

SYSTEMATIC DESCRIPTIONS

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Phylum ARCHAEOCYATHA Bornemann, 1884

[*nom. transl.* OKULITCH, 1955, p. E8 (ex class Archaeocyathinae BORNEMANN, 1884, p. 706), *nom. correct.* VOLOGDIN, 1937, p. 464] [=Archaeocyathinae TAYLOR, 1910, p. 105 (class); Cyathospongia OKULITCH, 1935, p. 88 (class); Archaeocyathi R. BEDFORD & W. R. BEDFORD, 1936, p. 9 (class); Archaeocyatha VOLOGDIN, 1937, p. 464 (subphylum of Porifera); Pleospongia OKULITCH, 1943 (class); Archaeocyatha OKULITCH, 1955, p. E8 (phylum); Archaeocyathi KRASNOPEEVA, 1955, p. 17 (phylum); Euarchaeocyathi ZHURAVLEVA, 1960, p. 80 (class)] [equivalent to Archaeocyathaceae SIMON, 1939, p. 5 (superfam.)]

Skeleton in form of calcareous cup composed of porous wall, or more commonly porous outer and inner walls, with central cavity; porous septa, tabulae, and nonporous rods, bars, and dissepiments may form in intervallum. Plates of skeleton not spiculate, of microgranular calcite. *L.Cam.-M.Cam.* (base), ?*U.Cam.*

Class REGULARES Vologdin, 1937

[*nom. correct. et transl.* ZHURAVLEVA, 1960, p. 80 (subclass) (ex Regularia VOLOGDIN, 1937, class) (use of this term to be avoided, because of its frequent use for major subdivisions of Echinoidea and Cystoidea)] [=Monocyatha OKULITCH, 1943, p. 44 (subclass); Septoidea KRASNOPEEVA, 1953, p. 55 (class); Monocyatha OKULITCH, 1955, p. E9 (class)] (*nom. correct. pro* Monocyatha OKULITCH, 1943)]

Solitary, rarely colonial; outer form of cup conical, ranging from cylindrical to saucer-shaped. Cups with one or more commonly two walls; intervallum with tabulae alone or with septa and commonly with flat or convex tabulae; axis of curvature of convex tabulae in intervallum; lon-

gitudinal pore-rows of septa diverge fanwise; dissepiments may be present. In early stages of *Ajacicyathus* type aporose tip widens and extends as one-walled porous cup without dissepiments, then, porous inner wall develops, quickly followed by septa or tabulae or both. *L.Cam.-M.Cam.* (*Paradoxides oelandicus* Zone).

Order MONOCYATHIDA Okulitch, 1935

[*nom. correct.* OKULITCH, 1955, p. E9 (*pro* Monocyathina OKULITCH, 1935, p. 90)] [=order Archaeolythida ZHURAVLEVA, 1957, p. 174]

Solitary, or rarely colonial; small. Cup either conical with one wall, porous except at tip, and in some, a pelta; or saclike and two-walled without pelta, the inner wall like a pocket, closed at base. *L.Cam.* (*low. Tommot.-low.Len.*).

Suborder MONOCYATHINA Okulitch, 1935

[*nom. transl.* ZHURAVLEVA in ZHURAVLEVA, KONYUSHKOV & ROZANOV, 1964, p. 59 (ex order Monocyathina OKULITCH, 1935, p. 90)]

Solitary or rarely colonial; not large. Cup conical or cylindrical, with one wall, porous except in early stages, and commonly with a pelta; without inner membranous sac. *L.Cam.* (*low.Tommot.-low.Len.*).

Family MONOCYATHIDAE Bedford & Bedford, 1934

[Monocyathidae BEDFORD & BEDFORD, 1934, p. 2] [=Rhabdocnemidae OKULITCH, 1943, p. 45 (nom. subst. pro Rhabdocyathidae VOLOGDIN, 1931, p. 52, invalid family-group name based on junior homonym); Archaeolythidae ZHURAVLEVA, 1949, p. 550; Monocyathinae (nom. transl. ZHURAVLEVA, 1963, p. 74); Rhabdocyathellidae ZHURAVLEVA, 1963, p. 114]

Small, solitary or colonial. Single wall, simply porous, or with pore canals. Pelta commonly porous. Adherent outgrowths massive, tubulose. *L.Cam.(low.Tommot.-low.Len.)*.

Archaeolythus TAYLOR, 1910, p. 158 [**Monocyathus porosus* R. BEDFORD & W. R. BEDFORD, 1934, p. 2; SD SIMON, 1939, p. 21] [=*Monocyathus* R. BEDFORD & W. R. BEDFORD, 1934, p. 2 (type, *M. porosus*; SD R. BEDFORD & W. R. BEDFORD, 1936, p. 20); *Rhabdocnema* OKULITCH, 1937, p. 252 (nom. subst. pro *Rhabdocyathus* VON TOLL, 1899, p. 45, non BROOK, 1893) (type, *R. sibiricus*, M), for discussion see HILL, 1965, p. 51; *Rhabdocyathella* VOLOGDIN, 1937, p. 474 (type, *R. lebedevae*; M), for discussion see HILL, 1965, p. 53]. Small, solitary or colonial, conical or cylindrical; wall with simple, rounded or angular pores which are arranged in quincunx and may be protected with spines. Top of cup may be screened by a porous pelta, commonly with central orifice. Tersiae may develop both externally and in central cavity. Anchoring processes tubular. *L.Cam.(low.Tommot.-low.Len.)*, USSR (S.Urals-Altay-Sayan-Sib.Platf.-Far East)-Mongolia-N.Afr.-Australia-Antarct.—FIG. 29,4a. **A. porosus* (BEDFORD & BEDFORD), lectotype, Botom., S. Australia; $\times 7$ (HILL, 1965).—FIG. 29,4b. *A. lebedevae* (VOLOGDIN), Mongolia; thin sec., $\times 5$ (Vologdin, 1940).

?**Rhabdolythus** ZHURAVLEVA, 1960, p. 91 [**R. conicus*; M]. Cup conical; wall with rounded pores, and with inner side strengthened by short, horizontal rods; anchoring processes massive. One specimen only figured. Wall structure may be questioned. *L.Cam.(low.Botom.)*, USSR (central R. Lena).—FIG. 29,3. **R. conicus*, Taryn hor., R. Lena; holotype, long. sec., $\times 74$ (Zhuravleva, 1960).

Family TUMULIOLYTHIDAE Rozanov, 1966

[Tumuliolythidae ROZANOV in ROZANOV & MISSARZHEVSKIY, 1966, p. 65]

Small; single wall with pores in tumuli; pelta may occur, but is without dependent saclike membrane; tersioid outgrowths may occur. *L.Cam.(up.Tommot.-Botom.)*.

Tumuliolythus ZHURAVLEVA, 1963, p. 101 [**Rhabdocyathus tubexternus* VOLOGDIN, 1932, p.

65; OD]. Like *Monocyathus* but wall with pores in tumuli. *L.Cam.(up.Tommot.-Botom.)*, USSR (S.Urals - Altay - Sayan - Sib.Platf. - Transbayk - Far East)-Mongolia-Australia.

T. (Tumuliolythus). With pores opening on upper surfaces of tumuli. *L.Cam.(up.Tommot.-low.Botom.)*, USSR (S.Urals-Altay-Sayan-Sib.Platf.-Far East)-Mongolia-Australia.—FIG. 29,1. **T. (T.) tubexternus* (VOLOGDIN), up.Aldan-Botom., Altay; *1a*, transv. sec. with secondary thickening, $\times 73$ (Vologdin, 1940b); *1b*, reconstr., $\times 15$ (Zhuravleva, 1963b); *1c*, long. sec. through tumulus, $\times 40$ (Zhuravleva, 1963b).

T. (Propriolythus) OKUNEVA, 1967, p. 133 [**Archaeolythus vologdini* YAKOVLEV, 1956, p. 855; OD]. With pores opening on lower surfaces of tumuli. *L.Cam.(Botom.)*, USSR (Tuva-Sib.Platf.-Far East)-Yukon.—FIG. 29,5. **T. (P.) vologdini* (YAKOVLEV), USSR (Far East); tang. sec., $\times 15$ (Okuneva, 1967).

Family ETHMOLYTHIDAE Zhuravleva, 1963

[nom. transl., herein, ex Ethmolythinae ZHURAVLEVA, 1963, p. 112]

Solitary, single-walled, free of internal skeletal elements; wall with horizontal pore-canals, communicating with one another. *L.Cam.(up.Atdaban.-Botom.)*.

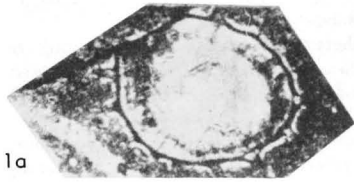
Ethmolythus ZHURAVLEVA, 1963, p. 112 [**E. rosanovi*; OD]. Solitary, slenderly conical or cylindrical; wall with horizontal intercommunicating pore-canals. *L.Cam.(up.Atdaban.-Botom.)*, USSR (Altay-Sayan).—FIG. 29,2. **E. rosanovi*, up.Atdaban., Kameshki; *2a*, Tuva, part of transv. sec., $\times 74$; *2b*, Altay, part of long. sec. of holotype, $\times 13.3$ (Zhuravleva, 1963b).

Family CRYPTOPOROXYATHIDAE Zhuravleva, 1960

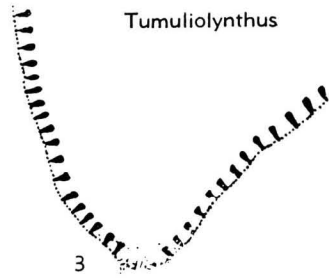
[Cryptoporocyathidae ZHURAVLEVA, 1960, p. 92] [=Cryptoporocyathidae ZHURAVLEVA, 1963, p. 117 (nom. null.)]

Solitary, widely conical, without anchoring processes. Single wall thick, with pore-canals of two sizes, the smaller all opening at outer surface and many into the larger. *L.Cam.(low.Tommot.-low.Atdaban.)*.

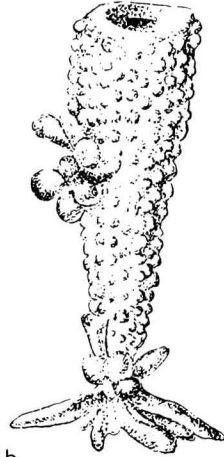
Cryptoporocyathus ZHURAVLEVA, 1960, p. 92 [**C. junicanensis*; OD] [=*Cryptaporocyathus* ZHURAVLEVA, 1963b, p. 117 (nom. null.)]. Solitary, widely conical, without anchoring processes. Single wall thick, with pore canals of two sizes, the smaller all opening at outer surface and into larger. *L.Cam.(low.Tommot.-low.Atdaban.)*, USSR (Yakutia).—FIG. 4,8; 30,2. **C. junicanensis*, holotype, up.Tommot.; 30,2*a,b*, long. sec., $\times 7$ (Zhuravleva, 1963); 4,8, reconstr., $\times 0.75$;



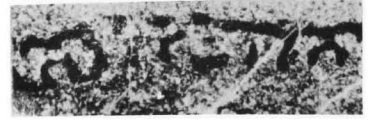
Tumuliolythus



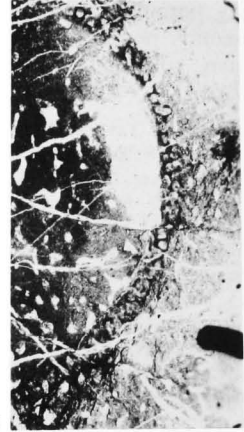
Rhabdolythus



1b



Ethmolythus



2a



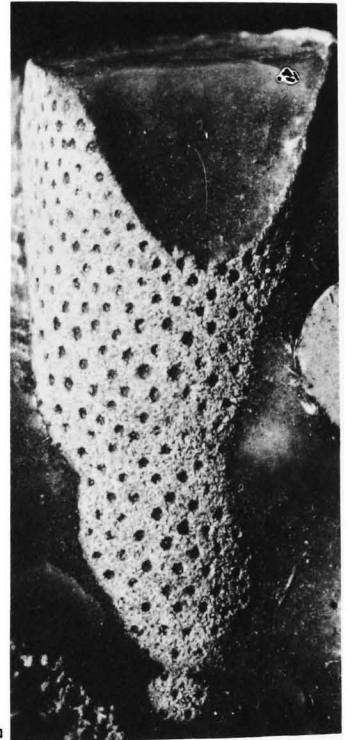
Archaeolythus



1c



Propriolythus



4a

30,2c, long. sec., diagram., $\times 13$ (Zhuravleva, 1960b).

Suborder GLOBOSOCYATHINA
Okuneva, 1969

[Globosocyathina OKUNEVA, 1969, p. 74]

Solitary, cups one-walled, saclike or hemispherical; upper surface with pelta having deep invagination bounded by porous membrane simulating an inner wall; pores of wall may be simple, or with tumuli, or may be canals. Heel-like outgrowths absent. *L.Cam.*(*up.Atdaban.-low.Len.*).

Family GLOBOSOCYATHIDAE
Okuneva, 1969

[Globosocyathidae OKUNEVA, 1969, p. 75]

Solitary, saclike cups, almost spherical; wall with canals provided with beaks; pelta sparsely porous with deeply invaginated membrane closed at proximal end. *L.Cam.* (*Botom.*).

Globosocyathus OKUNEVA, 1969, p. 75 [**G. bellus*; OD]. Solitary, cup saclike, almost spherical; wall with pore-canals provided with beaks; pelta sparsely porous, with a deep invagination bounded by a thin wall. *L.Cam.*(*Botom.*), USSR (Far East).—FIG. 30,4. **G. bellus*, holotype, near Chernigorsk, Primore, Far East; 4a, long. sec., $\times 4$; 4b, outer wall, tang. sec., $\times 13$; 4c, tang. sec., porous membrane, $\times 13$ (Zhuravleva, 1969).

Family CAPSOLYNTHIDAE
Okuneva, 1969

[Capsolyntidae OKUNEVA, 1969, p. 75]

Cup saclike or hemispherical; pores of wall simple or with tumuli. *L.Cam.*(*up. Atdaban.-Botom.*).

Capsolyntus OSADCHAYA in ZHURAVLEVA, *et al.*, 1967, p. 26 [**C. helenae*; OD]. Small, solitary, saclike or almost hemispherical, without anchoring processes. Pores of single wall simple, rounded. Pelta flat, aporose, with central orifice from edge of which a porous membrane sags deeply into cavity of the cup. *L.Cam.*(*up.Atdaban.-Botom.*), USSR (Tuva).—FIG. 30,3. **C. helenae*, holotype, Botom., R. Shivelig-Khem.; long. sec., $\times 4$ (Zhuravleva, *et al.*, 1967).

Family "RHABDOCYATHELLIDAE
Zhuravleva," 1963

[Rhabdocyathellidae ZHURAVLEVA, 1963, p. 114; invalidly based on a genus whose monotype species, *Rhabdocyathella lebedevae* VOLOGDIN, 1937, p. 474, was transferred to *Archaeocolynthus* by ZHURAVLEVA (1963, p. 84)]

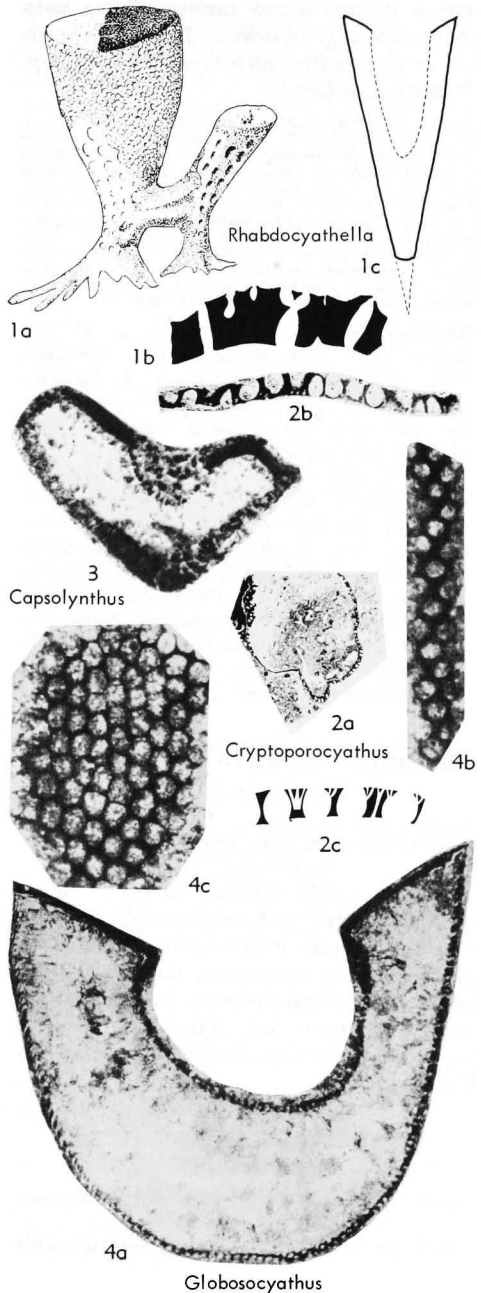


FIG. 30. Cryptoporocyathidae (2); Globosocyathidae (4); Capsolyntidae (3); "Rhabdocyathellidae" (1) (p. E51, E53-E54).

Single-walled cups, the wall with pore-canals and modified externally as micro-

porous sheath; upper surface of cup with pelta, from edge of orifice in which depends saclike thin porous membrane. *L.Cam.(up. Attaban-low.Len.)*.

[ZHURAVLEVA (1963, p. 84) accepted VOLOGDIN's (1940b, p. 95) invalid citation of *R. baileyi* VOLOGDIN, 1940b, as type of *Rhabdocyathella* VOLOGDIN, 1940. The genus based on *R. baileyi* should be given another name. The holotype of *R. baileyi* is not known, however (*vide* ZHURAVLEVA, *et al.*, 1967, p. 29); further, in this last work, a figure was given (fig. 7, p. 29) showing a cup with a pelta forming the upper surface, from the edge of the orifice in which is suspended a saclike porous membrane like that of *Capsulocyathus* and *Globosocyathus*. Until the holotype is found or a neotype is selected for *R. baileyi*, the systematic position of "*Rhabdocyathella*" must be in doubt.]

"*Rhabdocyathella*" VOLOGDIN, 1940, p. 95 [**R. baileyi*; OD] [*non Rhabdocyathella* VOLOGDIN, 1937, p. 474 (type by monotypy, *R. lebedevae* VOLOGDIN, 1937, p. 474)]. Single-walled cups, the wall with funnel-shaped pore-canals and modified by external microporous sheath; upper surface of cup with pelta from edge of orifice in which depends thin, saclike microporous sheet; anchoring processes massive, tubulose. [Type-specimen not known; definition following ZHURAVLEVA, *et al.*, 1967, p. 29.] *L.Cam.(up. Attaban-low.Len.)*, USSR (Altay-Sayan-Sib. Platf.).—FIG. 30, 1. **R. baileyi*, Sayan; 1a, reconstr., $\times 1.33$; 1b, part of transv. sec., $\times 27$ (Zhuravleva, 1963b); 1c, long. sec., diagram, $\times 1.3$ (Zhuravleva, *et al.*, 1967).

Suborder CAPSULO CYATHINA Zhuravleva, 1964

[Capsulocyathina ZHURAVLEVA in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 59] [=Uralocyathina DEBRENNE, 1964, p. 113]

Solitary, rarely colonial; saclike or hemispherical; outer wall with simple or complex pores, inner wall eccentric, formed by pushing down of part of outer wall into cavity; no skeletal elements in intervallum. At upper rim of cup inner wall may be produced funnel-like. *L.Cam.(up. Tommot.-Botom.)*.

Family CAPSULO CYATHIDAE Zhuravleva, 1964

[Capsulocyathidae ZHURAVLEVA in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 60]

Solitary, saclike or hemispherical, with eccentric inner wall; outer wall with numerous simple pores; inner wall thinner than outer, with numerous, simple pores. *L.Cam.(up. Tommot.-Botom.)*.

Capsulocyathus VOLOGDIN, 1962, p. 75 [**C. capsulifer* (not figured, described or separately diagnosed); OD (ZHURAVLEVA in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 61, invalidly

chose as type *C. subcallosus* ZHURAVLEVA in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 62)]. Cup oval in transverse section, wall with simple rounded pores and with weakly marked porous inner wall. *L.Cam.(up. Tommot.-Botom.)*, USSR (Sib. Platf.-Altay-Sayan-Transbayk-Far East)-Mongolia.—FIG. 31, 1a, b. *C. irregularis*

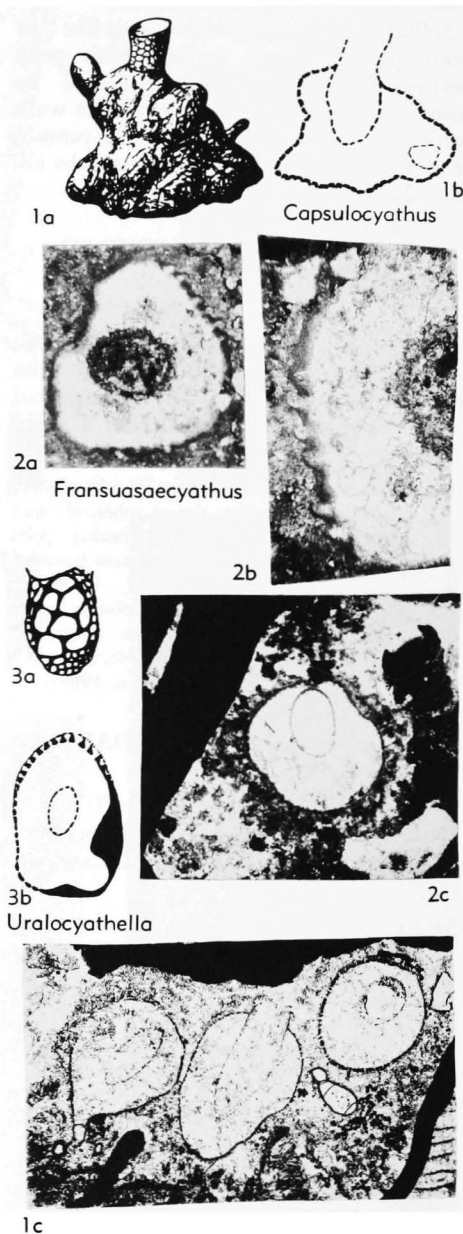


FIG. 31. Capsulocyathidae (1); Fransuasaeocyathidae (2); Uralocyathellidae (3) (p. E54-E55).

(ZHURAVLEVA), Sanashtykgol, Altay-Sayan; 1a, reconstr., 1b, long. sec., both $\times 74.5$ (Zhuravleva, et al., 1964).—FIG. 31,1c. *C. subcallosus* ZHURAVLEVA, Sanash., Sayan; thin secs., $\times 3$ (Zhuravleva, et al., 1964).

Family FRANSUASAECYATHIDAE
Debrenne, 1964

[Fransuasacyathidae DEBRENNE, 1964, p. 113]

Solitary, saclike or hemispherical, with eccentric inner wall; outer wall with pores in tumuli; inner wall thinner than outer, with numerous simple pores. *L.Cam. (Atdaban.-Botom.)*.

Fransuasacyathus ZHURAVLEVA, 1960, p. 103 [**F. subtumulatus*; OD]. Solitary, hemispherical or saclike; pores of outer wall tumulose, of thin inner wall simple, rounded or angulate. *L.Cam. (Atdaban.-Botom.)*, USSR (S.Urals-Sayan-Sib. Platf.-Far East).—FIG. 4,11; 31,2. **F. subtumulatus*, holotype, Atdaban., Yakutia; 4,11, reconstr., $\times 75$; 31,2a, transv. sec., $\times 5$; 31,2b, part of transv. sec., $\times 1.6$; 31,2c, thin sec., $\times 8$ (Zhuravleva, 1960b).

Family URALOCYATHELLIDAE
Zhuravleva, 1964

[Uralocyathellidae ZHURAVLEVA, 1964, in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, p. 72]

Solitary, saclike, hemispherical cups with eccentrically arranged inner wall. Outer wall comprises thick main wall with large pores and an outer sheath with small pores. Inner wall thin, with numerous simple pores. *L.Cam. (Botom.)*.

Uralocyathella ZHURAVLEVA in ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA, 1960, p. 99 [**U. repinae*; OD]. Solitary, hemispherical. Outer wall with large pores, and external microporous sheath. Inner wall thin, with simple pores. *L.Cam. (Botom.)*, USSR (Altay-Sayan).—FIG. 31,3a. **U. repinae*, holotype, Sanashtykgol, Sayan; tang. sec. outer wall, $\times 232$ (Zhuravleva, et al., 1964).—FIG. 31,3b. *U. bullata* ZHURAVLEVA, Sanashtykgol, E. Sayan; oblique long. sec., $\times 22$ (Zhuravleva, et al., 1964).

?Family URALOCYATHIDAE
Zhuravleva in Vologdin, 1956

[Uralocyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 878] [=Vacuocyathidae VOLOGDIN, 1962, p. 77]

Solitary, cylindrical to saclike. Outer wall vaguely porous, inner wall simply porous; no other skeletal elements. *L.Cam. (up. Tommot.-Botom.)*.

Vacuocyathus OKULITCH, 1950, p. 392 [**Coelo-*

cyathus kirdjassovensis VOLOGDIN, 1937, p. 478 (*nom. nud.*), 1939, p. 237; OD] [=Coelocyathus VOLOGDIN, 1934, p. 502 (*nom. nud.*), 1937, p. 472 (*nom. nud.*), 1939, p. 269 (*non Coelocyathus* SCHLÜTER, 1886, p. 899 (type, *C. socialis*); nec SARRS, 1857, p. 126); *Uralocyathus* ZHURAVLEVA, 1950, p. 8 (*nom. nud.*), 1960, p. 102, *nom. subst. pro Coelocyathus* VOLOGDIN, 1939]. Solitary, ?cylindrical. Outer wall with ?simple pores; inner wall commonly eccentric with simple pores; devoid of other skeletal elements. Holotype insufficiently known. *L.Cam. (up. Tommot.-Botom.)*, USSR (S.Urals-Transbayk.-Mongolia-N.Afr.-Eu. (France).—FIG. 32,1. **V. kirdjassovensis* (VOLOGDIN), Botom., Urals; 1a,b, transv. secs., $\times 76$ (Vologdin, 1939); 1c,d, transv. secs., $\times 75$ (Vologdin, 1940b).

Melkaniocyathus BELYAEVA, 1969, p. 88 [**M. limitatus*; OD]. Solitary cups with extensive beaks over pores of outer wall and with spine-like beaks over pores of inner wall; intervallum void. *L.Cam. (Botom.)*, USSR (Far East).—FIG. 32,2. **M. limitatus*, R. B. Melkan, Far East; 2a,b, transv. and long. sec., $\times 10$ (Zhuravleva, 1969).

Velicyathus DEBRENNE, 1964, p. 125 [**V. levillaini*; OD]. Solitary, cylindrical; outer wall regularly porous, with simple, close pores; inner wall regularly porous; dissepiments in intervallum. *L.Cam. (Tasoušek.)*, N.Afr. (Morocco).—FIG. 32,3. **V. levillaini*, holotype; 3a, part of transv. sec.; 3b, part of long. sec., both $\times 2.5$ (Debrenne, 1964).

Order PUTAPACYATHIDA
Vologdin, 1962

[Putapacyathida VOLOGDIN, 1962, p. 118] [=Putapacyathina (suborder), *nom. transl.* ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 101]

Solitary, rarely colonial. Cup conical or cylindrical in form, composed of commonly complex outer and inner walls; neither radial links nor septa present, but walls are connected by tabulae; dissepiments may occur. *L.Cam. (Atdaban.-Botom.)*.

Family PUTAPACYATHIDAE
R. Bedford & J. Bedford, 1936

[Putapacyathidae R. BEDFORD & J. BEDFORD, 1936, p. 24] [=Putapacyathacea DEBRENNE, 1970 (superfamily), p. 24]

Cup conical or cylindrical; outer wall with simple pores, inner wall with pore canals, both walls strengthened by alternating longitudinal ribs; only tabulae present in intervallum. *L.Cam. (up. Atdaban. or low. Botom.)*.

Putapacyathus R. BEDFORD & J. BEDFORD, 1936, p. 24 [**P. regularis*; OD]. Solitary, cups conical

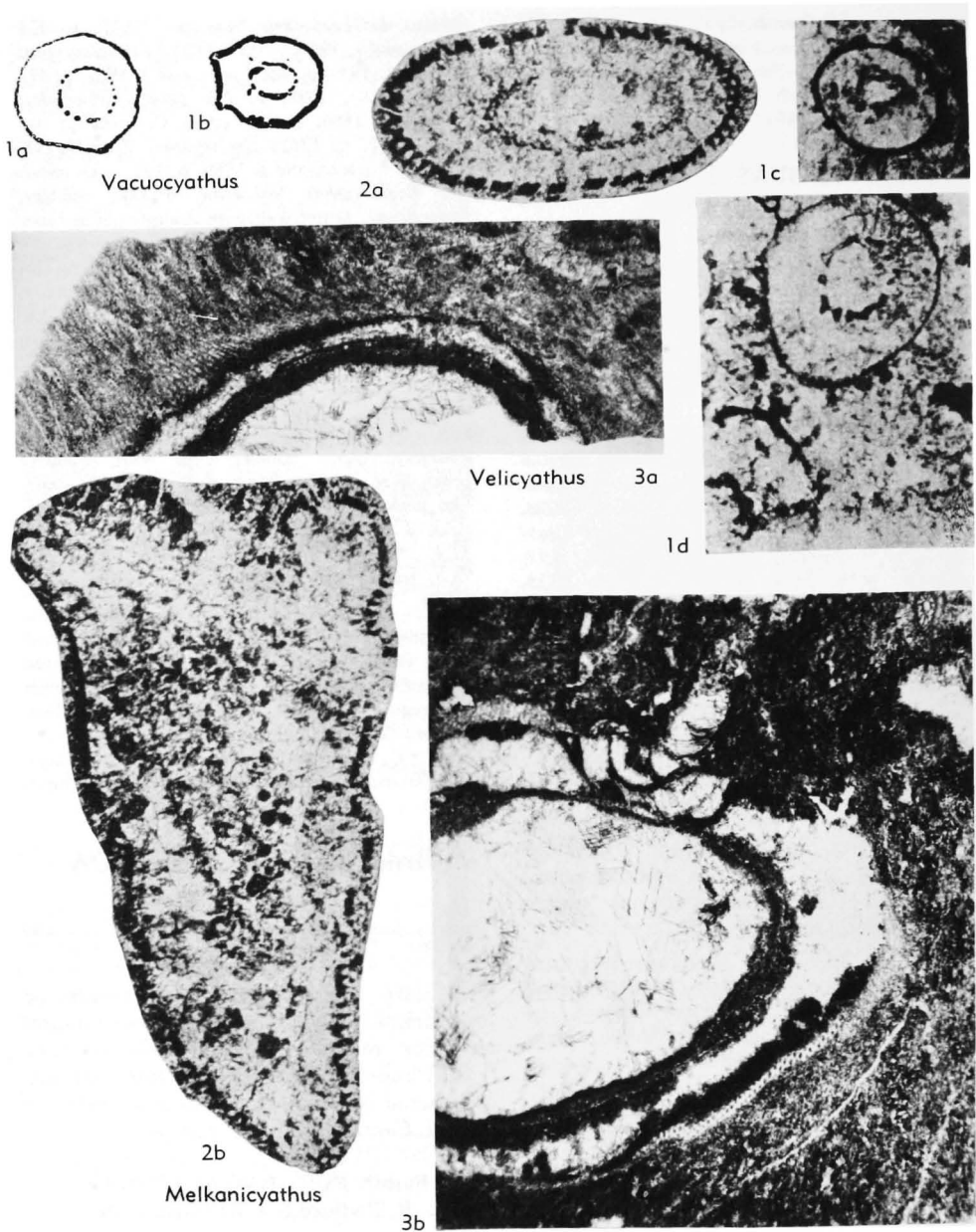


FIG. 32. Uralocyathidae (p. E55).

with outer and inner walls longitudinally ribbed or corrugated, ribs of outer and inner surfaces of wall alternating; outer wall simply porous, inner wall complex with pore canals; without septa or radial links; tabulae present, and in some, dissepiments. *L. Cam.* (up *Atdaban.* or low *Botom.*), S. Australia-Antarct.-USSR (S. Urals).—FIG. 8, 3;

33, 3; 34, 5. **P. regularis*, holotype, S. Australia (Ajax Mine); 8, 3, part of etched transv. sec., $\times 8$; 33, 3, view of inner wall, $\times 5$; 34, 5a, b, parts of transv. and long. secs., $\times 8$; 34, 5c, int. view of inner wall, $\times 5$; 34, 5d, ext. view of outer wall, $\times 8$; 34, 5e, inner wall, diagram. (Bedford & Bedford, 1936).

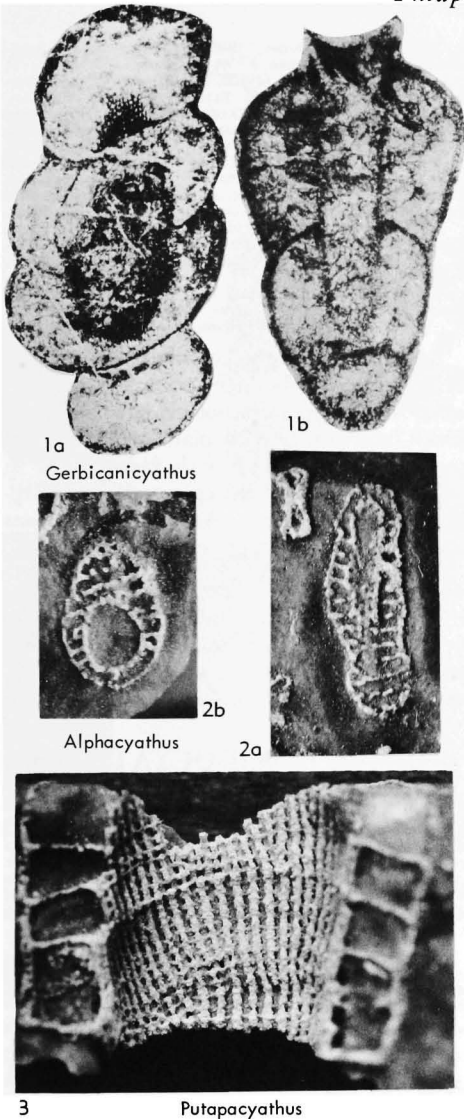


FIG. 33. Putapacyathidae (3); Aptocyathidae (2); Gerbicanicyathidae (1) (p. E55-E58).

Family APTOCYATHIDAE
Konyushkov, 1964

[Aptocyathidae KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 102] [=Aptocyathacea DEBRENNE, 1970 (superfamily), p. 24]

Solitary or colonial; cups conical or cylindrical. Outer and inner walls with simple pores, commonly complicated by longitudinal ribs developed on the interwall surfaces of the walls. Tabulae and dissepiments present. *L.Cam.(Aidaban.-Botom.)*.

