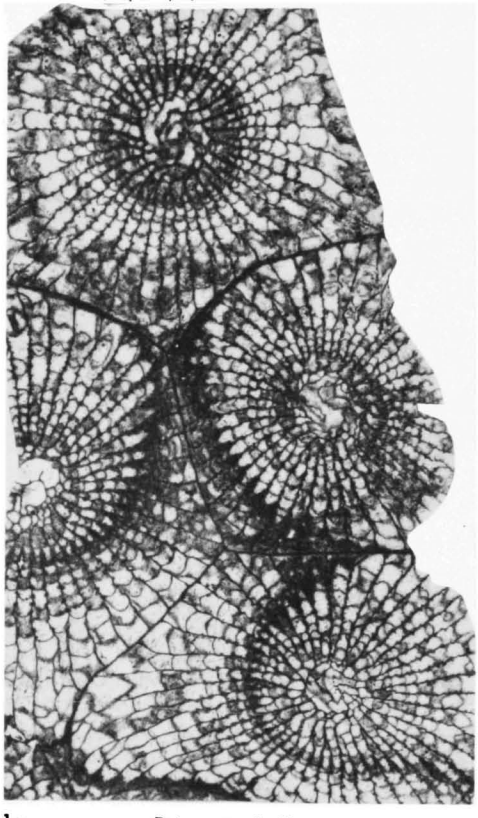
FIG. 189. Eridophyllidae (p. *F*291-*F*294).

elongatum; a, holotype, M.Dev., Onondaga Ls., N.Y., Clarksville, transv. sec., ×1.9; *b,* another specimen, reef facies Edgecliff Mbr., N.Y., long. sec., ×1.9 (Oliver, 1976a).

Acinophyllum McLAREN, 1959, p. 22 [**Eridophyllum simcoense* BILLINGS, 1859b, p. 132; OD; †neotype, 31144, GSC, Ottawa; by OLIVER, 1976a, p. 57]. Dendroid or phaceloid with lateral increase; corallites slender, cylindrical, rarely connected by tubular lateral projections from corallite walls; septa weakly dilated and carinate peripherally, commonly with zigzag carinae; septal trabeculae very fine, arranged in half fans; major septa short or long, never extending to axis; minor septa short; tabularium wide, with well-spaced, more or less horizontal tabulae, commonly complete but sometimes incomplete; dissepimentarium narrow, formed of one or two, rarely more, rows of small, globose dissepiments. [Compare with *Planetophyllum* CRICKMAY, 1960, Columnariina, Columnariidae; see also EASTON & OLIVER, 1973, p. 916]. *L.Dev.(Ems.)-M.Dev.(Eifel.),* N.Am. (Ont.-N. Y.-Ohio-Mich.-Va.-Ky.-Que.)-S. Am. (Venez.).——FIG. 189,*1a,b*. **A. simcoense* (BILLINGS), Ems., Bois Blanc F., Ont., Woodstock; *a,b,* transv., long. secs., ×0.8 (McLaren, 1959).



1b



1a Prismatophyllum

FIG. 190. Eridophyllidae (p. F294).

Asterobillingsia OLIVER, 1974, p. 167 [**A. magdisa*; OD; †163419, USNM, Washington] [?=*Asterocycles* VANUXEM, 1842, p. 136 (type, *A. confluens*, M; †lost or unrecognizable; M.Dev., Onondaga Ls., quarry S. of Chittenango near Perryville, N.Y.; probably based on specimen of *Asterobillingsia magdisa* OLIVER, 1974; OLIVER, 1974, p. 168); *?Billingsastraea* GRABAU, 1971b, p. 957 (type, *Phillipsastrea verneuili* MILNE-EDWARDS & HAIME, 1851, p. 447, M; figured syntype not found in DE VERNEUIL Coll., EM, Paris; possible syntype in that collection is *Arachnophyllum* probably from the Niag. Hopkinton Dol., *fide* OLIVER, 1974, p. 167), OLIVER considers generic name unusable in its conventional aspect]. Astreoid to thamnasterioid; calice with axial pit and broad horizontal or reflexed peripheral platform, commonly with raised zone around pit; septa attenuate, lightly to heavily carinate with zigzag to subyardarm carinae; major septa long, almost attaining axis; minor septa moderately long; dissepimentarium of globose dissepiments horizontally arranged except near tabularia; tabularium narrow, tabular floors closely spaced, more or less horizontal, may have raised axial zone, tabulae complete or incomplete [see OLIVER, 1976a, p. 88]. *L.Dev.(Ems.)-M.Dev.(Givet.)*, N.Am.(N.Y.-Ont.-Que.-Mich.).——FIG. 189,*3a,b*. **A. magdisa*, paratype, L.Dev., Bois Blanc F., Hagersville, Ont.; transv., long. secs., ×3.8 (Oliver, 1974; photographs courtesy W. A. Oliver, USNM163420).

Prismatophyllum SIMPSON, 1900, p. 218 [**P. rugosum*; OD (=*P. prisma* LANG & SMITH, 1935, p. 558, obj.—Ed.); †e-142, DE VERNEUIL Coll., EM, Paris; lectotype by LANG & SMITH, 1935, p. 558, lectotype slides R31370, 31371, BM(NH), London]. Cerioid, corallites thin-walled, with long uniformly attenuate septa typically with long, thin, zigzag to subyardarm, widely spaced carinae, weakly to strongly developed, mainly in dissepimentarium; major septa may reach axis or leave narrow axial space, axial ends may coil weakly or not; dissepiments numerous, small, subglobose; tabulae incomplete, more or less horizontal, may have narrow periaxial series of closer, concave tabellae [HILL & JELL, 1970b, p. 45; OLIVER, 1976a, p. 77]. *L.Dev.(Ems.)-M.Dev.(Couvin.-Givet.)*, N.Am.(Ind.-Ky.-Ohio).——FIG. 190,*1a,b*. **P. prisma*, BM(NH), London, slides of lectotype, ?M.Dev.(Eifel.), Ind., Charlestown Landing; *a,b*, transv., long. secs., ×3.4 (Hill, n).

Family ZAPHRENTIDAE Milne-Edwards & Haime, 1850

[*nom. correct.* ROEMER, 1883, p. 362, *pro* Zaphrentiniens DE FROMENTEL, 1861, p. 284, *nom. transl. ex* Zaphrentinae MILNE-EDWARDS & HAIME, 1850, p. lxv] [=Heliophyllidae NICHOLSON in NICHOLSON & LYDEKKER, 1889, p. 289; Zaphrentiadae MINATO, 1943, p. 230; Zaphrenthidae MOORE & JEFFORDS, 1945, p. 143; Zaphrenticae HILL, 1956b, p. F268]

Solitary, fasciculate or massive; bilateral symmetry distinct; septa long, dilated in

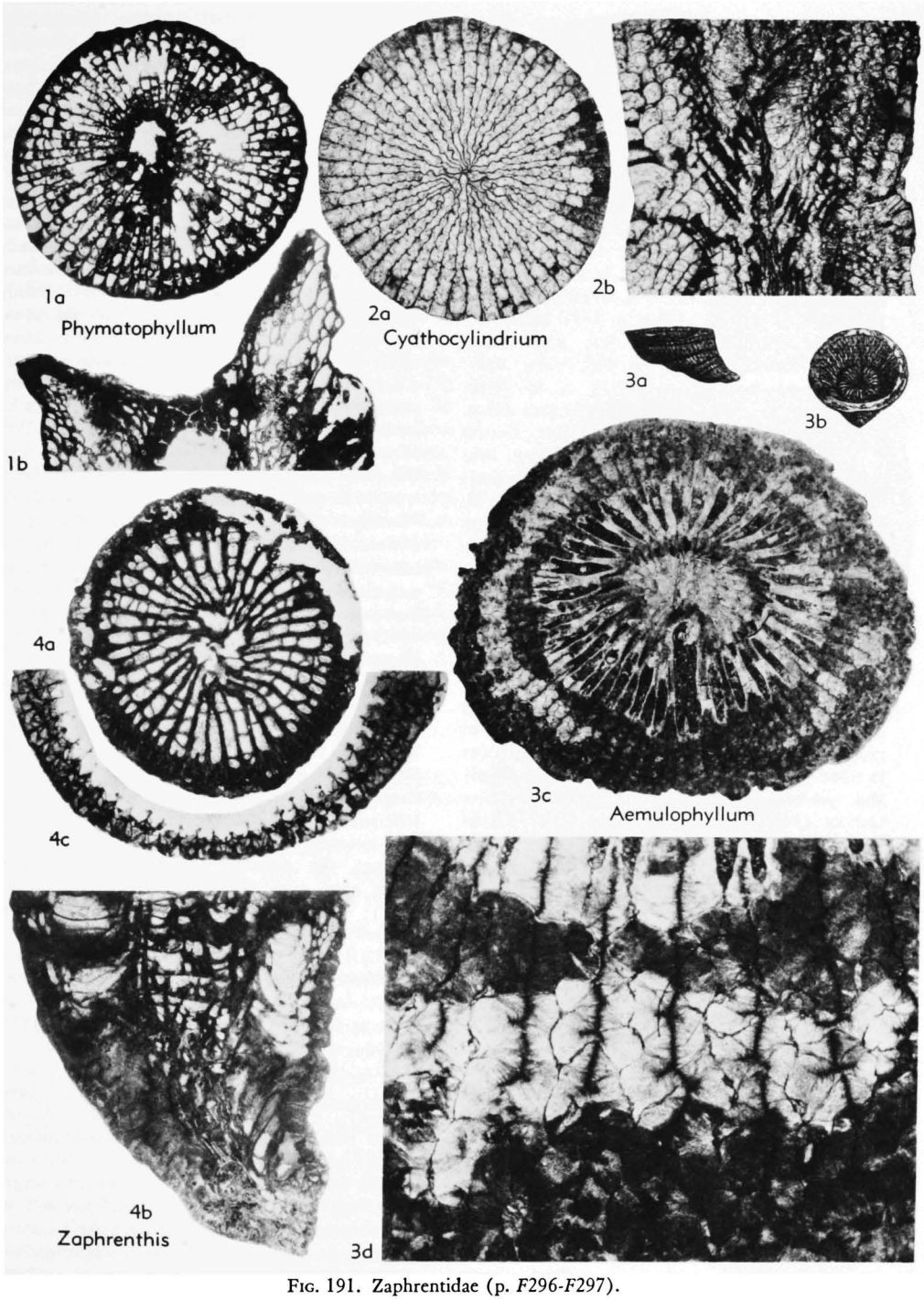


FIG. 191. Zaphrentidae (p. *F296-F297*).

early stages, attenuate and zigzag later with, in dissepimentarium, distant carinae yardarm in type or from zigzags; cardinal septum and in some counter septum also may be shorter, axial ends of major septa may be weakly convolute or irregularly curving;

minor septa complete; dissepiments when present globose, small lateral dissepiments also in some; tabular floors commonly low domes; tabulae incomplete, axial tabellae may be flat or arranged in concave floors [see OLIVER, 1974, p. 171]. *L.Dev.-M.Dev.*

Zaphrenthis RAFINESQUE & CLIFFORD, 1820, p. 234 [**Z. phrygia*; SD HALL & SIMPSON, 1887, p. xi; †neotype, 5251, UMMP, Ann Arbor; by STUMM, 1965, p. 34; hollow and rather coarsely silicified, section of calice clearly shows both carinae and dissepiments, *fide* OLIVER, 1976, written commun.] [=*Zaphrentis* HAIME, 1850, p. 161; MILNE-EDWARDS & HAIME, 1850, p. lxv, *nom. null.*; *Faphrentis* HALL, 1852b, p. 408, *nom. null.*; *?Helenterophyllum* GRABAU, 1910, p. 95 (type, *H. caliculoides*, OD; †13123, UMMP, Ann Arbor, lectotype by STUMM, 1949, p. 12; M.Dev., Detroit R. Ls., Anderdon Mbr., Anderdon Quarry, near Amherstberg, Ont., calical mold in dolomite); *?Heliophrentis* GRABAU, 1910, p. 98 (type, *H. alternatum*, OD; †?13081, 14051, UMMP, Ann Arbor; from same loc. near Amherstberg as *Helenterophyllum*, also calical molds in dolomite), see STUMM, 1949, p. 12; *Fafrentis* COTTON, 1973, p. 82, *nom. null.*]. Solitary, small; fossula long and narrow, on ?convex side; major septa long, pinnate toward fossula and slightly withdrawn from axis, cardinal and counter septa short in late stages; minor septa very short to short; septa with denticulate distal edges; dissepiments absent or present in one or two series of small globose plates in distal parts of steeply sloping calical wall, where also yardarm carinae may be present [*sensu* OLIVER, 1960b, p. 17]; tabulae incomplete, tabular floors in axial parts horizontal or distally arched, and peripheral parts depressed [see OLIVER, 1960b, p. 17; 1976a, p. 114]. *L.Dev.-M.Dev.(Eifel.)*, N. Am. (Ind.-Ky.-Ont.).——FIG. 191,*4a-c*. **Z. phrygia*, topotypes, M.Dev., above coral zone, Jeffersonville Ls., Ind.-Ky., Falls of the Ohio; *a*, transv. sec., ×2.7; *b,c*, another specimen, long. sec., transv. sec. distal part of calice, ×2.7 (Hill, n; photographs courtesy W. A. Oliver, USNM 52805-6, 52805-7).

Aemulophyllum OLIVER, 1958, p. 822, as subgenus of *Metriophyllum* MILNE-EDWARDS & HAIME, 1850, p. lxix [**Heliophyllum exiguum* BILLINGS, 1860, p. 261; OD; †3424,g, GSC, Ottawa] [=*Aemuliophyllum* STUMM, 1965, p. 23, *nom. null.*]. Solitary, flattened on lower part of convex, cardinal side; major septa extending to axis where they join and form dense axial structure; minor septa short; cardinal fossula deep, parallel-sided, invading axial structure, with long cardinal septum shortening in calice; marginarium wide, a peripheral stereozone in which carinate major and minor septa are thickened to contiguity, dissepiments absent; tabulae rising toward axis in early stages. *L.Dev.(Ems.)*, N.Am.(Ont.-N.Y.-Ky.-Ind.-Ohio).——FIG. 191,*3a-d*. **A. exiguum* (BILLINGS); *a,b*, paratype, Onondaga Ls., ?Bois Blanc Ls., Ont., Rama's Farm, Port Colborne, side, calical views, ×1.0 (Billings, 1860); *c*, another specimen, near Louisville, Ky., transv. sec. showing thickened septa carinate in marginarium, ×3.4; *d*, lower left portion of *c*, ×16.8 (Oliver, 1958; photographs courtesy W. A. Oliver).

Cyathocylindrium OLIVER, 1974, p. 172 [**C. opulens*; OD; †172197, USNM, Washington]. Fasciculate; septa numerous, biradially or bilaterally arranged, long or variously withdrawn from axis, attenuate and weakly to strongly carinate, mainly zigzag carinae, some yardarm; cardinal and counter septa commonly shorter than other major septa; dissepimentarium wide, dissepiments numerous, small, globose to subovoid; tabulae incomplete, tabular floors arched, arch may be depressed medially [see OLIVER, 1976a, p. 117]. *L.Dev. (Ems.)-M. Dev. (Eifel.)*, N. Am. (N. Y.-Ont.-Ky.-Ind.-?Ohio).——FIG. 191,*2a,b*. **C. opulens*, holotype, M.Dev., Onondaga Ls., Edgecliff Mbr., N.Y., Thompson's Lake; *a,b*, transv., long. secs., ×1.7 (Oliver, 1974; photographs courtesy W. A. Oliver).

Heliophyllum HALL in DANA, 1846b, p. 356, as subgenus of *Cyathophyllum* [**Cyathophyllum helianthoides* GOLDFUSS, 1826, p. 65, *sensu* HALL, 1843, p. 209, fig. 4; M; HALL's specimen not traced; =*Heliophyllum halli* MILNE-EDWARDS & HAIME, 1850, p. lxix, obj., unfigured specimen of MILNE-EDWARDS & HAIME, Z89a, MN, Paris, Dev., Falls of the Ohio)] [?=*Heliophylloides* STUMM, 1949, p. 18 (type, *Cyathophyllum brevicorne* DAVIS, 1887, pl. 79, fig. 17, OD; †7996, MCZ, Cambridge, SD STUMM, 1949, p. 18; M.Dev., Jeffersonville Ls., Falls of the Ohio; =*Heliophyllum venatum* HALL, 1882, p. 46, †11847, WM, Chicago, *fide* STUMM, 1965, p. 38, 118, 124, above coral zone, Jeffersonville Ls., Falls of the Ohio); *Heliogonium* STUMM, 1949, p. 21 (type, *Heliophyllum confluens* HALL, 1876, pl. 26, figs. 3,4, OD; †4975/1, AMNH, New York; Hamilton Sh., Genesee Valley, N.Y., which may or may not be conspecific, according to FENTON & FENTON, 1938, p. 222, or congeneric with 18974, ?NYSM, Albany, valid lectotype of *H. confluens* HALL, by WELLS, 1937, p. 10, from Ludlowville F., York, N.Y.)]. Solitary or weakly fasciculate ?(and astreoid); corallites subcylindrical to trochoid, fossula without distinct tabular depression though cardinal septum may be reduced, and in some counter septum may be short also; in early stages septa may be dilated and in lateral contact; in later stages septa attenuate from periphery inward and attenuate portions in wide dissepimentarium are carinate with widely spaced, mainly yardarm carinae; major septa may extend almost to or to axis and may develop slight axial convolution or less regular flexing; minor septa long, complete; tabularium wide, with horizontal, weakly domed or concave tabular floors, tabulae complete or

commonly incomplete; dissepiments numerous, small, globose to subglobose [see SMITH, 1945, p. 25; OLIVER, 1974, p. 174; 1976a, p. 123]. *?L. Dev.(?Siegen.)*, Australia(Vict.); *L.Dev.(Ems.)*, E.N.Am.-N.Afr.(Alg.); *M.Dev.(Eifel.)*, E.N.Am.-S.Am.(Venez.)-N.Afr.(Mauret.)-Eu.(Spain-?Ger.); *M.Dev.(Givet.)*, E.N.Am.-N.Afr.(Moroc.-Spanish Sahara)-Eu.(Spain).——FIG. 192,*1a-e*. **H. halli*; *a-c*, MILNE-EDWARDS & HAIME, 1851, figured specimen, M.Dev.(Eifel.), Falls of the Ohio, *a*, ext. view, ×1.0, *b*, long. sec., ×1.5, *c*, calical platform showing septa and carinae, enl. (Milne-Edwards & Haime, 1851); *d,e*, HALL's figured specimen, Hamilton Gr., W.N.Y., long., transv. secs., ×1.0 (Hall, 1876).

?Phymatophyllum STUMM, 1965, p. 41 [**Chonophyllum nanum* DAVIS, 1887, pl. 80, figs. 11-13; OD; †8179, MCZ, Cambridge; lectotype by STUMM, 1965, p. 41] [?=*Bethanyphyllum* STUMM, 1949, Bethanyphyllidae]. Solitary, ceratoid or trochoid; septa radially arranged, slightly dilated peripherally and extending to axis; sides of septa with closely set ?tubercles with random orientation; minor septa long; tabulae complete or incomplete; dissepiments large, numerous. *M. Dev.*, N.Am.(Ky.-Ind.).——FIG. 191,*1a,b*. **P. nanum* (DAVIS), lectotype, Beechwood Ls., Ind., 2.5 mi. W. of Charlestown; *a,b*, transv., long. secs., ×2.7 (Hill, n; photographs courtesy W. A. Oliver).

Family CYATHOPHYLLIDAE Dana, 1846

[Cyathophyllidae DANA, 1846b, p. 115] [?=Mictophyllidae HILL, 1940b, p. 264; ?Sterictophyllidae PEDDER, 1965a, p. 209]

Solitary, fasciculate or massive; with thin wall; septa numerous, thin or moderately thick and in many with structural modifications, in many with zigzag carinae; thickening greatest in early stages or lacking; major septa in mature stages reaching axis or leaving axial space, their axial ends may be weakly convolute or flexed; minor septa complete and little shorter than major; cardinal septum shortened, cardinal fossula evident in some; dissepimentarium with few to many series of small dissepiments, sparse lonsdaleoid dissepiments may occur; tabularium moderately wide to wide and predominantly of closely spaced tabulae or tabellae, tabularial floors commonly domed but may be axially depressed or, when septa are withdrawn, flat [BIRENHEIDE, 1963a, p. 367; JELL & HILL, 1969, p. 3]. *Dev.*

Cyathophyllum GOLDFUSS, 1826, p. 51 [**C. dianthus*; SD DANA, 1846a, p. 183; †neotype 12239, SM, Frankfurt; by BIRENHEIDE, 1963a, p. 377]

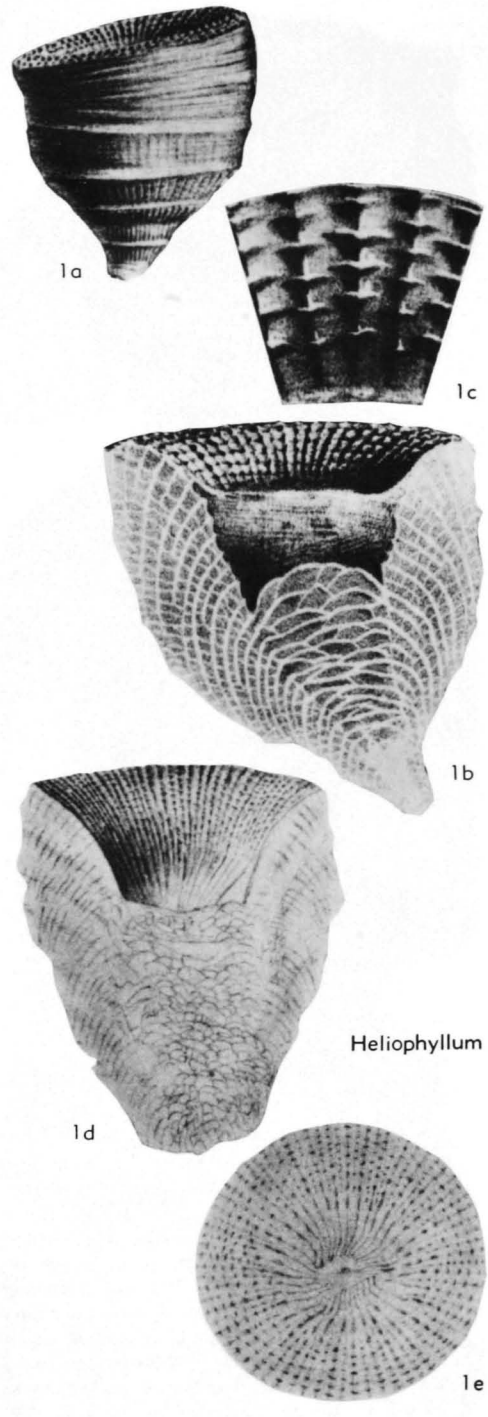
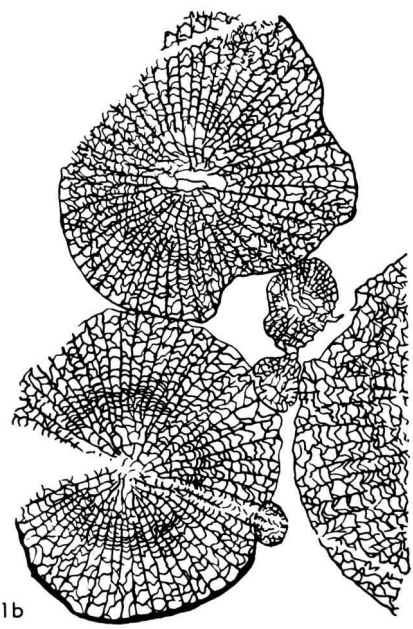


FIG. 192. Zaphrentidae (p. *F296-F297*).

1a Cyathophyllum



1b

FIG. 193. Cyathophyllidae (p. *F297-F298*).

[?=*Orthocyathus* MERRIAM, 1973b, which see]. Solitary, fasciculate or massive, mature corallites large; septa numerous, long, thin and variously withdrawn from axis, smooth or carinate, more or less fringed, carinae short and commonly alternate; fossula inconspicuous, cardinal septum commonly shorter than other major septa; tabularial floors flat or sagging; dissepimentarium wide, dissepiments numerous, globose and of moderate size [BIRENHEIDE, 1963a, p. 369; JELL & HILL, 1969, p. 4]. *?L.Dev.*, N.Am.(Nev.); *M.Dev.*, Eu.(Ger.-Czech.)-?Asia (Salair-Dzhung.-S.China)-?Australia (Queensl.).——FIG. 193,*1a,b*. **C. dianthus*, neotype, Givet., Loogh Beds, Ger., Hillesheim Basin; *a,b*, transv., long. secs., ×1.5 (Birenheide, 1963a).

?**Acanthophyllia** GUO, 1976, p. 94 [**A. delerensis*; OD; †Ru4062, IGMR, Shenyang; M.Dev., Eifel., Inner Mongolia]. Solitary; septa long, may have lateral dissepiments in peripheral regions; minor septa may be contratingent; axial ends of major septa turned aside to outline vaguely an axial depression in the tabular floors; tabulae incomplete, dissepiments small, globose, numerous. [Diagnosis tentative, from illustrations.] *M.Dev.(Eifel.)*, Asia (Inner Mongolia).

?**Commutatophyllum** KAPLAN, 1971a, p. 91 [**C. cincinnatum*; OD; †1, coll. 9806, TsGM, Leningrad]. Solitary; septa numerous, major septa long, corrugated, curved and weakly convolute in axial zone, where some may join; fossula marked by shortened cardinal septum; septal trabeculae thin, curved in fans; septa carinate in dissepimentarium, thickened in tabularium, especially in cardinal quadrants; minor septa may be contratingent; tabular floors shallowly convex, of numerous tabellae; dissepiments small, numerous, arranged concentrically; in early stages septa strongly thickened. *U.Dev.(Famenn.)*, Asia(Kazakh.).——FIG. 194, *2a,b*. **C. cincinnatum*, holotype, *C. sulcifer* beds, N. Cis-Balkhash; *a,b*, transv., long. secs., ×1.5 (Kaplan, 1971a).

Glossophyllum WEDEKIND, 1924, p. 76 [**G. Dohmi*; SD LANG, SMITH, & THOMAS, 1940, p. 63; †2322, WEDEKIND Coll., SM, Frankfurt; lectotype by BIRENHEIDE, 1969a, p. 40, fn.; ?=*Cyathophyllum ceratites* GOLDFUSS, 1826, p. 57, †196a$_1$ in GOLDFUSS Coll., IP, Bonn, lectotype by BIRENHEIDE, 1969a, p. 39] [?=*Ceratinella* SOSHKINA, 1941, p. 36, fig. 22 (no type species designated, genus compared with another, one species only, *C. soetenicum* (SCHLÜTER), illustrated: **Campophyllum soetenicum* SCHLÜTER, 1889, p. 297, M, syntypes 173, SCHLÜTER Coll., IP, Bonn, ?=*Cyathophyllum ceratites* GOLDFUSS, 1826; SOSHKINA's illustrated specimen, slides 373-379, in coll. PIN, Moscow, is from Givetian of Pashia works, C. Urals), *non Ceratinella* EMERTON, 1882, an arachnid; *?Mansuyphyllum* FONTAINE, 1961, which see]. Solitary, septa long, noncarinate, withdrawn from axis, cardinal septum short, in fossula; minor septa long; dissepiments small, subglobose; tabulae incomplete, an axial series of grouped, broad, subhorizontal tabellae and a periaxial series of smaller plates declined adaxially; septa somewhat thickened in tabularium in early stages. [Septal characters from lectotype; others based on *C. ceratites* GOLDFUSS, 1826; see BIRENHEIDE, 1969a, p. 40.] *M.Dev.*, Eu.(Ger.-Urals).——FIG. 195,*2a*. **G. dohmi*, lectotype, transv. sec., ×1.5 (Wedekind, 1924).——FIG. 195,*2b-d*. *?G. ceratites* (GOLDFUSS), lectotype, M.Dev., Eifel; *b,c*, transv., *d*, long. secs., ×2.0 (Birenheide, 1969a).——

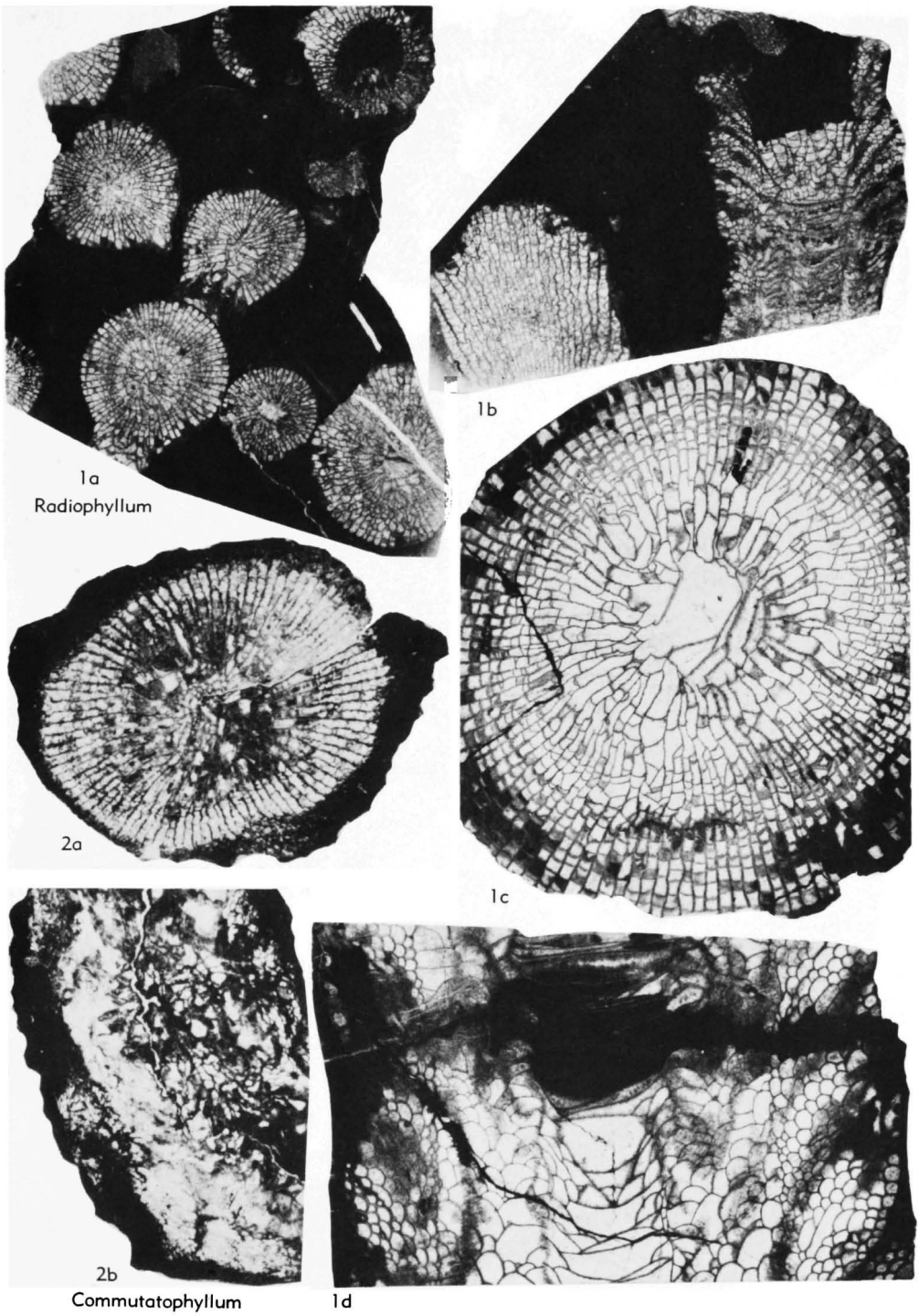


FIG. 194. Cyathophyllidae (p. *F298*, *F304*).

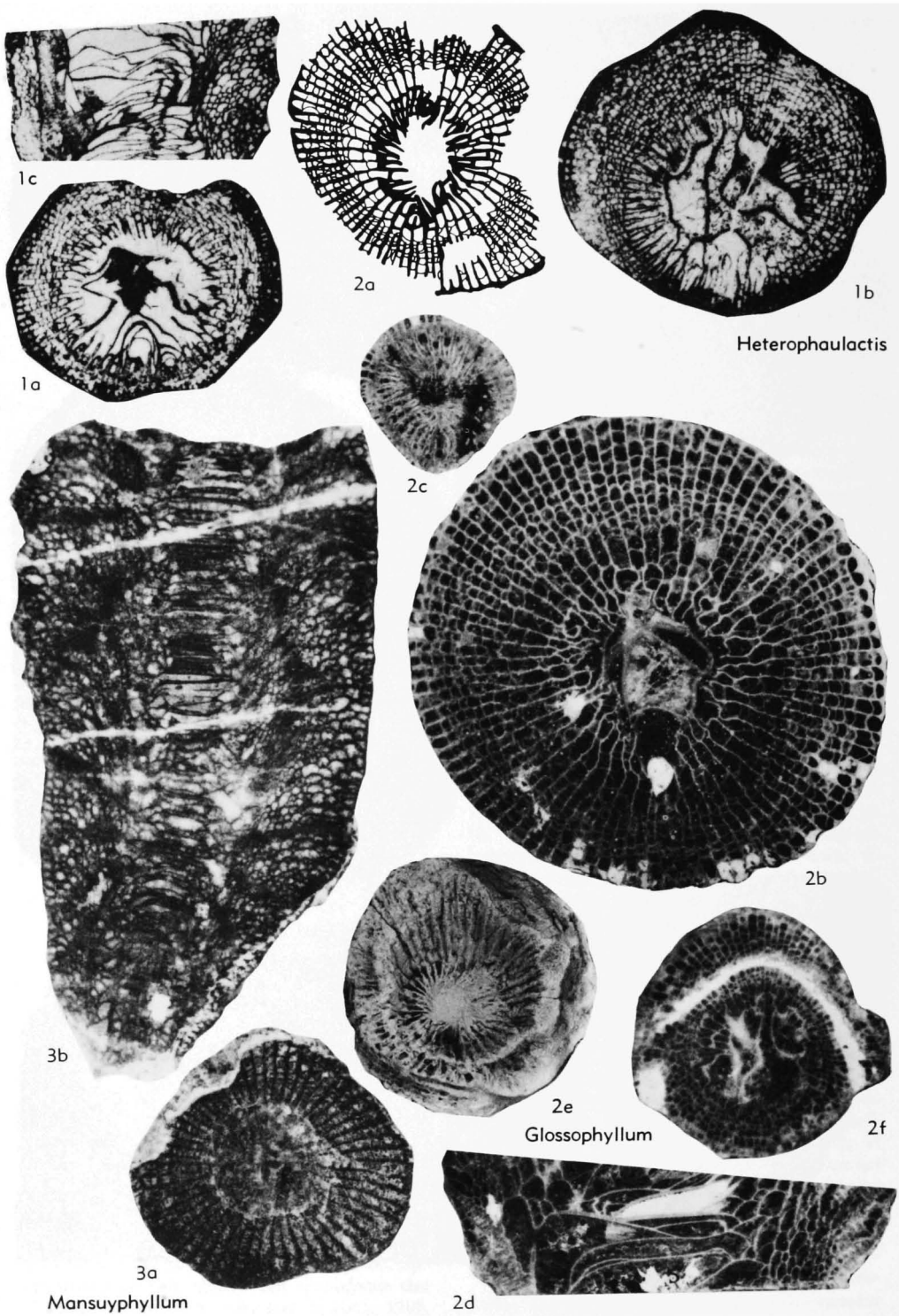


FIG. 195. Cyathophyllidae (p. *F298-F302*).

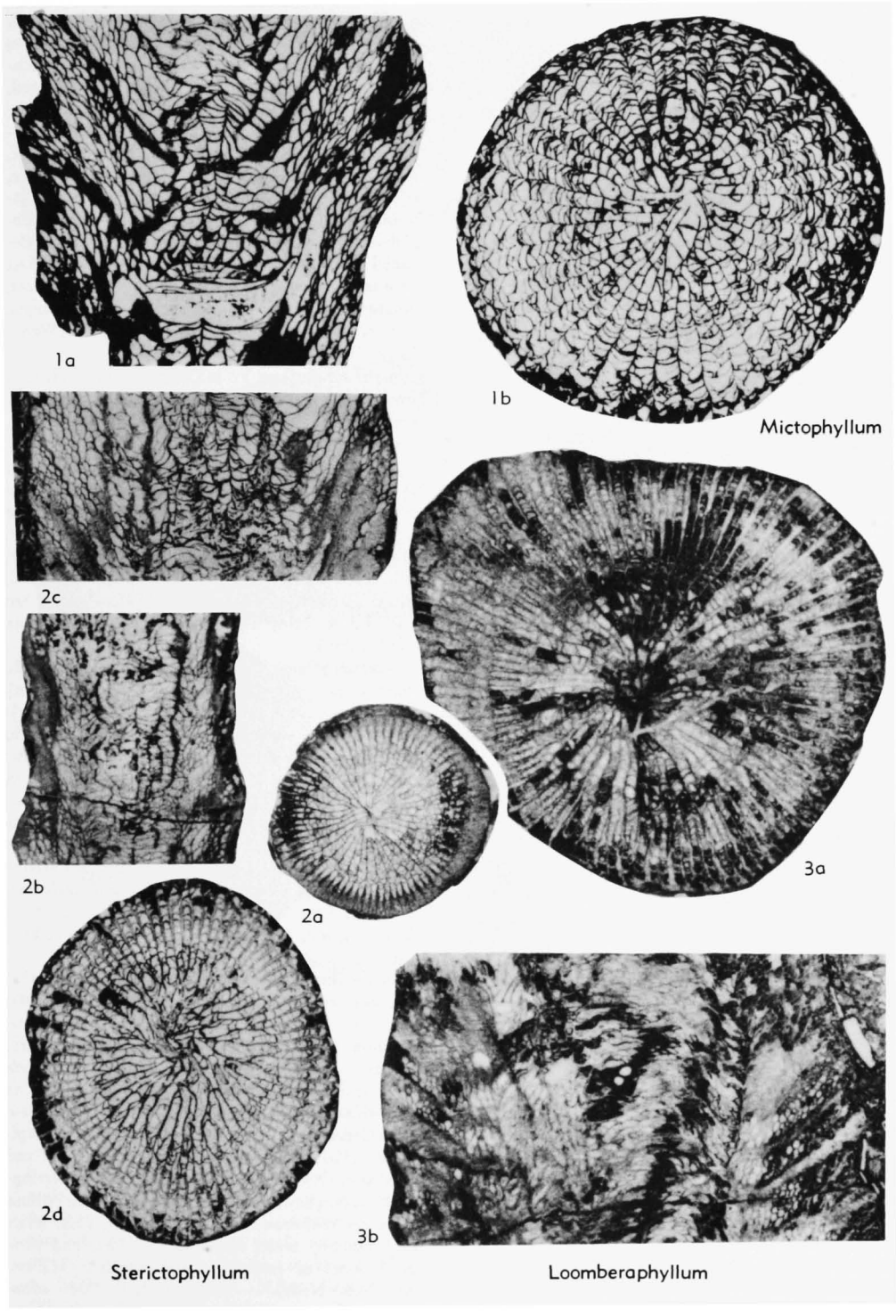


FIG. 196. Cyathophyllidae (p. *F*302-*F*305).

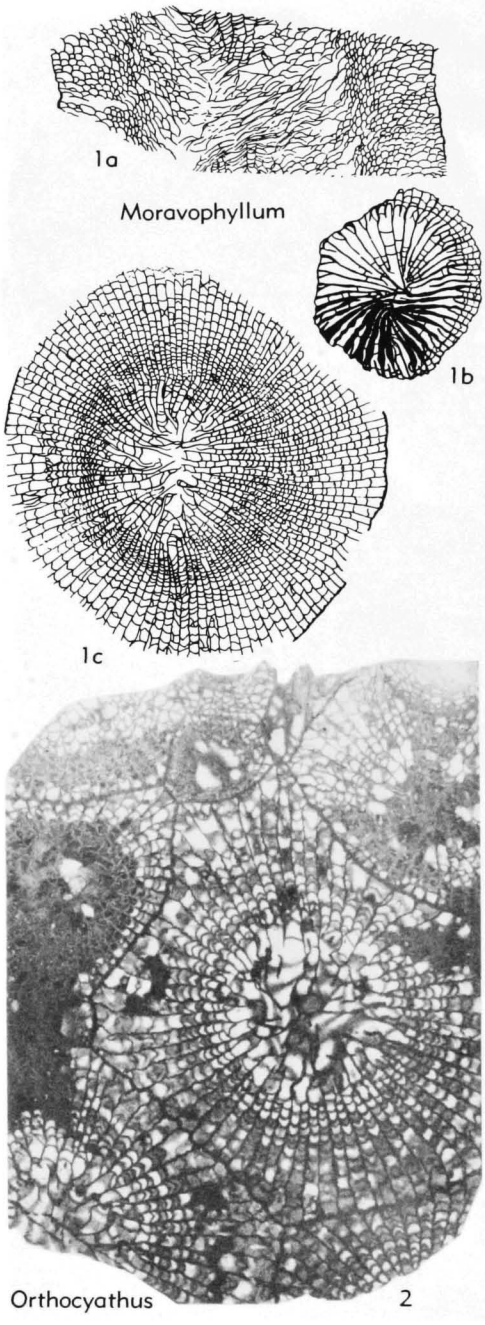


FIG. 197. Cyathophyllidae (p. *F303-F304*).

FIG. 195,*2e,f*. *G. soetenicum* (SCHLÜTER), syntype 173e, M.Dev., Eifel, Soetenich; *e,f*, calical view, transv. sec., ×1.0 (Hill, n; photographs courtesy R. Birenheide, GMBO173e).

Heterophaulactis Yü in WANG, Yü, & WU, 1974, p. 30 [**H. semicrassa*; OD; †18687-9, 18690, 18695-7, IGP, Nanking]. Solitary, large; septa numerous, in early stages dilated and long, reaching axis, in late stages thin, subradially arranged, crowded, thinning first in counter quadrants; minor septa long and may be contratingent; cardinal fossula moderately deep; tabularium wide, floors subhorizontal, tabulae commonly complete, edges may turn down or up slightly; dissepimentarium wide, of small, subequal, numerous, subglobose dissepiments, moderately to steeply declined from wall. *Low.L.Dev.* or *up.L.Dev.*, Asia (Kwangsi).——FIG. 195,*1a-c*. **H. semicrassa*, holotype, Yukiang F., Shizhou Mbr., Kwangsi, Liujing; *a,b*, transv., *c*, long. secs., ×1 (Wang, Yü, & Wu, 1974).

?**Houershanophyllum** Yü & LIAO in KONG & HUANG, 1978, p. 54 [**H. involutum*; OD; †specimen figured pl. 17, fig. 1, ?IGP, Nanking; M.Dev., Dushan, Kweichow]. Solitary; septa numerous, coarse, minor septa short, major septa long and axial ends curved about wide axial space into which cardinal fossula extends; periaxial tabellae in wide tabularium small and declined adaxially, axial tabulae widely spaced and subhorizontal; dissepimentarium narrow, dissepiments normal, small. [Diagnosis tentative, from illustrations; see also Yü & LIAO, 1978, p. 146.] *M.Dev.*, Asia (Kweichow).

Loomberaphyllum PEDDER, 1965a, p. 213 [**L. pustulosum*; OD; †8796, UNE, Armidale] [?=*Peripaedium* EHRENBERG, 1834, which see]. Solitary, large; septa numerous, thickened, smooth, long major septa attaining axis with some convolution; tabularium wide; tabular floors domes, in places with out-turned edges, of small, subglobose tabellae; dissepimentarium wide, dissepiments steeply declined adaxially, small, subglobose, and equal. *L.Dev., ?M.Dev.(Couvin.)*, Australia(New S.Wales-Vict.).——FIG. 196,*3a,b*. **L. pustulosum*, holotype, Ems. or Couvin., Loomberah Ls., New S. Wales; *a,b*, transv., long. secs., ×1.5 (Pedder, 1965a).

Mansuyphyllum FONTAINE, 1961, p. 100 [**Cyathophyllum annamiticum* MANSUY, 1913, p. 9; OD; †861, MANSUY Coll., MSG, Saigon] [?=*Glossophyllum* WEDEKIND, 1924, which see]. Solitary, ceratoid, calice cup-shaped; septa commonly with weak carinae; major septa extending almost to axis, minor septa half as long, but may withdraw toward periphery; dissepimentarium wide, dissepiments small, globose, horizontally based at and near periphery but steeply declined and in herringbone arrangement in inner parts where minor septa are withdrawn; tabularium with axial series of commonly wide, horizontal tabellae, and periaxial series of large, inclined tabellae. *M.Dev.*, Asia(Viet Nam).——FIG. 195,*3a,b*. **M. annamiticum* (MANSUY), Ron; *a,b*, transv., long. secs., ×2 (Mansuy, 1913).

?**Mictophyllum** LANG & SMITH, 1939, p. 155 [**M.*

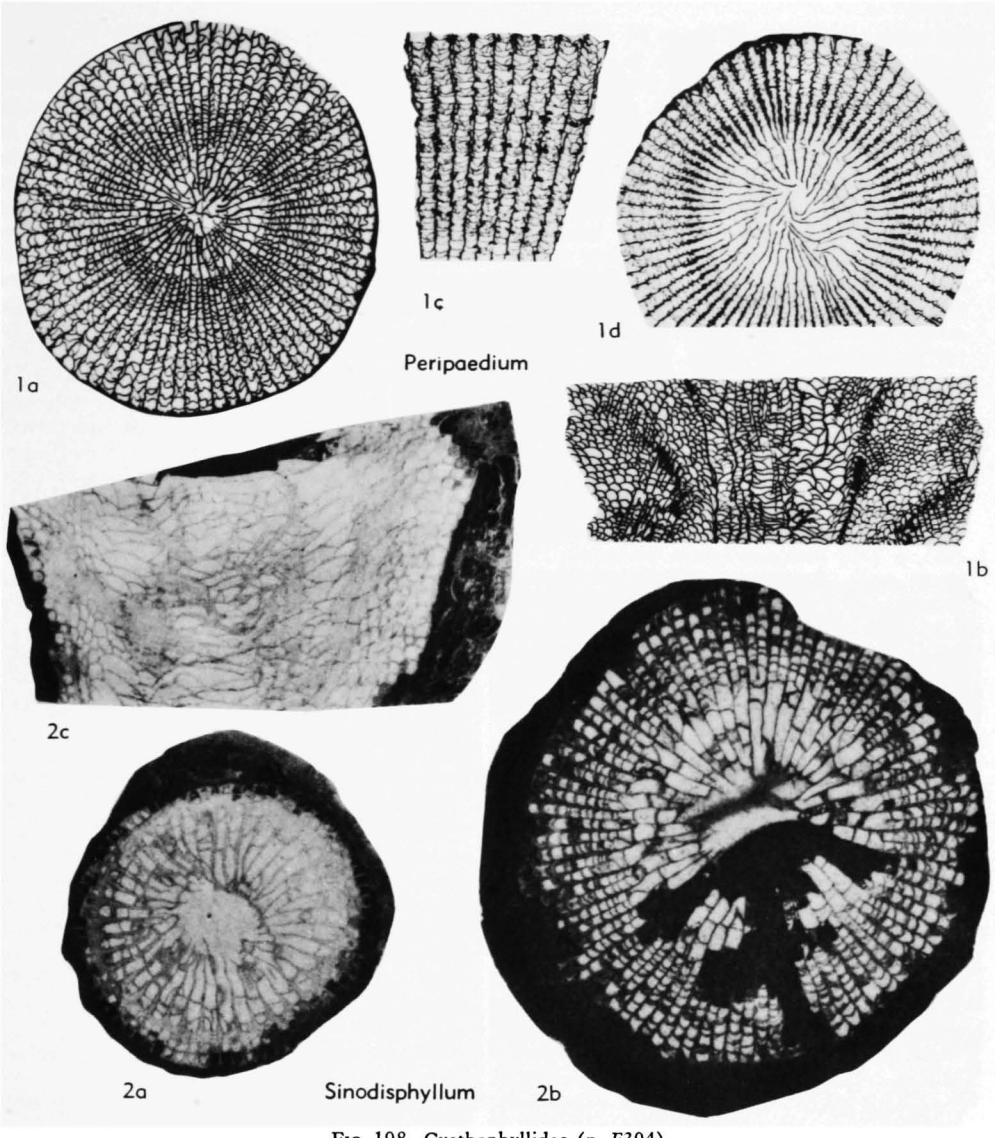


FIG. 198. Cyathophyllidae (p. *F*304).

nobile; OD; †9272, GSC, Ottawa]. Corallum solitary, large; major septa long, faintly convolute in tabularium, in young stages slightly thickened in tabularium, otherwise thin to attenuate; minor septa very short, withdrawn to periphery of wide herringbone dissepimentarium that narrows at wide fossula with shortened cardinal septum; tabularial floors domes with upturned edges, of thin tabellae; dissepiments small, unequal, steeply declined adaxially, not globose [see PEDDER, 1965a, p. 202]. *U.Dev.(Frasn.)*, N.Am.(Can.).——FIG. 196,*1a,b*. **M. nobile*, holotype, up.Frasn., Redknife F., Gorge of Redknife R., NW. Can., Mackenzie reg.; *a,b*, long., transv. secs., ×1.5 (Lang & Smith, 1939).

Moravophyllum KETTNEROVÁ, 1932, p. 27, 79 [**M. ptenophylloides*; OD; †PFKU 19, REMEŠ Coll., Charles Univ., Prague]. Large, solitary; septa numerous and long, in early stages major septa dilated in tabularium in cardinal quadrants, in late stages all septa very thin, major septa directed in small groups toward median plane; tabular floors irregular, tabellae numerous; dissepiments normal concentric or some angulate in transverse section. *M.Dev.(Givet.)*, Eu.(Czech.)-?N.Am. (Nev.).——FIG. 197,*1a-c*. **M. ptenophylloides*, holotype, Celechovice; *a*, long. sec., ×1.1; *b,c*, transv. secs., ×1.4, ×1.1 (Kettnerová, 1932).

Orthocyathus MERRIAM, 1973b, p. 34 [**Prismatophyllum flexum* STUMM, 1938, p. 483; OD; †96219a, USNM, Washington] [?=*Cyathophyllum* GOLDFUSS, 1826, which see]. Subcerioid or phacelocerioid, mature corallites large; septa numerous, thin, smooth to finely crenulate and weakly carinate, carinae alternate; major septa long, subequal, some reaching or almost reaching axis; minor septa long, complete; tabularium moderately wide, tabular floors slightly convex axially, with periaxial trough; dissepimentarium wide, floors somewhat everted, plates subglobose, subequal. *M.Dev.(Eifel.)*, N.Am.(Nev.).——FIG. 197,*2*. **O. flexus* (STUMM), paratype, unit 4 (=coral zone F) of Nevada F., Nev., Lone Mt.; transv. sec., ×2.8 (Hill, n; photograph courtesy W. A. Oliver, USNM 96219a).

Peripaedium EHRENBERG, 1834, p. 308 [**Cyathophyllum turbinatum* GOLDFUSS, 1826, p. 56; SD LANG, SMITH, & THOMAS, 1940, p. 97; †194, GOLDFUSS Coll., IP, Bonn; lectotype by GLINSKI, 1961, p. 277] [=*Keriophyllum* WEDEKIND, 1923, p. 27 (type, *K. heiligensteini*, M; †2798-2805, WEDEKIND Coll., SM, Frankfurt; =*Cyathophyllum turbinatum* GOLDFUSS, 1826, *fide* BIRENHEIDE, 1963a, p. 390); *Ceriophyllum* LANG, SMITH, & THOMAS, 1940, p. 35, *nom. van.*; *?Loomberaphyllum* PEDDER, 1965a, which see]. Solitary, fasciculate or cerioid, with long, smooth to heavily carinate or fringed septa, major septa extending to axis commonly with weak convolution adaxially; carinae commonly alternate; tabularial floors horizontal to strongly arched, composed of numerous small, convex tabellae; dissepimentarium wide, may be somewhat everted in some, dissepiments small, globose, numerous [BIRENHEIDE, 1963a, p. 389]. *M.Dev.*, Eu.(Ger.)-Asia(Salair-Kuzbas-? Altay-Burma-? Yunnan)-? N. Am. (NW. Terr.-Nev.).——FIG. 198,*1a,b*. **P. turbinatum* (GOLDFUSS), Eifel., Ahrdorf Beds, Ger., Hillesheim Basin; *a,b*, transv., long. secs., ×1.5 (Birenheide, 1963a).——FIG. 198,*1c,d*. *P. heiligensteini* (WEDEKIND), monotype, Eifel., Niederehe Beds, Ger., Gerolstein Basin; *c,d*, tang. long. sec. through dissepimentarium, transv. sec., ×2.0 (Wedekind, 1923).

?Qiannanophyllum KONG in KONG & HUANG, 1978, p. 56 [**Q. duyunense*; OD; †Gcr 421, GB, Guiyang; M.Dev., Duyun, Kweichow]. Solitary; major septa long, somewhat thickened in tabularium, axial ends may curve slightly about axial space; minor septa somewhat withdrawn toward periphery, leaving inosculating dissepiments in inner zone; tabulae subhorizontal, supplemented peripherally by adaxially declined tabellae; dissepiments steeply inclined, small. [Diagnosis tentative, from illustrations.] *M.Dev.*, Asia(Kweichow).

Radiophyllum HILL, 1942b, p. 17 [**Entelophyllum arborescens* HILL & JONES, 1940, p. 188; OD; †P6190, SU, Sydney] [=*Stathmoelasma* PEDDER, 1965a, p. 207 (type, *S. amplum*, OD; †8778, UNE, Armidale; upper beds of Sulcor Ls., late Ems. or Couvin., near Attunga, New S. Wales), corallum solitary, large; *Strathmoelasma* PEDDER, 1965a, p. 201, *nom. null.*]. Fasciculate or solitary, mature corallites large; septa numerous, straight or slightly flexuose, commonly thin but may be weakly fusiform in transverse section; carinae absent or alternate and weakly developed; major septa subequal, may reach axis but commonly withdrawn, cardinal septum may be shorter; tabularial floors domed when septa are longest, but shaped like hat with central dent and outturned or upturned brim when septa somewhat withdrawn, tabulae commonly incomplete; when septa strongly withdrawn tabulae may be complete and mesa-shaped; dissepimentarium wide, floors fairly steeply declined adaxially, dissepiments subglobose to globose, commonly small and subequal [STRUSZ & JELL, 1970, p. 122]. *?L.Dev.(Gedinn.)*, Asia (Kuzbas); *L.Dev.(Siegen.-Ems.)-M.Dev.(Couvin.)*, Australia(New S.Wales-Queensl.)-Asia(Amur R.-Transcauc.).——FIG. 194,*1a,b*. **R. arborescens* (HILL & JONES), topotype, late ?Siegen. or Ems., Garra F., Nora Cr., New S. Wales, near Molong; *a,b*, transv., long. secs., ×1.5 (Hill, n; photographs courtesy D. Strusz, SU6189).——FIG. 194,*1c,d*. *R. amplum* (PEDDER), holotype, late Ems. or early Couvin., upper part of Sulcor Ls., New S. Wales, near Attunga; *c,d*, transv., long. secs., ×1.5 (Pedder, 1965a; photographs courtesy A. H. Pedder).

Sinodisphyllum SUN, 1958, p. 11 [**Disphyllum (Sinodisphyllum) variabile*; OD; †S1289, ?CU, Peking; lectotype by IVANOVSKIY, 1976, p. 157]. Solitary, moderately large; septa dilated and major septa almost reaching axis in young stages; in late stages septa numerous and thinned, major long but withdrawn from axis, minor shorter, dissepimentarium moderately wide, dissepiments small, subequal, subglobose, becoming steeply declined in inner series; tabulae incomplete, floors flat or somewhat sagging. [Diagnosis based on lectotype; other syntypes not necessarily congeneric, may include *Mansuyphyllum* sp.] *U.Dev.*, Asia (Hunan).——FIG. 198,*2a-c*. **S. variabile*, lectotype, Lungkouchung F., *Sinodisphyllum* Zone, Hunan, Hsianghsiang; *a,b*, transv., *c*, long. sec., ×2 (Sun, 1958).