Aptocyathus VOLOGDIN, 1937, p. 471 [**A. gordonii*; M]. Solitary or colonial cups slenderly conical or cylindrical; outer and inner walls represented by longitudinal, inwardly projecting ribs invested with thin sheath having one longitudinal row of round pores between neighboring ribs; tabulae and dissepiments present. *L.Cam.(Botom.)*, USSR (S. Urals-Altay-Sayan).—FIG. 34.2. **A. gordonii*, Sanashtykol, Altay-Sayan; 2a-c, transv. sec., $\times 6.7$ (Vologdin, 1940, Atlas).

Alpacyathus R. BEDFORD & J. BEDFORD, 1939, p. 72 [**Dictyocyathus annularis* R. BEDFORD & W. R. BEDFORD, 1936, p. 13; OD]. Cup cylindrical or conical; outer wall with small round pores arranged in quincunx; no septa; tabulae with 2

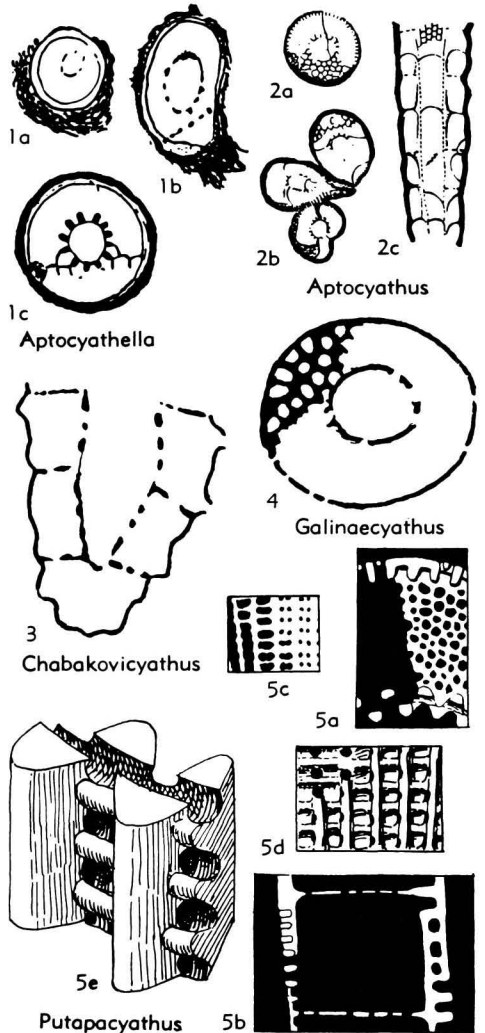


FIG. 34. Putapacyathidae (5); Aptocyathidae (1-4) (p. E55-E58).

circles of large pores between the two walls; inner wall with one horizontal row of pores to each intertabular space (see Debrenne, 1970b, p. 28). *L.Cam.(up.Atdaban. or low.Botom.)*, S.Australia.—FIG. 33,2. **A. annularis* (BEDFORD & BEDFORD), Ajax Mine; 2*a,b*, transv., oblique long. sec., $\times 6$ (Hill, 1965).

Aptocyathella KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 111 [**A. prima*; OD]. Cup solitary, small, slenderly conical or cylindrical; outer wall simply porous, inner wall with longitudinal ribs on intervallar face; pores of both walls rounded; tabulae and sparse dissepiments present. *L.Cam.(Botom.)*, USSR (W.Sayan-Far East).—FIG. 34,1. **A. prima*, Sanashtykgol, W.Sayan; 1*a-c*, transv. sec., $\times 20$ (Zhuravleva, Konyushkov, & Rozanov, 1964).

Chabakovicyathus KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 114 [**C. tumulatus*; OD]. Solitary, slenderly conical or cylindrical small cups; outer wall with tumular pores; inner wall with simple rounded pores; tabulae flat or weakly domed. *L.Cam.(?up.Atdaban.-Botom.)*, USSR (S.Urals).—FIG. 34,3. **C. tumulatus*, ?up.Atdaban. or Botom.; long. sec., $\times 20$ (Zhuravleva, Konyushkov, & Rozanov, 1964).

Galinacyathus KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 102 [**G. lebedensis*; OD]. Solitary cups small, regularly conical or cylindrical; inner and outer walls with round pores; tabulae and sparse dissepiments present. *L.Cam.(low.Atdaban.-Botom.)*, USSR (S. Urals-Altay-Sayan-Sib.Platf.).—FIG. 34,4. **G. lebedensis*, L.Cam., USSR; transv. sec. showing inner and outer walls and part of tabula, $\times 10$ (Zhuravleva, Konyushkov, & Rozanov, 1964).

Family GERBICANICYATHIDAE Belyaeva, 1969

[Gerbicanicyathidae BELYAEVA, 1969, p. 90]

Solitary; cup conical or cylindrical; outer wall not independent, formed from the up-turned edges of the tabulae; inner wall independent; tabulae porous; no septa. *L.Cam.(Botom.)*.

Gerbicanicyathus BELYAEVA, 1969, p. 90 [**G. emili*; OD]. Solitary; cup widely conical or cylindrical in form; outer wall formed of up-turned edges of porous tabulae; inner wall simply porous; no septa. *L.Cam.(Botom.)*, USSR (Far East).—FIG. 33,1. **G. emili*, holotype, R. Gerbikan, Far East; 1*a*, oblique long. sec., $\times 6$; 1*b*, paratype, long. sec., $\times 14$ (Zhuravleva, 1969).

Order AJACICYATHIDA R. Bedford & J. Bedford, 1939

[*nom. correct.* OKULITCH, 1955, p. E10 (pro Ajaciccyathina

R. BEDFORD & J. BEDFORD, 1939, p. 70)] [=order Acanthinocyathida R. BEDFORD & W. R. BEDFORD, 1936, p. 11 (*nom. correct.* VOLOGDIN, 1962d, p. 131, pro Acanthinocyathina R. BEDFORD & W. R. BEDFORD, 1936, p. 11; *nom. subst. pro Acanthocyathina* OKULITCH, 1935, p. 90, invalid name based on junior homonym); order Loculicyathida ZHURAVLEVA, 1955a, p. 9, *nom. correct.* VOLOGDIN, 1962d, p. 118 (pro Loculicyathida ZHURAVLEVA, 1955a, p. 9, invalid name based on *nom. null.*); order Coscinocyathida ZHURAVLEVA, 1955a, p. 9; superorder Loculicyathina ZHURAVLEVA, 1955, p. 9 (*nom. transl.* VOLOGDIN, 1962d, p. 118, ex order Loculicyathida ZHURAVLEVA, 1955a, p. 9); order Nochoroicyathida ZHURAVLEVA in VOLOGDIN, 1956, p. 879; order Dokidocyathida VOLOGDIN, 1957a, p. 205; order Bosceculida KRASNOPEEVA, 1960, p. 41; order Ethmophyllida VOLOGDIN, 1962d, p. 121; order Cyclocyathellida VOLOGDIN, 1962d, p. 122; order Bosceculida KRASNOPEEVA, 1969, p. 63 (*nom. null.*)]

Solitary or rarely colonial. Cup cylindrical or conical, with porous outer and inner walls, the pores not infrequently complex. Intervallum with plane septa, or with septa and tabulae, or with radial links in horizontal planes; dissepiments or synapticulae may develop. Anchoring processes massive. In early stages cup is single-walled

and simply porous; then appear a porous inner wall and radial links, and later, septa, or tabulae and septa; finally complex pores may appear, first those of outer wall, then those of inner wall. *L.Cam.-M.Cam.(base)*.

Suborder DOKIDOCYATHINA Vologdin, 1957

[*nom. transl.* ZHURAVLEVA, 1960b, p. 95 (ex order Dokidocyathida VOLOGDIN, 1957a, p. 205)] [=order Acanthinocyathida R. BEDFORD & W. R. BEDFORD, 1936, p. 11 (*nom. correct.* VOLOGDIN, 1962d, p. 131, pro Acanthinocyathina R. BEDFORD & W. R. BEDFORD, 1936, p. 11; *nom. subst. pro Acanthocyathina* OKULITCH, 1935, p. 90, invalid name based on junior homonym)]

Solitary, with simply or complexly porous outer and inner walls connected by sparse

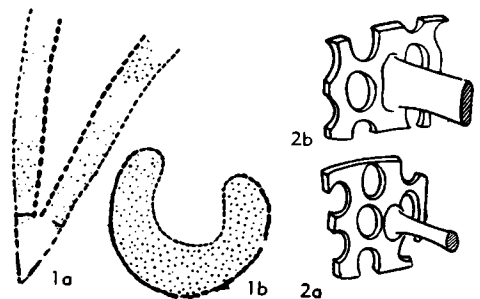


FIG. 35.—1. Open conical central cavity (1*a*) of Dokidocyathina compared with 1*b*, hemispherical central cavity of Capsulocyathina.—2. Radial horizontal links of Dokidocyathina; 2*a*, rounded in section; 2*b*, flattened and platelike (Zhuravleva, Konyushkov, & Rozanov, 1964).

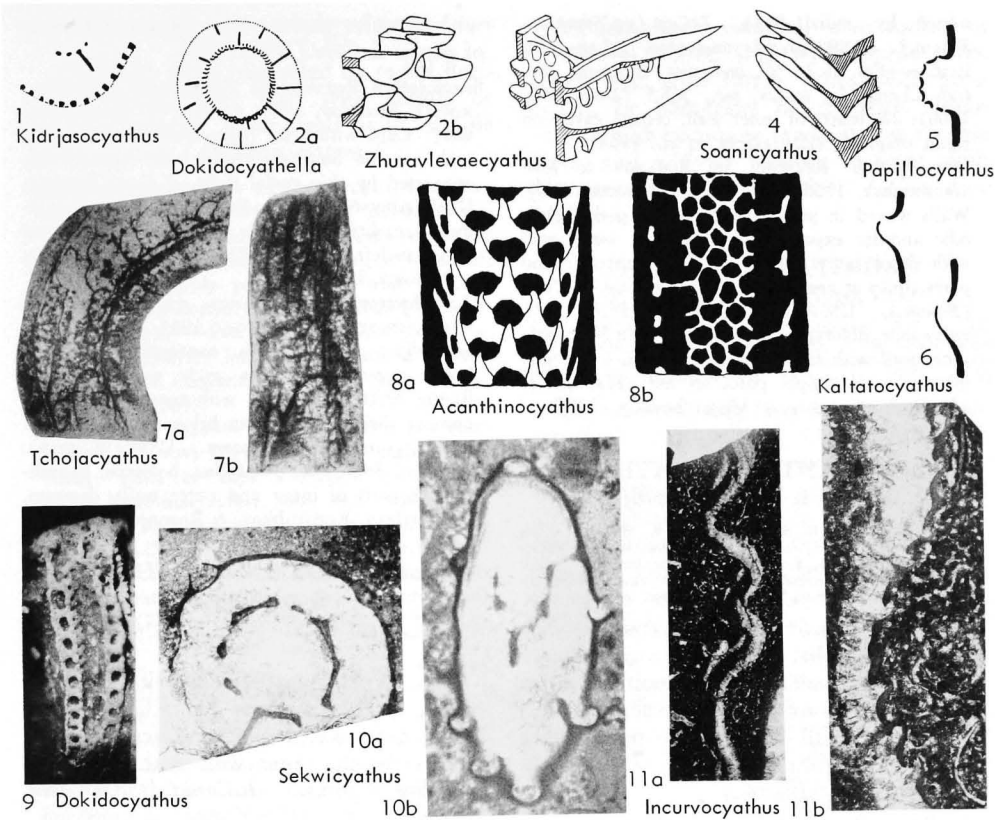


FIG. 36. Dokidocyathidae (2,9,11); Acanthinoocyathidae (8); Soanicyathidae (3-4); Kidrjasocyathidae (1,7); Kaltatocyathidae (5-6,10) (p. E 59-E61).

radial horizontal links or by septa with single longitudinal row of pores almost as wide as septum. [DEBRENNE (1970b, p. 33) has discovered that in *Dokidocyathus simplicissimus* the links are parts of septa in which a single longitudinal row of large round or oval pores occurs. The other forms at present placed in this suborder should be investigated to establish whether this condition is general (Fig. 35).] *L.Cam.(low. Tommot.-up.Botom.)*.

Family DOKIDOCYATHIDAE R. Bedford & W. R. Bedford, 1936

[Dokidocyathidae R. BEDFORD & W. R. BEDFORD, 1936, p. 12] [=Dokidocyathacea DEBRENNE, 1970 (superfamily), p. 24]

Cups conical or cylindrical. Outer and inner walls with simple pores; walls connected by sparse radial horizontal links or by coarsely retiform septa with one row of

such large round or oval pores that area of pores vastly exceeds area of septal tissue. No tabulae. *L.Cam.(Tommot.-Botom.)*.

Dokidocyathus TAYLOR, 1910, p. 146 [**D. simplicissimus*; M]. Cup cylindrical or conical; outer and inner walls with simple pores. Walls connected by radial horizontal links or by retiform septa with one longitudinal row of very large round or oval pores (see Debrenne, 1970, p. 33). *L.Cam.(Tommot.-Botom.)*, S.Australia-USSR (S. Urals-Sib.Plattf.-Altay-Sayan-Transbayk.-Far East). —FIG. 36,9. **D. simplicissimus*, up.Atdaban. or low.Botom., S.Australia (Ajax Mine); long. sec., $\times 3$, showing 2 septa each with 1 long. row of large round or oval pores (photo courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris).

Dokidocyathella ZHURAVLEVA, 1960b, p. 100 [**D. incognita*; OD]. Outer wall with simple, small pores; inner wall longitudinally ribbed on intervallar side, with large pores each protected by deep bract on side of central cavity; walls con-

nected by radial links. *L.Cam.*(*up.Tommot.-Botom.*), USSR(Altay-Sayan-central R.Lena-?Far East.—FIG. 36,2. **D. incognita*, Atdaban., central R.Lena; 2*a*, transv. sec., $\times 5.5$ (Zhuravleva, 1960); 2*b*, bracts of inner wall, central cavity on right, diagram. (Zhuravleva, *et al.*, 1964).

Incurvocyathus ROZANOV in ROZANOV & MISSARZHEVSKIY, 1966, p. 50 [**I. voronovae*; OD]. Walls waved in parallel transversely, giving periodic annular expansions of the cup; outer wall with simple pores, inner wall with bracts around pores; links at acute angle to axis of cup. *L.Cam.*(*Botom.*), USSR(Tuva).—FIG. 36,11. **I. voronovae*, holotype; 11*a,b*, part of thin long. sec., inner wall with bracted pores to right, outer wall thinner with simple pores to left; 11*a*, $\times 1.3$; 11*b*, $\times 7$ (Rozanov & Missarzhevskiy, 1966).

Family ACANTHINOCYATHIDAE R. Bedford & W. R. Bedford, 1934

[Acanthinocyathidae R. BEDFORD & W. R. BEDFORD, 1936, p. 11 (*nom. subst. pro Acanthocyathidae* R. BEDFORD & W. R. BEDFORD, 1934, p. 4, invalid name based on junior homonym)] [=Acanthinocyathidae ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 99 (*nom. null.*)]

Cup with two walls connected by thin cylindrical radial horizontal or oblique links. Outer wall with long pointed scales projecting upward and very slightly outward from wall above each pore; inner wall with simple pores. *L.Cam.*(*up.Atdaban.* or *low.Botom.*).

Acanthinocyathus R. BEDFORD & W. R. BEDFORD, 1936, p. 11 [**Acanthocyathus apertus* R. BEDFORD & W. R. BEDFORD, 1934, p. 4; OD] [=Acanthocyathus R. BEDFORD & W. R. BEDFORD, 1934, p. 4 (*non* EDWARDS & HAIME, 1848, p. 292, a coral); *Acanthinocyathus* ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 100 (*nom. null.*)]. Cup with two walls connected by thin, cylindrical, radial, horizontal links. Outer wall retiform, with long pointed scales rising from wall above each pore and projecting upward and very slightly outward; inner wall retiform with simple pores (see Debrenne, 1969b, p. 306). *L.Cam.*(*up.Atdaban.* or *low.Botom.*), S.Australia(Ajax).—FIG. 36,8. **A. apertus* (BEDFORD & BEDFORD); 8*a,b*, views of etched outer wall and of etched long. sec. showing inner wall, $\times 2.7$ (Bedford & Bedford, 1934).

Family SOANICYATHIDAE Roazanov, 1964

[Soanicyathidae ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 97]

Slenderly conical cups with two concentric walls connected by thin radial links; outer wall with flaring bracts over the pores, inner wall with similar flaring bracts or

with annular shelves over horizontal rows of pores. *L.Cam.*(*Botom.*).

Soanicyathus ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 98 [**S. admirandus*; OD]. Cups with bract rising from lower edge of each pore in both outer and inner walls; walls connected by thin radial links. *L.Cam.*(*Botom.*), USSR(Altay-Sayan).—FIG. 36,4. **S. admirandus*, Sanashtykgol; bracts of inner wall, central cavity to left, reconstr. (Zhuravleva, Konyushkov, & Rozanov, 1964).

Zhuravlevaacyathus ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 98 [**Z. pulchellus*; OD]. Walls connected by radial links; outer wall pores each with upwardly flaring bract; inner wall with upwardly directed annular shelves rising from below each horizontal row of pores. *L.Cam.*(*Botom.*), USSR(W.Sayan).—FIG. 36,3. **Z. pulchellus*, holotype, Sanashtykgol; parts of inner and outer walls, diagram. (Zhuravleva, Konyushkov, & Rozanov, 1964).

Family KIDRJASOCYATHIDAE Roazanov, 1964

[Kidrijasocyathidae ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 95]

Conical or cylindrical cup with two concentric walls connected by radial links or plates; outer wall with supplementary finely porous sheath, inner wall with simple or complex pores. *L.Cam.*(*Atdaban.-low.Botom.*).

Kidrijasocyathus ROZANOV, 1960, p. 43 [**K. uralensis*; OD] [=Kidrijasocyathus ROZANOV, 1960, *nom. null.* in REPINA, *et al.*, 1964, p. 174]. Walls of cup connected by radial horizontal or inclined links, and sometimes by dissepiments; outer wall coarsely porous but with supplementary finely porous external sheath, inner wall with simple large pores. *L.Cam.*(*up.Atdaban.-low.Botom.*), USSR(S.Ural-E.Sayan).—FIG. 36,1. **K. uralensis*, ?*low.Botom.*, S.Ural; part of transv. sec., diagram. (Zhuravleva, Konyushkov, & Rozanov, 1964).

Tchojacyathus ROZANOV, 1960, p. 46 [**T. validus*; OD]. Cups with walls connected by inclined, sometimes inosculated links; dissepiments abundant. Outer wall of S-curved plates forming pore-canals directed irregularly upward and outward; external finely porous sheath present. Inner wall of S-curved plates forming pore-canals directed irregularly upward into central cavity. *L.Cam.*(*Atdaban.*), USSR(Altay).—FIG. 36,7. **T. validus*, holotype, R. Tyrga, Kameshki; 7*a,b*, parts of transv. and long. secs., $\times 3$ (Zhuravleva, Konyushkov, & Rozanov, 1964).

Family KALTATOCYATHIDAE Roazanov, 1964

[Kaltatocyathidae ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 92]

Cup with walls connected by radial horizontal links, outer wall with simple or knobby tumuli, inner wall with simple pores. *L.Cam. (Atdaban.-Botom.)*.

Kaltatocyathus ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 92 [**K. kaschinae*; OD]. Cup with radial horizontal links connecting an outer wall in which each pore is in simple tumulus to simply porous inner wall. *L.Cam. (Atdaban.-low.Botom.)*, USSR (E.Sayan-Far East)-Can. (Yukon).—FIG. 36.6. **K. kaschinae*, Atdaban., E.Sayan; long. sec. of pore in tumulus of outer wall, diagram. (Zhuravleva, Konyushkov, & Rozanov, 1964).

Papillocyathus ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 94 [**P. vacuus*; OD]. Small; walls of cups connected by flattened radial horizontal links; outer wall with multiperforate knobby tumuli; inner wall simply porous. *L.Cam. (up.Atdaban.-low.Botom.)*, USSR (Altay-Sayan).—FIG. 36.5. **P. vacuus*, Sayan; multiperforate, knobby tumulus of outer wall, diagram. (Zhuravleva, Konyushkov, & Rozanov, 1964).

Sekwicyathus HANDFIELD, 1971, p. 34 [**S. nahanniensis*; OD]. Outer wall with spherical tumuli that protrude into intervallum also; tumuli open upward(?) on both sides of wall; intervallum with links flattened in longitudinal plane; inner wall simply porous. *L.Cam. (up.Atdaban. or low.Botom.)*, Can. (NW.Terr.).—FIG. 36.10. **S. nahanniensis*, Sekwi F., NW.Terr.; 10a, holotype, transv. sec., $\times 8$; 10b, oblique long. sec. showing subspherical tumuli with pores opening on both sides of wall, $\times 10$ (Handfield, 1971).

Suborder AJACICYATHINA

R. Bedford & J. Bedford, 1939

[*nom. transl. et correct.* ZHURAVLEVA, 1960b, p. 106 (ex order Ajacicyathina R. BEDFORD & J. BEDFORD, 1939, p. 70)] [=superorder Loculicyathina VOLOGDIN, 1962d, p. 118; order Loculicyathida VOLOGDIN, 1962d, p. 118 (*nom. correct.*, pro Loculicyathida ZHURAVLEVA, 1955a, p. 9, invalid name based on *nom. null.*); suborder Boscekulcyathina KRASNOPEVA, 1969, p. 63; suborder Schidertycyathina KRASNOPEVA, 1969, p. 63]

Solitary or rarely colonial. Cup cylindrical or conical, with porous outer and inner walls, pores simple or complex. Intervallum with planar septa, without tabulae; synapticulae and dissepiments may occur and latter may penetrate into central cavity. *L.Cam.-base M.Cam.*

Superfamily AJACICYATHACEA

R. Bedford & J. Bedford, 1939

[*nom. transl.* ZHURAVLEVA, 1960b, p. 106 (ex Ajacicyathidae R. BEDFORD & J. BEDFORD, 1939, p. 73)]

Solitary, rarely colonial. Cup conical or cylindrical. Outer wall with simple pores. Inner wall with simple pores, with pore-canal, or pore-tubes or annulate. Intervallum with porous or rarely almost aporose septa, and without tabulae; in some with dissepiments or synapticulae. *L.Cam.-base M.Cam.*

Family AJACICYATHIDAE

R. Bedford & J. Bedford, 1939

[Ajacicyathidae R. BEDFORD & J. BEDFORD, 1939, p. 73] [=?Somphocyathidae OKULITCH, 1935, p. 98; Densocyathidae VOLOGDIN, 1937b, p. 471; Archaeocyathellidae SIMON, 1939, p. 57; Loculocyathidae ZHURAVLEVA, 1955a, p. 9]

Cups conical, may have transverse or longitudinal corrugations. Outer wall with simple pores; pores of inner wall simple or with bracts or scales, and in more than one longitudinal row to each intersept. Intervallum with septa that are porous or very rarely aporose, and in some with dissepiments or synapticulae; without tabulae. *L.Cam. (low.Tommot.-Botom.)*.

Ajacicyathus R. BEDFORD & J. BEDFORD, 1939, p. 73 [**Archaeocyathus ajax* TAYLOR, 1910, p. 118; OD] [=?Somphocyathus TAYLOR, 1910, p. 134 (type, *S. coralloides*; OD) (for discussion see HILL, 1965, p. 62); *Ventriculocyathus* VOLOGDIN, 1931, p. 51 (type, *V. caulius*; M) (for discussion see HILL, 1965, p. 62); *Densocyathus* VOLOGDIN, 1937b, p. 471 (type, *D. sanaschitcolensis*; M) (colonial, for discussion see HILL, 1965, p. 63); *Asocyathus* VOLOGDIN, 1960, p. 422 (type, *Archaeocyathus arteintervallum* VOLOGDIN, 1931, p. 84; OD) (for discussion see ZHURAVLEVA, 1960, p. 126); *Sclerocyathus* VOLOGDIN, 1960, p. 424 (type, *S. scrofulosus*; OD) (for discussion see HILL, 1965, p. 67)]. Pores of both walls in several longitudinal rows in each intersept; those of inner wall may be protected by simple spines and may include stirrup-pores; septa sparsely porous or aporose; no tabulae. *L.Cam. (low.Tommot.-Botom.)*, USSR (S.Urals-Altay-Sayan-Sib.Platt.-Transbaik.-Far East)-Mongolia-N.Afr. (Morocco)-S.Australia-Antarct.-N.Am. (Yukon-B. C.-Nev.).—FIG. 37.6. **A. ajax* (TAYLOR), up. Atdaban. or low.Botom., S.Australia (Ajax Mine); 6a, outer wall and septa; 6b, inner wall and septa, seen from outside; 6c, inner wall seen from central cavity; all $\times 4$ (Hill, 1965).

Ajacicyathellus DEBRENNE, 1959, p. 64 [**A. hollardi*; M]. Conical, outer and inner walls crenulate (furrowed at junctions with septa); outer wall with 4 to 5 longitudinal rows of simple pores to an intersept, in quincunx; septa perforate; inner wall thick, with 2 to 3 longitudinal rows of large oval simple pores to an intersept. *L.Cam. (Atdaban.)*, N.Afr. (Morocco).

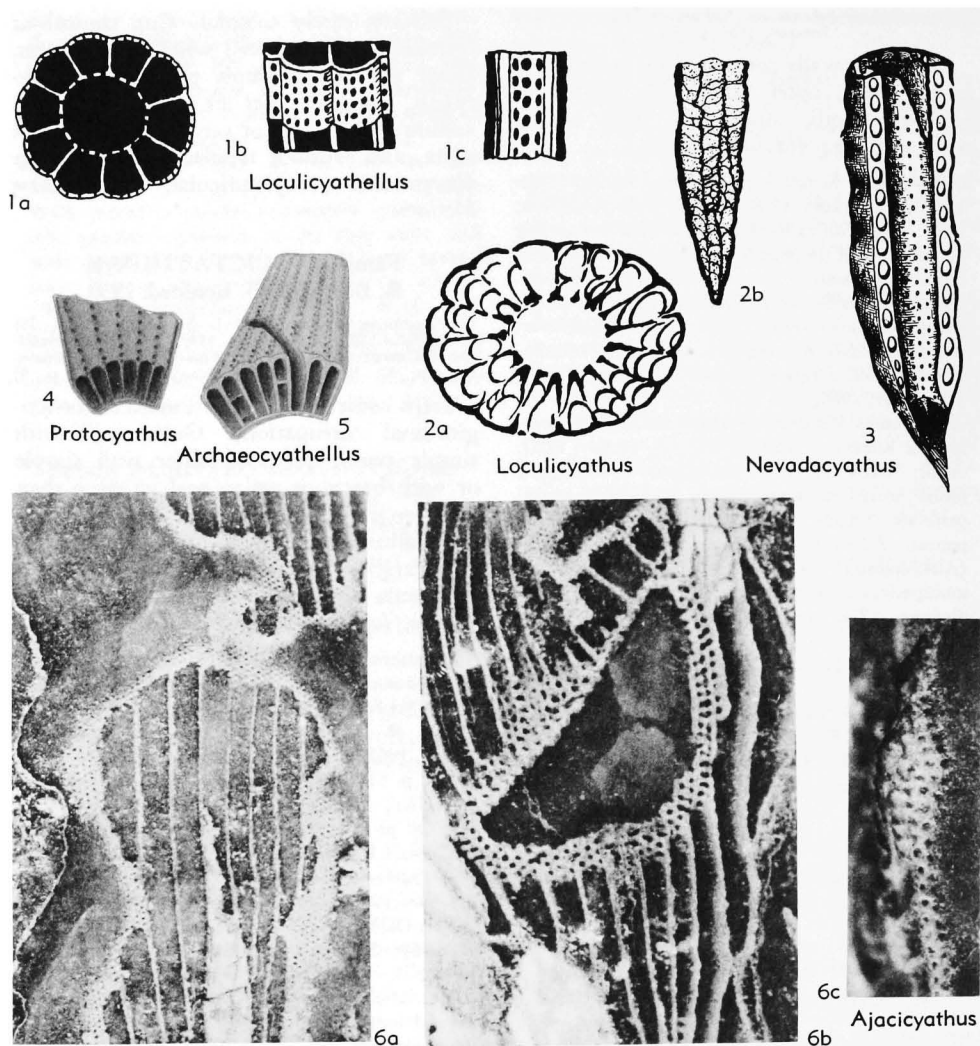


FIG. 37. Ajacicyathidae (p. E61-E65).

Archaeocyathellus FORD, 1873, p. 135 [*Archaeocyathus? rensseleericus* FORD, 1873, p. 211; M]. Very small, conical; outer wall longitudinally furrowed at septa; pores of outer wall alternating in 2 longitudinal rows to each intersept, 1 row close beside each septum; septa ?imperforate, dissepiments (or ?synapticulae) present. Characters of inner wall unknown. Type-species insufficiently known. *L.Cam.*, USA (N.Y.); *L.Cam. (Atdaban.-Botom.)*, USSR (Sayan-Sib.Plattf.-Far East).—FIG. 37,5. **A. rensseleericus* (FORD), Troy, N.Y.; sector of cup, diagram. (Okulitch, 1943).

Dentatocyathus OKUNEVA, 1967 (quoted in BELYAeva, 1969, p. 92) [**D. maritimus*?; OD].

Solitary, cup conical; outer wall simply porous, with cog-like projections between septa, 2 or 3 longitudinal rows of pores to each side of the cog; septa straight, porous; inner wall with simple pores; no tabulae. *L.Cam. (Botom.)*, USSR (Far East).—FIG. 38,3. *D. indigenus* BELYAeva, R. Melkan, Far East; holotype, transv. sec., $\times 10$ (Belyaeva, 1969).

Loculicyathus VOLOGDIN, 1931, p. 54 [**L. tolli* (= *Coscinocyathus irregularis* VON TOLL, 1899, p. 44, for which it was invalid *nom. nov.*); OD] [= *Loculocyathus* VOLOGDIN, 1937b, p. 468 (*nom. null.*); *Mikhncocyathus* MASLOV, 1957, p. 307 (type, *M. zolaensis*; OD) (for discussion see VORONIN, 1964, p. 20); *Mukhncocyathus* MASLOV,

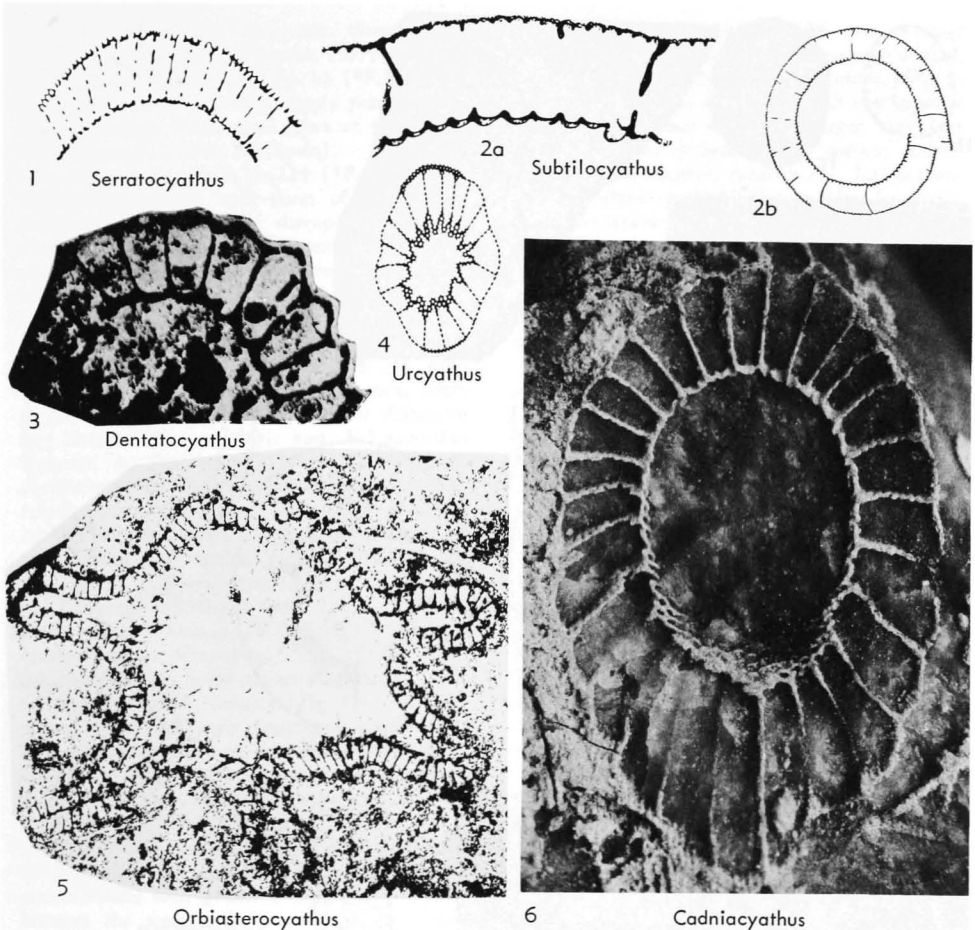


FIG. 38. Ajacicyathidae (1-5); Tennericyathidae (6) (p. E62-E67).

1957, p. 308 (*nom. null.*); ?*Zolacyathus* VOLOGDIN, 1962, p. 10 (type, *Z. loculosus*; M, incompletely described]. Cup cylindrical, with simply porous outer and inner walls and septa and with dissepiments crossing both intervallum and central cavity; no tabulae. *L. Cam. (Atdaban-Botom.)*, USSR (S. Urals-Sib. Platf.-Altay-Sayan-Transbayk-Far East)-S. Australia-N. Afr.-Can. (Yukon).

L. (Loculicyathus). Outer wall without longitudinal furrow at junction with each septum. *L. Cam. (Atdaban-Botom.)*, USSR (S. Urals-Sib. Platf.-Altay-Sayan-Transbayk-Far East)-S. Australia-N. Afr.-Can. (Yukon).—FIG. 37.2. **L. (L.) irregularis* (VON TOLL), up. Atdaban., Kameshki; 2a, part of transv. sec., $\times 2.7$; 2b, long. sec., $\times 2$ (Vologdin, 1931).

L. (Loculicyathellus) DEBRENNE, 1969, p. 310 [**Archaeocyathus florens* R. BEDFORD & W. R. BEDFORD, 1934, p. 2; OD]. Outer wall with

longitudinal furrow at junction with each septum. *L. Cam. (up. Atdaban. or low. Botom.)*, S. Australia (Ajax Mine).—FIG. 37.1. **L. (L.) florens* (BEDFORD & BEDFORD), holotype; 1a, transv. sec.; 1b, outer wall; 1c, inner view of inner wall, all approx. $\times 4$ (Bedford & Bedford, 1934).

Nevadacyathus OKULITCH, 1943, p. 59 [**Archaeocyathus septaporus* OKULITCH, 1935, p. 101; M]. Cup very small, cylindrical; outer wall with small, sparse, oblique pore-canals (directed upward and inward); inner wall with numerous, small pores; septa with very large pores, commonly in one longitudinal row; no tabulae. *L. Cam. (Atdaban-low. Botom.)*, N. Am. (Nev.)-USSR (Sib. Platf.).—FIG. 37.3. **N. septaporus* (OKULITCH), Nev.; reconstr., $\times 7.5$ (Okulitch, 1935).