Sterictophyllum PEDDER, 1965a, p. 209 [**Cyathophyllum cresswelli* CHAPMAN, 1925, p. 111; OD; †P1267, 1270, NM, Melbourne] [=*Cavanophyllum* PEDDER, 1965a, p. 215 (type, *Mictophyllum trochoides* HILL, 1940b, p. 265, OD; †F17110, AM, Sydney; L.Dev., Cavan, near Taemas, New S. Wales]. Solitary, moderately large; major septa mostly extending to axis, somewhat flexed in tabularium and variably dilated peripherally; dissepimentarial floors steeply declined adaxially, dissepiments small, globose; tabularial floors arched, may be flattened axially, of numerous, small tabellae. *L.Dev.*, Australia(New S.Wales-Vict.).——FIG. 196,*2a,b*. **S. cresswelli* (CHAPMAN), Lilydale

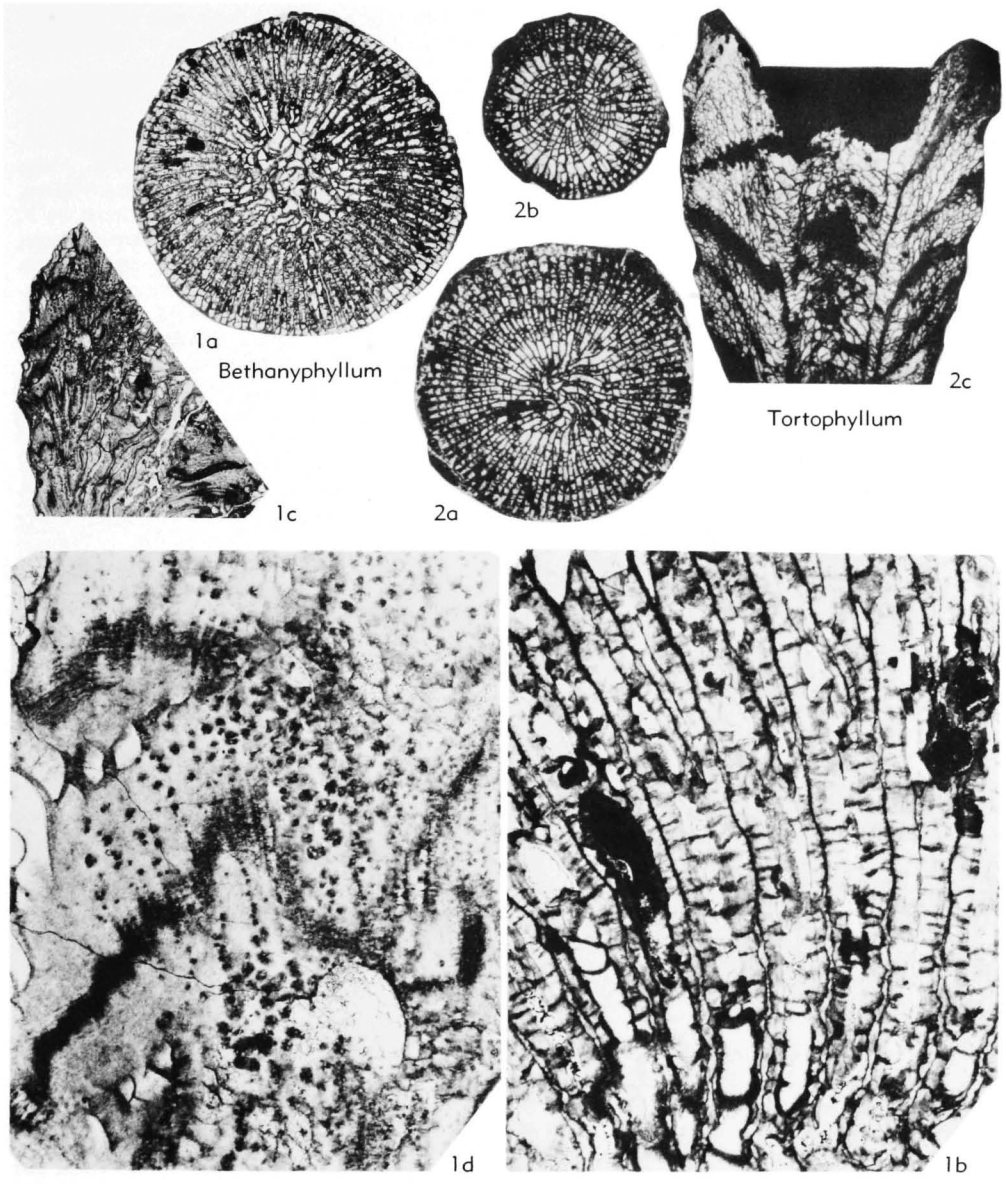


FIG. 199. Bethanyphyllidae (p. *F306*).

Ls., Vict., Lilydale; *a,b,* transv., long. secs., ×1.5 (Pedder, 1965a).——FIG. 196,*2c,d*. *S. trochoides* (HILL), Cavan Bluff F.; *c,d,* long., transv. secs., ×1.5 (Pedder, 1965a).

?Family BETHANYPHYLLIDAE Stumm, 1949

[Bethanyphyllidae STUMM, 1949, p. 17; incl. Bethanyphyllinae STUMM, 1949, p. 17]

Solitary, moderately large; calice with moderately steep walls flattening peripherally to form narrow, inwardly sloping peripheral platforms; septa numerous, not carinate but thickened and vepreculate in tabularium, major long, extending nearly to axis, becoming elevated at axial ends to form low calical boss; minor septa half as long; cardinal fossula prominent on convex

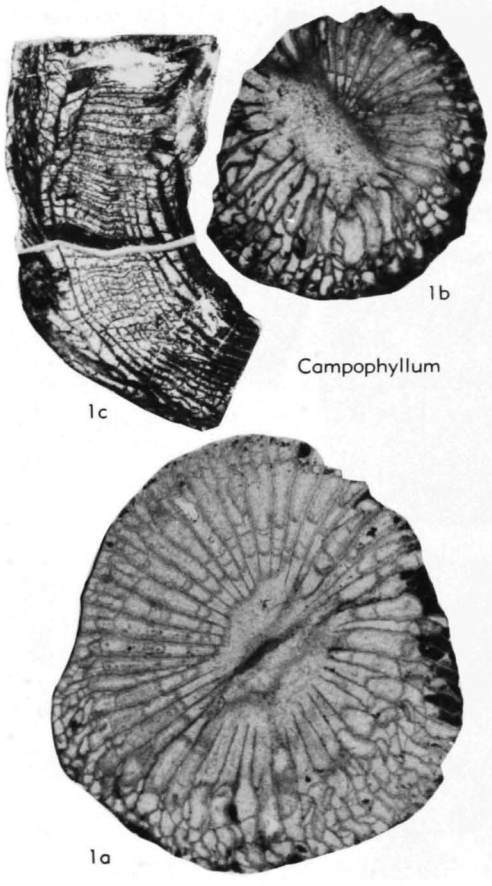


FIG. 200. Campophyllidae (p. *F306*).

side of corallum, with shortened cardinal septum. Possibly related to Halliidae. *M. Dev.*

Bethanyphyllum STUMM, 1949, p. 18 [**Cyathophyllum robustum* HALL, 1876, pl. 22, fig. 1-14; OD; †4954/3, AMNH, New York; lectotype by STUMM, 1949, p. 18] [?=*Phymatophyllum* STUMM, 1965, Zaphrentidae]. Moderately large, solitary, curved, convex side cardinal; calice bell-shaped with moderately steep walls flattening peripherally to form narrow, inwardly sloping peripheral platforms; septa numerous, not carinate, and except in late stages thickened and vepreculate in tabularium, major long, extending nearly to axis, becoming elevated at axial ends to form low calical boss in some; minor septa half as long; cardinal fossula prominent; tabular floors distally arched, of tabellae; dissepiments small, globose, normal [see also STUMM, 1965, p. 40]. *M.Dev.*, N.Am.(N.Y.-Ind.-Ky.-Mich.-?Ont.).——FIG. 199,*1a-d*. **B. robustum* (HALL), lectotype, Hamilton Gr., W. N.Y.; *a*, transv. sec., ×1.0, *b*, portion of *a*, ×6.7, *c*, long. sec., ×1.0, *d*, upper portion of *c*, ×6.7 (Hill, n; photographs courtesy W. A. Oliver).

?**Tortophyllum** SLOSS, 1939, p. 54 [**Zaphrentis cystica* WINCHELL, 1866, p. 90; OD; †14355, UMMP, Ann Arbor, *fide* STUMM, 1963b, p. 138, presumably =2724-t in Alma College Coll., Alma; lectotype by SLOSS, 1939, p. 55; no locality given, probably from lake-cliffs outcrops of Gravel Pt. F. at Petoskey, Mich.]. Solitary, moderately large; septa numerous, long, major septa attaining axis or nearly so and somewhat convolute in axial region where they form, with axial tabellae, weak axial calical boss; fossula indistinct, minor septa long, dissepimentarium wide, with numerous small dissepiments; tabulae incomplete, axial and periaxial, the periaxial tabellae larger and less steeply inclined, forming in calice periaxial trough around boss. [See also STUMM, 1963b, p. 137. Figures of internal structure of lectotype required.] *M.Dev. (Givet.)*, N.Am.(Mich.).——FIG. 199,*2a-c*. **T. cysticum* (WINCHELL), Traverse Gr., Gravel Pt. F., up. blue sh., Mich., Bell Quarry; *a*, transv. sec., ×1; *b,c*, another specimen, transv. sec., early stage, long. sec, ×1 (Sloss, 1939).

Family CAMPOPHYLLIDAE Wedekind, 1922

[Campophyllidae WEDEKIND, 1922a, p. 3; incl. Campophyllinae WEDEKIND, 1922a, p. 3]

Characters as for genus. *M.Dev.* or *L. Carb.*

Campophyllum MILNE-EDWARDS & HAIME, 1850, p. lxviii [**Cyathophyllum flexuosum* GOLDFUSS, 1826, p 57; OD; †197a, GOLDFUSS Coll., IP, Bonn; lectotype by HILL & JULL, 1965, p. 207]. Solitary with beaker-form calice; major septa long but amplexoid, with caninioid dilatation in tabularium decreasing with age, and thin and flexuose in dissepimentarium; neither cardinal nor counter septum of distinctive length, and cardinal fossula not strongly marked, wide, parallel-sided and short, with slight tabular depression; minor septa also thin and flexuose but most are contratingent and except in late stages their inner ends are thickened, the thickening continuous with that of their neighboring major septa; tabulae broad and horizontal, with downturned edges; dissepimentarium narrow with steeply declined, small but unequal and not globose dissepiments. [Diagnosis based on lectotype only, from uncertain locality and horizon. See HILL & JULL, 1965, p. 207.] *M.Dev.* or *L.Carb.(Etroeungt.)*, Eu.(Ger.).——FIG. 200,*1a-c*. **C. flexuosum* (GOLDFUSS), lectotype, "Heisterstein"; *a,b*, transv. secs., ×3.0; *c*, long. sec., ×1.5 (Hill & Jull, 1965).

Family PTYCHOPHYLLIDAE Dybowski, 1873

[Ptychophyllidae DYBOWSKI, 1873c, p. 331; incl. Ptychophyllinae HILL, 1956b, p. *F276*; Ptychophyllicae IVANOVSKIY,

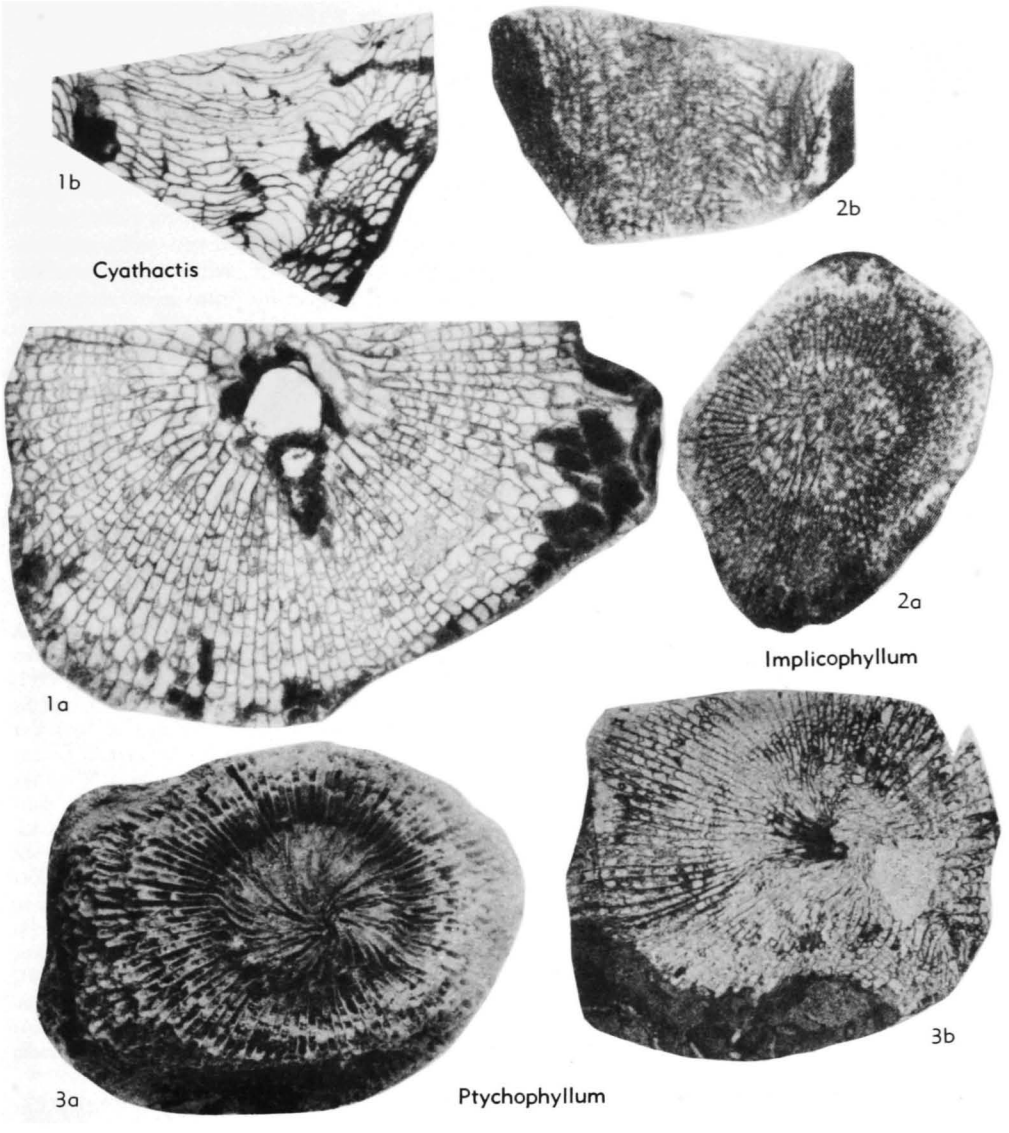


FIG. 201. Ptychophyllidae (p. *F*307-*F*308).

1963, p. 71] [?=Cyathactidae SOSHKINA in IVANOVA *et al.*, 1955, p. 122]

Solitary, moderately large; tabularium wide, forming low axial boss in calice; fossula long, narrow, invading axial boss and in some, dissepimentarium also; septa numerous, long, attaining axial region and commonly convolute in tabularium; dissepimentarium wide, with numerous small dissepiments; tabular floors low domes, in some with axial depression, tabulae commonly incomplete [see also McLEAN, 1975b, p. 57]. *L.Sil.-L.Dev.*

Ptychophyllum MILNE-EDWARDS & HAIME, 1850, p. lxix [**P. stokesi*; OD; †R25162, BM(NH), London; lectotype by SMITH, 1945, p. 51] [?=*Implicophyllum* SYTOVA, 1966, which see]. Solitary, turbinate or patellate; calice with wide, commonly everted platform and broad axial boss in tabularial pit; septa numerous, long, may bear lateral dissepiments; tabularial parts of major septa convolute, unequal, longer reaching axis and shorter confluent with longer; tabular floors domes with edges turned out or up; tabulae in-

complete; dissepiments numerous, small, subglobose, interseptal; cardinal fossula long, narrow, inconspicuous, invading tabularium. [SMITH, 1945, p. 51; longitudinal section required; MCLEAN, 1975b, p. 57.] *L.Sil.*, N.Am.(Mich.-Ont.)-?Asia (Sib. Platf.-Altay-Sayan-Tadzhik.)-Australia (New S.Wales-Queensl.); *U.Sil.*, N.Am.(Devon I.).——FIG. 201,*3a,b*. **P. stokesi*, Manistique-Cordell dol., Mich., Drummond I., L. Huron; *a*, lectotype, calical view, ×1, *b*, topotype, transv. sec., ×1 (Smith, 1945).

?**Cyathactis** SOSHKINA in IVANOVA *et al.*, 1955, p. 122 [**C. typus*; OD; †759, coll. 587, PIN, Moscow]. Solitary; fossula on convex side or somewhat displaced sideways, may invade dissepimentarium; cardinal septum short; septa thin in all stages, numerous, long; major more or less attaining axis and not convolute; minor septa may be contratingent; tabular floors convex in type species with broad, shallow median depression; tabulae incomplete; dissepimentarium wide with numerous subglobose dissepiments, declined adaxially. *M.Sil.*, Asia(Sib.Platf.).——FIG. 201,*1a,b*. **C. typus*; holotype, Gk_3, R. Stony Tunguska; *a,b*, transv., long. secs., ×3 (Ivanova *et al.*, 1955).

Implicophyllum SYTOVA in SYTOVA & ULITINA, 1966, p. 239 [**I. vesiculosum*; OD; †135, coll. 8732, TsGM, Leningrad] [?=*Ptychophyllum* MILNE-EDWARDS & HAIME, 1850, which see]. Solitary, cylindroconical; calical platform adaxially declined; septa thin, major septa reaching axis and convolute in tabularium; tabulae incomplete, forming wide, broadly convex floors; dissepimentarium not wide, normal, dissepiments steeply declined adaxially. *U.Sil.* or *L.Dev.(Aynasu.)*, Asia(Kazakh.).——FIG. 201,*2a,b*. **I vesiculosum*, holotype, Aynasu horizon, zone of *Nataliella poslavskajae*, C. Kazakh., S. flank of Karaganda Basin; *a,b*, transv., long. secs., ×2 (Sytova & Ulitina, 1966).

Suborder STEREOLASMATINA Hill, new suborder

Solitary small Stauriida without dissepimentarium; fossula on convex side except in Hapsiphyllidae; major septa long, axial edges not lobed, trabeculae fine and distal edges of septa smooth; septa may be rhopaloid in some and may form solid axial structure that commonly does not form boss in calice; septa with subhorizontal flanges in some (Stereolasmatidae); minor septa (except *Km* in some) short; tabulae declined abaxially; cardinal septum commonly shortened, counter septum long in some. *L.Dev.-U.Perm.*

Family STEREOLASMATIDAE Fomichev, 1953

[*nom. correct.* HILL, herein, *ex* Stereolasmidae FOMICHEV, 1953a, p. 96]

Solitary, small; major septa long, subequal, subradially arranged, contiguous axially to form commonly solid axial structure that does not project into calice; cardinal fossula on ?convex side, narrowing toward axis but with small parallel-sided part projecting into axial structure; septa with or without horizontal metriophylloid flanges; *Km* (minor septal pair neighboring counter septum) long and contratingent; remaining minor septa may also be long and contratingent; tabulae declined from axial structure to wall; dissepiments absent. *M.Dev.; L.Carb.-M.Carb.*

Stereolasma SIMPSON, 1900, p. 205 [**Streptelasma rectum* HALL, 1876, explanation to pl. 19 (part); OD; syntypes 4940/1,2, AMNH, New York, and 3740/1, NYSM, Albany, see STUMM, 1965, p. 15] [=*Stereoelasma* LANG, SMITH, & THOMAS, 1940, p. 123, *nom. van.*; ?=*Buschophyllum* STUMM, 1949, p. 9 (type, *Caninia complexa* BUSCH, 1941, p. 399, OD; syntypes 18763, OSU, Columbus; M.Dev., Wanokah F., N.Y.; presence of long *Km* and contratingent minor septa not certain in figured syntype); *Buschphyllum* STUMM & WATKINS, 1961, p. 446, *nom. null.*]. Small, ceratoid, erect or slightly curved; major septa thick, long, extending to axis to form axial structure that does not project into calice; minor septa contratingent, *Km* long, remainder short; cardinal fossula narrowing adaxially and extending into axial structure; septa without flanges; tabulae tall, flat-topped domes, no dissepiments [see STUMM & WATKINS, 1961, p. 445]. *M.Dev.*, N.Am.(N.Y.-Ind.-Ky.)-S.Am. (Venez.).——FIG. 202,*2a,b*. **S. rectum* (HALL); Hamilton Sh., W. N.Y.; *a,b*, transv., long. secs., enl. (Simpson, 1900).

?**Amplexiphyllum** STUMM, 1949, p. 9 [**Amplexus hamiltoniae* HALL, 1876, explanation to pl. 19, fig. 20-23; OD; syntypes, 4973/1-3, AMNH, New York]. Solitary, ceratoid to cylindrical, or irregularly contorted, not large; major septa thick and extending to axis in young stages, thinning and retreating from axis in later stages; cardinal fossula distinguished by short cardinal septum; minor septa very short, no dissepiments; tabulae complete or incomplete, typically horizontal axially and becoming deflected proximally as they approach periphery [see STUMM & WATKINS, 1961, p. 446]. *M.Dev.(Givet.)*, N.Am.(N.Y.).——FIG. 202,*4*. **A. hamiltoniae* (HALL), syntype, Hamilton Gr., N.Y.; long. sec., ×1.0 (Hall, 1876).

Lopholasma SIMPSON, 1900, p. 206 [**L. carinatum*;

OD; syntypes 291-292, type coll., NYSM, Albany; =*Streptelasma rectum* HALL, 1876, explanation to pl. 19 (part)] [=*Lophelasma* LANG, SMITH, & THOMAS, 1940, p. 80, *nom. van.*]. Like *Stereolasma* but septa flanged. *M.Dev.(Givet.)*, N.Am. (N.Y.); *?L.Carb.(up.Visean)* or *M.Carb.(low. Moscov.)*, Asia(China).——FIG. 202,*1a,b*. **L. carinatum*, Hamilton Sh., W. N.Y.; *a,b*, transv., long. secs., enl. (Simpson, 1900).

Saleelasma WEYER, 1970a, p. 59 [**Zaphrentis delépini* VAUGHAN, 1915, p. 34; OD; †E11467, SM, Cambridge, and R19567, BM(NH), London; lectotype by WEYER, 1970a, p. 61] [=*Drewerelasma* WEYER, 1973c, p. 975 (type, *D. schindewolfi*, OD; †X730, SCHINDEWOLF Coll., ZGI, E. Berlin; L.Carb., low.Tournais., Drewer, Rhenish Schiefergebirge), cardinal septum not shortened in calice]. Small, solitary, with metriophylloid septal flanges and with *Km* septa long and contratingent in early stages; other minor septa short, not contratingent (in calice at least); major septa axially fused at central base of calice; cardinal septum on convex side of corallum shortened in upper calice but reaching axis in and below base of calice; tabulae strongly domed, with well-developed cardinal fossula; distal septal edges not crenulate. *L.Carb.(low.Tournais.-mid.Tournais.)*, Eu.(Belg.-France-Ger.); *L.Carb.(low.Visean-mid. Visean)*, Eu.(Eng.-Eire).——FIG. 202,*5a-c*. **S. delepini* (VAUGHAN), Landelies Ls. (Tn2b), Belg., abandoned quarry NNE. of Mévergnies, 3 specimens, *a*, transv. sec., ×5.8, *b*, tang. sec., ×9.6, *c*, long. sec., ×5.8 (Weyer, 1970a).

?Stewartophyllum BUSCH, 1941, p. 393 [**Amplexus intermittens* HALL, 1876, explanation to pl. 32, fig. 8-13; OD; syntypes, 4971/1-2, AMNH, New York]. Solitary, subcylindrical to ceratoid, with irregular flangelike expansions; calice relatively flat; major septa thick, extending almost to axis, their ends in contact about irregular narrow axial space in early stage, but withdrawing somewhat in late stages; cardinal fossula weakly to moderately developed, cardinal septum shortened in mature stages; minor septa very short, no dissepiments; tabulae complete or incomplete, relatively flat-topped axially, their peripheral edges may be deflected upward or downward [see STUMM & WATKINS, 1961, p. 447]. *M.Dev.(Givet.)*, N. Am.(N.Y.).——FIG. 202,*3a,b*. **S. intermittens* (HALL); syntypes, Hamilton Gr., W. N.Y.; *a,b*, ext. views, ×1.0 (Hall, 1876).

Family ANTIPHYLLIDAE Ilina, 1970

[Antiphyllidae ILINA, 1970, p. 149; incl. Antiphyllinae WEYER, 1973a, p. 34] [=Actinophrentidae FOMICHEV, 1953a, p. 70, *nom. inval.*, based on genus for which no type species nominated until IVANOVSKIY, 1967, p. 40, *fide* WEYER, 1975b, p. 756]

Small, solitary, suberect or curved; cardinal fossula on convex side (except position in *Actinophrentis* not known); major

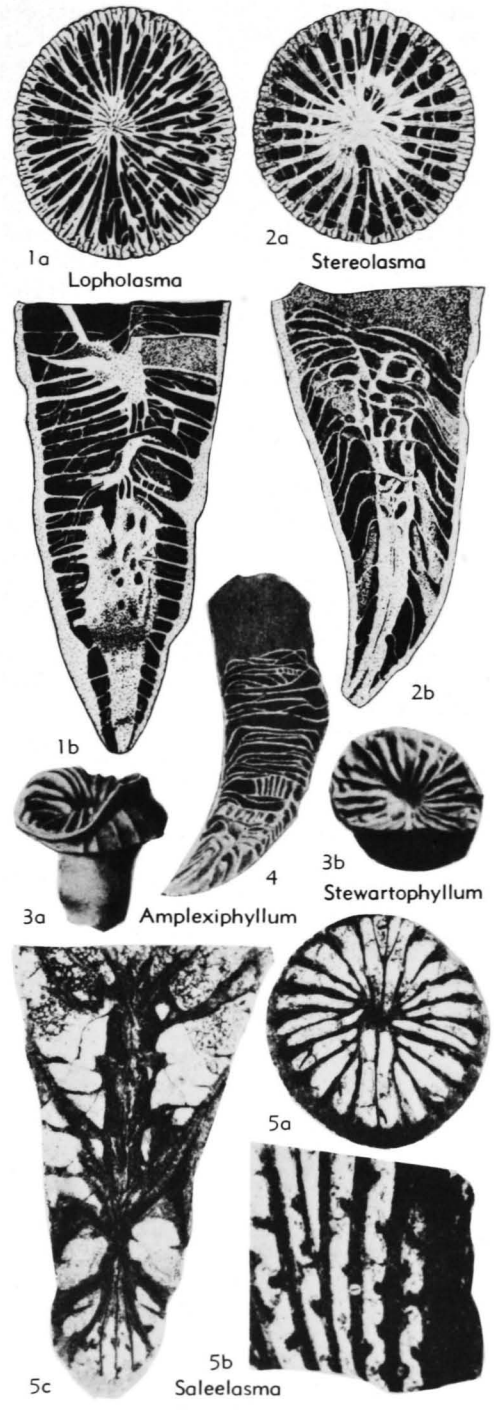


FIG. 202. Stereolasmatidae (p. *F*308-*F*309).

septa subequal, biradially arranged, straight or somewhat curved in quadrants, their axial edges uniting near or at axis, singly or in groups, their calical edges ?smooth; inner end of fossula reaching or almost reaching axis and fossula either lenticular or sphenoid in transverse section (narrowing toward axis); cardinal septum seldom shortened, counter septum long; axial ends of some major septa may be rhopaloid in some; minor septa very short; tabulae declined abaxially; dissepiments in Pseudoclaviphyllinae only. *L.Carb.-L.Perm.*

Subfamily ANTIPHYLLINAE Ilina, 1970

[*nom. transl.* Weyer, 1973a, p. 34, *ex* Antiphyllidae Ilina, 1970, p. 149]

Antiphyllidae without dissepiments. *L. Carb.-L.Perm.*

Actinophrentis Ivanovskiy, 1967, p. 40 [**A. donetziana*; OD; †23, coll. 5030, TsGM, Leningrad] [?=*Rotiphyllum* Hudson, 1942a, which see; *Actinophrentis* Fomichev, 1953a, p. 70, *nom. nud.*, see Weyer, 1975b, p. 759]. Solitary, not large, conical; calice moderately deep, position of cardinal fossula not stated; in early stages major septa thickened to contiguity, radially arranged and reaching to or almost to axis; in late stages septa contiguous only in peripheral stereozone and wide axial structure; fossula narrow, its axial end reaching to or almost to axis, with thinner and somewhat shorter cardinal septum, neighboring septa somewhat curved; tabulae present, minor septa very short, no dissepiments. *U.Carb.*(C_3'), Eu.(Donbas).——Fig. 203,*7a,b*. **A. donetziana*, holotype, Ls. M_7, Orlova ravine; *a,b*, transv. secs., ×4 (Fomichev, 1953a).

Bradyphyllum Grabau, 1928, p. 35 [**B. bellicostatum*; OD; †1567, not traced, ?Peking] [?=*Lytvolasma* Soshkina, 1925, which see; *Brachyphyllum* Chi, 1931, p. 6, *nom. null.*; ?*Pseudobradyphyllum* Dobrolyubova, 1940, which see; ?*Proheterelasma* Cotton, 1973, p. 162, *nom. subst. pro Heterelasma* Grabau, 1922, p. 41 (type, *Hadrophyllum edwardsianum* de Koninck, 1872, p. 52, OD, but see Hudson, 1942a, p. 258; †? in de Koninck Coll., IRSN, Brussels; L.Carb., Tournai, Belg.; =*Zaphrentis omaliusi* Milne-Edwards & Haime, 1851, p. 337, †not traced, MN, Paris, L.Carb., Tournai, Belg., *fide* Carruthers, 1908, p. 25, see also Weyer, 1975b, p. 759), *non Heterelasma* Girty, 1908, a Paleozoic brachiopod]. Small, solitary, fossula on convex side or variable; in early stages septa straight, long, axial parts somewhat thickened and contiguous; insertion of septa in counter quadrants accelerated; in late stages major septa withdrawn somewhat from axis, axial ends of some may cease to be conjoined, and length of cardinal and counter septa may vary from long to short; rhopaloid thickening of axial ends of septa variable; minor septa very short; tabulae domed; no dissepiments. *U.Carb.(Moscov.)*, Asia(Kansu); *L.Penn.*, N.Am.(Mont.).——Fig. 203,*3a-d*. **B. bellicostatum*, holotype, M.Carb., Moukou F., Kansu, Moukou, Fu-I-Hsien; *a-d*, transv. secs., ×3 (Grabau, 1928).

Clavilasma Weyer, 1975b, p. 762 [**C. carinatum*; OD; †X4540, Schindewolf Coll., ZGI, Berlin]. Like *Claviphyllum*, but septa with metriophylloid flanges. *L.Carb.(up.Visean)*, Hurlet Ls., Eu.(Beith, Scotland).

Claviphyllum Hudson, 1942a, p. 262 [**Cyathopsis? eruca* McCoy, 1851a, p. 167; OD; †A2183a,b, SM, Cambridge; lectotype by Hill, 1938-1941, p. 132] [=*Antiphyllum* Schindewolf, 1952, p. 205 (type, *A. inopinatum*, OD; †K78, M. Schwarzbach Coll., HU, E. Berlin; up. Namur., marine Roemer-Horizon, near Gliwice, up. Silesian coal basin; see Weyer, 1974b, p. 347]. Small, solitary, slender; major septa straight; counter septum rhopaloid, longer and thicker than others, extending to axis; alar, counter-lateral, first counter metasepta short; second and third counter metasepta and first and second cardinal metasepta longer and rhopaloid; cardinal septum short and fossula on convex side of corallum; minor septa if long contratingent; no dissepiments; tabular floors domes, depressed axially and with edges steeply declined abaxially; tabulae incomplete [see Hudson & Fox, 1943, p. 110]. *L.Carb.(Visean)*, Eu. (Scot.-Eng.).——Fig. 203,*2a,b*. **C. eruca* (McCoy); *a*, Auchenskeith, Scot., transv. sec., ×2, *b*, Roughwood, Scot., long. sec., ×2 (Hill, 1938-1941).

Fasciculophyllum Thomson, 1883, p. 448(153) [**F. dybowski*; SD Gregory, 1917, p. 238; †destroyed by fire, *fide* Hill, 1938-1941, p. 130; L.Carb., Visean, Charleston, Fifeshire]. Hill (1938-1941, p. 130) interpreted *F. dybowski* as congeneric with *Cyathopsis? eruca* McCoy, 1851a, p. 167, type species of *Claviphyllum* Hudson, 1942a, p. 262, above; but Hudson (1942a, p. 260) considered it congeneric with *Zaphrentis omaliusi* Milne-Edwards & Haime, 1851, p. 337 (†not traced, MN, Paris, L.Carb., Tournai, Belg.). In absence of suitable neotype, generic name is best not used.

?Lytvolasma Soshkina, 1925, p. 82 [**L. asymmetricum*; M; †803, coll. 146, PIN, Moscow] [?=*Bradyphyllum* Grabau, 1928, which see; *Lytvelasma* Lang, Smith, & Thomas, 1940, p. 82, *nom. van.*]. Solitary, small; major septa thickened, laterally contiguous over much of their length, long, somewhat curved and almost reaching axis, in cardinal quadrants grouped about open fossula that narrows midlength, then widens into axial space around which axial ends of septa of counter-quadrants join; minor septa very short, confined to narrow peripheral stereozone; tabulae convex,

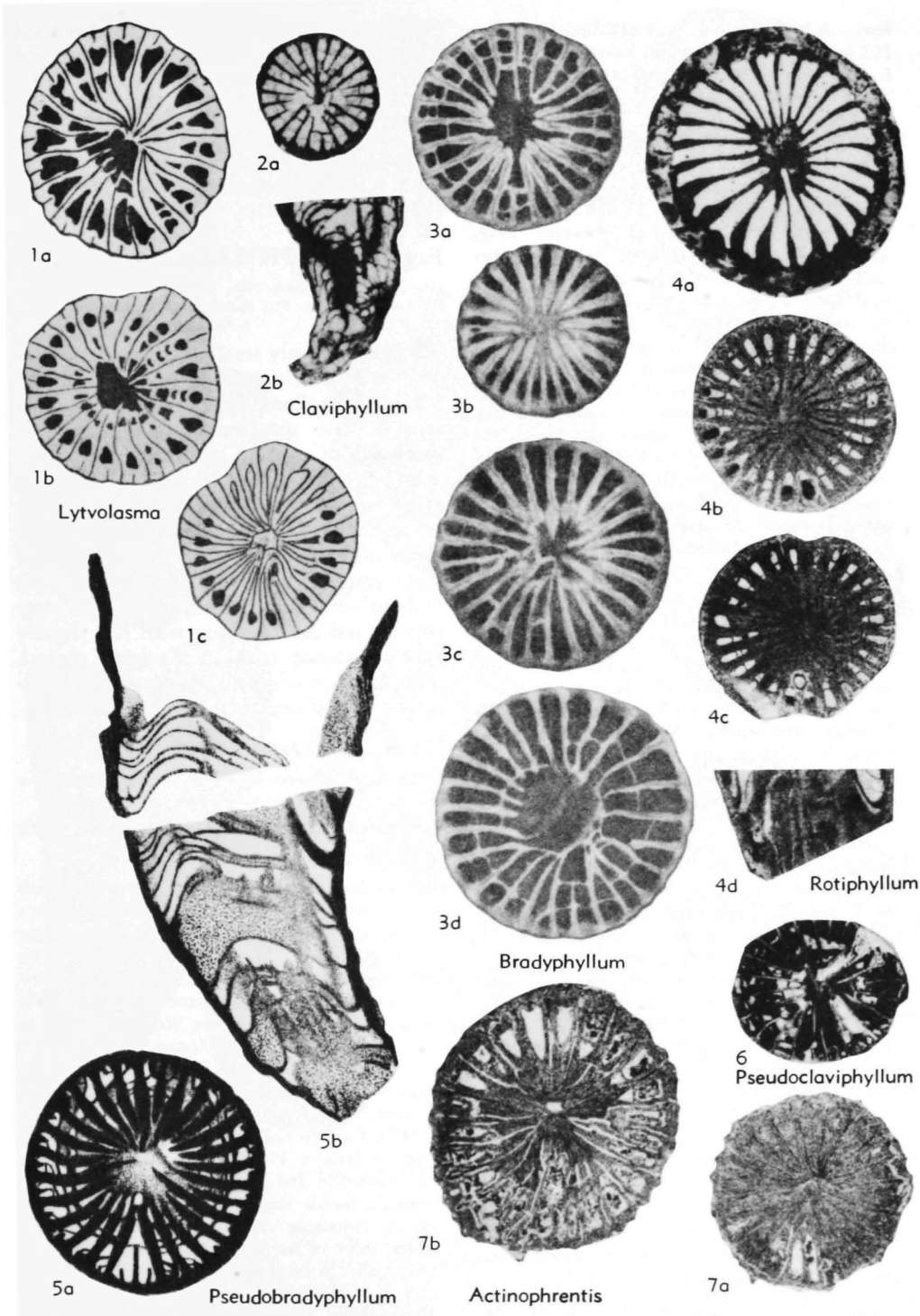


FIG. 203. Antiphyllidae (p. *F*310-*F*312).

few. *L.Perm.(Artinsk.)*, Eu.(C.Urals).——FIG. 203,*1a-c*. **L. asymmetricum*, holotype, R. Lytva, 6 km. below Alexandrovskiy works; *a-c*, serial transv. secs., ×4 (Soshkina, Dobrolyubova, & Porfirev, 1941).

Pseudobradyphyllum DOBROLYUBOVA, 1940, p. 12 [**Zaphrentis nikitini* SHTUKENBERG, 1888, p. 8; OD; holotype not preserved *fide* DOBROLYUBOVA, 1940, p. 19, paratypes 19-22, 24, coll. 321, TsGM, Leningrad] [?=*Bradyphyllum* GRABAU, 1928, which see]. Solitary, not large; in early stages long major septa reach axis, in later stages their axial ends become somewhat rhopaloid, and they are unequal, the cardinal and counter septa shortest, and counter-lateral, alar, and first cardinal metasepta longest; insertion in counter quadrants accelerated; fossula distinct in late stages, variably placed in relation to curvature of corallum; minor septa very short; tabulae convex, may be incomplete; no dissepiments. *U.Carb.(Gshel.)*, Eu.(Moscow Basin).——FIG. 203,*5a,b*. **P. nikitini* (SHTUKENBERG), topotype, quarry on Gshel R. between Troshkova and Glebova; *a,b*, transv., long. secs., ×2 (Dobrolyubova, 1940).

Rotiphyllum HUDSON, 1942a, p. 257 [**Densiphyllum rushianum* VAUGHAN, 1908, p. 459; OD; †T10/1009, TC, Dublin] [?=*Centrocellulosum* THOMSON, 1883, p. 452 (157) (type, *C. densothecum*, SD GREGORY, 1917, p. 238; †lost by fire, *fide* HILL, 1938-1941, p. 126, lectotype by HUDSON, 1942a, p. 261; L.Carb., Visean, Charleston, Fifeshire); *Monophyllum* FOMICHEV, 1953a, p. 110 (type, *M. sokolovi*; OD; †70, coll. 5030, TsGM, Leningrad; M.Carb., Ls. L_{1b}, Petrodonetsk Mine, Donbas)]. Small, solitary, cornute, fossula on convex side; major septa dilated, with extra thickening in inner third of their length, joined to form dense axial structure; counter septum longer than others and cardinal septum may withdraw from center of axial structure into which cardinal fossula may extend, narrowing adaxially; alar fossulae not marked; minor septa short; bases of septa dilated and in contact, forming narrow peripheral stereozone; tabulae conical; no dissepiments. *L.Carb.(Visean)*, Eu.(U.K.-Eire)-Asia(Kazakh.); *U.Carb.(Moscov.)*, Eu.(Donbas).——FIG. 203,*4a*. **R. rushianum* (VAUGHAN), L. Carb., *Cyathaxonia* beds, Eire, Rush; transv. sec., ×4 (Vaughan, 1906).——FIG. 203,*4b-d*. *R. sokolovi* (FOMICHEV), holotype; *b,c*, transv., *d*, long. secs., ×3 (Fomichev, 1953a).

Subfamily PSEUDOCLAVIPHYLLINAE Hill, new subfamily

Antiphyllidae with a narrow dissepimentarium. *L.Carb.(Visean)*.

Pseudoclaviphyllum VASILYUK, 1964, p. 65 [**P. tenuiseptatum*; OD; †454, coll. 11, DPI, Donetsk]. Corallum small, solitary, somewhat curved; major septa straight, radial, unequal; counter septum longer than others, reaching axis or beyond and somewhat rhopaloid; cardinal septum always and alar septa commonly short; two metasepta in each quadrant longer than others; tabulae conical; minor septa short in narrow dissepimentarium. *L.Carb.(Visean)*, Eu.(Donbas).——FIG. 203,*6*. **P. tenuiseptatum*, holotype, zone $C_1^{\gamma}g$, ls. B_1, left bank R. Kalmius below Konsomolsk; transv. sec., ×2 (Vasilyuk, 1964).

Family HAPSIPHYLLIDAE Grabau, 1928

[Hapsiphyllidae GRABAU, 1928, p. 118] [=Stereophrentidae FOMICHEV, 1953a, p. 141; Hapsiphyllinae IVANOVSKIY, 1965a, p. 65]

Solitary, mostly small and curved; fossula on concave side, expanded adaxially through center of corallum, and containing cardinal septum that shortens in mature stages; metasepta of cardinal quadrants pinnate toward fossula, may have axial ends fused; metasepta of counter quadrants radial or at angles to alar septa; counter septum rarely differentiated by size; calical edge of septa smooth; axial edges of major septa without vermiform lobes; minor septa may be long and contratingent with *Km* slightly longer; tabulae incomplete, floors conical, apex at inner edge of fossula, which is eccentric; no dissepiments. *Dev.-Perm.*

Subfamily HAPSIPHYLLINAE Grabau, 1928

[*nom. transl.* IVANOVSKIY, 1965a, p. 65, *ex* Hapsiphyllidae GRABAU, 1928, p. 118]

Hapsiphyllidae with apical part with epithecate wall. *M.Dev.-Perm.*

Hapsiphyllum SIMPSON, 1900, p. 203 [**Zaphrentis calcariformis* HALL, 1882, p. 33; OD; SIMPSON's specimens, which may be HALL's syntypes, are probably 11969-11976, NYSM, Albany, *fide* B. M. BELL, written commun.; HALL's designated horizon and locality of "Corniferous limestone; Falls of the Ohio" is in error, see WORTHEN, 1890, p. 76; =*Zaphrentis cassedayi* MILNE-EDWARDS, 1860, p. 341, †not traced, ?Paris, L.Carb., St. Louis Gr., Ind., see GROVE, 1935, p. 362] [=*Enallophyllum* GREENE, 1901, p. 54 (type, *E. grabaui*, OD; †23629, GREENE Coll., AMNH, New York, lectotype by STUMM, 1948d, p. 73; mid.Miss., Salem Ls., Lanesville, Ind.]. Small, solitary, ceratoid or trochoid; fossula large on concave side, expanded axially, containing cardinal septum long in early stages, short in late stages, and bounded laterally and axially, in early stages at least, by fused axial ends of remaining major septa; minor septa long, contratingent; tabulae incomplete, floors conical with apex at inner edge of fossula; no dissepiments. *?M.Dev.*, Eu.(Spain); *Miss.*, N.Am.(Ind.-Ky.-?N.Mex.).——FIG. 204,*4a-d*. **H. cassedayi*

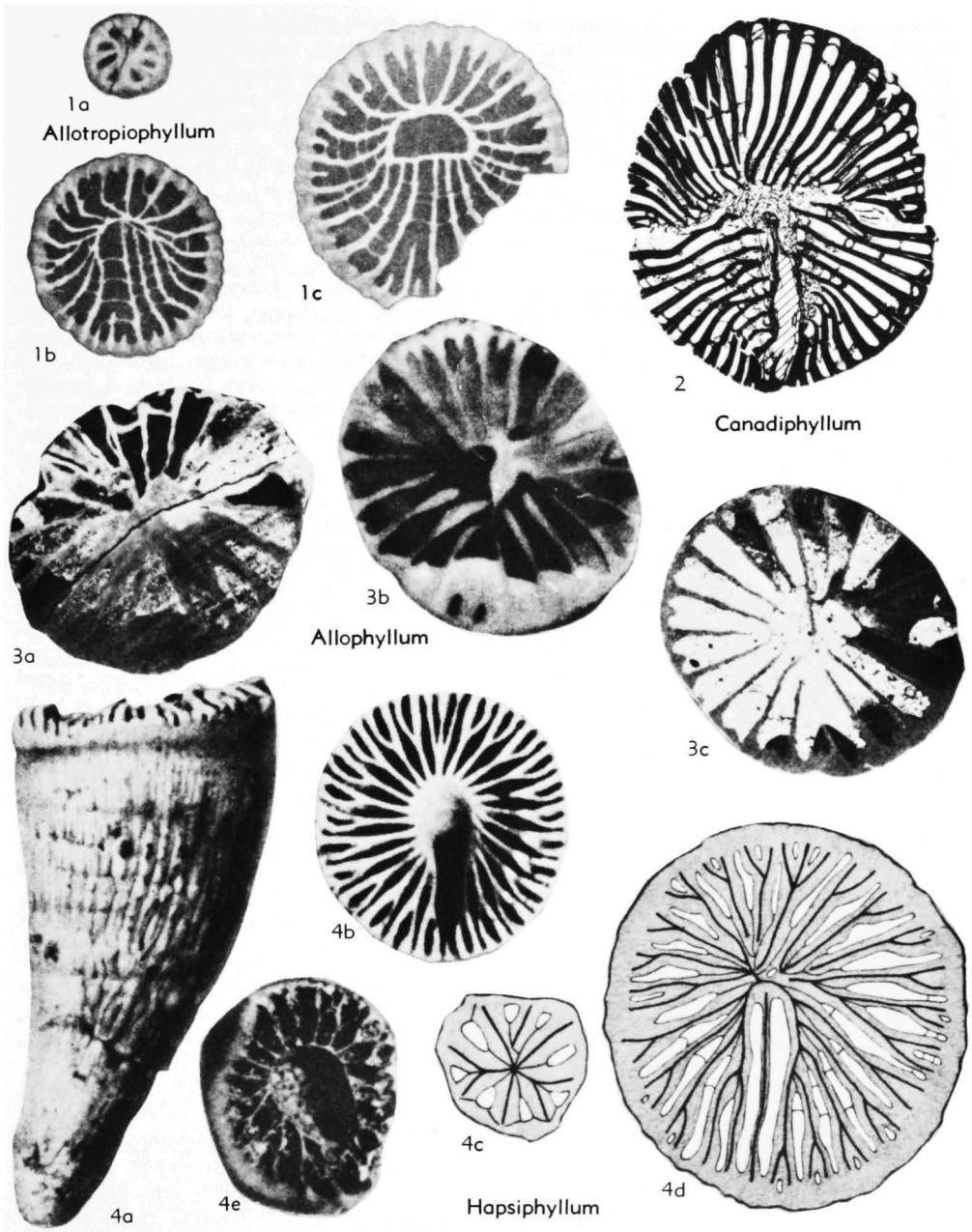


FIG. 204. Hapsiphyllidae (p. *F*312-*F*314).

(MILNE-EDWARDS), Miss., Ind., St. Louis Gr.; *a,b,* lat., calical views, ×4; *c,d,* transv. secs., ×15, ×8 (Schindewolf, 1938).——FIG. 204,*4e*. *H. grabaui* (GREENE), lectotype; calical view, ×4 (Stumm, 1948d).

Allophyllum SCHOUPPÉ, 1957, p. 362 [**A. grunaui*; M; †D5438, NM, Basel]. Solitary, curved, cardinal side concave; cardinal septum short to very short, counter septum long, its adaxial end may be transiently both separate and distally produced as timorphylloid columella; other protosepta not distinct in length or thickness from metasepta;

cardinal fossula closed at least in later young stages due to coalescence of axial ends of neighboring major septa as part of a general axial coalescing, thickening, and immersion in sclerenchyme of axial ends of major septa; rhopaloid thickening of axial ends of septa in cardinal quadrants retained longer than in counter quadrants; all major septa withdrawn somewhat from axis in mature stages; minor septa very short; tabulae subhorizontal, complete; no dissepiments. *L.Perm.*, Asia (Timor).——Fig. 204,*3a-c*. **A. grunaui*, holotype, G167, Cribas-Anticlinal, E. of Cribas, former Port. Timor; *a-c*, transv. secs., ×3 (Schouppé, 1957).

Allotropiophyllum Grabau, 1928, p. 130 [**Amplexus spinosus* de Koninck var. *sinensis* Grabau, 1922, p. 64; OD; 2 syntypes of var. *sinensis*, 159-160, Geol. Survey China, Peking; †holotype of species *sinensis*, 1600, IGP, Nanking, selected by Grabau, 1928, p. 136]. Small, ceratoid and typically with scattered hollow spines; fossula on concave side, narrowing inward and then expanding into axial space bounded on narrow counter side by conjoined axial ends of septa of counter quadrants, in which septal insertion is greatly accelerated; axial ends of long, thin metasepta of cardinal quadrants may reach across axial space to partial inner wall or may themselves join and extend wall around fossula; cardinal septum short; tabulae rising to wall of fossula; minor septa short; no dissepiments. *?L.Carb.(Tournais.-Visean)*, Eu.(Belg.-U.K.); *Miss.*, N.Am.(Alberta); *L.Perm.(Artinsk.)*, Asia(China).——Fig. 204,*1a-c*. **A. sinense* (Grabau), L.Perm., Chihsia Ls., China, Chihsiashan, Nanking reg.; *a-c*, transv. secs., ×5 (Grabau, 1928).

Amplexizaphrentis Vaughan, 1906, p. 315, as *Amplexi-Zaphrentis* [**Zaphrentis curvulena* Thomson, 1881, p. 223; SD ICZN Op. 854; †T2106, KM, Glasgow; lectotype by Hill, 1938-1941, p. 142; see also Shrestha, 1966, p. 349; Mitchell, 1966, p. 83] [=*Triplophyllites* Easton, 1944b, p. 35 (type, *T. palmatus*, OD; †3519, ISGS, Urbana; L.Carb., Chester., Kinkaid Ls., near Cedar Grove Church, Johnson Co., Ill.), may have spinose outgrowths, fossula commonly to one side of concave side, see Easton, 1975, p. 675, 678, Sando, 1969, p. 288; *Enniskillenia* Kabakovich in Soshkina, Dobrolyubova, & Kabakovich, 1962, p. 323 (type, *Zaphrentis enniskilleni* Milne-Edwards & Haime, 1851, p. 334, OD; †5460, Geological Society coll., IGS, Leeds; Carb. Ls., Lough Gill, Co. Sligo, Eire; see Lewis, 1930, p. 277), =*Enniskiellenia* Flügel, 1970, p. 102, *nom. null.*]. Solitary, moderately large, curved trochoid, cardinal side concave; calice deep, with large fossula expanding adaxially, commonly extending beyond center; axial ends of major septa may unite around fossula but in late stages become amplexoid and withdraw from it, first in counter quadrants; alar fossulae not conspicuous in late stages; cardinal septum long in early stages, shortened later; counter septum may shorten slightly; tabulae commonly complete domes, flattened or even concave axially, descending steeply toward periphery in fossulae [see Easton, 1975, p. 678; Sando, 1969, p. 288]. *L.Carb.(Visean)*, Eu. (Brit. I.-Donbas-Russ. Platf.)-N.Afr. (Alg.); *L. Carb.(Tournais.-Visean)*, Asia(Kuzbas-Taymyr); *L.Carb.*, S.Am.(Venez.); *U.Miss.*, N.Am.(Nova Scotia-B.C.-N.Mex.-Ariz.); *U.Miss.(Chester.)*, N. Am.(Ill.).——Fig. 205,*1a-c*. *A. palmata* (Easton); same loc. as holotype; *a-c*, transv. secs., 3 specimens, ×2 (Easton, 1944b).——Fig. 205,*1d*. **A. curvulena* (Thomson), holotype, up.Visean, Scot., Brockley, Lanarkshire; transv. sec., ×2 (Hill, 1938-1941).——Fig. 205,*1e-n*. *A. enniskilleni* (Milne-Edwards & Haime); *e*, holotype, L. Carb.; ext. view, ×1 (Vaughan, 1911); *f-n*, specimens from C_2S_1, *Chonetes carinata* Band, near Skillecore, Derbyhaven, Isle of Man, *f*, transv. sec., ×3, *g*, long. sec., ×3, *h-n*, transv. secs., ×3, *m,n*, ×4 (Lewis, 1930).

Barytichisma Moore & Jeffords, 1945, p. 131 [**B. crassum*; OD; †P11908b, UTBEG, Austin] [=*Thecophyllum* Fomichev, 1953a, p. 175 (type, *T. lebedevi*, OD; †126, coll. 5030, TsGM, Leningrad; M.Carb., Ls. L_7, R. Likhaya; see Weyer, 1965, p. 449)]. Solitary, medium to large, curved conical in early stages, straight cylindrical in adult; with narrow, peripheral stereozone; in early stages septa long, thick, joined at axis, but open fossula on concave side and alar fossulae notable; in adult stages major septa, except short cardinal septum, are subequal, and meet or are joined in axial region only on upper surfaces of tabulae; they then withdraw between tabulae in amplexoid manner; accelerated septal insertion occurs in counter quadrants; minor septa rudimentary; tabulae domed, with flat tops or concave axially; no dissepiments. *L.Penn.*, N.Am.(Texas-Ark.-Utah); *U. Carb.(Moscov.)*, Eu.(Donbas).——Fig. 206,*1a-c*. **B. crassum*, holotype, Low. Marble Falls ls., Texas, San Saba Co.; *a,b*, transv., *c*, long. secs., all ×1.9 (Moore & Jeffords, 1945).

Canadiphyllum Sutherland, 1954, p. 361 [**C. knoxi*; OD; †10566, GSC, Ottawa]. Solitary, small, erect, trochoid; with prominent, long, parallel-sided, deep fossula ?(on concave side) with very short cardinal septum, and bounded by thickened and downturned parts of tabulae; alar fossulae distinct; septa of cardinal quadrants pinnate to or nearly at right angles to the fossula; septa of counter quadrants subparallel to radial; tabulae rising gradually from periphery, slightly domed at edge of fossula, descending sharply into it; minor septa very short or immersed in wall; no dissepiments. *U.Miss.*, N.Am.(B.C.); *L.Carb. (?Visean)*, Asia(?Taymyr), see Rogozov, 1972, p. 54.——Fig. 204,*2*. **C. knoxi*, holotype, B.C., Halfway River Valley; transv. sec., ×3 (Sutherland, 1954).

Clinophyllum GROVE, 1935, p. 364 [**Zaphrentis chouteauensis* MILLER, 1891, p. 10; M; †3916, UCGM, Cincinnati; lectotype by EASTON, 1944b, p. 47]. Solitary, small to medium-sized, curved, conical; calice commonly deep and very oblique; major septa thick, tapering, long, their axial edges free, becoming amplexoid in late stages; counter septum on concave side, very long, flanked in calice by short minor septa, cardinal septum next longest; alar septa shortest; minor septa rudimentary; tabulae complete, plane, may have downturned edges, depressed at cardinal and alar fossulae ?(and also at counter septum); no dissepiments. *Miss.*, N.Am.(Mo.-Ind.).——FIG. 207, *1a-c*. **C. chouteauense* (MILLER), paratypes, Chouteau Ls., Mo., Sedalia; *a*, ext. view, ×2; *b,c*, other specimens, Chouteau Ls., Mo., near Sedalia; transv., long. secs., ×2 (Easton, 1944b).

?**Duplophyllum** KOKER, 1924, p. 21 [**D. zaphrentoides* KOKER, 1924, p. 21; M, see CHI, 1938, p. 164, LANG, SMITH, & THOMAS, 1940, p. 55; †not traced in TH, Delft (orig. of KOKER, pl. 8, fig. 2a); lectotype by SCHOUPPÉ & STACUL, 1959, p. 242]. Solitary, cardinal side commonly convex, less commonly concave; septa of quadrants arranged pinnately to shallow cardinal and alar fossulae, their axial ends in late stages may withdraw somewhat to leave open fossula, and cardinal septum may shorten markedly; thickness of major septa variable, may be marked; minor septa variable, may be long, thin, and either contratingent, contraclined, or contrajunct, *Km* longest; tabulae declined abaxially. *U.Perm.*, Asia(Timor). ——FIG. 206,*3*. **D. zaphrentoides* KOKER, lectotype, Timor, Basleo; transv. sec., ?enl. (Koker, 1924).

Euryphyllum HILL, 1938, p. 25 [**E. reidi*; OD; †F3243, UQ, Brisbane] [=*Euryphyllum* HILL, 1937, p. 150, *nom. nud.*]. Solitary, commonly small, typically with oblique calical floor; major septa extending to axis and pinnately grouped about long, closed fossula bisected by long cardinal septum on concave side of corallum; alar fossulae present; septa dilated, in early stages laterally contiguous throughout, but with growth dilatation decreases in a widening zone midway between periphery and axis, leaving wide peripheral stereozone, and an axial structure formed by the conjoined axial edges of septa; minor septa very short; tabulae widely separated, complete or incomplete; no dissepiments. *Perm.*, Australia(Queensl.-New S. Wales-W. Australia)-N. Z.-Asia (Timor)-Eu. (W.Urals).——FIG. 207,*3a,b*. **E. reidi*, holotype, Queensl., Cabbage Cr., Springsure distr.; *a,b*, transv., long. secs., ×2 (Hill, 1938).

Famennelasma WEYER, 1973e, p. 684 [**F. rhenanum*; OD; †K45, SCHWALM 1899 Coll., HU, E. Berlin]. Solitary, small, conical, ?concave side cardinal, with deep calice; cardinal tabular fossula expanding slightly to merge with axial space,

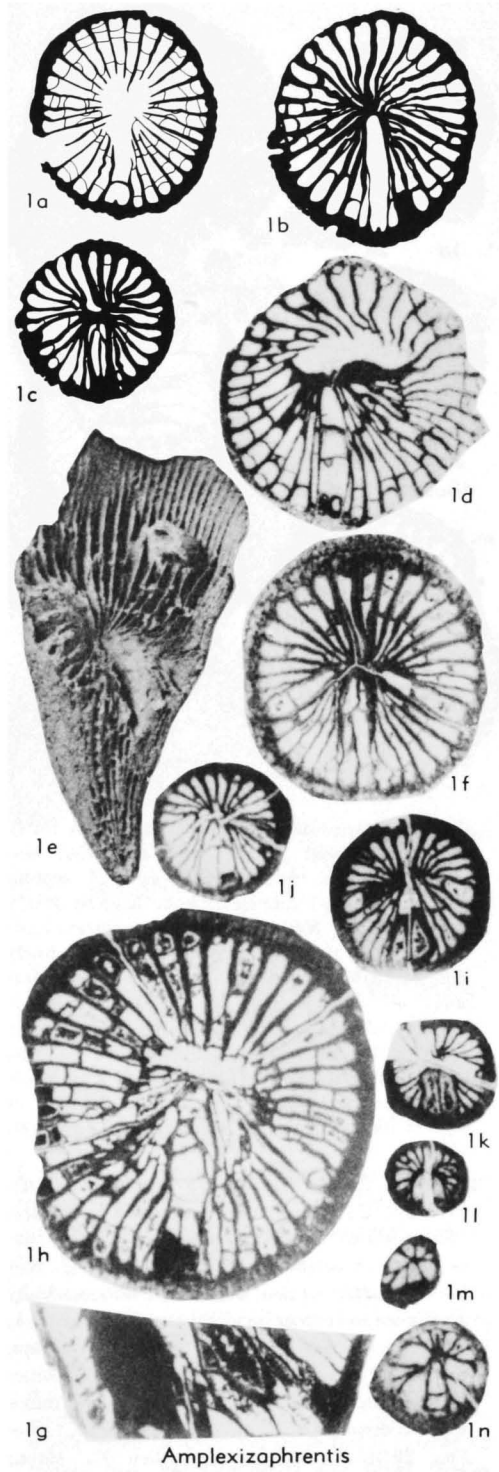


FIG. 205. Hapsiphyllidae (p. *F*314).

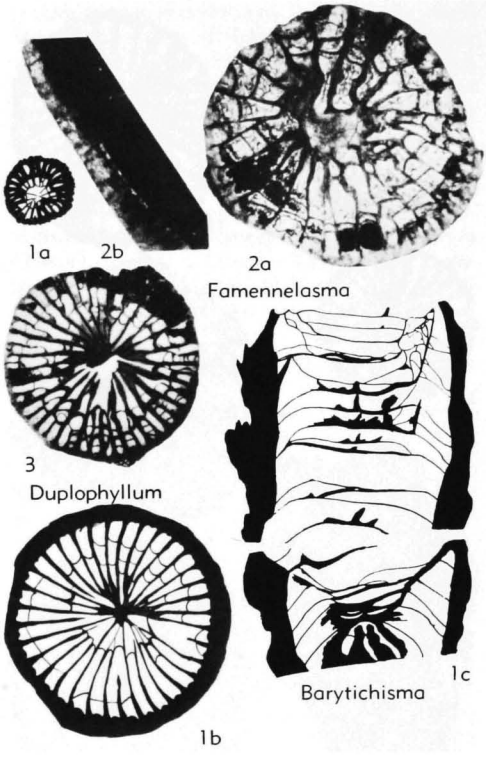


FIG. 206. Hapsiphyllidae (p. *F*314-*F*316).

discontinuous fossular wall being formed by fused, slightly rhopaloid axial ends of somewhat pinnately arranged major septa; cardinal septum shortens distally; counter septum longest; minor septa including *Km* very short, not contratingent; calical edges of septa finely dentate, septa finely monacanthate; tabulae declined from wall of fossula; no dissepiments. *U.Dev.*, Eu.(Ger.-Pol.).——FIG. 206,*2a,b*. **F. rhenanum*, holotype, up. Famenn., *Clymenia*-Stage or *Wocklumeria*-Stage, Ger., Braunau, Kellerwald; *a*, transv. sec., ×3.8, *b*, radial long. sec. peripheral, calical part of septum indicating fine monacanths, ×4.7 (Weyer, 1973e).

Longiclava EASTON, 1962, p. 33 [**L. tumida*; OD: †118729, USNM, Washington]. Small, solitary; calice shallow, with deep cardinal fossula on concave side of corallum and prominent, long, rhopaloid counter septum; septal insertion markedly accelerated in counter quadrants; major septa thick, long, but unequal, axial edges fused in groups, the longest in a group joining axial ends of counter septum; cardinal septum short in late stages; minor septa rudimentary. *U.Miss.*, N.Am.(Mont.).——FIG. 207,*5a,b*. **L. tumida*, Allen F., Mont.; *a*, topotype (paratype), calical view, ×2; *b*, holotype, transv. sec., ×3 (Easton, 1962).

Meniscophyllum SIMPSON, 1900, p. 199 [**M. minutum*; OD; †295, NYSM, Albany; lectotype by EASTON, 1944b, p. 46] [?=*Heptaphyllum* CLARK, 1924, p. 416 (type, *H. gracile*, OD; †A3382, SM, Cambridge, insufficiently known); ?*Caenophyllum* CLARK, 1926, p. 85 (type, *C. varians*, OD; †A3384, SM, Cambridge, insufficiently known)]. Small, cornute; minor septa very short or absent; cardinal fossula on concave side; major septa thickened, axial ends conjunct in fossular wall that is crescentic in transverse section and located eccentrically, on convex side of corallum; four or five septa on concave side longer, thinning axially, and disjunct from fossular wall; tabulae thin; no dissepiments; minor septa rudimentary [see EASTON, 1944b, p. 46]. *Miss.*, N.Am.(Mo.); ?*L.Carb.*, Eu.(Ire.).——FIG. 207,*2a-d*. **M. minutum*, Miss., Mo.; *a*, ext. view, ×1; *b*, long. sec., enl.; *c,d*, transv. secs., enl. (Simpson, 1900).

?**Neozaphrentis** GROVE, 1935, p. 358 [**Zaphrentis tenella* MILLER, 1891, p. 621; OD; †3360, UCGM, Cincinnati]. Small, solitary, curved, conical; long, deep fossula on ?concave side or variable in position and commonly open, with cardinal septum progressively shortening; counter septum long, taller than others; metaseptal arrangement quadripartite, pinnate to counter septum and to fossula; minor septa very short or not projecting from wall; tabulae arched distally; no dissepiments [see EASTON, 1958, p. 26; 1975, p. 676]. *Miss.*, N. Am.(Mo.-Mexico).——FIG. 207,*4a-c*. **N. tenella* (MILLER), Mo.; 3 specimens, transv. secs., all ×5 (Easton, 1944b).

Zaphrentites HUDSON, 1941, p. 309, *non Zaphrentites* VON BUBNOFF, 1926, p. 150, *nom. null.* [**Zaphrentis parallela* CARRUTHERS, 1910, p. 533; OD; †GSM PF1256(56567), IGS, Leeds] [?=*Cypellophyllum* TOLMACHEV, 1933, p. 287, *nom. subst. pro Craterophyllum* TOLMACHEV, 1931, p. 344 (type, *C. abyssum*, M; †?in coll. 2555, TsGM, Leningrad; L.Carb., Kuzbas, Asia), *non Craterophyllum* FOERSTE, 1909a, p. 101, see Arachnophyllina, Arachnophyllidae, *nec Craterophyllum* BARBOUR, 1911, p. 38, renamed *Barbouria* by LANG, SMITH, & THOMAS, 1940, p. 26, 42, see *Crataniophyllum* LANG & THOMAS, 1957, Caniniina, Cyathopsidae; *Stereophrentis* FOMICHEV, 1953a, p. 141 (type, *Zaphrentis delanouei* MILNE-EDWARDS & HAIME, 1851, p. 332, OD; 5 unfigured syntypes, Z19a,b, in MILNE-EDWARDS Coll., MN, Paris; lectotype by HUDSON, 1941, p. 291; L.Carb., Tournai; original of MILNE-EDWARDS & HAIME, 1851, pl. 5, fig. 2, not traced); *Parastereophrentis* FOMICHEV, 1953a, p. 162 (type, *P. virgata*, SD HILL, herein; †117, coll. 5030, TsGM, Leningrad; M.Carb., Moscov., Ls. K_7, Stashkova Gorge, Donbas)]. Small, conical, slightly curved, with strong longitudinal ribbing; cardinal fossula on concave side; in early forms and early stages cardinal fossula closed, expanding adaxially, and

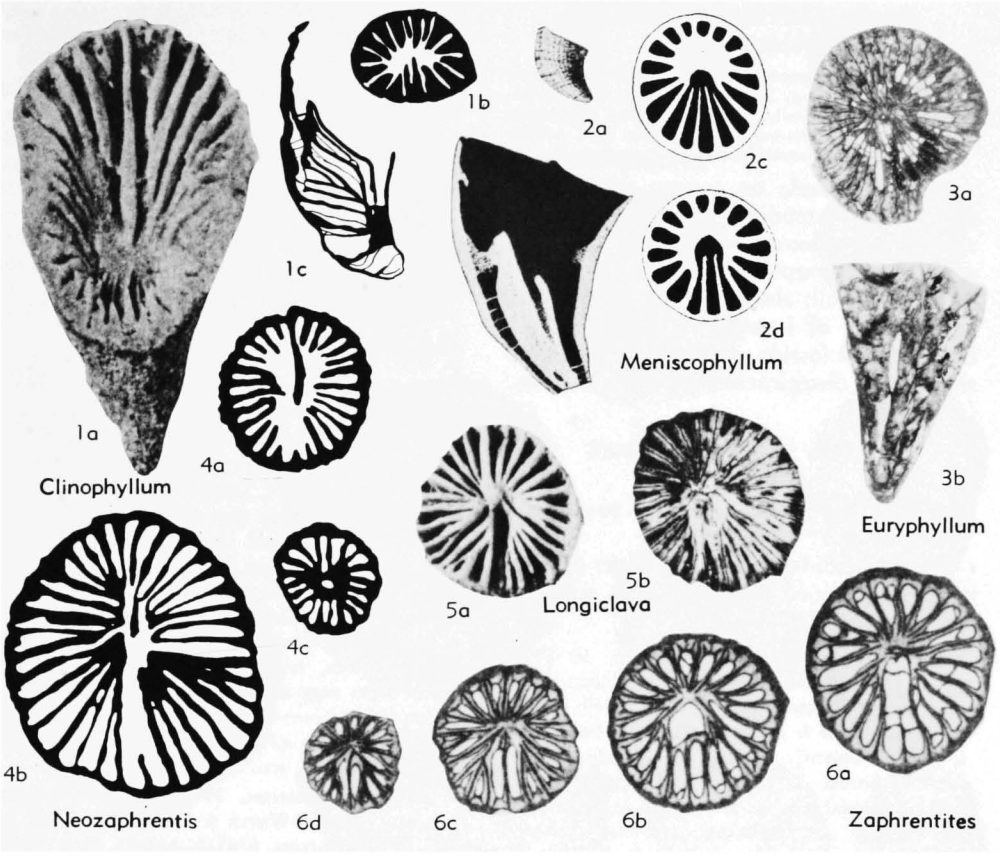


FIG. 207. Hapsiphyllidae (p. *F*315-*F*317).

major septa pinnately arranged with respect to cardinal and alar fossulae; in later forms and later stages cardinal septum shortened and septa withdrawn from fossula, first in cardinal quadrants, then in counter quadrants, so that radial arrangement supercedes pinnate arrangement; minor septa very short or immersed in wall; tabulae incomplete, floors conical, with highest point at inner edge of fossula. *M.Dev.*, Eu.(Spain, as *?Hapsiphyllum simplex* KULLMAN, 1965, p. 106); *L.Carb.-U.Carb.(Tournais.-Namur.)*, Eu. (Brit. I.-Belg.-Russ.Platf.-Urals-Donbas)-Asia(Kuzbas-Kazakh.); *L.Miss.-L.Penn.*, N.Am.——FIG. 207,*6a-d*. **Z. parallelus* (CARRUTHERS), L.Carb. (Tournais.), Cementstone Gr., top band of ls., Scot., Larriston Quarry, Liddesdale; *a-d*, transv. secs., ×4 (Carruthers, 1910).

?Zaphrentula BOLKHOVITINOVA, 1915, p. 64 [**Z. primitiva*; M; †part of type material in MGU, Moscow] [=*Zaphrentulla* BOLKHOVITINOVA, 1915, p. 67, *nom. van.*]. Very small, ceratoid, attached by side or convex surface (type material attached to *Chaetetes* sp.), solitary, with occasional offsets; with few septa and small columella; without tabulae or dissepiments. [Insufficiently known.] *L.Carb.*, Eu.(Moscow Basin).

Subfamily ADRADOSIINAE Birenheide & Soto, 1977

[Adradosiinae BIRENHEIDE & SOTO, 1977, p. 9]

Hapsiphyllidae with apex of corallum lacking wall so that pinnately arranged major septa are exposed; cardinal fossula on concave side with short cardinal septum in calice. *L.Dev.*

Adradosia BIRENHEIDE & SOTO, 1977, p. 9 [**A. barroisi*; OD; †11271, DPO, Oviedo]. Corallum small, conical, curved or straight; apex without wall, only pinnately arranged septa exposed; cardinal fossula on concave side, closed, with cardinal septum short in calice but long below calice; minor septa short; tabulae normally ascending toward axis, but descending and closer tabulae ?(or flanges) may also be found. *L.Dev.*, Eu. (Spain).

Family ZAPHRENTOIDIDAE Schindewolf, 1938

[Zaphrentoididae SCHINDEWOLF, 1938, p. 451] [=Zaphrentoidinae WANG, 1950, p. 203; Zaphrentoidida SCHINDEWOLF, 1952, p. 164, superfamily; Sychnoclasmatidae KABAKOVICH in SOSHKINA, DOBROLYUBOVA, & KABAKOVICH, 1962, p. 323; Zaphrentoidicae IVANOVSKIY, 1967, p. 78, superfamily]

Solitary; fossula on convex side, closed, deep, long, extending to or beyond axis and enclosing somewhat shortened cardinal septum; major septa conjoined by axial ends in fossular wall; alar fossulae notable; tabulae complete or incomplete, declined from inner edge of fossula, or absent; minor septa short, no dissepiments. *L.Miss.-L.Penn.; U.Perm.*

Subfamily ZAPHRENTOIDINAE Schindewolf, 1938

[*nom. transl.* WANG, 1950, p. 203, *ex* Zaphrentoididae SCHINDEWOLF, 1938, p. 451]

Zaphrentoididae with distal edges of septa in calice declined adaxially from wall. *L. Miss.-L.Penn.; U.Perm.*

Zaphrentoides SHTUKENBERG, 1895, p. 38 [**Zaphrentis griffithi* MILNE-EDWARDS & HAIME, 1851, p. 333; SD SCHINDEWOLF, 1938, p. 449; †Z20a, MILNE-EDWARDS & HAIME Coll., MN, Paris, only specimen known]. Turbinate, slightly curved; solitary; fossula on convex side, deep, long, extending beyond axis, greatest width in calice midway to axis and enclosing somewhat shortened cardinal septum; alar fossula midside peripherally; major septa long, somewhat flexuous, unequal, axial ends may unite in pairs; minor septa short; no dissepiments [EASTON, 1975, p. 679]. *L.Carb. (Visean.)*, Eu.(Eng.).——FIG. 208,*1a-d*. **Z. griffithi* (MILNE-EDWARDS & HAIME), holotype, Eng., "Clifton"; *a,b*, side, calical views, approx. ×1 (Milne-Edwards & Haime, 1852); *c*, transv. peel, ×2, *d*, calical view, ×1 (Easton, 1975).

Ankhelasma SANDO, 1961, p. 66 [**A. typicum*; OD; †120201, USNM, Washington]. Small, solitary, ceratoid or trochoid; calice deep with well-developed fossula on long, convex side that is flattened in adult; fossula long, extending beyond axis, deep, adaxially gradually widening, bounded laterally by tall, fused axial segments of septa of cardinal quadrants and axially by fused ends of counter septum and septa of counter quadrants; alar fossulae notable; in late stages counter-lateral and alar septa and older metasepta retreating from wall of fossula; some minor septa may be contratingent; tabulae absent; no dissepiments, interseptal loculi filled by septal thickening proximally; cardinal septum stunted in early stages, relatively short in late stages. *U.Miss.(Meramec.)*, N.Am.(Utah-Mont.).——FIG. 208,*2a,b*. **A. typicum; a*, holotype, up. Brazer dol., NE. Utah, Crawford Mts., calical view, ×2; *b*, another specimen, calical view of neanic corallum, diagram. (Sando, 1961).

?Basleophyllum SCHOUPPÉ & STACUL, 1959, p. 270 [**Duncania indica* KOKER, 1924, p. 11; OD; †11754, TH, Delft]. Solitary, curved, trochoid, shallow cardinal fossula on convex side; major septa somewhat withdrawn from axis, ending at edge of axial depression in tabulae that slope upward from wall, counter septum longest, cardinal septum half as long as other major septa; minor septa mostly very short, buried in narrow peripheral stereozone; septal insertion slightly accelerated in counter quadrants [SCHOUPPÉ & STACUL, 1959, p. 270]. *U.Perm.*, Asia(Timor).——FIG. 208,*6a-d*. **B. indicum* (KOKER), Basleo; *a*, holotype, ×1.0 (Koker, 1924); *b-d*, topotype, transv. secs., ×3.0, ×1.5, long. sec., ×2.0 (Schouppé & Stacul, 1959).

Fasciculiamplexus EASTON, 1962, p. 31 [**F. contortus*; OD; †118724, USNM, Washington]. Solitary, with moderately deep calice; cardinal fossula commonly on convex side; major septa thick, long, their axial edges fused in groups in early stages, but free and markedly amplexoid later; cardinal septum shortened in late stages; distal edges of septa smooth; tabular floors tall, flat-topped domes, tabulae complete or incomplete; minor septa very short, no dissepiments. *L.Penn.*, N.Am.(Mont.).——FIG. 208,*5a-c*. **F. contortus*, Cameron Cr. F.; *a,b*, holotype, transv. secs., ×3; *c*, paratype, long. sec., ×3 (Easton, 1962).

Homalophyllites EASTON, 1944b, p. 42 [**Lophophyllum calceola* WHITE & WHITFIELD, 1862, p. 305; OD; 2 syntypes, 6365/1, AMNH, New York] [?=*Sychnoelasma* LANG, SMITH, & THOMAS, 1940, which see; SAYUTINA, 1976, p. 113]. Solitary, curved, conical, commonly with cardinal side convex and flattened at least in apical parts; fossula deep, commonly expanding somewhat adaxially, bounded by fused axial ends of major septa, cardinal septum shortening in late stages; major septa long, ?(may be thickened to contiguity in early stages); minor septa very short; tabular floors declined from axial region; no dissepiments. *L.Miss. (Kinderhook.-Osag.)*, N.Am.(Iowa-Mo.); *L.Miss.*, N.Am.?(Ind.-Colo.-N. Mex.-Ariz.-Mont.).——FIG. 208,*3a,b*. **H. calceola* (WHITE & WHITFIELD), topotype, Iowa, Burlington; *a*, flattened convex side, *b*, calical view, both ×1 (White, 1880).

Sychnoclasma LANG, SMITH, & THOMAS, 1940, p. 128, *nom. subst. pro Verneuilia* SHTUKENBERG, 1895, p. 40, *non* HALL & CLARKE, 1894, a brachiopod [**Verneuilia urbanowitschi* SHTUKENBERG; M; †?coll. 45, LGI, Leningrad] [?=*Homalophyllites* EASTON, 1944b, which see; *Verneuilites* VASILYUK, 1960, p. 46 (type, *Zaphrentis konincki* MILNE-EDWARDS & HAIME, 1851, p. 331, OD; probable figured syntype Z17a, MN, Paris; L.Carb., Tournai, Belg.; see DOBROLYUBOVA & KABAKOVICH, 1966, p. 36)]. Solitary, small, cera-

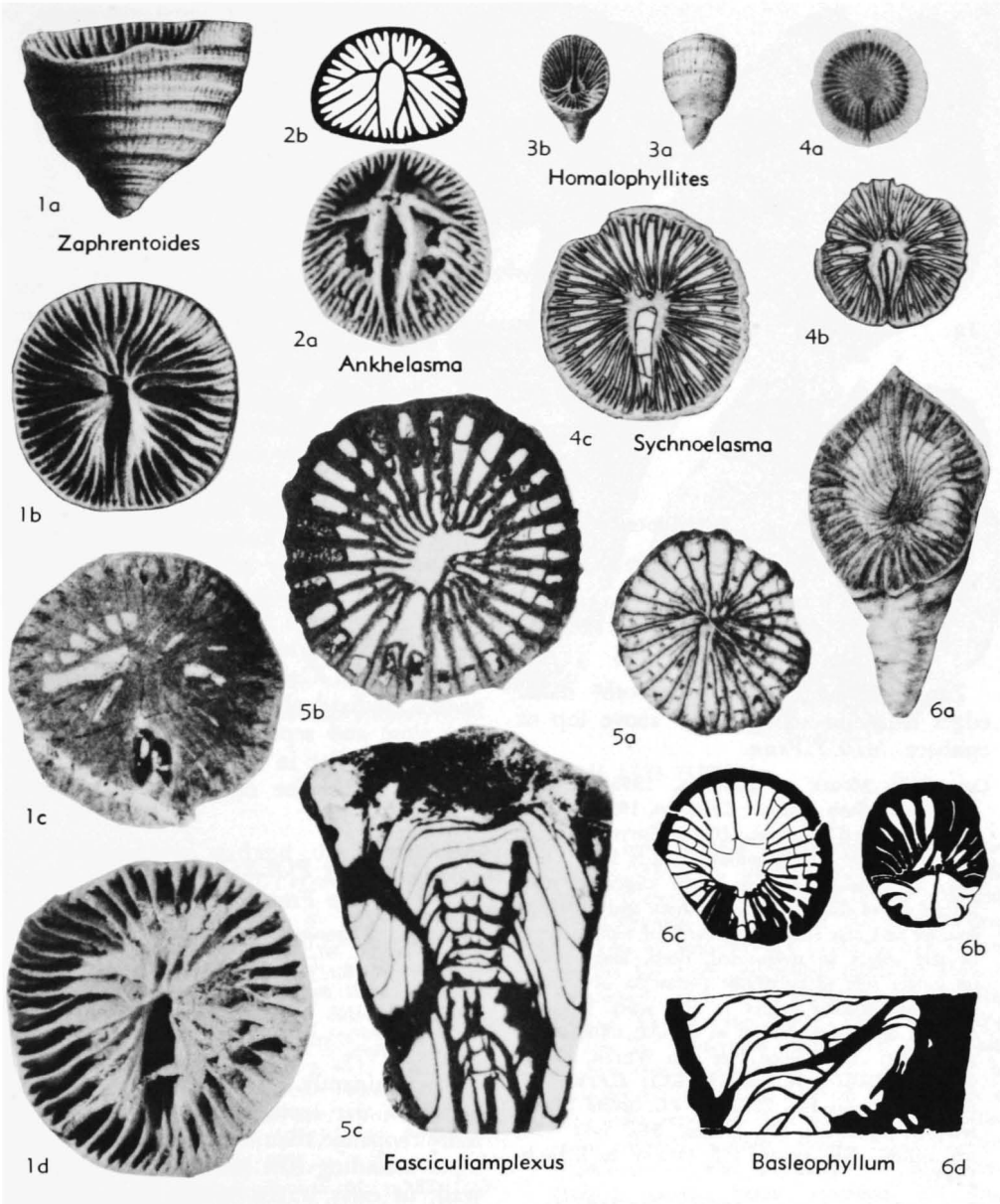


FIG. 208. Zaphrentoididae (p. *F*318-*F*319).

toid, cardinal side convex; calice moderately deep, bell-shaped; septa numerous, long, commonly thick, their axial ends fused to form thickened wall to cardinal fossula which is long, deepest at peripheral, and widest at axial end; trabeculae moderately coarse; cardinal septum thinning and shortening in later stages of development; minor septa may be long, not contratingent; tabular floors convex, sagging deeply in fossula, tabulae complete or incomplete; no dissepiments [see also SAYUTINA, 1976, p. 113]. *L.Carb.*, Eu.(U.K.-Belg.-Ger.-Russ.Platf.-Donbas-Urals-N.Zem.)-Asia (Kuzbas-Kazakh.-NE.USSR); *?Miss.*, N.Am.——FIG. 208,*4a*. **S. urbanowitschi* (SHTUKENBERG), basal Visean, Urals; calical view, enl. (Shtukenberg, 1895).——FIG. 208,*4b,c*. *S. koninckí* (MILNE-EDWARDS & HAIME), Belg., Tournai; *b,c*, transv. secs., ×3 (Carruthers, 1908).

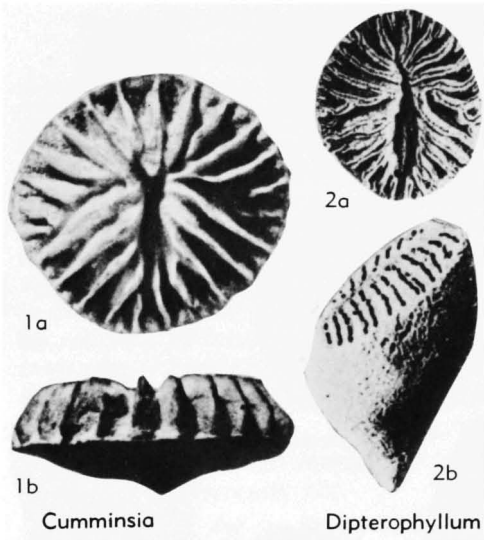


FIG. 209. Zaphrentoididae (p. *F320*).

Subfamily CUMMINSIINAE Weyer, 1975

[Cumminsiinae WEYER, 1975a, p. 19]

Zaphrentoididae with ?smooth distal edges to major septa arched above top of epitheca. *Miss.-L.Penn.*

Cumminsia MOORE & JEFFORDS, 1945, p. 164 [**Hadrophyllum aplatum* CUMMINS, 1891, p. 552; OD; 2 figured syntypes, ?Geol. Survey Texas]. Patellate, thick; base commonly nearly flat, epithecate, apex nearly central; distal edges of septa arched above distal edge of epitheca and ?smooth; counter and alar septa long, cardinal septum short in late stages in steep-sided, deep, long fossula on longer side of corallum; metasepta of counter quadrants making angles to alar septa, those of cardinal quadrants pinnate to fossula; minor septa very short; ?no tabulae [see also WEYER, 1975a, p. 19]. *U.Miss.*, N.Am.(Ky.-?Ill.); *L.Penn.*, N. Am.(Texas).——FIG. 209,*1a,b*. **C. aplata* (CUMMINS), Smithwick Sh., Texas, San Saba Co.; *a,b*, calical, side views, ×2 (Moore & Jeffords, 1945).

?Dipterophyllum ROEMER, 1883, p. 371 [**Zaphrentis glans* WHITE, 1862, p. 32; M; †9316, USNM, Washington]. Small, trochoid, somewhat curved; fossula on longer side, long, lenticular in outline, may extend beyond axis toward short counter septum, contains short cardinal septum; alar fossulae marked, insertion of septa in counter quadrants a little accelerated; septa thick, pinnately arranged toward cardinal, counter, and alar septa, their distal edges ?smooth and ?arched above distal edge of epitheca; minor septa short. [Type material eroded by transport. See BASSLER, 1937, p. 200; JEFFORDS, 1955, p. 10; WEYER, 1975a, p. 17.] *L.Miss.*, N.Am.(Iowa).——FIG. 209,*2a,b*. **D. glans* (WHITE), Burlington Ls., Iowa, Burlington; *a,b*, calical, lat. views, ×2 (Jeffords, 1955).

Suborder PLEROPHYLLINA Sokolov, 1960

[*nom. transl. et correct.* HILL, herein, *ex* Plerophyllida SOKOLOV, 1960, p. 53, order] [=Polycoeliina KABAKOVICH, 1962, p. 324; Tachylasmatina FEDOROWSKI, 1973, p. 113]

Corallum predominantly solitary; one or more protosepta longer than other septa and commonly more rhopaloid; cardinal or counter septa or both may be shortened; some metasepta may be longer and more rhopaloid than others; minor septa including *Km* commonly confined to wall; tabulae declined from axial region; a few with long minor septa and dissepimentarium; in early stages, where known, septa of cardinal quadrants pinnately arranged about cardinal septum and long fossula, and those of counter quadrants lengthening and becoming less parallel to alar septa and fossulae with age. In Carboniferous and Permian genera, individual septal monacanths fine and close and septa commonly dilated by growth lamellae in which accretions to individual trabeculae cannot be recognized. *U.Sil.-U.Perm.*

Family POLYCOELIIDAE de Fromentel, 1861

[*nom. correct.* LECOMPTE, 1952, p. 485, *pro* Polycoelidae ROEMER, 1883, p. 397, *nom. partim correct. pro* Polycaeliens DE FROMENTEL, 1861, p. 283] [=Sochkineophyllidae GRABAU, 1928, *nom. transl.* SOKOLOV, 1960, p. 53, *ex* Sochkineophyllinae GRABAU, 1928, p. 75; Hexalasmatidae SOKOLOV, 1960, p. 53; Polycoelacea LECOMPTE, 1952, p. 485; Polycoeliicae IVANOVSKIY, 1965a, p. 77; Polycoelaceae FLÜGEL, 1971, p. 111]

Predominantly solitary; cardinal, counter, and two alar septa longer and commonly more rhopaloid than remaining septa; minor septa including *Km* commonly confined to wall; in early stages, where known, septa of cardinal quadrants pinnately arranged about cardinal septum and long fossula, those of counter quadrants lengthening and becoming less parallel to alar septa with age; tabulae declined abaxially; a few with longer minor septa and dissepimentarium. *U.Sil.-L.Dev.; L.Carb.-Perm.*

Subfamily POLYCOELIINAE de Fromentel, 1861

[*nom. transl.* SCHINDEWOLF, 1942, p. 61, *nom. correct.* SCHINDEWOLF, 1952, p. 208, *pro* Polycoelidae ROEMER, 1883, p. 397, *nom. partim correct. pro* Polycaeliens DE FROMENTEL, 1861, p. 283]

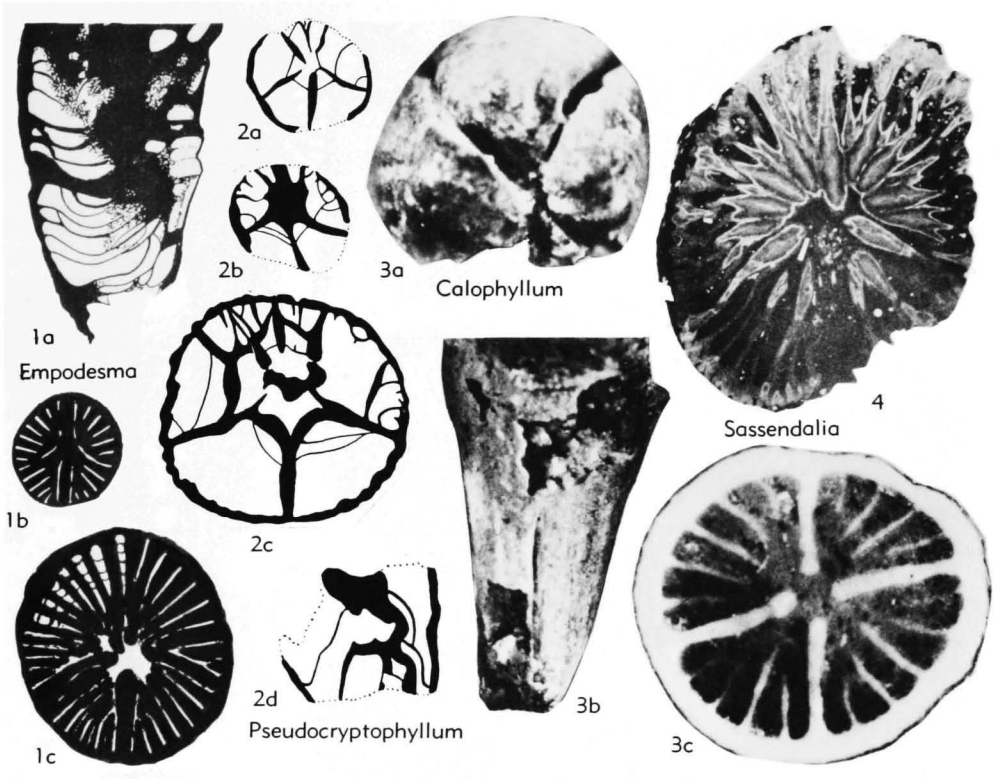


FIG. 210. Polycoeliidae (p. *F321*, *F323-F325*).

Polycoeliidae without dissepimentarium. *U.Sil.-L.Dev.; L.Carb.-Perm.*

Calophyllum DANA, 1846a, p. 183 [**Turbinolia donatiana* KING, 1848, p. 6; SM KING, 1850, p. 22; †neotype by FLÜGEL, 1973c, p. 62; in Hancock Museum, Newcastle-upon-Tyne; Perm., Magnesian Ls., Humbleton Hill, near Sunderland, Eng.; =*Caryophillia quadrifida* HOWSE, 1848, p. 260, *nom. oblit.* (FLÜGEL, 1973c, p. 65)] [=*Polycoelia* KING, 1849, p. 388, obj., *non Polycoelia* DE FROMENTEL, 1860, a Mesozoic sponge, see ICZN Art. 69(a)(II) and FLÜGEL, 1972, p. 57; *?Phryganophyllum* DE KONINCK, 1871, p. 321, *nom. nud.*, 1872, p. 62 (type, *P. duncani*, M; †a587, IRSN, Brussels; L.Carb., Tournai, Belg.; *Phrynganophyllum* TOTTON, 1930, Zool. Rec., p. 18, *nom. null., fide* COTTON, 1973, p. 155]. Solitary, small; cardinal, counter, and two alar protosepta almost equally spaced, longer and thicker than other major septa, but in upper third of calice shortened so that all septa appear equal; minor septa confined to wall except at calical margin; metaseptal insertion accelerated slightly in counter quadrants; tabulae complete, flat axially, with downturned margins; no dissepiments. [Septal plan in early stages of type species not known. FLÜGEL, 1973c, p. 65, indicates that *Cyathophyllum profundum* GEINITZ, 1842, on which *Calophyllum* (=*Polycoelia*) is commonly interpreted, is not conspecific with *Calophyllum donatianum*. As described from topotypes by SCHINDEWOLF (1942, p. 68), *C. profundum* has more and longer metasepta than *C. donatianum*, and, in its early stages, a marked cardinal fossula extending to axis. Its cardinal septum lies ?always on concave side of corallum. Russian specimens referred to *C. profundum* by IVANOVSKIY (1972, p. 5) have in the midplane of their septa very fine, close trabeculae with orthogonal fibers.] *?L.Carb.; Perm.*, Eu.(Brit.I.-Ger.-USSR)-Asia.——FIG. 210,*3a,b*. **C. donatianum* (KING), neotype, Perm., Magnesian Ls., Eng., Humbleton Hill, Co. Durham; *a,b*, internal molds of calice, ×6.7, ×6.0 (Flügel, 1973c).——FIG. 210,*3c*. *C. profundum* (GEINITZ), Zechstein, lower part "Rote Fäule," Ger., Eisleben Wolfsschacht, Saxony; transv. sec., ×4.0 (Flügel, 1973c).

Amandaraia LAVRUSEVICH, 1968, p. 108 [**A. prima*; OD; †8836/245, UpG, Dushanbe] [?=*Tetralasma* SCHINDEWOLF, 1942, which see; *Amandaria* COTTON, 1973, p. 16, *nom. null.*]. Solitary, very small; in all stages of growth only four septa are well developed—cardinal, counter and alar—and are

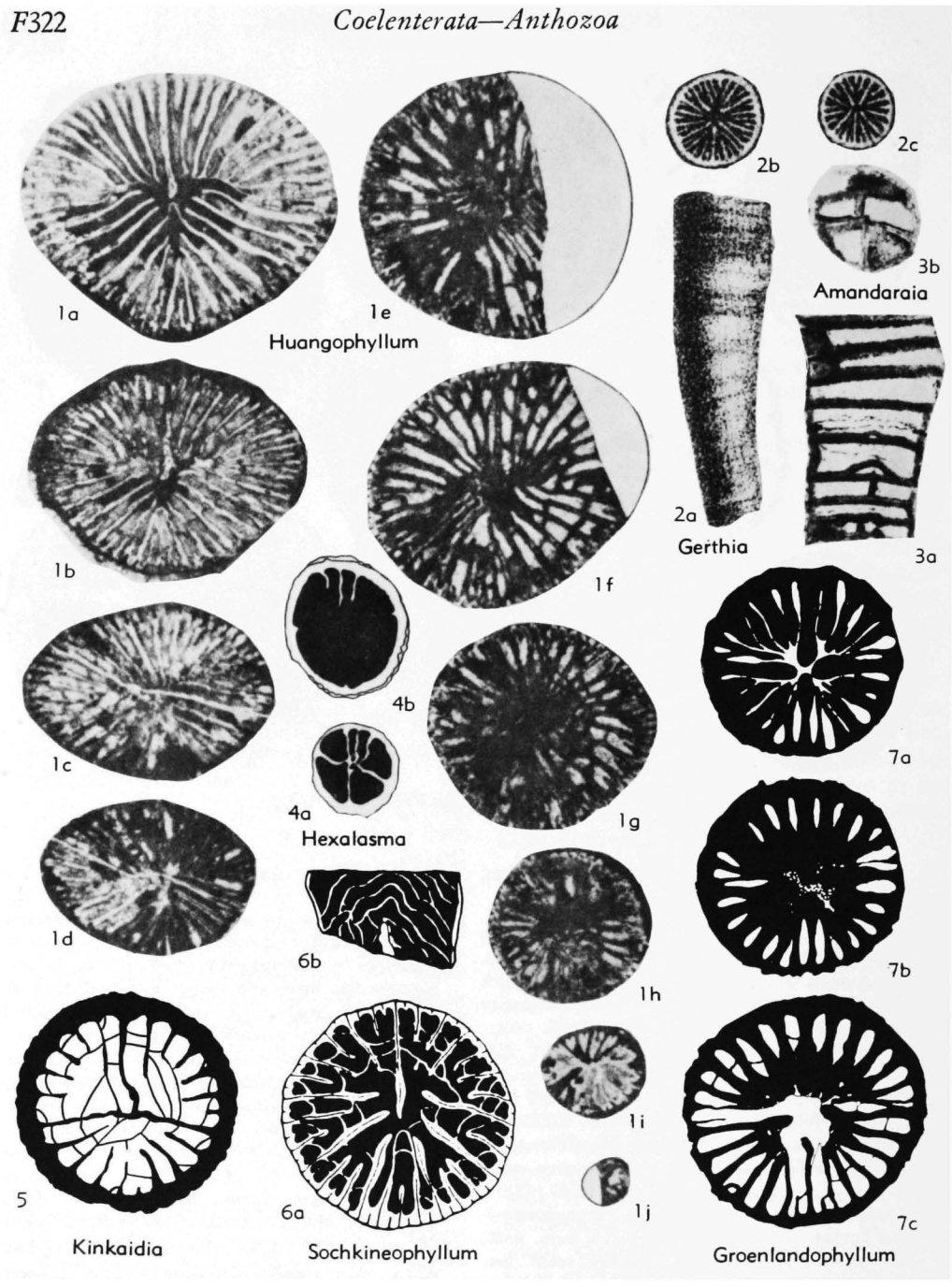


FIG. 211. Polycoeliidae (p. *F321-F325*).

unthickened throughout; remaining septa confined to wall or very short; tabulae horizontal, complete; no dissepiments. *U.Sil.* or *L.Dev.*, Asia(Tadzhik.). ——FIG. 211,*3a,b*. **A. prima*, holotype, L.Dev., Kunzhak horizon, N. slope of Zeravshan Ra., Shishkat ravine, left side; *a,b*, long., transv. secs., ×3 (Lavrusevich, 1968).

Calophylloides IVANOVSKIY, 1976, p. 35 [**Polycoelia dobrolyubovae* ILINA, 1970, p. 148; OD; †68, coll. 2376, PIN, Moscow]. Like *Calophyllum* but

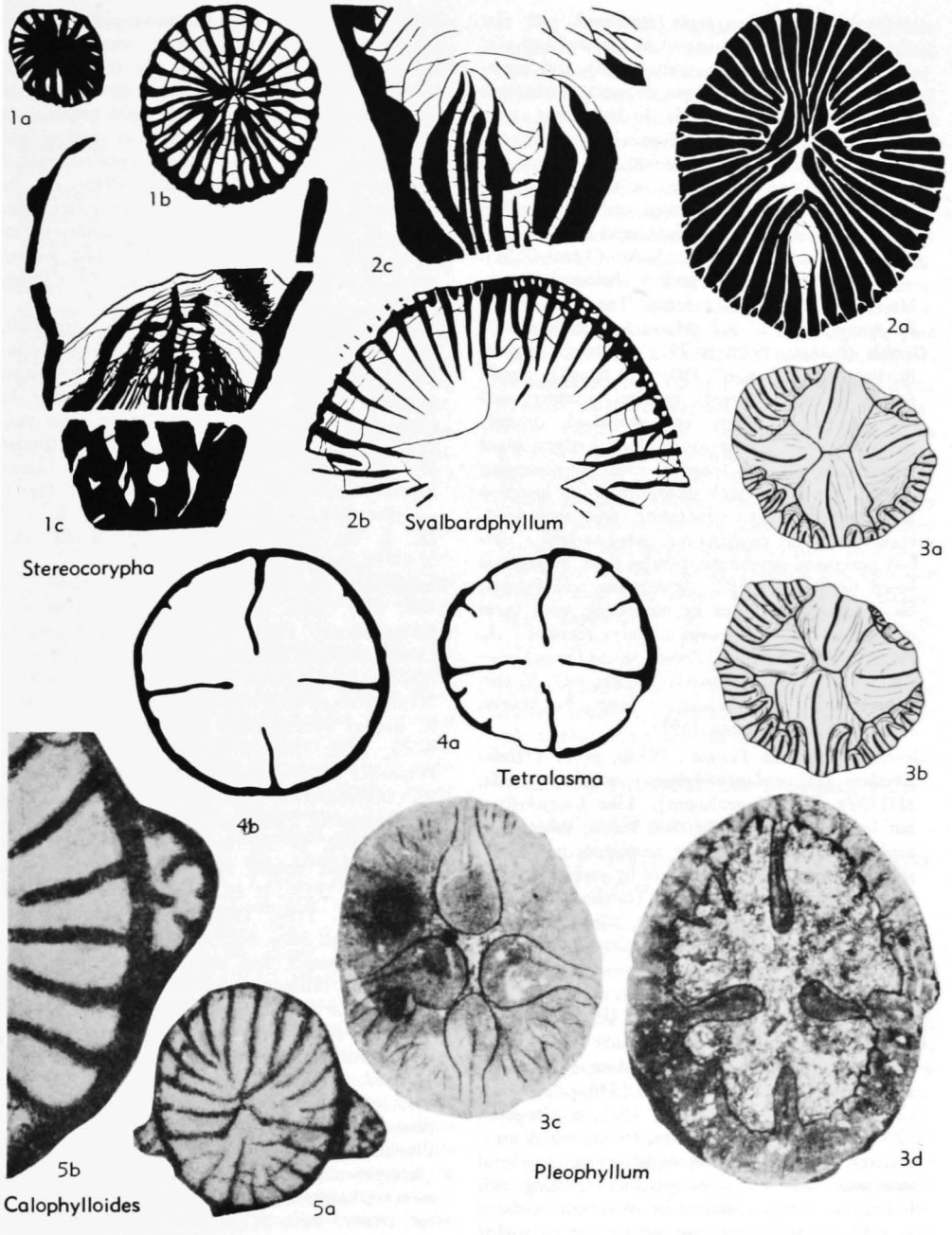


FIG. 212. Polycoeliidae (p. *F322-F325*).

fasciculate, with lateral increase. *L.Perm.*, Asia (SE.Pamir).——FIG. 212,*5a,b*. **C. dobrolyubovae* (ILINA), holotype, right side of right dry gully of R. Sulistyk, basin of R. Irpimyuz; *a,b*, transv. secs., ×4, ×10 (Ilina, 1970).

Empodesma MOORE & JEFFORDS, 1945, p. 89 [**E. imulum*; OD; †140334, USNM, Washington] [?=*Sochkineophyllum* GRABAU, 1928, which see, *fide* FEDOROWSKI, 1973, p. 102]. Solitary, conical, slightly curved, calice very oblique; in young stage

cardinal and counter septa conjoined and alar septa long, other septa angled to cardinal and alar septa, major septa thick with smooth and somewhat swollen axial edges, not in contact, dilatation being great just above tabula; in late stages cardinal septum withdrawn from axis, leaving fossula, variable in position but commonly on convex side of corallum, and septa thin; septal insertion accelerated in counter quadrants; tabulae sagging, complete or incomplete; minor septa rudimentary, no dissepiments. *L.Penn.*, N.Am.(Texas-Okla.). ——Fig. 210,*1a-c.* **E. imulum*, holotype, Bend., Marble Falls Ls., N. central Texas; *a*, long., *b,c*, transv. secs., all ×2 (Moore & Jeffords, 1945).

Gerthia Grabau, 1928, p. 29 [**Polycoelia angusta* Rothpletz, 1892, p. 69; OD; †not traced]. Small, solitary, slightly curved; cardinal, counter, and two alar septa longer and rhopaloid, strongly thickened toward their rounded axial edges; other major septa unequal, longest commonly occupying median position in each quadrant; septal insertion accelerated in counter quadrants; minor septa moderately long, no dissepiments, marginarium a narrow peripheral stereozone; tabulae thin. [Diagnosis based on Gerth's 1921 descriptions and figures; his specimens may not be conspecific with those of Rothpletz. The genus requires revision.] *L. Perm.*, W.Australia; *U.Perm.*, Asia(Timor).——Fig. 211,*2a-c.* **G. angusta* (Rothpletz), Timor, Ajer Mati R. near Kupang; *a*, long., *b,c*, transv. secs., all ×2 (Rothpletz, 1892).

Groenlandophyllum Flügel, 1973b, p. 11 [**Calophyllum (Groenlandophyllum) teicherti*; OD; †H11928, MM, Copenhagen]. Like *Calophyllum* but lacking epitheca in earliest stages; subpinnate, zaphrentoid arrangement of protosepta and metasepta replaced in mature stages by radial arrangement in which four protosepta (cardinal, two alar, and counter septa) remain long, others are somewhat reduced; tabulae declined abaxially; no dissepiments. *U.Perm.*, E.Greenl.——Fig. 211,*7a-c.* **G. teicherti* (Flügel), holotype, *Productus* Ls., Kap Stosch; *a-c*, transv. secs., ×4 (Flügel, 1973b).

Hexalasma Soshkina, 1928, p. 365 [**H. primitivum*; M; †498, coll. 146, PIN, Moscow] [=*Hexelasma* Lang, Smith, & Thomas, 1940, p. 70, *nom. van., non Hexelasma* Hoek, 1915, a cirripede; *?Pseudocryptophyllum* Easton, 1944b, which see]. Solitary, with deep calice; with narrow peripheral stereozone and six protosepta, all reaching axis but in calice much shortened; metasepta confined to wall; counter quadrants equal to or somewhat larger than cardinal; tabulae present in late stages; dissepiments absent [see Sokolov, 1960, p. 55]. *L.Perm.(Artinsk.)*, Eu.(N.Urals); *U.Perm.*, Asia (Timor-NE.USSR).——Fig. 211,*4a,b.* **H. primitivum*, ?syntype, R. Shchugor; *a,b*, transv. secs., *b* in calice?, ×2 (Kabakovich, 1962).

?Huangophyllum Tseng, 1948, p. 3 [**H. symmetricum*; OD; †6942, not traced, ?Peking]. Solitary, curved trochoid, concave side cardinal; counter and alar septa longest, counter septum may be rhopaloid but does not form separate columella; cardinal septum short; major septa in all quadrants successively shorter with sequence of insertion, and pinnately arranged to cardinal and alar fossulae; axial ends of major septa of cardinal quadrants free, those of counter quadrants may be conjoined; no dissepiments; in early stages septa meet at axis. *Perm.*, Asia(Szechwan).——Fig. 211,*1.* **H. symmetricum*, Maokou Ls.; *a-d,e-j*, series of transv. secs., 2 specimens, ×3 (Tseng, 1948).

Kinkaidia Easton, 1945, p. 384 [**K. trigonalis*; OD; †3512, ISGS, Urbana]. Small, curved, ceratoid; counter and two alar septa long, dominant; cardinal septum short; counter-laterals may be long; metasepta short in young stages; septa may be weakly rhopaloid; minor septa short; tabulae low domes with downturned edges, no dissepiments. *Up.U.Miss.(Chester.)*, N.Am.(Ill.-Ark.). ——Fig. 211,*5.* **K. trigonalis*, holotype, Kinkaid Ls., S. Ill., Cedar Grove Church; transv. sec., ×4.5 (Easton, 1945).

Pleophyllum Lecompte, 1952 [2nd quarter], p. 486, *nom. subst. pro Polycoelia (Weissermelia)* Schindewolf, 1942, p. 93, *non Weissermelia* Lang, Smith, & Thomas, 1940, p. 139, a Silurian rugosan [**Polycoelia (Weissermelia) compacta* Schindewolf; OD; †in Schindewolf Coll., ZGI, E. Berlin] [=*Polycoelia (Pycnocoelia)* Schindewolf, 1952 (Nov.), p. 165, *nom. subst. pro Polycoelia (Weissermelia)* Schindewolf, 1942, p. 93 (Schindewolf, 1952, p. 165, stated this is not a synonym of *Polycoelia (Tetralasma)* Schindewolf, 1942, p. 93, as Wang, 1950, p. 208, claimed, and upheld its validity); *Maichelasma* Fomichev, 1953b, p. 30 (type, *M. magnum*, OD; †? in coll. 7184, TsGM, Leningrad; U.Perm., Doliolinovaya Suite, NE. USSR)]. Solitary, small; cardinal, counter, and two alar septa long, rhopaloid and thickened and laterally contiguous so that tabulae are suppressed; counter-lateral and metasepta equal, short and thick, forming peripheral stereozone in which also short minor septa are confined. *L.Carb.(Visean)*, Eu.(Ger.); *U.Perm.*, Asia(NE.USSR).——Fig. 212,*3a,b.* **P. compactum* (Schindewolf), holotype, Visean, Ger., Überkehr, Frankenwald; *a,b*, transv. secs., ×4.0 (Schindewolf, 1942).——Fig. 212,*3c,d.* *P. magnum* (Fomichev), holotype, U.Perm., USSR; *c,d*, transv. secs., ×2.5 (Kabakovich, 1962).

Pseudocryptophyllum Easton, 1944b, p. 34 [**P. cavum*; OD; †unnumbered, Univ. Missouri, Columbia] [?=*Hexalasma* Soshkina, 1928, which see]. Solitary, small; six primary septa in earliest stage, three (cardinal and alars) persistently strongest, longest; counter septum very strong in early stages, rapidly weakening, but persisting into latest stage observed; metasepta and minor septa projecting from wall ?only in counter quadrants;

tabulae steeply arched with slight axial sag; no dissepiments. *L.Miss.*, N.Am.(Mo.); *?L.Perm.*, USSR(N.Urals).——FIG. 210,*2a-d*. **P. cavum*, holotype, Chouteau Ls., Mo., Pettis Co.; *a-c*, transv., *d*, long. secs., ×3.4 (Easton, 1944b).

?Sassendalia TIDTEN, 1972, p. 28 [**S. turgidiseptata*; OD; †B2.138, GPI, Münster]. Solitary, cardinal side concave; major septa dilated, rhopaloid in late stages, dilatation decreasing distally leaving anteperipheral zone of interseptal loculi in addition to cardinal and alar fossulae present from early stages; counter and two alar septa longest and thickest, cardinal septum short; other major septa unequal with some alternation in length; septal insertion accelerated in counter quadrants; minor septa visible in calice; tabulae declined outward from axis; no dissepiments. *L.Perm.(Artinsk.)*, Eu.(Spits.).——FIG. 210,*4*. **S. turgidiseptata*, holotype, *Productus*-bearing cherty rocks, Sassendal; transv. sec. through base of calice, ×2.7 (Tidten, 1972).

Sochkineophyllum GRABAU, 1928, p. 75 [**Plerophyllum artiense* SOSHKINA, 1925, p. 91; OD; †809, coll. 146, PIN, Moscow] [?=*Empodesma* MOORE & JEFFORDS, 1945, which see; *Soshkineophyllum* KABAKOVICH, 1962, p. 325, *nom. van.*]. Solitary, small; counter septum and two alar septa longer and more thickened toward their rounded axial edges than others; cardinal septum short and lying in fossula; septal insertion in counter quadrants accelerated; other major septa unequal, longer ones also becoming rhopaloid; tabulae complete, conical or centrally depressed cones; minor septa very short; no dissepiments. [See also KABAKOVICH, 1962, p. 325; septal plan in early stages of type species not known.] *U.Carb.(Moscov.)*, Eu.(Spain); *L.Perm.(Artinsk.)*, Eu.(W. Urals)-Asia (China-Japan-?NE. USSR)-N.Am.(Kans.).——FIG. 211,*6a,b*. **S. artiense* (SOSHKINA), up. Artinsk., W. slopes of N. Urals; *a,b*, transv., long. secs., ×1.5 (Grabau, 1928).