Orbiasterocyathus ZHURAVLEVA in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 183 [**O. geri*; OD]. Cups starshaped in trans-

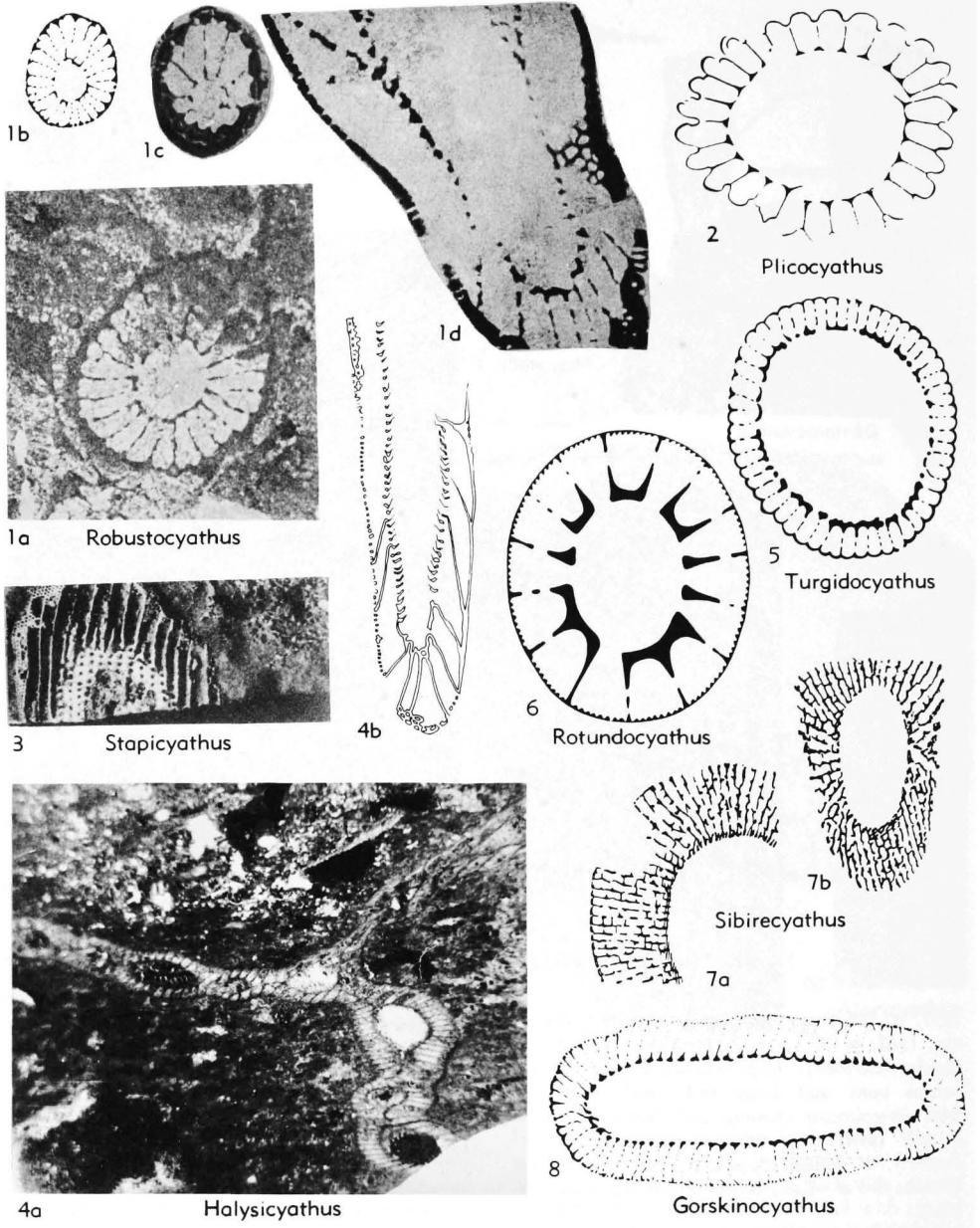


FIG. 39. Robustocyathidae (p. E65-E66).

verse section due to deep longitudinal folds affecting both walls; pores of walls simple; septa porous; no tabulae. *L.Cam.(up.Atdaban.)*, USSR (Shoria Mts.).—FIG. 38,5. **O. geri*, holotype, Kameshki; transv. sec., $\times 4$ (Repina, Khomentovskiy, Zhuravleva, & Rozanov, 1964).

Orbicyathus VOLOGDIN, 1937, p. 470 [*O. mongolicus*; M]. Cup conical, with periodic annular

expansions due to both walls being waved in parallel transversely; outer wall with numerous small pores in quincunx; septa porous; inner wall with up to 3 longitudinal rows of simple pores per intersept. Tabulae absent. *L.Cam.(up.Tommot-Botom.)*, Mongolia-USSR (S.Urals-Sayano-Altay-central R.Lena)-N.Afr.(Morocco).—FIG. 4,6. **O. mongolicus*, Mongolia (L.Kara-Ussu); 6a,

- reconstr., $\times 3.5$; *6b,c*, tang. sec. through two transv. expansions, $\times 7$ (Vologdin, 1937).
- Pachecocyathus** RINCÓN, 1971, p. 81 [**P. cabanasi*; OD]. Outer wall and septa simply porous; inner wall thick, two longitudinal rows of pore-canals to an intersept. *L.Cam.*, Eu.(Spain).
- Protocyathus** FORD, 1878, p. 124 [**P. rarus*; M]. Very small, conical, with pores of outer wall confined to single row of stirrup-pores in each septal furrow, with thin septa, and inner wall of unknown structure. Type-species insufficiently known. *L.Cam.*, USA(N.Y.).—FIG. 37.4. **P. rarus*, Troy, N.Y.; sector of cup, diagram. (Okulitch, 1943).
- Serratocyathus** VOLOGDIN, 1960, p. 424 [**S. echinatus*; OD] [= *?Echinocyathus* VOLOGDIN, 1960, p. 424 (type, *E. bilateralis*; OD) (for discussion see HILL, 1965, p. 66); *non Echinocyathus* TERMIER & TERMIER, 1950, p. 47 (type, *E. goundafensis*; OD)]. Cup conical; outer wall with pore-canals with short outwardly projecting rims; inner wall pores simple; septa thin, radial, plane, porous; no tabulae. *L.Cam.*, USSR(Tuva).—FIG. 38.1. **S. echinatus*; part of transv. sec., $\times 2.7$ (Vologdin, 1960).
- Subtilocyathus** VOLOGDIN, 1960, p. 423 [**Archaeocyathus subtilis* VOLOGDIN, 1932, p. 41; OD]. Cup conical, with finely porous outer and coarsely porous inner walls, connected by few, coarsely porous septa; wall pores (?screened with bubble-like sheaths). Imperfectly known. *L.Cam.*, USSR (Altay).—FIG. 38.2. **S. subtilis* (VOLOGDIN); *2a*, part of transv. sec., $\times 13$ (Vologdin, 1940b); *2b*, transv. sec., $\times 2.7$ (Vologdin, 1960).
- Urcyathus** VOLOGDIN, 1940, p. 64 [**U. asteroides*; OD]. Outer wall and septa finely and simply porous; inner wall plicate longitudinally (ribbed between the septa and furrowed at the septa), with several longitudinal rows of simple pores to each flank of plication; tabulae absent. *L.Cam.* (*Atdaban.-Botom.*), USSR (E.Sayan-Salair)-?Spain-?N.Afr.(Morocco).—FIG. 38.4. **U. asteroides*, Salair; oblique transv. sec., $\times 2.2$ (Vologdin, 1957a).
- Family ROBUSTOCYATHIDAE**
Debrenne, 1964
- [Robustocyathidae DEBRENNE, 1964, p. 140] [= *?Leecyathidae* VOLOGDIN, 1957c, p. 495]
- Outer wall with simple pores; inner wall with single longitudinal row of pores to each intersept; inner wall pores may have bracts; septa porous or almost aporose, may be synaptaculate. *L.Cam.*
- Robustocyathus** ZHURAVLEVA, 1960, p. 133 [**Archaeocyathus robustus* VOLOGDIN, 1937a, p. 25; OD] [= *?Septocyathus* VOLOGDIN, 1937b, p. 468 (type, *S. pedaschenkoi*; M) (for discussion see VORONIN, 1964, p. 16); *?Leecyathus* VOLOGDIN, 1957, p. 495 (type, by OD, *Archaeocyathus yavorskii* VOLOGDIN, 1931, p. 86, has a fringe of tersioid outgrowths)]. Cup slenderly conical, with 2 to 4 longitudinal rows of simple pores to an intersept in outer wall and 1 such row in inner wall; pores of inner wall much larger, may have protective spines or bracts; septa porous; anchoring processes massive, canaliculate. *L.Cam.* (*low. Tommot.-Botom.*), USSR (S.Urals-Altay-Sayan-Sib. Platf.-Transbayk.-Far East)-N.Am.(B.C.-Nev.)-S. Australia-Antarct.-Spain-N.Afr. (Morocco).—FIG. 39.1. **R. robustus* (VOLOGDIN), *L.Cam.* (up. Tommot.-Botom.), USSR (R.Lena); *1a,b*, ?transv. sec., $\times 8$ (Vologdin, 1937a); *1c*, transv. sec. of cup with secondary thickening of outer wall, $\times 5.6$; *1d*, long. sec. of cup without secondary thickening, $\times 4.8$ (Zhuravleva, 1960b).
- Afiacyathus** VORONIN, 1962, p. 26 [**A. lativallum*; OD]. Cup conical; outer wall with simple pores; septa straight, porous, united by synaptaculae; inner wall thick, perforated by straight pore-canals not interconnected, one longitudinal row to each intersept. *L.Cam.* (*?Atdaban.-Botom.*), USSR (Tuva)-Mongolia-N.Afr. (Morocco)-?N.Am.—FIG. 40.2. **A. lativallum*, holotype, Botom. Tuva; *2a*, part of transv. sec., $\times 2$; *2b*, part of oblique long. sec., $\times 2$ (Voronin, 1962).
- ?Carpicyathus** OSADCHAYA, in ZHURAVLEVA, ZARDOROZHNAJA, OSADCHAYA, POKROVSKAYA, RODIONOVA, & FONIN, 1967, p. 51 [**C. mysticus*; OD]. Solitary, slenderly conical or cylindrical cups; outer wall strong, its short pore-canals each with vertically rising bract, inner wall thick, with two longitudinal rows of pore-canals to an intersept, the pore-canals with bracts sharply bent up into central cavity; septa porous. [VORONIN (1969, p. 102) lists this as synonym of *Inessocyathus*.] *L.Cam.* (*up.Botom.*), USSR (Tuva).—FIG. 40.1. **C. mysticus*, holotype; *1a,b*, transv. and long. sec., $\times 2.7$; *1c*, tang. sec. outer wall, $\times 10$; *1d*, part of inner wall, $\times 10$ (Zhuravleva, *et al.*, 1967).
- Gorskinocyathus** VOLOGDIN, 1960, p. 422 [**Archaeocyathus gorskinensis* VOLOGDIN, 1940b, p. 60; OD]. Outer wall thin and finely porous; inner wall thicker with 1 or 2 longitudinal rows of pores per intersept; septa thin, porous, not radial. *L.Cam.*, USSR (Salair).—FIG. 39.8. **G. gorskinensis* (VOLOGDIN); transv. sec., $\times 4.8$ (Vologdin, 1960).
- Halysicyathus** DEBRENNE, 1965, p. 143 [**H. multifurcus*; OD]. Colonial, cups associated in *Halysites*-like chain; outer wall with simple pores; inner wall with single longitudinal row of pores to an intersept, each pore with thin-edged peak from its upper edge; septa straight, sparsely porous; no tabulae or dissepiments. *L.Cam.* (*up.Atdaban.*), N. Afr.(Morocco).—FIG. 39.4. **H. multifurcus*, Timghit; *4a*, holotype, thin sec., $\times 4$ (photo courtesy of MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris); *4b*, tang. sec., $\times 8$ (Debrenne, 1965).
- Inessocyathus** DEBRENNE, 1964, p. 143 [**Archaeocyathus spatiosus* BORNEMANN, 1887, p. 59; OD].

Outer wall with simple rounded or hexagonal pores, inner wall thickened with one longitudinal row of large pore-canals to an intersept; septa thin, porous, without synapticalae. *L.Cam.* (*Atdaban.-Botom.*), Eu.(Sardinia-Spain)-USSR

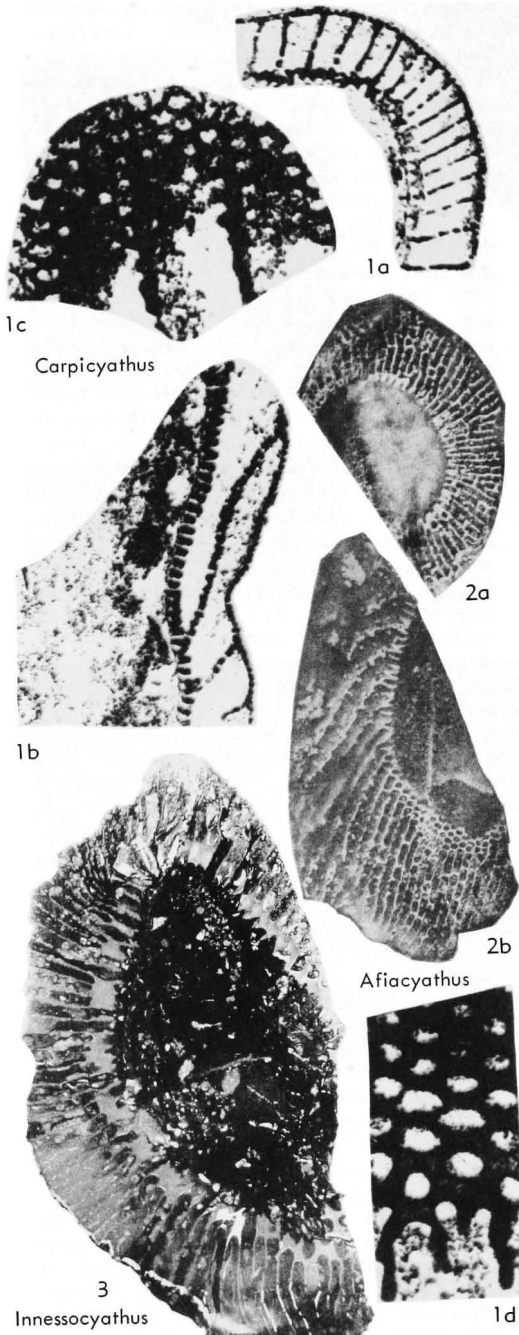


FIG. 40. Robustocyathidae (p. E65-E66).

(Altay-Sayan)-Mongolia-N.Afr. (Morocco)-Antarct.-N.Am.(Nev.).—FIG. 40,3. **I. spatiosus* (BORNEMANN), Botom., Sardinia; part of transv. sec., $\times 2$ (Debrenne, 1964).

?*Plenocyathus* VOLOGDIN, 1962b, p. 13 [**P. crassiseptatus*; M]. Incompletely figured and not described. *L.Cam.*(*Botom.*), USSR(Sayan).

Plicocyathus VOLOGDIN, 1960, p. 424 [**P. krassnyi*; OD]. Conical cups; porous outer wall longitudinally plicate with deep furrows at outer ends of the septa; inner wall slightly thickened, with a single longitudinal row of large pores; septa indistinctly porous, radial, thickened at inner wall. *L.Cam.*, USSR(Far East).—FIG. 39,2. **P. krassnyi*; transv. sec., $\times 4$ (Vologdin, 1960).

?*Rugocyathus* VOLOGDIN, 1962b, p. 13 [**R. venustus*; M]. Incompletely figured and not described. *L.Cam.*(*Botom.*), USSR(Sayan).

Rotundocyathus VOLOGDIN, 1960, p. 422 [**R. rotaceus*; OD]. Cup conical, with smooth commonly finely porous outer wall; inner wall and septa coarsely porous; septa thickening toward thick inner wall, in which is one longitudinal row of pores to an intersept; no tabulae. [May be senior synonym of *Robustocyathus*.] *L.Cam.*, USSR(Altay).—FIG. 39,6. **R. rotaceus*; transv. sec., $\times 3$ (Vologdin, 1960).

Sibirecyathus VOLOGDIN, 1937, p. 468 [**S. naletovi*; M]. Outer wall thin, finely and simply perforate; inner wall with ?1 longitudinal row of pores to an intersept, the pores may be protected by thorns or bracts springing from below; septa porous, connected by synapticalae. *L.Cam.*(?up.*Tommot.-up.Botom.*), USSR(Altay-Sayan-Sib.Plattf.)-Mongolia-Eu.(France [Mont.Noire]-Sardinia)-N.Afr.-N.Am.(Can.).—FIG. 39,7. **S. naletovi*, *Atdaban.-Botom.*, Mongolia; 7a,b, oblique secs. of two specimens, $\times 3$ (Vologdin, 1937b).

Stapicyathus DEBRENNE, 1964, p. 127 [*nom. transl.* DEBRENNE, 1970b, p. 43, ex *Archaeocyathellus* (*Stapicyathus*) DEBRENNE, 1964] [**Archaeocyathus stapipora* TAYLOR, 1910, p. 118; OD]. Cup conical; outer wall thin, with simple pores; septa imperforate except at their junctions with inner wall where all pores are stirrup pores, developed in one longitudinal row to each septum. *L.Cam.*(up.*Atdaban.* or low.*Botom.*), S.Australia-Antarct.—FIG. 39,3. **S. stapipora* (TAYLOR), Ajax Mine; tang. long. sec., $\times 2.4$ (Taylor, 1910).

Turgidocyathus VOLOGDIN, 1960, p. 422 [**T. ippolitovenski*; OD]. Cup conical, longitudinally arched between septa; outer wall thin; inner wall thickened, with one (?or two) longitudinal rows of simple pores to an intersept; septa thin, straight, perforate, angles at walls rounded; no tabulae. *L.Cam.*(*Botom.*), USSR(W.Sayan).—FIG. 39,5. **T. ippolitovenski*; transv. sec., $\times 4$ (Vologdin, 1960).

Family TENNERICYATHIDAE
Roazanov in Zhuravleva, Korshunov,
& Roazanov, 1969

[Tennericyathidae ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 34]

Outer wall pores with short outwardly projecting rims; inner wall with several longitudinal rows of pores provided with scales that commonly cover several intersepts or several pore mouths; intervallum with porous septa; no tabulae. *L.Cam. (Atdaban.-Botom.)*.

Tennericyathus ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 35 [**T. malycanicus*; OD]. Cup conical, rounded in transverse section; outer wall with simple pores with short outwardly projecting rims, septa abundantly porous, inner wall with several longitudinal rows of pores to an intersept, provided with bracts amalgamating with one another to form scales common to several intersepts. *L.Cam. (Atdaban.)*, USSR (Sib. Platf.-Altay-Sayan).—FIG. 41, I. **T. malycanicus*, R. Lena, near Malykan, Sib. Platf.; 1a, b, parts of transv. sec., $\times 20$; 1c, part of long. sec., $\times 10$ (Zhuravleva, Korshunov, & Rozanov, 1969).

Cadnacyathus R. BEDFORD & J. BEDFORD, 1937, p. 36 [**C. asperatus*; OD]. Cup conical, outer wall longitudinally furrowed at the septa; outer wall and septa simply porous; 3 longitudinal rows of opposed pores to each intersept of inner wall; each pore protected by scale projecting inward and upward into central cavity, neighboring scales being contiguous and forming incomplete annuli; tabulae absent. (See Debrenne, 1970b, p. 30.) *L.Cam. (up. Atdaban. or low. Botom.)*, S. Australia. —FIG. 38, 6. **C. asperatus*, S. Australia (?Ajax Mine); etched oblique transv. sec., $\times 5$ (Hill, 1965).

Family ETHMOCYATHIDAE

Debrenne, 1969

[Ethmocyathidae DEBRENNE, 1969, p. 322] [= ?Ethmopectinidae DEBRENNE, 1970, p. 34]

Solitary; outer wall simply porous; septa sparsely porous; inner wall a thin porous sheet, with one or two longitudinal rows of pores to an intersept and with narrow annuli projecting into central cavity from sheet. *L.Cam. (?up. Atdaban.-Botom.)*.

Ethmocyathus R. BEDFORD & W. R. BEDFORD, 1934, p. 2 [**E. lineatus*; M] [= ?*Ethmopectinus* DEBRENNE, 1970, p. 34 (type, *E. walteri*; OD)]. Solitary; outer wall simply porous; septa straight, sparsely porous; inner wall a thin sheet with hexagonal pores (one longitudinal row to an intersept) screened from central cavity by thin, flat, narrow, horizontal annuli. [May be atabulate specimens of *Ethmopectinus* DEBRENNE, 1970b, p. 34.] *L.Cam. (up. Atdaban. or low. Botom.)*, S. Australia (Ajax Mine).—FIG. 17, 1; 42, 6. **E. lineatus*; 17, 1, holotype, view of inner wall, $\times 14$; 42, 6, inner wall and septa, diagram.

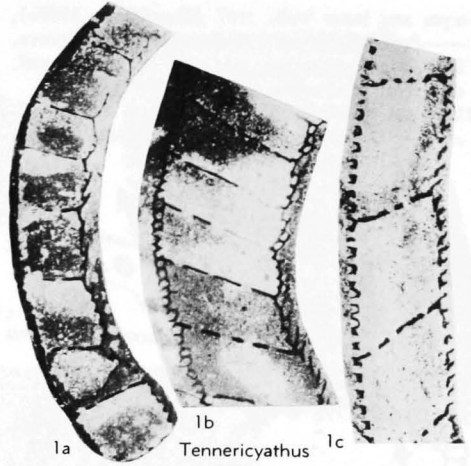


FIG. 41. Tennericyathidae (p. E67).

(Debrenne, 1969).

Denaacyathus ZHURAVLEVA in ZHURAVLEVA, ZADOROZHNYAYA, OSADCHAYA, POKROVSKAYA, RODIONOVA, & FONIN, 1967, p. 57 [**D. biporosus*; OD]. Cup slenderly conical; outer wall simply porous, septa aporose or sparsely porous; inner wall commonly a thin porous sheet with two longitudinal rows of pores per intersept, and V-shaped annuli attached to sheet. *L.Cam. (Botom.)*, USSR (Tuva)-Mongolia.—FIG. 42, 1; 43, 1. **D. biporosus*, Tuva; 42, 1, reconstr. of part of inner wall and septa, enl.; 43, 1a, holotype, part of transv. sec., $\times 4$; 43, 1b, part of oblique long. sec., $\times 7$; 1c, tang. sec. outer wall, $\times 20$; 1d, part of tang. sec., showing annuli of inner wall, $\times 7$ (Zhuravleva, 1967).

Family COMPOSITOCYATHIDAE Zhuravleva, 1967

[Compositocyathidae ZHURAVLEVA in ZHURAVLEVA, ZADOROZHNYAYA, OSADCHAYA, POKROVSKAYA, RODIONOVA & FONIN, 1967, p. 52]

Solitary; outer wall with simple pores; septa sparsely porous or aporose; inner wall of annuli with their axial edges attached to a porous sheet directly or by spines. *L.Cam. (up. Tommot.-up. Botom.)*.

Compositocyathus ZHURAVLEVA, 1960, p. 159 [**Thalamocyathus muchattensis* ZHURAVLEVA in ZHURAVLEVA, & ZELENOV, 1955, p. 71; OD]. Slenderly conical cups with simply porous, thin outer wall, narrow intervallum and aporose septa; inner wall constructed of horizontal annuli; a porous sheet is applied to axial edges of annuli or to horizontal spines projecting from them. *L.Cam. (up. Tommot.-Botom.)*, USSR (Altay-Sayan-Sib. Platf.).—FIG. 16, 4. **C. muchattensis* (ZHURAVLEVA), Kenyad., Sib. Platf.; reconstr. of

septa and inner wall, $\times 67$ (Zhuravleva, 1960b).

—FIG. 42,2. *C. vladimirskii* ZHURAVLEVA, Bograd, Tuva; view of part of inner wall, diagram. (Zhuravleva, *et al.*, 1967).

?*Leptosocyathus* VOLOGDIN, 1937, p. 470 [**L. curviseptum* (= *Leptocyathus curviseptatus* VOLOG-

DIN, 1940a, p. 146); OD] [= *Leptocyathus* VOLOGDIN, 1937, p. 468, *nom. null. pro Leptosocyathus* VOLOGDIN; *non Leptocyathus* EDWARDS & HAIME, 1850, a scleractinian]. Cup slenderly conical; outer wall thin with simple pores; septa aporose or sparsely porous; inner wall scaly, the base of the scales wide and each stretching across 2 to 7 intersepts; pores of inner wall large, formed by the spaces between the septal edges and the edges of successive scales. *L. Cam.* (*up. Tommot.-Botom.*), USSR (S. Urals-Altay-Sayan-Sib. Platf.-Transbayk.-Far East)-Mongolia.—FIG. 14,6; 42,3. *L. polyseptus* (LATIN), *up. Tommot.-Atdaban.*, Sib. Platf. (R. Lena); 14,6, reconstr., showing parts of inner and outer walls, $\times 40$; 42,3, early stage of development, $\times 5$ (Zhuravleva, 1960b).

Family CYCLOCYATHELLIDAE Zhuravleva, 1960

[Cyclocyathellidae ZHURAVLEVA in KHALFIN, 1960, p. 104] [= Cyclocyathellidae ZHURAVLEVA, 1959, p. 426, invalid name based on MS generic name; Cyclocyathellidae ZHURAVLEVA, 1960, p. 155, invalid name based on *Cyclocyathella* VOLOGDIN MS in ZHURAVLEVA, 1960, p. 155, generic name without assigned species]

Solitary, cups slenderly conical or cylindrical, without deep transverse wrinklings. Outer wall simple, with two to eight longitudinal rows of rounded or chinklike pores to an intersept. Intervallum with straight, porous or aporose septa. No tabulae. Inner wall of annuli. *L. Cam.* (*up. Tommot.-up. Botom.*).

Cyclocyathella VOLOGDIN in ZHURAVLEVA, KRASNOPEVA, & CHERNYSHEVA in KHALFIN, 1960, p. 105 [**Cyclocyathus yakovlevi* VOLOGDIN, 1931, p. 49; OD] [= *Cyclocyathus* SIMON, 1939, p. 27 (type, *C. yakovlevi* VOLOGDIN, 1931, p. 49); *Cyclocyathus* VOLOGDIN, 1931, p. 49, *nom. nud.* (*non Cyclocyathus* EDWARDS & HAIME, 1850, a genus of Scleractinia; *nec Cyclocyathus* DUNCAN & THOMPSON, 1867, a genus of Rugosa); *Cyclocyathella* VOLOGDIN in ZHURAVLEVA, 1960, p. 155, *nom. nud.*]. Solitary, cup conical; outer wall with simple pores, inner wall of annuli; annuli inverted V-shaped in section; septa porous; no tabulae. *L. Cam.* (*Atdaban.-Botom.*), USSR (Altay-Sayan).—FIG. 42,7. **C. yakovlevi* (VOLOGDIN), *up. Atdaban.*, Kameshki; 7a, part of transv. sec., $\times 7$; 7b, part of long. sec., $\times 5$, inner wall to right (Vologdin, 1931).

Cyathocriscus DEBRENNE, 1969, p. 318 [**Archaeocyathus tracheodentatus* R. BEDFORD & W. R. BEDFORD, 1934, p. 2; OD] [= ?*Cricopectinus* DEBRENNE, 1970, p. 32 (type, *C. dentulus*; OD)]. Outer wall simply porous; septa with sparse pores; inner wall of undulating annuli, horizontal or slightly inclined plates that are neither S- nor V-shaped in section, having a dentate axial rim; no tabulae are known. [May be atabulate spec-

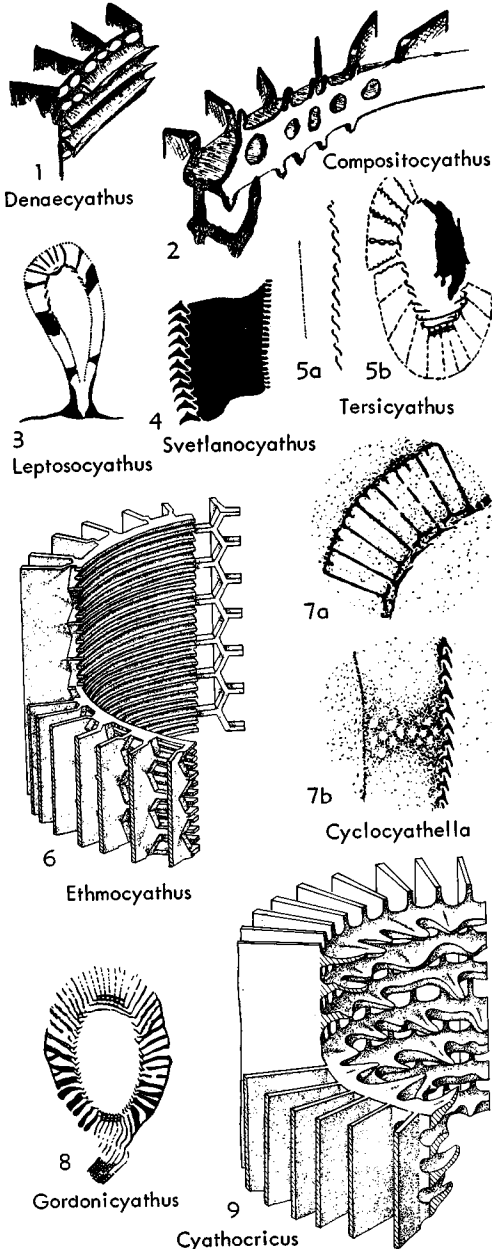


FIG. 42. Ethmocyathidae (1,6); Compositocyathidae (2,3); Cyclocyathellidae (4-5,7-9) (p. E67-E70).

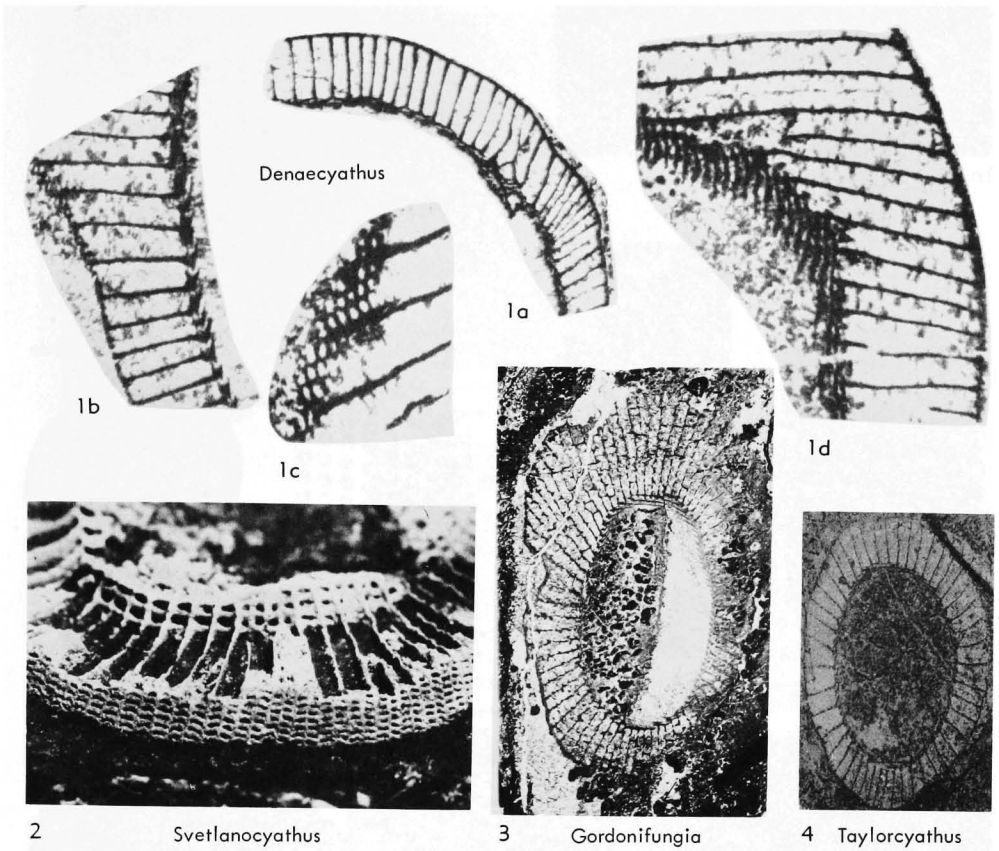


FIG. 43. Ethmocycathidae (1); Cyclocyathellidae (2-4) (p. E67, E69).

imens of *Cricopectinus* DEBRENNE, 1970, p. 32.] *L.Cam.*(*up.Atdaban.* or *low.Botom.*), S.Australia.—FIG. 42,9. **C. tracheodentatus* (BEDFORD & BEDFORD), S. Australia (Ajax Mine); inner wall and septa, diagram. (Debrenne, 1969a).

Gordonicyathus ZHURAVLEVA, 1959, p. 426 [**Thalamocyathus gerassimoviensis* KRASNOPEEVA, 1955, p. 95; OD]. Solitary; cup conical or cylindrical with simply porous outer wall and septa; without tabulae; inner wall of annuli, V-shaped in section. *L.Cam.*(*up.Tommot.-up.Botom.*), USSR (Altay-Sayan-Zabaykalia)-S.Australia.—FIG. 42,8. **G. gerassimoviensis* (KRASNOPEEVA), Botom., Sayan; oblique sec., $\times 2$ (Krasnopeeveva, 1955).

Gordonifungia ROZANOV in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 193 [**G. batinensis*; OD]. Like *Gordonicyathus* but with synapticalae connecting the septa. *L.Cam.*(*up.Atdaban.-Botom.*), USSR (Kuznetsk Alatau).—FIG. 43,3. **G. batinensis*; holotype, oblique transv. sec., $\times 2.7$ (Rozanov in Repina, *et al.*, 1964).

?**Hemithalamocyathus** TING, 1937, p. 367 [**Archaeocyathus sibiricus* VON TOLL, 1899, p. 40; M]. Type-species insufficiently known. *L.Cam.*(*up.Atdaban., Kameshki*), USSR (Sayan).

Svetlanocyathus MISSARZHEVSKIY & ROZANOV, 1962, p. 43 [**S. primus*; OD]. Like *Cyclocyathella* but pores of outer wall chinklike and septa aporose. *L.Cam.*(*Botom.*), USSR (Tuva).—FIG. 42,4; 43,2. **S. primus*, holotype; 42,4, part of long. sec., $\times 4$; 43,2, view of prepared part of cup, $\times 3$ (Missarzhevskiy & Rozanov, 1962).

Taylorcyathus VOLOGDIN, 1955, p. 143 [**Cyclocyathus subtersiensis* VOLOGDIN, 1940, p. 63; OD]. Cup slenderly conical; outer wall with small, simple pores; inner wall of annuli S-shaped in section directed upward and inward into central cavity; septa porous; no tabulae. *L.Cam.*(*Atdaban.-Botom.*), USSR (Altay-Sayan-Sib.Plattf.-Transbayk.)-Eu. (Sardinia-France [Montagne Noir])-S. Australia (Ajax).—FIG. 43,4. **T. subtersiensis* (VOLOGDIN), USSR (Salair); part of oblique sec., $\times 2.7$ (Vologdin, 1940a).