Stereocorypha MOORE & JEFFORDS, 1945, p. 84 [**S. annectans*; OD; †P11931c, UTBEG, Austin]. Solitary, small to medium-sized, slightly curved, conical with cardinal side commonly concave; major septa long, radial, most or all reaching axis or axial region where they may be conjoined; cardinal septum commonly thinner, shortening during late stages, in obscurely marked fossula; insertion in counter quadrants accelerated; minor septa absent or rudimentary; tabulae broadly conical, some incomplete; no dissepiments; septa of early stages greatly thickened. *L.Penn.*, N.Am.(Texas-Okla.).——FIG. 212,*1a-c*. **S. annectans*, holotype, Morrow., base of Marble Falls Ls., Texas, 10 mi. SW. San Saba; *a,b*, transv., *c*, long. secs., ×3 (Moore & Jeffords, 1945).

?Svalbardphyllum FEDOROWSKI, 1965a, p. 45 [**S. pachyseptatum*; OD; †164, BIRKENMAJER Coll., PZI, Poznan] [=*Svalardphyllum* FLÜGEL, 1970, p. 272, *nom. null.*]. Solitary, ceratoid, longer side cardinal; major septa strongly dilated; cardinal and counter septum shortened; alar septa rhopaloid, very long, may be joined to first metasepta of counter quadrants or with neighboring cardinal metasepta; metasepta pinnately arranged with respect to alar and cardinal septa; cardinal and alar fossulae closed, opening only in calice; minor septa very short; one series of dissepiments developed only in calice; tabulae strongly arched, with downturned edges. [Possibly cyathopsid.] *L.Perm.*, Eu.(Spits.).——FIG. 212,*2a-c*. **S. pachyseptatum*, holotype, up. Treskelodden Beds, Hornsund; *a*, transv. sec., mature, *b*, transv. sec. through part of calice, *c*, long. sec., all ×2 (Fedorowski, 1965a).

Tetralasma SCHINDEWOLF, 1942, p. 90 [**Polycoelia (Tetralasma) quadriseptata*; OD; † ?, in SCHINDEWOLF Coll., ZGI, E. Berlin] [?=*Amandaraia* LAVRUSEVICH, 1968, which see]. Solitary, small; like *Calophyllum*, with long (but thin), equally spaced cardinal, counter, and alar septa, and two or three metasepta in each quadrant, but counterlateral and metasepta become confined to wall in late stages and the counter, cardinal, and two alar septa remain long almost to calical edge; earliest stages zaphrentoid [see SCHINDEWOLF, 1952, p. 165, and FLÜGEL, 1973b, p. 5]. *L.Carb.(low. Visean)*, Eu.(Ger.); *?Perm.*, Eu.(Hung.); *U. Perm.*, Greenl.——FIG. 212,*4a,b*. **T. quadriseptatum*, holotype, Erdbach Ls., Ger., Erdbach; *a,b*, transv. secs., ×4 (Schindewolf, 1942).

Subfamily PROSMILIINAE Ivanovskiy, 1973

[Prosmiliinae IVANOVSKIY, 1973a, p. 78]

Solitary Polycoeliidae with dissepimentarium. *U.Perm.*

Prosmilia KOKER, 1924, p. 28 [**Plerophyllum cyathophylloides* GERTH, 1921, p. 90; SD LANG, SMITH, & THOMAS, 1940, p. 105; syntypes, 11785-11789, TH, Delft, 28 in WANNER Coll., IP, Bonn]. Solitary; cardinal, counter, and alar septa long, somewhat thickened, with rhopaloid axial ends; cardinal septum may shorten in late stages; septal insertion accelerated in counter quadrants, counterlateral septa and one or more of the metasepta in each quadrant, commonly one toward middle of quadrant, may be longer and stronger than other metasepta; minor septa long, thinner than major; tabulae complete or incomplete, low domes; dissepimentarium moderately wide, dissepiments normal, steep, some elongate. *U.Perm.*, Asia(Timor).——FIG. 213,*1a-c*. **P. cyathophylloides* (GERTH), Basleo; *a,b*, transv. secs., ×8, ×4; *c*, another specimen, long. sec., ×3 (Schindewolf, 1942).

Family ANISOPHYLLIDAE Ivanovskiy, 1965

[Anisophyllidae IVANOVSKIY, 1965a, p. 77]

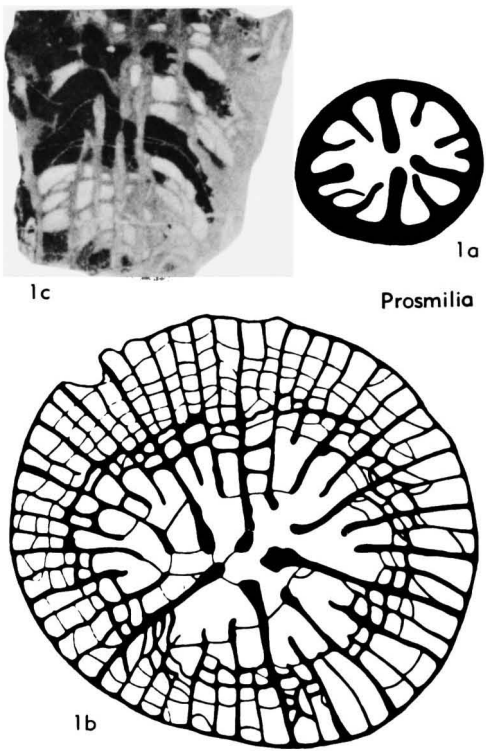


FIG. 213. Polycoeliidae (p. *F325*).

Solitary, small; cardinal and two alar septa long, meeting in axial region, thickened and rhopaloid. *U.Sil.*

Anisophyllum MILNE-EDWARDS & HAIME, 1850, p. lxvi [**A. agassizi*; OD; †e-136/1, EM, Paris]. Solitary, small; cardinal side convex, with deep, oblique calice with pit at end of elongate cardinal septum, which like the two alar septa is rhopaloid and longer and taller than others; these three meeting in axial region, but not forming columellar boss in calice; counter and counter-lateral septa no longer than metasepta, and minor septa short and ?contratingent; tabulae ?absent [see AMSDEN, 1949, p. 104; SUTHERLAND, 1965, p. 42; ILINA, 1978, p. 31]. *U.Sil.*, N.Am.(Tenn.-Okla.).——FIG. 214,*1*. **A. agassizi*, Brownsport F., Blue Mound glade 30-45 ft. above Dixon-Brownsport contact, Tenn., Perryville Quadrangle; lat. view, ×2 (Amsden, 1949).

Family PLEROPHYLLIDAE Koker, 1924

[Plerophyllidae KOKER, 1924, p. 17]

Solitary; early stages zaphrentoid with axial ends of major septa conjoined around closed cardinal fossula and on counter sides of alar fossulae; in later stages axial ends of major septa become free and septa more radially arranged, and five septa (cardinal, alar, and counter-lateral) are longer, thicker, taller, and more rhopaloid than others, while counter septum is shorter; cardinal septum shortens in late stages in some; axial and distal edges of septa smooth; trabeculae where observed monacanthine, fine; tabular floors tall domes or conical, tabulae complete or incomplete. *Dev.-U.Perm.*

Subfamily PLEROPHYLLINAE Koker, 1924

[*nom. transl.* GRABAU, 1928, p. 54, *ex* Plerophyllidae KOKER, 1924, p. 17]

Trochoid to slenderly conical or cylindrical Plerophyllidae, epithecate and with tabulae. *Dev.-U.Perm.*

Plerophyllum HINDE, 1890, p. 195 [**P. australe*; SD GRABAU, 1928, p. 46; †R13984, BM(NH), London; lectotype by HILL, 1937b, p. 49] [?=*Timorosmilia* KOKER, 1924, p. 30 (type, *Plerophyllum radiciforme* GERTH, 1921, p. 92, OD; syntypes, 29, GERTH Coll., IP, Bonn, and 11790, TH, Delft; U.Perm., Basleo and Oilmasi, Timor; trabeculae in two alternating series)]. Solitary, ceratoid, cardinal side commonly concave; five septa (cardinal, counter-lateral, and alar) larger and more dilated and rhopaloid than other major septa; in early stages septal plan zaphrentoid, and septa may be thickened so that lumen is filled; in later stages axial edges of septa free; distal edges of septa smooth; trabeculae where noted monacanthine; minor septa rudimentary to short; tabulae gently declined from axis; no dissepiments. *L.Perm.*, Australia (W. Australia-Queensl.); *U.Perm.*, Asia(Timor-NW.Iran-Nakhichev.)-Eu.(N.Urals).——FIG. 214,*3a,b*. **P. australe*, syntype, L.Perm., W. Australia, Irwin R.; *a,b*, transv. secs., ×2.5 (Hinde, 1890).——FIG. 214,*3c*. *?*P. radiciforme* GERTH, syntype, U.Perm., Timor, Oilmasi; transv. sec., ×4.0 (Gerth, 1921).

Barbarella FLÜGEL, 1972, p. 65 [**Plerophyllum (Barbarella) stellaforma*; OD; †P2704, UG, Graz]. Like *Plerophyllum* in having long cardinal, two counter-lateral, and two alar septa, and short counter septum, but lacking epitheca in earliest stages. *U.Perm.*, Asia(E.Iran).——FIG. 214,*6a,b*. **B. stellaforma*, holotype, low. Jamal F., Kuh-e-Bagh-e-Vang; *a,b*, side, apical views, enl. (Flügel, 1972).

Pleramplexus SCHINDEWOLF, 1940, p. 401 [**P. similis*; OD; †in SCHINDEWOLF Coll., ZGI, E. Berlin]. Solitary; early stages first zaphrentoid, then plerophylloid; cardinal septum shortens early and in late stages all septa become thinner and less rhopaloid and withdraw from contact, leaving widening axial zone free of septa; tabulae commonly complete, declined from inner ends of septa to periphery and into shallow cardinal fos-

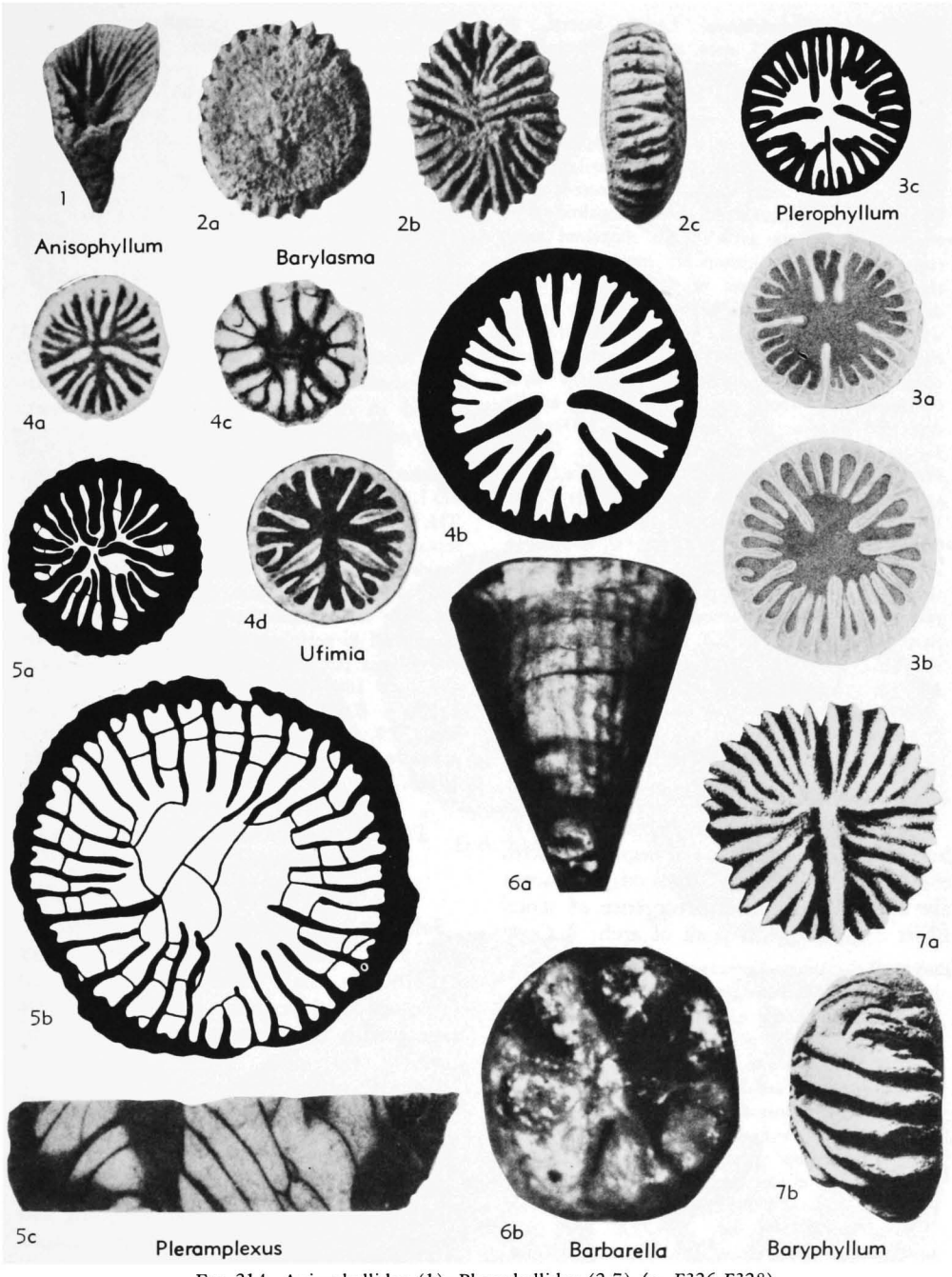


FIG. 214. Anisophyllidae (1); Plerophyllidae (2-7) (p. *F326-F328*).

sula; minor septa rudimentary to short; no dissepiments. *U.Perm.*, Asia(Timor-NW.Iran-Nakhichev.)-Eu.(Greece).——FIG. 214,*5a-c*. **P. similis*, Basleo; *a,b*, holotype, transv. secs., ×4; *c*, paratype, long. sec., ×4 (Schindewolf, 1942).

Ufimia SHTUKENBERG, 1895, p. 27 [**U. carbonaria*; M; †21 and probably 23/45, SHTUKENBERG Coll., LGI, Leningrad, plus unnumbered piece in Univ. Kazan; lectotype by FEDOROWSKI, 1973, p. 112] [=*Rhopalolasma* HUDSON, 1936b, p. 93 (type, *R. tachyblastum*, OD; †54752 and PF1125-9, IGS, Leeds; low. Visean, Butterhaw Quarry, Gargrave,

Yorkshire); *Rhopalelasma* LANG, SMITH, & THOMAS, 1940, p. 115, *nom. van.; ?Plerophyllum (Meniscophylloides)* KULLMAN, 1966, p. 452 (type, *M. simulans,* OD; †Coel1300/1482, KULLMAN Coll., GPI, Tübingen; low. Namur., gray marls of *Eumorphoceras* Stage, Perlora, Spain; see WEYER, 1973d, p. 675)]. Solitary, small; in late stages with four septa (alar and counter-lateral) longer, taller, thicker, and more rhopaloid than others; early stages zaphrentoid; rhopaloid axial ends of major septa commonly conjunct in axial region in middle stages of development, withdrawing and becoming free axially in late stages, with smooth distal edges; longest and strongest metasepta commonly mid-quadrant; counter and cardinal septa shorten progressively; minor septa rudimentary to short; tabular floors tall, axially depressed domes; no dissepiments. *L.Dev.(up. Ems.),* Eu.(Ger.); *M.Dev.,* Eu.(Spain); *U.Dev. (Famenn.),* Eu.(Ger.-Pol.); *L.Carb.,* Eu.(U.K.-Ger.-USSR); *U.Carb.,* Eu.(Donbas-Spain); *Perm.,* Eu. (Urals)-Asia (Timor-Nakhichev.-NW. Iran); *?Perm.* (China).——FIG. 214,*4a,b.* **U. carbonaria,* syntype, L.Carb., USSR, R. Ufa; *a,* transv. sec. through base of calice, enl.; *b,* diagram. septal plan drawn from SHTUKENBERG's figure by SCHINDEWOLF (1942), ×4 (Shtukenberg, 1895). ——FIG. 214,*4c,d. U. tachyblasta* (HUDSON), holotype, ?occurrence; *c,d,* transv. secs., ×5, ×2 (Hudson, 1936b).

Subfamily BARYPHYLLINAE Weyer, 1973

[Baryphyllinae WEYER, 1973b, p. 56]

Turbinate, patellate, or discoid Plerophyllidae, with or without epitheca, and with everted calice in which distal edges of septa are arched; an axis of divergence of septal fibers coincides with peak of arch. *L.Carb.*

Baryphyllum MILNE-EDWARDS & HAIME, 1850, p. lxvi [**B. verneuilianum*; OD; 3 syntypes, e-148_{1-3}, DE VERNEUIL Coll., EM, Paris]. Small, discoid with small central peduncle of attachment and without epitheca; on calical surface long, stout cardinal septum and alar septa reach axis, but counter septum short and weakly developed; minor septa ?lacking; metasepta of cardinal quadrants pinnate to cardinal septum; septa of counter quadrants directed to alar septa; cardinal fossula shallow [see JEFFORDS, 1955, p. 12]. *Miss.,* N.Am. (Tenn.-Ala.-Ky.).——FIG. 214,*7a,b.* **B. verneuilianum,* Osag., New Providence F., Tenn.; *a,* calical view of figured syntype; *b,* lat. view of another specimen, ×2 (Jeffords, 1955).

Barylasma WEYER, 1973b, p. 58 [**Hadrophyllum ovale* BASSLER, 1937, p. 198; OD; syntypes, 91059, USNM, Washington]. Solitary, turbinate to discoid, with everted calice and epithecate; cardinal, counter-lateral, and alar septa long, counter septum shortened; minor septa weak, may be contratingent; tabulae ?absent; fibers of septum diverging from axis coinciding with peak of arch in distal septal edge, which is smooth. *L.Miss.,* N. Am.(Ala.-Ky.-Tenn.).——FIG. 214,*2a-c.* **B. ovale* (BASSLER), syntype, Osag., Fort Payne chert, Ala., near Florence; *a-c,* proximal, distal, and lat. views, ×1.5 (Bassler, 1937).

Family ENDOTHECIIDAE Schindewolf, 1942

[*nom. transl.* LECOMPTE, 1952, p. 487, *ex* Endotheciinae SCHINDEWOLF, 1942, p. 167]

Solitary, small, with aulos; in late stages alar septa longest, cardinal and counter septa shortened; major septa pinnately arranged in early stages; minor septa short. *U.Perm.*

Endothecium KOKER, 1924, p. 23 [**E. apertum*; SD LANG, SMITH, & THOMAS, 1940, p. 57; †11770, TH, Delft]. Solitary, small; in late stages alar septa outstanding, cardinal and counter septa short, major septa thickened, their inner edges thickened and withdrawn from axis, rhopaloid and forming an aulos; minor septa short; tabulae declined from inner wall to periphery; no dissepiments; in early stages septa pinnately arranged [see SCHINDEWOLF, 1942, p. 168]. *U.Perm.,* Asia(Timor).——FIG. 215,*4a-e. E. decipiens* KOKER, Basleo; *a,b,* transv. secs., ×9, *c,* transv. sec., ×7, *d,* long. sec., ×6; *e,* another specimen, transv. sec., ×4 (Schindewolf, 1942).

Family ADAMANOPHYLLIDAE Vasilyuk, 1959

[Adamanophyllidae VASILYUK, 1959, p. 85]

Solitary or compound, with counter-lateral, alar, and cardinal protosepta longer and thicker than other major septa; in some, cardinal septum shortened in late stages; with dissepimentarium. *L.Carb.-U. Carb.*

Subfamily ADAMANOPHYLLINAE Vasilyuk, 1959

[*nom. transl.* IVANOVSKIY, 1967, p. 25, *ex* Adamanophyllidae VASILYUK, 1959, p. 85]

Solitary or compound Adamanophyllidae in which cardinal septum remains long and tabular floors are concave in late stages. *L.Carb.-U.Carb.*

Adamanophyllum VASILYUK, 1959, p. 85 [**A. incertum*; OD; †35, coll. 1405, IG, Kiev]. Solitary; major septa unequal, cardinal, alar, and counter-lateral protosepta longer and thicker, reaching or almost reaching axis; minor septa much thinner and discontinuous; dissepimentarium wide, with some lonsdaleoid dissepiments disrupt-

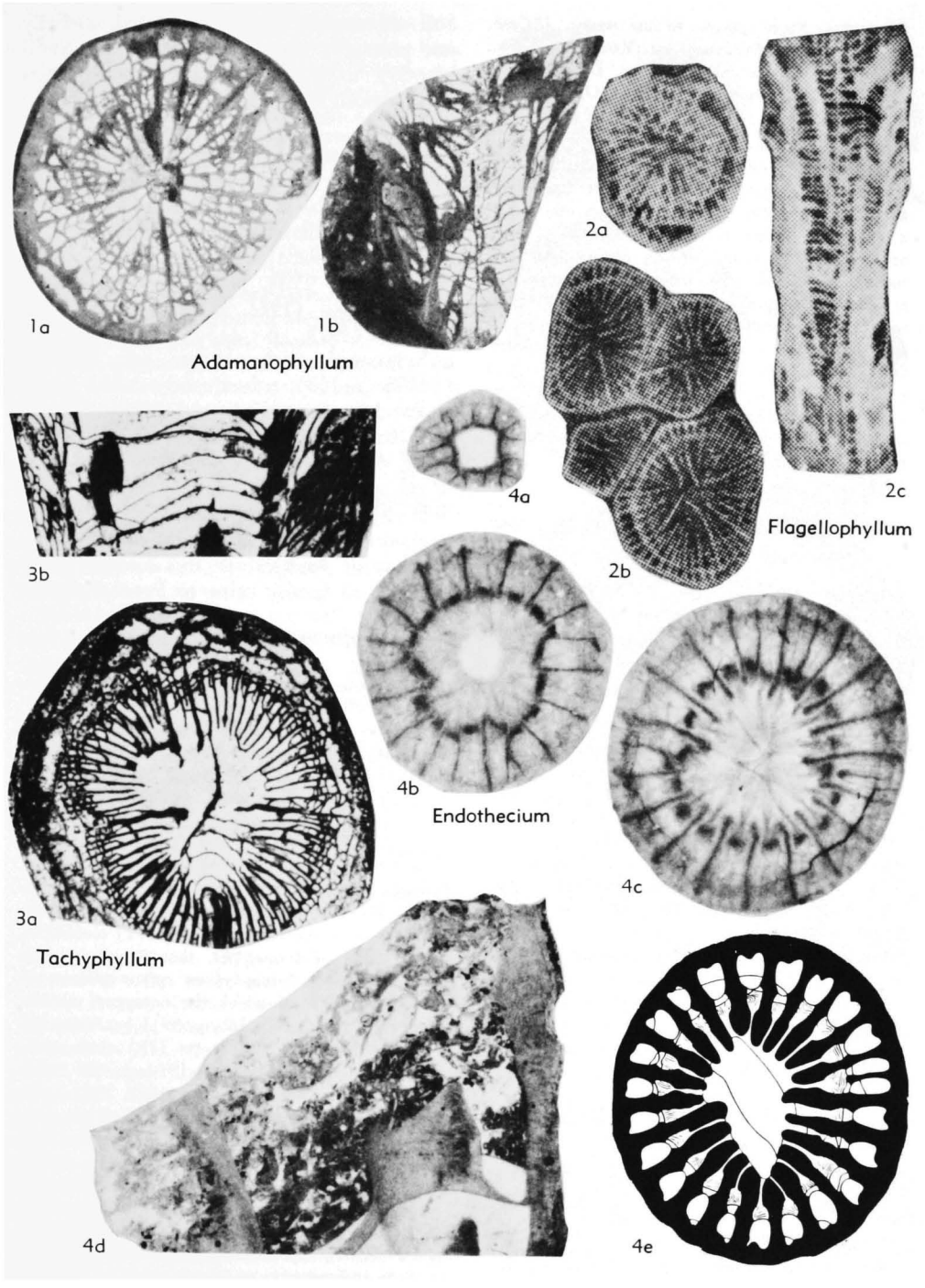


FIG. 215. Adamanophyllidae (1-3); Endotheciidae (4) (p. *F328-F330*).

ing one or more major septa, more numerous dissepiments that cross loculi between two neighboring major septa, and small dissepiments in two overlapping series in each such loculus; tabulae

incomplete, floors concave in late stages. *U.Carb. (Namur.),* Eu.(Donbas)-?Asia(Kuzbas).——Fig. 215,*1a,b.* **A. incertum,* holotype, Donbas, right bank of R. Berestovayya opposite Obilnoe; *a,b,* transv., long. secs., ×2 (Vasilyuk, 1960).

Flagellophyllum Fan in Yü, Lin, & Fan, 1962, p. 15 [**F. shengi*; OD; †Co428, ?GC, Changchun]. Compound, in part cerioid, in part fasciculate; five to seven major septa longer than others and a little curved, almost reaching axis; two of these are separated by shorter major septum and commonly one of the other long septa is opposite it so that the septal plan appears plerophylloid; minor septa shorter, discontinuous in narrow dissepimentarium including some lonsdaleoid plates; tabular floors flat or low domes with downturned edges and some slightly depressed axially. *L.Carb. (Visean),* Asia(Sinkiang).——Fig. 215,*2a-c.* **F. shengi,* holotype, China, Sinkiang Prov.; *a,b,* transv., *c,* long. secs., ×1.5 (Yü, Lin, & Fan, 1962).

Subfamily TACHYPHYLLINAE Ivanovskiy, 1967

[Tachyphyllinae Ivanovskiy, 1967, p. 26]

Adamanophyllidae in which cardinal septum shortens in late stages and lies in wide, deep, and axially expanding open fossula; tabular floors weakly convex with downturned edges. Horizontal skeletal elements ?caninioid. *L.Carb.(Tournais.).*

Tachyphyllum Dobrolyubova in Soshkina, Dobrolyubova, & Kabakovich, 1962, p. 317 [**T. artyshtense*; OD; †1034, coll. 1560, PIN, Moscow]. Solitary, cylindrical; alar and counter-lateral septa longer and thicker than other major septa, with somewhat rhopaloid axial ends; cardinal septum thick but shorter in deep, open, adaxially expanding fossula; minor septa thin, long; dissepimentarium wide, of peripheral lonsdaleoid zone and inner zone of small, concentric dissepiments; tabulae sparse, slightly convex, ?cyathopsoid. *L.Carb. (Tournais.),* Asia(Kuzbas).——Fig. 215,*3a,b.* **T. artyshtense,* holotype, low. Terei horizon, R. Artyshta; *a,b,* transv., long. secs., ×1.5 (Dobrolyubova & Kabakovich, 1966).

Family PENTAPHYLLIDAE Schindewolf, 1942

[*nom. transl.* Hill, herein, *ex* Pentaphyllinae Schindewolf, 1942, p. 171] [?=Tachylasmatidae Grabau, 1928, p. 54 (*nom. correct.* Hill, 1956b, p. F262, *pro* Tachyelasmidae Hill, 1948, p. 124; *nom. transl. et emend.* Hill, 1948, p. 124, *ex* Tachylasmainae Grabau, 1928, p. 54); Tachyelasminae Hill, 1952, p. 21; ?Tachylasmatina Fedorowski, 1973, p. 113, suborder, includes Dalniidae Fedorowski, 1973, p. 126]

Solitary, not large; five protosepta (cardinal, alar, and counter-lateral) long and thick and with free axial ends even in earliest stages; counter septum rudimentary and metasepta variously stunted, radially not pinnately arranged; minor septa rudimentary to short; tabulae declined from axial region; no dissepiments. *Dev.-L.Carb.; Perm.*

Validity of this family is still arguable; Ilina (1965, p. 21) and Weyer (1972b, p. 728; 1973b, p. 47) consider its genera to be intergradational also with plerophyllid genera, and place its genera in Plerophyllidae Koker, 1924. On the other hand, Schindewolf (1942, p. 171) and Fedorowski (1973, p. 113) considered the tachylasmoid early stages of Hudson (1936b, p. 100), subsequently called pentaphylloid by Schindewolf (1942, p. 59), to be taxonomically important, Schindewolf as of subfamily value and Fedorowski as of subordinal value. There is the additional difficulty that ontogenesis has not been studied in the type species of either *Pentaphyllum* or *Tachylasma*; this *Treatise* tentatively gives family value to Pentaphyllidae.

Subfamily PENTAPHYLLINAE Schindewolf, 1942

[Pentaphyllinae Schindewolf, 1942, p. 171] [?=Tachylasmatinae Grabau, 1928 (*nom. correct.* Hill, herein, *pro* Tachylasmainae Grabau, 1928, p. 54); Tachyelasminae Hill, 1952, p. 21]

Pentaphyllidae with five protosepta dominant throughout (cardinal, alar, counter-lateral); in some, counter-lateral septa shorter and subequal to metasepta. *Dev.-L.Carb.; Perm.*

Pentaphyllum de Koninck, 1872, p. 58 [**P. armatum*; SD Hinde, 1890, p. 195; †a586, IRSN, Brussels; Schindewolf (1942, p. 172) considered, from study of monotypes, that *P. armatum* is conspecific with *Pentaphyllum caryophyllatum* de Koninck, 1872, of which the ontogeny was described by Hudson (1936b, p. 99)] [=*Pentaphyllum* de Koninck, 1871, p. 321, *nom. nud.; Cryptophyllum* Carruthers, 1919, p. 439 (type, *C. hibernicum,* OD; †PF1090, 1091, IGS, Leeds, lectotype by Hudson, 1936b, p. 98; L.Carb., low. Calp Series, Bundoran, Donegal Bay, Eire; *?Heptaphyllum* Clark, 1924, p. 416 (type, *H. gracile,* OD; †A3382, SM, Cambridge; L.Carb. (Z_1), Co. Sligo, Eire; insufficiently known)]. Solitary, small; five septa (cardinal, counter-lateral, and alar) almost reaching axis and thinning adaxially; counter septum rudimentary to short; metasepta stunted; minor septa rudimentary except *Km,* which may be short; tabulae few; early stages pentaphylloid (five long protosepta, counter septum rudimentary; septa subradial not pinnate in plan; metasepta rudimentary to short). *L.Carb.,* Eu.(Belg.-U.K.-

Eire-Ger.); *?U.Perm.*, Asia(Timor).——Fig. 216, *1a-d*. **P. caryophyllatum*, low. Visean, Eng., Butterhaw Quarry, Gargrave, near Skipton; *a-d*, transv. secs., ×4 (Hudson, 1936b).——Fig. 216, *1e-i*. *P. hibernicum* (Carruthers); *e*, ext. view, ×2, *f-h*, another specimen, transv. secs., ×4, *i*, third specimen, transv. sec., ×4 (Carruthers, 1919).

Antikinkaidia Fedorowski, 1973, p. 115 [**A. triseptata*; OD; †Tc-6/22, PZI, Poznan]. Solitary, small; cardinal and alar septa predominant and except in very late stages joined axially; counter septum rudimentary; counter-lateral septa little if any longer than neighboring metasepta, which are of moderate length; septal insertion accelerated in counter quadrants; axial ends of protosepta and some metasepta may be rhopaloid; cardinal fossula shallow; tabulae present. [Based on one corallite.] *U.Dev.(Famenn.)*, Eu.(Pol.).——Fig. 217,*3a-c*. **A. triseptata*, holotype, *Wocklumeria* or *Gattendorfia* Stage, Holy Cross Mts., Dalnia Hill near Kielce; *a-c*, transv. secs., ×5.0 (Fedorowski, 1973).

Carinotachylasma Xu in Jia *et al.*, 1977, p. 123 [**C. shimenense*; OD; †IV38509, HPRIGS, Yichang; L.Perm., Ganxigou, Shimen Xian (county), Hunan]. Like *Tachylasma* but septa with metriophylloid flanges. *L.Perm.*, Asia(Hunan).

Cystelasma Miller, 1891, p. 12 [**C. lanesvillense*; OD; †not traced]. Solitary, very small, commonly irregularly cylindrical and with talons; cardinal, counter-lateral, and alar septa dominant but short; metasepta and counter septum rudimentary to very short; minor septa not observed; tabulae complete, horizontal; large peripheral longitudinal dissepiments may appear in single series in late stages. [Early stages not described. See Stumm, 1948d, p. 68.] *L.Carb.(mid.Miss.)*, N.Am.(Ind.-Ky.).——Fig. 217,*2a,b*. **C. lanesvillense*, Salem Ls., Ind., Lanesville; *a,b*, calical, ext. views, enl. (Miller, 1892).

Oligophyllum Počta, 1902, p. 192 [**O. quinqueseptatum*; OD; †unnumbered, Barrande Coll., NM, Prague] [=*Pentelasma* Kullman, 1965, p. 133 (type, *Oligophyllum (Pentelasma) rariseptatum*, OD; †Coe1281/534, Kullman Coll., GPI, Tübingen; Ems., Arruz beds, Prov. Palencia, Spain)]. Solitary, small; five septa (cardinal, counter-lateral, and alar) elongate and slightly rhopaloid, counter septum short or stunted; septal plan subradial; metasepta short to stunted, minor septa reduced to moderately thick wall; tabulae ?absent; no dissepiments [see Schindewolf, 1942, p. 177; Kullman, 1965, p. 122; Weyer, 1973b, p. 52]. *L.Dev.*, Eu.(Czech.-Spain-Ger.); *M.Dev.(Eifel.)*, Eu. (Czech.-Spain.-?Ger.)-Asia (Urals-Rudny Altai); *?U.Dev.(Famenn.)*, Eu.(Spain-Ger.-Pol.).——Fig. 217,*4a,b*. **O. quinqueseptatum*, syntype, L.Dev.(Prag.), Dvorce Ls., Czech., Dvorce; *a,b*, transv. secs., enl. (Počta, 1902).

Pentamplexus Schindewolf, 1940, p. 403 [**P. simulator*; OD; †in ?Schindewolf Coll., ZGI, E. Berlin]. Solitary, small, with deep cardinal fossula on convex side; in intermediate stages of growth, counter-lateral, alar, and cardinal septa longer than counter septum and metasepta, not arranged on zaphrentoid plan, may be thickened so as almost to fill lumen; in late stages all septa thinner and amplexoid; earliest observed stage pentaphylloid; tabulae declined abaxially; minor septa short. *L.Perm.*, Asia(Timor); *?U.Perm.*, Asia(NW.Iran-Nakhichev.).——Fig. 217,*1a-c*. **P. simulator*, holotype, Timor, Bitauni; *a*, calical view, ×1.0; *b*, long. sec., ×2.0; *c*, transv. sec. early stage, ×3.0 (Schindewolf, 1942).

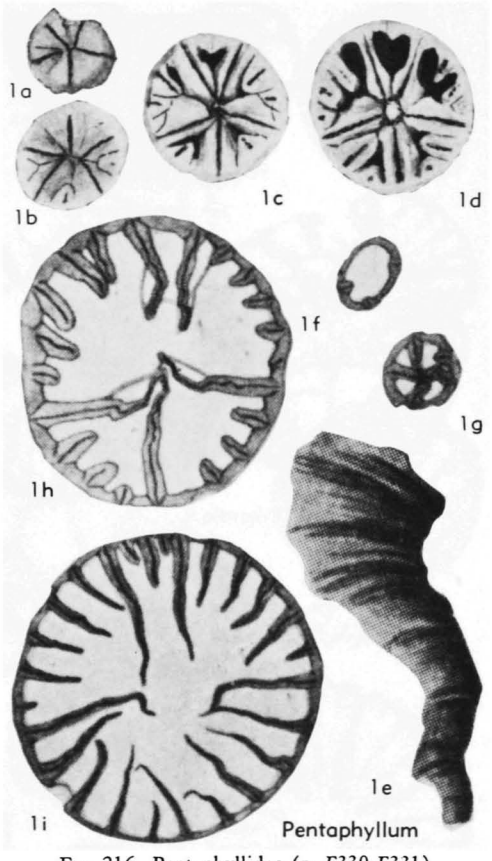


Fig. 216. Pentaphyllidae (p. *F330-F331*).

Tachylasma Grabau, 1922, p. 34 [**T. cha*; OD; †142, Geol. Survey China, ?Peking] [?=*Ufimia* Shtukenberg, 1895, p. 27, see Plerophyllidae, Plerophyllinae; *Tachyelasma* Lang, Smith, & Thomas, 1940, p. 130, *nom. van.*; *?Prionophyllum* Schindewolf, 1942, p. 209 (type, *Pentaphyllum (Prionophyllum) crassiseptum*, OD; †single specimen in ?Schindewolf Coll., ZGI, E. Berlin; L. Perm., Bitauni, Timor; zigzag lamellation in septa

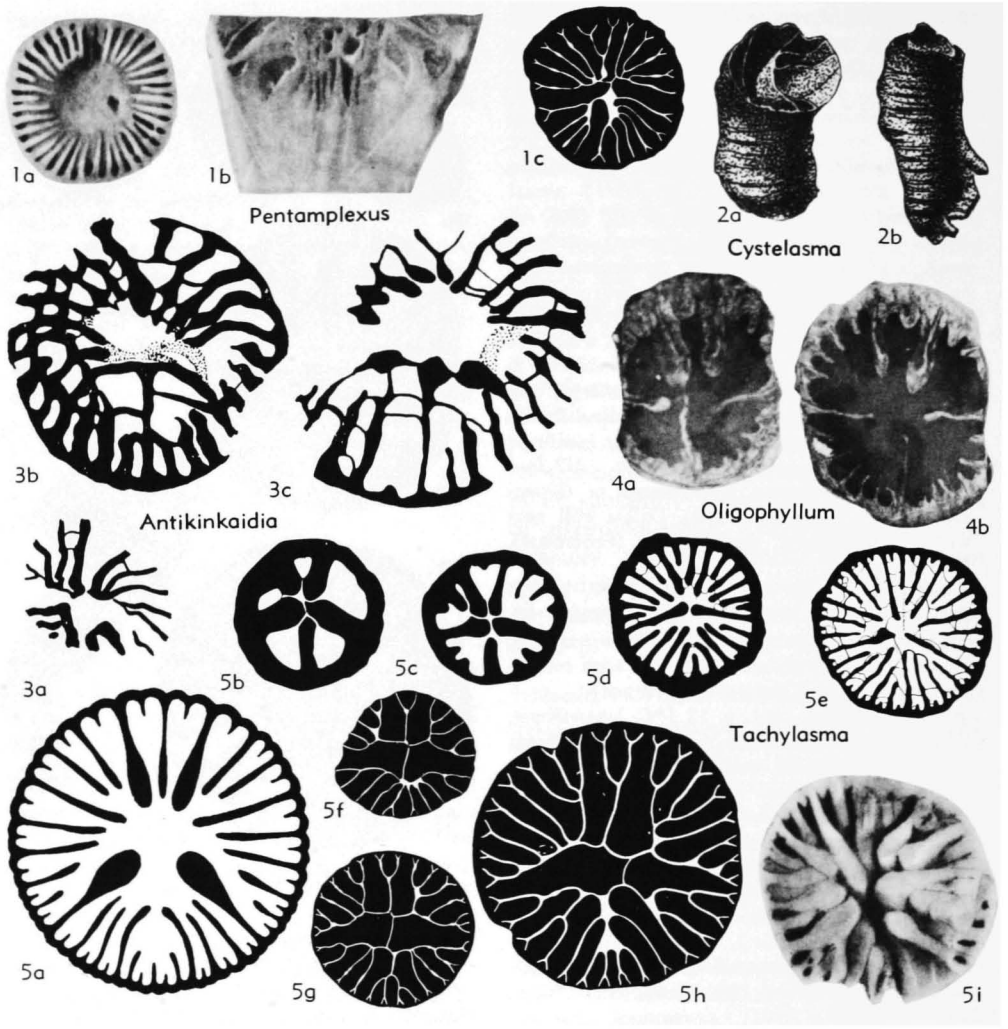


FIG. 217. Pentaphyllidae (p. *F331-F332*).

herein considered diagenetic)]. Solitary, small, four protosepta (alar and counter-lateral) longest, tallest, and most rhopaloid; counter septum thin but moderately long and rhopaloid, cardinal septum greatly shortened; metasepta unequal, somewhat rhopaloid, those in midquadrant stronger than others; minor septa very short; tabulae sparse; early stages in type species unknown. [SCHINDEWOLF (1942, p. 195) noted pentaphylloid early stages in his new Permian tachylasmoid species *Pentaphyllum (Tachylasma) variable,* and (1942, p. 53) thought it possible that the Permian *Tachylasma cha* and more probably *T. elongatum* GRABAU, 1922, has this type of early stage, rather than the zaphrentoid early stages found in homeomorphic *Ufimia,* a supposition that is tentatively accepted in this *Treatise.*] *Perm.,* Asia(China-Timor).——FIG. 217,*5a.* **T. cha,* holotype, ?S. China; diagram. transv. sec., ×3.0 (Grabau, 1922).——FIG. 217,*5b-e. T. variabile* (SCHINDEWOLF), L.Perm., Bitauni, Timor; *b-e,* transv. secs., ×5.0, ×3.8, ×2.0, ×1.4 (Schindewolf, 1942).——FIG. 217,*5f-i. ?T. crassiseptum* (SCHINDEWOLF), holotype, Bitauni; *f-h,* transv. secs., ×2.0; *i,* calical view, ×1.5 (Schindewolf, 1942).

Subfamily COMMUTIINAE Fedorowski, 1973

[Commutiinae FEDOROWSKI, 1973, p. 117]

Pentaphyllidae with irregular aulos formed from axial ends of septa. *U.Dev. (Famenn.).*

Commutia FEDOROWSKI, 1973, p. 118 [**C. szulczewskii*; OD; †Tc-6/33, PZI, Poznan]. Solitary,

small, funnel-shaped; in late stages corallum expands sharply and axial ends of cardinal, alar, and counter-lateral protosepta, and in some a few metasepta, unite to form inner wall that may be impersistent, but counter septum and other metasepta are short; in early slender stages of corallum no aulos is present, and only five protosepta are visible; tabulae concave within aulos, declined abaxially in peripheral regions. *U.Dev.(Famenn.)*, Eu.(Pol.).——Fig. 218,*2a-d*. **C. szulczewskii*, *Wocklumeria* or *Gattendorfia* Stage, Holy Cross Mts., Dalnia; *a,b*, holotype, transv. secs., ×5; *c,d*, another specimen, transv., long. secs., ×5 (Fedorowski, 1973).

Subfamily DALNIINAE Fedorowski, 1973

[*nom. transl.* Hill, herein, *ex* Dalniidae Fedorowski, 1973, p. 126]

Pentaphyllidae with both cardinal and counter septa rudimentary to short. *U.Dev.(Famenn.)* or *L.Carb.*

Dalnia Fedorowski, 1973, p. 127 [**D. tetraseptata*; OD; †Tc-6/68, PZI, Poznan]. Slender, widening in calice; two alar and two counter-lateral septa appear first and may join at axial edges; cardinal septum appears later and thicker but does not join others; metasepta few and rudimentary to short; counter septum appears late and remains short; tabulae sparse. *U.Dev.(up.Famenn.)* or *L.Carb.(Tournais.)*, Eu.(Pol.).——Fig. 218,*1a-c*. **D. tetraseptata*, holotype, *Wocklumeria* or *Gattendorfia* Stage, Holy Cross Mts., Dalnia; *a-c*, transv. secs., ×5 (Fedorowski, 1973).

Family LOPHOPHYLLIDAE Grabau, 1928

[Lophophyllidae Grabau, 1928, p. 97] [=Lophophyllidiidae Moore & Jeffords, 1945, p. 92; Lophophyllidinae Wang, 1947b, p. 335; Lophophyllidiinae Wang, 1950, p. 207; Stereostylidae Ilina, 1974, p. 215]

Solitary, with calically projecting axial structure composed of medial plate that is prolongation of axial end of counter septum and in earliest stages is commonly continuous also with cardinal septum; axial structure commonly includes also septal lamellae and axial tabellae and all components may be variably thickened; cardinal septum shortens early, in fossula that narrows adaxially; in late stages and in calice, distal notch may separate counter septum from axial structure; septa more or less radially arranged in counter quadrants, where insertion is accelerated, and pinnately arranged in cardinal quadrants; septa commonly thickened, may be rhopaloid; trabeculae may be detectable in median longitudinal section of septa, and are thin and close

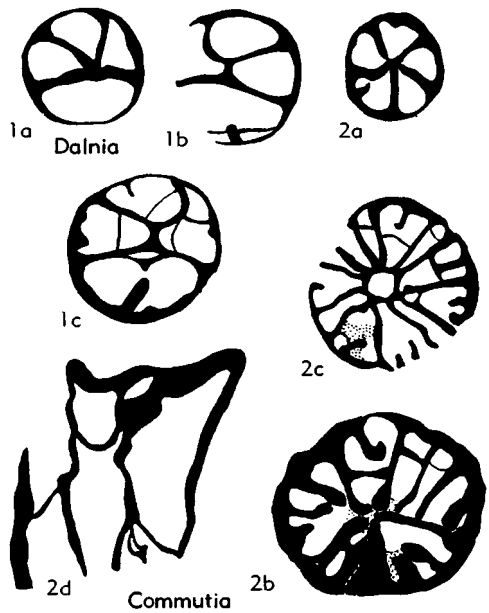


Fig. 218. Pentaphyllidae (p. *F332-F333*).

and distal and axial edges of septa are smooth or only very finely denticulate; tabulae declined from axial structure, complete or incomplete; no dissepiments. *L. Carb.-U.Perm.*

Lophophyllum Milne-Edwards & Haime, 1850, p. lxvi [**L. konincki*; OD; †no. 1 of 6 syntypes, Z37a, MN, Paris; lectotype by Hill, herein]. Solitary, small, with oblique calice; cardinal side convex; with small, laterally compressed, distally projecting columella proximally continuous with both cardinal and counter septa, distally separated from cardinal septum by wide notch; with closed fossula in front of and embracing columella and widening adaxially; major septa (except those that border fossula) reaching columella in proximal parts and arranged with marked bilateral symmetry; in cardinal quadrants they are curved slightly toward axis and fuse variably to delimit fossula; in counter quadrants they are commonly isolated, radial, and shorter; minor septa but little developed; arched tabulae present, but no dissepiments [see Lecompte, 1955, p. 410]. *L.Carb.(Tournais.)*, Eu.(Belg.).——Fig. 219,*2a-c*. **L. konincki*, lectotype, Tournai; *a*, calical view, ×3; *b,c*, views of right and left longitudinal fractured surfaces, showing tabula, ×3 (Lecompte, 1955).

Lophamplexus Moore & Jeffords, 1941, p. 90 [**L. eliasi*; OD; †23292, KUMIP, Lawrence]. Solitary, conical to subcylindrical; young stages with axial end of counter septum thickened and extended to form columella; short cardinal septum

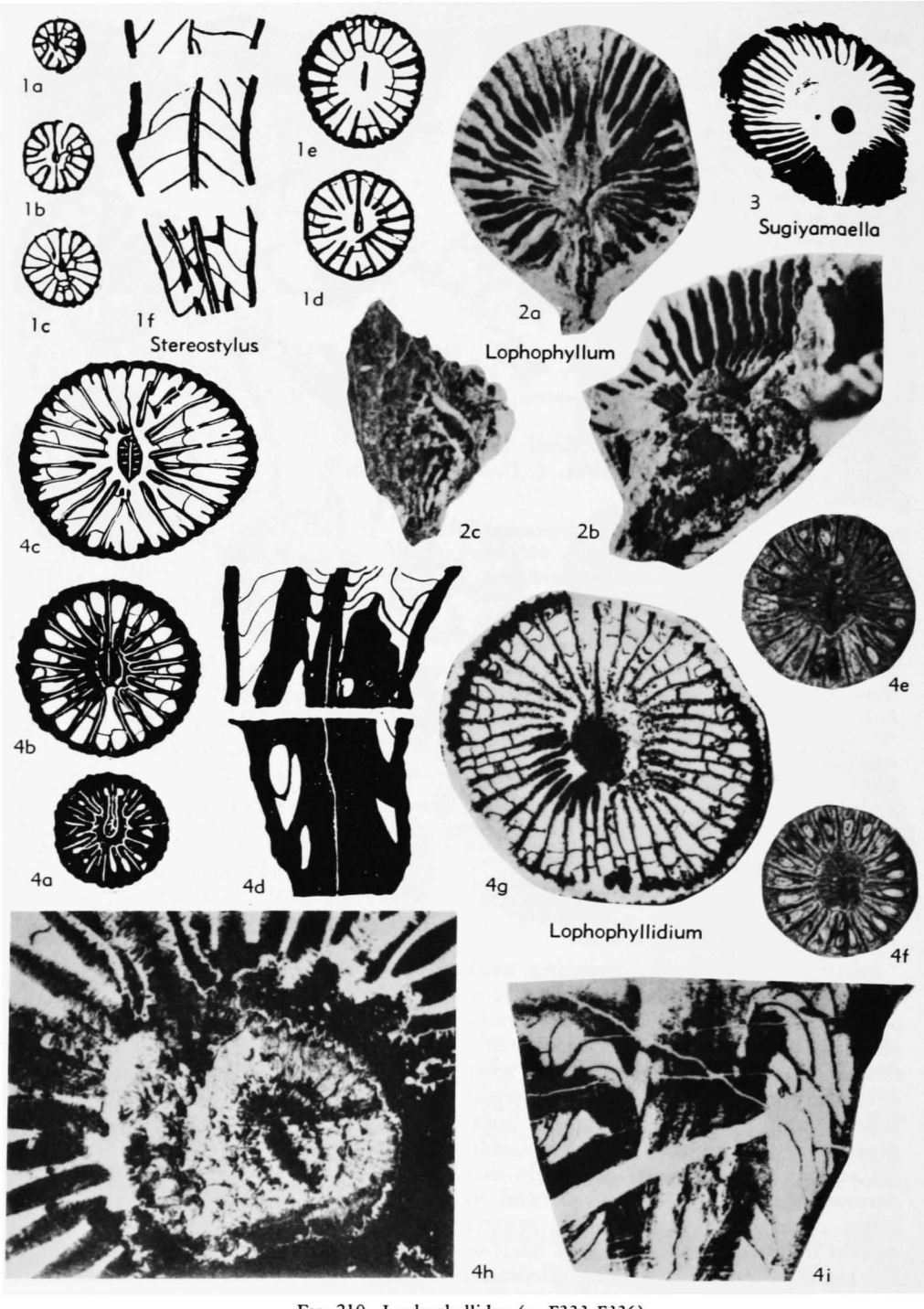


FIG. 219. Lophophyllidae (p. *F333-F336*).

in shallow fossula and other major septa equal and at first in contact with, then withdrawing from columella; in later stages columella failing and septa becoming amplexoid; minor septa rudimentary; tabulae flat-topped domes, complete or incomplete; dissepiments absent. *Penn.-L.Perm.*, N.Am.(Ohio-Okla.-Kans.-Mo.); *U.Carb.*, S.Am. (Venez.).——Fig. 220,*1a-d*. **L. eliasi*, holotype, Perm.(Wolfcamp.), Kans., near Grand Summit, Cowley Co.; *a-c*, transv., *d*, long. secs., ×3 (Moore & Jeffords, 1941).

Lophocarinophyllum Grabau, 1922, p. 46 [**Lophophyllum (Lophocarinophyllum) acanthiseptatum*; OD; †147, IGP, Nanking, *fide* catalog, but cited as †146 by Ivanovskiy, 1976, p. 100, following Fomichev, 1953b, p. 38 (work not seen by Hill)]. Solitary, small, curved; with prominent columella formed by distal prolongation of expanded axial end of long counter septum; cardinal septum short in late stages, other major septa subequal, long; septa with subhorizontal flanges; minor septa very short; tabulae ?conical, thin; no dissepiments; in early stages major septa confluent axially in axial structure. *U.Carb.-U.Perm.*, Asia (Shantung, Shensi-Camb.)-Eu. (Italy-Aus.-Donbas).——Fig. 220,*2a-e*. **L. acanthiseptatum*, syntypes, U.Carb., Shantung, Tung Chuang, I-Hsien; *a-d*, oblique transv., *e*, long. secs., ×2.5 (Grabau, 1922).

Lophophyllidium Grabau, 1928, p. 98 [**Cyathaxonia prolifera* McChesney, 1860, p. 75; OD; †neotype, W46064a (?or 4064a), ISGS, Urbana; by Jeffords, 1942, p. 219, probably lost, *fide* Fedorowski, 1974a, p. 442] [?=*Sinophyllum* Grabau, 1928, p. 99 (type, *Lophophyllum pendulum* Grabau, 1922, p. 48, OD; †1584-1586, IGP, Nanking; Perm., Fengcheng, Kiangsi, China, *fide* Grabau, 1928, p. 70; cardinal side concave, structure of large dense columella not clear, ?(of medial plate and radial septal lamellae); until holotype is sectioned and topotypes described name is best not used); *?Malonophyllum* Okulitch & Albritton, 1937, p. 24 (type, *M. texanum*, OD; †not traced; L.Perm., Leonard F., Malone Hills, Hudspeth Co., Texas; like *Lophophyllidium* but ?without tabulae; until syntypes can be traced and topotypes studied, name is best left unused); *?Agarikophyllum* Fomichev, 1953a, p. 196 (type, *Lophophyllidium (Agarikophyllum) pavlovi*, OD; †146, coll. 5030, TsGM, Leningrad, monotype; U.Carb., limestone N_1^2, Chernovaya Gorge, Donbas; tabulae virtually absent); *Agaricophyllum* Kabakovich, 1962, p. 325, *nom. null.*; *?Gerthophyllum* Heritsch, 1937, p. 323, invalid MS name quoted for "the form described from Timor as *Carruthersella wichmanni*," Schouppé & Stacul (1955, p. 181-182) considered *C. wichmanni* to equal *Lophophyllidium spinosum* (Martin, 1881); *Khmerophyllum* Fontaine, 1961, p. 81 (type, *K. cambodgense*, OD; †S/G1, coll. J. Gubler, MSG, Saigon; Perm., Kazan., Pnom Sway, Camb.;

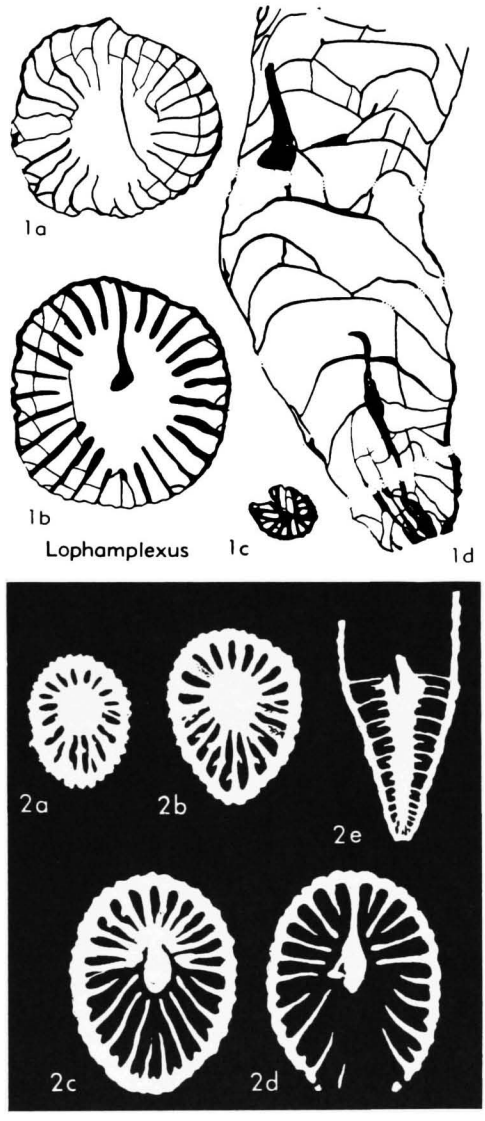


Fig. 220. Lophophyllidae (p. *F*334-*F*335).

axial structure large and dense, of medial plate and numerous contiguous radial septal lamellae)]. Solitary, with distally projecting dense axial structure composed of thickened medial plate and commonly contiguous septal lamellae; distally structure may be separated from counter septum by septal notch; cardinal septum short except in earliest stages where it may be continuous with long counter septum; remaining major septa subequal, discontinuous with septal lamellae of axial structure, their axial ends may be rhopaloid and

they may be thickened to form, around axial structure and touching it or separated from it, a collar discontinuous at open cardinal fossula, to which youngest septa of cardinal quadrants are pinnate and which is commonly on concave side of corallum; tabular floors declined from axial structure to wall, which may be moderately thick, but axial edges of tabulae may also be slightly deflected proximally where they meet the axial structure; no dissepiments [see also FEDOROWSKI, 1974a, p. 441, and FLÜGEL, 1972, p. 74]. *Penn.-Perm.*, N.Am.(Ill.-Ark.-Okla.-Kans.-Ohio-N.Mex.-Texas-Alaska-C. Am.-Guat.)-S.Am.(Peru-Venez.); *U. Carb.-Perm.*, Eu. (Spain-USSR-Aus.)-W. Australia-Asia(China-Japan-Viet Nam-Camb.-Burma-Iran).——FIG. 219,*4a-d*. **L. proliferum* (MCCHESNEY), neotype, Penn.(Missour.), Ill., near Springfield; *a-c*, transv., *d*, long. secs., ×3.0 (Jeffords, 1942).——FIG. 219,*4e,f*. *?L. pavlovi* (FOMICHEV), holotype; *e,f*, transv. secs., ×3.0 (Fomichev, 1953a).——FIG. 219,*4g-i*. *L. cambodgense* (FONTAINE); *g,h*, holotype, transv. secs., ×3.3, ×9.0; *i*, another specimen, Pnom Takream, long. sec., ×3.0 (Fontaine, 1961).