Tersicyathus VOLOGDIN, 1955, p. 143 [**Cyclocya-*

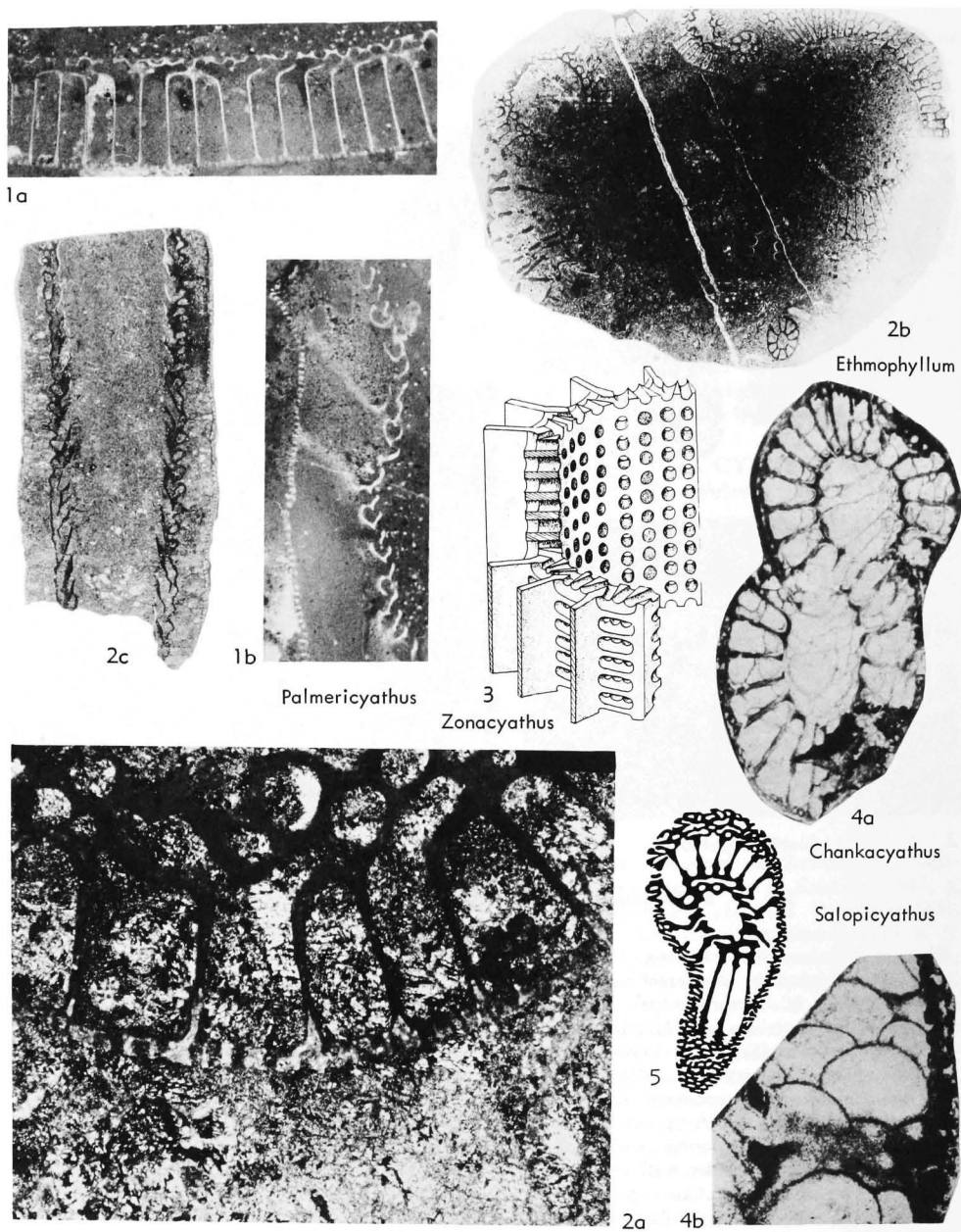


FIG. 44. Chankacyathidae (4); Ethmophyllidae (1-3,5) (p. E71-E73).

thus tersiensis VOLOGDIN, 1931, p. 87; OD]. Cup slenderly conical; outer wall with small simple pores; septa porous; inner wall of annuli S-shaped in section projecting downward into central cavity; no tabulae. *L. Cam. (Atdaban. low. Botom.)*, USSR (Altay-Sayan-Transbayk.).—FIG. 42,5. **T. tersiensis* (VOLOGDIN), low. Botom., Kuznetsk

Alatau; 5a, part of long. sec., 5b, oblique transv. sec., both $\times 1.3$ (Vologdin, 1931).

Family CHANKACYATHIDAE
Yakovlev, 1959

[Chankacyathidae YAKOVLEV, 1959, p. 91]

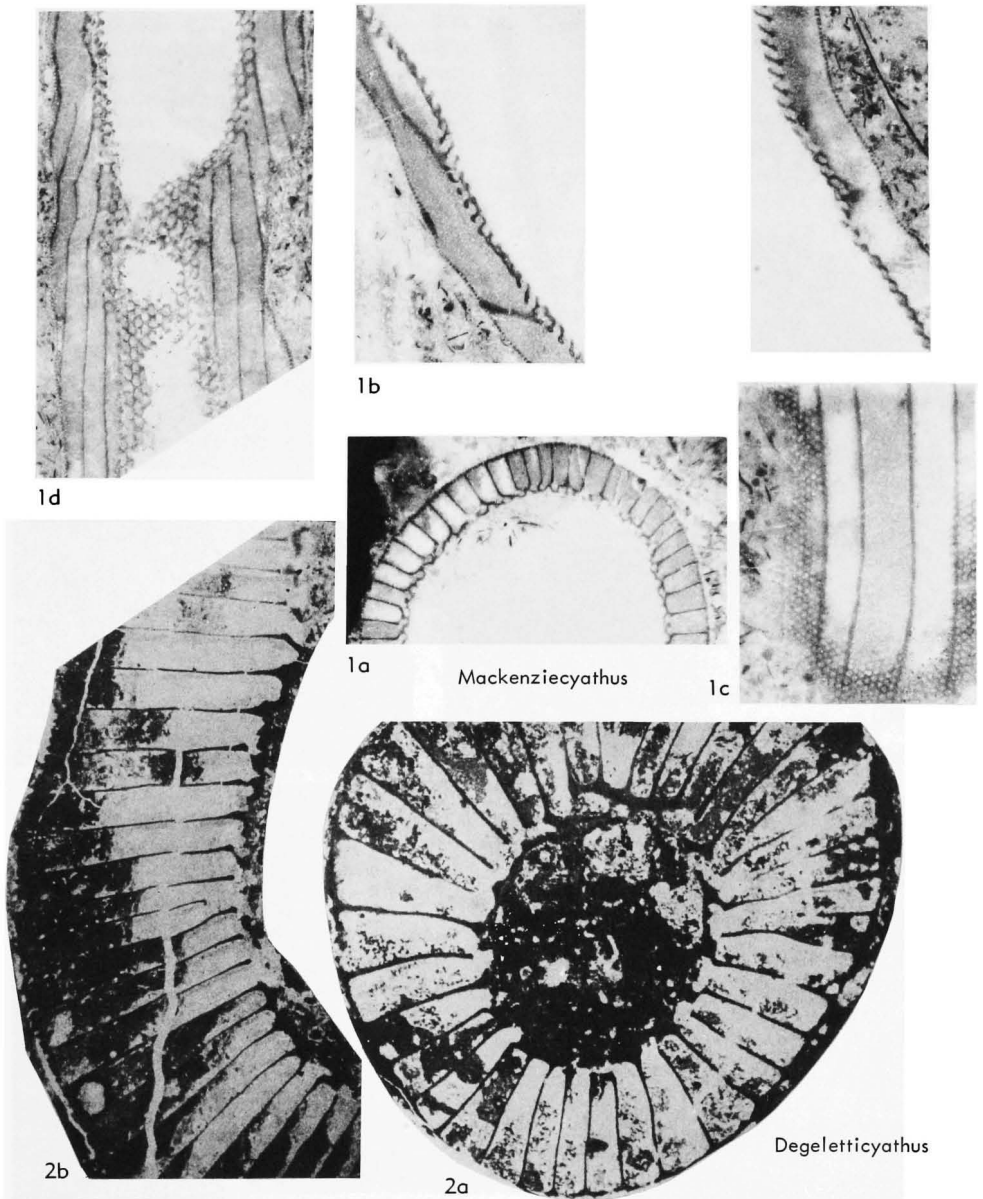


FIG. 45. Ethmophyllidae (p. E73).

Solitary or colonial; cups cylindrical, outer wall with pore-canals; inner wall with simple pores; septa porous; no tabulae; abundant dissepiments. *L. Cam. (Botom.)*.

Chankacyathus YAKOVLEV, 1959, p. 91 [**C. strachovi*; ?M]. Pore-canals of outer wall geniculate, opening downward. [See OKUNEVA, 1969, p. 82.] *L. Cam. (Botom.)*, USSR (Primore, Far

East).—FIG. 44,4. **C. strachovi*, neotype; 4a, transv. sec., $\times 4$; 4b, part of long. sec., outer wall to right, $\times 13$ (Zhuravleva, 1969).

Family ETHMOPHYLLIDAE
Okulitch, 1943

[Ethemphyllidae OKULITCH, 1943, p. 52]

Solitary or colonial; outer wall with

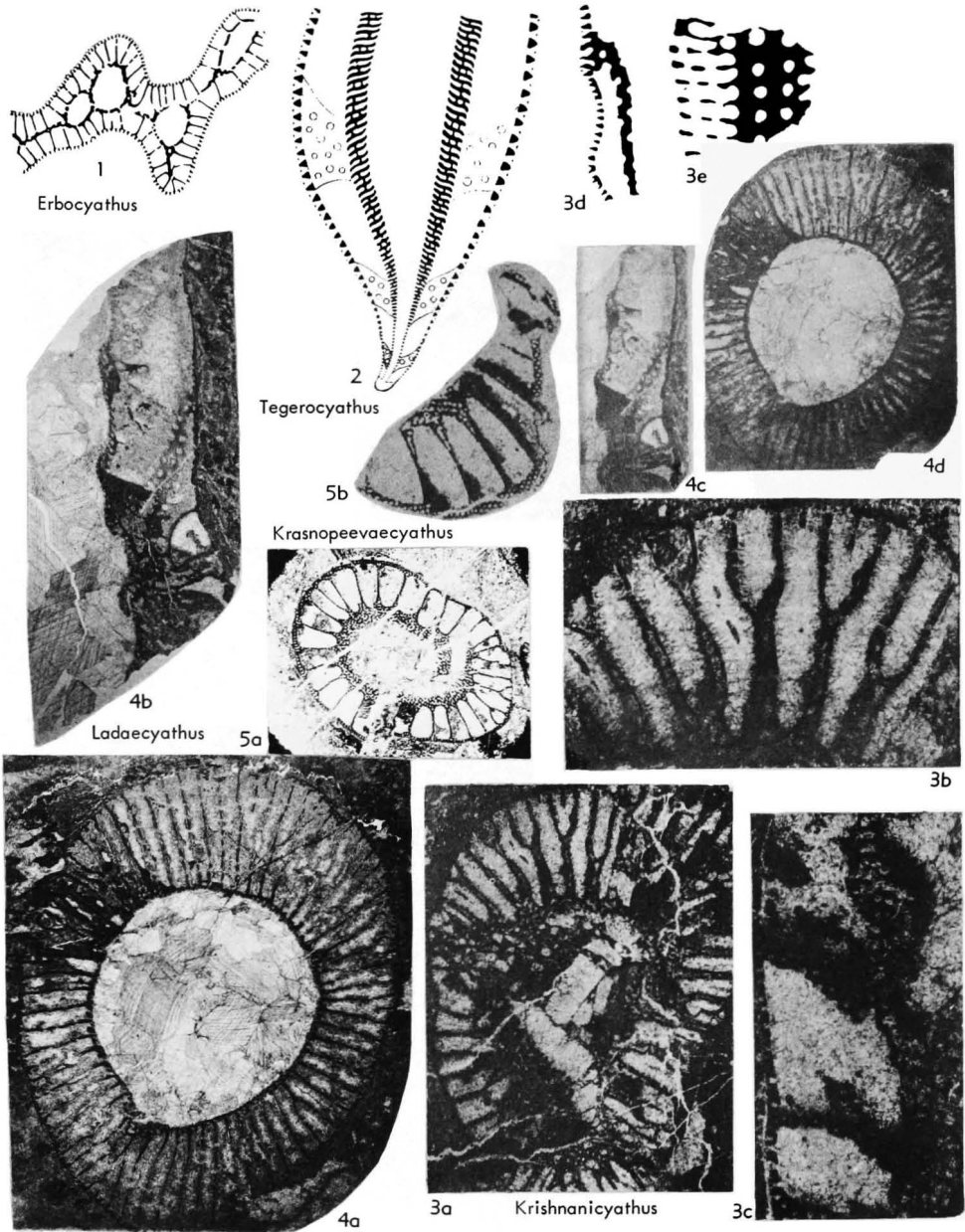


FIG. 46. Erboocyathidae (p. E73-E74).

simple short pore-canals; septa porous; inner wall composed of pore-tubes which are formed by junction of opposed waves in inner edges of neighboring septa and are commonly intercommunicating. *L.Cam.* (*Aidaban.*)-*M.Cam.*(*low.Amg.*).

Ethmophyllum MEEK, 1868, p. 64 [**E. whitneyi*; OD]. Solitary, rarely colonial; cup cylindrical or slenderly conical; outer wall with simple short and curved (or ?geniculate) pore-canals in quincunx; septa porous, inner edges waved; inner wall of pore-tubes formed by junction of opposed waves in inner edges of neighboring septa (Fig.

16,2). *L.Cam.* (*Atdaban.*)-*M.Cam.* (*low.Amg.*), N. Am. (Calif.-Nev.-B.C.)-Antarct.-S.Australia-USSR (S. Urals-Altay-Sayan-Sib. Platf.-Transbayk.-Far East)-Mongolia.—FIG. 44,2. **E. whitneyi*, lectotype, *L.Cam.*, Nev.; 2a, part of transv. sec., $\times 5$; 2b, same, $\times 3$; 2c, part of long. sec., $\times 3$ (Hill, 1965).

?*Degeletticyathus* ZHURAVLEVA in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 36 [**Ethmophyllum? galuschkoi* ZHURAVLEVA, 1960, p. 169; OD]. Large solitary cups of conical form; outer wall with rounded pores; septa with sparse, small pores in median parts and large stirrup pores at their junctions with the inner wall; inner wall thick, with one longitudinal row of stirrup pore-canals to an intersept. *L.Cam.* (*Atdaban.-Botom.*), USSR (Sib.Platf.).—FIG. 45,2. **D. galuschkoi* (ZHURAVLEVA), ?*Atdaban.*, Oy-Muran, Sib.Platf.; 2a, part of transv. sec., $\times 7$; 2b, part of long. sec., $\times 4$ (Zhuravleva, Korshunov, & Rozanov, 1969).

?*Mackenziocyathus* HANDFIELD, 1971, p. 43 [**M. bukryi*; OD]. Cup cylindrical; outer wall with simple pores; inner wall of intercommunicating oblique pore-tubes, two longitudinal rows to an intersept; septa imperforate. *L.Cam.* (*up.Atdaban.*), Can. (Yukon).—FIG. 45,1. **M. bukryi*, holotype; 1a, transv. sec., 1b, med. long. sec., both $\times 2.7$; 1c, tang. sec. outer wall, $\times 7$; 1d, tang. sec. inner wall, $\times 2$ (Handfield, 1971).

?*Palmericyathus* HANDFIELD, 1971, p. 44 [**Ethmophyllum lineatum* GREGGS, 1959, p. 66; OD]. Cup solitary; outer wall with simple pores; septa imperforate; inner wall of geniculate pore-tubes, 1.5 to 2 longitudinal rows to an intersept. *L.Cam.* (*up.Atdaban.* or *low.Botom.*), Can. (B.C.-NW.Terr.).—FIG. 44,1. **P. lineatus* (GREGGS), NW.Terr.; 1a, transv. sec., $\times 4$; 1b, long. sec., $\times 5$ (Handfield, 1971).

?*Salopicyathus* VOLOGDIN, 1962, p. 86 [**S. complanatorosus*; OD] [= *Salopicyathus* VOLOGDIN, 1958, p. 706, *nom. nud.* (occurs only as generic and specific name in list)]. Slenderly conical cup; outer and inner walls with complexly branching intercommunicating pore-canals; septa ?aporous. *L.Cam.*, USSR (Transbayk.).—FIG. 44,5. **S. complanatorosus*, holotype, R.Yangud, Transbayk.; oblique sec., $\times 4$ (Vologdin, 1962c).

?*Zonocyathus* R. BEDFORD & J. BEDFORD, 1937, p. 36 [**Archaeocyathus retevallum* R. BEDFORD & W. R. BEDFORD, 1934, p. 2; OD]. Solitary; outer wall simply porous; septa sparsely porous to aporous; inner wall has branching pore-tubes with initial tube located in middle of each intersept, then branching so that secondary tubes open in front of septa. Tubes may lengthen and curve into central cavity, never formed by fluting of septa. *L.Cam.* (*up.Atdaban.-low.Botom.*), S.Australia-USSR (Altay-Sayan)-Mongolia-Can. (Yukon-NW.Terr.-B.C.).—FIG. 44,3. Z. *retezona* (TAYLOR), S.Australia (Ajax); inner wall and septa, diagram. (Debrenne, 1969a).

Superfamily ERBOCYATHACEA Vologdin & Zhuravleva, 1956

[*nom. transl.* ZHURAVLEVA, 1960, p. 187 (*ex* Erbocyathidae VOLOGDIN & ZHURAVLEVA, in VOLOGDIN, 1956, p. 879)]

Colonial, rarely solitary, cups slenderly conical, cylindrical; outer wall thick with pore-canals screened externally, elements of screen increasing in number and decreasing in thickness outward; septa porous, outer edges decreasing in thickness to form part of screen; pores of septa may be irregularly disposed; dissepiments may occur; inner wall with simple pores, or pore-canals, or of annuli. *L.Cam.* (*Atdaban.-Len.*)-*base M.Cam.*

Family ERBOCYATHIDAE Vologdin & Zhuravleva in Vologdin, 1956

[Erbocyathidae VOLOGDIN & ZHURAVLEVA, in VOLOGDIN, 1956, p. 879 (*nom. nov. pro* Polycyathidae VOLOGDIN, 1928, p. 35, invalid name based on junior homonym)] [= *Ladaecyathidae* DEBRENNE, 1964, p. 114]

Colonial, rarely solitary, cups slenderly conical or cylindrical; outer wall thick with pore canals screened externally, elements of screen increasing in number and decreasing in thickness outwards; septa porous, pores may be irregularly disposed; dissepiments may occur; inner wall with simple pores or pore canals. *L.Cam.* (*Atdaban.-Len.*)-*base M.Cam.*

Erbocyathus ZHURAVLEVA, 1950a, p. 11 [*nom. subst. pro Polycyathus* VOLOGDIN, 1928, p. 32 (type, *P. heterovalium*), *non Polycyathus* DUNCAN, 1876, a coelenterate] [**Polycyathus heterovalium* VOLOGDIN, 1928, p. 32; SD SIMON, 1939, p. 34] [= *Pluralicyathus* OKULITCH, 1950, p. 503 (*nom. subst. pro Polycyathus* VOLOGDIN, 1928, p. 32)]. Colonial; individual cups cylindrical or slenderly conical. Outer wall thick with pore-canals screened externally, elements of screen increasing in number and decreasing in thickness outward; septa widely spaced, each with row of stirrup pores at junction with outer wall, and with sparse pores elsewhere; dissepiments may occur; inner wall with one or two longitudinal rows of simple pores to an intersept; anchoring processes absent. *L.Cam.* (*Len.*), USSR (Altay-Sayan-Sib. Platf.).—FIG. 46,1. **E. heterovalium* (VOLOGDIN), *Len.*, Mt. Dolgiy Mys; transv. sec. of part of colony, $\times 2$ (Vologdin, 1962d).

Krasnopeevacyathus ROZANOV, in REPINA, KHO-MENTOVSKII, ZHURAVLEVA, & ROZANOV, 1964, p. 208 [**K. tyrgaensis*; OD]. Outer wall with auxiliary finely porous sheath; septa regularly porous; inner wall complex and crenulate, with complexly intercommunicating pore-tubes extending into central cavity. *L.Cam.* (*Botom.*), USSR

(Altay).—FIG. 46,5. **K. tyrgaensis*; R. upper Tyrga, Altay; 5a, transv. sec. holotype, $\times 2$; 5b, part of oblique long. sec., $\times 2$ (Rozanov, 1964).

?*Krishnanicyathus* VOLOGDIN, 1964, p. 358 [**K. elegans*; OD]. Cup conical; outer wall with wall screened as in *Erbocyathus* [?]; inner wall thick, complexly porous, of intercommunicating ?horizontal pore-canals or ?pore-tubes; ribs of inner wall porous tissue project into intervallum, each rib continuous with inner end of one septum or of two axially confluent septa. No tabulae or dissepiments. *L.Cam.(Botom.)*, USSR (Sayan).—FIG. 46,3. **K. elegans*, R.Abakan, Sayan; 3a,b, transv. sec., $\times 2.7, \times 7$; 3c, oblique long. sec., $\times 7$; 3d, part of long. sec., $\times 17$; 3e, partly tang. sec. inner wall, $\times 7$ (Vologdin, 1964).

Ladaocyathus ZHURAVLEVA, 1960a, p. 43 [**Tegerocyathus limbatus* ZHURAVLEVA, 1955, p. 46; OD] [= ?*Neocyathus* VOLOGDIN, 1960, p. 422 (type, *Archaeocyathus laevis* VOLOGDIN, 1940b, p. 57; = ?*A. laevis* VOLOGDIN, 1932, p. 41)]. Solitary, rarely colonial; outer wall screened as in *Erbocyathus*; septa uniformly porous; inner wall with simple pores in 2 to 5 longitudinal rows to an intersept, bars and ribs between pores with short hairlike outgrowths on side of central cavity, forming screen across mouth of each pore. *L.Cam.(Atdaban-Botom.)*, USSR (Altay-Sayan-Sib.Platf.-Far East)-Can.(Yukon)-Antarct.—FIG. 46,4. **L. limbatus* (ZHURAVLEVA), holotype, Botom., Mt. Martyuhkin, Kuznetsk Alatau; 4a,b, transv. sec., part of long. sec., $\times 7$; 4c,d, parts of long. and transv. secs., $\times 5$ (Zhuravleva, 1955).

Schidertycyathellus KONYUSHKOV, 1967, p. 108 [**S. borucaeui*; OD]. Solitary, conical, cylindrical or fungus-like cups; outer wall strong with branching or conical pores covered with thin finely porous sheath; inner wall strong, with straight or somewhat crooked pore-canals; septa closely porous. *Up.L.Cam.-base M.Cam.*, USSR (Kazakhstan).—FIG. 47,1. **S. borucaeui*, Mt. Agyrek, Kazakhstan; oblique sec. holotype, $\times 6$ (Konyushkov, 1967).

Tegerocyathella KONYUSHKOV, 1967, p. 109 [**T. borovikovi*; OD]. Solitary, conical cups; outer wall strong with conical pores widening outward, covered with finely porous sheath; septa aporose, commonly thickening at edges where stirrup-pores are developed; inner wall thick, with rare, somewhat crooked pore-canals; central cavity free of skeletal elements. *Up.L.Cam.-base M.Cam.*, USSR (Kazakhstan).—FIG. 47,2. **T. borovikovi*, Mt. Agyrek, Kazakhstan; oblique sec. holotype, $\times 5$ (Konyushkov, 1967).

Tegerocyathus KRASNOPEEVA, 1953, p. 36 (fide ZHURAVLEVA, 1960, p. 192) [**T. edelsteini* (= *Ethmophyllum edelsteini* VOLOGDIN, 1931, p. 47, fide ZHURAVLEVA, 1960, p. 193); M]. Solitary, rarely colonial; outer wall as in *Erbocyathus*; inner wall thick, with crooked, intercommunicating pore-canals; septa sparsely porous. *L.Cam.(Botom.-Len.)*, USSR (Altay-Sayan-Sib.Platf.).—

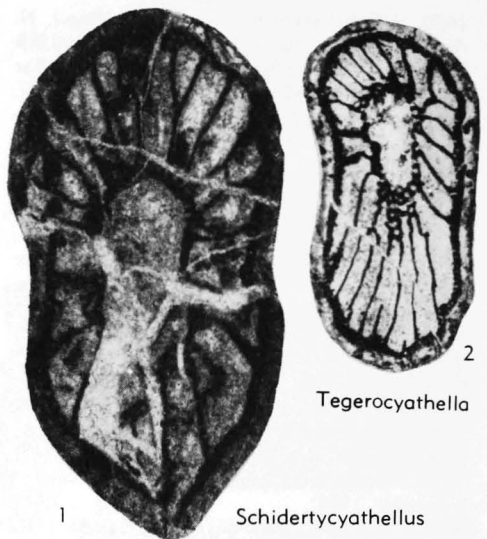


FIG. 47. *Erbocyathidae* (p. E74).

FIG. 46,2. **T. edelsteini* (VOLOGDIN); diagram long. sec. showing ontogenetic changes (Zhuravleva, 1960b).

[KRASNOPEEVA (1953b, p. 52, 56) cited *Tegerocyathus* as a new genus, but mentioned and illustrated only two (new) species, *T. potaechini* (cited as *gen. et. sp. nov.*) and *T. tannu-ola*. These two were transferred to *Porocyathus* ZHURAVLEVA, 1960, by ZHURAVLEVA 1960, p. 180. KRASNOPEEVA (1955, p. 90) cited *Tegerocyathus* as a new genus and designated as type-species "*Tegerocyathus abakanensis* (Vol.)." ZHURAVLEVA (1960, p. 193) and ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA (1960, p. 116) included both *E. edelsteini* and *E. abakanensis* in *Tegerocyathus*.]

?Family SAJANOCYATHIDAE Vologdin, 1956

[*Sajanocyathidae* VOLOGDIN, 1956, p. 879] [= ?*Serligocyathidae* VOLOGDIN, 1959, p. 671]

Colonial, branching; outer wall finely and ?simply porous; septa almost aporose, dissepiments sparse; no tabulae or synapticulae; inner wall thick with curved, intercommunicating pore-canals. Porosity of outer wall insufficiently known (see Zhuravleva, 1960b, p. 188). *L.Cam.(Botom.-low.Len.)*.

Sajanocyathus VOLOGDIN, 1940b, p. 81 [**S. ussowi*; OD] [= *Sajanocyathus* VOLOGDIN, 1937, p. 471, *nom. nud.*; *Sajanocyathus* VOLOGDIN, 1937, p. 479, *nom. nud.* (type, *Sajanocyathus ussowi* VOLOGDIN, 1937, p. 479, M); *Sajanocyathus* DEBRENNE, 1964, p. 114, *nom. null.*; ?*Leiocyathus* VOLOGDIN, 1959, p. 671 (type, *L. inaequitaenialis*, OD)]. Colonial; outer wall structure uncertain (fide ZHURAVLEVA, 1960, p. 188); septa porous, no tabulae or synapticulae; inner wall with curved, intercommunicating pore-canals in 2 to 3 longitudinal rows to an intersept. *L.Cam.(Botom.-low.*

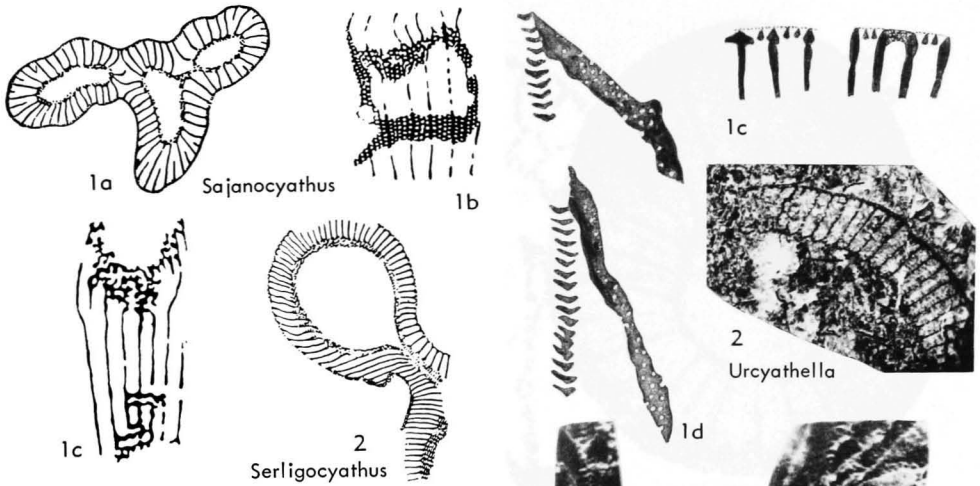


FIG. 48. Sajanocyathidae (p. E74-E75).

Len.), USSR (Altay-Sayan).—FIG. 48, 1. **S. ussoui*, R. Sanashtykgol, Sayan; 1a, transv. sec. of colony; 1b, tang. sec. of outer wall, 1c, tang. sec. of inner wall; all $\times 3$ (Vologdin, 1940b).

Serligocyathus VOLOGDIN, 1959, p. 671 [**S. lukashevi*; OD]. Solitary or colonial; outer wall with simple pores; septa aporose; inner wall thick with single longitudinal row of chinky pores to an intercept. *L. Cam.*, USSR (Tuva).—FIG. 48, 2. **S. lukashevi*, R. Serlig, Tuva; transv. sec. of colony, $\times 2.7$ (Vologdin, 1959b).

Superfamily PRETIOSOCYATHACEA Rozanov, 1969

[Pretiosocyathacea ROZANOV, 1969, p. 112]

Outer wall consists of a framework and an openwork finely porous isolated auxiliary sheath. *L. Cam.* (*Atdaban.-Botom.*).

Family PRETIOSOCYATHIDAE Rozanov, 1969

[Pretiosocyathidae ROZANOV, 1969, p. 112]

Inner wall with pore-canals. *L. Cam.* (*up. Atdaban.*).

Pretiosocyathus ROZANOV, in ROZANOV & MISSARZHEVSKIY, 1966, p. 55 [**P. subtilis*; OD]. Outer wall a framework screened with finely porous independent sheet; septa very porous; inner wall thicker, with two longitudinal rows of pore-canals to an intercept, canals not opening into one another. *L. Cam.* (*up. Atdaban.*), USSR (Kuznetsk Alatau).—FIG. 49, 3. **P. subtilis*, holotype, Kameshki; part of transv. sec., $\times 7$ (Rozanov in Rozanov & Missarzhevskiy, 1966).

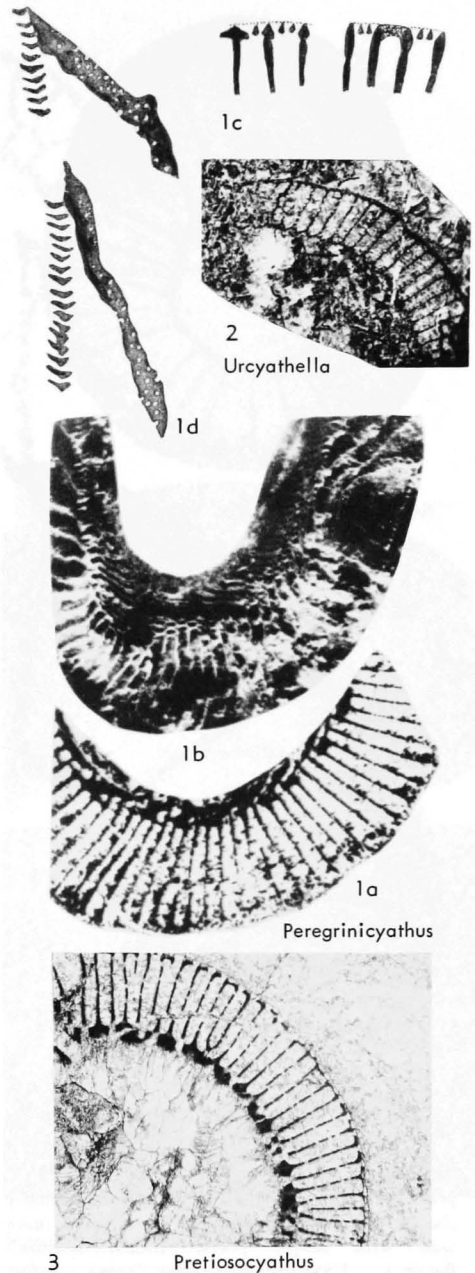


FIG. 49. Pretiosocyathidae (3); Robertocyathidae (2); Peregrinicyathidae (1) (p. E75-E76).

Family ROBERTOCYATHIDAE Rozanov, 1969

[Robertocyathidae ROZANOV, 1969, p. 112]

Outer wall a framework with isolated

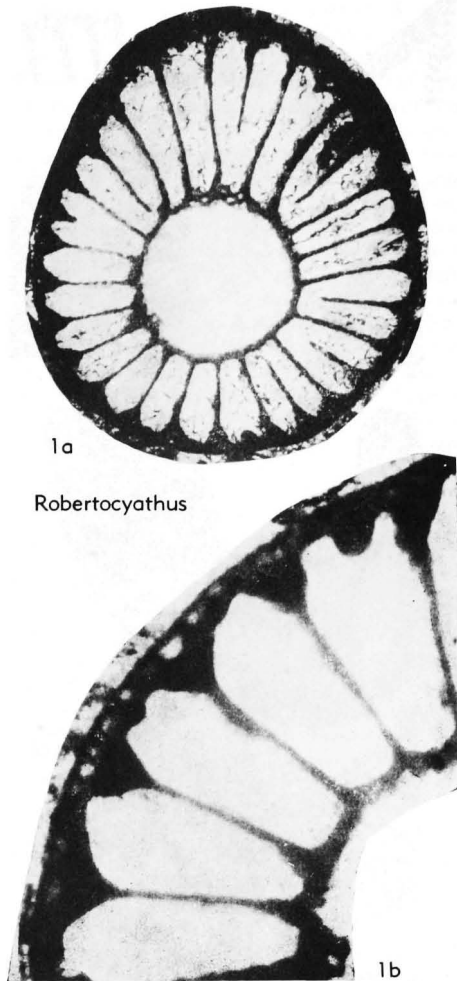


FIG. 50. Robertocyathidae (p. E76).

auxiliary sheath; no tabulae; septa porous; inner wall with simple pores. *L.Cam. (Atdaban.-Botom.)*.

Robertocyathus ROZANOV, 1969, p. 112 [**R. polaris*; OD]. Outer wall with isolated auxiliary sheath; septa evenly porous; no tabulae; inner wall with simple pores. *L.Cam. (Atdaban.-Botom.)*, USSR (Sib. Platf.-Altay-Sayan).—FIG. 50, 1. **R. polaris*, holotype, Botom., Olenek uplift; 1a, transv. sec., $\times 8$; 1b, part of transv. sec., $\times 13$ (Rozanov, 1969).

Urcyathella ZHURAVLEVA, 1961, p. 25 [**U. tercyathoides*; OD]. Solitary; outer wall with simply porous framework invested externally with independent microporous sheath; septa porous; inner wall with angular longitudinal crenulation and with small, simple pores. (Structure of outer wall

vide ROZANOV, 1969, p. 111). *L.Cam. (Atdaban.)*, USSR (Sayan).—FIG. 49, 2. **U. tercyathoides*, Bazaikh.; transv. sec., $\times 4$ (Zhuravleva, 1961).