Stereostylus JEFFORDS, 1947, p. 38 [**S. lenis*; OD; †1875-21b, KUMIP, Lawrence, missing, *fide* FEDOROWSKI, 1974a, p. 444]. Solitary; columella lathlike and without radiating septal lamellae, continuous with counter septum except in late stages and in calice, where it projects; cardinal septum short except in earliest stages, in open fossula to which younger septa of cardinal quadrants are pinnate, position of fossula variable in type species, commonly on concave side; other major septa subequal and commonly rhopaloid, in late stages withdrawn from axis; in early stages septa are thickened, and alar, counter-lateral, and metasepta are joined to each other and to columella, alar fossulae are prominent, cardinal septum is short in large fossula, and counter septum long; minor septa rudimentary or short; tabulae declined from columella; no dissepiments. *Penn.*, N. Am. (Mo.-Kans.-Iowa-Texas-Colo.-Okla.); *L. Perm.*, N.Am.(Kans.-Nev.)-?N.Z.——FIG. 219, *1a-f*. **S. lenis*, holotype, Missour., Frisbie Ls. Mbr., Mo., Kansas City; *a-e*, transv., *f*, long. secs., ×3 (Jeffords, 1947).

?Sugiyamaella YABE & MINATO, 1944a, p. 143 [**S. carbonaria*; M; syntypes, R15126-15135, UH, Sapporo] [=*Sugiyamella* FLÜGEL, 1970, p. 271, *nom. null.*]. Solitary, ceratoid, curved; calice deep with prominent round, dense columella and deep, open fossula widening adaxially; major septa pinnately arranged and greatly thickened in cardinal quadrants; in early stages septa long and so dilated as to leave no interspaces, later withdrawing from columella and thinning; septal insertion in counter quadrants not accelerated; cardinal septum very short, counter septum short in late stages; tabulae ?absent in syntypes [rising toward columella, *fide* KATO, 1968a, p. 49]; no dissepiments. *L.Carb. (up.Tournais.)*, Asia(Japan-China); *?L.Carb.(low. Visean)*, Asia.——FIG. 219,*3*. **S. carbonaria*, Japan, Kitakami Mts.; oblique transv. sec., ×2 (Yabe & Minato, 1944a).

Family TIMORPHYLLIDAE Soshkina, 1941

[*nom. transl.* HILL, 1956b, p. F266, *ex* Timorphyllinae SOSHKINA in SOSHKINA, DOBROLYUBOVA, & PORFIREV, 1941, p. 110, as Timorphollinae, *lapsus calami*]

Characters of genus. *U.Perm.*

Timorphyllum GERTH, 1921, p. 69 [**T. wanneri*; M; †16-18, WANNER Coll., IP, Bonn; lectotype by SCHOUPPÉ & STACUL, 1955, p. 153]. Solitary, somewhat scolecoid, epitheca almost smooth; with relatively simple axial structure, comprising lathlike columella commonly separated from septa in late stages and buttressed by sharply upturned axial parts of tabulae, a very few radial septal lamellae may appear in some; cardinal septum short, even in earliest known stage, counter septum may remain long but other septa withdraw from axis; septal insertion accelerated in counter quadrants; wall very thin, minor septa represented only by epithecal grooves or rudimentary; tabulae commonly complete, flat, with downturned edges and updrawn axial parts; septa thickened in early stages; septal trabeculae very fine, close, arranged fanwise, normal to more or less convex distal edges of septa [see FEDOROWSKI, 1974a, p. 470]. *U.Perm.*, Asia(Timor-China)-N.Am.(Texas).——FIG. 221,*4a,b*. **T. wanneri*, Timor; transv., long. secs., ×2 (Schouppé & Stacul, 1955).

Family VERBEEKIELLIDAE Schouppé & Stacul, 1955

[Verbeekiellidae SCHOUPPÉ & STACUL, 1955, p. 141]

Solitary; with axial column of septal lamellae and axial tabellae; in late stages cardinal septum short and distal parts of other major septa discontinuous with septal lamellae and column; septa may be greatly thickened; metaseptal insertion somewhat accelerated in counter quadrants; minor septa rudimentary or short; tabular floors convex or conical, drawn up into column, complete or incomplete; no dissepiments. *L.Miss.-L.Penn.; U.Penn.-Perm.*

Verbeekiella PENECKE, 1908b, p. 187, *nom. subst. pro Verbeekia* PENECKE, 1908a, p. 657, *non Verbeekia* FRITSCH, 1877, an echinoderm [**Verbeekia permica*; M; †not traced; =*Clisiophyllum australe* BEYRICH, 1865, p. 85, *fide* GERTH, 1921, p. 84, †K91.1, BEYRICH Coll., HU, E. Berlin, lectotype by SCHOUPPÉ & STACUL, 1955, p. 143, Perm., Kupang, Timor] [=*Wannerophyllum* SCHOUPPÉ & STACUL, 1955, p. 159 (type, *Carcinophyllum cristatum* GERTH, 1921, p. 82, OD; †11793, TH,

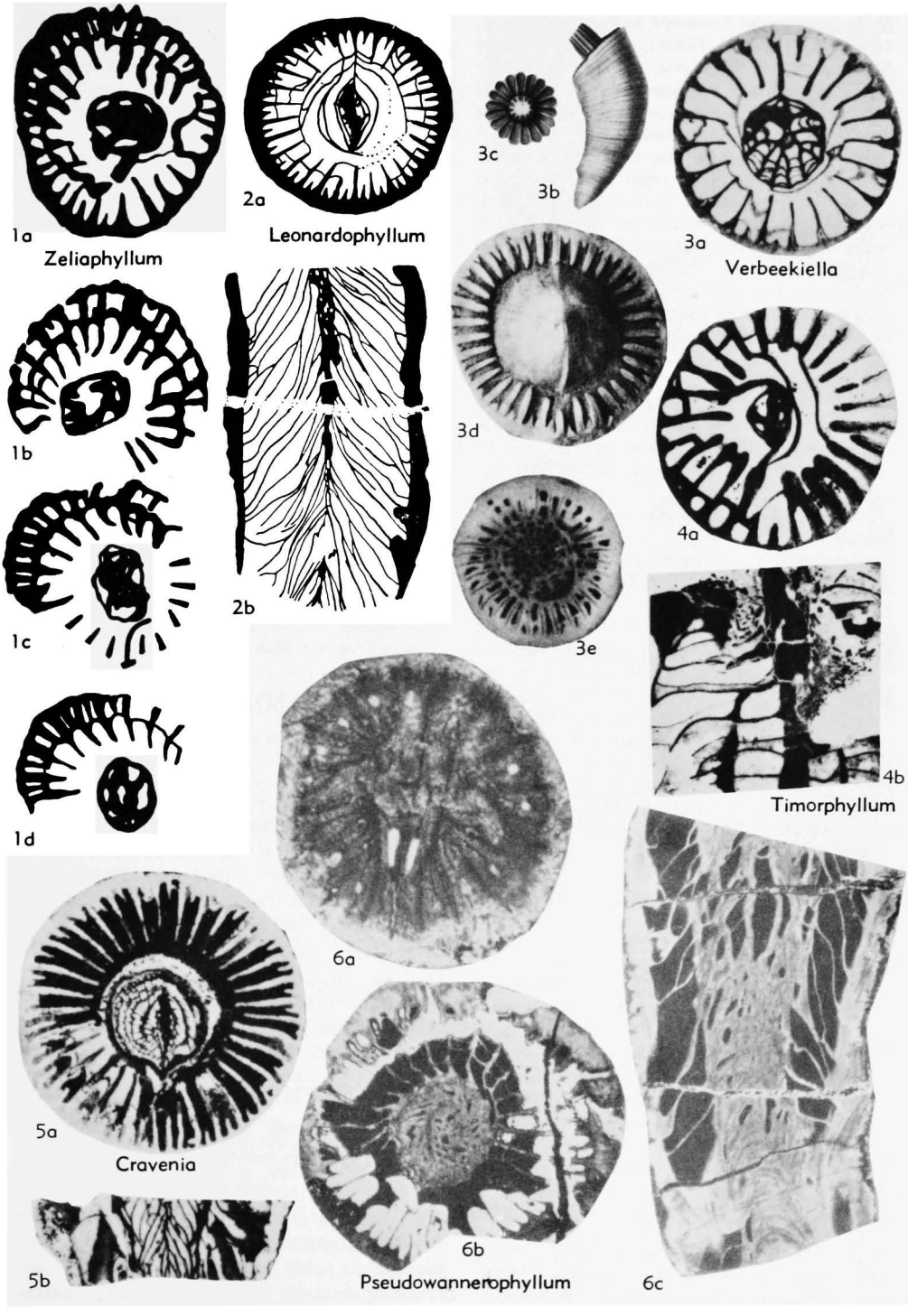


FIG. 221. Verbeekiellidae (1-3, 5, 6); Timorphyllidae (4) (p. *F336-F338*).

Delft, lectotype by SCHOUPPÉ & STACUL, 1955, p. 162, U.Perm., Basleo, Timor), minor septa project from peripheral stereozone, and cardinal side commonly convex]. Solitary, with large axial column of few to numerous septal lamellae (in some with long or short medial plate) and axial tabellae; major septa in late stages discontinuous with column, their distal edges may be convex; cardinal septum shortens; septa may be thickened, especially in cardinal quadrants, and moderately wide peripheral stereozone may form; minor septa may be rudimentary to projecting from stereozone; axial tabellae domes or cones, numerous; pericolumnar tabellae less numerous, abaxially declined and weakly to moderately globose; no dissepiments. *Perm.*, Asia(Timor-Japan-Nepal-Iran)-Eu.(Urals)-W. Australia-?N.Am.(Texas).——FIG. 221,*3a*. **V. permica*, type material, Ajermati R. near Kupang, Timor; transv. sec., ×2.7 (Gerth, 1921).——FIG. 221,*3b,c*. *V. australis* (BEYRICH), lectotype; side, calical views, ×1.0 (Beyrich, 1865).——FIG. 221,*3d,e*. *V. cristata* (GERTH), lectotype; calical view, transv. sec., ×2.0 (Gerth, 1921).

?**Cravenia** HUDSON, 1928, p. 252 [**C. rhytoides*; OD; †R25971-6, BM(NH), London]. Solitary, small, cornute, fossula on convex side, axial structure a large, well-defined column with median plate produced into cusp on cardinal side and continuous in young stages with cardinal septum, which withdraws in late stages; numerous thin septal lamellae radiate with some curvature from median plate; tabellae within column more steeply declined than those between column and wall; septa somewhat dilated in early stages, their bases contiguous to form narrow peripheral stereozone; no dissepiments. [Possibly aulophyllid rather than verbeekiellid.] *L.Carb.(low.Visean)*, Eu.(Eng.-Wales-Eire-Urals).——FIG. 221,*5a,b*. **C. rhytoides*, holotype, C_2, Haw Crag lower quarry, Yorkshire, Bell Busk; *a,b*, transv., long. secs., ×3 (Hudson, 1928).

Leonardophyllum MOORE & JEFFORDS, 1941, p. 85 [**L. distinctum*; OD; †74161, KUMIP, Lawrence]. Solitary, erect or gently curved, conical to cylindrical; with axial structure that is without well-defined wall but consists of lathlike median plate that is continuous with counter septum and several septal lamellae and sharply updrawn axial parts of conical tabulae plus auxiliary axial tabellae; cardinal septum short in indistinct fossula, remaining major septa withdrawn somewhat from axial structure; minor septa short; no dissepiments. *L.Penn.(Morrow.)*, N.Am.(Okla.); *U.Penn.(?Virgil.)-L.Perm.(Leonard.)*, N.Am.(Texas).——FIG. 221,*2a,b*. **L. distinctum*, holotype, L.Perm., Texas, near Leonard Mt., Glass Mts.; *a,b*, transv., long. secs., ×3 (Moore & Jeffords, 1941).

?**Pseudowannerophyllum** FLÜGEL, 1975a, p. 113 (49) [**P. differens*; OD; †P111, UG, Graz]. Solitary, curved-conical, cardinal side concave; axial structure variably thickened, of median lamella, radially or spirally disposed septal lamellae, and axial tabellae, thickening commonly decreasing somewhat distally; cardinal septum long, in long adaxially expanding closed fossula in early stages, in later stages short, in open fossula; peripheral stereozone of moderate thickness, minor septa projecting from it in late stages; pericolumnar tabulae declined abaxially, complete or incomplete and subglobose. [Dense packing of elements in axial structure may indicate relationship to Lophophyllidae.] *U.Carb.(low.Bashkir.)*, Asia(Iran).——FIG. 221,*6a-c*. **P. differens*, Sadar F. I, Cheshmesh-shir, Ozbak-Kuh Ra.; *a,b*, holotype, transv. secs., ×10, ×3; *c*, paratype, long. sec., ×3 (Flügel, 1975a).

?**Zeliaphyllum** HERITSCH, 1936, p. 130 [**Z. suessi*; OD; †2070, UG, Graz] [=*Zelaeophyllum* LANG, SMITH, & THOMAS, 1940, p. 141, *nom. van.*]. Small, solitary; with axial structure of sparse, irregular, and strongly thickened septal lamellae and tabellae; major septa in late stages widely withdrawn from axial structure; form of tabulae unknown; presence of single series of thickened dissepiments doubtful (possibly tabulae). [Imperfectly known.] *L.Perm.*, Eu.(Carnic Alps).——FIG. 221,*1a-d*. **Z. suessi*, monotype, low. *Pseudoschwagerina* ls., Ringmauer, Carnic Alps; *a-d*, transv. secs., ×6 (Heritsch, 1936).

Suborder CANINIINA Wang, 1950

[*nom. correct.* DOBROLYUBOVA in SOSHKINA, DOBROLYUBOVA, & KABAKOVICH, 1962, p. 314, *pro* Caniniacea WANG, 1950, p. 207]

Predominantly large and solitary Stauriida; dissepimentarium wide, commonly with lonsdaleoid dissepiments dominant at least in later stages; tabular fossula distinct, with shortened cardinal septum; counter septum may be elongate; septa thick in early stages, thinning from axis and toward cardinal fossula and amplexoid in tabularium; tabular floors flat with downturned edges but in some axially depressed; tabulae commonly complete. *Carb.-low.U.Perm.*

Family CYATHOPSIDAE Dybowski, 1873

[Cyathopsidae DYBOWSKI, 1873c, p. 331] [=Cyathopsinae DYBOWSKI, 1873c, p. 331; Caniniidae HILL, 1939 in 1938-1941, p. 102; Caninidae FOMICHEV, 1953a, p. 213; ?Dagmaraephyllidae ROGOZOV, 1962, p. 5; Cyathopsicae IVANOVSKIY, 1965a, p. 53]

Solitary or fasciculate, with open tabular fossula; septa typically dilated and amplexoid in wide tabularium, dilatation decreasing first in counter quadrants; cardinal joined with counter septum in earliest stages, cardinal shortening in late stages but counter commonly remains long; tabu-

lae complete, domed, or flat, with downturned edges; marginarium a regular concentric or herringbone or, in some, lonsdaleoid dissepimentarium. *Carb.-L.Perm.*

Caninia MICHELIN in GERVAIS, 1840, p. 485, *non Caninia* OWEN, 1846, a worm [**C. cornucopiae*; OD; †disappeared during wartime partial destruction of collections at Caen (SEMENOFF-TIAN-CHANSKY, 1974, p. 174)] [=*Cyathopsis* D'ORBIGNY, 1849, p. 12 (type, *Caninia cornu-bovis* MICHELIN, 1846, p. 185, M; †? in MICHELIN Coll., MN, Paris, lectotype by LANG, SMITH, & THOMAS, 1940, p. 44; L.Carb., Tournai, Belg.), see CARRUTHERS, 1908, p. 159; *Peetzia* TOLMACHEV, 1924, p. 309 (type, *P. minor,* M; †? in coll. 2555, TsGM, Leningrad; L.Carb., R. Tykta, near Kuznetsk, *fide* DOBROLYUBOVA & KABAKOVICH, 1966, p. 73); *Disophyllum* TOLMACHEV, 1924, p. 316 (type, *D. symmetricum,* SD TOLMACHEV, 1933, p. 287; †? in coll. 2555, TsGM, Leningrad; L. Carb., R. Nizhniy Ters, *fide* DOBROLYUBOVA & KABAKOVICH, 1966, p. 73); *Petzia* FOMICHEV, 1931, p. 41, 70, *nom. null.; ?Kassinella* KELLER, 1959, p. 90 (type, *K. longiseptata,* OD; †6022/16-E, coll. 28, MGU, Moscow; L.Carb., low. Tournais., Kazakh.), *non Kassinella* BORISYAK, 1956, a Paleozoic brachiopod; *?Corphalia* POTY, 1975b, Lithostrotionina, Lithostrotionidae, Thysanophyllinae]. Solitary, curved, conical, but in some straight or curved and cylindrical in late stages; major septa in early stages long but except for counter septum commonly not reaching axis, dilated, particularly in cardinal quadrants, but in late stages thin and straight or slightly concave toward cardinal septum, axially free, becoming shorter as growth proceeds; cardinal septum short, in open fossula on convex side of corallum; counter septum long; tabulae convex, commonly complete; minor septa short, may be discontinuous, dissepimentarium narrow, normal, or, with failure of minor septa, of inosculating dissepiments, or, in zones of rejuvenescence, lonsdaleoid. [HUDSON, 1945a, p. 195, states that no zaphrentoid stage occurs in ontogeny of type species.] *L.Carb.-U. Carb.(Tournais.-Namur.),* Eu.(Brit.I.-Belg.-USSR)-N. Afr. (Alg.)-Asia (Kazakh.-Kuzbas-?Taymyr-?China-NE.USSR); *Miss.,* N.Am.(N.Mex.-Mont.-Mo.).——FIG. 222,*1a-l.* **C. cornucopiae,* L.Carb., Belg., Tournai; *a,* ext. view, *b-h,* serial transv. secs., *i-k,* long. secs., *l,* calical view, all ×1 (Carruthers, 1908).

Arctophyllum FEDOROWSKI, 1975, p. 43 [**Campophyllum intermedium* TOULA, 1875, p. 50; OD; †TOULA, pl. 5, fig. 13, UG, Graz] [?=*Pseudozaphrentoides* SHTUKENBERG, 1904, which see]. Solitary; major and minor septa continuous, in late stages major withdrawn from axis, cardinal septum short, counter less so; in early stages cardinal and alar septa long, counter short; septal thickening notable in tabularium and especially in cardinal quadrants; fossula deep, open; dissepimentarium narrow, without lonsdaleoid dissepiments; tabulae low domes, flattened axially, complete or incomplete; tabellae broad. *Carb.,* Eu. (N.Zemlya); *U.Carb.,* Eu.(USSR); *U.Carb.-L. Perm.,* Eu.(Spits.).——FIG. 223,*3a-d.* **A. intermedium* (TOULA); *a,b,* holotype, Novaya Zemlya, transv. secs., ×2.5; *c,d,* another specimen, U.Carb. (Gshel.) or L.Perm., Spitsbergen, Bellsund; *c,d,* transv., long. secs., ×2.0 (Fedorowski, 1975).

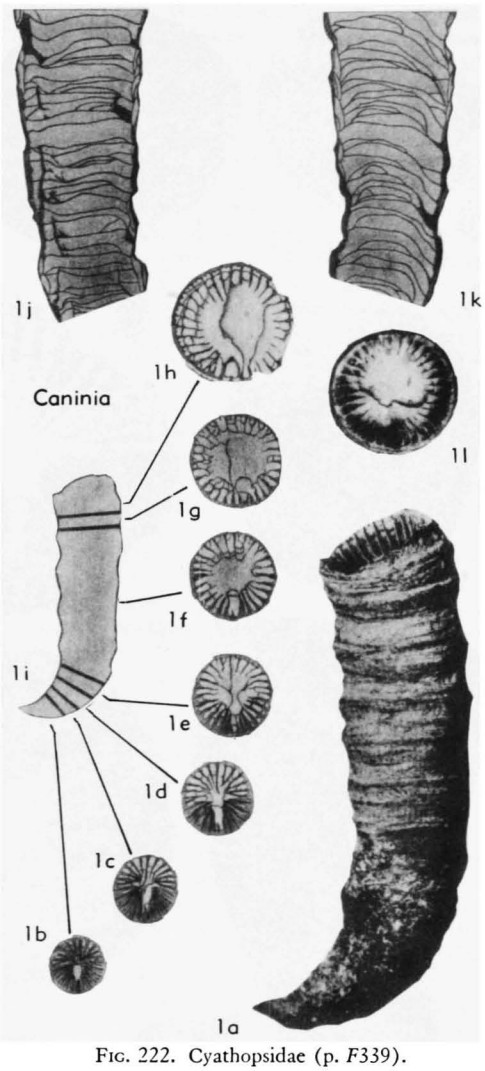


FIG. 222. Cyathopsidae (p. *F339*).

Crataniophyllum LANG & THOMAS, 1957, p. 341, *nom. subst. pro Barbouria* LANG, SMITH, & THOMAS, 1940, p. 26, *nom. subst. pro Craterophyllum* BARBOUR, 1911, p. 42, *non Barbouria*

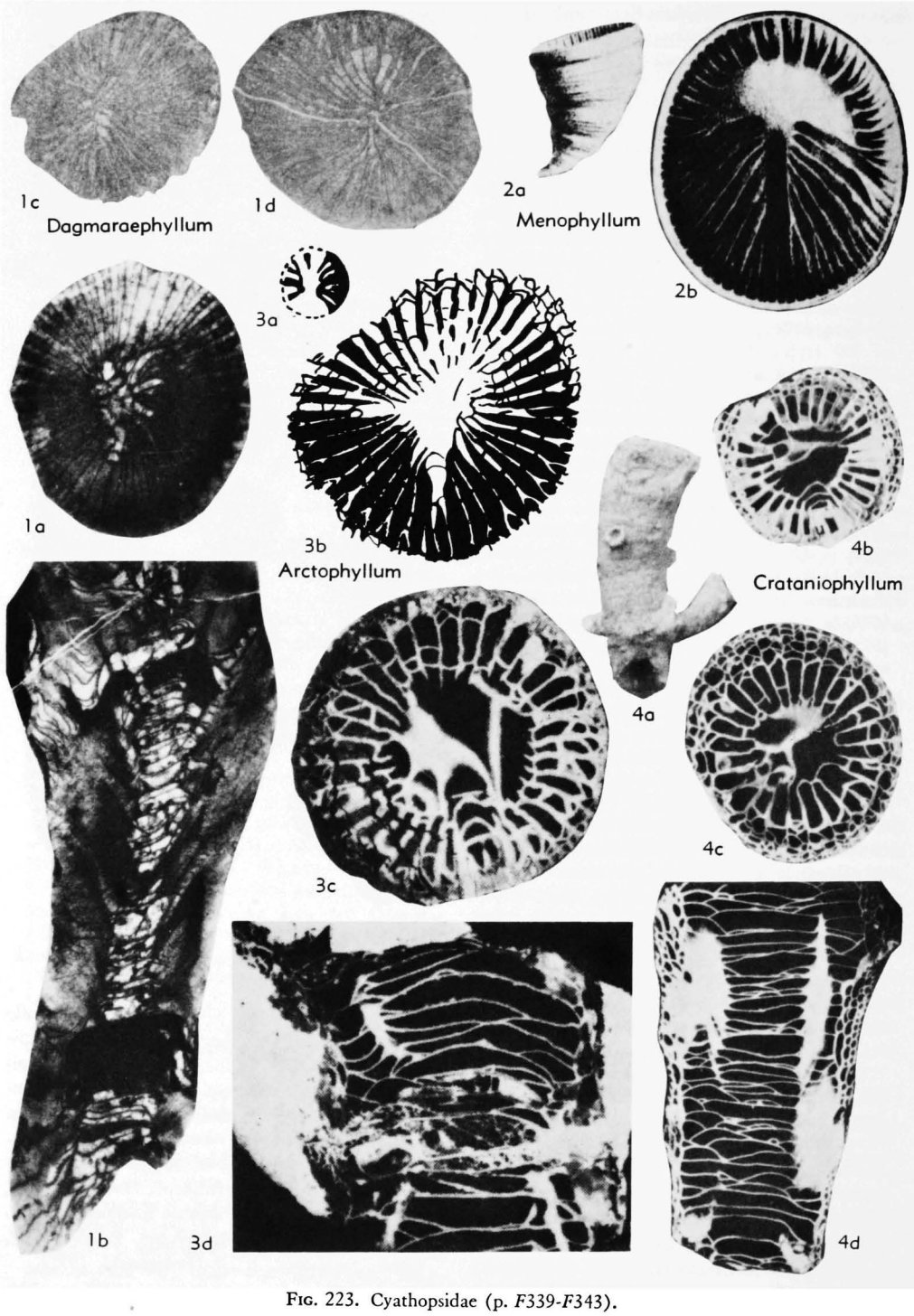


FIG. 223. Cyathopsidae (p. *F*339-*F*343).

RATHBUN, 1912, a crustacean, *nec Craterophyllum* FOERSTE, 1909a, Stauriida, Arachnophyllina, Arachnophyllidae [**Craterophyllum verticillatum* BARBOUR; M; †5466, UNSM, Lincoln]. Like *Fomichevella,* but solitary or with offsets commonly arising laterally in verticils [see FAGERSTROM & EISELE, 1966, p. 595]. *U.Penn.,* N.Am.(Neb.); *U.Carb.,* Eu.(SE.USSR).——FIG. 223,*4a-d*. **C. verticillatum* (BARBOUR), Virgil., Neb., Nehawka; *a,* ext. view, ×1.0; *b-d,* other specimens, transv., long. secs., ×2.0 (Fagerstrom & Eisele, 1966).

?**Dagmaraephyllum** ROGOZOV, 1962, p. 5 [**D. patoki*; OD; †7, coll. 8190, TsGM, Leningrad] [?=*Pseudotimania* GORSKIY, 1951, p. 30 (type, *P. irregularis,* OD; †? in coll. 6091, TsGM, Leningrad; ?Carb., C. Makarov, Novaya Zemlya, which, however, lacks dissepiments and has cardinal septum that may join counter septum), *non Pseudotimania* DOBROLYUBOVA & KABAKOVICH, 1948, Caniniina, Bothrophyllidae]. Solitary; long major septa, in tabularium lanceolate and dilated almost to contiguity except for their axial ends, which in late stages stop unequally just short of axis and are suddenly attenuate there; fossula inconspicuous; in early stages major septa interknit at axis; septa thinner in dissepimentarium, which is narrow even in late stages and may contain very short ridgelike minor septa at wall; tabulae complete or incomplete, flat or slightly convex in wide median zone, and with auxiliary tabellae peripherally forming troughlike periaxial zone. *L.Carb.(low.Tournais.),* Eu.(Polar Urals).——FIG. 223,*1a,b*. **D. patoki,* holotype, middle section of R. B. Patok; *a,b,* transv., long. secs., ×3 (Rogozov, 1962).——FIG. 223,*1c,d*. *?D. irregularis* (GORSKIY), ?low.U.Carb., low. part Barents Ser.; C. Marakov, Novaya Zemlya; *c,d,* transv. secs., ×2 (Gorskiy, 1951).

Fomichevella FEDOROWSKI, 1975, p. 53 [**Campophyllum hoeli* HOLTEDAHL, 1913, p. 24; OD; †K67-8, PM, Oslo] [=*Stuckenbergia* FOMICHEV, 1953a, p. 297 (type, *Campophyllum (Stuckenbergia) stuckenbergi,* M; †241, coll. 5030, TsGM, Leningrad; U.Carb., Moscov., ls. K_2, Donbas, left bank gully of Topshin ravine, Dyadin farm), *non Stuckenbergia* TSERVINSKIY, 1898, a termite]. Phaceloid; major septa radial, thin but not disrupted in dissepimentarium, in late stages withdrawn subequally from axis; tabular floors rising from dissepimentarium to ring of axial septal ends of major septa and flat or saucered in axial space within ring; may be slightly thickened in tabularium in early stages; cardinal septum somewhat shorter, in shallow fossula; length of counter septum variable, may be shorter or longer; minor septa may extend from periphery to tabularium or be more or less withdrawn toward periphery, leaving inosculating dissepiments. *?L.Carb.,* Eu.(Urals); *U.Carb.,* Eu.(Donbas-Spits.-Bear I.); *?L. Perm.,* Eu.(Urals).——FIG. 224,*1a-d*. **F. hoeli* (HOLTEDAHL), holotype, U.Carb., base of *Fusulina* Ls., Vestspits., W. of Green Harbour; *a,b,* transv., long. secs., ×2 (Holtedahl, 1913); *c,d,* SCHINDEWOLF's long. and transv. secs., approx. ×2 (Heritsch, 1939).——FIG. 224,*1e,f*. *F. stuckenbergi* (FOMICHEV), holotype; transv., long. secs., ×2 (Fomichev, 1953a).

Kusbassophyllum DOBROLYUBOVA in DOBROLYUBOVA & KABAKOVICH, 1966, p. 165 [**K. tychtense*; OD; †2497, coll. 1560, PIN, Moscow]. Fasciculate; increase both lateral and parricidal; septa numerous, somewhat thickened near boundary of dissepimentarium and tabularium; major septa short in all growth stages; cardinal septum shorter; minor septa about half to two-thirds as long as major; dissepimentarium wide, narrowing at cardinal fossula, dissepiments of variable size, some large lonsdaleoid plates near periphery; tabulae wide, flat in wide median part, and with troughed or downturned edges. *L.Carb.(Visean),* Asia(Kuzbas).——FIG. 224,*3a,b*. **K. tychtense,* holotype, Podyakov horizon, R. Tykhta; *a,b,* transv., long. secs., ×2 (Dobrolyubova & Kabakovich, 1966).

Lublinophyllum KHOA, 1977, p. 372 [**L. fedorowskii*; OD; †1403.II.140, IG, Warsaw]. Fasciculate, with marginarial increase; minor septa short, longitudinally discontinuous adaxially so that dissepiments may inosculate in places; major septa short, somewhat thickened in tabularium; cardinal septum shortened in late stages, counter septum equal to or longer than others; dissepimentarium sporadically lonsdaleoid; tabulae broad, mesa-shaped. *L.Carb.(Visean),* Eu.(Pol.-Donbas).

?**Melanophyllum** GORSKIY, 1951, p. 40 [**M. keyserlingophylloides*; M; †? in coll. 6091, TsGM, Leningrad]. Solitary; lonsdaleoid dissepiments disrupt both major and minor septa in peripheral parts of dissepimentarium, but only minor septa in inner parts; major septa mostly withdrawn somewhat from axis, but cardinal and counter septa may form continuous septum, and the axial ends of two or three pairs of major septa neighboring the cardinal and counter septa may also join in parallel; tabular floors appear, from transverse section, to be mesa-shaped. *Carb.(Visean* or *Namur.),* Eu.(N.Zemlya).

?**Menophyllum** MILNE-EDWARDS & HAIME, 1850, p. lxvi [**M. tenuimarginatum*; OD; †Z35a, MN, Paris. Note by R. G. CARRUTHERS, 1908, attached (*fide* MS notes by STANLEY SMITH of visit to Paris, April 4-12, 1930) to holotype states, "rim is almost completely broken down and some foreign matter adheres to the tip. But I have no hesitation in recognising this as the type Pl. 111, fig. 1a and referring it to *Caninia cornucopiae* Mich." The holotype (studied by HILL, Sept. 1975) indeed resembles young *C. cornucopiae* between "dumonti" and "nystiana" phases described by CARRUTHERS, 1908, p. 161]. Solitary, small, curved trochoid, with, on convex side, narrow, deep, parallel-sided fossula to which metasepta of cardinal quadrants are pinnately directed, their

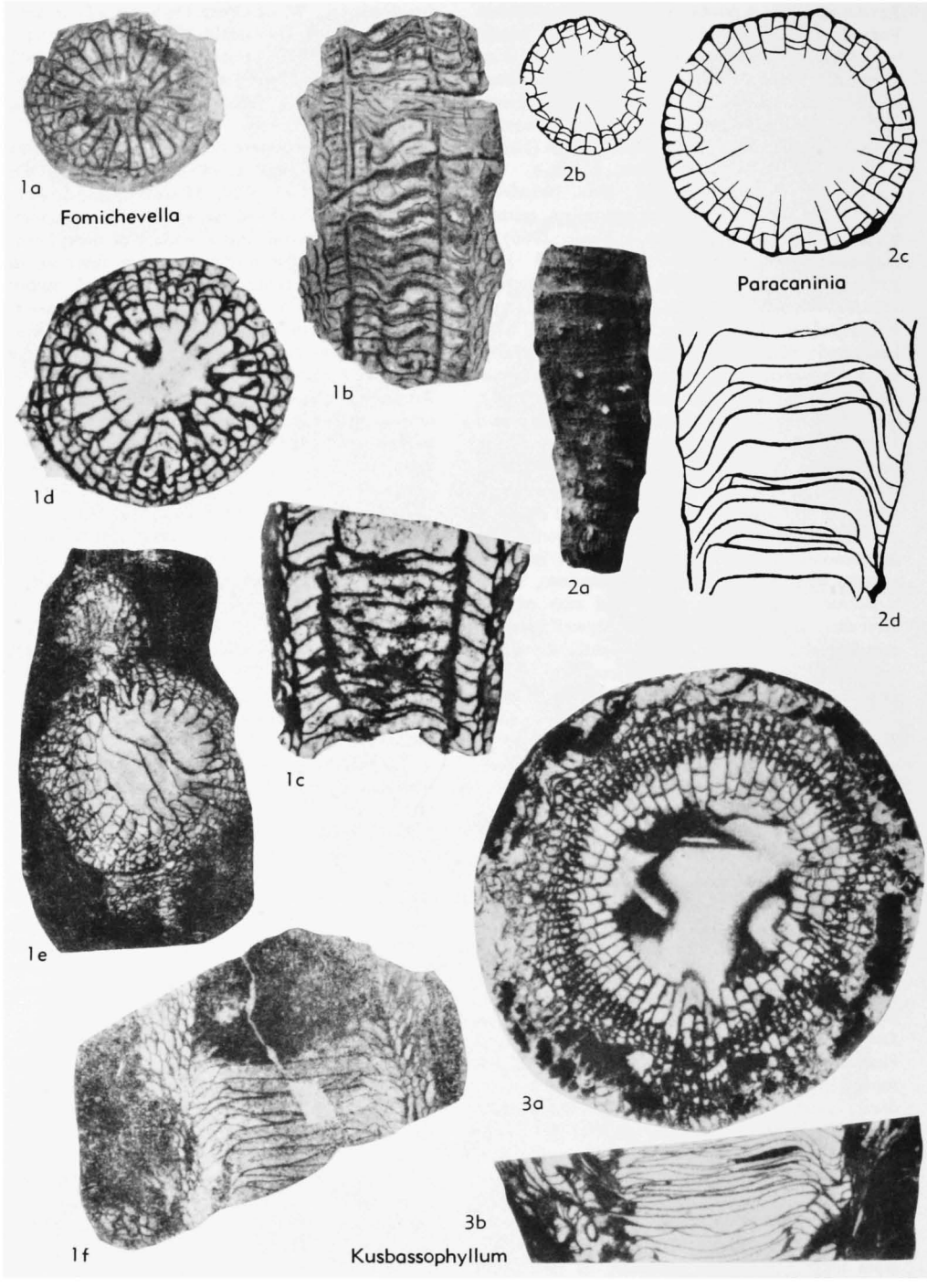


FIG. 224. Cyathopsidae (p. *F*341-*F*344).

ends fusing in fossular wall; alar fossulae present; cardinal septum shortened; in counter quadrants major septa withdrawn, radial and subequal, counter septum may elongate slightly onto upper sur-

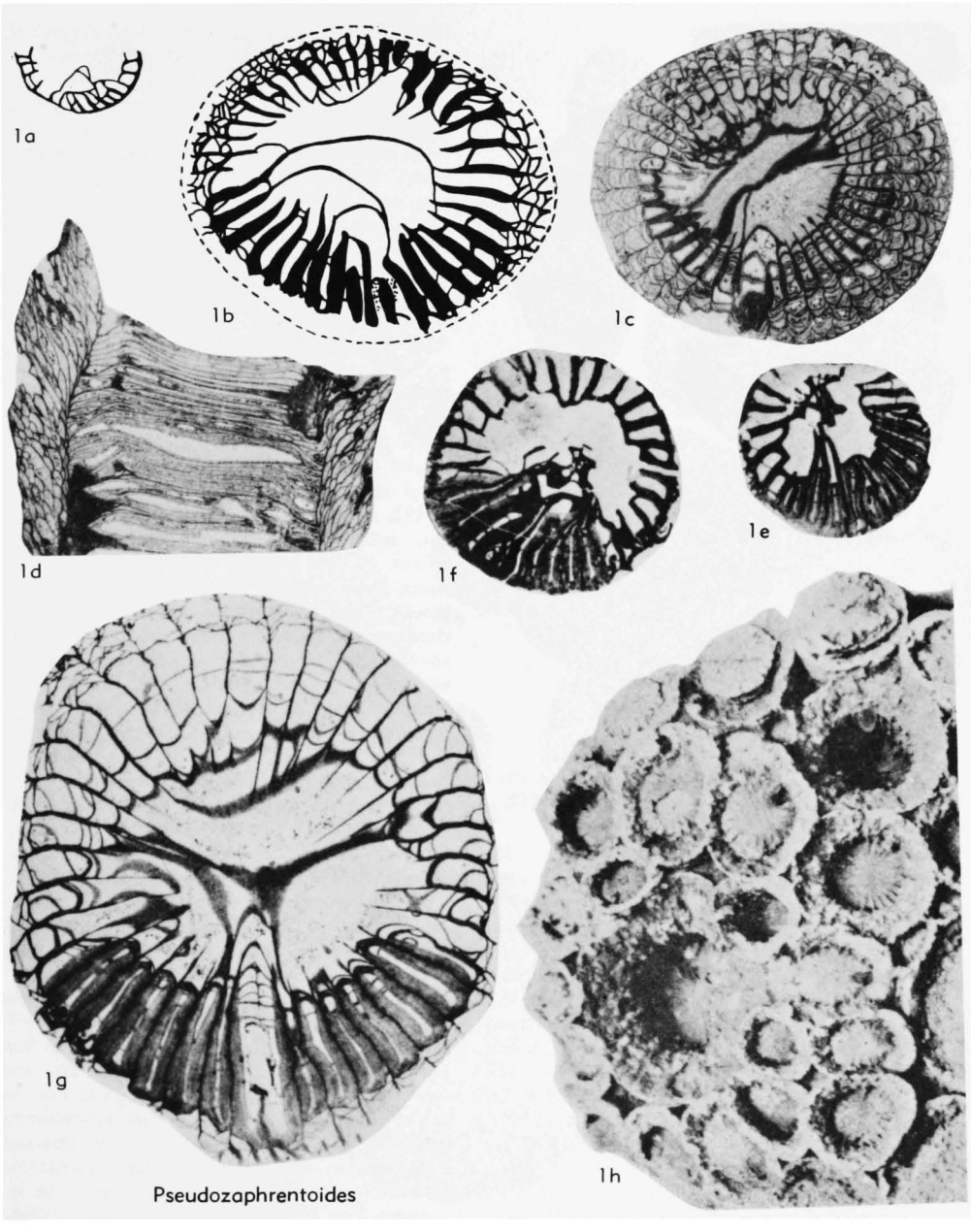


FIG. 225. Cyathopsidae (p. *F344*).

face of tabula that forms flat floor of inner part of counter quadrants of calice; minor septa moderately long. [Further study of ?monotype desirable.] *L.Carb.(Tournais.),* Eu.(Belg.).——FIG. 223,*2a,b.* **M. tenuimarginatum,* holotype, Tournais., Tournai; *a,* lat. view, ×1; *b,* calical view, approx. ×3 (Milne-Edwards & Haime, 1851).

Paracaninia CHI, 1937, p. 93 [**P. sinensis*; OD; †not traced, Peking]. Solitary, with spinose processes; major septa thin and long in early stages, short and amplexoid in later stages; cardinal fossula marked by shortened cardinal septum; minor septa short, dissepiments absent; tabulae mesa-shaped, with long downturned edges, complete or incomplete. *L.Perm.,* Asia(China).——FIG. 224, *2a-d.* **P. sinensis,* holotype, Chihs., up. Wumaling

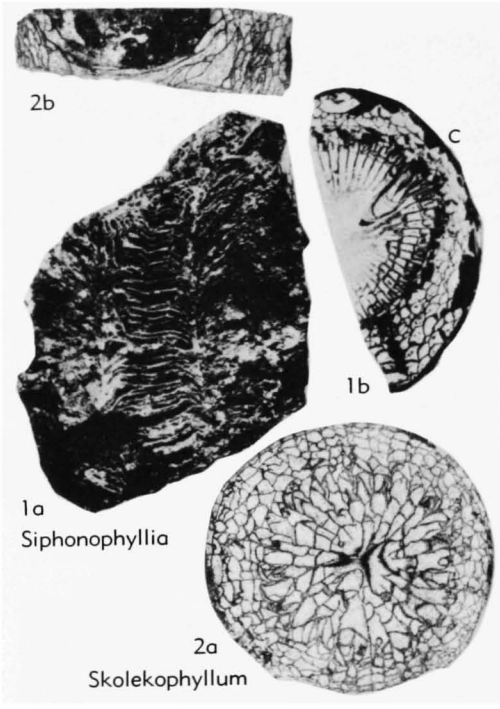


FIG. 226. Cyathopsidae (p. *F*344).

Ser., Kiangsi, Wumahuitou, Yungsin distr.; *a*, ext. view, ×1; *b-d*, transv., long. secs., ×2 (Chi, 1937).

Pseudozaphrentoides SHTUKENBERG, 1904, p. 32 [**P. jerofeewi*; M; †50, coll. 336, TsGM, Leningrad; *?=Caninia inostranzewi* SHTUKENBERG, 1904, p. 26, †36, coll. 336, TsGM, Leningrad, lectotype by DOBROLYUBOVA, 1952b, p. 72, up. Visean or low. Namur., Steshevsk horizon, Luzhki on R. Oka 12 km. from Serpukhov] [*?=Lithodrumus* GREENE, 1904 (May 9), p. 168 (type, *L. veryi*, OD; †not traced in GREENE Coll., AMNH, New York; Miss., Chester., 4 mi. SE. of Mammoth Cave, Ky.; but this specimen is subcerioid; see also EASTON, 1944a, p. 129); *Lithodrymus* LANG, SMITH, & THOMAS, 1940, p. 78, *nom. van.*; *?Arctophyllum* FEDOROWSKI, 1975, which see]. Solitary, ?(and subcerioid), corallites large; major septa continuous and commonly thin in dissepimentarium, somewhat amplexoid and thick in tabularium, thickening weaker in counter than in cardinal quadrants and decreasing distally and adaxially; cardinal septum shortens in deep fossula; minor septa discontinuous except at periphery and in early stages so that dissepiments commonly inosculate in major septal loculi; tabulae wide, flat, with downturned edges, commonly complete [see SEMENOFF-TIAN-CHANSKY, 1974, p. 189; see also FEDOROWSKI, 1975, p. 33]. *L.Carb.-U.Carb.(up.Visean-low.Namur.)*, Eu.(Brit.I.-Spain-USSR)-Asia (Kuzbas-Kazakh.-?China-?Japan)-N. Afr.(Alg.); *?Miss.*, N.Am.(Ala.-Ky.-Tenn.-Va.); *Miss.*, N.Am.(Nova Scotia-Mont.).——FIG. 225, *1a,b*. **P. jerofeewi*, holotype, Carb., Novaya Zemlya; *a,b*, transv. secs., ×2 (Fedorowski, 1975). ——FIG. 225,*1c-g*. *?P. inostranzewi* (SHTUKENBERG), Steshevsk horizon, Luzhki; *c,d*, transv., long. secs., late stage, ×1; *e-g*, another specimen, transv. secs., ×2 (Dobrolyubova, 1952b).——FIG. 225,*1h*. *?P. veryi* (GREENE), holotype; calical view, ×1 (Greene, 1904).

Siphonophyllia SCOULER MS in MCCOY, 1844, p. 187 [**S. cylindrica*; M; †80-1925, GRIFFITH Coll., NM, Dublin] [*?=Paleocaninia* LISITSYN, 1925, p. 56-57, *nom. inval.* in combinations "*Paleocaninia cylindrica* cf. mutation γ VAUGHAN, mutation δ VAUGHAN" and "*Paleocaninia cylindrica*," genus summarily described as "with wide lonsdaleoid peripheral zone," no citation as new genus or of type species; *Palaeocaninia* FLÜGEL, 1970, p. 192, *nom. null.*]. Solitary, large; septa numerous, with lonsdaleoid (transeptal) dissepimentarium in late stages; major septa continuous plates, thickened only in peripheral parts of tabularium where edges of flat-topped and medianly depressed or domed tabulae are turned down, adaxially major septa thinner and continuous only on upper surfaces of tabulae, in late stages edges withdraw from axis; fossula with short cardinal septum, a deep depression shallowing adaxially and may be crossed by tabellae; longer or shorter counter septum may lie in shallower tabular depression; early stages unknown from type locality [see LEWIS, 1927a, p. 374; DIXON, 1970, p. 62]. *L.Carb.*, Eu. (Brit. I.-Belg.-France-USSR)-N. Afr. (Alg.)-Asia (Kazakh.-Kirg.-Iran-Kuzbas-Sib.Platf.-NE.USSR-Armenia).——FIG. 226,*1a,b*. **S. cylindrica*, holotype, Ardsallagh, Drumquin, Ire.; *a*, long. fracture, ×0.3; *b*, transv. sec., ×0.7 (Lewis, 1927a).

Skolekophyllum FOMICHEV, 1953a, p. 299 [**Campophyllum (Skolekophyllum) rotayi*; OD; †244, coll. 5030, TsGM, Leningrad]. Solitary, with thin septa, major a little withdrawn from axis and somewhat curved or tortuous, discontinuous in places in moderately wide, loose dissepimentarium; cardinal septum shorter; minor septa very thin and discontinuous; dissepiments irregularly concentric to lonsdaleoid; tabulae saucerlike, complete or incomplete [see IVANOVSKIY, 1967, p. 54]. *U.Carb. (Moscov.)*, Eu.(Donbas).——FIG. 226,*2a,b*. **S. rotayi*, holotype, ls. L7, Mechetnaya ravine; *a,b*, transv., long. secs., ×1.3 (Fomichev, 1953a).

Family BOTHROPHYLLIDAE Fomichev, 1953

[Bothrophyllidae FOMICHEV, 1953a, p. 317]

Solitary; septa numerous, long, or somewhat withdrawn from axis but seldom amplexoid, leaving axial septal free space of

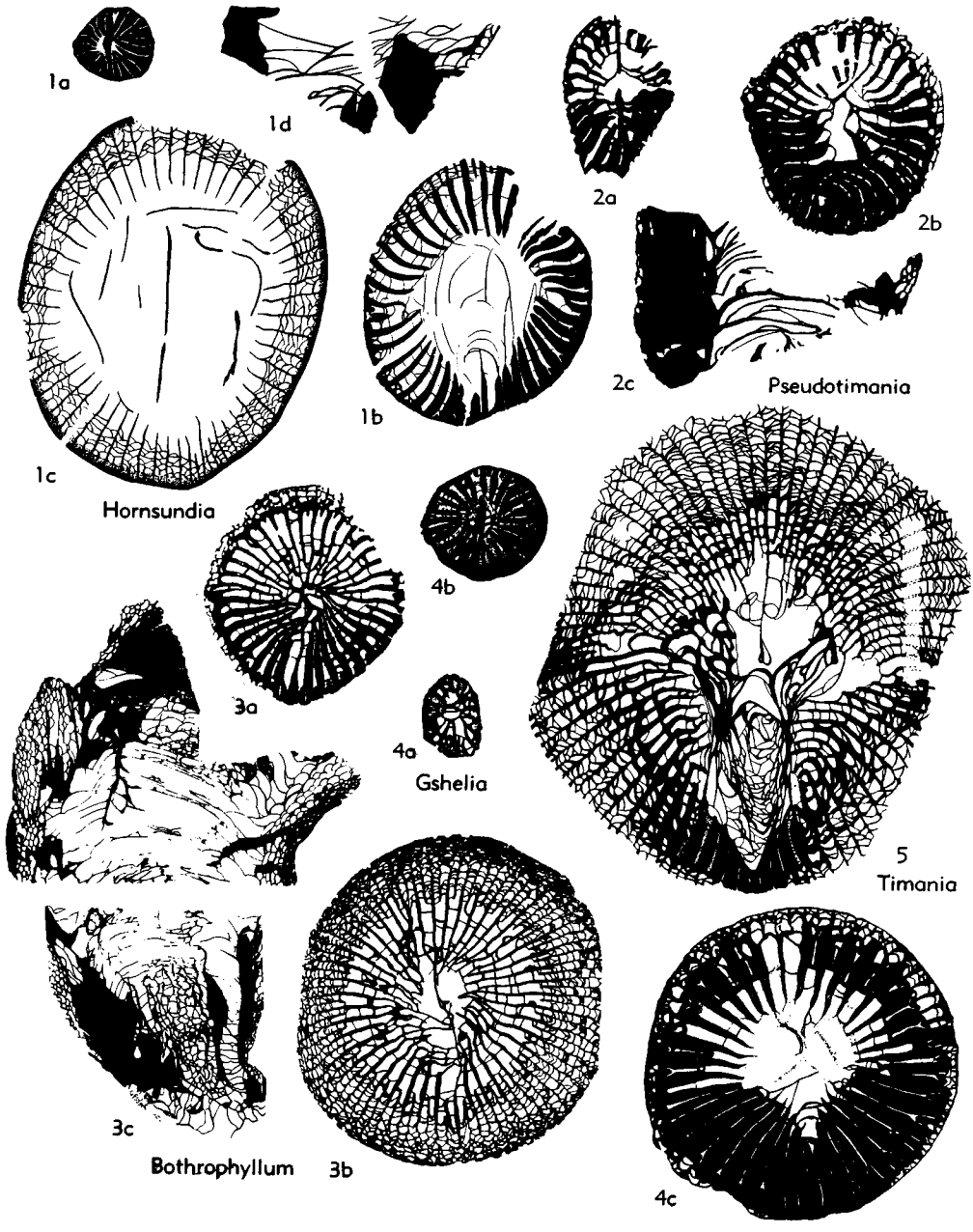


FIG. 227. Bothrophyllidae (p. *F346-F348*).

tear-shaped transverse section; cardinal fossula more or less deep and invading dissepimentarium, with metasepta of cardinal quadrants increasing in length away from it and either radial or with their axial edges curving toward but commonly not closing axial end of fossula; cardinal septum long or short, counter may be long; septa thick in early stages, thinning in late stages first in counter quadrants; minor septa continu-

ous or less commonly discontinuous; dissepimentarium commonly narrow, dissepiments normal concentric, or angulate, sparse transeptal; tabular floors low domes, tabulae complete or incomplete. *Carb.-L.Perm.*

Bothrophyllum TRAUTSCHOLD, 1879, p. 30 [**Turbinolia conica* FISCHER VON WALDHEIM, 1830, explanation of pl. 30, fig. 6, *sensu* TRAUTSCHOLD, 1879, p. 30; M; †in coll. 83, LGU, Leningrad; lectotype by DOBROLYUBOVA, 1937, p. 35] [=*Rossophyllum* SHTUKENBERG, 1888, p. 11 (type, *R. novum*, M; †? in coll. 321, TsGM, Leningrad; M.Carb., Myachkovo; considered by DOBROLYUBOVA, 1937, p. 34, to be young forms of *B. conicum*); *Pseudocaninia* SHTUKENBERG, 1888, p. 12 (type, *P. conica* (FISCHER VON WALDHEIM) SHTUKENBERG, SD LEWIS, 1931, p. 227; syntypes nos. 28-52, 55-77, coll. 321, TsGM, Leningrad; M. Carb., Myachkovo; see DOBROLYUBOVA, 1937, p. 34, and FEDOROWSKI, 1975, p. 57); *Botrophyllum* SHTUKENBERG, 1895, p. 56, *nom. null.*; *?Caninophyllum* LEWIS, 1929, which see; *?Bothroclisia* FOMICHEV, 1953a, which see; *?Siedleckia* FEDOROWSKI, 1975, which see]. Solitary, large, with numerous long septa; cardinal and more commonly counter septum may be elongate, and may be conjoined in long, thin, irregular lamina; ends of major septa may be fused in groups axially, forming weak and inconstant axial structure that may be reinforced by axial tabellae; fossula open; septa may be thickened in tabularium, thinning first from counter quadrants; thickened part of cardinal septum may be short; septa thin in dissepimentarium, dissepiments small, normal concentric, anguloconcentric, or replaced by two smaller, inosculating plates; tabular floors low domes with auxiliary tabellae in inconstant axial structure. [Lectotype needs restudy.] *?L.Carb.(Tournais.)*, Asia(Kazakh.); *L.Carb.(Visean)*, Eu.(Brit.I.-N. Zemlya); *U.Carb.(Moscov.)*, Eu.(Spits.-?Spain-Czech.-USSR); *?Penn.*, N.Am.——FIG. 227,*3a-c*. **B. conicum* (FISCHER VON WALDHEIM), U.Carb. (Moscov.), Moscow Basin, Myachkovo; *a,b*, transv. secs., ×2.0; *c*, another specimen, long. sec., ×1.3 (Dobrolyubova, 1937).

Bothroclisia FOMICHEV, 1953a, p. 339 [**Bothrophyllum (Bothroclisia) clisiophylloides*; OD; †293, coll. 5030, TsGM, Leningrad] [?=*Bothrophyllum* TRAUTSCHOLD, 1879, which see, see also FEDOROWSKI, 1975, p. 57]. Solitary, conical, not large; in early stages major septa thickened, their axial ends joining in groups from which a few, with long cardinal septum, reach axis and form irregular plexus; in later stages thickening becomes confined to cardinal quadrants, inner ends of major septa may curve and become discontinuous before reaching axis, where narrow and variable axial structure of sparse radial lamellae and axial tabellae may develop; fossula open; tabulae conical, incomplete, rising more steeply in axial structure; dissepimentarium narrow, dissepiments regular concentric or anguloconcentric. *U.Carb.(Moscov.)*, Eu.(Donbas). ——FIG. 228,*2a-c*. **B. clisiophylloides*, holotype, U.Carb.(Moscov.), ls. M_1, Gelmersenova ravine; *a-c*, transv., long. secs., ×2.1 (Fomichev, 1953a).