Family PEREGRINICYATHIDAE Zhuravleva, 1967

[Peregrinicyathidae ZHURAVLEVA in ZHURAVLEVA, ZADOROZHNYAYA, *et al.*, 1967, p. 74]

Solitary; outer wall coarsely porous with finely porous independent external sheath; septa porous; no tabulae; inner wall of annuli. *L.Cam. (Botom.)*.

Peregrinicyathus ZHURAVLEVA in ZHURAVLEVA, ZADOROZHNYAYA, *et al.*, 1967, p. 75 [**P. dorotheae*; OD]. Solitary; outer wall coarsely porous with microporous external sheath; septa porous; inner wall of annuli, V-shaped in section. *L.Cam. (Botom.)*, USSR (Tuva).—FIG. 49, 1. **P. dorotheae*; 1a, holotype, part of oblique transv. sec., $\times 4$; 1b, part of oblique transv. sec., $\times 4$; 1c, outer wall and septa; 1d, part of long. sec., both $\times 2$ (Zhuravleva, 1967, in Zhuravleva, *et al.*).

Superfamily HUPECYATHELLACEA Rozanov, 1969

[Hupecyathellacea ROZANOV, 1969, p. 111]

Outer wall of cup a framework of pore-canals (or tubes?) of S-form in longitudinal section, covered with microporous external sheath. Septa porous, inner wall of S-shaped pore-tubes; no tabulae or dissepiments. *L.Cam. (Botom.)*.

Family HUPECYATHELLIDAE Rozanov, 1969

[Hupecyathellidae ROZANOV, 1969, p. 111]

Outer wall a framework of pore-canals (?or tubes) of S-form in longitudinal section, covered with microporous external sheath; inner wall of S-shaped pore-tubes; no tabulae. *L.Cam. (Botom.)*.

Hupecyathellus ROZANOV, in DATZENKO, ZHURAVLEVA, *et al.*, 1968, p. 149 [**H. schuberti*; OD]. Framework of outer wall with canals (?or tubes) close to S-form; thin external sheath with consistent vertical rows of sub-rectangular pores; septa regularly porous; inner wall with two longitudinal rows of S-shaped pore-tubes to an intersept. *L.Cam. (Botom.)*, USSR (NW.Sib. Platf.).—FIG. 51, 2. **H. schuberti*, holotype, Taryn horizon, R. Sukharikha, Sib. Platf.; 2a, part of long. sec., $\times 13$; 2b, part of tang. sec. of outer wall, $\times 12$ (Datzenko, *et al.*, 1968).

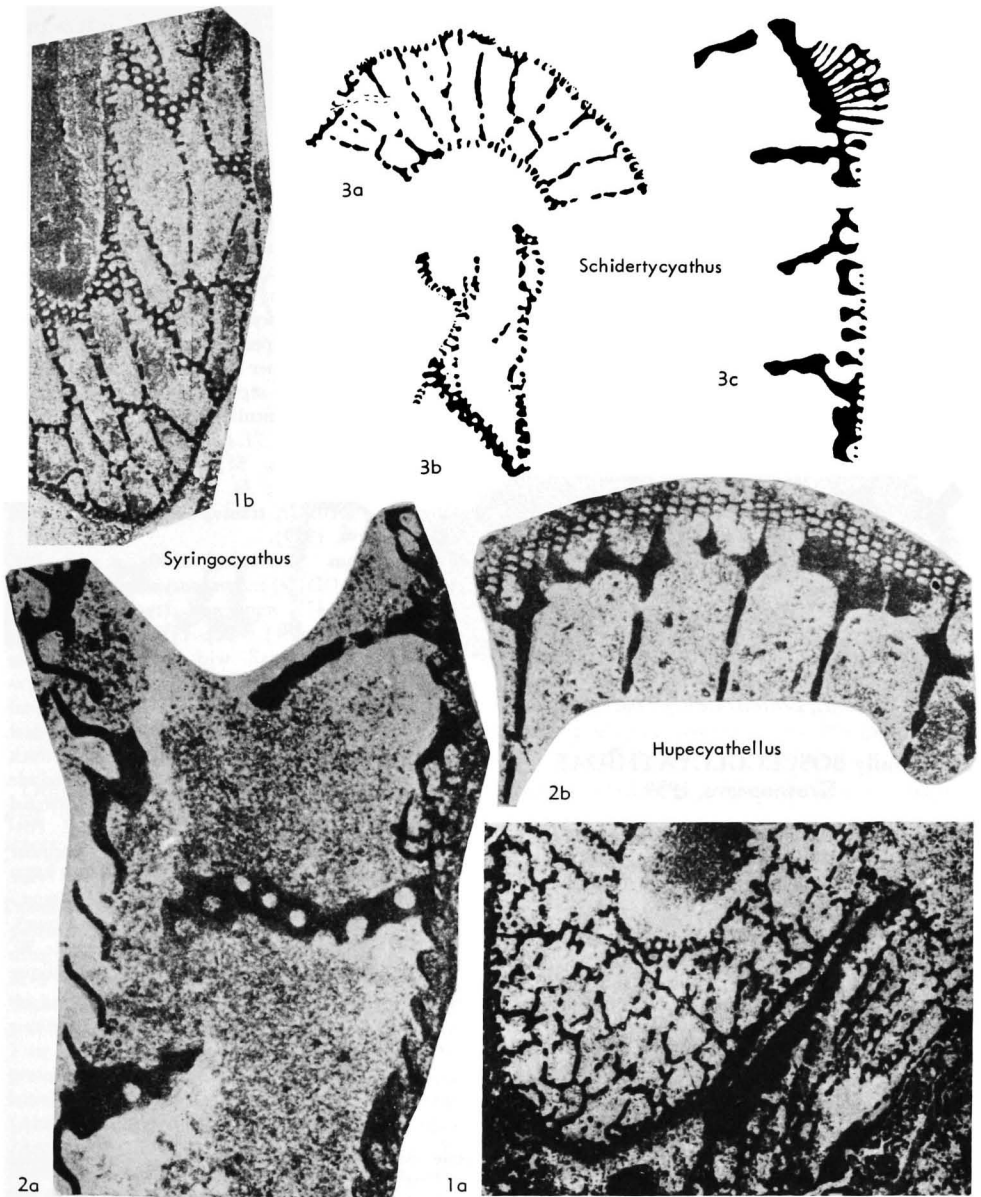


FIG. 51. Hupecyathellidae (2); Schidertycyathidae (1,3) (p. E76, E78).

Superfamily
BOSCECULCYATHACEA
Krasnopeeva, 1959

[*nom. transl.* HILL, herein (*ex* Bosceculcyathidae KRASNOPEEVA, 1959, p. 7)] [=Bosceculida KRASNOPEEVA, 1960, p. 41 (order); Bosceculida KRASNOPEEVA, 1969, p. 63 (order); Bosceculcyathina KRASNOPEEVA, 1969, p. 63 (suborder); Schidertycyathina KRASNOPEEVA, 1969, p. 63 (suborder)]

Outer wall of cup framework of pore-canals covered with microporous external sheath; inner wall with simple pores (?or pore canals); intervallum with some or no normal ajacyathoid interseptal loculi, and with vertical polygonal subloculi formed by bending or ?branching of the septa; porrows of septal elements vertical or sub-

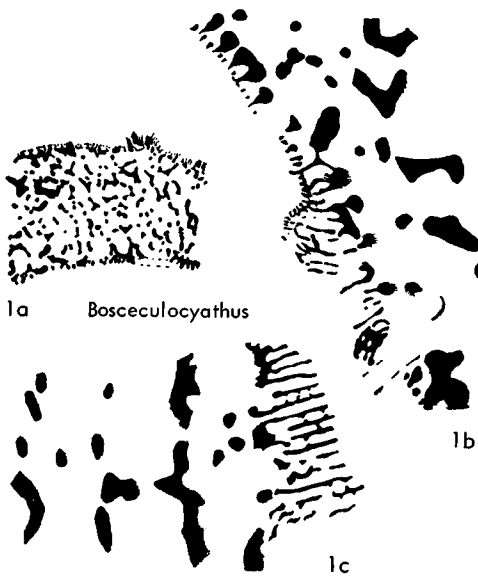


FIG. 52. Bosceculocyathidae (p. E78).

vertical; tabulae absent, dissepiments exceptional. *L.Cam.(Botom.-Len.)-?base M.Cam.*

Family BOSCECULCYATHIDAE Krasnopeeva, 1959

[Bosceculocyathidae KRASNOPEEVA, 1959, p. 7]

Outer wall framework of pore-canals covered with microporous external sheath; inner wall thick with simple pores (?or pore-canals) intervallum with vertical polygonal loculi formed by bending or branching of porous septa; pore rows of septal elements vertical or subvertical; tabulae ?absent and no dissepiments. *L.Cam.(Botom. or ?Len.) or ?base of M.Cam.*

Bosceculocyathus KRASNOPEEVA, 1959, p. 7 [**B. agyrekensis*; OD] [= *Bosceculocyathus* KRASNOPEEVA, 1959, p. 7, *nom. null.*]. Characteristics of family. *L.Cam.(Botom. or ?Len.) or ?base M.Cam.*, USSR (Kazakh.).—FIG. 52, 1. **B. agyrekensis*, Mt. Agyrek, Kazakh.; 1a, part of transv. sec., $\times 7$; 1b,c, parts of transv. and long. secs. near wall, $\times 14$ (Krasnopeeva, 1959).

Family SCHIDERTYCYATHIDAE Krasnopeeva, 1969

[Schidertycyathidae KRASNOPEEVA, 1969, p. 63]

Outer wall of cup framework of simple pores (?or pore-canals) covered with a microporous external sheath; intervallum

with some normal ajacicyathoid interseptal loculi; in other parts of cups septa bend or branch to meet neighbors and form vertical polygonal subloculi; septa porous, longitudinal pore-rows vertical or subvertical; dissepiments exceptional and tabulae absent. *L.Cam.(Botom.-Len.) or ?base M.Cam.*

Schidertycyathus KRASNOPEEVA, 1959, p. 3 [**S. borucaevi*; M] [= *Schidertycyathus* DEBRENNE, 1964, p. 117, *nom. null.*]. Possibly a junior synonym of *Syringocyathus*, *q.v.*; below. Outer wall with funnel-shaped pores and a finely porous external sheath; inner wall thick, with simple pores or pore-canals; septa porous, mostly straight, some curved; synapticulae present but rare; dissepiments present? *?L.Cam.*, USSR (Mt. Agyrek, Kazakhstan).—FIG. 51, 3. **S. borucaevi*, Mt. Agyrek, Kazakhstan; 3a, transv. sec., $\times 10$; 3b, long. sec., $\times 10$; 3c, transv. sec. outer wall, $\times 14$ (Krasnopeeva, 1959).

?Syringocyathus VOLOGDIN, 1940, p. 82 [**S. aspectabilis*; OD] [= *Syringocyathus* VOLOGDIN, 1937, p. 471, 477, *nom. nud.* (type, *S. spirocyathoides nom. nud.*)]. Cup cylindrical; may be compound; outer wall with large pores; septa porous and for the most part regular, some curving and confluent or connected by longitudinal but not radial porous plates so that some vertical polygonal subloculi are formed; inner wall thick with simple pores. [VOLOGDIN's figures preclude neither the presence of a finely porous external sheath to the outer wall, nor synapticulae. Possibly, therefore, *Syringocyathus* may be a member of this family.] *L.Cam.(Botom.-up.Len. or ?base M.Cam.)*, USSR (Altay-Sayan-Kazakh.)-?Antarct.-?Can.—FIG. 51, 1. **S. aspectabilis* (VOLOGDIN), *L.Cam.(Botom.)*, USSR (R. Sanashtykgol, W. Sayan); 1a, oblique transv. sec., $\times 4$; 1b, oblique long. sec., $\times 4$ (Vologdin, 1940b, 1962d).

Superfamily TUMULOCYATHACEA Krasnopeeva, 1953

[*nom. transl.* DEBRENNE, 1964, p. 113 (ex Tumulocyathidae KRASNOPEEVA, 1953, p. 56)]

Solitary; outer wall with simple or complex (knobby) tumuli; septa porous; no tabulae or dissepiments; inner wall simple, or with pores provided with plates, bracts or scales. (For discussion see Rozanov, 1969, p. 108.) *L.Cam.(up.Tommot.-up.Len.)*.

Family TUMULOCYATHIDAE Krasnopeeva, 1953

[Tumulocyathidae KRASNOPEEVA, 1953b, p. 56]

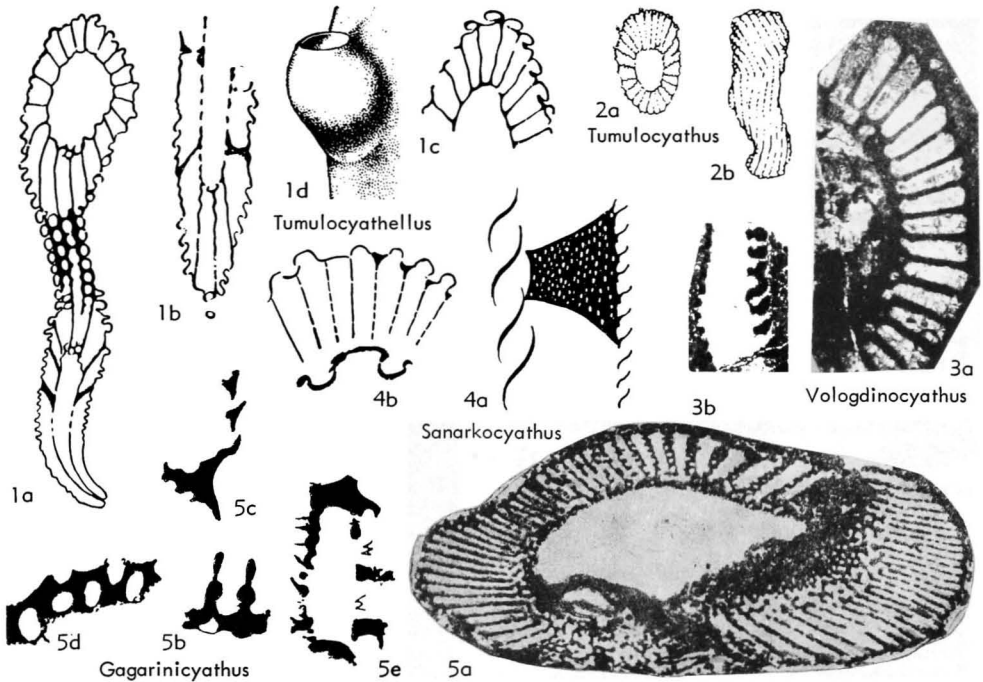


FIG. 53. Tumulocyathidae (1-2); Sanarkocyathidae (4); Vologdinocyathidae (3,5) (p. E79-E80).

Outer wall with pores in tumuli; inner wall with simple pores that may have bracts; septa porous; no tabulae. *L.Cam.* (*up.Tommot.-Botom.*).

Tumulocyathus VOLOGDIN, 1937, p. 470 [**T. pustulatus*; M]. Outer wall with 1 or 2 longitudinal rows of pores to an intersept, each pore set in a hollow knob or tumulus; septa thin, some thickened at their junction with walls, regularly porous; inner wall simple, within each intersept 1 or 2 longitudinal rows of pores that may be protected by spines or bracts; anchoring processes lamellar. *L.Cam.* (*up.Tommot.-Botom.*), USSR (Altay-Sayan-Transbayk.-Far East)-Mongolia-?Antarct.-N.Afr. (Morocco).—FIG. 53,2. **T. pustulatus*, *L.Cam.*, Mongolia; 2a,b, oblique transv. and tang. long. secs., $\times 3$ (Vologdin, 1937b).

Dailycyathus DEBRENNE, 1970, p. 32 [**Paranacyathus margarita* BEDFORD, & J. BEDFORD, 1937, p. 34; OD]. Cup large, conical, with narrow intervallum; outer wall with one longitudinal row of pores between 2 adjacent septa, each pore covered by a hemispherical tumulus perforated laterally; septa straight, perforated only by stirrup-pores; inner wall with a longitudinal row of stirrup-pores at each septum; skeletal structures in central cavity, arising from intervalum. *L.Cam.* (*up.Atdaban.* or *low.Botom.*), S. Australia.

Tumulocyathellus ZHURAVLEVA, 1960, p. 174 [*nom. transl.* REPINA, *et al.*, 1964, p. 194 (*ex Tumulocyathus* (*Tumulocyathellus*) ZHURAVLEVA, 1960, p. 174)] [**Tumulocyathus admirabilis* VOLOGDIN, 1940b, p. 72; OD]. Like *Tumulocyathus* but septa sparsely porous or with stirrup-pores. *L.Cam.* (*up.Tommot.-Botom.*), USSR (Altay-Sayan-Transbayk.-Sib.Platf.-?Far East).—FIG. 53,1a-c. **T. admirabilis* (VOLOGDIN), *Botom.*, Sayan; 1a, random sec. through curving cup; 1b, oblique long. sec.; 1c, oblique transv. sec.; $\times 3$ (Vologdin, 1940b).—FIG. 11,4; 53,1d. *T. unicumus* ZHURAVLEVA, *low.Botom.*, R.*Botoma*, Sib.Platf.; 11,4, septum, $\times 30$; 53,1d, tumulus of outer wall, $\times 67$ (Zhuravleva, 1960b).

Family SANARKOCYATHIDAE Hill, new family

[Sanarkocyathidae HILL, herein] [=?Sanaricyathidae ROZANOV, 1969, p. 107, name based on assumedly invalid generic name *Sanaricyathus* ROZANOV, 1969, p. 108, ?*nom. null.* *pro Sanarkocyathus* ZHURAVLEVA, 1963a, p. 118]

Outer wall with simple tumuli opening upward; inner wall squamate, one scale to each two or three interseptal loculi; scales S-shaped in section, forming pore-tubes opening downward; septa porous, no tabuli. (For discussion see Rozanov, 1969, p. 107.) *L.Cam.* (*Botom.*).

Sanarkocyathus ZHURAVLEVA, 1963, p. 118 [**S. mamaevi*; OD] [=?*Sanaricyathus* ROZANOV, 1969, p. 108 (?*nom. null. pro Sanarkocyathus* ZHURAVLEVA, 1963a, p. 118)]. Cup conical or cylindrical; outer wall with simple tumuli opening upwards, S-formed in longitudinal section, one longitudinal row to an intersept; septa finely porous; inner wall squamate, one scale to each 2 or 3 interseptal loculi, scales S-shaped in longitudinal section, forming pore-tubes opening downward. *L.Cam. (Botom.)*, USSR(S.Urals).—FIG. 53.4. **S. mamaevi*, R.Sanarka, S.Urals; 4a, long. sec., 4b, transv. sec., both $\times 4$ (Zhuravleva, 1963a).

Family VOLOGDINOCYATHIDAE Yaroshevich, 1957

[Vologdinocyathidae YAROSHEVICH, 1957, p. 1015]

Solitary; outer wall with tumuli, the pores being near or at the summits of the tumuli; intervallum with septa and without tabulae; inner wall thick, with pore-canals. *L.Cam. (Atdaban-up.Len.)*.

Vologdinocyathus YAROSHEVICH, 1957, p. 1016 [**V. erbiensis*; OD]. Solitary; outer wall with simple tumuli, pores being at or near summits of tumuli; inner wall thick, with one longitudinal row of intercommunicating horizontal pore-canals to an intersept, pore-canals narrowing appreciably at their outlets to central cavity; septa sparsely porous. *L.Cam. (up. Atdaban-up.Len.)*, USSR (Altay-Sayan-Far East).—FIG. 53.3. **V. erbiensis*, up.Len., Kuznetsk Alatau; 3a,b, parts of transv. and long. secs., $\times 20$ (Yaroshevich, 1957).

Gagarinicyathus ZHURAVLEVA in DATZENKO, ZHURAVLEVA, *et al.*, 1958 p. 146 [**G. ethmophylloides*; OD]. Outer wall with weak simple tumuli, one longitudinal row to an intersept; septa porous; inner wall spongy, with large ramifying pore-canals opening into one another horizontally, one longitudinal row to an intersept. *L.Cam. (Atdaban-low.Botom.)*, USSR (NW.Sib.Platf.).—FIG. 53.5. **G. ethmophylloides*, low.Botom., Sib.Platf.; 5a, oblique transv. sec., $\times 4$; 5b,c, parts of tang. and long. secs. outer wall, $\times 19$, $\times 20$ (5b, showing pore opening); 5d, part of septum in tang. sec., $\times 13$; 5e, part of inner wall in long. sec., $\times 17$ (Datzenko, Zhuravleva, *et al.*, 1968).

Superfamily ANNULOCYATHACEA Krasnopeeva, 1953

[*nom. transl.* ZHURAVLEVA, 1960, p. 171 (*ex Annulocyathidae* KRASNOPEEVA, 1953, p. 56)]

Cup solitary, conical or cylindrical; outer wall either with plates of S-formed longitudinal section forming pore-tubes, or with short pore-canals with bracts forming genic-

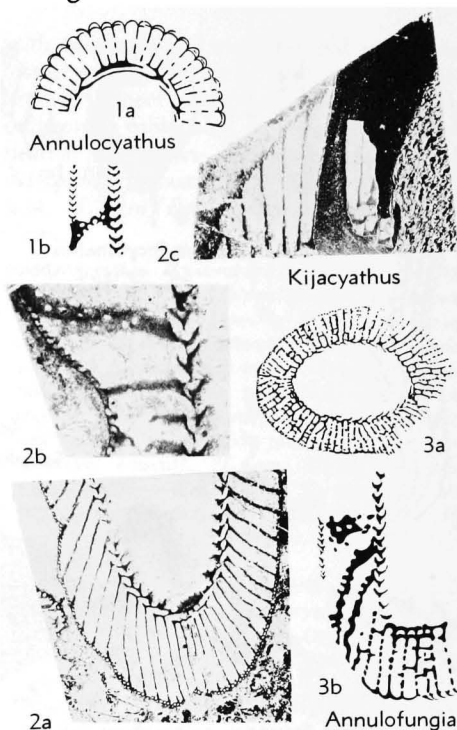


FIG. 54. Annulocyathidae (1,3); Kijacyathidae (2) (p. E80-E81).

ulate pore-tubes; septa porous or aporose; no tabulae; inner wall with simple pores, or with different types of pore-tubes, or of annuli. (For discussion see Rozanov, 1969, p. 109.) *L.Cam. (Atdaban-Botom.)*.

Family ANNULOCYATHIDAE Krasnopeeva, 1953

[Annulocyathidae KRASNOPEEVA, 1953, p. 56]

Solitary, cup conical or cylindrical; outer wall with short canals with external bracts forming geniculate pore-tubes; septa porous, synapticulae may occur; no tabulae or dissepiments; inner wall of annuli. *L.Cam. (Botom.)*.

Annulocyathus VOLOGDIN, 1937, p. 468 [**A. pulcher*; M]. Outer wall with short canals bracted externally to give geniculate pore-tubes; inner wall of annuli S- or V-shaped in section; septa porous; no synapticulae, tabulae or dissepiments. *L.Cam. (Botom.)*, USSR (Altay-Sayan-Transbayk.).—FIG. 54.1. **A. pulcher*, W. Sayan; 1a,b, parts of transv. and long. secs., enl. (Repina, *et al.*, 1964).

Annulofungia KRASNOPEEVA, 1955, p. 99 [**A.*

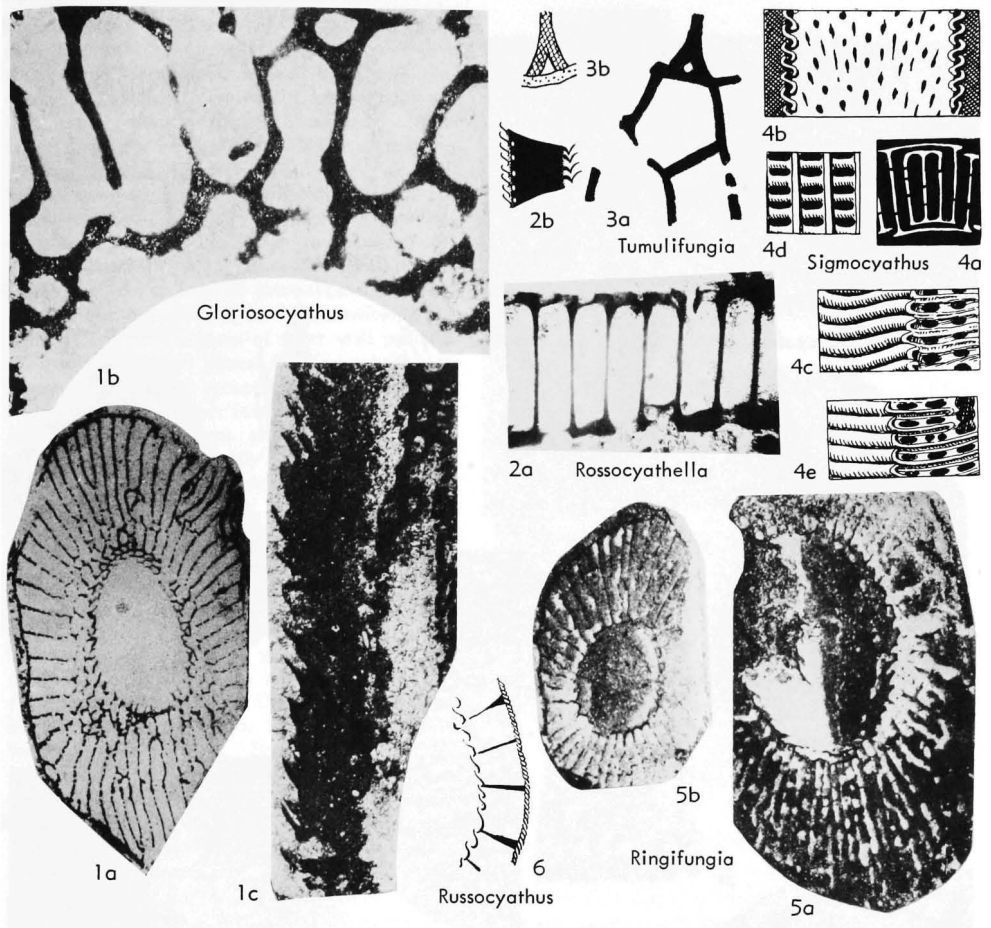


FIG. 55. Gloriosocyathidae (1-3,5-6); Sigmocyathidae (4) (p. E83-E84).

taylori; OD] [= *Annulofungia* KRASNOPEEVA, 1953b, p. 56, *nom. nud.* (summary diagnosis given but no species named); *Annulofungia* KRASNOPEEVA, 1954, p. 602, *nom. nud.* (two species named but no definitions given)]. Like *Annulocyathus* but septa connected by synapticulae. *L. Cam. (Botom.)*, USSR (Altay-Sayan); *L. Cam.* (with *Holmia* and *Nevadia*, N. Am. (Nev.)).—FIG. 54, 3. **A. taylori*, up. Botom., USSR (R. Erba, Kuznetsk Alatau); 3a, transv. sec., $\times 2$; 3b, oblique long. sec., $\times 4$ (Krasnopeevea, 1955).

Family KIJACYATHIDAE Zhuravleva, 1964

[Kijacyathidae ZHURAVLEVA in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 195]

Outer wall with S-form plates forming pore-tubes; septa porous; no tabulae or dissepiments; inner wall of annuli of V- or S-section. (For discussion see Rozanov,

1969, p. 108.) *L. Cam. (Atdaban-up. Botom.)*.

Kijacyathus ZHURAVLEVA, 1959, p. 424 [**K. chomentovskii*; OD] [= *Annulocyathella* VOLOGDIN, 1962d, p. 123 (type, *Annulocyathus lavrenovae* KRASNOPEEVA, 1955, p. 99 (= *Annulocyathus lavrenovae* KRASNOPEEVA, 1937, p. 32); OD; for discussion see REPINA, *et al.*, 1964, p. 196)]. Outer wall with S-form plates forming pore-tubes; septa closely porous; inner wall of annuli of V- or S-section. *L. Cam. (Atdaban-Botom.)*, USSR (Altay-Sayan-Transbayk.).—FIG. 54, 2. **K. chomentovskii*, Atdaban., R. Kiyia, Kuznetsk Alatau; 2a, part of oblique transv. sec. of holotype, $\times 2.8$; 2b, part of long. sec., $\times 8.5$; 2c, tang. sec. inner wall, $\times 5.7$ (Zhuravleva, 1959a).

Family GLORIOSOCYATHIDAE Rozanov, 1969

[Gloriosocyathidae ROZANOV, 1969, p. 108]

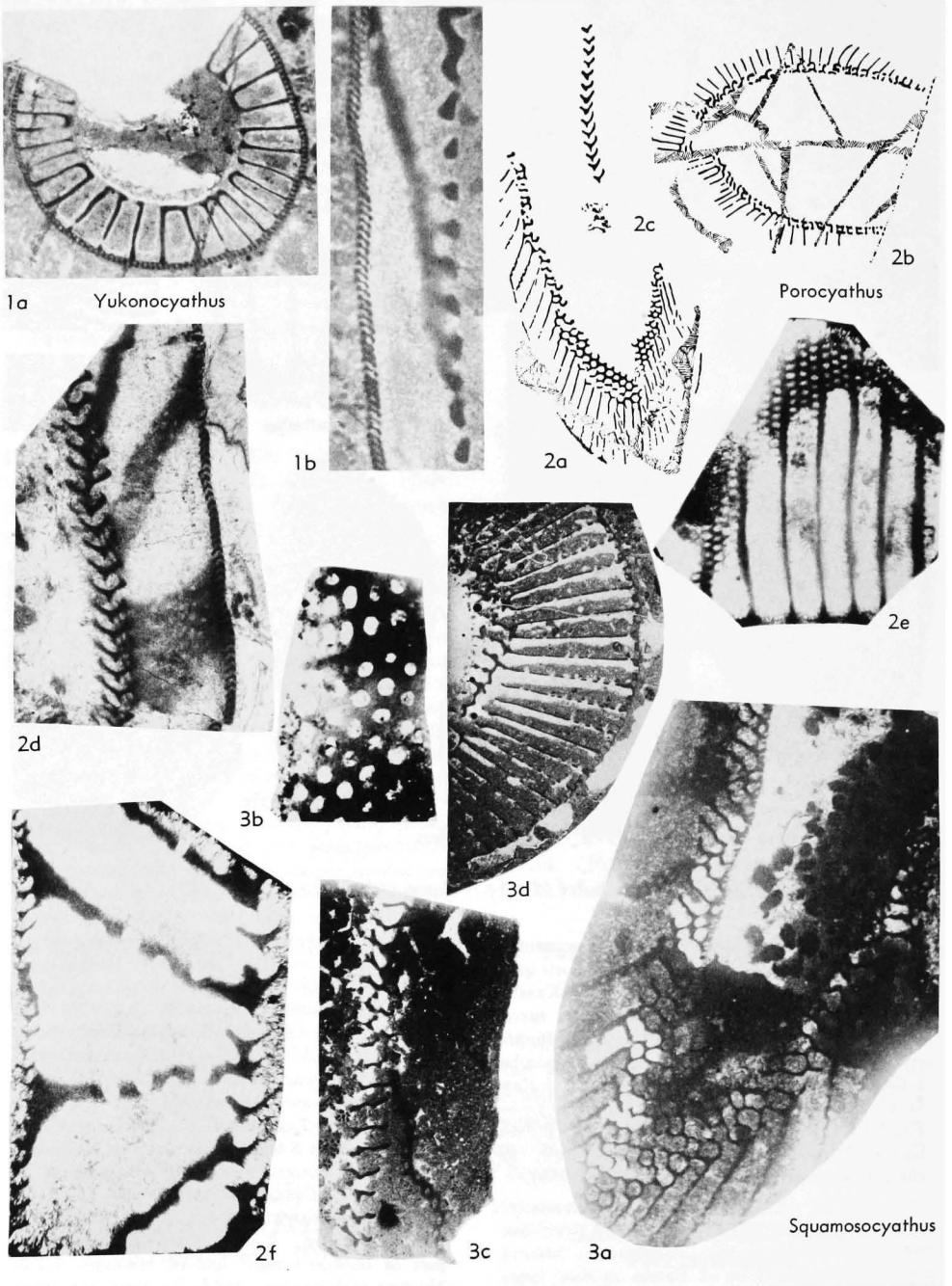


FIG. 56. Porocyathidae (p. E83-E84).

Outer wall of plates of S-form in longitudinal section, forming tubes; inner wall

of various section; intervallum with porous septa and without tabulae. *L.Cam.(Attaban.-Botom.)*.

Gloriosocyathus ROZANOV, 1969, p. 108 [**G. permultus*; OD]. Outer wall with pore-canals S-shaped in longitudinal section, inner wall constructed of plates almost flat in longitudinal section; septa porous, in places connected by inner wall plates or by synapticula-like structures. *L.Cam.(Botom.)*, USSR (Sib.Platf.).—FIG. 55,1. **G. permultus*, Olenok uplift, Sib. Platf.; 1a, holotype, transv. sec., $\times 7$; 1b, part of transv. sec. showing inner wall, $\times 27$; 1c, part of long. sec., inner wall to left, $\times 13$ (Rozanov, 1969).

Ringifungia KORSHUNOV in ZHURAVLEVA, KORSHUNOV & ROZANOV, 1969, p. 38 [**R. vavilovi*; OD]. Solitary, cylindrical; pores of outer wall provided with small S-shaped plates, forming tubes; septa porous, connected by synapticulae which are commonly under-developed; inner wall with one longitudinal row of pores to an intersept, pores screened by scales, mostly common to several intersepts. *L.Cam.(Atdaban.)*, USSR (Sib.Platf.).—FIG. 55,5. **R. vavilovi*, R.Lena; 5a, holotype, transv. sec., $\times 4$; 5b, transv. sec., $\times 4$ (Zhuravleva, Korshunov, & Rozanov, 1969).

Rossocyathella ZHURAVLEVA, 1960, p. 178 [**R. ninaekosti*; OD]. Conical; outer wall with S-shaped plates forming pore-tubes; septa almost aporose; inner wall of geniculate pore-tubes, single longitudinal row to an intersept. *L.Cam.(up.Atdaban.-Botom.)*, USSR (Altay-Sayan-Sib. Platf.-Transbayk.).—FIG. 55,2. **R. ninaekosti*, low.Botom.(Taryn.), R. Botoma, Yakutia; 2a, holotype, part of tang. sec., $\times 13$; 2b, part of long. sec., $\times 13$ (Zhuravleva, 1960b).

Russocyathus ZHURAVLEVA, 1955, p. 104 [**R. basaichensis*; OD]. Solitary; outer wall with S-shaped plates forming pore-tubes; septa aporose; inner wall of larger, S-shaped pore-tubes. *L.Cam.(Atdaban.-Botom.)*, USSR (Altay-Sayan).—FIG. 55,6. **R. basaichensis*, R. Bazaikha, Sayan; part of long. sec., $\times 13$ (Zhuravleva, 1955).