Calmiussiphyllum VASILYUK, 1959, p. 87 [**C. calmiussi*; OD; †7, coll. 1405, IG, Kiev]. Solitary, large; septa numerous, long, major septa extending almost to axis except for short cardinal and its neighboring pair in marked, partly closed fossula; minor septa half as long and contratingent or contrajunct; septa dilated in early stages, dilatation decreasing first in counter quadrants in dissepimentarium and tabularium, and then in cardinal quadrants where decrease of thickening through dissepimentarium is gradual; tabular floors domed, tabulae incomplete; dissepiments normal, some transeptal plates developing peripherally in late stages. *L.Carb.(low.Visean)*, Eu.(Donbas).—— FIG. 228,*5a,b*. **C. calmiussi*, holotype, R. Kalmius; *a,b*, transv. secs., ×1.7 (Vasilyuk, 1960).

?Caninella GORSKIY, 1938, p. 40 [**C. pulchra*; OD; †44, coll. 5769, TsGM, Leningrad]. Solitary, large; major septa numerous, long, but leaving small axial space, dilated and lanceolate in transverse section in tabularium, particularly in cardinal quadrants; cardinal septum shortening in open fossula at least in late stages; minor septa commonly withdrawn to peripheral half of wide dissepimentarium; dissepiments numerous, small and rather irregular, some lateral, along sides of septa; tabular floors moderately tall domes with edges turned out or up; tabulae complete or incomplete. *?Carb.*(in boulders), Eu.(N.Zemlya); *?U.Carb.*, Eu.(Donbas).——FIG. 228,*4a,b*. **C. pulchra*, holotype, Novaya Zemlya (boulder in Russian Harbor); *a,b*, transv., long. secs., ×1.7 (Gorskiy, 1938).

Caninophyllum LEWIS, 1929, p. 457 [**Cyathophyllum archiaci* MILNE-EDWARDS & HAIME, 1852, p. 183; OD; †5462, Geol. Soc. coll., Leeds, and PF 1893-5, IGS, Leeds] [?=*Bothrophyllum* TRAUTSCHOLD, 1879, which see, FEDOROWSKI, 1975, p. 57; *Neocaninia* LISITSYN, 1925, p. 56, *nom. inval.* in combination *Neocaninia patula*, no diagnosis, illustration, or citation as new genus or of type species]. Solitary, moderately large; with numerous long septa somewhat thickened in tabularium or only in counter quadrants, thinning and rarely amplexoid toward axis; cardinal septum short, in fossula expanding toward axis, axial ends of neighboring metasepta may curve around fossula but do not meet, fossula marked by depression in tabular floors that projects into dissepimentarium; counter septum may remain long; thin axial ends of major septa may come together in groups at or near axis; dissepiments variable, small, concentric, anguloconcentric, or in places an angulate plate replaced by two inosculating plates; tabular floors flat medianly, with downturned edges. *L.Carb.*, Eu. (Brit. I.-France-Belg.-USSR)-N. Afr.

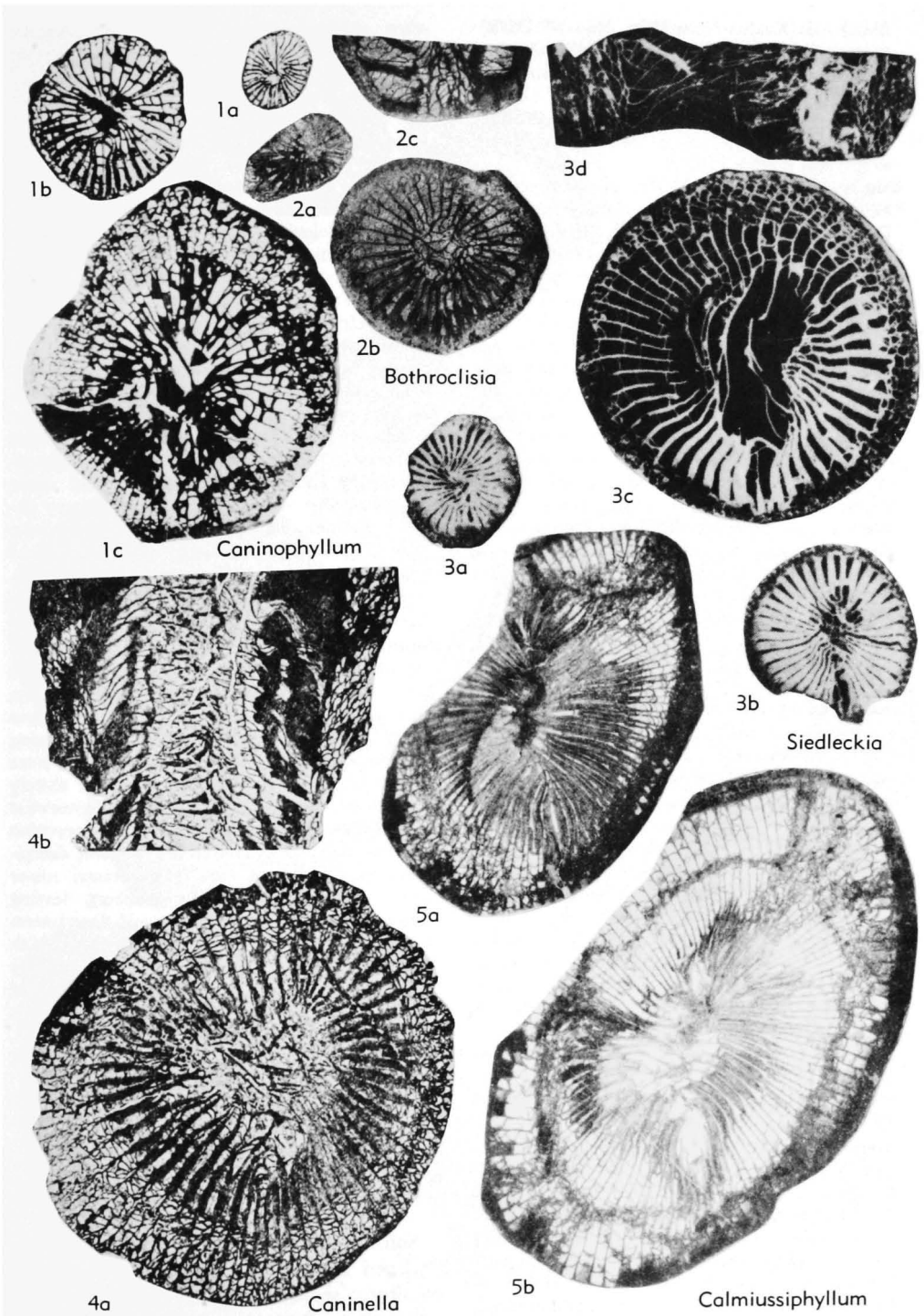


FIG. 228. Bothrophyllidae (p. *F346-F348*).

(Alg.)-Asia(Kuzbas-?Laos-?Viet Nam-NE.USSR)-Australia(New S.Wales); *U.Carb.*, Eu.(Donbas-?Spits.); *?U.Carb.-L.Perm.*, Eu.(Spits.-Urals-Carnic Alps).——FIG. 228,*1a-c*. **C. archiaci* (MILNE-EDWARDS & HAIME), holotype, L.Carb.(Visean), Wales, Llanymynech, near Oswestry; *a-c*, transv. secs., ×0.8 (Lewis, 1929).

Gshelia SHTUKENBERG, 1888, p. 24 [**G. rouilleri*; M; †88, coll. 321, TsGM, Leningrad; lectotype by DOBROLYUBOVA, 1940, p. 49]. Solitary, large; major septa thick in tabularium, thinning first in counter quadrants; cardinal metasepta pinnate toward cardinal septum, which shortens in fossula about whose inner end new metasepta may curve somewhat; major septa of counter quadrants subradial, and like those of cardinal quadrants withdrawing somewhat from axis; counter septum, and in places, alar septa may be shorter; thick, laminar columella present in early but not in earliest stages, connected with either counter or cardinal septum or both, becoming free and disappearing in later stages; tabulae incomplete, floors domes whose edges may be troughed; alar fossulae more or less distinct; dissepimentarium narrow, minor septa continuous, dissepiments fine, their distal concavity normal or angulate [see DOBROLYUBOVA, 1940, p. 38]. *?U.Carb.*, Eu.(Spits.); *U.Carb.*, Eu.(USSR).——FIG. 227,*4a-c*. **G. rouilleri*, U.Carb.(Gshel.), Moscow Basin; *a-c*, transv. secs., ×2.0 (Dobrolyubova, 1948).

Hornsundia FEDOROWSKI, 1965a, p. 37 [**H. lateseptata*; OD; †114, PZI, Poznan]. Solitary, large, curved, concave side cardinal; calice oval, deep, oblique; major septa dilated in tabularium, thinning first in counter quadrants, withdrawn from axis in late stages, leaving ovoid or drop-shaped space; in early stages cardinal and counter septa linked; fossula open, deep, in late stages with cardinal septum shortened but longer than neighboring metasepta; dissepimentarium narrow, minor septa may withdraw toward periphery leaving inosculating dissepiments in major septal loculi; tabulae broadly domed, incomplete. [Two specimens only of type species. See also FEDEROWSKI, 1975, p. 31.] *L.Perm.*, Eu.(Spits.).——FIG. 227, *1a-d*. **H. lateseptata*, holotype, 5th coral ls. horizon, up. Treskelodden beds, Vestspits., Hornsund; *a-c*, transv., *d*, long. secs., ×1.3 (Fedorowski, 1965a).

Pseudotimania DOBROLYUBOVA & KABAKOVICH, 1948, p. 8 [**Timania mosquensis* DOBROLYUBOVA, 1937, p. 22; OD; †190, coll. 141, PIN, Moscow] [=*Timanophyllum* FOMICHEV, 1953a, p. 252 (type, *Timania mosquensis* DOBROLYUBOVA, 1937, OD)]. Solitary, conicocylindrical; major septa of unequal length and thickness, counter septum in early stages long and nearly united with cardinal, which shortens in later stages, as do the shorter alar septa; major septa pinnate toward cardinal and counter septa; fossula in early stages almost closed when cardinal septum is long, may close when cardinal septum shortens; alar fossulae notable; tabulae complete or incomplete, tabular floors broadly arched with downturned edges deepening into fossula; dissepimentarium narrow, normal concentric, septa thin within it. *U.Carb. (Myachkov.-Gshel.)*, Eu.(Donbas-Moscow Basin-Spits.).——FIG. 227,*2a-c*. **P. mosquensis* (DOBROLYUBOVA), holotype, Myachkovo horizon, Moscow Basin, near Novlinskoye; *a,b*, transv., *c*, long. secs., ×2.0 (Dobrolyubova, 1937).

Siedleckia FEDOROWSKI, 1975, p. 47 [**S. bjornoyana*; OD; †A32129, ?PM, Oslo] [?=*Bothrophyllum* TRAUTSCHOLD, 1879, which see]. Solitary, moderately large; septa numerous, thickened in tabularium except in late stages, thickening decreasing first in counter quadrants; ?(lateral metasepta pinnate to alar septa in late neanic stages); cardinal septum shortened early, in open tabular fossula, counter septum ?variable; septa somewhat withdrawn ?(amplexoid) in late stages; dissepimentarium narrow, with septa thin and minor septa but little withdrawn from tabularium; dissepiments fine and may be angulate; tabulae broadly domed and incomplete. [Further study of ontogeny desirable.] *U.Carb.*, Eu.(Bear I.-?USSR).——FIG. 228,*3a-d*. **S. bjornoyana*, holotype; *a-c*, transv., *d*, long. secs., ×1.7 (Fedorowski, 1975).

Timania SHTUKENBERG, 1895, p. 62 [**T. schmidti*; M; †494-5, coll. 305, TsGM, Leningrad; lectotype by DOBROLYUBOVA, 1937, p. 22]. Large, solitary; septa numerous, major septa of counter quadrants thinner and longer than others; fossula deepening and expanding adaxially, with cardinal and some counter metasepta curving more or less sharply toward it; other metasepta withdrawn somewhat from axis and radial or pinnate and somewhat convex toward long, thin counter septum; dissepimentarium wider in counter quadrants; minor septa withdrawn almost to periphery, leaving inosculating dissepiments; lonsdaleoid dissepiments absent or very sparse; tabulae subhorizontal with downturned edges, complete or with auxiliary tabellae peripherally; floor of fossula may be of small tabellae [see FEDOROWSKI, 1975, p. 31]. *U.Carb.*, Eu.(Moscow Basin-Timan).——FIG. 227, *5*. **T. schmidti*, lectotype, Timan, R. Indiga; transv. sec., ×1.3 (Fedorowski, 1975).

Family URALINIIDAE Dobrolyubova, 1962

[Uraliniidae DOBROLYUBOVA in SOSHKINA, DOBROLYUBOVA, & KABAKOVICH, 1962, p. 316] [=Cystophrentidae YÜ, 1963, p. 318]

Solitary; floor of calice commonly oblique, declined toward fossula on convex side of corallum; septa of counter quadrants markedly more numerous and in late stages thinner than those of cardinal quadrants; septa commonly discontinuous in dissepimentarium, disrupted by transeptal dissepi-

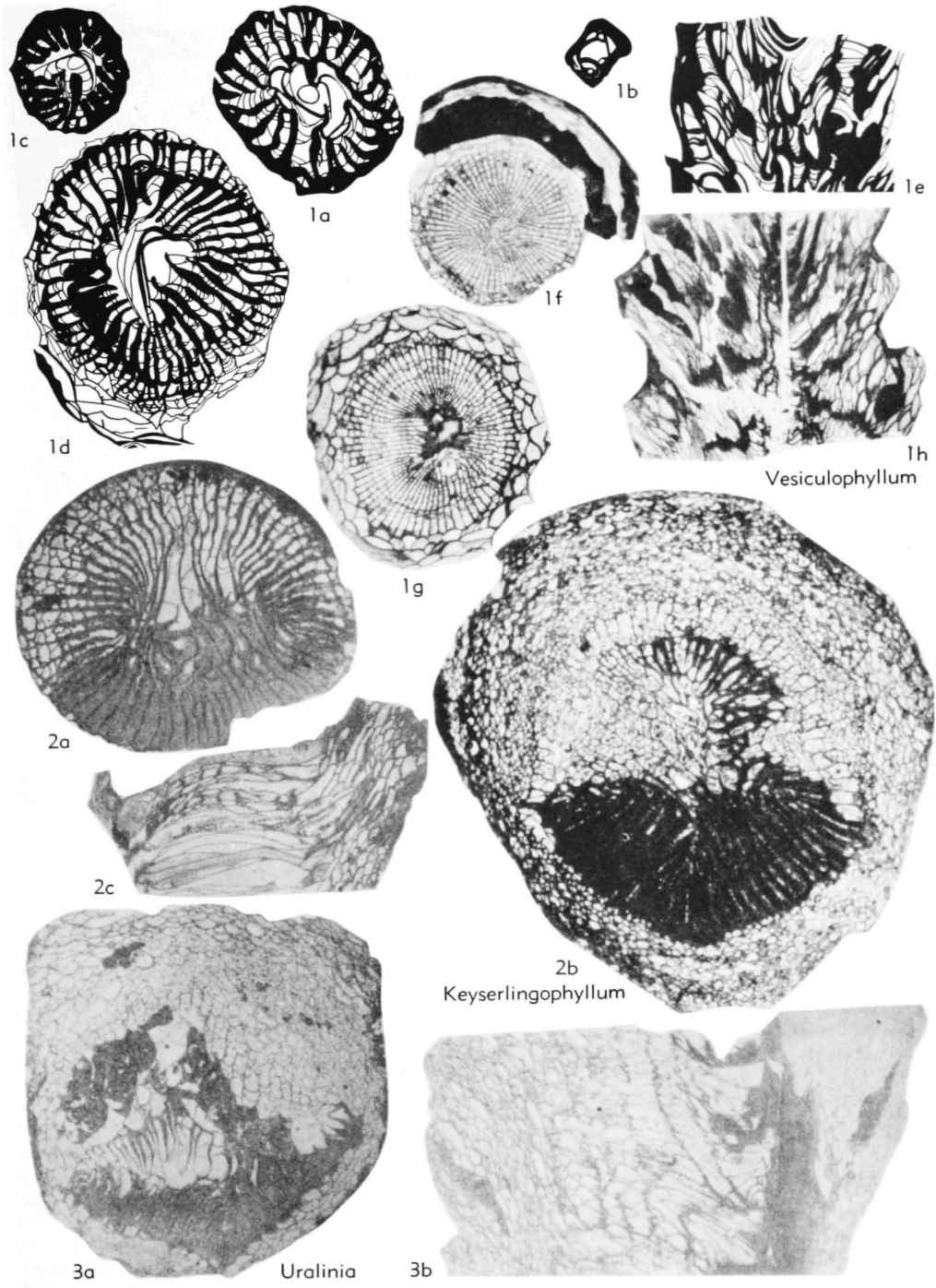


FIG. 229. Uraliniidae (p. *F*350-*F*351).

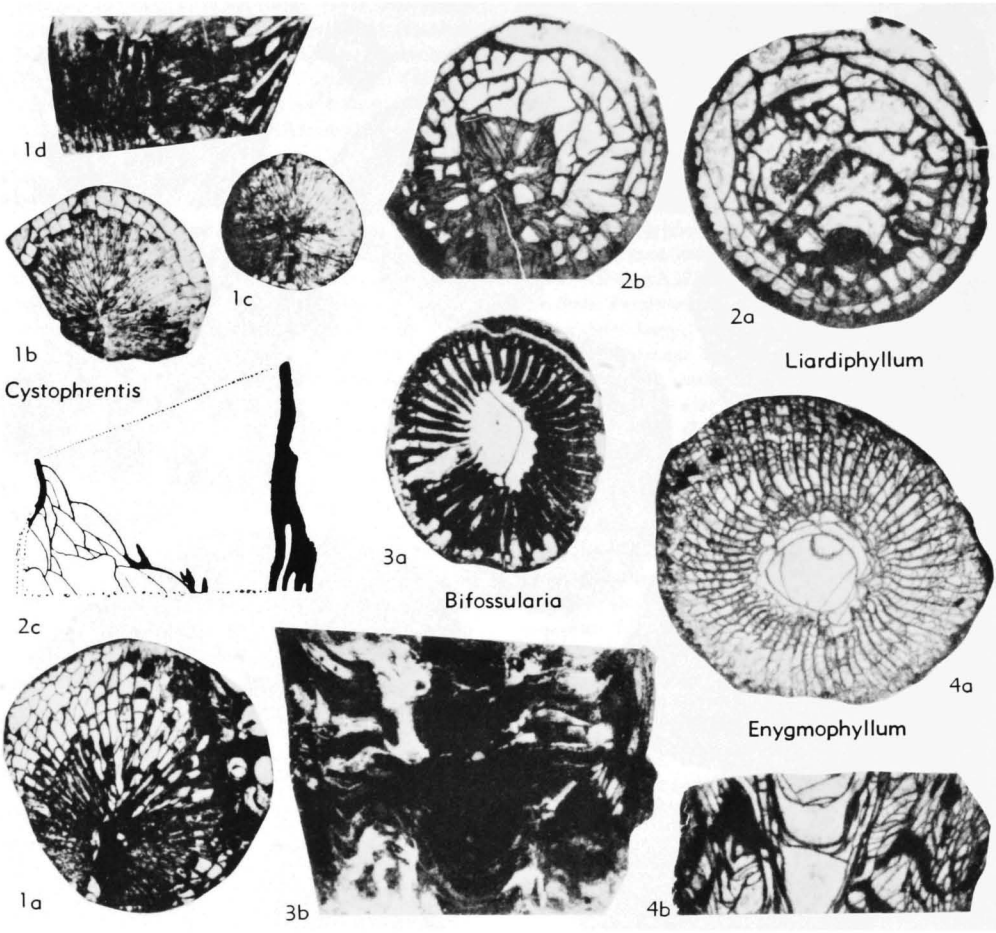


FIG. 230. Uraliniidae (p. *F350-F351*).

ments; tabular floors low domes declined into fossula, flattened or depressed in axial region in some; tabulae commonly incomplete. *L.Carb.*

Uralinia SHTUKENBERG, 1895, p. 103 [**Heliophyllum multiplex* LUDWIG, 1862, p. 199; SD LANG, SMITH, & THOMAS, 1940, p. 137; †not traced] [=*Pseudouralinia* YÜ, 1931, p. 21 (type, *P. tangpakouensis,* OD; †4390, IGP, Nanking; L. Carb., 1.5 mi. S. of Kolaoho Bridge, Tu-shan-hsien, Kweichow); *Neomicroplasma* ROGOZOV, 1960, p. 48 (type, *N. dobrolyubovae,* OD; †1, coll. 9136, TsGM, Leningrad; up.Tournais., Polar Urals)]. Solitary, cornute; dissepimentarium of lonsdaleoid dissepiments, commonly wider on counter side than on fossular side; septa represented in dissepimentarium by weak crests and at outer edges of tabularium by thick major septal segments, thinner in counter quadrants; cardinal and alar septa shorter than others, metasepta neighboring cardinal fossula curving but not meeting around inner edge of cardinal septum; tabular floors declined toward or into fossula commonly on convex side of corallum, tabulae incomplete. [In absence of modern published studies of holotype and of SHTUKENBERG's specimens, genus is interpreted on SOSHKINA, 1960, p. 301.] *L.Carb. (Tournais.),* Eu.(Moscow Basin-Urals-Timan-?N. Zemlya)-Asia(Kuzbas-NE.USSR-Viet Nam-Kweichow-Hunan-Armenia).——FIG. 229,*3a,b.* **U. multiplex* (LUDWIG), Tournais., Moscow Basin, Chernyshino; *a,b,* transv., long. secs., ×1.3 (Soshkina, 1960).

Bifossularia DOBROLYUBOVA in DOBROLYUBOVA & KABAKOVICH, 1966, p. 113 [**Caninia ussowi* GABUNIYA, 1919, p. 28; OD; †neotype 233, coll. 1560, PIN, Moscow; by DOBROLYUBOVA in DOBROLYUBOVA & KABAKOVICH, 1966, p. 121]. Solitary, with septa dilated in tabularium, dilatation de-

creasing first in counter quadrants; minor septa short; major septa long, not reaching axis, subequal except that cardinal and counter septa are shorter and lie in deep tabular fossulae; dissepimentarium narrow, septa thin within it, dissepiments small, normal concentric; tabulae complete or incomplete, floors domes with axial depression and upturned edges. *L.Carb.(Tournais.-Visean),* Asia(Kuzbas). ——Fig. 230,*3a,b*. **B. ussowi* (Gabuniya), neotype, Visean, Podyakov horizon, R. Tom; *a,b,* transv., long. secs., ×2 (Dobrolyubova & Kabakovich, 1966).

Cystophrentis Yü, 1931, p. 18 [**C. kolaohoensis*; OD; †4904, IGP, Nanking] [?=*Keyserlingophyllum* Shtukenberg, 1895, which see; *Cystiphrentis* Lang, Smith, & Thomas, 1940, p. 48, *nom. van.*]. Solitary, not large, in early stages septa dilated leaving few interspaces; in cardinal quadrants major septa short and pinnate about fossula with short cardinal septum, in counter quadrants major septa long; counter septum may be very long; minor septa vestigial, as traces on upper surfaces of dissepiments in marginarium that is wider in counter quadrants than in cardinal; lonsdaleoid dissepiments develop in later stages; septa thinning first in counter quadrants; tabulae incomplete, floors declined into fossula on convex side of corallum. [There is no confirmation of Yü's view (1963, p. 310) that septal insertion occurs in counter sextants; see Papoyan, 1974, p. 205.] *L.Carb.(Tournais.),* Asia(China-Japan-NE.USSR-Armenia)-?Eu.(Urals).——Fig. 230,*1a-d*. **C. kolaohoensis,* holotype, Tournais., lower part Kolaoho ls., Kweichow, Kolaoho, Tu-shan-hsien; *a-c,* transv., *d,* long. secs., ×2 (Yü, 1934).

Enygmophyllum Fomichev, 1931, p. 42 [**E. taidonense*; M; †? in coll. 2478, TsGM, Leningrad] [=*Aenigmatophyllum* Lang, Smith, & Thomas, 1940, p. 14, *nom. van.*]. Solitary, large; major septa withdrawn somewhat from axis leaving subcylindrical space in which axial parts of tabular floors are deeply concave; cardinal septum shorter; periaxial parts of tabular floors variably inclined; minor septa thin, somewhat discontinuous, dissepiments rather elongate, irregular. *L.Carb.,* Asia (Kuzbas)-?Eu.(N.Zemlya); *Miss.,* N.Am.(Mont.). ——Fig. 230,*4a,b*. **E. taidonense,* monotype, Tournais., Kuzbas; *a,b,* transv., long. secs., ×1 (Soshkina, Dobrolyubova, & Kabakovich, 1962).

Keyserlingophyllum Shtukenberg, 1895, p. 101 [**Cystiphyllum obliquum* Keyserling, 1846, p. 160; SD Lang, Smith, & Thomas, 1940, p. 72; †? in coll. 46, LGI, Leningrad] [=*Humboldtia* Shtukenberg, 1895, p. 115 (type, *H. rossica,* OD; †? in coll. 45, MGI, or coll. 305, TsGM, Leningrad; L.Carb., R. Usva, Perm); *?Cystophrentis* Yü, 1931, which see; *Humboltia* Cotton, 1973, p. 100, *nom. null.*]. Solitary, large; in late stages with lonsdaleoid dissepimentarium of small dissepiments bearing major and minor septal crests; major septa long and thickened in tabularium, grouped pinnately about short cardinal and long counter septa and less distinctly about alar fossulae, thinning first in counter quadrants; tabular floors deepening into fossula on convex side of corallum, tabellae large [see Dobrolyubova & Kabakovich, 1966, p. 86]. *L.Carb.(Tournais.),* Eu. (Urals-France)-Asia (Armenia); *L. Carb. (Visean),* Asia(Iran-Kuzbas)-?Eu.(France).——Fig. 229,*2a-c*. **K. obliquum* (Keyserling), Tournais., Chernyshino substage; *a,b,* R. Koshva, transv. secs., ×1.3; *c,* another specimen, R. Voya, left tributary of R. Pechora, long. sec., ×1.3 (*a,c,* Soshkina, 1960; *b,* Soshkina, Dobrolyubova, & Kabakovich, 1962).

Liardiphyllum Sutherland, 1954, p. 368 [**L. hagei*; OD; †10571, GSC, Ottawa]. Solitary, small to medium-sized, trochoid to cylindrical; septa discontinuous, developed as crests on upper surfaces of dissepiments and tabulae, thicker in cardinal than in counter quadrants; cardinal septum short, in fossula, counter septum long; minor septa very weak; tabulae complete or incomplete, gradational with lonsdaleoid plates of dissepimentarium, floors declined into fossula on convex side of corallum. *Mid.Miss.,* N.Am.(NW.Terr.); *L.Carb.,* ?Asia(Taymyr).——Fig. 230,*2a-c*. **L. hagei,* holotype, Can., Liard Range, NW. Terr.; *a,b,* transv., *c,* long. secs., ×2 (Sutherland, 1954).

Vesiculophyllum Easton, 1944b, p. 52 [**Chonophyllum sedaliense* White, 1880, p. 157; OD; † probably destroyed by fire, *fide* Easton, 1944b, p. 53; Ivanovskiy, 1976, p. 181, ?invalidly chose 3506 Geol. Survey Illinois as lectotype] [=*Faviphyllum?* Hall, 1852b, p. 407 (type, *F.? rugosum,* SD Sando, 1965b, p. E27; †144768, USNM, Washington, lectotype by Sando, 1965b, p. E28; Utah; Sando, 1965a, p. 55, successfully applied for suppression under plenary powers ZN(S)1662, see ICZN 1968-9, Op. 813); *Kakwiphyllum* Sutherland, 1954, p. 365 (type, *K. dux,* OD; †10569, GSC, Ottawa; Kakwa-Jarvis Lakes region, NE. B.C.)]. Large, solitary, cylindrical; with numerous septa that commonly reach axis but may be short; septal plan bilateral, palmate or radial; cardinal septum long or short, in more or less marked fossula; counter septum commonly short; septa dilated, in late stages dilatation confined to axial region; minor septa impersistent; dissepimentarium wide, an outer transeptal (lonsdaleoid) zone and an inner zone with anguloconcentric dissepiments; tabular floors deeply concave, tabulae incomplete [see Sando, 1960, p. 179]. *Miss.,* N.Am.(Ill.-Miss. - Iowa - Nev. - Cal. - Ariz. - Mont. - Mex. - Alberta-B.C.-NW.Terr.).——Fig. 229,*1a-e*. **V. sedaliense* (White), Chouteau Ls., Ill.; *a-d,* transv., *e,* long. secs., ×2.7 (Easton, 1944b).——Fig. 229, *1f-h*. *V. dux* (Sutherland); *f,* holotype, B.C., Kakwa-Jarvis Lakes area; transv. sec., ×0.7; *g,h,* another specimen, NW.Terr., Laird region; transv., long. secs., ×0.7 (Sutherland, 1954).

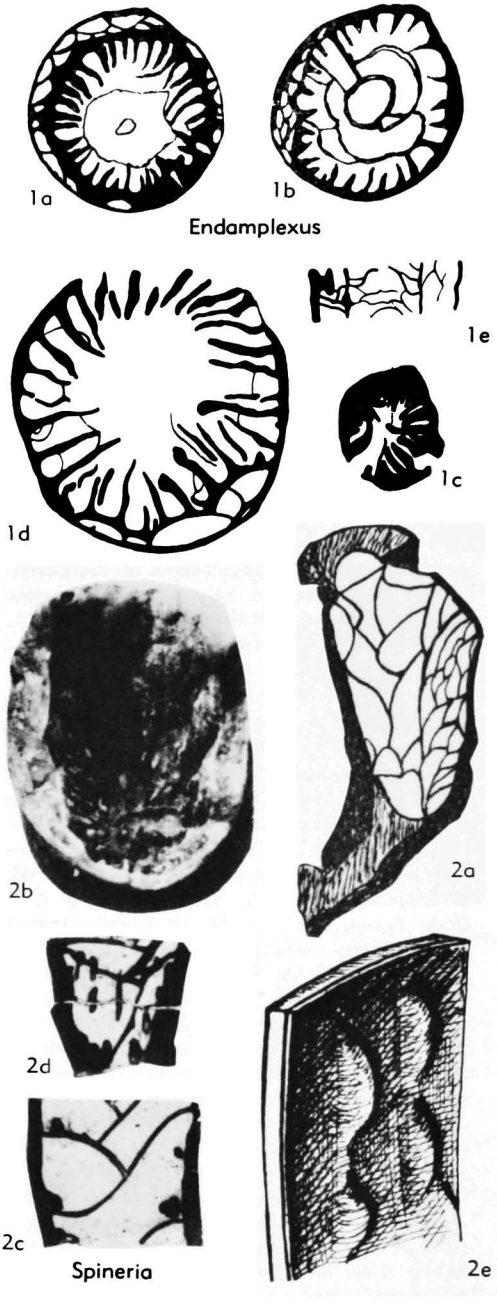


FIG. 231. Endamplexidae (p. *F352*).

Family ENDAMPLEXIDAE Schouppé & Stacul, 1959

[Endamplexidae SCHOUPPÉ & STACUL, 1959, p. 324] [=Endamplexinae, Spineriinae SCHOUPPÉ & STACUL, 1959, p. 324]

Solitary; septa short, unequal, somewhat thickened in tabularium, may be thinner in lonsdaleoid dissepimentarium of irregular width and completeness; septa continuous laminae or each of longitudinally discontinuous leaflike segments; tabulae incomplete, tabellae unequal. *Low.U.Perm.*

Endamplexus KOKER, 1924, p. 31 [**E. dentatus*; OD; †11783, TH, Delft; lectotype by SCHOUPPÉ & STACUL, 1959, p. 326] [=*Spaniophyllum* SCHOUPPÉ & STACUL, 1959, p. 328 (type, *Endamplexus (Spaniophyllum) makros,* OD; †Sé 270, GPI, Münster/Westfalen; low.U.Perm., Basleo beds, Basleo, Timor); *Endoamplexus* LANG, SMITH, & THOMAS, 1940, p. 56, *nom. van.*]. Solitary, conical to cylindrical; major septa short, thick, irregular, in places separated from wall by irregular lonsdaleoid dissepimentarium or by single lonsdaleoid dissepiments; neither protosepta nor fossula distinct; tabulae irregular. *Low.U.Perm.*, Asia (Timor). FIG. 231,*1a,b*. **E. dentatus,* holotype, Basleo; *a,b,* thin secs., ×2 (Koker, 1924).——FIG. 231, *1c-e*. *E. makros* (SCHOUPPÉ & STACUL), holotype, Basleo; *c,d,* transv., *e,* long. secs., ×2 (Schouppé & Stacul, 1959).

Spineria SCHOUPPÉ & STACUL, 1959, p. 331 [**Cystiphyllum diplochone* KOKER, 1924, p. 26; OD; †11775, TH, Delft; lectotype by SCHOUPPÉ & STACUL, 1959, p. 333] [=*Cystina* SCHOUPPÉ & STACUL, 1959, p. 334 (type, *Cystiphyllum ultimum* KOKER, 1924, p. 25, OD; †11776, TH, Delft, lectotype by SCHOUPPÉ & STACUL, 1959, p. 334; low.U.Perm., Basleo, Timor)]. Solitary, conical or cylindrical with major septa represented each by radial longitudinal series of discontinuous small leaflike segments developed on wall and on upper surfaces of dissepiments and tabulae; width of dissepimentarium irregular, of sparse or numerous lonsdaleoid dissepiments that are smaller than tabulae, which are large and somewhat irregularly disposed in wide axial region. *Low.U.Perm.*, Asia (Timor).——FIG. 231,*2a,b*. **S. diplochone* (KOKER), Basleo; *a,* lectotype, long. sec., ×1.0 (Koker, 1924); *b,* another specimen, calical view, ×1.5 (Schouppé & Stacul, 1959).——FIG. 231, *2c,d*. *S. ultima* (KOKER), Basleo; *c,d,* long. secs., ×2.0 (Schouppé & Stacul, 1959).——FIG. 231,*2e*. *Spineria* sp., diagram. view of two septa, ×2.0 (Schouppé & Stacul, 1959).

Suborder AULOPHYLLINA Hill, new suborder

[=Acrophyllina DOBROLYUBOVA in SOSHKINA, DOBROLYUBOVA, & KABAKOVICH, 1962, p. 327 *(partim), non* Acrophyllidae STUMM, 1949, p. 14, *nec* Acrophyllum THOMSON & NICHOLSON, 1876a, p. 455]

Predominantly solitary and large Stauriida; dissepimentarium wide, commonly normal concentric or angulate; septa long,

numerous, approaching radial arrangement, may retain thickening from early stages longest in cardinal quadrants of tabularium; commonly with axial structure that may be a platelike columella, or a complex of septal lamellae or septa and tabellae that may include axial or median plate, or a sharply bounded axial column; fossula may indent dissepimentarium; tabular floors declined abaxially; in some with axial structure weakly developed to absent, septa shortened, tabular floors depressed axially, or becoming flat or even sagging. *?U.Dev.-L.Perm.*

Family AULOPHYLLIDAE Dybowski, 1873

[Aulophyllidae Dybowski, 1873c, p. 332; Aulophyllicae Ivanovskiy, 1973a, p. 78] [=Diplocyathophyllidae Thomson, 1882, p. 477, *nom. inval.*; Clisiophyllidae Nicholson in Nicholson & Lydekker, 1889, p. 291; Amygdalophyllidae Grabau in Chi, 1935, p. 23; Dibunophyllinae Wang, 1950, p. 211; Koninckophyllinae Wang, 1950, p. 221; ?Kumpanophyllidae Fomichev, 1953a, p. 256; Neokoninckophyllidae Fomichev, 1953a, p. 351; ?Kupanophyllidae Thomas, 1961, p. 51, *nom. null.*; Rozkowskiidae Fedorowski, 1970, p. 604; Kolymophyllidae Onoprienko, 1974, p. 412]

Solitary or fasciculate; with axial structure either a platelike columella, a vaguely bounded complex with medial plate, septal lamellae, and axial tabellae, or a sharply bounded axial column; major septa long, continuous or not with septal lamellae; minor septa may be discontinuous; tabular floors declined abaxially, commonly of tabellae in axial and periaxial series; fossula commonly with shortened cardinal septum and indenting dissepimentarium that is commonly wide and of concentric or anguloconcentric plates; in early stages cardinal and counter septa conjoined. *L.Carb.-L. Perm.*

The fasciculate and massive corals of the family Lithostrotionidae d'Orbigny, 1852, Lithostrotionina, appear closely related to those of the family Aulophyllidae.

Subfamily AULOPHYLLINAE Dybowski, 1873

[*nom. transl.* Hill, 1956b, p. F286, *ex* Aulophyllidae Dybowski, 1873c, p. 332]

Solitary; axial structure a sharply bounded column of fine axial tabellae and commonly without medial plate but with numerous septal lamellae; periaxial tabellae coarse and slightly declined abaxially; fossula with short cardinal septum and indenting moderately wide dissepimentarium with continuous minor septa and fine concentric dissepiments. *L.Miss.-U.Penn.*

Aulophyllum Milne-Edwards & Haime, 1850, p. lxx [**Clisiophyllum prolapsum* McCoy, 1849, p. 3; OD; syntypes A1817-9, 2368-9, SM, Cambridge; L.Carb., Derbyshire; =*Turbinolia fungites* Fleming, 1828, p. 510, †C4366, HM, Glasgow, lectotype by Smith & Lang, 1930, p. 187, L.Carb., E. Kilbride, Scot.] [=*Cyclophyllum* Duncan & Thomson, 1867b, p. 328, *nom. subst. pro Cyclocyathus* Duncan & Thomson, 1867a, p. 1 (type, *Aulophyllum bowerbanki* Milne-Edwards & Haime, 1851, p. 414, SD Gregory, 1917, p. 222; †not found in BM(NH), London, nor in MN, Paris; L.Carb., Ire.), *non Cyclocyathus* Milne-Edwards & Haime, 1850, p. liv, a scleractinian; *?Permia* Shtukenberg, 1895, p. 26 (type, *P. iwanowi,* M; †in University, Kazan, see Fedorowski, 1971, p. 24; L.Carb., Gubakhi, Urals, USSR); *?Setamainella* Minato, 1943, p. 229 (type, *S. hayasakai,* M; †R15451, UH, Sapporo; L.Carb., NE. Honshu, Japan; material imperfect); *?Berkhia* Gorskiy, 1951, which see; *?Staurophyllum* Gorskiy, 1951, which see]. Solitary, moderately large; with numerous septa, a regular dissepimentarium with small, normal concentric dissepiments; with axial structure a well-defined and medianly depressed column, cuspidate toward fossula in transverse sections and built up of closely packed lamellae and tabellae without median plate, tabellar floors being close and domes with median depression; major septa may be dilated in tabularium, commonly in cardinal quadrants only; cardinal septum short after early stages, in fossula on convex side of corallum; tabellae between column and marginarium large, widely separated, subhorizontally based or slightly declined outward [see Smith, 1913, p. 58]. *L.Carb.-U.Carb.(Visean-Namur.),* Eu.(Brit.I.-Belg.-France-Ger.-Pol.-USSR)-N.Afr.(Alg.)-Asia(Turkey-?Japan).——Fig. 232, *3a,b.* **A. fungites* (Fleming), Pendleian, Namur., Great Ls., Eng., Weardale, Durham; *a,b,* transv., long. secs., ×1.4 (Smith, 1913).

Auloclisia Lewis, 1927b, p. 30 [**A. mutata*; OD; †R25866, BM(NH), London]. Solitary, large; with numerous septa and regular dissepimentarium with small, normal concentric dissepiments; with axial structure a moderately well-defined column that is dibunophylloid in early stages, but loses median plate while retaining domed tabellar floors without median depression in late stages; major septa may be dilated in tabularium, more commonly in cardinal quadrants only; cardinal septum short after early stages, in open fossula; tabellae between column and marginarium large, slightly declined abaxially. *L.Carb.(Visean),* Eu.(Brit.I.-Urals-?N.Zemlya)-N.Afr.(Alg.)-?Asia(China).——Fig. 232,*6a-d.* **A. mutata,* holotype, D_1, Isle of Man, Scarlet Point; *a,b,* transv. secs., ×2.8, ×1.4; *c,d,* long. secs., ×2.8, ×1.4 (Lewis, 1927b).

Berkhia Gorskiy, 1951, p. 77 [**B. elegans*; OD; †? in coll. 6091, TsGM, Leningrad] [?=*Aulophyllum* Milne-Edwards & Haime, 1850, which

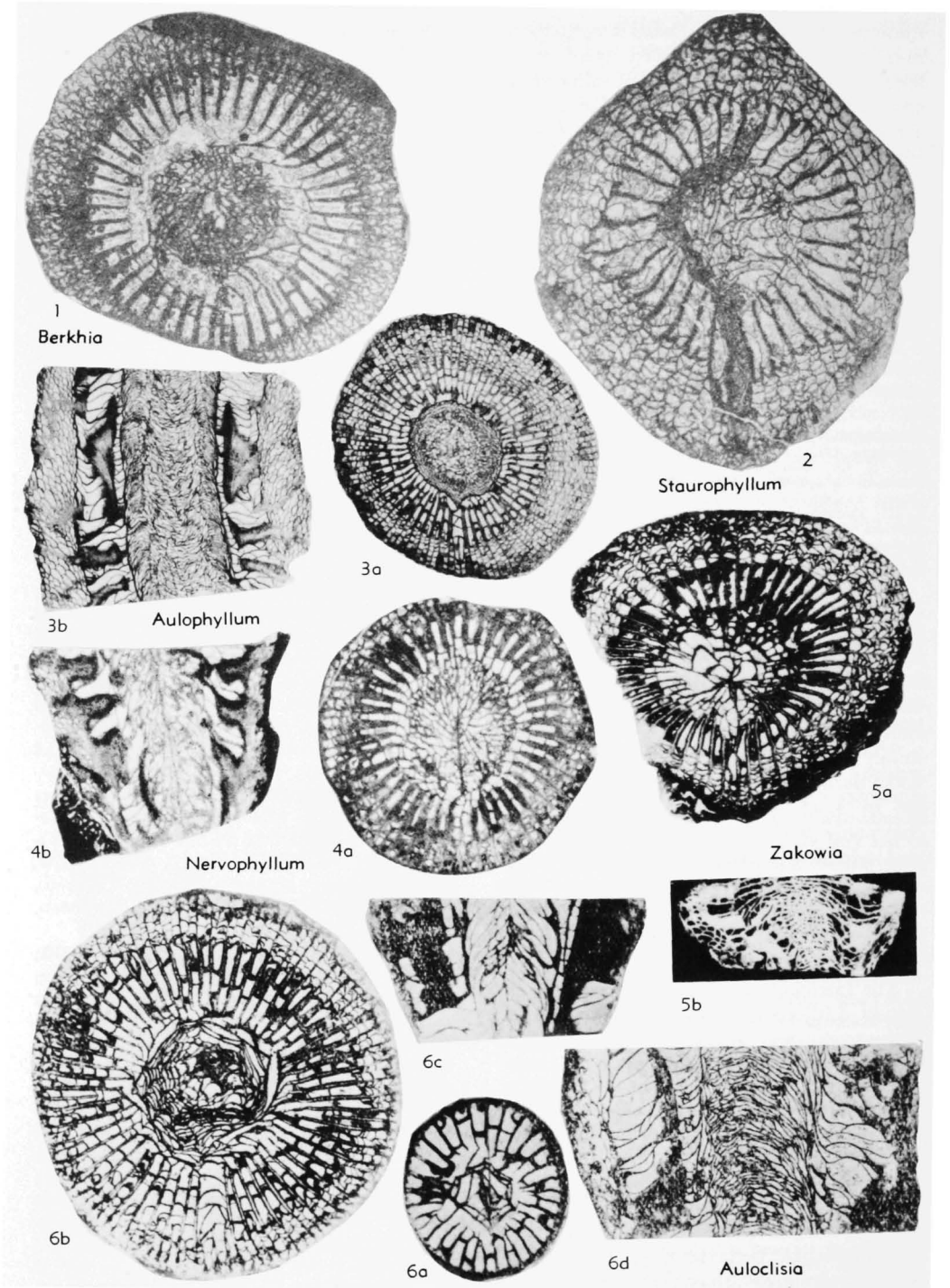


FIG. 232. Aulophyllidae (p. *F*353-*F*355).

see]. Solitary; with axial structure of thin septal lamellae and axial tabellae, without median plate; minor septa complete, thin, in moderately wide dissepimentarium with dissepiments angulate in transverse section in late stages, concentric in early stages; periaxial tabellae widely separated, declined abaxially. [See FEDOROWSKI, 1971, p. 30. Longitudinal section required to show presence or absence of tabellar boundary to axial structure and of median depression in structure.] *?Carb. (Barentsov Ser.)*, Eu.(N.Zemlya).——FIG. 232,*1*. **B. elegans*, holotype, Novaya Zemlya; transv. sec., ×1.9 (Gorskiy, 1951).

Nervophyllum VASILYUK, 1959, p. 88 [**N. beschevense*; OD; †25, coll. 1405, IG, Kiev]. Solitary, with axial column consisting of median plate thickened in cardinal half and center from which somewhat irregularly radiate, thin septal lamellae including some related to minor septa, and numerous small tabellae declined abaxially; periaxial tabellae somewhat less steeply declined and more widely separated; major septa thick in outer tabularium and mostly continuous with their corresponding septal lamellae; minor septa thinner, discontinuous in places; cardinal septum thinner, in small, open fossula that indents dissepimentarium slightly; dissepiments fine, mostly normal, concentric. *U.Carb.(low.Namur.)*, Eu.(Donbas-?Pol.).——FIG. 232,*4a,b*. **N. beschevense*, holotype, limestone D_3, R. Kalmius; *a,b*, transv., long. secs., ×1.9 (Vasilyuk, 1960).

Staurophyllum GORSKIY, 1951, p. 79 [**S. thomsoni*; OD; †? in coll. 6091, TsGM, Leningrad] [*?=Aulophyllum* MILNE-EDWARDS & HAIME, 1850, which see]. Solitary; with axial structure of thin, somewhat irregular septal lamellae directed toward axis, without medial plate, but with more or less crowded axial tabellae; major septa may be connected to septal lamellae, and are somewhat thickened in periaxial tabularium, where periaxial tabellae are declined abaxially and ?farther apart; cardinal ?(and alar) fossulae indent dissepimentarium in which minor septa are complete and dissepiments are irregularly concentric. [Not well known; longitudinal section required.] *L.Carb.-U.Carb.(up.Visean-low.Namur.)*, Eu.(N.Zemlya).——FIG. 232,*2*. **S. thomsoni*, holotype, I. Berkha; transv. sec., ×1.9 (Gorskiy, 1951).

?Zakowia FEDOROWSKI, 1971, p. 30 [**Z. sanctaecrucensis*; OD; †OS70/366, IG, Kielce]. Solitary; with axial structure formed by thin septal lamellae of which several join at axis, and few axial tabellae, without sharp boundary; major septa thickened in tabularium, especially in cardinal quadrants, and some continuous with lamellae of axial structure; cardinal septum short, in open, parallel-sided fossula that indents dissepimentarium, may be connected by long, thin lamella to axial structure that reaches axis; minor septa may be discontinuous in inner parts of anguloconcentric dissepimentarium. *L.Carb.(up.Visean)*, Eu.(Pol.).——FIG. 232,*5a,b*. **Z. sanctaecrucensis*, Holy Cross Mts.; *a*, holotype, transv. sec., ×1.9; *b*, paratype, long. sec., ×1.9 (Fedorowski, 1971).

Subfamily AMYGDALOPHYLLINAE Grabau, 1935

[*nom. transl.* HILL, 1956b, p. F290, *ex* Amygdalophyllidae GRABAU in CHI, 1935, p. 23] [*?=Kumpanophyllidae FOMICHEV, 1953a, p. 256; Kupanophyllidae THOMAS, 1961, p. 51, *nom. inval.*, based on *nom. null.*; Rozkowskiidae FEDOROWSKI, 1970, p. 604]

Solitary, axial structure a biscuspidate columella composed of median plate and fused septal lamellae or of median plate and fused thickened axial tabellae; tabular floors tent-shaped, of wide tabellae; cardinal septum short in fossula that indents dissepimentarium with continuous or discontinuous minor septa; septal structural modifications not uncommon. *L.Carb.-U.Carb.*

Amygdalophyllum DUN & BENSON, 1920, p. 339 [**A. etheridgei*; M; †F1311, AM, Sydney and R22072 BM(NH), London] [*?=Arachnolasmella* BYKOVA, 1966, which see; *?Rozkowskia* FEDOROWSKI, 1970, which see]. Solitary, large, with large dense columella composed of median plate and very numerous contiguous septal lamellae; columella may be cuspidate toward fossula, which is narrow but may expand slightly near cusp; septa numerous, long, somewhat dilated, major septa commonly extending to columella; dissepimentarium wide, of small, normal concentric plates; tabular floors cones with upturned edges, of tabellae [see also FEDOROWSKI, 1970, p. 566, and SEMENOFF-TIAN-CHANSKY, 1974, p. 148]. *L. Carb.*, Australia (New S. Wales-Queensl.)-Eu. (?Brit. I.-Pol.-Urals)-N. Afr. (Alg.)-Asia (Malaya-Sinkiang-NE.USSR-?Japan); *U.Carb.*, Eu.(Spain)-Asia (Yunnan-Kwangsi).——FIG. 233,*2a,b*. **A. etheridgei*, L.Carb., New S. Wales, Babbinboon; *a,b*, transv., long. secs., ×2.0 (Benson & Smith, 1923).

Arachnolasmella BYKOVA, 1966, p. 120 [**Arachnolasma (Arachnolasmella) interruptocolumellatum*; OD; †5140/4[9], IG, Alma-Ata] [*?=Amygdalophyllum* DUN & BENSON, 1920, which see]. Solitary; with variably developed amygdalophylloid columella; tabulae declined tentwise from columella, may carry crestal septal lamellae to columella from axial edges of few to many of major septa, which are commonly somewhat withdrawn from columellar region; minor septa discontinuous in inner, wider part of anguloconcentric dissepimentarium; cardinal septum short, in shallow fossula [see FEDOROWSKI, 1970, p. 566; SAYUTINA, 1973, p. 98]. *L.Carb.-U.Carb.(Visean-Namur.)*, Asia(Kazakh.)-Eu.(Urals).——FIG. 234,*4a,b*. **A. interruptocolumellatum*, holotype, Namur., Dalashikskian suite, E. Kazakh., Ketmenskiy Ra.; *a,b*, transv., long. secs., ×2.5, ×2.0 (Bykova, 1966).

Carruthersella GARWOOD, 1913, p. 555 [**C. com-*

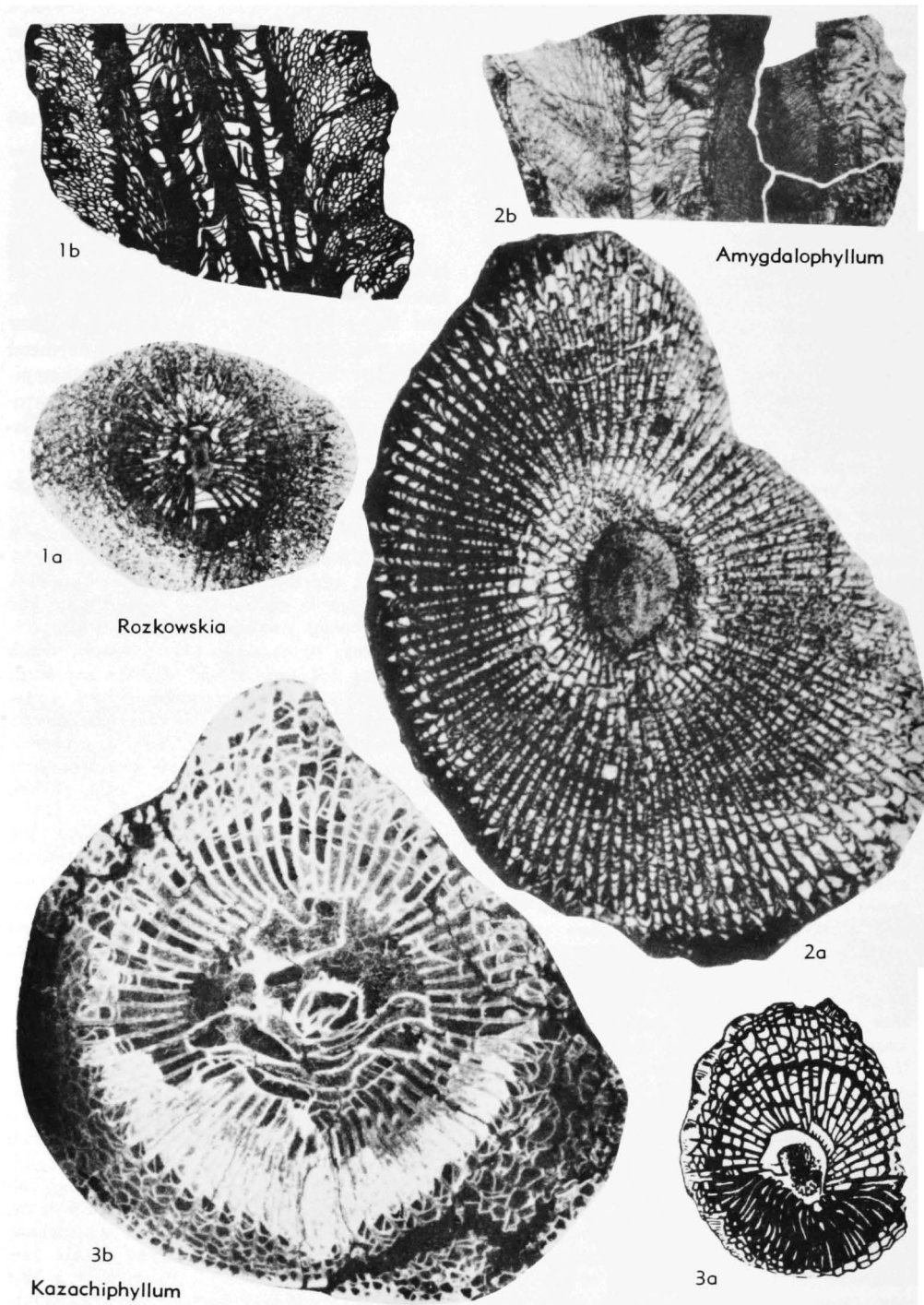


FIG. 233. Aulophyllidae (p. *F*355-*F*358).

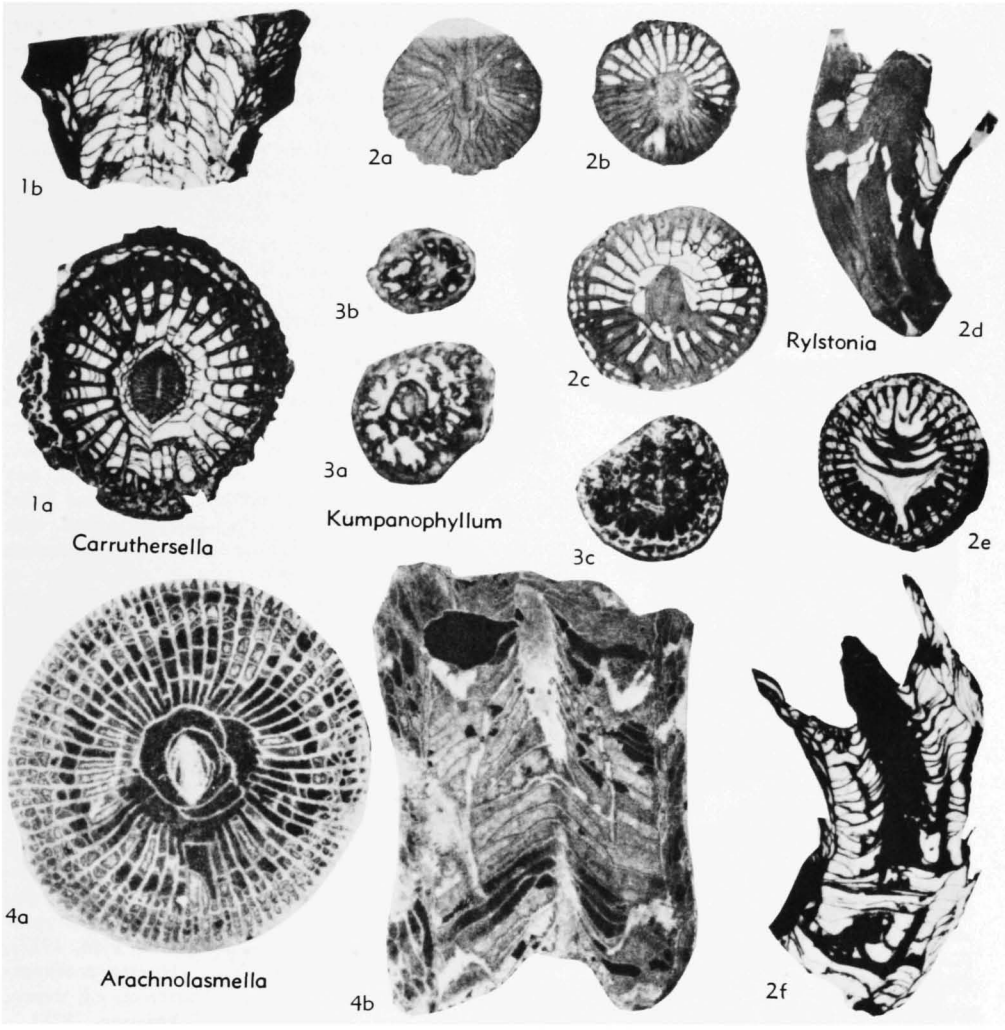


FIG. 234. Aulophyllidae (p. *F355-F358*).

pacta; M; †63904 and PF2545-8, IGS, Leeds and R22228-9, BM(NH), London, *fide* MITCHELL & WHITE, 1966, p. 25]. Solitary, small; columella of tightly packed septal lamellae abutting on median plate and some continuous with major septa; septa dilated; dissepimentarium narrow, with lonsdaleoid plates peripherally; tabellae in pericolumnar zone declined abaxially [see also FEDOROWSKI, 1970, p. 563]. *L.Carb.(low.Visean)*, Eu.(Eng.-Pol.)-?N.Afr.(Alg.).——FIG. 234,*1a,b*. **C. compacta*, holotype, Westmoreland, Meathop, Arnside; *a,b*, transv., long. secs., ×3.0 (Garwood, 1913).

?Echigophyllum YABE & HAYASAKA in HAYASAKA, 1924, p. 20 [**E. giganteum*; M; †not traced]. Solitary, cylindrical; with axial structure not solid, composed of numerous, thin and encircling axial tabellae and few or no septal lamellae, and more or less distinct median plate; septa numerous, long, minor complete, ?tertiary septa may occur; septa with numerous lateral ?(or acutely angulate) dissepiments in broad marginarium; periaxial tabellae small, arched. [YAMAGIWA, 1961, p. 104, compares it with *Nagatophyllum* OZAWA, 1925, Dibunophyllinae.] *L.Carb.* or *low.* or *mid.U.Carb.*, Asia(Japan, Atetsu-Omi).

Kazachiphyllum BYKOVA, 1966, p. 74 [**K. densicolumellatum*; OD; †1703-10, depository not traced]. Solitary, moderately large; major septa thickened in cardinal quadrants only or more strongly than in counter quadrants; cardinal septum short in distinct open fossula that indents dissepimentarium; minor septa withdrawn to peripheral parts of anguloconcentric dissepimentarium; in early stage columella present, consisting of fused axial

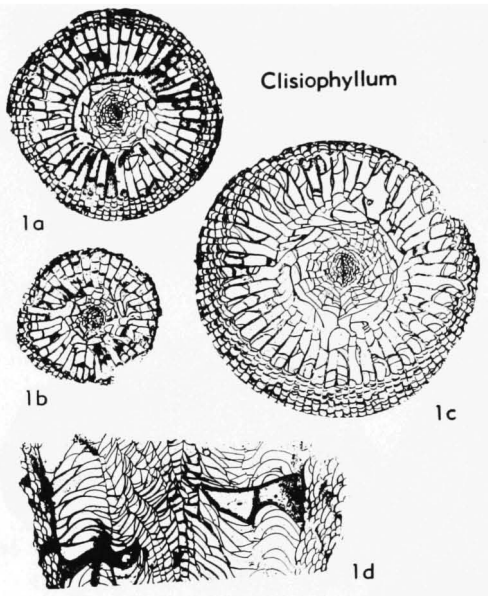


FIG. 235. Aulophyllidae (p. F358-F360).

ends of major septal lamellae ?(and medial plate), in later stages plates of columella thin and columella becoming stellate in transverse section and loculate to acrophylloid, and in latest stages may disappear. [Illustration of longitudinal section required; see also SAYUTINA, 1970, p. 136; 1973, p. 100.] *L.Carb.-U.Carb.(Visean-Namur.)*, Asia (Kazakh.)-Eu.(N.Urals).——FIG. 233,*3a,b*. **K. densicolumellatum*, Visean-Namur.; *a*, holotype, S. Kazakh., Betpak-Dala, Lake Dzamantuz, early stage, transv. sec., ×?1.5; *b*, another specimen, Kazakh., Ketmenskiy Ra., late stage, ×2.0 (Bykova, 1966).

?**Kumpanophyllum** FOMICHEV, 1953a, p. 257 [**K. kokinense*; OD; †199, coll. 5030, TsGM, Leningrad] [=*Kupanophyllum* THOMAS, 1961, p. 52, *nom. null.*]. Small, solitary; in early stages major septa thin, long, counter septum connected with thick, dense columella; in later stages septa short, columella free, with traces of median plate and radial septal lamellae, with a narrow, normal dissepimentarium and short minor septa; tabulae elevated toward columella; fossula indistinct. [Insufficiently known.] *U.Carb.(Bashkir.)*, Eu.(Donbas).——FIG. 234,*3a-c*. **K. kokinense*, ls. H_2, right bank of Mechetna ravine, at upper end of Andriapol; *a*, holotype, *b,c*, paratypes, transv. secs., ×5.0 (Soshkina, Dobrolyubova, & Kabakovich, 1962).

Rozkowskia FEDOROWSKI, 1970, p. 605 [**R. compacta*; OD; †OS-70/106, IG, Kielce] [?=*Amygdalophyllum* DUN & BENSON, 1920, which see]. Solitary, with columella consisting of thin median lamella thickened by more or less contiguous axial tabellae in which septal lamellae are not distinct; major septa withdrawn from axis and thickened in tabularium; peripheral ends of septa wide and may be discretely multitrabecular; vesicular modifications of septa may be present; minor septa continuous or discontinuous; tabulae tent-shaped, incomplete, with upturned edges; fossula distinct; dissepiments concentric with supplementary lateral plates in some; early growth stages clisiophylloid. *L.Carb.(up.Visean)*, Eu.(Pol.)-Australia(Queensl.). ——FIG. 233,*1a,b*. **R. compacta*, holotype, Pol., Galezice, Holy Cross Mts.; *a,b*, transv., long. secs., ×2.0, ×1.8 (Fedorowski, 1970).

?**Rylstonia** HUDSON & PLATT, 1927, p. 39 [**R. benecompacta*; OD; †R25563, BM(NH), London] [=*Hettonia* HUDSON & ANDERSON, 1928, p. 335 (type, *H. fallax*, OD; †R26072, BM(NH), London; Visean, Hetton Beck Ls., near Rylstone, Yorkshire; columella a thickened axial plate, may show traces of longitudinally discontinuous radial lamellae]. Solitary, curved conicocylindrical, with columellalike axial structure of dilated median plate and radial septal lamellae and tabellae; in early stages median plate continuous with counter septum and all septa dilated, dilatation decreasing first in counter quadrants; cardinal and commonly also neighboring pair of major septa shorter, in fossula on convex side of corallum; in late stages marginarium with large, concentric or in part angulate dissepiments, minor septa degenerate; tabulae declined from columella to marginarium; diphymorphic growth phases may occur in which columella disappears and tabulae flatten. *L.Carb.(Visean)*, Eu.(Brit.I.-?Donbas).——FIG. 234,*2a-d*. **R. benecompacta*, Visean, Skelterton Ls., Yorkshire, Clints Quarry near Rylstone; *a*, transv. sec., ×2.0, *b,c*, transv. secs., ×1.5, *d*, another specimen, long. sec., ×1.5 (Hudson & Platt, 1927). ——FIG. 234,*2e,f*. *R. fallax* (HUDSON & ANDERSON), paratypes, Mill Gate Plantation; *e,f*, transv., long. secs., ×1.0 (Hudson & Anderson, 1928).

Subfamily CLISIOPHYLLINAE Nicholson, 1889

[*nom. transl.* WANG, 1950, p. 220, *ex* Clisiophyllidae NICHOLSON in NICHOLSON & LYDEKKER, 1889, p. 291] [=Clisaxophyllidae GRABAU in Yü, 1934, p. 102, *nom. inval.*, based on junior homonym; Kolymophyllidae ONOPRYIENKO, 1974, p. 412]

Solitary; with axial structure of medial plate and numerous, commonly convolute septal lamellae and close, steeply declined axial tabellae interfingering with more distant and less steeply declined periaxial tabellae so that structure is not sharply bounded; cardinal septum shortens in fossula that indents moderately wide dissepimentarium, with continuous minor septa and fine, concentric dissepiments. *L.Carb.-U.Carb.(L.Miss.-L.Penn.)*.

Clisiophyllum DANA, 1846a, p. 187 [**Clisiophyllum*

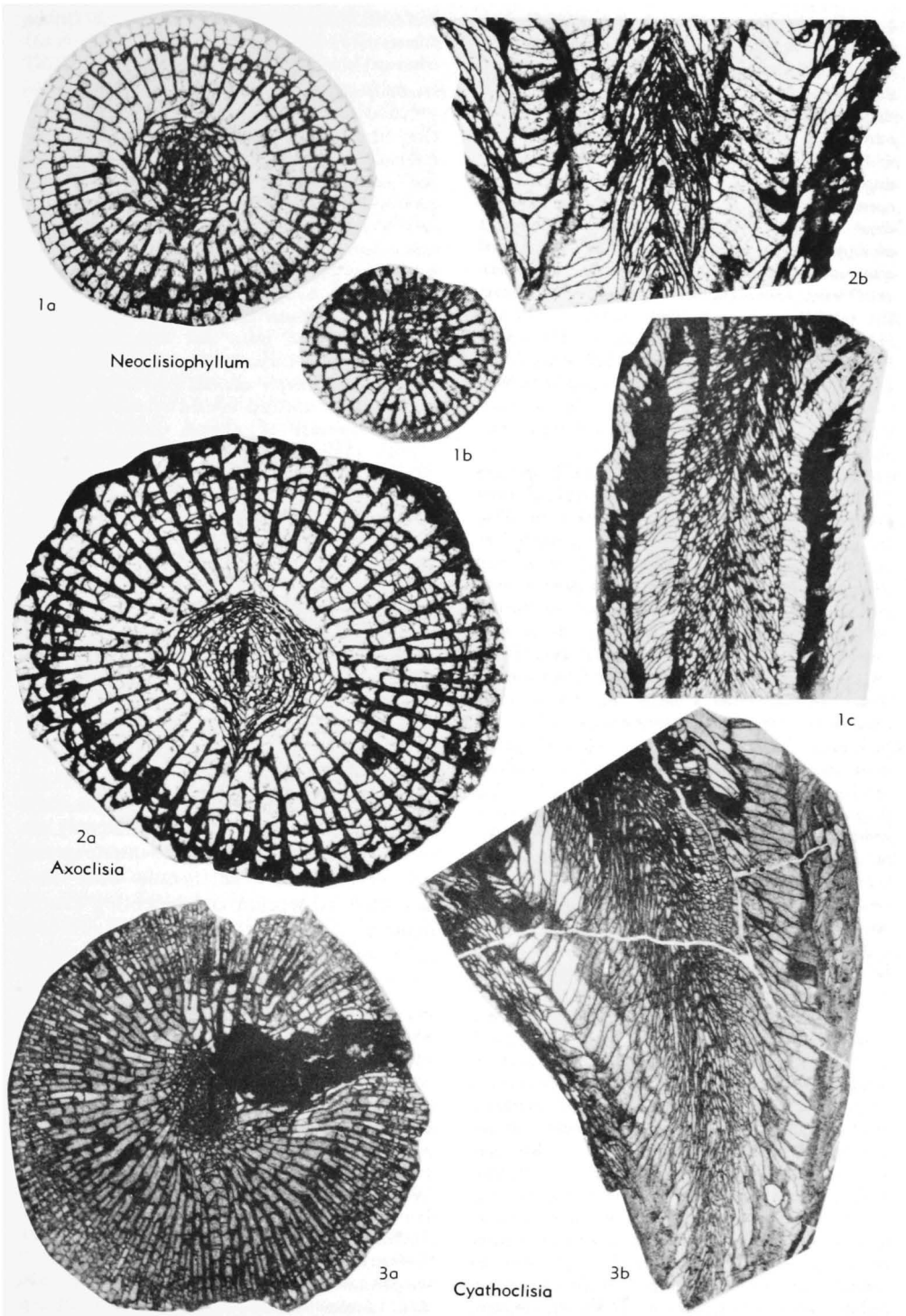


FIG. 236. Aulophyllidae (p. *F360*).

keyserlingi McCoy, 1849, p. 2; SM; †A2353, SM, Cambridge]. Solitary; with numerous septa, normal minor septa in regular dissepimentarium with small concentric dissepiments; with wide axial structure with thin septal lamellae about half as numerous as major septa, typically continuous with major septa and commonly convolute, abutting on short, thickened, medial plate; fossula open, parallel-sided, bounding septa radial; cardinal septum short in late stages; tabularial parts of septa may be thickened, especially in cardinal quadrants; tabular floors conical, tabellae in periaxial series fewer and less steeply inclined than, but interfingering with, those of axial structure [Hill, 1938-1941, p. 58]. *L.Carb.*, Eu.(Brit.I.-France-Belg.-Ger.-Pol.-USSR)-N. Afr. (Alg.)-Asia (Turkey-?Kazakh.-Kirghiz.-China-Japan)-?N. Am. ——Fig. 235,*1a-d*. **C. keyserlingi* McCoy, holotype, Eng., Derbyshire; *a-c*, transv., *d*, long. secs., all ×1.5 (Hill, 1938-1941).

Axoclisia Semenoff-Tian-Chansky, 1974, p. 233 [**A. cuspiforma*; OD; †11, sample 667, Pareyn Coll., MN, Paris] [*?=Neoclisiophyllum* Wu, 1963, which see]. Solitary; like *Neoclisiophyllum* but minor septa discontinuous and crestal on oblique dissepiments; axial column cuspidate with median plate thickened axially and continuous with cardinal septum and in early stages with counter septum also. *L.Carb.(low.Visean)*, N.Afr. (Alg.).——Fig. 236,*2a,b*. **A. cuspiforma*, monotype, Tafilalt, Djebel Begaa; *a,b*, transv., long. secs., ×2.7 (Semenoff-Tian-Chansky, 1974).

Cyathoclisia Dingwall, 1926, p. 13 [**C. tabernaculum*; OD; †R16756, BM(NH), London] [=*Clisaxophyllum* Grabau in Chi, 1931, p. 23 (type, *Cyathophyllum coniseptum* Keyserling, 1846, p. 164, OD; †neotype 304, coll. 2705, PIN, Moscow, by Sayutina, 1973, p. 68; Tournais., R. Bolshoy Soplyas, Pechoraland, USSR), *non Clisaxophyllum* Grabau in Yü, 1934, p. 103, invalid junior homonym; *Clisiaxophyllum* Lang, Smith, & Thomas, 1940, p. 38, *nom. van.; ?Kolymophyllum* Onopryienko, 1974, p. 412 (type, *K. columen*, OD; †2/447, SVTGUp, Magadan; up. Tournais., Omolonsk massif, NE. USSR]. Solitary, moderately large; with axial structure not defined by bounding wall, but projecting from calice as conical structure formed of short, nuclear medial plate, of very crowded, flattened, steeply declined tabellae, and of numerous septal lamellae that are continuous with major septa and somewhat convolute; fossula long, expanding into tabularium, with short or thin cardinal septum; septa may be dilated in tabularium, more markedly in cardinal quadrants; minor septa with long axial parts extending into tabularium and lying closer to counter side of major septa; dissepimentarium rather narrow with normal concentric dissepiments. *L.Carb.(up.Tournais.-Visean)*, Eu.(Brit.I.-Belg.-Donbas-Tatar. ASSR-Urals-?N. Zemlya)-Asia (Kuzbas-Armenia).——Fig. 236,*3a,b*. **C. tabernaculum*, horizon Y, Brit. I., Burrington Combe, Somerset; *a*, holotype, transv. sec., ×1.8; *b*, another specimen, long. sec., ×3.6 (Dingwall, 1926).

Neoclisiophyllum Wu in Yü *et al.*, 1963, p. 92 [**Clisiophyllum yengtzeense* Yoh, 1929a, p. 2; OD; †not traced] [*?=Axoclisia* Semenoff-Tian-Chansky, 1974, which see]. Solitary; septa numerous, thin in dissepimentarium, dilated in outer part of tabularium and thinning adaxially; axial ends of many curve and pass into axial structure; minor septa thin; cardinal fossula parallel-sided to subkeyhole-shaped in transverse section; axial structure sharply bounded in some, "nucleate" by numerous fine septal lamellae abutting on slightly thickened medial plate that commonly attains about one-third diameter of axial structure, and by numerous, steeply conical, axial tabellae; outer tabellae long, declined toward commonly narrow dissepimentarium of normal, small, concentric plates. *L. Carb.-U. Carb.(Visean-Namur.)*, Asia (Kazakh.-China)-Eu.(Urals-Donbas-Brit.I.-?Spain). ——Fig. 236,*1a-c*. **N. yengtzeense* (Yoh), syntypes, Visean, Kwangsi, near Liucheng; *a,b*, transv., *c*, long. secs., ×2.7, ×2.7, ×1.8 (Yoh, 1929a).

Subfamily DIBUNOPHYLLINAE Wang, 1950

[Dibunophyllinae Wang, 1950, p. 211] [=Koninckophyllinae Wang, 1950, p. 221; Neokoninckophyllidae Fomichev, 1953a, p. 351]

Solitary or fasciculate; with axial structure a median plate commonly thickened in axial part, becoming discontinuous first with cardinal then with counter septum, and septal lamellae few to absent; in some, axial tabellae closer and more steeply declined abaxially than, but interfingering with periaxial tabellae; fossula with shortened cardinal septum and indenting dissepimentarium, with more or less discontinuous minor septa; septal structural modifications not uncommon. *L.Carb.-L.Perm.*

Dibunophyllum Thomson & Nicholson, 1876a, p. 457 [**D. Muirheadi*; SD Gregory, 1917, p. 222; †T1032, KM, Glasgow, lectotype by Hill, 1938-1941, p. 72; =*Clisiophyllum bipartitum* McCoy, 1849, p. 2, †A1971, SM, Cambridge, lectotype by Hill, 1938, p. 67, Derbyshire] [=*Clisiophylloides* Dybowski, 1873c, p. 340 (type, *Clisiophyllum turbinatum* McCoy, 1851a, p. 169, SD Weyer, 1971a, p. 16; †A2393, SM, Cambridge, lectotype by Smith, 1916, p. 266; Derbyshire; =*Clisiophyllum bipartitum* McCoy, 1849, p. 2); *Rodophyllum* Thomson, 1874, p. 556 (type, *R. craigianum*, SD Gregory, 1917, p. 222; †T1020, KM, Glasgow, lectotype by Hill, 1938-1941, p. 78; Trearn Quarry, Ayrshire); *Rhodophyllum* Thomson, 1875, p. 273, *nom. van.; Aspidiophyllum* Thomson, 1875, p. 273 (type, *A. koninckii-*

anum, SD GREGORY, 1917, p. 222; †T1026, KM, Glasgow, lectotype by HILL, 1938-1941, p. 75; Thirdpart Quarry near Beith, Ayrshire); *Kurnatiophyllum* THOMSON, 1875, p. 273, misspelling for *Kumatiophyllum* THOMSON, 1876; *Aspidophyllum* THOMSON & NICHOLSON, 1876a, p. 68, *nom. null.; Kumatiophyllum* THOMSON, 1876, p. 166, 1877, p. 250 (type, *K. concentricum,* SD GREGORY, 1917, p. 223; †T1038, KM, Glasgow, lectotype by HILL, 1938-1941, p. 76; Langside, near Beith, Ayrshire); *Cymatiophyllum* THOMSON, 1878, p. 166, *nom. van.; Albertia* THOMSON, 1878, p. 165 (type, *A. victoria-regia,* SD GREGORY, 1917, p. 223; †T1043, KM, Glasgow, lectotype by HILL, 1938, p. 76; Langside, near Beith, Ayrshire), *non Albertia* DUJARDIN, 1838, a rotifer; *Histiophyllum* THOMSON, 1879, p. 323 (type, *H. ramsayi,* SD GREGORY, 1917, p. 223; †T448, KM, Glasgow, lectotype by HILL, 1938-1941, p. 77; Brockley, Lanarkshire; *Centrephyllum* THOMSON, 1880, p. 227 (type, *C. subcentricum,* SD GREGORY, 1917, p. 223; †T1060, KM, Glasgow, lectotype by HILL, 1938-1941, p. 77; Thirdpart Quarry near Beith, Ayrshire); *Centrophyllum* THOMSON, 1883, p. 467, *nom. van.; Cymateophyllum* THOMSON, 1883, p. 471, *nom. null.; Centrolamellum* THOMSON, 1901, p. 484, invalid *nom. subst. pro Centrephyllum* THOMSON, 1880; *?Protodibunophyllum* LISITSYN, 1925, p. 68 (type, *P. simplex,* SD LANG, SMITH, & THOMAS, 1940, p. 106; †not traced, see DOBROLYUBOVA in SOSHKINA, DOBROLYUBOVA, & KABAKOVICH, 1962, p. 327; L.Carb., Novocherkask, USSR); *Hunanoclisia* WU, 1964, p. 89 (type, *H. sinensis,* OD; †13443-7, IGP, Nanking; L.Carb., Tzemenchiao Mbr., Qixianjie, Lianyuan distr., Hunan); *Protiodibunophyllum* FLÜGEL, 1970, p. 220, *nom. null.; ?Biphyllum* FEDOROWSKI, 1971, which see; *?Katranophyllum* KROPACHEVA, 1972, which see; *Proalbertia* COTTON, 1973, p. 160, *nom. subst. pro Albertia* THOMSON, 1878. For discussion of subjective synonymy, see HILL, 1938-1941, p. 66 *et seq.,* and WEYER, 1971a, p. 16. Apparently, no case has been made to ICZN for retention of the name *Dibunophyllum.*]. Large, solitary, with variable axial structure typically one-third as wide as corallum and consisting of long medial plate, a few (commonly four to eight) septal lamellae on either side, and numerous axial tabellae declined steeply at its periphery; less commonly lamellae may be convolute, median plate shortens toward fossula or disappears, and biradial arrangement is lost; minor septa discontinuous so that dissepiments of wide dissepimentarium inosculate; cardinal septum shortens in open, commonly parallel-sided fossula that indents dissepimentarium; periaxial tabellae less steeply declined outward than axial tabellae; in early stages cardinal and counter septa and median plate continuous [HILL, 1938-1941, p. 65]. *L.Carb.-U.Carb.(Visean-Namur.),* Eu. (Brit. I.-Belg.-France-Ger.-Czech.-Pol.-USSR)-Asia (Taymyr-China-Sinkiang-Japan)-N. Afr. (Alg.-Moroc.)-N. Am. (N. Scotia-Texas-Ore.); *?Penn.,* N.Am.(Kans.-Okla.).——FIG. 237, *1a-h.* **D. bipartitum* (MCCOY); *a,* lectotype of *D. muirheadi* THOMSON, Visean, Ayrshire, Gateside near Beith, transv. sec., ×1.0 (Hill, 1938-1941); *b,* lectotype of *D. bipartitum* (MCCOY), Visean, Derbyshire, long. sec., ×1.0 (Hill, 1938-1941); *c,d,* lectotype of *Aspidiophyllum koninckianum* THOMSON, transv., long. secs., ×1.0 (Thomson, 1883); *e,f,* lectotype of *Kumatiophyllum concentricum* THOMSON, long., transv. secs., ×1.0 (Thomson, 1877); *g,h,* lectotype of *Rodophyllum craigianum* THOMSON, transv., long. secs., ×1.0 (Thomson & Nicholson, 1876b).——FIG. 237,*1i,j. D. sinense* (WU), holotype; *i,j,* transv., long. secs., ×1.5 (Wu, 1964).

Arachniophyllum SMYTH, 1915, p. 558, *non Arachniophyllum* LANG, SMITH, & THOMAS, 1940, p. 19, *nom. van. pro Arachnophyllum* DANA, 1846a, p. 186 [**A. simplex*; M; †T14/1009, TC, Dublin]. Solitary, small; with dibunophylloid axial structure and very narrow dissepimentarium commonly of one series of dissepiments and with very short minor septa; major septa thin, long, cardinal septum short in late stages in open, parallel-sided fossula; tabular floors conical. *L.Carb.(low.Viséan),* Eu.(Eire).——FIG. 238,*1a-c.* **A. simplex,* Carlyan Ls., C_2S_1, Co. Dublin; *a,* transv. sec., ×1.8, *b,c,* transv. secs., ×1.5 (Smyth, 1915).

Arachnolasma GRABAU, 1922, p. 59 [**Lophophyllum sinense* YABE & HAYASAKA, 1920, explanation to pl. 6, fig. 2; †not traced] [=*Arachnelasma* LANG, SMITH, & THOMAS, 1940, p. 19, *nom. van.*]. Solitary, large; like *Dibunophyllum* but median plate of axial structure stronger, thickened spindlewise in transverse section and retaining contact longer with counter septum; also, septal lamellae of axial structure commonly shorter, weaker, and fewer. *L.Carb.(Tournais.),* Asia(Kuzbas); *L.Carb.(Visean),* Asia(China-Japan-Viet Nam-Kazakh.)-Eu. (USSR-Pol.)-N. Afr. (Alg.).——FIG. 238,*3a-c.* **A. sinense,* monotype, China, E. of Ai-chia-ping, Wei-ning-hsien, Kweichow; *a-c,* transv. secs., long. sec., ×1.5 (Yabe & Hayasaka, 1920).

Biphyllum FEDOROWSKI, 1971, p. 119 [**B. vallum*; OD; †OS-70/1593, IG, Kielce] [?=*Dibunophyllum* THOMSON & NICHOLSON, 1876a, which see]. Like *Dibunophyllum* but with counter septum shortened in late stages equally with cardinal septum, and with inconstant, thickened boundary to axial structure. *L.Carb.(up.Visean),* Eu.(Pol.).——FIG. 238,*4a,b.* **B. vallum,* holotype, Galezice, Holy Cross Mts.; *a,b,* transv., long. secs., ×2 (Fedorowski, 1971).

Caninostrotion EASTON, 1943, p. 134 [**C. variabilis*; OD; †UC18367, FM, Chicago]. Fasciculate, increase peripheral, corallites may be large; with conspicuous fossula invading inner part of dissepimentarium, containing short cardinal septum; septa numerous, long, dilated in tabularium, in dissepimentarium buttressed by numerous semi-

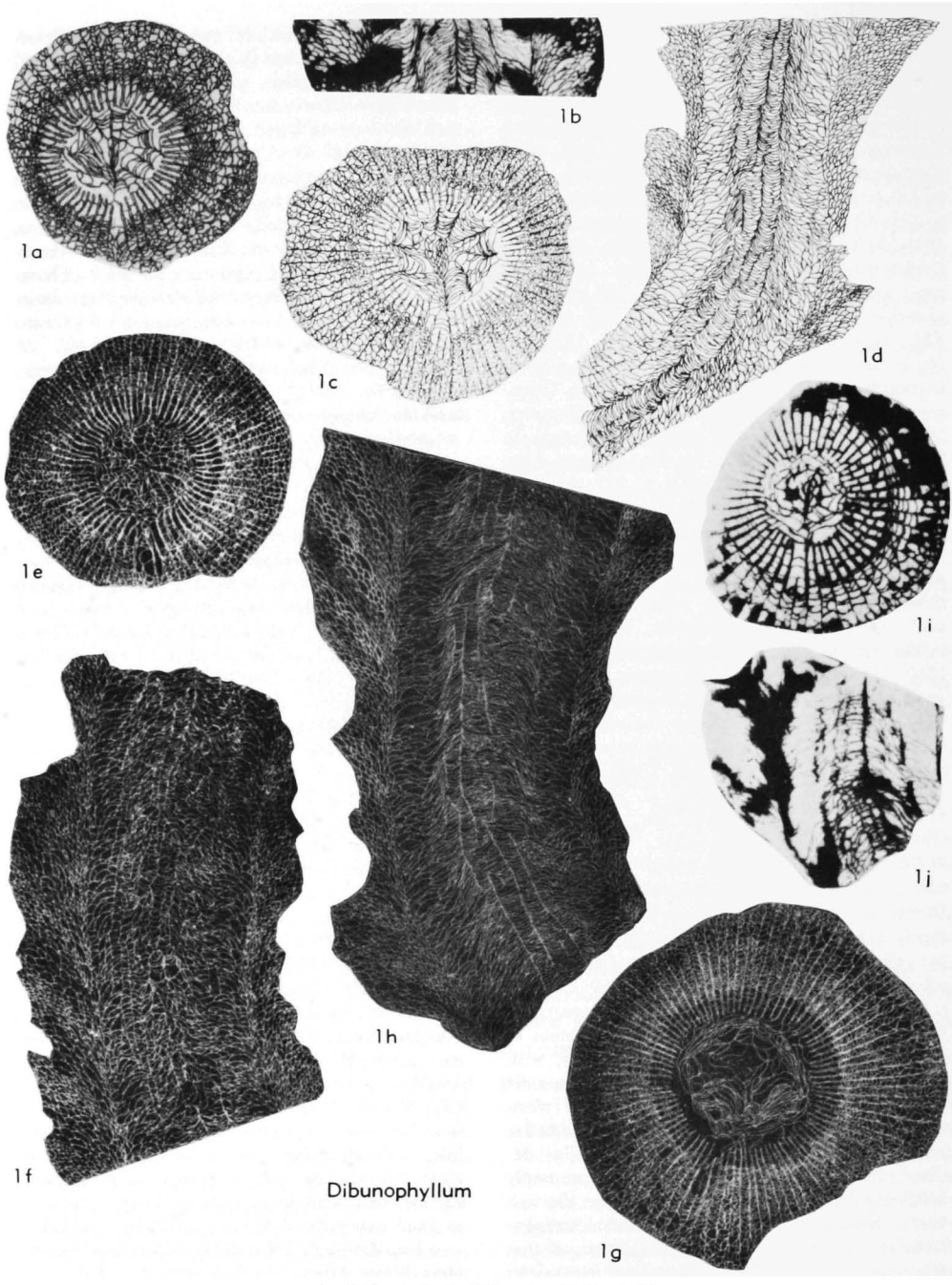


FIG. 237. Aulophyllidae (p. *F360-F361*).

dissepiments; minor septa thinner and discontinuous in inner part of dissepimentarium, where dissepiments then inosculate; tabular floors low domes, tabulae complete or incomplete; an irregular, impersistent axial structure may develop, with few septal lamellae. *U.Miss.(Chester.)*, N.Am. (Ark.-Ill.); *?U.Carb.(Namur.)*, ?Eu.(Brit.I.).—— FIG. 238,*5a,b*. **C. variabile; a*, holotype, Pitkin F., uppermost Chester., Ark., Pitkin Bluff, transv. sec., ×2; *b*, another specimen, long. sec., ×2 (Easton, 1943).

Copia VASILYUK & KOZYREVA, 1974, p. 31 [**C.*

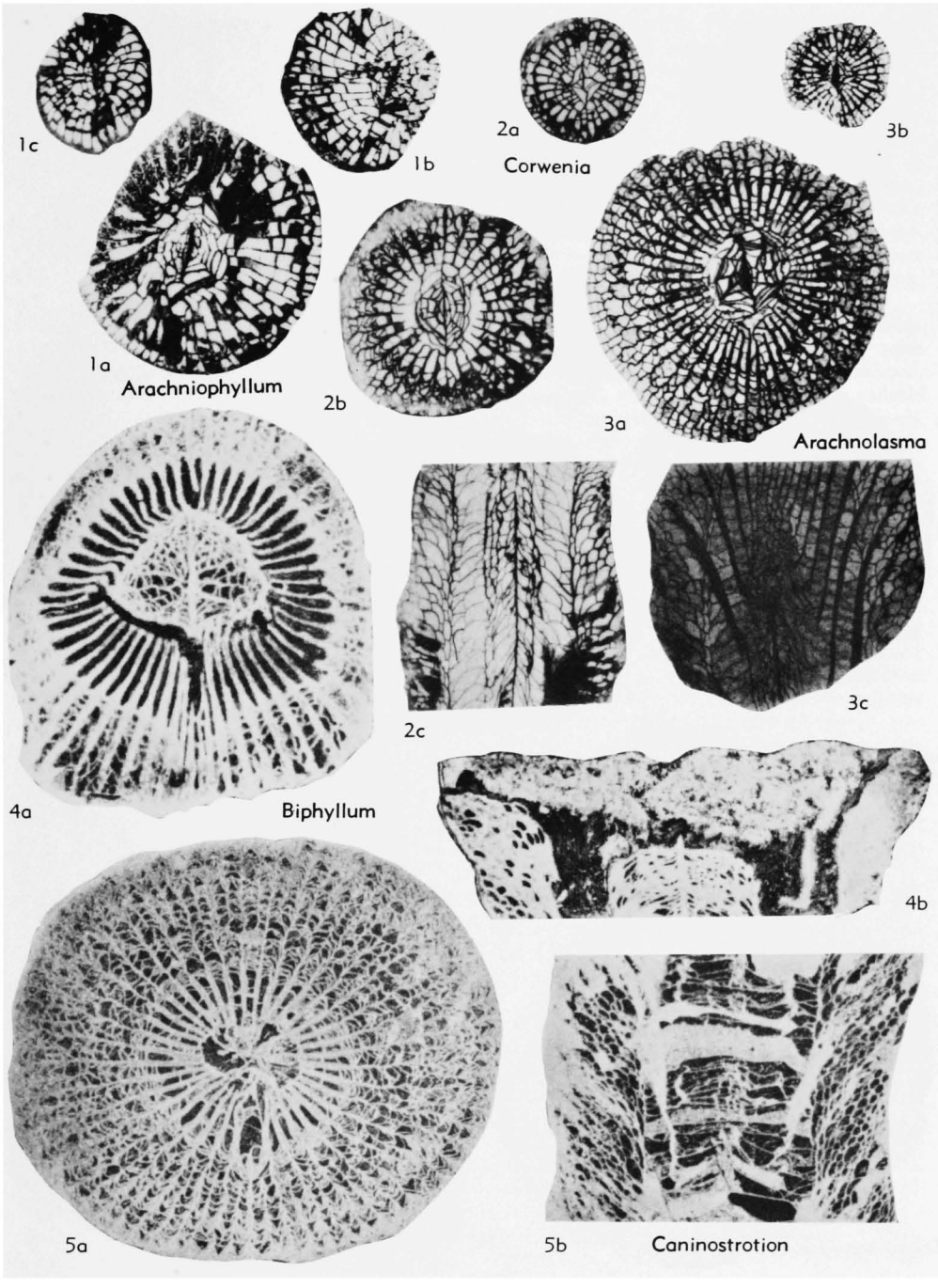


FIG. 238. Aulophyllidae (p. *F361-F365*).

admiranda; OD; †364, coll. 14, DPI, Donetsk]. Fasciculate; corallites large; axial structure dibunophylloid but commonly with numerous radial septal lamellae; septa thickened in outer tabularium, particularly in cardinal quadrants, cardinal septum short in distinct fossula, counter septum commonly connected with median lamella; minor septa commonly continuous in wide marginarium

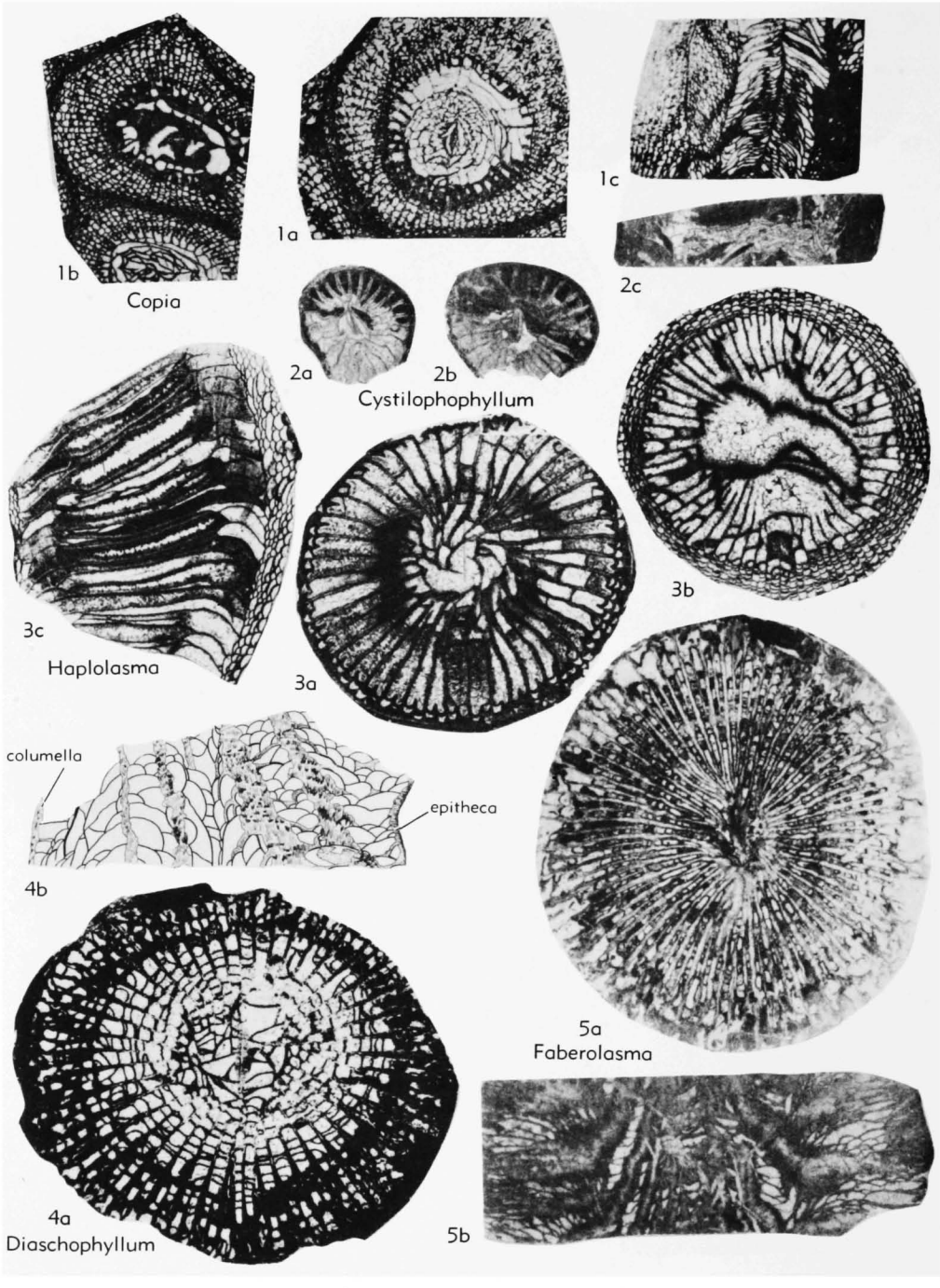


FIG. 239. Aulophyllidae (p. *F362-F365*).

with normal concentric dissepiments; septa may be complexly structured in dissepimentarium, in some with naotic modifications peripherally; tabular floors dibunophylloid. *L.Carb.-U.Carb.(up. Visean-low.Namur.)*, Eu.(USSR).——FIG. 239, *1a-c*. **C. admiranda*; *a*, holotype, Belgorod Distr.,

Voronezh anteclise, S. slope, Rovenki, borehole 507, at depth 386-393 m., V_6, transv. sec., ×1.3; *b,c,* another specimen, Voroshilovgrad Distr., borehole 475, at 480 m., transv., long. secs., ×1.3 (Vasilyuk & Kozyreva, 1974).

Corwenia SMITH & RYDER, 1926, p. 150 [**Lonsdaleia rugosa* McCOY, 1849, p. 13; OD; †A1931, SM, Cambridge] [=*Gorwenia* WEDEKIND, 1937, p. 64, *nom. null.*]. Phaceloid, increase peripheral, nonparricidal; corallites with dibunophylloid axial structure of medial plate that may be continuous with cardinal and counter septa, of septal lamellae and axial tabellae; major septa unthickened in tabularium; minor septa discontinuous, weak; periaxial tabellae less steeply declined abaxially and fewer than those of axial structure; dissepiments overlapping zigzag along planes of minor septal failure; dissepimentarium narrowed at fossula. *L. Carb.(up.Visean),* Eu.(Brit.I.-Belg.-Moscow Basin-Urals)-Asia(Kazakh.); *?U.Carb.(Moscov.),* Eu. (Spain-Donbas); *?M. Penn. (Atokan),* N. Am. (Alaska).——FIG. 238,*2a-c.* **C. rugosa* (McCOY), Corwen, Hafod-y-calch; *a,b,* transv., *c,* long. secs., all ×2 (Smith, 1916).

?Cystilophophyllum FOMICHEV, 1953a, p. 274 [**Lophophyllum (Cystilophophyllum) kalmiusi*; OD; †213, coll. 5030, TsGM, Leningrad]. Solitary; in early stages with well-developed lamellar columella connected to counter septum, with long thick major septa, cardinal septum being shorter; in later stages major septa unequal and not reaching columella which may be poorly developed, septa thinning first in counter quadrants and cardinal septum shortened; minor septa thin, dissepimentarium with inosculating dissepiments; tabulae arched up to columella. [Insufficiently known.] *U.Carb.(Bashkir.),* Eu.(Donbas).——FIG. 239, *2a-c.* **C. kalmiusi,* holotype, ls. G_1, Donbas, near Kislichya Ravine; *a,b,* transv., *c,* long. secs., all ×2.0 (Fomichev, 1953a).

?Diaschophyllum SEMENOFF-TIAN-CHANSKY, 1974, p. 135 [**D. chevalieri*; OD; †PAR174/6, MN, Paris]. Like *Koninckophyllum* but tabular floors broad domes with outward turned or upturned edges and with median plate in deep, broad axial depression to periphery of which major septa are withdrawn. [Only two specimens known.] *U. Carb.(low.Namur.),* N.Afr.(Alg.).——FIG. 239, *4a,b.* **D. chevalieri,* holotype, Wadi Narkla, Cirque de Tagnana; *a,* transv. sec., ×2.7; *b,* long. sec., dissepimentarium and right half of tabularium shown, columella at extreme left, ×4.4 (Semenoff-Tian-Chansky, 1974).

Eostrotion VAUGHAN, 1915, p. 39 [**Cyathaxonia tortuosa* MICHELIN, 1847, p. 258, *sensu* CARRUTHERS, 1913, pl. 3, fig. 1, 2; †FOR1969, PF2160-4, IGS, Leeds, here chosen, original of fig. 1, not necessarily the same as *Cyathaxonia tortuosa* MICHELIN, 1847, p. 258, of which type specimen is missing from MICHELIN Coll., MN, Paris, *fide* CARRUTHERS] [?=*Koninckophyllum* THOMSON & NICHOLSON, 1876a, which see]. Solitary, cornute; early stages with long thin major septa and cardinal fossula that expands somewhat at inner end and contains long cardinal septum connected to barlike columella; in late stages septa withdraw from columella, which may then weaken; tabulae conical, with some change of curvature near very narrow dissepimentarium; minor septa short. *L.Carb.(Tournais.),* Eu.(Brit.I.-Belg.).——FIG. 240,*1a-f.* **E. tortuosum* (MICHELIN) *sensu* CARRUTHERS, lectotype, Belg., Cornet Quarry, Tournai; *a,* side view, *b-e,* transv., *f,* long. secs., all ×1.0 (Carruthers, 1913).

Faberolasma BYKOVA, 1974, p. 35 [**F. buconica*; OD; †2959/21, IG, Alma-Ata]. Solitary; septa very long, variably thickened, numerous, subradially arranged, many attaining axis where variable axial structure present; axial structure commonly of simple oval or median-platelike columella in young stages, variably thickened, in late stages with columella inconstant to indistinct, axial ends of longer major septa or septal lamellae joining or not at axis, and connected by abaxially declined tabellae; fossula variable, shallow, indistinct in dissepimentarium, closed or more commonly open, widening or more commonly narrowing adaxially; length of cardinal septum variable; counter septum commonly connected with axial structure; tabular floors domed, in some with edges turned out, not depressed axially; tabulae incomplete; dissepimentarium wide, dissepiments mostly normal, concentric, some lateral to septa; septal trabeculae may be multiserial at peripheral ends of septa. *U.Carb.*(C_2), Asia(Kazakh.).——FIG. 239, *5a,b.* **F. buconicum*; holotype, Bukonskaya suite, C_2, E. Kazakh., Semipalatinsk distr.; *a,b,* transv., long. secs., ×2.0 (Bykova, 1974).

?Haplolasma SEMENOFF-TIAN-CHANSKY, 1974, p. 196 [**Caninia subibicina* McCOY, 1851a, p. 167; OD; †A2358, SM, Cambridge] [=*Haplophyllia* SEMENOFF-TIAN-CHANSKY in PLUSQUELLEC & SEMENOFF-TIAN-CHANSKY, 1973, p. 434, *nom. nud.,* in binomen *H. parvicarinata*]. Solitary, moderately large; septa numerous, thin, radial, major septa subequally withdrawn from axis, minor septa complete; tabulae flat with downturned edges; fossula wide, shallow, invading dissepimentarium, with shortened cardinal septum; counter septum may be long; dissepimentarium narrow, normal concentric, dissepiments fine, steeply inclined and subglobose. [Possibly cyathopsid.] *L.Carb.(Visean),* Eu.(Brit.I.-Moscow Basin-Donbas-?Urals-?N.Zemlya)-N.Afr.(Alg.)-?Asia(Hunan); *U.Miss.,* ?N.Am.(Nev.-Utah).——FIG. 239,*3a,b.* **H. subibicinum* (McCOY), holotype, low. Visean, Eng., Kendal, Westmoreland; *a,b,* transv. secs., ×2.7, ×1.3; *c,* long. sec., ×1.3 (Semenoff-Tian-Chansky, 1974).

Heintzella FEDOROWSKI, 1967b, p. 18 [**H. multiseptata*; OD; †A25158, PM, Oslo] [?=*Fischerina* SHTUKENBERG, 1904, p. 107 (type, *F. rossica,* M;

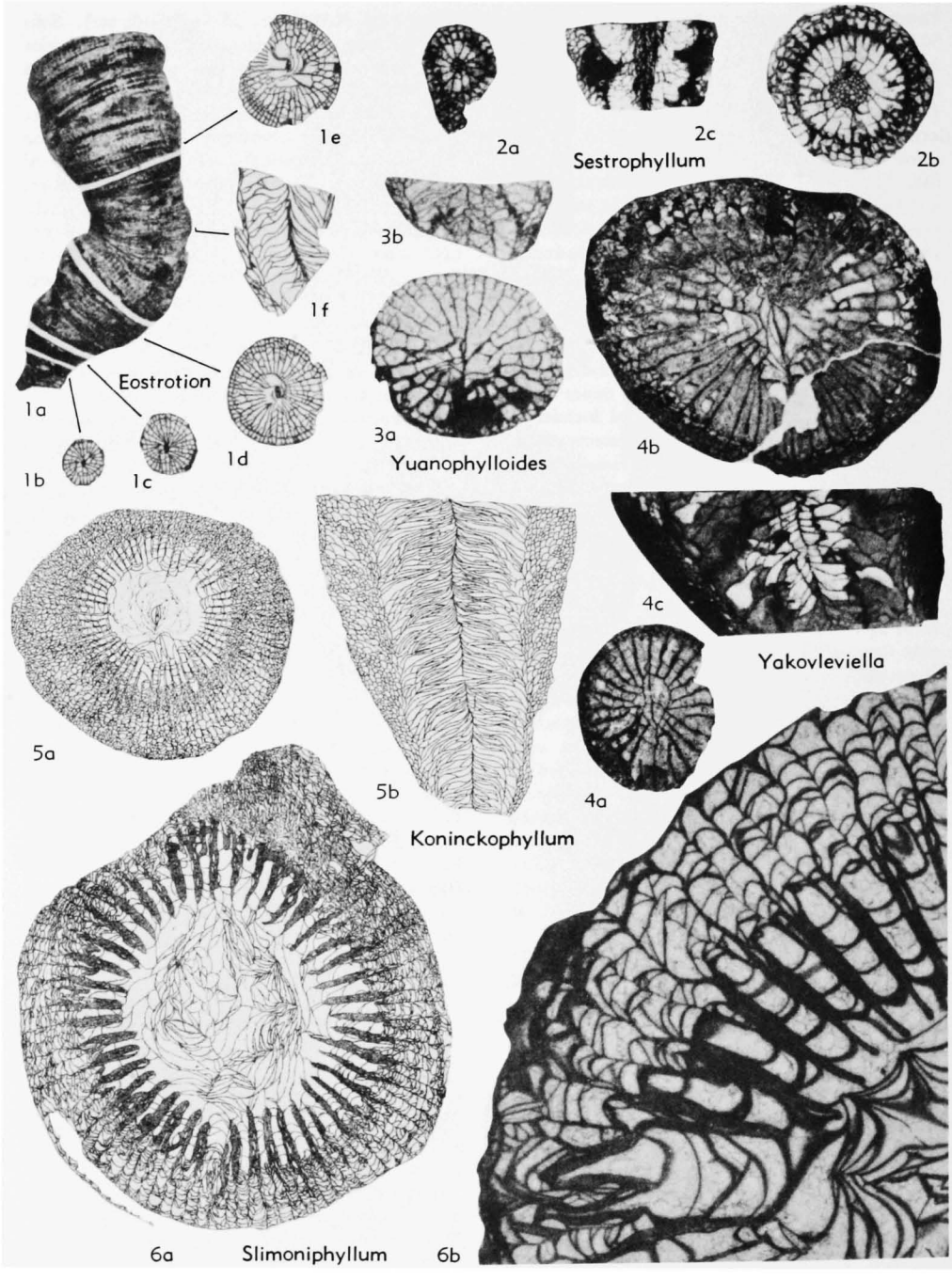


FIG. 240. Aulophyllidae (p. *F365-F371*).

†not traced, ?Kazan University; ?L.Carb., Vyshniy Volochek, C. USSR; monotype shows irregularly prismatic corallites, presence or absence of fossula not established, possibly *Stylastraea* LONSDALE, 1845, Lithostrotionina, Lithostrotionidae, Thysanophyllinae), *non Fischerina* TERQUEM, 1878, a foraminifer; *?Profischerina* COTTON, 1973, p. 162, *nom. subst. pro Fischerina* SHTUKENBERG, 1904].

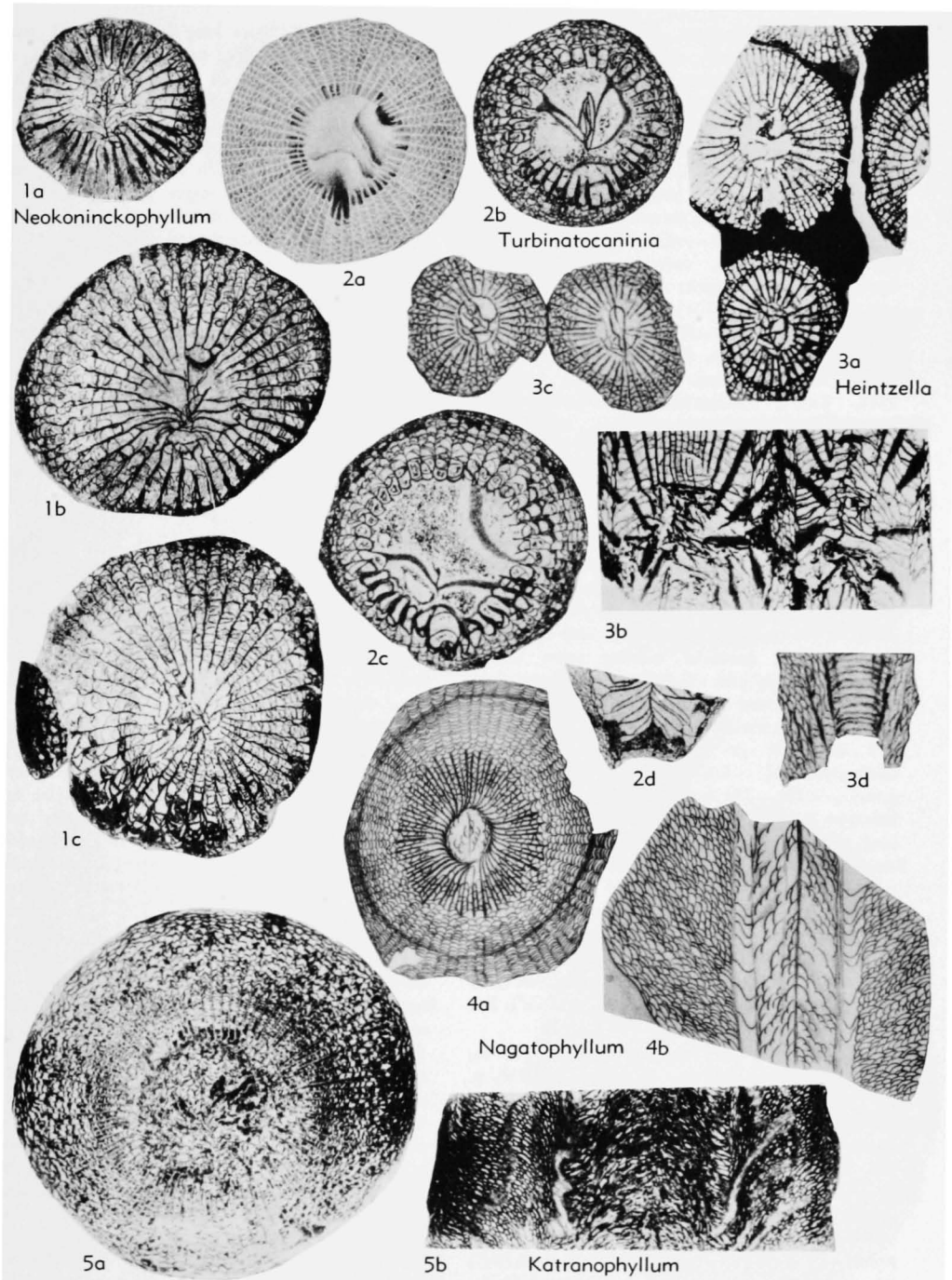


FIG. 241. Aulophyllidae (p. *F365-F369*).

Phaceloid; with poorly developed, irregular and discontinuous axial structure formed only by septal lamellae and auxiliary axial tabellae without medial plate; septa somewhat thickened in tabularium, major septa withdrawn from axial structure; cardinal septum shortened in shallow open fossula that

indents dissepimentarium slightly; minor septa may withdraw abaxially, so that normal concentric dissepimentarium becomes anguloconcentric; tabular floors broadly conical, tabulae incomplete. *?L.Carb.(Visean),* Eu.(Moscow Basin-Urals-N. Zemlya); *U.Carb.,* Eu.(N.Zemlya); *Penn.,* N.Am. (Nev.); *L.Perm.,* Eu.(Spits.-?Urals).——Fig. 241, *3a,b.* **H. multiseptata,* holotype, L.Perm., Vestspits., Treskelodden; *a,b,* transv., long. secs., ×1.3 (Fedorowski, 1967b).——Fig. 241,*3c,d.* *?H. rossica* (Shtukenberg), monotype, ?L.Carb., C. USSR, Vyshniy Volochek; *c,d,* transv., long. secs., ×1.3 (Shtukenberg, 1904).