?**Tumulifungia** ZHURAVLEVA in DATZENKO, ZHURAVLEVA, *et al.*, 1968, p. 144 [**T. datzenkoi*; OD] [= *Tumulifungia* ZHURAVLEVA in ZHURAVLEVA, ZADOROZHNYAYA, *et al.*, 1967, p. 68, invalid name; no diagnosis, no species named, but descriptions and illustrations of *T. sp.* given]. Outer wall with plates of S-form in longitudinal section, forming pore-tubes (see Rozanov, 1969, p. 108); septa synapticulate; inner wall with simple pores that may be toothed with bracts or spines. *L.Cam.(up.Atdaban.-Botom.)*, USSR (Sib.Platf.-Tuva-Far East).—FIG. 55,3. **T. datzenkoi*, Taryn., R. Sukharikha; 3a,b, part of transv. sec., diagram. (Datzenko, Zhuravleva, *et al.*, 1968).

Family POROCYATHIDAE Zhuravleva, 1957

[Porocyathidae ZHURAVLEVA MS in VOLOGDIN, 1957, p. 206; ZHURAVLEVA, 1960, p. 179, see below under *Porocyathus*]

Cup slenderly conical or cylindrical; outer wall with short pore-canals with external

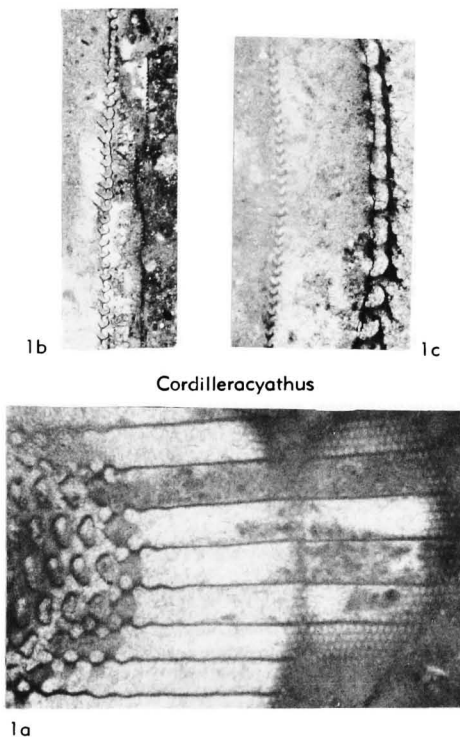


FIG. 57. Porocyathidae (p. E84).

bracts so that openings are geniculate in longitudinal section; septa close, porous; inner wall with pore-tubes of plates, or with simple pores with bracts or scales. *L.Cam.(Atdaban.-Botom.)*.

Porocyathus ZHURAVLEVA in VOLOGDIN, 1957, p. 206 [**Ethmophyllum caveaquadratum* VOLOGDIN, 1932, p. 47; M (ZHURAVLEVA, 1960, p. 180, treated the genus as new and invalidly named *P. pinus* ZHURAVLEVA, 1960, p. 180, as type-species)]. Outer wall with short pore-canals with external bracts so that openings are curved or geniculate in longitudinal section; septa porous; no tabulae; inner wall with pore-tubes formed by plates, bracts or scales; tubes may intercommunicate. [Genus requires redefinition following restudy of VOLOGDIN's type-specimens.] *L.Cam.(Atdaban.-Botom.)*, USSR (Altay-Sayan-Sib.Platf.-Transbayk.)-Antarct.-Can.(Yukon).—FIG. 56,2a-c. **P. caveaquadratus* (VOLOGDIN), Botom., R. Karagan, Altay; 2a, oblique long. sec.; 2b, transv. sec., 2c, part of long. sec. showing pore-tubes of inner wall, diagram. (Vologdin, 1940b).—FIG. 56,2d,e. *P. squamosus* (ZHURAVLEVA), low. Botom., Yakutia; 2d, R.Lena, long. sec., $\times 13$; 2e, R.Botoma, long. sec., $\times 13$ (Zhuravleva, 1960b).—FIG. 56,2f. *P. pinus* ZHURAVLEVA,

Atdaban., R.Botoma, Yakutia; holotype, part of ?long. sec., $\times 27$ (Zhuravleva, 1960b).

?**Cordilleracyathus** HANDFIELD, 1971, p. 49 [**C. blussoni*; M]. Conical or cylindrical cups; outer wall with pore-tubes (?or -canals) of inverted-V-shape; septa aporose; inner wall with pore-tubes of reversed-S section, partitioned so that central cavity has one longitudinal row of pores to each intersept, while intervallar side of wall has 2; spines(?bracts) project upward into central cavity from edge of pore-tubes. *L.Cam.*(*Atdaban.* or *Botom.*), Can.(Yukon).—FIG. 57,1. **C. blussoni*, Atdaban. or Botom.; 1a, tang. sec. inner and outer walls, $\times 12$; 1b, radial long. sec. inner and outer walls, $\times 6.5$; 1c, the same, $\times 18$ (Handfield, 1971).

Squamocyathus ZHURAVLEVA, 1960, p. 183 [**S. taumatus*; OD]. Slenderly conical or cylindrical cups; outer wall with short pore-canals provided with beaks or scales at angle to canals; intervallum wide, septa porous, no tabulae or dissepiments; inner wall of horizontal or downwardly inclined, strongly bent, intercommunicating pore-tubes, whose mouths may have protective formations. *L.Cam.*(*Atdaban.-Botom.*), USSR(Altay-Sayan-Sib.Plaf.).—FIG. 56, 3. **S. taumatus*, Atdaban., Yakutia; 3a, oblique sec., $\times 7$; 3b,c, holotype, 3b, septum, $\times 13$, 3c, long. sec. of inner wall, $\times 7$; 3d, part of transv. sec., $\times 7$ (Zhuravleva, 1960b).

?**Yukonocyathus** HANDFIELD, 1971, p. 51 [**Y. francesi*; OD]. Cup slenderly conical; outer wall with inclined pore-canals, whose external openings are provided with short protective formations turned down like peak of cap; septa each with pores in single longitudinal row near outer wall; inner wall with one longitudinal row of simple pores to an intersept. *L.Cam.*(?Atdaban.), Can. (Yukon).—FIG. 56,1. **Y. francesi*, 1a, transv. sec., $\times 3$; 1b, long. sec., $\times 4$ (Handfield, 1971).

Superfamily SIGMOCYATHACEA Krasnopeeva, 1953

[*nom. transl.* DEBRENNE, 1970, p. 25 (*ex* Sigmocyathidae KRASNOPEEVA, 1953, p. 56) (*as* Sygmocyathidae *nom. null.*)]

Both walls of annuli, septa aporose or with remote large pores; no tabulae or synapticulae. *L.Cam.*(*up.Atdaban.* or *low.Botom.*).

Family SIGMOCYATHIDAE Krasnopeeva, 1953

[*nom. correct.* ZHURAVLEVA, 1960, p. 49 (=Sygmocyathidae KRASNOPEEVA, 1953b, p. 56, *nom. null.*, based on erroneous spelling of generic name)]

Both walls of annuli, S-shaped in longitudinal section; septa aporose or with remote large pores; no tabulae or synapticulae. *L.Cam.*(*up.Atdaban.* or *low.Botom.*).

Sigmocyathus R. BEDFORD & J. BEDFORD, 1936, p. 23 [**Cosinocyathus didymoteichus* TAYLOR, 1910, p. 140; OD] [=Hemistillicidocyathus TING, 1937, p. 368 (type, *Cosinocyathus didymoteichus* TAYLOR, 1910, p. 140), obj.; *Sygmocyathus* KRASNOPEEVA, 1953, p. 56 (*nom. null.*)]. Cups large; both walls of annuli, S-shaped in longitudinal section; septa aporose or sparsely porous; no tabulae or synapticulae. (For discussion see Debrenne, 1970, p. 42.) *L.Cam.*(*up.Atdaban.* or *low.Botom.*), S.Australia.—FIG. 55,4. **S. didymoteichus* (TAYLOR), Ajax Mine; 4a, transv. sec., $\times 2$; 4b, part of radial long. sec., 4c,d, ext. and int. views of outer wall, 4e, view of inner wall from central cavity, all $\times 4$ (Bedford & Bedford, 1936).

Superfamily TERCYATHACEA Vologdin, 1937

[*nom. transl.* ZHURAVLEVA, 1960, p. 184 (*ex* Tercyathidae VOLOGDIN, 1937, p. 495)]

Solitary; slenderly conical or cylindrical; outer wall latticed; inner wall of pore-tubes; intervallum with porous septa, without tabulae; dissepiments may occur. *L.Cam.*(*Botom.-low.Len.*).

Family TERCYATHIDAE Vologdin, 1937

[Tercyathidae VOLOGDIN, 1937, p. 495]

Solitary; slenderly conical or cylindrical; outer wall latticed; intervallum with porous septa, without tabulae; inner wall of pore-tubes. *L.Cam.*(*Botom.-low.Len.*).

Tercyathus SIMON, 1939, p. 40 [**T. duplex* VOLOGDIN, 1932, p. 55; OD] [=Tercyathus VOLOGDIN, 1932, p. 55 (*nom. nud.*, established without designation of type-species)]. Solitary, conical; outer wall clathrate; septa finely porous; inner wall thick with numerous crooked pore-tubes in communication with one another by small pores. *L.Cam.*(*Botom.-low.Len.*), USSR (Altay-Sayan).—FIG. 58,1a,b. **T. duplex*, Botom., R.Lebed, Altay; 1a,b, parts of transv. and long. secs., $\times 5$ (Vologdin, 1932).—FIG. 58,1c. *T. sp.*, Botom., Kuznetsk Alatau; tang. sec. clathrate outer wall, $\times 7$ (Zhuravleva, 1960b).

Clathricyathus SIMON, 1939, p. 25 [**C. firmus* VOLOGDIN, 1932; OD] [=Clathricyathus VOLOGDIN, 1932, p. 50 (*nom. nud.*, established without designation of type-species); *Clathrocyathus* VOLOGDIN, 1937, p. 495 (*nom null.*)]. Solitary, conical; outer wall latticed; septa porous; inner wall thick, of geniculate pore-tubes opening upward and in communication with one another by small pores in their walls; arm of V adjoining septa is shorter than other. *L.Cam.*(*Botom.-low.Len.*), USSR(Altay-Sayan).—FIG. 58,2. **C. firmus*, R.Lebed, Altay; 2a, part of transv. sec.; 2b,

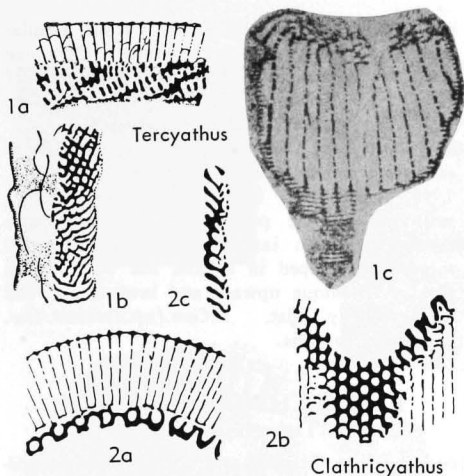


FIG. 58. Tercyathidae (p. E84-E85).

tang. sec. inner wall; 2c, radial long. sec. of inner wall, intervallum to right, all $\times 2.6$ (Vologdin, 1957a).

Suborder NOCHOROICYATHINA
Zhuravleva, 1956

[*nom. transl.* ZHURAVLEVA, 1960b, p. 198 (ex order Nochoroicyathida ZHURAVLEVA in VOLOGDIN, 1956, p. 879)]
[=Bronchocyathida ZHURAVLEVA in VOLOGDIN, 1957, p. 207]

Solitary Archaeocyatha with simply or complexly porous outer and inner walls; intervallum with straight porous septa and pectinate tabulae; rarely with dissepiments. *L.Cam.(Tommot.-Botom., rare in Len.)*, *?M.Cam.(base of Amg.)*.

Superfamily
NOCHOROICYATHACEA
Zhuravleva, 1956

[*nom. transl.* ZHURAVLEVA, 1960, p. 198 (ex Nochoroicyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879)]

Solitary Archaeocyatha with simply porous outer wall; intervallum with straight septa and pectinate tabulae; inner wall with simple pores, pore-tubes or annuli. *L.Cam.(Tommot.-Botom., rare in Len.)*, *?M.Cam.(base of Amg.)*.

Family NOCHOROICYATHIDAE
Zhuravleva, 1956

[Nochoroicyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879]
[=Trininaeacyathidae DEBRENNE, 1964, p. 114]

Cups not large. Outer wall thin with

simple pores; intervallum narrow, with numerous thin, porous septa and rare, flat, pectinate tabulae; rare dissepiments may occur; inner wall simply sieve-like, but pores may be protected on side of central cavity by spines or bracts. Central cavity free of skeletal elements. *L.Cam.(Tommot.-Botom., rare in Len.)*, *?M.Cam.(base of Amg.)*.

Nochoroicyathus ZHURAVLEVA, 1951, p. 78 [**N. mirabilis*; OD] [=Howellicyathus VOLOGDIN, 1962, p. 126 (type, *Coscinocyathus howelli* VOLOGDIN, 1940b, p. 88)]. Outer wall thin with simple pores; intervallum narrow with numerous thin, porous septa, and rare, flat, pectinate tabulae; dissepiments rare; inner wall with simple pores that may be protected on side of central cavity by spines or bracts. *L.Cam.(Tommot.-Botom., rare Len.)*, *?M.Cam.(base Amg.)*, USSR (S.Urals-Altay-Sayan-Sib.Platf.-Transbayk.-Far East).—**FIG. 59.I. *N. mirabilis**, Tommot., R.Nokhoroï, Sib.Platf.; 1a, transv. sec. of part of cup showing pectinate tabula and inner wall simply porous with bracts, $\times 27$; 1b, long. sec. showing nodular swellings representing bases of pectinate tabulae, $\times 45$ (Zhuravleva, 1960b).

Pectenocyathus KASHINA in REPINA, KHOMEN-TOVSKIY, ZHURAVLEVA, and ROZANOV, 1964, p. 211 [**P. torgaschivicus*; OD]. Outer wall thin, smooth, with simple pores; septa porous; tabulae pectinate; inner wall with simple pores, but plicate

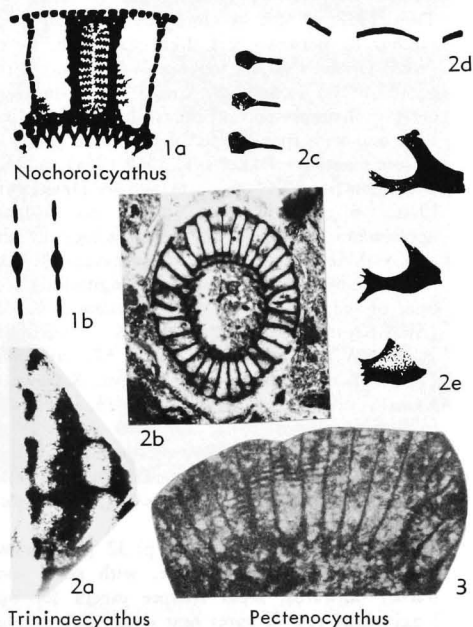


FIG. 59. Nochoroicyathidae (p. E85-E86).

longitudinally, starshaped in transverse section. *L.Cam.*(*up.Atdaban.-Botom.*), USSR(Altay-Sayan).—FIG. 59,3. *P. densus* (VOLOGDIN), *L. Cam.*, R.Bazaikha, Sayan; part of transv. sec. showing pectinate tabula and plicate inner wall, $\times 10$ (Repina, *et al.*, 1964).

Trininaecyathus ZHURAVLEVA, 1960, p. 218 [**T. macroporus*; OD]. Outer wall with large simple pores, 1 longitudinal row to an intersept; intervalum narrow with sparsely porous septa and pectinate tabulae; inner wall wide, of bracted pore-canals opening upward into central cavity. *L.Cam.*(*Atdaban.-Botom.*), USSR(Altay-Sayan-Sib.Plattf.).—FIG. 59,2. **T. macroporus*, Taryn., R.Botoma, Sib.Plattf.; 2a, holotype, part of long. sec., outer wall on left, $\times 13$; 2b, oblique transv. sec., $\times 7$; 2c,d, long. and transv. secs. outer wall, and 2e, long. and oblique long. sec. bracts of pore-canals of inner wall, central cavity to left; all enl. (Zhuravleva, 1960b).

Family BRONCHOCYATHIDAE

R. Bedford & J. Bedford, 1936

[Bronchocyathidae BEDFORD & J. BEDFORD, 1936, p. 25]
[=Thalamocyathidae ZHURAVLEVA, 1951, p. 98; Glaessnericyathidae DEBRENNE, 1970, p. 35]

Outer wall with simple pores; intervallum with porous septa and sporadic pectinate tabulae; inner wall of annuli. *L.Cam.*(*Atdaban.-Botom.*).

Thalamocyathus GORDON, 1920, p. 687 [**Archaeocyathus trachealis* TAYLOR, 1910, p. 125; SD TING, 1937, p. 368, by elimination] [=Bronchocyathus R. BEDFORD & J. BEDFORD, 1936, p. 25 (type, *Archaeocyathus trachealis* TAYLOR, 1910, p. 125; OD)]. Solitary, conical or cylindrical; outer wall simply porous; intervallum with porous septa and with sporadic pectinate tabulae (in 10% of specimens; see DEBRENNE, 1969 (26a), p. 263, but absent from TAYLOR's syntypes; see DEBRENNE, 1970b, p. 45; lectotype shows no tabulae; nontabulate specimens have morphology of the ajacicyathine *Gordonicyathus* ZHURAVLEVA); annuli of inner wall V-shaped in longitudinal section of cup. *L.Cam.*(*Atdaban.-Botom.*), USSR (Altay-Sayan-Transbayk.)-Antarct.-S. Australia-?Can.(NW.Terr.).—FIG. 60,1. **T. trachealis* (TAYLOR), *up.Atdaban.* or *low.Botom.*, S.Australia (Ajax Mine); 1a, ext. view, $\times 1.6$; 1b, inner wall from intervallum, $\times 4.8$; 1c, outer wall, $\times 4.8$; 1d, oblique transv. sec. showing V-shaped annuli, $\times 4.8$ (photos courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris).

Cricopectinus DEBRENNE, 1970, p. 32 [**C. dentulus*; OD]. Outer wall simple, with pores contracted outwards; septa aporose except for one longitudinal row of pores near outer wall, tabulae pectinate; inner wall complex; horizontal canals serve as apertures for several interseptal loculi

and extend into central cavity by an annular shelf with deeply dentate free rims. [Only one specimen known. May be tabulate specimen of *Cyathocricus* DEBRENNE, 1969, p. 318.] *L.Cam.*(*up.Atdaban.* or *low.Botom.*), S.Australia.

Glaessnericyathus DEBRENNE, 1970, p. 35 [**Bronchocyathus sigmoideus* BEDFORD & J. BEDFORD, 1936, p. 25; OD]. Cup slenderly conical; outer wall with simple pores; septa aporose, sparse tabulae pectinate; inner wall of annuli, annuli somewhat S-shaped in section, but with middle part of S oblique upward and inward, and end parts nearly flat. *L.Cam.*(*up.Atdaban.-low.Botom.*), S.Australia.

Family ETHMOPECTINIDAE

Debrenne, 1970

[Ethmopectinidae DEBRENNE, 1970, p. 25] [=?Ethmocyathidae DEBRENNE, 1969, p. 322]

Outer wall simply porous; septa porous, tabulae pectinate; inner wall double, one row of rhombic pore-canals to each intersept, screened by horizontal annuli. *L.Cam.*(*up.Atdaban.* or *low.Botom.*).

Ethmopectinus DEBRENNE, 1970, p. 34 [**E. walteri*; OD] [=?Ethmocyathus R. BEDFORD & W. R. BEDFORD, 1934, p. 2 (type, *E. lineatus*; OD)]. Cup conical, outer wall gently fluted, with chinky pores arranged in quincunx; septa porous, tabulae pectinate; inner wall double, one row of rhombic pore-canals to each intersept, screened against central cavity by horizontal annuli. [May be tabulate specimens of *Ethmocyathus lineatus* R. BEDFORD & W. R. BEDFORD, 1934, p. 2.] *L.Cam.*(*up.Atdaban.-low.Botom.*), S.Australia.

Family FORMOSOCYATHIDAE

Rozanov, 1963

[Formosocyathidae ROZANOV, 1963, p. 5]

Outer wall simply porous, septa porous, tabulae pectinate; wide inner wall of intercommunicating, crooked pore-tubes. *L.Cam.*(*up.Tommat.-Botom.*).

Formosocyathus VOLOGDIN, 1937b, p. 471 [**F. bulynnikovi*; M]. Solitary; outer wall with simple pores; inner wall wide, of intercommunicating crooked pore-tubes; septa porous, tabulae pectinate. *L.Cam.*(*up.Tommat.-Botom.*), USSR (Altay-Sayan-Sib. Plattf.-Transbayk.)-Antarct.—FIG. 60,3. **F. bulynnikovi*, Botom., R. Sanash-tykgol, Sayan; 3a, oblique long. sec., $\times 8$; 3b, part of transv. sec., $\times 8$ (Vologdin, 1940b).

Heckericyathus ZHURAVLEVA, 1960, p. 220 [**Ethmophyllum heckeri* ZHURAVLEVA, 1955, p. 69; OD]. Slenderly conical or cylindrical cups; outer wall simply and finely porous; septa porous; tabulae rare, pectinate; inner wall with 1 to 2

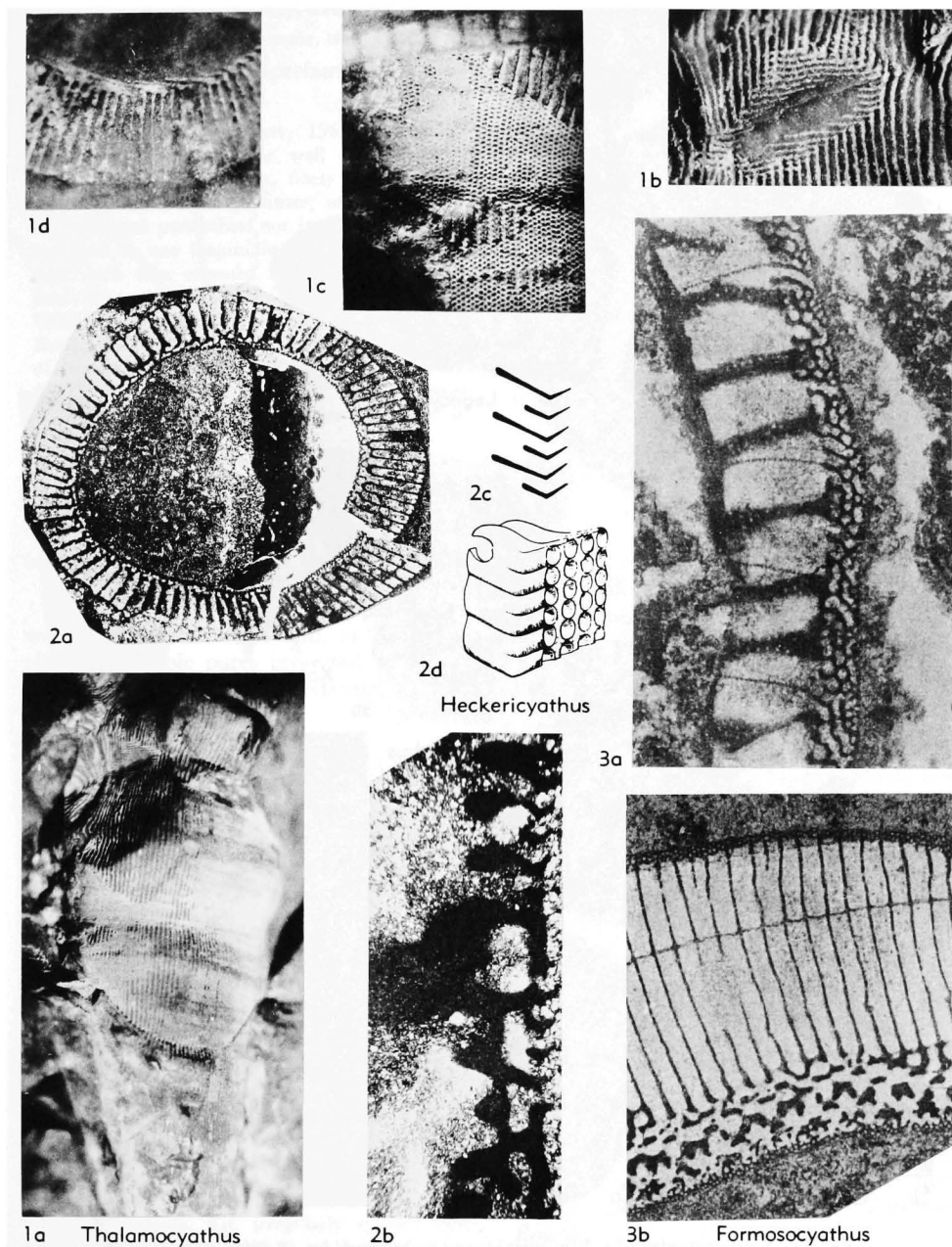


FIG. 60. Bronchocyathidae (1); Formosocyathidae (2-3) (p. E86-E87).

longitudinal rows of geniculate pore-tubes to an intersept; the pore-tubes open upward and may divide into finer ones at central cavity. *L.Cam.* (*Atdaban.*), USSR (Sib. Platf.).—FIG. 60,2. **H.*

heckeri (ZHURAVLEVA), R. Lena, Sib. Platf.; 2a, transv. sec.; 2b, oblique long. sec., both $\times 4.8$; 2c, long. sec. inner wall; 2d, reconstr., part of inner wall, both $\times 56$ (Zhuravleva, 1960b).

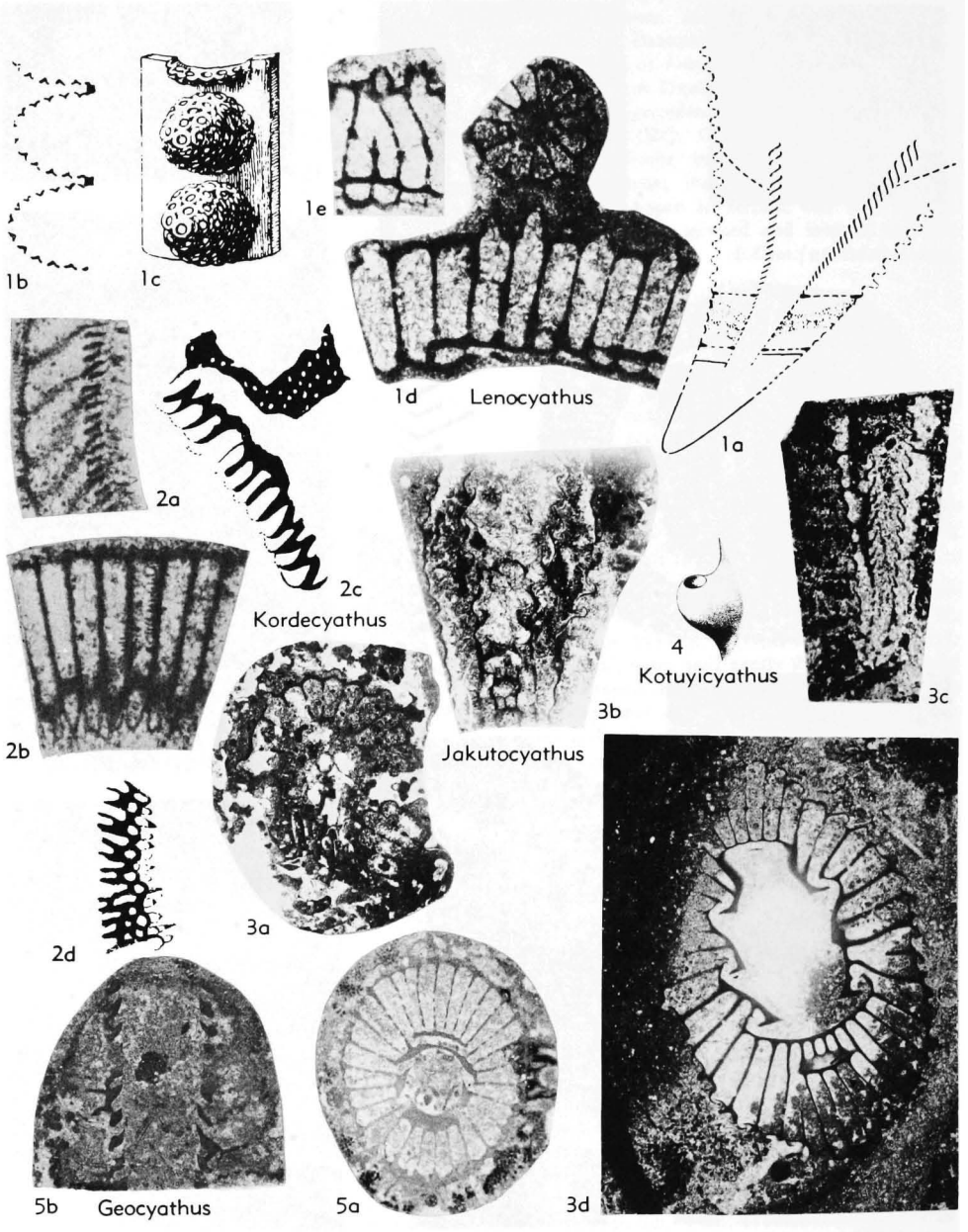


FIG. 61. Kordecyathidae (2); Lenocyathidae (1); Geocyathidae (3-5) (p. E89-E90).

Superfamily KORDECYATHACEA
Missarzhevskiy, 1961

[*nom. transl.* MISSARZHEVSKIY in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 218 (ex Kordecyathidae MISSARZHEVSKIY, 1961, p. 21)]

Outer wall of large pores screened with auxiliary microporous sheath; septa porous; tabulae pectinate; inner wall of pore-tubes arranged in one longitudinal row to an intersept. *L. Cam. (?up. Atadaban.-Botom.)*.

Family KORDECYATHIDAE
Missarzhevskiy, 1961

[Kordecyathidae MISSARZHEVSKIY, 1961, p. 21]

Characteristics of superfamily. *L.Cam.* (?*up.Atdaban-Botom.*).

Kordecyathus MISSARZHEVSKIY, 1961, p. 21 [**K. shiveligensis*; OD]. Outer wall of large pores screened with an auxiliary, finely porous sheath; septa porous; tabulae pectinate; inner wall wide, of horizontal pore-tubes, not intercommunicating, arranged in one longitudinal row in each intersept; each tube screened from central cavity by finely porous film. *L.Cam.* (?*up.Atdaban-Botom.*), USSR (Tuva).—FIG. 61,2. **K. shiveligensis*, *Botom.*; 2*a,b*, holotype, oblique long. sec. and part of transv. sec., $\times 2.4$, $\times 4.8$ (Missarzhevskiy, 1961); 2*c,d*, long. and transv. secs., part of inner wall, diagram. (Zhuravleva, Zardorozhnaya, *et al.*, 1967).

Superfamily LENOCYATHACEA
Zhuravleva, 1956

[*nom. transl.* ZHURAVLEVA, 1960, p. 224 (*ex Lenocyathidae* ZHURAVLEVA in VOLOGDIN, 1956, p. 879)]

Outer wall with pores in tumuli; inner wall of pore-tubes or annuli, or exceptionally with simple pores protected by bracts; septa porous and tabulae pectinate. *L.Cam.* (*mid.Tommot-Botom.*).

Family LENOCYATHIDAE
Zhuravleva, 1956

[Lenocyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879]

Conical or cylindrical cups, sometimes with longitudinal folds. Outer wall with one longitudinal row of compound tumuli to each intersept; intervallum narrow, with porous septa and very rare pectinate tabulae; inner wall of pore-tubes S-shaped or V-shaped in section, in one or two longitudinal rows to an intersept, or of annuli. *L.Cam.* (*Atdaban.*).

Lenocyathus ZHURAVLEVA in ZHURAVLEVA & ZELENOV, 1955, p. 73 [**L. lenaicus*; OD]. Conical cups, rarely with longitudinal folds; outer wall with 1 longitudinal row of compound tumuli to each intersept; intervallum narrow; septa porous; tabulae pectinate, flat, irregularly spaced; inner wall wide with pore-tubes S- or V-shaped in section, one or two longitudinal rows to each intersept. *L.Cam.* (*Atdaban.*), USSR (Sib.Plaf.).—FIG. 61,1. **L. lenaicus*, R. Lena, Sib.Plaf.; 1*a*, long. sec., diagram; 1*b*, long. sec. outer wall (diagram); 1*c*, view of three tumuli of outer wall(enl.); 1*d*, part of transv. sec., outer wall at top, $\times 16$; 1*e*, part of transv. sec. through two

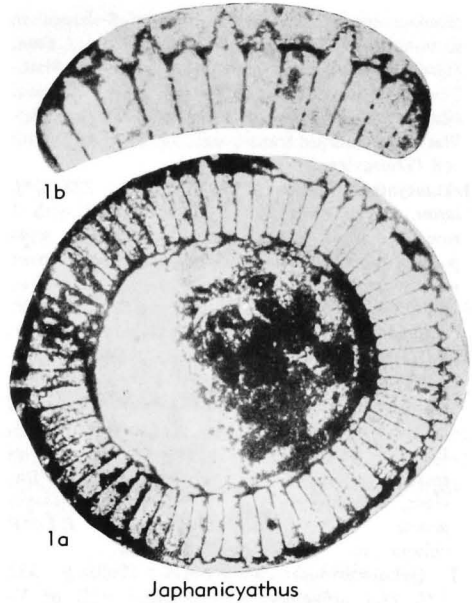


FIG. 62. Lenocyathidae (p. E89).

tumuli, outer wall at top, $\times 16$ (Zhuravleva, 1960b).

Japhancyathus KORSHUNOV, in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 45 [**J. genurosus*; OD]. Cup conical with narrow intervallum; outer wall with compound tumuli; septa porous, tabulae pectinate, irregular in arrangement; inner wall of annuli V-shaped in section, some with spines on edges projecting into central cavity. *L.Cam.* (?*Atdaban.*), USSR (Sib.Plaf.).—FIG. 62,1. **J. genurosus*, Oy-Muran, Sib.Plaf.; 1*a*, holotype, part of transv. sec. showing compound tumuli; 1*b*, part of transv. sec., $\times 7.8$ (Korshunov, in Zhuravleva, Korshunov, & Rozanov, 1969).

Family GEOCYATHIDAE
Debrenne, 1964

[Geocyathidae DEBRENNE, 1964, p. 114] [=Kotuyicyathidae ROZANOV in ROZANOV, MISSARZHEVSKIY, *et al.*, 1969, p. 186]

Outer wall with simple tumuli; intervallum with porous septa and pectinate tabulae; inner wall with simple pores with thornlets or of S- or V-shaped pore-tubes, or of annuli. *L.Cam.* (*mid.Tommot-Botom.*).