Katranophyllum Kropacheva in Degtyarev & Kropacheva, 1972, p. 88[**Dibunophyllum (Katranophyllum) miclucho-maclaji*; OD; †1, coll. 9548, TsGM, Leningrad] [?=*Dibunophyllum* Thomson & Nicholson, 1876a, which see; *?Debaophyllum* Zhang in Jia *et al.,* 1977, p. 221 (type, *D. multitabellum,* OD; †IV16012, GB, ?Nanning; L.Carb., Datang Stage, Debao Co., Guangxi [Kwangsi])]. Solitary, large; septa very numerous and long, like those of *Palaeosmilia* but some major septa connected with radial lamellae of axial column; minor septa somewhat thinner; axial structure large and dibunophylloid with medial plate, radial lamellae, and very numerous axial tabellae; periaxial tabellae more widely spaced, also declined abaxially; dissepimentarium wide, with narrow outer zone of lonsdaleoid dissepiments, otherwise dissepiments fine, normal, and concentric or anguloconcentric. [Possibly Clisiophyllinae.] *L.Carb.(Visean),* Asia(S.Fergana).——Fig. 241,*5a,b.* **K. micluchomaclaji,* holotype, Pumskaya suite, Katran Ra.; *a,b,* transv., long. secs., ×1.3 (Degtyarev & Kropacheva, 1972).

Koninckophylloides Gorskiy, 1978, p. 131 [**Lophophyllum (Koninckophylloides) uralicum*; OD; †slide 345, coll. 5766, TsGM, Leningrad]. Like *Arachnolasma* but compound and phaceloid with large corallites with minor septa better developed and with axial structure irregular to diphymorphic in late stages of some corallites. *U.Carb.*(C_2^2), Eu. (Baskiria, R.Min'yar).

Koninckophyllum Thomson & Nicholson, 1876a, p. 297 [**K. magnificum*; SD Thomson, 1883, p. 419; †T1037, KM, Glasgow, lectotype by Hill, 1938-1941, p. 89] [?=*Lophophylloides* Shtukenberg, 1904, p. 33 (type, *L. schellwieni,* M; †? in coll. 336, TsGM, Leningrad; L.Carb., Podmokloe, R. Oka, C. USSR); *?Eostrotion* Vaughan, 1915, which see; *?Eokoninckophyllum* Fomichev, 1953a, p. 353, *nom. nud.* (type, *Koninckophyllum proprium* Sibly, 1908, p. 70; †not traced; L.Carb.(D_2); near Wensley, Derbyshire, U.K.); *?Yuanophylloides* Fomichev, 1953a, which see; *Koninckinaotum* Fedorowski, 1971, p. 123 (type, *K. pseudocoloniale,* OD; †Tc-4/2883, PZI, Poznan; up. Visean, Galezie, Holy Cross Mts., Pol.), some septa with peripheral naotic modifications; in pseudocolonial associations]. Solitary ?(or weakly dendroid); septa numerous, major septa long but amplexoid, may be thickened in periaxial tabularium, especially in cardinal quadrants; minor septa long and continuous or discontinuous, leaving inosculating dissepiments; septa may bear lateral dissepiments or be otherwise structurally modified; fossula indenting dissepimentarium and with short cardinal septum in late stages; in early stages with clisiophylloid or dibunophylloid axial structure, the medial plate continuous with cardinal and counter septa; in late stages axial structure reduced to lathlike columella supported by conical tabellae or absent; tabular floors broad cones or broad and flat with downturned edges; dissepimentarium commonly wide [see also Fedorowski, 1971, p. 78; Semenoff-Tian-Chansky, 1974, p. 107]. *L.Carb.-U.Carb.(Visean-Namur.),* Eu.(Brit.I.-?Belg.-Pol.-?USSR-N.Zemlya)-N.Afr.(Alg.)-Asia (?Kazakh.); *Miss.,* N.Am.(Nova Scotia-Texas-Ark.).——Fig. 240,*5a,b.* **K. magnificum,* lectotype, Charlestown Main Ls., Scot., Charlestown; *a,b,* transv., long. secs., ×1.0 (Thomson, 1883).

?Lophophrentis Chi, 1935, p. 18 [**L. trilobita*; OD; †5987, IGP, Nanking]. Solitary; cardinal fossula deep, cardinal septum very short, major septa numerous, long, axial ends grouped; counter septum continuous with median plate; tabulae koninckophylloid; minor septa and dissepiments unknown. [Insufficiently known.] *U.Carb.(Weining.),* Asia(Kwangsi).

?Nagatophyllum Ozawa, 1925, p. 78 [**N. satoi*; M; syntype III_{30}, Ozawa Coll., UT, Tokyo]. Fasciculate, corallites large, with axial structure consisting of median plate and axial tabellae arranged in conical floors, with long major and minor septa modified to form columns of naotic dissepiments in wide dissepimentarium, and with periaxial tabellae sharply concave; fossula marked in periaxial tabularium. *L.Carb.-?U.Carb.,* Asia (Japan).——Fig. 241,*4a,b.* **N. satoi,* syntype, Nagato, Tobinosu in Odamura; *a,b,* transv., long. secs., diagram., ×1.3 (Ozawa, 1925).

Neokoninckophyllum Fomichev, 1939, p. 58 [**N. tanaicum*; SD Lang, Smith, & Thomas, 1940, p. 88; †310, coll. 5030, TsGM, Leningrad]. Solitary, conical, large; may have few offsets; in early stages septa somewhat thickened, fossula indistinct, and thin median plate connected with both cardinal and counter septa, other major septa not reaching axis, and narrow dissepimentarium; in later stages thickening disappears first in counter quadrants, dissepimentarium widens and develops anguloconcentric structure as minor septa withdraw to periphery, septa may bear lateral dissepiments, cardinal septum shortens slightly, a thin, weak, platy columella is either retained, now separate and commonly somewhat displaced to side of cardinal septum, with few sparse impersistent septal lamellae, or absent; tabular floors broad cones drawn up sharply at columella. *?L.Carb. (Visean),* Eu.(Pol.); *U.Carb.,* Eu.(Donbas)-Asia

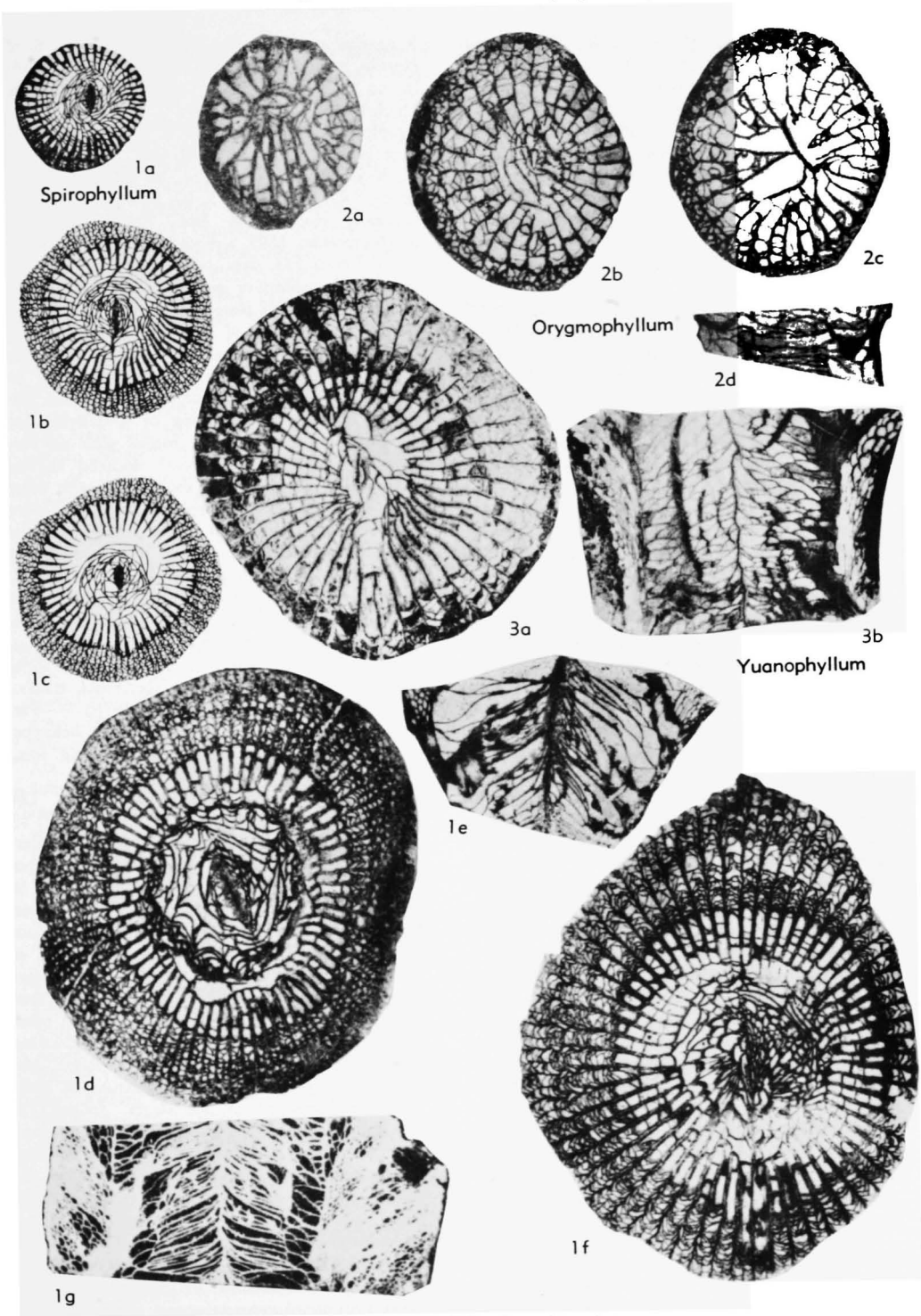


FIG. 242. Aulophyllidae (p. *F370-F371*).

(?Japan); *Penn.*, N. Am. (Okla.-Texas-Kans.-?Ariz.).——FIG. 241,*1a-c*. **N. tanaicum*, holotype, ls. M_5, Donbas, Churilina ravine; *a-c*, transv. secs., all ×1.3 (Fomichev, 1953a).

Orygmophyllum FOMICHEV, 1953a, p. 304 [**O. convexum*; OD; †257, coll. 5030, TsGM, Leningrad]. Solitary, conical; septa in early stages thin or but slightly thickened, commonly somewhat bent or wavy, many reaching axis especially in cardinal quadrants, where long, open fossula with thin, cardinal septum may extend to axis; in late stages septa commonly somewhat shortened; dissepimentarium appears early; minor septa weak and withdrawn toward periphery, leaving inosculating dissepiments; axial structure absent or weak, tabulae flat, complete or incomplete with a periaxial series divided from wider axial series by axial ends of major septa. *U.Carb.*, Eu.(Donbas-Spits.).——FIG. 242,*2a-d*. **O. convexum*, holotype, ls. N_5, Gshel., Donbas, Aleksandro-Nevsky Farm; *a-c*, transv., *d*, long. secs., all ×2.5 (Fomichev, 1953a).

Sestrophyllum FOMICHEV, 1953a, p. 380 [**S. astraeforme*; OD; †336, coll. 5030, TsGM, Leningrad]. Solitary, conicocylindrical, slender, with axial structure of radial lamellae, with or without median plate continuous with both cardinal and counter septa, and steeply declined axial tabellae; with narrow dissepimentarium that appears early; calicular platforms everted in some; major septa commonly reach axial structure, cardinal septum not shortened, so that fossula is not apparent; septa thickened in inner parts of dissepimentarium, thinning adaxially; minor septa weaker; septa may become discontinuous abaxially; periaxial tabellae globose, floors declined slightly abaxially. *U.Carb.*, Eu.(Donbas); *Penn.*, ?N.Am.(Kans.-Okla.-Texas).——FIG. 240,*2a-c*. **S. astraeforme*, holotype, U. Carb., C_3^{α}, USSR, left bank R. Kalmius; *a,b*, transv., *c*, long. secs., all ×3.0 (Fomichev, 1953a).

Slimoniphyllum KATO & MITCHELL, 1961, p. 281 [**Rodophyllum slimonianum* THOMSON, 1874, p. 558; OD; †T1021, KM, Glasgow; lectotype by HILL, 1938-1941, p. 111]. Solitary, ceratoid to trochoid, with weak axial structure in which medial plate tends to degenerate and thin septal lamellae to become twisted; septa thin in dissepimentarium and dilated but vesiculate in tabularium, small lateral tabellae invested with sclerenchyme appearing to one side of median plane of septum; cardinal septum short in open and parallel-sided fossula that indents dissepimentarium somewhat and lies on convex side of corallum; counter septum also shortened, but less so than cardinal; dissepiments normal concentric to angulate and irregular; tabulae flat and complete in early stages, later incomplete and declined abaxially. *L.Carb. (up.Visean)*, Eu.(Brit.I.-?Pol.).——FIG. 240,*6a,b*. **S. slimonianum* (THOMSON); *a*, holotype, Low. Limestone Gr., Lanarkshire, Brockley, near Lesmahagow, transv. sec., ×2.0 (Thomson, 1874); *b*, another specimen, D_2, Yorkshire, 3.5 mi. S. of Horton, part of transv. sec. showing lateral tabellae on septa and cardinal fossula, ×3.0 (Kato & Mitchell, 1961).

Spirophyllum FEDOROWSKI, 1970, p. 570 [**S. sanctaecrucense*; OD; †OS-70/639, IG, Kielce] [=*Mira* FEDOROWSKI, 1971, p. 126 (type, *M. prima*, OD; †OS-70/2413, IG, Kielce; up. Visean, Galezice, Holy Cross Mts., Pol.), *non Mira* SCHELLENBERG, 1803, a dipteran; *Mirka* FEDOROWSKI, 1974b, p. 533, *nom. subst. pro Mira* FEDOROWSKI, 1971]. Solitary or incipiently compound; with columella a medial plate that may be augmented by fused axial ends of septal lamellae and may be immersed in wide axial structure of tabellae and commonly convolute lamellae that may be continuous with major septa; the augmented columella in some disintegrating or simplifying but not disappearing completely; medial plate shortens at counter end; tabular floors declined slightly from medial plate; tabulae incomplete, with outer series of tabellae more steeply declined and more widely spaced; dissepimentarium anguloconcentric at least in inner parts where minor septa discontinuous; lateral dissepiments may be developed. *L.Carb.(up.Visean)*, Eu.(Pol.-Donbas-Urals); *U. Carb. (?Namur.-Moscov.)*, Eu. (Spain).——FIG. 242,*1a-e*. **S. sanctaecrucense*, holotype, up. Visean, D_2, Pol., Galezice, Holy Cross Mts.; *a-c*, serial transv. secs., ×1.8; *d,e*, other specimens, transv., long. secs., ×2.0 (Fedorowski, 1970).——FIG. 242,*1f,g*. *S. primum* (FEDOROWSKI), holotype, same locality and horizon; *f,g*, transv., long. secs., ×2.0 (Fedorowski, 1971).

Turbinatocaninia DOBROLYUBOVA, 1970, p. 129 [**Caninia okensis* SHTUKENBERG, 1904, p. 27; †? in coll. 336, TsGM, Leningrad]. Solitary, moderately large to large; septa numerous; major septa commonly thickened in cardinal quadrants in tabularium, cardinal shortening in wide, open fossula that may indent dissepimentarium; minor septa commonly discontinuous in inner parts of anguloconcentric dissepimentarium; early stages with first dibunophylloid then koninckophylloid axial structure that disappears in late stages; tabularium wide, major septa commonly withdrawing abaxially in koninckophylloid and late stages, tabular floors updrawn to axial structure in early stages, subhorizontal in late stages. *L.Carb.(Visean)*, Eu.(USSR).——FIG. 241,*2a-d*. **T. okensis* (SHTUKENBERG); *a*, monotype, Lushki on R. Oka, transv. sec., ×0.7 (Shtukenberg, 1904); *b-d*, topotype, transv., long. secs., ×1.3 (Dobrolyubova, 1960).

Yakovleviella FOMICHEV, 1953a, p. 318 [**Y. tschernyschewi*; OD; †265, coll. 5030, TsGM, Leningrad] [?=*Yuanophyllum* YÜ, 1931, which see]. Solitary, conical; in early stages all septa somewhat thickened, cardinal septum not separated from counter septum, remaining septa failing to reach axis, dissepimentarium narrow; in later stages

septal thickening decreasing, persisting longest in cardinal quadrants of tabularium, fossula wide and open, cardinal septum remaining long and commonly connected to median plate while counter septum shortens; axial tabellae combining with median plate to form axial structure; tabular floors conical, tabulae incomplete; minor septa may withdraw to periphery leaving inosculating dissepiments. *U.Carb.(Moscov.),* Eu.(Donbas).——FIG. 240,*4a-c.* **Y. tschernyschewi,* holotype, ls. M_8^2, left bank of R. Kundryuchey; *a-c,* transv., long. secs., ×2.5 (Fomichev, 1953a).

Yuanophylloides FOMICHEV, 1953a, p. 278 [**Yüanophylloides gorskyi*; OD; †219, coll. 5030, TsGM, Leningrad] [?=*Koninckophyllum* THOMSON & NICHOLSON, 1876a, which see, FEDOROWSKI, 1971, p. 78]. Solitary, conical, not large; major septa long, thin, but commonly not reaching thin, lathlike columella that may become isolated from end of long counter septum, cardinal septum having first withdrawn from its connection with counter septum in early stages; fossula indistinct; dissepimentarium normal concentric, narrow; tabulae elevated toward axial lath. *U.Carb.(Moscov., Gshel.),* Eu.(Donbas).——FIG. 240,*3a,b.* **Y. gorskyi,* holotype, ls. M_9, Rodnikov ravine; *a,b,* transv., long. secs., ×2.5 (Sokolov, 1962c).

Yuanophyllum Yü, 1931, p. 26 [**Y. kansuense*; OD; †4882, IGP, Nanking] [?=*Yakovleviella* FOMICHEV, 1953a, which see; *Arachnolasmia* BYKOVA, 1966, p. 126 (type, *Arachnolasma (Arachnolasmia) karatawica,* OD; †2111/3, IG, Alma-Ata; Namur., Malyy Karatau Ra., S. Kazakh.)]. Solitary, moderately large to large; convex side cardinal; with short and commonly thickened medial plate that may be continuous with counter septum; major septa thickened at least in cardinal quadrants of tabularium and withdrawn unequally from medial plate, which shows few or no traces of septal lamellae; cardinal septum short in wide, open fossula that indents dissepimentarium; minor septa discontinuous except at periphery in mainly herringbone dissepimentarium; tabular floors broadly conical, of tabellae [see MINATO & ROWETT, 1967a, p. 333]. *L.Carb.(Visean),* Asia(Kansu-Anwuei - Kweichow - Sinkiang - Japan - ?Kuzbas - Kazakh.).——FIG. 242,*3a,b.* **Y. kansuense,* holotype, Visean, Choniukou F., Kansu, Cho-niu-kou, We-wei-hsien; *a,b,* transv., long. secs., ×2.0 (Yü, 1934).

Subfamily HETEROCANINIINAE Hill, new subfamily

Solitary, moderately large to large, curved, convex side cardinal; with very numerous, closely spaced, long major septa, minor septa either complete or developed only as peripheral ridges or septal crests in outer parts of commonly narrow dissepimentarium; septa thickened usually only in cardinal quadrants of outer tabularium; cardinal septum commonly short; tabularium wide, with loose, irregularly arachnoid axial structure without distinct wall, with few septal lamellae or axial ends of septa that may be convolute, with or without small, median, nuclear plate or long, thin, irregular median lamella; tabular floors domed or concave, lacking peripheral troughs and median depression; fossula long, narrow, open and widening adaxially with floor subhorizontal. *L.Carb.(Visean).*

Heterocaninia YABE & HAYASAKA, 1920, pl. xi, fig. 2a-d [**H. tholusitabulata*; M; †47151, TohU, Sendai] [?=*Kesenella* NAGAO & MINATO, 1941, p. 107 (type, *Yuanophyllum (Kesenella) yabei,* M; syntypes R15442-15450, UH, Sapporo; up. Visean, Setamai distr., Kitakami, Japan), see MINATO & ROWETT, 1967a, p. 338, minor septa discontinuously developed and few major septa continuous into axial structure, may be closer to *Kueichouphyllum* Yü, 1931]. Solitary, moderately large to large, curved, convex side cardinal; with very numerous, closely spaced, long major septa commonly thickened only in cardinal quadrants of outer tabularium; minor septa present only as ridges on inner side of wall, or sparsely as crests on anguloconcentric dissepiments of narrow to moderately wide dissepimentarium; tabularium wide with wide, loose axial structure, somewhat irregularly arachnoid and composed of axial ends of septal lamellae of minority of major septa; fossula long, narrow, open and somewhat expanded adaxially, may invade dissepimentarial zone; tabular floors rising from dissepimentarial boundary to eccentric axis or irregular median ridge, except in fossula where they are less steep, subhorizontal, or rising slightly toward periphery [see also KATO, 1959a, p. 279]. *L.Carb.(Visean),* Asia (Hunan-Sinkiang-?Thailand-Japan).——FIG. 243,*2a,b.* **H. tholusitabulata,* ?holotype, Visean, Hunan, Hsia-lo shi-chiao, Chi-yang-hsien, *a,b,* long., transv. secs., ×1.5 (Yabe & Hayasaka, 1920).

Kueichouphyllum Yü, 1931, p. 23 [**K. sinense*; OD; †4970, IGP, Nanking] [=*Yabeella* Yü, 1934, p. 75 (type, *Y. kuangtungensis,* OD; †4994, IGP, Nanking; Visean, Yingteh Ls., Chü-chiang-hsien, Kuangtung, *fide* Yü *et al.,* 1963, p. 129)]. Like *Heterocaninia* but with commonly complete, long minor septa, wide dissepimentarium of very small, concentric dissepiments, and axial structure commonly with small, nuclear median plate and septal lamellae in some convolute. [Holotype is crushed specimen in which axial structural features are not visible; these are interpreted *sensu* Yü, 1931, 1934.] *L.Carb.(Visean),* Asia(China-Viet Nam - Laos - Sinkiang - Japan - Iran - Uzbek. -

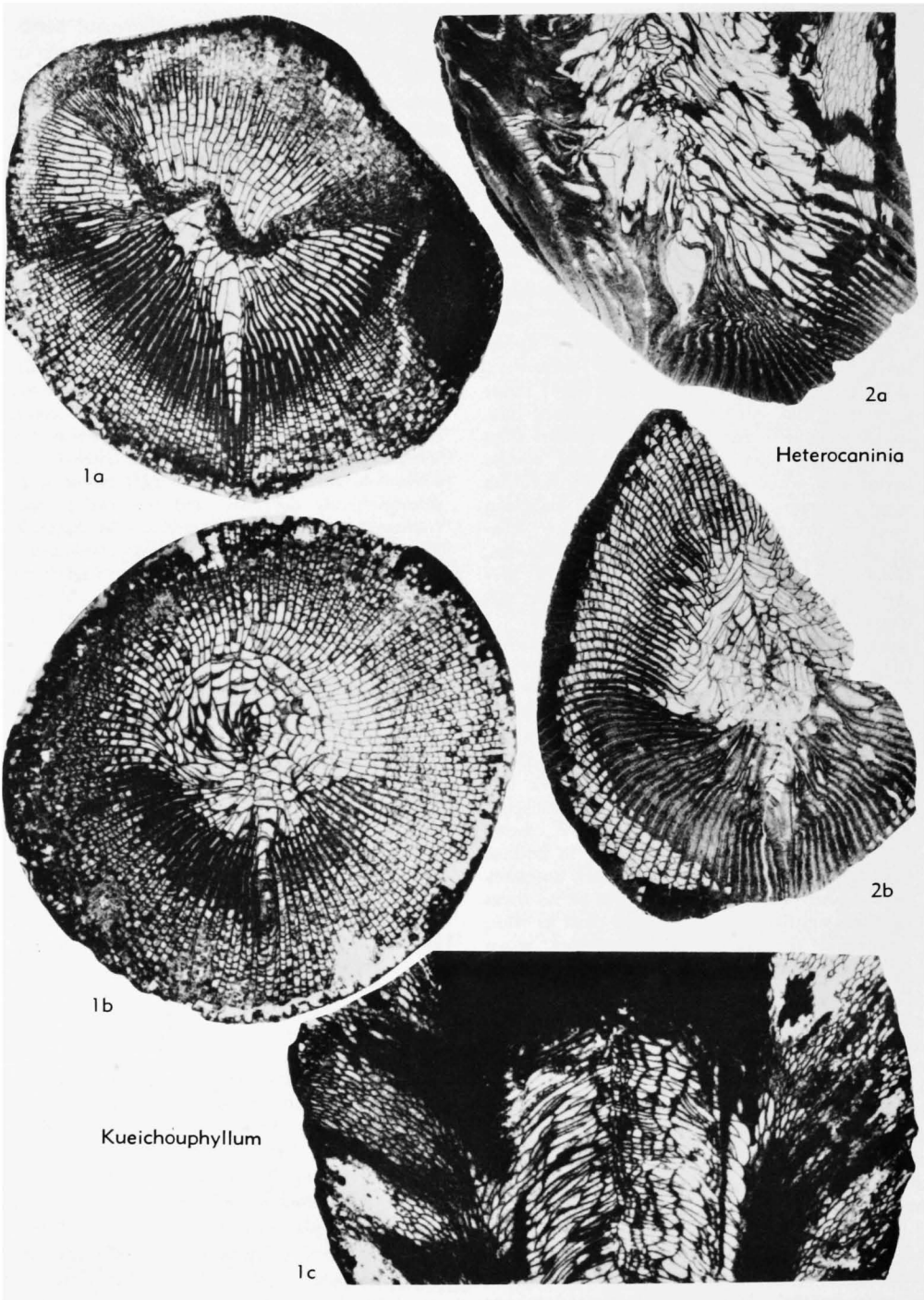


FIG. 243. Aulophyllidae (p. *F371-F373*).

Kazakh.-Armenia)-Eu. (Czech.)-W. Australia.—— FIG. 243,*1a-c*. **K. sinense; a,* holotype, Visean, Jung-tung, Kweichow, Ting-fan-hsien, transv. sec., ×1.5; *b,c,* another specimen, Visean, Kwangsi, Tang-chia-shih, Hsing-an-hsien, transv., long. secs., ×1.5 (Yü, 1934).

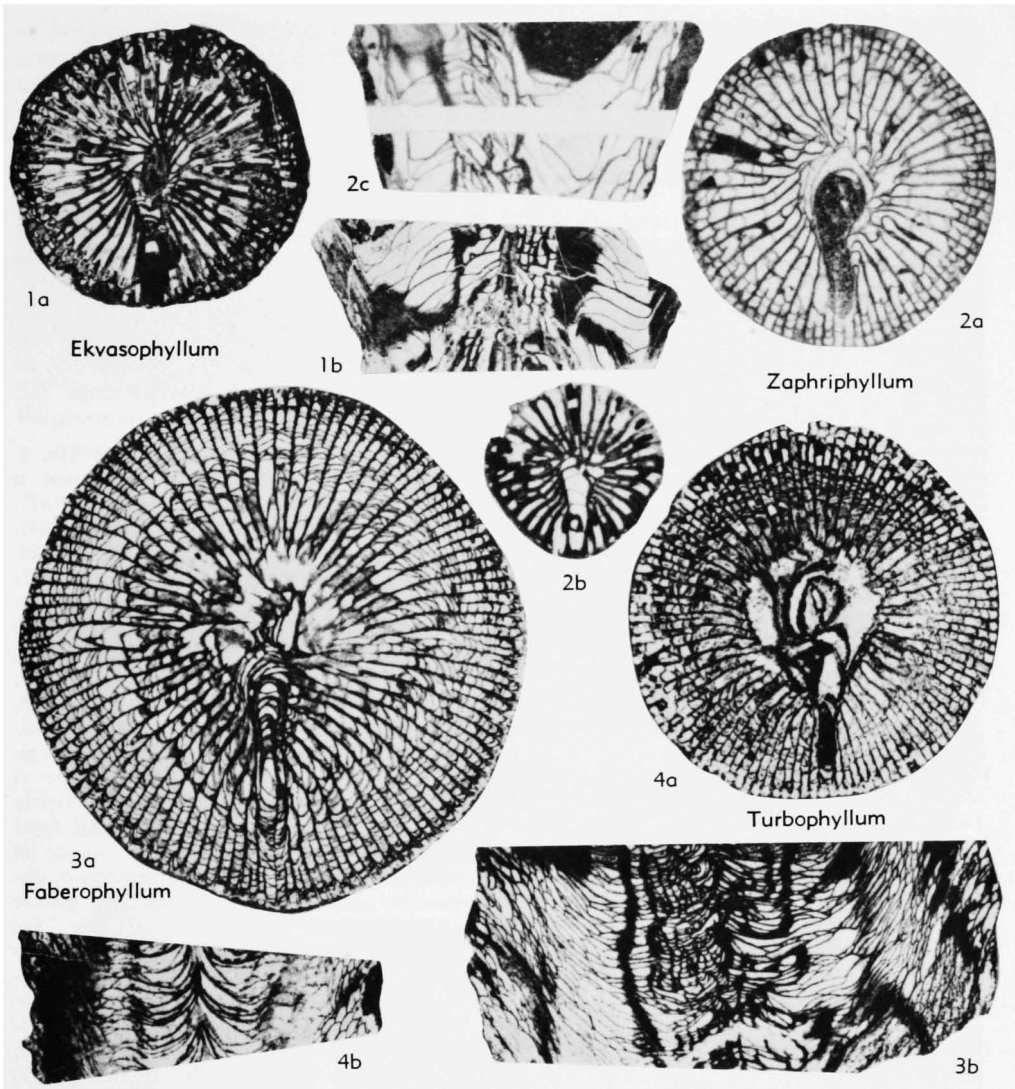


FIG. 244. Ekvasophyllidae (p. *F373-F374*).

Family EKVASOPHYLLIDAE Hill, new family

Solitary, curved, convex side cardinal; cardinal septum short, major septa long, numerous, subradial in counter quadrants, in cardinal quadrants pinnate toward long, deep fossula that expands and is deepest adaxially and in some may embrace part of solid columella; axial structure commonly present, columellar in early stages but may be acrophylloid or absent in late stages; tabular floors axially conical where axial structure present, otherwise sagging; minor septa short to moderately long, dissepimentarium narrow to moderately wide. *L.Carb.*

Ekvasophyllum PARKS, 1951, p. 175 [**E. inclinatum*; OD; †115997, USNM, Washington] [=*Ekwasophyllum* IVANOVSKIY, 1973b, p. 273, *nom. null.*]. Solitary, slightly curved, trochoid; septa numerous, tending toward radial symmetry except near prominent fossula, to which they are pinnately arranged; cardinal septum very short, on convex side of corallum in long, deep fossula whose axial end embraces part of rodlike columella commonly slightly compressed laterally; septa thickened in early stages, especially in tabularium and in cardinal quadrants; tabular floors broadly

conical, with upturned edges, tabulae incomplete; dissepimentarium narrow, normal concentric [see ARMSTRONG, 1970, p. 11]. *Low.U.Miss.(Meramec.),* N. Am. (Utah-?Cal.-Ariz.-B. C.-Alberta-Alaska); *L.Carb.,* ?Asia(Hunan).——FIG. 244, *1a,b.* **E. inclinatum,* holotype, Brazer Ls., Utah, Leatham Hollow, Wasatch Mts.; *a,b,* transv., long. secs., ×2 (Parks, 1951).

Faberophyllum PARKS, 1951, p. 177 [**F. occultum*; OD; †116001, USNM, Washington] [?=*Turbophyllum* PARKS, 1951, which see]. Solitary, large, curved, convex side cardinal; septa very numerous, long, tending toward radial symmetry except near prominent fossula, toward which they are pinnately arranged; early stages ekvasophylloid with columella; in later stages minor septa long, cardinal septum short in deep, narrow fossula commonly closed and not embracing any part of weak axial structure that may consist of thin irregular medial plate with few septal lamellae and tabellae, or may fail; tabular floors sagging but uparched and conical axially when axial structure present; tabulae complete, close together; dissepimentarium wide, normal concentric [see ARMSTRONG, 1970, p. 14]. *Low.U.Miss.(Meramec.),* N.Am.(Utah-?Idaho-B.C.-Alberta-Alaska); *L. Carb.,* ?Asia (Taymyr-Kazakh.-Kuzbas)-?Eu. (Urals).——FIG. 244,*3a,b.* **F. occultum,* holotype, Brazer Ls., Utah, Wasatch Mts., *a,b,* transv., long. secs., ×2 (Parks, 1951).

Turbophyllum PARKS, 1951, p. 176 [**T. multiconum*; OD; †115999, USNM, Washington] [?=*Faberophyllum* PARKS, 1951, which see]. Like *Faberophyllum* but tabellae drawn up to continuity axially in late stages so that weak acrophylloid axial structure is formed with or without short medial plate. *Low.U.Miss.(Meramec.),* N.Am.(Utah-Alberta).——FIG. 244,*4a,b.* **T. multiconum,* holotype, Brazer Ls., Utah, Dry Lake, Wasatch Mts.; *a,b,* transv., long. secs., ×2 (Parks, 1951).

?Zaphriphyllum SUTHERLAND, 1954, p. 363 [**Z. disseptum*; OD; †10568, GSC, Ottawa]. Solitary, trochoid, curved, small to medium-sized; on convex side with prominent, deep fossula that expands and is deepest in axial region; cardinal septum very short; counter septum long with somewhat swollen axial edge in early stages, later shorter, other major septa long with subradial arrangement in counter quadrants, pinnate to fossula in cardinal quadrants; minor septa rather short; dissepimentarium narrow with normal, small, concentric dissepiments [see also SEMENOFF-TIAN-CHANSKY, 1974, p. 43]. *L.Carb.(mid.Miss.),* N.Am.(NW. Terr.-?Mont.); *L.Carb.(Visean),* ?Asia(Taymyr)-?N.Afr.(Alg.).——FIG. 244,*4a-c.* **Z. disseptum,* holotype, Can., Liard Ra., NW. Terr., *a,b,* transv., *c,* long. secs., all ×2 (Sutherland, 1954).

Family PALAEOSMILIIDAE Hill, 1940

[Palaeosmiliidae HILL, 1940 in 1938-1941, p. 115]

Solitary, ?fasciculate; cerioid, astreoid, or aphroid, corallites large; septa very numerous, long and subradially arranged, major may withdraw somewhat from axis, cardinal may shorten more than others; cardinal fossula long, narrow, shallow, distinct only in wide tabularium, commonly open and widening adaxially, merging with adaxial depression when septa withdrawn from axis, and with upturned peripheral edges; tabulae incomplete; dissepimentarium wide, normal concentric, lateral dissepiments correlated with septal structural complexity, or lonsdaleoid dissepiments may develop. *?U. Dev.-U.Carb.*

Palaeosmilia MILNE-EDWARDS & HAIME, 1848b, p. 467 [**P. murchisoni*; SM, MILNE-EDWARDS & HAIME, 1848c, p. 261; †48398, BOWERBANK Coll., BM(NH), London] [=*Strephodes* MCCOY, 1849, p. 4 (type, *S. multilamellatum,* M; †A2404, SM, Cambridge, lectotype by GARWOOD, 1913, p. 562; L.Carb., ?Arnside, U.K.); *Clisiophyllites* LÖWENECK, 1932, p. 98 (type, *C. tianschanensis,* M; †not traced, originally in Bayer. Staatssammlung, Münich, part of which was destroyed during war; Visean, Tianshan, China]. Solitary, ?fasciculate, corallites moderately large, with numerous, radially arranged, long septa, wide, regular dissepimentarium, and long, shallow fossula narrow at outer part of wide tabularium, widening slightly nearer to axis; tabulae incomplete; tabular floors flattened domes with upturned edges, sagging at axis when major septa somewhat withdrawn; dissepiments numerous, regular, small and globose [see KABAKOVICH, 1952, p. 85]. *?U.Dev.,* Eu. (Belg.-Ger.)-W.Australia; *L.Carb.-U.Carb.(?Tournais.-Visean-?Namur.),* Eu. (Brit. I.-France-Belg.-Ger.-Carnic Alps-?Czech.-Pol.-USSR)-Asia(?Urals-A.Minor-Taymyr-Kazakh.-Kirghiz.-?Kuzbas-Kweichow-Kwangsi-Sinkiang-Japan-NE. USSR)-N. Afr. (W.Sahara).——FIG. 245,*1a,b.* **P. murchisoni,* D_2, Somerset, Frome; *a,* transv. sec., ×1.7 (Yü, 1937); *b,* another specimen, long. sec., ×1.7 (Hill, n; UQF12443).

Palastraea MCCOY, 1851b, p. 111 [**Astraea carbonaria* MCCOY, 1849, p. 125; M; †lectotype here chosen, A2395, SM, Cambridge; Visean, near Bakewell, Derbyshire, U.K.] [=*Palaeastraea* LANG, SMITH, & THOMAS, 1940, p. 93, *nom. van.; Palaeosmilastraea* YÜ & LIN in YÜ, LIN, & FAN, 1962, p. 17 (type, *Palaeosmilia (Palaeosmilastraea) suni,* OD; †Co451, GC, Changshun; Visean, Qinghai); *Paleosmilastraea* COTTON, 1973, p. 146, *nom. null.; Palaeasmiliastraea* IVANOVSKIY, 1973b, p. 279, *nom. null.*]. Cerioid, astreoid, or aphroid *Palaeosmilia. L. Carb. (Visean),* Eu. (Brit. I.-France-Belg.-Ger.-Urals)-N.Afr. (W.Sahara)-Asia (Taymyr-Kirghiz.-A.Minor-Kweichow-Chinghai); *U.Miss.(Chester.),* N. Am. (Ky.-Tenn.); *U. Carb. (Namur.),* Asia

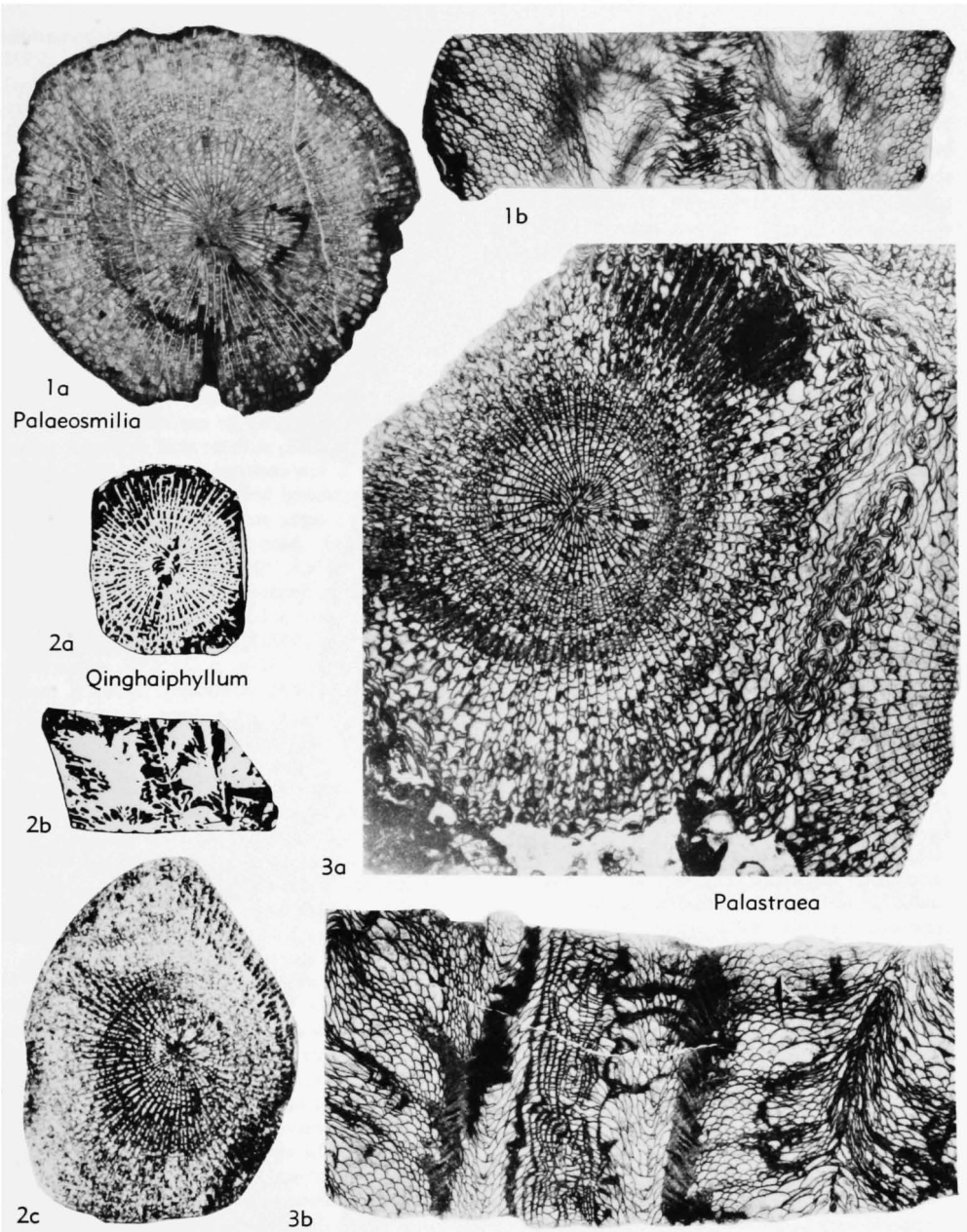


FIG. 245. Palaeosmiliidae (p. *F374-F376*).

(Kirghiz.).——FIG. 245,*3a,b*. **P. carbonaria* (McCoy), lectotype, Visean, U.K., near Bakewell, Derbyshire; *a,b,* transv., long. secs., ×1.7 (Hill, n; photographs courtesy Colin Forbes).

Qinghaiphyllum Lo, 1962, reference not traced, quoted from YOH & WU, 1964, p. 132 [?**Q. sinense* Lo, 1962; ?OD; †not traced]. Solitary, cylindrical; like *Palaeosmilia* but with lathlike columella in median plane. [Insufficiently known.] *L.Carb.(Visean),* Asia(Kweichow).——FIG. 245, *2a,b*. ?**Q. sinense*; transv., long. secs., ×0.8 (Yoh & Wu, 1964).——FIG. 245,*2c*. *Q.* sp., up. Visean, W. Kweichow; transv. sec., ×1.2 (Wu, Chang, & Ching, 1974).

?Family APHROPHYLLIDAE Hill, 1973

[Aphrophyllidae HILL, 1973, p. 135]

Solitary or compound; major septa commonly extending to axial region, axial ends of one to four commonly asymmetrically placed groups of small numbers of neighbors curving toward one another around shorter septum, not necessarily a protoseptum; less commonly major septa somewhat withdrawn from axis and septal grouping not apparent; protosepta and fossula commonly not distinct; irregular axial structure of sparse septal lamellae and axial tabellae may develop; tabulae broadly domed, nearly flat or when major septa are withdrawn from axis, gently sagging; in dissepimentarium septa may be replaced by naotic columns of dissepiments or be discontinuous through peripheral zone of irregular, large lonsdaleoid dissepiments [see also JULL, 1974, p. 7]. *L.Carb.(up.Tournais.-Visean).*

Aphrophyllum SMITH, 1920, p. 51 [**A. hallense*; M; †F17640, AM, Sydney and A5051, SM, Cambridge]. Cerioid; major septa commonly long and including one, two, or a few pinnate groups in which axial ends curve toward one another about a shorter septum not necessarily a protoseptum, but may be short; an inconstant and irregular axial structure may be present; minor septa well-developed; peripheral parts of septa may be replaced each by column of naotic dissepiments; irregular, unequal lonsdaleoid dissepiments developed peripherally, in variably wide zone; tabulae domed or less commonly mesa-shaped, altering to flat or sagging in corallites with short major septa; increase lateral, rarely parricidal-peripheral; trabeculae monacanthine [see JULL, 1974, p. 8]. *L.Carb.(Visean)*, Australia(New S.Wales-Queensl.).——FIG. 246,*4a,b*. **A. hallense*, New S. Wales, Halls Cr., about 17 mi. S. of Bingara; *a,b*, transv., long. secs., of different specimens, ×1.7 (Jull, 1969b).

Aphrophylloides PICKETT, 1967a, p. 32 [**A. careyi*; OD; †F7983, UNE, Armidale]. Cerioid or fasciculate; axial ends of some major septa may fuse and participate, with discrete septal lamellae and tabellae, in variable, ill-defined, loose axial structure; minor septa short, dissepimentarium with large, low, lonsdaleoid dissepiments peripherally, and normal concentric dissepiments in inner parts; cardinal and, less commonly, counter septum may be longer than others; naotic modifications of septa may develop; tabular floors tent-shaped, with upturned edges, the axial parts contributing to ill-defined axial structure [JULL, 1974, p. 15]. *L. Carb.(Visean)*, Australia(New S.Wales-Queensl.).——FIG. 247,*2a,b*. **A. careyi*, holotype, Parish New S. Wales, Babbinboon, Hill 60, Por. 60; *a,b*, transv., long. secs., ×2.0, ×2.5 (Pickett, 1967a).

Coenaphrodia JULL, 1974, p. 21 [**Orionastraea lonsdaleoides* HILL, 1934, p. 91; OD; †F2938, UQ, Brisbane, part is A5485, SM, Cambridge]. Like *Aphrophylloides* but partly or completely aphroid and with flat or sagging tabulae in corallites, which commonly have axial structure. *L. Carb.(Visean)*, Australia(Queensl.).——FIG. 246, *1a,b*. **C. lonsdaleoides* (HILL), holotype, Riverleigh Ls., Latzas Farm, 6.4 km. NW. of Mundubbera; *a,b*, transv., long. secs., ×1.7 (Jull, 1974).

Merlewoodia PICKETT, 1967a, p. 24 [**M. bensoni*; OD; †F5588, UNE, Armidale]. Solitary, moderately large; septa numerous; major septa reach or nearly reach axis, with slightly enlarged axial ends, but not confluent; cardinal septum short, counter septum long; minor septa short; septa dilated, dilatation may be continuous over dissepiments and tabulae; without axial structure; tabular floors like a low-crowned hat with axial depression and upturned brim; dissepiments lonsdaleoid peripherally; septa may be naotic in places. *L. Carb.(Visean)*, Australia(New S.Wales-Queensl.).——FIG. 246,*3a,b*. **M. bensoni*, Swains Gully Ls., New S. Wales, Swains Gully, Babbinboon; *a*, holotype, long. sec., ×1.7; *b*, paratype, transv. sec., ×1.7 (Pickett, 1967a).

Naoides PICKETT, 1967a, p. 24 [**N. rangariensis*; OD; †F5612, UNE, Armidale]. Solitary, moderately large; major septa long, nearly reaching axis, minor septa short; all septa greatly dilated and laterally contiguous except for sporadic dissepiments, becoming naotic peripherally in late stages; septa of cardinal quadrants pinnate about short cardinal septum; counter septum long; tabular floors shallow domes. [Insufficiently known.] *L.Carb.(up.Tournais.)*, Australia(New S.Wales).——FIG. 247,*3a,b*. **N. rangariensis*, holotype, Rangari Ls., Co. Nandewar, Por. 1, Parish Rangari; *a,b*, transv., long. secs., ×2.0 (Pickett, 1967a).

Nothaphrophyllum PICKETT, 1967a, p. 23 [**N. gregarium*; OD; †F5621, UNE, Armidale]. Phaceloid; septa discontinuous peripherally with lonsdaleoid or some naotic dissepiments; major septa almost reaching axis except for cardinal, which is shorter or ?longer than others; ends of adjacent septa may be curved around inner end of cardinal septum; without axial structure; minor septa short, may be contratingent or reduced from periphery, leaving inosculating dissepiments in loculi between major septa; dissepiments steeply inclined; tabulae incomplete, tabular floors flatly domed axially, periaxial tabellae variable; increase lateral or, rarely, parricidal-peripheral [see JULL, 1974, p. 22]. *L.Carb.(Visean)*, Australia(New S.Wales-Queensl.).——FIG. 246,*2a-c*. **N. gregarium*, holotype, New S. Wales, Chatham Quarry, Taree; *a,b*, transv. secs., ×2.9; *c*, long. sec., ×1.7 (Pickett, 1967a).

Symplectophyllum HILL, 1934, p. 64 [**S. mutatum*; OD; †F2943, UQ, Brisbane]. Solitary; with axial structure wide and with variable dibuno-

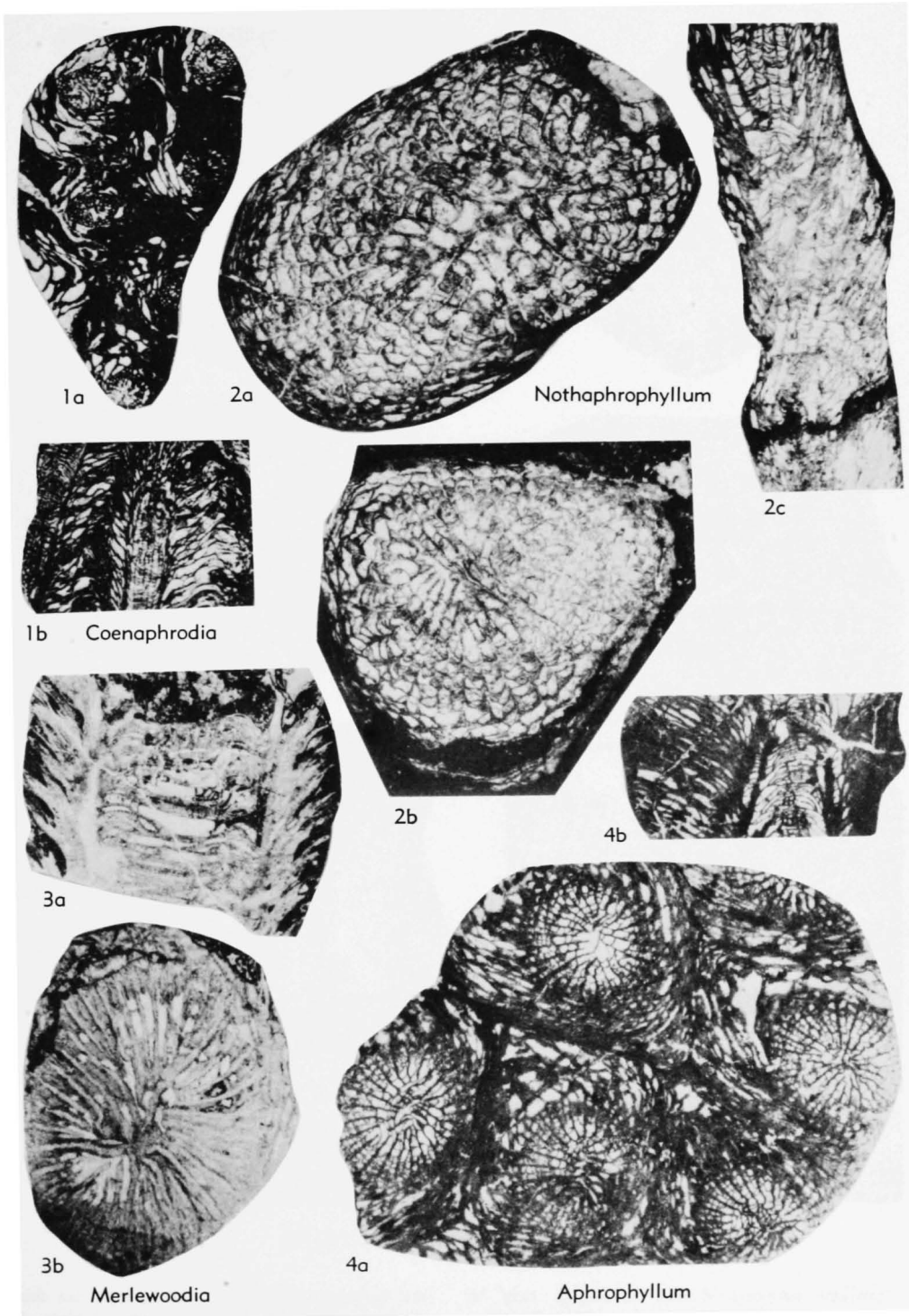


FIG. 246. Aphrophyllidae (p. *F376-F377*).

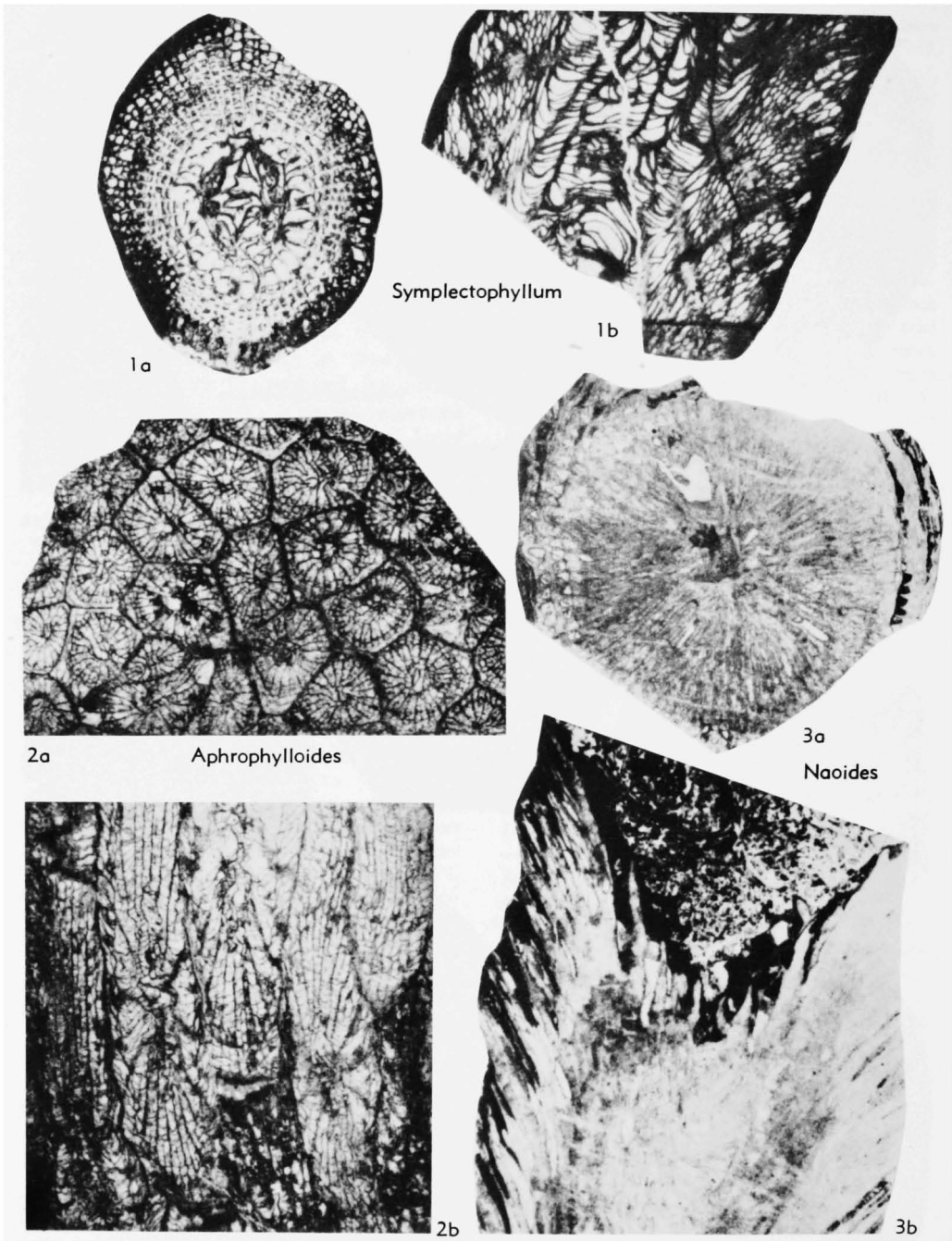


FIG. 247. Aphrophyllidae (p. *F376-F378*).

phylloid patterns; skeletal thickening may be great, not regular; septa naotic peripherally; tabulae low domes, complete or incomplete; minor septa well developed; fossula commonly not distinct; inner parts of dissepimentarium with normal concentric dissepiments where septa are thin. *L. Carb. (Visean),* Australia (Queensl.-New S. Wales).——FIG. 247,*1a,b.* **S. mutatum,* holotype, Latzas F., Riverleigh Ls., Queensl., near Mundubbera; *a,b,* transv., long. secs., ×2.0 (Jull, 1969b).