Geocyathus ZHURAVLEVA, 1960, p. 234 [**Thalamocyathus botomanensis* ZHURAVLEVA in ZHURAVLEVA & ZELENOV, 1955, p. 71 (= *T. botomaensis* ZHURAVLEVA, 1960b, p. 234, *nom. null.*); OD]. Cups not large; outer wall with simple tumuli in one or two rows to each intersept; intervallum with finely porous septa and sparse pectinate

tabulae; inner wall annuli, flat or S-shaped in section, their axial edges rising upwards. *L.Cam.* (*Atdaban.-Botom.*), USSR (Altay-Sayan-Sib.Platf.-Transbayk.).—FIG. 61,5. **G. botomanensis* (ZHURAVLEVA), holotype, Atdaban., R.Botoma, Sib. Platf.; 5a, oblique transv. sec., 5b, long. sec., both $\times 8$ (Zhuravleva, 1960b).

Jakutocyathus ZHURAVLEVA, 1960, p. 228 [**J. latini*; OD]. Cups not large, outer wall with 1 row of simple tumuli to each intersept; septa porous; tabulae pectinate, irregularly spaced; inner wall wide, of S-shaped or V-shaped pore-tubes, 1 or 2 longitudinal rows to each intersept. *L.Cam.* (*Atdaban.-Botom.*), USSR (Altay-Sayan-Sib.Platf.).

J. (*Jakutocyathus*). Inner wall of S-shaped pore-tubes; septa sparsely porous. *L.Cam.* (*Atdaban.*), USSR (Altay-Sayan-Sib.Platf.).—FIG. 61,3a-c. **J. (*J.*) latini* ZHURAVLEVA, Atdaban.; 3a,b, R. Botoma, Yakutia, holotype, transv. and long. secs., $\times 8$; 3c, R.Lena, long. sec., $\times 12$ (Zhuravleva, 1960b).—FIG. 61,3d. *J. (*J.*) krasnopeevae* (ZHURAVLEVA), low.Botom., R.Lena; oblique sec., $\times 8$ (Zhuravleva, 1960).

J. (*Jakutocarinus*) ZHURAVLEVA, 1960, p. 232 [**J. (*J.*) jakutensis*; OD]. Inner wall of V-shaped pore-tubes. *L.Cam.* (*Atdaban.*), USSR (Sib.Platf.).

Kotuyicyathus ZHURAVLEVA, 1960, p. 226 [**K. kotuyikensis*; OD]. Cups not large; outer wall with pores in simple tumuli; intervallum with porous septa and sparse pectinate tabulae; inner wall with simple pores that may have protective thornlets. *L.Cam.* (*up.Tommot.-Botom.*), USSR (Kuznetsk Alatau-Sib.Platf.).—FIG. 4,4; 61,4. **K. kotuyikensis*, up.Tommot., R. Kotuyi, Sib. Platf.; 4,4, reconstr., $\times 1$; 61,4, tumulus, $\times 40$ (Zhuravleva, 1960b).

Superfamily FANSYCYATHACEA Korshunov & Rozanov, 1969

[*nom. transl.* ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 46 (*ex Fansycyathidae* KORSHUNOV & ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 47)]

Outer wall with oblique pore-tubes, outer mouths provided with bracts or peaks; intervallum with porous septa and pectinate tabulae; inner wall with simple pores, or of geniculate pore-tubes, or of annuli. *L.Cam.* (*Atdaban.-low.Len.*).

Family FALLOCYATHIDAE Rozanov, 1969

[Fallocyathidae ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 47]

Outer wall with oblique pore-tubes, their outer mouths provided with bracts or peaks; intervallum with porous septa and pectinate

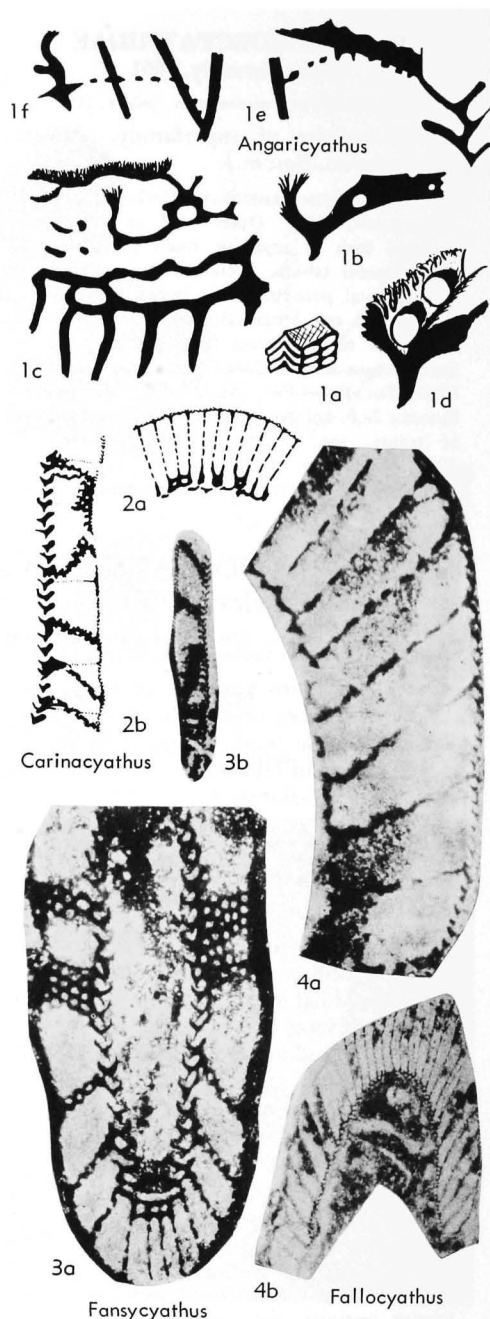


FIG. 63. Fallocyathidae (4); Fansycyathidae (3); Carinacyathidae (1-2) (p. E90-E91).

tabulae; inner wall with simple pores. *L.Cam.* (*Atdaban.*).

Fallocyathus ROZANOV in ZHURAVLEVA, KORSHUNOV,

& ROZANOV, 1969, p. 47 [**F. dubius*; OD]. Outer wall with oblique pore-tubes, their outer mouths provided with bracts; inner wall with simple pores; intervallum with porous septa and very sparse pectinate tabulae. *L.Cam.(Atdaban.)*, USSR (Sib.Platf.).—FIG. 63,4. **F. dubius*, ?Atdaban., Oy-muran, Sib.Platf.; 4a, holotype, part of oblique sec., $\times 27$; 4b, oblique long. sec., $\times 7$ (Rozanov in Zhuravleva, Korshunov, & Rozanov, 1969).

Family FANSYCYATHIDAE
Korshunov & Rozanov, 1969

[Fansycyathidae KORSHUNOV & ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 47]

Outer wall with short pore-canals provided with peaks; septa porous, tabulae pectinate; inner wall of annuli. *L.Cam.(Atdaban.)*.

Fansycyathus KORSHUNOV & ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 48 [**F. lermontovae*; OD]. Outer wall with short pore-canals provided with peaks: septa porous; tabulae pectinate; inner wall constructed of V-section annuli, widening upward. *L.Cam.(Atdaban.)*, USSR (Sib.Platf.).—FIG. 63,3. **F. lermontovae*; 3a, long. sec., $\times 13$; 3b, part of long. sec., outer wall to left, $\times 4$ (Zhuravleva, Korshunov, & Rozanov, 1969).

Family CARINACYATHIDAE
Krasnopeeva, 1953

[*nom. correct.* ZHURAVLEVA, 1960, p. 240 (*pro* Carinocyathidae KRASNOPEEVA, 1953b, p. 53)]

Cups cylindrical or slenderly conical without longitudinal folds; outer wall with oblique pore-tubes, their outer mouths provided with bracts or peaks; inner wall of larger oblique pore-tubes with bracts, one or two longitudinal rows to each intersept; intervallum with porous septa and pectinate tabulae. [See ROZANOV, 1969, p. 108.] *L.Cam.(Atdaban.-low.Len.)*.

Carinocyathus VOLOGDIN, 1932, p. 37 [**C. loculatus*; M] [= *Carinocyathus* VOLOGDIN, 1937, p. 471, *nom. null.*]. Characters of family. *L.Cam.(Atdaban.-Botom.)*, USSR (Altay-Sayan-Sib.Platf.).—FIG. 63,2. **C. loculatus*, Botom., R. Lebed, Altay; 2a,b, parts of transv. and long. secs., $\times 4.5$ (Vologdin, 1940b).

?**Angaricyathus** ZHURAVLEVA, 1965, p. 7 [**A. cyrenovi*; OD]. Outer wall of geniculate pore-tubes opening downward; septa porous; tabulae pectinate, very rare; inner wall of incomplete and perforate annuli, V-shaped in section, their axial edges fringed; successive annuli connected by one vertical crosspiece to each 3 to 6 interseptal loculi. *L.Cam.(low.Len.)*, USSR (N. Baykal uplands).—FIG. 63,1. **A. cyrenovi*; 1a,

reconstr., geniculate pore-tubes of outer wall, $\times 45$; 1b, radial long. sec., annulus of inner wall, $\times 24$; 1c, tang. sec., annuli of inner wall, showing fringe on axial edge, $\times 19$; 1d, reconstr., annulus of inner wall, $\times 27$; 1e,f, secs. showing tabulae, $\times 19$ (Zhuravleva, 1965).

Superfamily
PIAMAECYATHACEA
Zhuravleva, 1960

[*nom. transl.* ZHURAVLEVA, 1960, p. 50 (*ex* Piamacyathidae ZHURAVLEVA, 1960, p. 44)]

Outer wall latticed, with systems of fine horizontal and longitudinal laths; intervallum with porous septa and pectinate tabulae; inner wall simply porous, or wide, with one to two longitudinal rows of pore-tubes to each intersept, or of annuli. *L.Cam.(up.Atdaban.-Botom.)*.

Family PIAMAECYATHIDAE
Zhuravleva, 1960

[Piamacyathidae ZHURAVLEVA, 1960, p. 44]

Outer wall latticed with horizontal and longitudinal systems of laths; intervallum with porous septa and pectinate tabulae; inner wall simply porous, or wide, with 1 or 2 longitudinal rows of pore-tubes to each intersept. *L.Cam.(Botom.)*.

Piamacyathus ZHURAVLEVA, 1960, p. 45 [**P. sajanicus*; OD] [= *Piamacyathus* ZHURAVLEVA, 1960a, p. 45, *nom. null.*]. Outer wall latticed, with systems of horizontal and longitudinal laths; intervallum with porous septa and pectinate tabulae; inner wall wide, with 1 to 2 longitudinal rows of pore-tubes to each intersept. *L.Cam.(Botom.)*, USSR (Altay-Sayan).—FIG. 64,2. **P. sajanicus*, W.Sayan; 2a, oblique long. sec., $\times 2.8$ (Repina, *et al.*, 1964); 2b,c, part of transv. secs., $\times 2.8$ (2c is holotype) (Zhuravleva, 1960a).

Piamacyathellus ROZANOV in REPINA, KHOMENOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 217 [**P. simplex*; OD]. Cup with latticed outer wall, porous septa, pectinate tabulae, and simply porous inner wall. *L.Cam.(Botom.)*, USSR (Altay).—FIG. 64,1. **P. simplex*, R.B.Isha, Altay; transv. sec., $\times 2.8$ (Repina, *et al.*, 1964).

Family BOTOMOCYATHIDAE
Zhuravleva, 1955

[Botomocyathidae ZHURAVLEVA, 1955, p. 628] [= Botomocyathidae VOLOGDIN, 1956, p. 879 (*nom. null.*)]

Cup with latticed (clathrate) outer wall, porous septa, sparse pectinate tabulae, and inner wall of annuli. *L.Cam.(up.Atdaban.-Botom.)*.

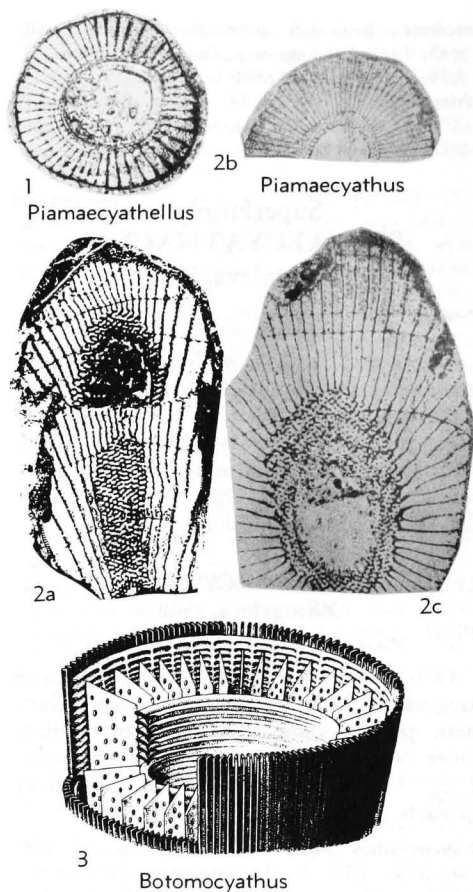


FIG. 64. Piamaecyathidae (1-2); Botomocyathidae (3) (p. E91-E92).

Botomocyathus ZHURAVLEVA, 1955, p. 629 [**B. zelenovi*; OD] [= *Botomocyathus* VOLOGDIN, 1956, p. 879 (*nom. null.*)]. Solitary, conical; outer wall clathrate (latticed); septa porous; tabulae pectinate but sparse (see ZHURAVLEVA, KORSHUNOV, and ROZANOV, 1969, p. 50); inner wall of annuli V-shaped in longitudinal section of the cup. *L.Cam.*(*up.Atdaban.-Botom.*), USSR (Sib.Plattf.).—FIG. 64.3. **B. zelenovi*, *up. Atdaban.-Botom.*, R.Botoma, Sib.Plattf.; reconstr., with part of cup cut away (Zhuravleva, 1960b).

Suborder COSCINOCYATHINA Zhuravleva, 1955

[*nom. transl.* ZHURAVLEVA, 1960, p. 245 (*ex order* Coscinocyathida ZHURAVLEVA, 1955, p. 10)]

Solitary, rarely colonial Archaeocyatha; inner and outer walls simply or complexly porous; intervallum with porous septa and

tabulae and, in some, dissepiments; pores of tabulae rounded or slit-like. *L.Cam.* (*mid.Tommot.-low.Len.*)-base *M.Cam.*

Superfamily COSCINOCYATHACEA Taylor, 1910

[*nom. transl.* ZHURAVLEVA, 1960, p. 245 (*ex Coscinocyathidae* TAYLOR, 1910, p. 137)] [= *Erimascoscinacea* DEBRENNE, 1964, p. 166 (*nom. transl.* DEBRENNE, 1970, p. 25, *ex Erimascoscinidae* DEBRENNE, 1964, p. 166)]

Outer wall simply porous or with pore-canals or pseudo-latticed; inner wall with simple pores, or of pore-tubes, or of annuli; septa porous; tabulae with rounded or slit pores. *L.Cam.*(*mid.Tommot.-low.Len.*)-base ?*M.Cam.*

Family COSCINOCYATHIDAE Taylor, 1910

[*Coscinocyathidae* TAYLOR, 1910, p. 137] [= *Asterocyathidae* VOLOGDIN, 1956, p. 879; *Erimascoscinidae* DEBRENNE, 1964, p. 166]

Solitary, rarely colonial; cups cylindrical or conical, curved or erect, not infrequently with dents and longitudinal folds. Outer wall with simple or pseudo-latticed pores or pore-canals; intervallum with porous septa, and tabulae with round or slit-like pores, and rare dissepiments; inner wall with simple pores that may be protected by scoops or complex spines or with pore-tubes. *L.Cam.*(*mid.Tommot.-low.Len.*).

Coscinocyathus BORNEMANN, 1884, p. 705 [**C. tuba*; SD TING, 1937, p. 360 (DEBRENNE, 1970a, p. 207, has requested exemption from application of the Code, and asked for a new type-species, *C. dianthus* BORNEMANN, 1884, p. 704, which is more representative of BORNEMANN'S conception, and of general use. If the requests are granted, *Coscinocyathus* will be defined as *Erimascoscinus* (see below) now is, and *Erimascoscinus* will become a junior subjective synonym of *Coscinocyathus*. DEBRENNE, 1970a, p. 207, has proposed a new generic name *Tubicoscinus* for the genus at present based on *C. tuba*.]. Cup small, conical; outer wall with oblique or very widely geniculate pore-canals; septa and tabulae thin and porous; inner wall with one longitudinal row of pore-tubes to an intercept. *L.Cam.*(*Atdaban.-Botom.*), USSR (Urals-Altay-Sayan-Baykal.-Far East)-Sardinia-Can. (Yukon-NW. Terr.)-S.Australia-Antarct. [See DEBRENNE, 1964, p. 162; 1970a, p. 207.]—FIG. 65.1. **C. tuba*, Botom., Sardinia; 1a,b, long. secs. of holotype, $\times 3.2$, $\times 8$; 1c, tang. long. sec. inner wall, $\times 8$ (Debrenne, 1964).

Asterocyathellus VOLOGDIN, 1962, p. 126 [**A.*

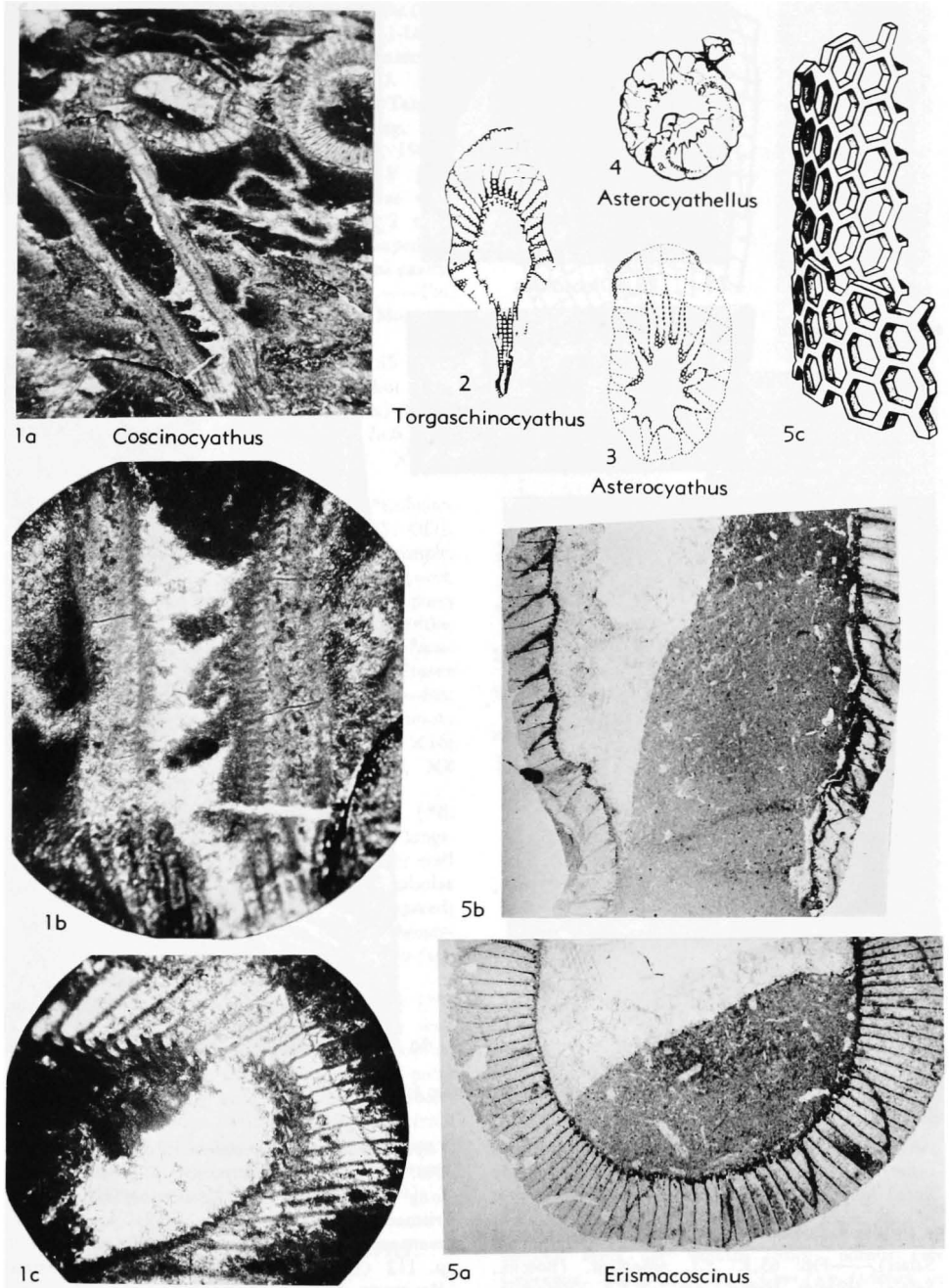


FIG. 65. Coscinocyathidae (p. E92-E95).

compositus; OD]. Outer wall furrowed at junctions with septa and finely porous; septa and tabulae finely porous; inner wall finely porous, with one or two longitudinal folds to an intersept.

L. Cam. (? Botom.), USSR (Salaïr).—FIG. 65, 4. **A. compositus*; transv. sec., $\times 4$ (Vologdin, 1962d).

Asterocyathus VOLOGDIN, 1940, p. 92 [*A. salairi*-

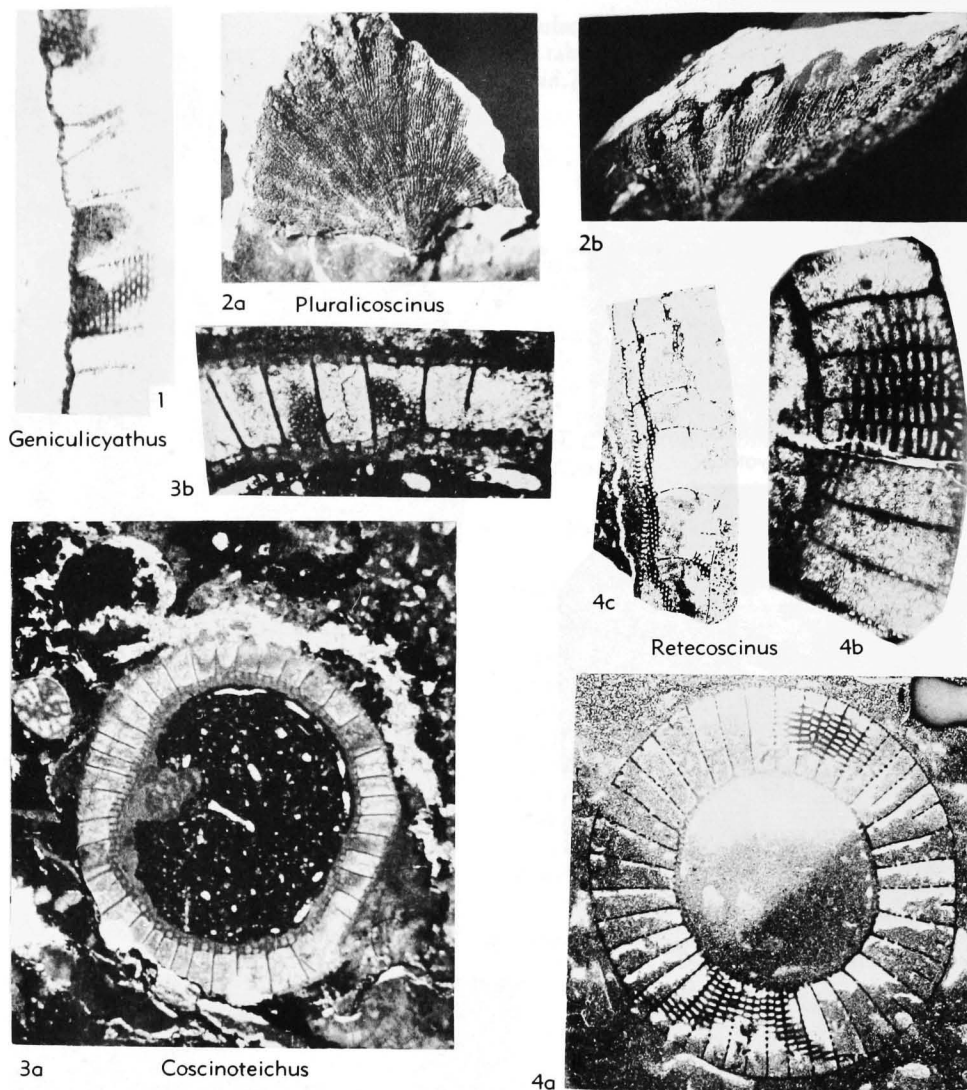


FIG. 66. Coscinocyathidae (p. E94-E95).

cus; OD]. Solitary, rarely colonial; outer and inner walls simply porous, inner wall deeply fluted longitudinally, stellate in transverse section of cup; septa and tabulae simply porous. *L.Cam.* (*Atdaban.-Botom.*), USSR (S.Urals-Altay-Sayan-Salair).—FIG. 65,3. **A. salairicus*, ?*Botom.*, Salair; oblique transv. sec., $\times 3.2$ (Vologdin, 1962d).

Cosciniteichus DEBRENNE, 1964, p. 180 [**C. minimiporus* (= *C. microporus* DEBRENNE, 1964 (expl. to pl. 26, fig. 1,2), *nom. null.*); OD]. Outer and inner walls thickened, with straight, oblique pore-canals; septa and tabulae finely porous and forming rectangular loculi. *L.Cam.*

(*up.Atdaban.* or *low.Botom.*), Eu. (Sardinia).—FIG. 66,3. **C. minimiporus*; 3a,b, transv. sec., long. sec., $\times 4.8$, $\times 12$ (Debrenne, 1964).

Erismacosinus DEBRENNE, 1959, p. 65 [**E. maroccanus*; M] [= ?*Tuvacyathus* VOLOGDIN, 1940, p. 112 (type, *T. mollimurus*; M); *Tuvacyathus* VOLOGDIN, 1937, p. 471, *nom. nud.*]. Cup slenderly conical to cylindrical; may be irregularly folded longitudinally; outer wall with numerous regularly alternating longitudinal rows fine pores to each intersept, inner wall thicker, more than one longitudinal row of simple or stirrup-pores to an intersept; small spikelets of varied form may project from wall between pores. *L.Cam.*(*mid.*

Tommat-low.Len.), N.Afr.(Morocco)-Eu.(Sardinia-Spain-France [Montagne Noire])-USSR (Altay-Sayan-Sib. Platf.)-?Mongolia-Antarct.-S. Australia-Can.(Yukon-B.C.).—FIG. 65,5. **E. maroccanus*, Amouslek., Morocco (Jebel Taïssa), holotype; 5a, transv. sec., $\times 3.2$; 5b, long. sec., $\times 2.4$; 5c, outer wall, diagram.(Debrenne, 1964).

Genticilyathus DEBRENNE, 1960, p. 118 [**G. varius*; M]. Outer wall, septa and tabulae with simple, rounded pores; inner wall with 2 to 3 longitudinal rows small pore-tubes S-shaped in long. sec. and opening upward into central cavity. *L.Cam.(Atdaban.)*, N.Afr.(Morocco).—FIG. 66,1. **G. varius*, holotype, Jebel Taïssa, Morocco; long. sec., $\times 8$ (Debrenne, 1961).

Pluralicosinus DEBRENNE, 1963, p. 135 [**P. alanisensis*; OD]. Like *Erismacosinus* but colonial, catenulate. *L.Cam.*, Spain(Alanis)-S.Australia.—FIG. 66,2. **P. alanisensis*; 2a,b, side view of fan-shaped catenulate colony, $\times 1.6$, $\times 2.4$ (Debrenne, 1963).

Retecosinus ZHURAVLEVA, 1960, p. 247 [**Coscinocyathus retetabulae* VOLOGDIN, 1931, p. 75; OD]. Outer and inner walls and septa with simple, rounded pores; tabulae with 2 rows slit-like pores, 1 row on each side of median radial band, pores of inner wall provided with small bubble-like, breached covers. *L.Cam.(mid.Tommat-?low.Botom.)*, USSR (Altay-Sayan-Sib.Platf.)-Eu.(France [Montagne Noire])-N.Afr.(Morocco).—FIG. 66,4. **R. retetabulae* (VOLOGDIN), up.Tommat., R.Moyero, Sib.Platf.; 4a,b, transv. sec., $\times 8$, $\times 16$; 4c, part of long. sec., inner wall to left, $\times 8$ (Zhuravleva, 1960b).

Rozanovicosinus DEBRENNE, 1970, p. 41 [**R. fonini*; OD]. Cup cylindrical with narrow longitudinal furrows at outer edges of septa; outer wall with round pores arranged in quincunx; tabulae porous, flat, numerous, but irregularly spaced; inner wall with short pore-tubes as in a honeycomb, two or three to an intercept. *L.Cam.(up.Atdaban-low.Botom.)*, S.Australia.

Torgaschinocyathus VOLOGDIN, 1957d, p. 699 [**T. spinosus*; M]. Cup conical, with thin outer wall with simple pores; septa and tabulae thin, porous; inner wall with single longitudinal row of pores to an intercept, each pore with scoop or half-tumulus over its lower part, spine projecting from about center of half-tumulus. *L.Cam.(?Botom.)*, USSR(Sayan)-Antarct.—FIG. 65,2. **T. spinosus*, Sayan; oblique sec., $\times 5.6$ (Vologdin, 1962d).

Family STILLICIDOCYATHIDAE Ting, 1937

[Stillicidocyathidae TING, 1937, p. 367] [=Salairocyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879]

Outer wall simple, inner wall of annuli; septa and tabulae porous. *L.Cam.(?up.Atdaban-Botom.)*.

Stillicidocyathus TING, 1937, p. 367 [**Coscinocya-*

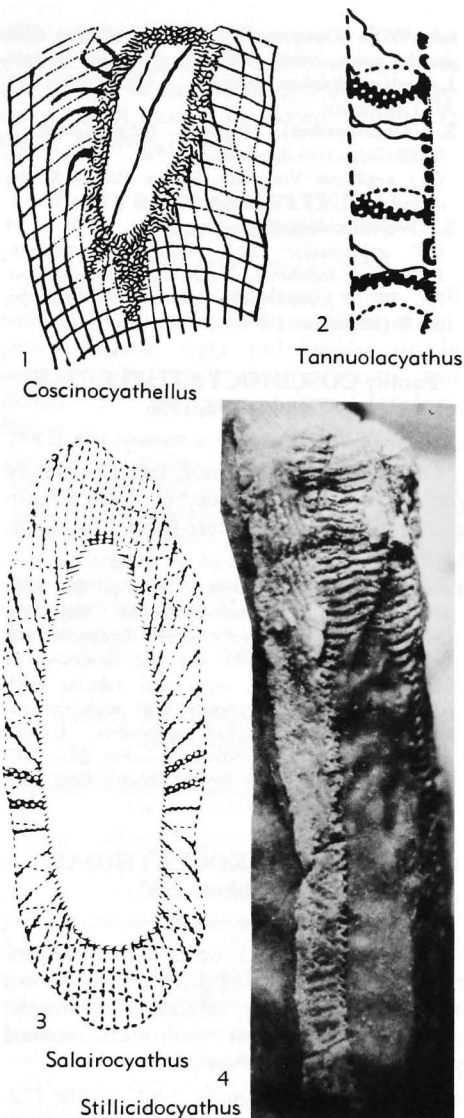


FIG. 67. Stillicidocyathidae (3-4); Coscinocyathellidae (1); Tannuolacyathidae (2) (p. E95-E96).

thus aulax TAYLOR, 1910; OD]. Outer wall with simple pores; inner wall of annuli S-shaped in section; septa and tabulae simply porous (see Debrenne, 1969b, p. 263). *L.Cam.(up.Atdaban. or low.Botom.)*, S.Australia.—FIG. 67,4. **S. aulax* (TAYLOR), holotype, up.Atdaban. or low.Botom., S.Australia (Ajax Mine); oblique surface showing annuli of inner wall, $\times 3$ (photo, MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris).

Salairocyathus VOLOGDIN, 1940, p. 89 [**S. zenko-*

vae; OD]. Outer wall, septa and tabulae with simple pores; inner wall of geniculate annuli. *L.Cam.* (*up.Atdaban.-Botom.*), USSR (Salair)-N. Afr. (Morocco).

S. (Salairocyathus). Solitary. *L.Cam.* (*Botom.*), USSR (Salair)-?S. Australia.—FIG. 67,3. **S. (S.) zenkova* VOLOGDIN, Belaya Gorka, Salair; oblique sec., $\times 5$ (Vologdin, 1957a).

S. (Polystillicidocyathus) DEBRENNE, 1959, p. 14 [**P. erbosimilis*; OD]. Colonial, catenulate. *L.Cam.* (*up.Atdaban.*), N. Afr. (Morocco).—FIG. 5,3. **S. (P.) erbosimilis* (DEBRENNE); holotype, $\times 1.5$ (Debrenne, 1959b).

Family COSCINOCYATHELLIDAE Zhuravleva, 1956

[Coscinocyathellidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879]

Outer wall, septa and tabulae simply porous; inner wall wide, of intercommunicating, crooked pore-tubes. *L.Cam.* (*Botom.*).

Coscinocyathellus VOLOGDIN, 1940, p. 91 [**C. parvus*; OD] [= *Coscinocyathellus* VOLOGDIN, 1937, p. 471 (*nom. nud.*), genus diagnosed, one species *C. parvus* listed but not described or figured]. Outer wall, septa and tabulae with simple rounded pores; inner wall wide, of intercommunicating, crooked pore-tubes. *L.Cam.* (*Botom.*), USSR (Altay-Sayan).—FIG. 67,1. **C. parvus*, R. Sanashytkgol, Sayan; oblique long. sec., $\times 3.3$ (Vologdin, 1940b).

Family AGYREKOCYATHIDAE Konyushkov, 1967

[Agyrekocyathidae KONYUSHKOV, 1967, p. 110]

Solitary or colonial; outer wall with funnel-shaped pores provided with finely porous sheath; septa porous; tabulae with simple, rounded pores; inner wall with crooked pore-canals. *L.Cam.-base M.Cam.*

Agyrekocyathus KONYUSHKOV, 1967, p. 110 [**A. malovi*; OD]. Solitary or colonial; outer wall with funnel-shaped pores provided with finely porous sheath; septa porous; tabulae with simple, rounded pores; inner wall with crooked pore-canals. ?*Up.L.Cam.-base of ?M.Cam.*, USSR (Kazakhstan).—FIG. 68,1. **A. malovi*, Mt. Agyrek, Kazakhstan; transv. sec. of holotype, $\times 1$ (Konyushkov, 1967).

Family TANNUOLACYATHIDAE Debrenne, 1964

[Tannuolacyathidae DEBRENNE, 1964, p. 188]

Outer wall with simple pores; septa and tabulae porous; dissepiments may be present; inner wall thick and coarsely porous

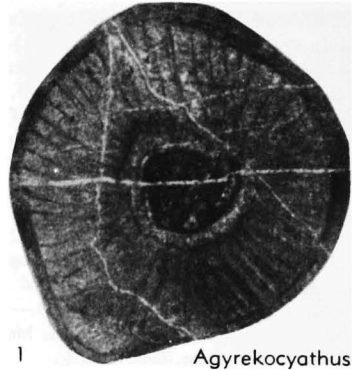


FIG. 68. Agyrekocyathidae (p. E96).

and covered on side of central cavity by finely porous sheath. *L.Cam.* (*low.Botom.*).

Tannuolacyathus VOLOGDIN, 1957, p. 496 [**T. multiplex*; OD]. Outer wall with simple pores; septa and tabulae porous; dissepiments may be present; inner wall thick and coarsely porous and covered on side of central cavity by finely porous sheath. *L.Cam.* (*low.Botom.*), USSR (Tuva)-N. Afr. (Morocco).—FIG. 67,2. **T. multiplex*, Tuva, part of long. sec., central cavity to right, $\times 5$ (Vologdin, 1957c).

Superfamily CLATHRICOSCINACEA Rozanov, 1964

[*nom. transl.* DEBRENNE, 1964, p. 115 (*ex Clathricoscinidae* ROZANOV in REPINA, *et al.*, 1964, p. 223)]

Cups with outer wall formed from downturned edges of tabulae and reinforced by longitudinal ridgelets and finely porous external sheath; intervallum with simply porous septa and tabulae; inner wall with simple pores protected by bracts. *L.Cam.* (*Atdaban.-low.Len.*).

Family CLATHRICOSCINIDAE Rozanov, 1964

[Clathricoscinidae ROZANOV in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 223]

Cups with outer wall formed from downturned edges of tabulae and reinforced by longitudinal ridgelets and finely porous external sheath; intervallum with simply porous septa and tabulae; inner wall with simple pores protected by bracts. *L.Cam.* (*Atdaban.-low.Len.*).

Clathricoscinus ZHURAVLEVA, 1955, p. 627 [**Coscinocyathus infirmus* VOLOGDIN ("1937") in

ZHURAVLEVA, 1955, p. 627; OD]. Solitary or colonial; outer wall formed from downturned edges of tabulae reinforced by finely porous sheath applied to longitudinal ridgelets; septa and tabulae with simple rounded pores; inner wall with simple pores protected by bracts. *L.Cam.(Atdaban.-low.Len.)*, USSR (Altay-Sayan-Sib.Platf.-Transbayk.-Far East)-Mongolia.—FIG. 69,1. **C. infirmus* (VOLOGDIN), *L.Cam.*, USSR; 1a, part of long. sec.; 1b, part of transv. sec.; 1c, tang. view outer wall and outer edges of tabulae; all $\times 25$; 1d, bract of inner wall, $\times 50$ [*r*, longitudinal ridgelets; *s*, external sheath; *t*, tabula] (Zhuravleva, 1955).

Superfamily
ANAPTYCTOCYATHACEA
Debrenne, 1970

[Anaptyctocyathacea DEBRENNE, 1970, p. 25]

Cup conical or cylindrical; outer wall double, a coarsely porous framework, pores screened by sieves (see Debrenne, 1970b, p. 29); septa and tabulae simply porous; inner wall with simple pores. *L.Cam.(Atdaban.-Botom.)*.

Family ANAPTYCTOCYATHIDAE
Debrenne, 1970

[Anaptyctocyathidae DEBRENNE, 1970, p. 25]

Characteristics of superfamily. *L.Cam.(Atdaban.-Botom.)*.

Anaptyctocyathus DEBRENNE, 1969, p. 340, as subgenus of *Alataucyathus* ZHURAVLEVA, 1955, p. 626 [**Coscinocyathus cribripora* R. BEDFORD & W. R. BEDFORD, 1934, p. 3; OD]. Cup conical or cylindrical; outer wall double, a coarsely porous framework, the pores screened by sieves (see Debrenne, 1970b, p. 29); septa and tabulae simply porous; inner wall simple, with two rows of pores to an intersept; toward top of cup the two neighboring pores may coalesce. *L.Cam.(Atdaban.-Botom.)*, S.Australia-USSR (Altay-Sayan).—FIG. 69,4. **A. cribripora* (BEDFORD & BEDFORD), S. Australia (Ajax Mine), holotype; 4a, part of transv. sec., 4b, tang. sec. outer wall; 4c, tang. sec. inner wall, all $\times 4$ (5, BEDFORD & BEDFORD, 1934).

Superfamily
ALATAUCYATHACEA
Zhuravleva, 1955

[*nom. transl.* ZHURAVLEVA, 1960, p. 264 (ex Alataucyathidae ZHURAVLEVA, 1955, p. 626)] [=Sigmocosciniacea DEBRENNE, 1970, p. 25]

Cup conical or cylindrical; outer wall tumulose or of imperfect annuli; tumuli

with one or many pores; septa and tabulae simply porous; inner wall simply porous and stellate in section, or of S-shaped pore-tubes, or of poorly developed annuli. *L.Cam.(Atdaban.-Botom.)*.

Family ALATAUCYATHIDAE
Zhuravleva, 1955

[Alataucyathidae ZHURAVLEVA, 1955, p. 626]

Cup conical or cylindrical; outer wall with knobby, multipored tumuli or of imperfect annuli; septa and tabulae simply porous; inner wall simply porous and stellate in section. *L.Cam.(Atdaban.-Botom.)*.

Alataucyathus ZHURAVLEVA, 1955, p. 626 [**A. jaroschevitschi*; OD]. Cup solitary; outer wall with multipored tumuli; septa and tabulae porous; inner wall with simple pores and with those parts between neighboring septa projecting like low folds into central cavity, or unfolded. *L.Cam.(Atdaban.-Botom.)*, USSR (Altay-Sayan).—FIG. 69,3. **A. jaroschevitschi*, Kuznetsk Alatau; part of transv. sec., $\times 15$ (Zhuravleva, 1955).

Family ETHMOCOSCINIDAE
Zhuravleva, 1957

[Ethmocosciniidae ZHURAVLEVA in VOLOGDIN, 1957, p. 208] [=Tumulocosciniinae ZHURAVLEVA, 1960, p. 265; Ethmocosciniinae HILL, 1965, p. 110]

Cup solitary; outer wall with simple tumuli each with one pore; septa and tabulae simply porous; inner wall simply porous and unfolded or longitudinally fluted, or formed of single longitudinal row of S-shaped pore-tubes to each intersept. *L.Cam.(Atdaban.-Botom.)*.

Ethmocoscinus SIMON, 1939, p. 28 [**Coscinocyathus papillipora* R. BEDFORD & W. R. BEDFORD, 1934, p. 4; OD]. Cup solitary, conical or cylindrical; outer wall with single-pored tumuli, one longitudinal row to an intersept; septa with sparse simple pores and tabulae with polygonal, somewhat irregular pores; inner wall of S-shaped pore-tubes, single longitudinal row to an intersept. *L.Cam.(up.Atdaban. or low.Botom.)*, S.Australia-?Can.—FIG. 8,2; 69,8. **E. papillipora* (BEDFORD & BEDFORD), holotype, S.Australia (Ajax Mine); 8,4; 69,8, 2 views, both $\times 4$ (Hill, 1965). **Asterotumulus** KASHINA in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 229 [**A. receptori*; OD]. Solitary; outer wall with single-pored tumuli; septa and tabulae simply porous; inner wall longitudinally sharply folded, each intersept projecting into central cavity; pores of inner wall simple. *L.Cam.(Atdaban.-Botom.)*, USSR (Sayan-Sib.Platf.).—FIG. 69,5. **A. recep-*

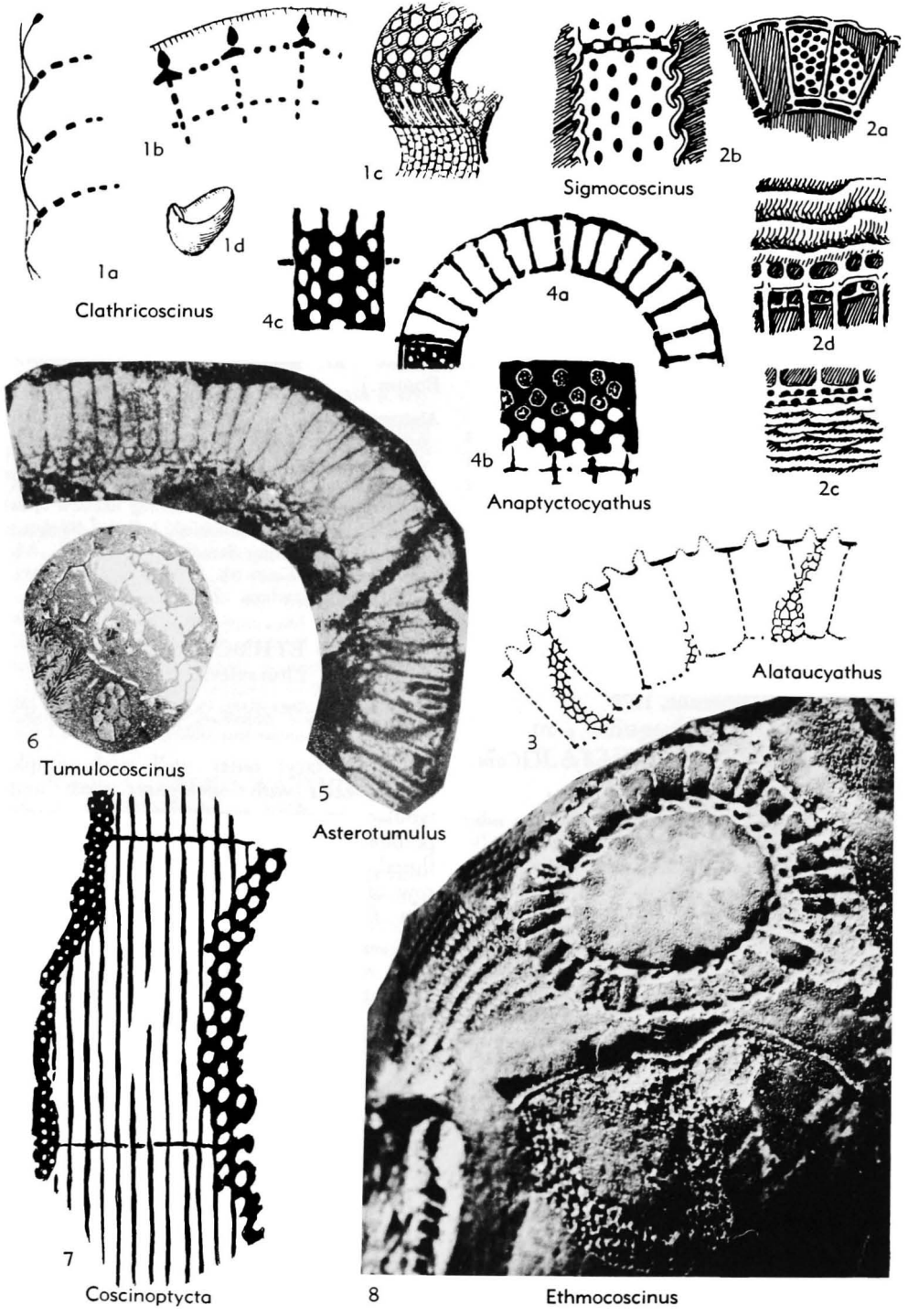


FIG. 69. Clathricoscinidae (1); Anaptyctocyathidae (4); Alataucyathidae (3); Ethmocoscinidae (5-8); Sigmocoscinidae (2) (p. E96-E97, E99).

tori, Bazaikh., Sayan; part of transv. sec., $\times 6$ (Repina, *et al.*, 1964).

Coscinoptycta BROILI, 1915, p. 121 [*nom. subst. pro Coscinoptycha* TAYLOR, 1910, p. 141 (type, *C. convoluta*) (non *Coscinoptycha* MEYRICK, 1881, an insect)] [**Coscinoptycha convoluta* TAYLOR, 1910, p. 141; SD SIMON, 1939, p. 26]. Cup large and bowl-shaped with irregular longitudinal folds; outer wall with one longitudinal row of laterally perforated simple tumuli to an intersept; inner wall with 2 or 3 longitudinal rows of pores protected by spines; intervallum very narrow; septa porous to aporose; tabulae remote, with micropores. [Diagnosis by courtesy of Dr. F. DEBRENNE who has studied the type material.] *L.Cam.*(*up.Atdaban.* or *low.Botom.*), S.Australia-Antarct.-Eu.(?Sardinia).—FIG. 4,11; 69,7. **C. convoluta* (TAYLOR), S.Australia (Ajax Mine); 4,11, reconstr.; 69,7, part of long. sec., enl. (Taylor, 1910).

Tumulocoscinus ZHURAVLEVA, 1960, p. 265 [**T. atdabanensis*; OD]. Cup not large; outer wall with single-pored tumuli; septa, tabulae and inner wall with simple pores. *L.Cam.*(*Atdaban.-low. Botom.*), USSR(Sib.Platf.)-N.Afr.(Morocco).—FIG. 69,6. **T. atdabanensis*, R. Lena, Sib.Platf., holotype; transv. sec., $\times 10$ (Zhuravleva, 1960b).

Family SIGMOCOSCINIDAE

R. Bedford & J. Bedford, 1939

[Sigmocoscinidae R. BEDFORD & J. BEDFORD, 1939, p. 76]

Cup solitary and conical or cylindrical; each intersept of outer wall with lower edges of pores projecting as bracts that may fuse laterally forming imperfect annular shelves; septa and tabulae simply porous; inner wall of annuli, S-shaped in section. *L.Cam.*(*up.Atdaban.* or *low.Botom.*).

Sigmocoscinus R. BEDFORD & J. BEDFORD, 1936, p. 24 [**S. sigma*; OD]. Cup solitary, conical or cylindrical; each intersept of outer wall with several longitudinal rows of pores, pores also arranged in horizontal rows; lower edges of pores project as bracts that may fuse laterally to form imperfect annular shelves; septa and tabulae simply porous, tabulae flat; inner wall of annuli, S-shaped in section. *L.Cam.*(*up.Atdaban.* or *low. Botom.*), S.Australia.—FIG. 69,2. **S. sigma*, S.Australia (Ajax Mine); 2a, transv. sec.; 2b, radial long. sec.; 2c, tang. sec. outer wall; 2d, tang. sec. inner wall, all $\times 8$ (Bedford & Bedford, 1936).

?**Schumnyicyathus** ZHURAVLEVA, 1968, p. 164 [**S. validus*; OD]. Solitary, cup slenderly conical; outer wall of large rounded pore-tubes, S-formed in longitudinal section, each tube closed externally with finely perforate screen; septa and tabulae simply porous; inner wall of annuli, S-formed in longitudinal section of cup. *L.Cam.*(*low.Botom.*),

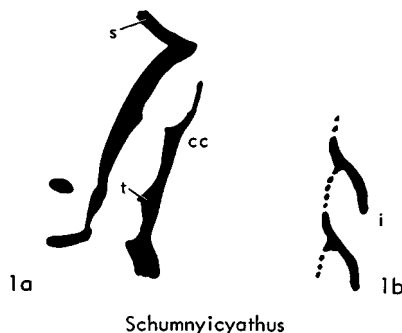


FIG. 70. Sigmocoscinidae (p. E99).

USSR(R.Sukharikha, Sib.Platf.).—FIG. 70,1. **S. validus*; 1a, part of transv. sec. of inner wall [cc, central cavity; s, septum; t, trace of wall of pore-tube]; 1b, part of long. sec. outer wall [i, intervallum], diagram. (Zhuravleva, 1968b).

Superfamily ROZANOVICYATHACEA Korshunov, 1969

[Rozanoviclyathacea KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 54]

Outer wall with geniculate canals or S-shaped canals; intervallum with simply porous septa and tabulae; inner wall with simple pores with bracts, or of V-shaped pore tubes. *L.Cam.*(*Botom.*).

Family ROZANOVICYATHIDAE Korshunov, 1969

[Rozanoviclyathidae KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 54]

Outer wall with geniculate canals or S-shaped canals; septa porous and tabulae with simple or chinky pores; inner wall with large pores with bracts. *L.Cam.*(*Botom.*).

Rozanoviclyathus KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 54 [**R. alexi*; OD]. Cup conical or cylindrical; outer wall with geniculate canals, opening downwards; septa porous, tabulae with chinky pores; inner wall with one longitudinal row of large pores with bracts to each intersept. *L.Cam.*(*Botom.*), USSR(Sib. Platf.).—FIG. 71,1. **R. alexi*, R. Mukhatta, Sib. Platf.; 1a, transv. sec., $\times 6$; 1b, oblique long. sec., $\times 6$ (Zhuravleva, 1969).

Family POROCOSCINIDAE Debrenne, 1964

[Porocoscinidae DEBRENNE, 1964, p. 190]

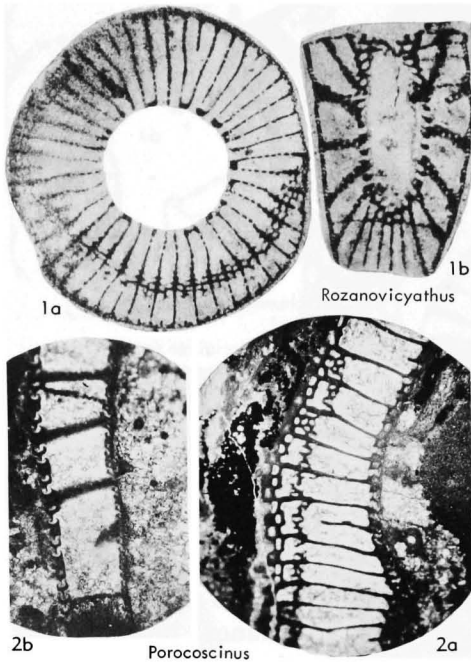


FIG. 71. Rozanovicyathidae (1); Porocosciniidae (2)
(p. E99-E100).

Pores of outer wall each protected by bract surrounding its base and sides; septa and tabulae porous; inner wall with rectangular pores, and V-shaped pore-tubes. *L.Cam.(up.Atdaban. or Botom.)*.

Porocoscinus DEBRENNE, 1964, p. 190 [**P. flexibilis*; OD]. Cup solitary; pores of outer wall each protected by bract rising from its base and sides; septa and tabulae porous; inner wall with rectangular pores, from base of each pore springs, on the intervallar side, a louvre-like plate extending upward into intervallum, and on side of central cavity, a scoop that protects base and sides of pore. *L.Cam.(up.Atdaban. or Botom.)*, Eu.(Sardinia). —FIG. 71,2. **P. flexibilis*, holotype; 2a,b, parts transv. and long. secs., $\times 6$ (Debrenne, 1964).

Superfamily MRASSUCYATHACEA Vologdin, 1960

[*nom. transl.* ZHURAVLEVA & ROZANOV in REPINA, KHOMEN-TOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 130 (ex Mrassucyathidae VOLOGDIN in ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA, 1960, p. 130)] [=Calyptocosciniacea DEBRENNE, 1964, p. 115]

Solitary or rarely colonial; outer wall a framework with large pores covered by

finely porous external sheath; septa and tabulae porous; inner wall with multipored tumuli, or of intercommunicating pore-canals, simply porous, or of large pores covered by finely porous sheath on side of central cavity. *L.Cam.(Atdaban.-Botom.)*.

Family MRASSUCYATHIDAE Vologdin, 1960

[Mrassucyathidae VOLOGDIN in ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA, 1960, p. 130] [=Mrassocycyathidae VOLOGDIN, 1956, p. 879, *nom. nud.*]

Solitary; outer wall coarsely porous with finely porous external sheath; septa and tabulae porous; inner wall with multipored tumuli. *L.Cam.(Atdaban.)*.

Mrassucyathus KRASNOPEEVA in ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA, 1960, p. 130 [**M. schoriensis*; OD] [=Mrassocycyathus KRASNOPEEVA in VOLOGDIN, 1956, p. 879, *nom. nud.*; Mrassocycyathus KRASNOPEEVA, 1960, p. 38 (type, *M. micropora*; M), *nom. null.*]. Solitary; with longitudinal folds; outer wall coarsely porous with a finely porous external sheath; septa and tabulae porous; inner wall with one to two longitudinal rows of multipored tumuli to each intersept. *L.Cam.(Atdaban.)*, USSR (Shoria Mts.). —FIG. 72,1. **M. schoriensis*, Bazaikha; part of oblique long. sec., $\times 5$ (Zhuravleva, Krasnopeeva, & Chernysheva, 1960).

Family KASYRICYATHIDAE Zhuravleva, 1961

[Kasyricyathidae ZHURAVLEVA, 1961, p. 29]

Outer wall with large pores and covered by a finely porous external sheath; septa and tabulae porous; inner wall of intercommunicating pore canals. *L.Cam.(Atdaban.-Botom.)*.

Kasyricyathus ZHURAVLEVA, 1961, p. 31 [**K. schirokovae*; OD]. Outer wall with large pores and covered by a finely porous external sheath; septa and tabulae porous; inner wall of intercommunicating pore-canals, one longitudinal row to an intersept. *L.Cam.(Botom.)*, USSR (Sayan). —FIG. 73,1. **K. schirokovae*; 1a, oblique sec., $\times 6.4$; 1b, part of transv. sec., inner wall of holotype, $\times 12.8$ (Repina, *et al.*, 1964).

Orienticyathus BELYAEVA, 1969, p. 95 [**O. mamontovi*; OD]. Solitary or colonial; cup slenderly conical or cylindrical; outer wall a framework and microporous sheath; septa and tabulae simply porous; inner wall with numerous (up to 13) rows of geniculate pore-canals to an intersept. *L.Cam.(Atdaban.)*, USSR (Far East). —FIG. 73,4. **O. mamontovi*, R. Gerbikan, Far East; holotype, part of transv. sec., inner wall below, $\times 12.8$ (Zhuravleva, 1969).

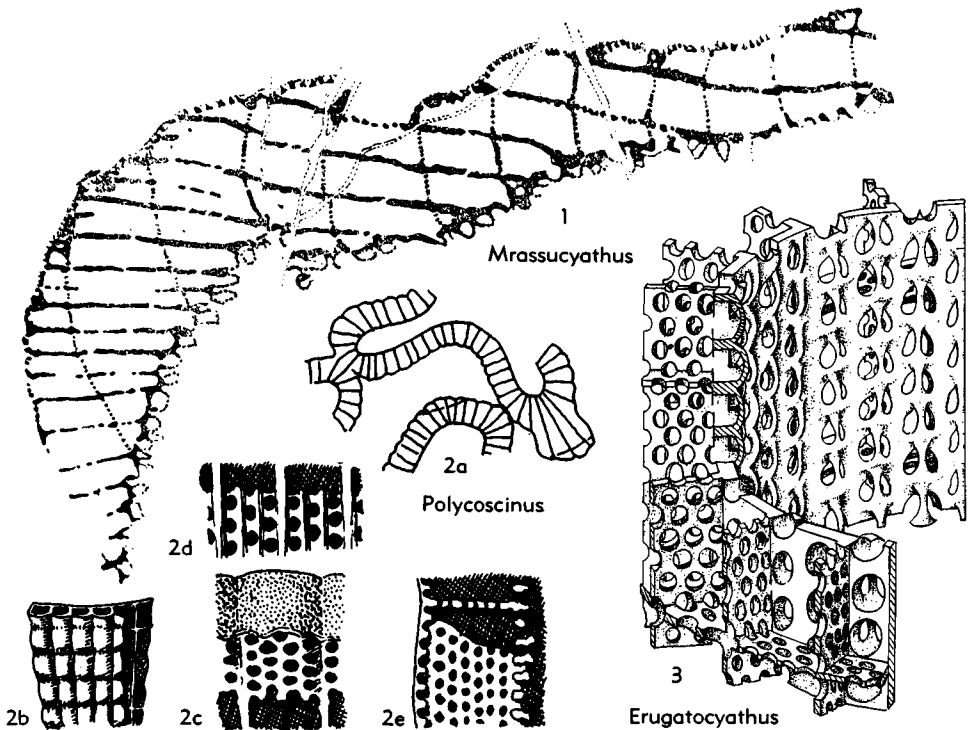


FIG. 72. Mrassucyathidae (1); Polycoscinidae (2-3) (p. E100-E101).

Family POLYCOSCINIDAE Debrenne, 1964

[Polycoscinidae DEBRENNE, 1964, p. 194]

Solitary or colonial; outer wall with large pores and covered by a finely porous external sheath; septa and tabulae porous; inner wall simply porous, may be longitudinally plicate or with spines. *L.Cam. (Atdaban.-Botom.)*.

Polycoscinus R. BEDFORD & J. BEDFORD, 1937, p. 37 [**P. contortus*; OD]. Colonial, increasing by bifurcation; cup longitudinally furrowed at porous septa and transversely furrowed independently of the flat tabulae whose pores are closed; outer wall with large pores in 3 or 4 longitudinal rows to an intersept and covered by finely porous sheath; inner wall with longitudinal ridges toward intervallum and cupules over pores in lower part of cup toward central cavity. *L.Cam. (?Botom.)*, S. Australia ("Paint Mine").—FIG. 72.2. **P. contortus*; transv. sec. of colony, $\times 1.3$; 2b, surface view of outer wall, $\times 2.5$; 2c, tang. sec. outer wall, $\times 11$; 2d, outer view of inner wall, $\times 11$; 2e, radial long. sec. showing septum and tabulae, $\times 11$ (Bedford & Bedford, 1937).

Erugatocyathus DEBRENNE, 1969, p. 334 [**Coscinocyathus papillatus* R. BEDFORD & W. R. BEDFORD, 1934, p. 3; OD]. Like *Tomocyathus* but with unfolded inner wall. *L.Cam. (Atdaban.-low. Botom.)*, S. Australia-USSR (Altay-Sayan)-N. Afr.—FIG. 72.3. **E. papillatus* (BEDFORD & BEDFORD), ?Botom., S. Australia ("Paint Mine"); reconstr., enl. (Debrenne, 1969a).

Tomocyathus ROZANOV, 1960, p. 663 [**T. operosus*; OD]. Solitary; outer wall with large pores and covered by a finely porous external sheath; septa and tabulae porous; rare dissepiments; inner wall simply porous, longitudinally plicate. *L.Cam. (Atdaban.-Botom.)*, USSR (Altay-Sayan-Sib. Platf.-Far East)-S. Australia-N. Afr.—FIG. 73.2. **T. operosus*, Atdaban., R.B.Erba; 2a, part of transv. sec., $\times 3$; 2b, holotype, part of transv. sec., $\times 3$ (Rozanov & Missarzhevskiy, 1966).

Family CALYPTOCOSCINIDAE Debrenne, 1964

[Calyptocosciniidae DEBRENNE, 1964, p. 196]

Outer wall with large pores and covered by a finely porous external sheath; septa and tabulae porous; inner wall coarsely

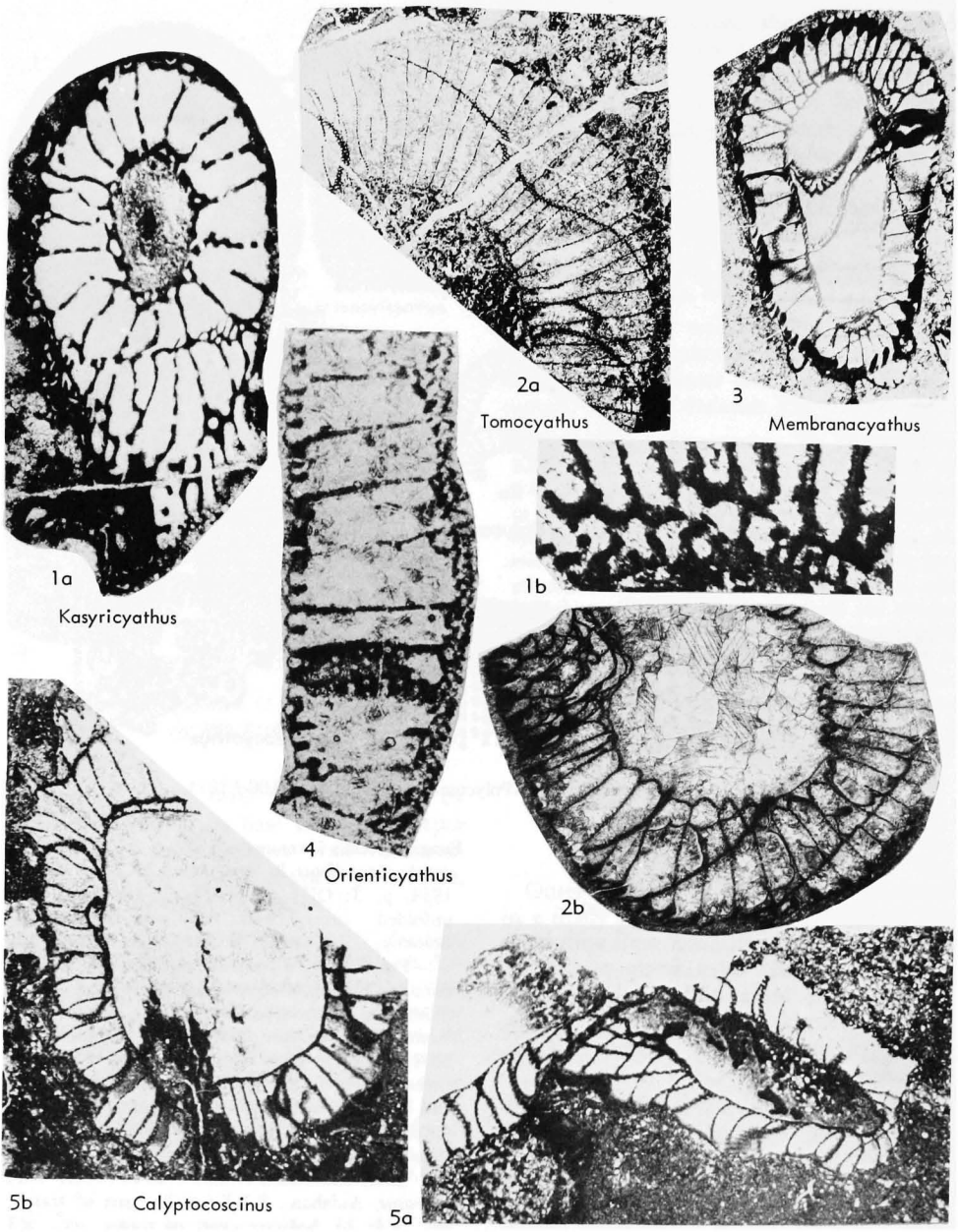


FIG. 73. Kasyricyathidae (1,4); Polycosciniidae (2); Calyptocosciniidae (3-5) (p. E100-E103).

porous and covered on side of central cavity by finely porous sheath. *L.Cam.*(*Atdaban-low.?Botom.*).

Calyptocoscinus DEBRENNE, 1964, p. 196 [*Coscincocyathus cornucopiae* BORNEMANN, 1887, p. 63 (*partim*); OD]. Slenderly conical, with irregular

bourrelets developed between tabulae; outer and inner walls coarse, each with finely porous sheath on side away from intervalum. *L.Cam.*(*up. Atdaban-low.?Botom.*), Eu.(Sardinia).—FIG. 73,5. **C. cornucopiae* (BORNEMANN); Atdaban or low.?Botom.; 5a,b, parts of long. and transv. secs. of paratype, X3.8 (Debrenne, 1964).

Membranacyathus ROZANOV, 1960, p. 664 [**M. repinae*; OD]. Outer wall with large pores and covered by finely porous external sheath; septa and tabulae porous; inner wall coarsely porous and covered on side of central cavity by finely porous sheath. *L.Cam.(Atdaban.)*, USSR (Shoria Mts.).—FIG. 73,3. **M. repinae*, Kameshki, Mrassu; oblique sec., holotype, $\times 3$ (Rozanov, 1960a).

Class IRREGULARES Vologdin, 1937

[*nom. correct.* ZHURAVLEVA, 1960, p. 267 (as subclass) (*ex Irregularia* VOLOGDIN, 1937, p. 461)] [=Syringioidea KRASNOPEEVA, 1953b, p. 55 (class); Anthocyathea OKULITCH, 1955, p. E18 (*ex Anthocyatha* OKULITCH, 1943); Taenioidea VOLOGDIN, 1959a, p. 1134 (class)]

Solitary, rarely colonial; cup conical in outer form, ranging from cylindrical to discoid, outline frequently irregular. Cups with one or commonly two porous walls; intervallum with rods and bars or septa and commonly with tabulae and always with dissepiments; septa are commonly porous, pores arranged in longitudinal rows arching upward and outward from inner wall, at right angles to curvature of tabulae, whose axis of curvature coincides with axis of cup; pores of outer wall may be of irregular outline. In early stages of *Metacyathus* type, aporose tip widens and extends as one-walled porous cup in which first dissepiments and randomly disposed rods and bars arise, then, later than in *Regulares*, inner wall, and finally septa and tabulae. *L.Cam.-M.Cam.(Paradoxides oelandicus Zone)*; one genus in *U.Cam.*, Antarctic.

Order THALASSOCYATHIDA Vologdin, 1962

[Thalassocyathida VOLOGDIN, 1962, p. 116] [This name replaces Rhizacyathida ZHURAVLEVA, 1955, p. 629, which was based on *Rhizacyathus* R. BEDFORD & J. BEDFORD, 1939, p. 69, an invalid name based on *Protophareira radix* R. BEDFORD & J. BEDFORD, 1937, p. 28 as type-species; DEBRENNE, 1970, p. 41, concluded that *R. radix* is not an independent species but may be only a part of a tersioid outgrowth]

Cup one-walled, with a single internal cavity in which are rods or bars and dissepiments. *L.Cam.(Tommot.-Botom.)*.

Family BACATOCYATHIDAE Zhuravleva, 1960

[*nom. correct.* HILL, 1965, p. 116 (*pro* Batchatocyathidae ZHURAVLEVA, 1960, p. 268)] [=Thalassocyathidae VOLOGDIN, 1962, p. 116]

Cup one-walled, internal cavity with dis-

sepiments but lacking rods; wall with sparse, simple pores. *L.Cam.(Tommot.-Botom.)*.

Bacatocyathus VOLOGDIN, 1940, p. 95 [*nom. correct.* HILL, 1965, p. 116 (*pro* Bacatocyathus VOLOGDIN, 1940, p. 95)] [**B. kazakevici*; OD] [=Cysticyathus ZHURAVLEVA, 1955, p. 629 (type, *C. tunica-tus*; OD); Batchatocyathus VOLOGDIN, 1956, p. 878 (*nom. null.*); Batchatocyathus ZHURAVLEVA, 1960, p. 268 (*nom. null.*)]. Cup solitary, of irregular baggy form, with marked swellings and indentations. Single wall has sparse simple pores, irregularly arranged; only dissepiments in internal cavity. *L.Cam.(Tommot.-Botom.)*, USSR (S. Urals-Altay-Sayan-Sib.Plaf.).—FIG. 74,5. **B. kazakevici*, Tommot.-Botom., Salair; long. sec., $\times 4$ (Zhuravleva, 1963b).

Thalassocyathus VOLOGDIN, 1957, p. 699 [**T. acutatus*; M]. Cup slenderly conical, small, with constrictions; single-walled; in early stages filled with dissepiments and sparse, more or less distinctly porous tabulae [?]. Incompletely described. *L.Cam.(Botom.)*, USSR (Sayan).—FIG. 74,1. **T. acutatus*; long. sec., $\times 7.5$ (Vologdin, 1957d).

Order ARCHAEOCYATHIDA Okulitch, 1935

[*nom. correct.* ZHURAVLEVA, 1950, p. 9 (*pro* Archaeocyathina OKULITCH, 1935, p. 90)] [=Metacyathina R. BEDFORD & W. R. BEDFORD, 1936, p. 16 (*order*); Dictyocyathina (*sic*) R. BEDFORD & J. BEDFORD, 1937, p. 37; Spirocyathina ZHURAVLEVA, 1950, p. 10; Metacyathida OKULITCH, 1955, p. E14 (*order*); Dictyocyathida VOLOGDIN, 1956, p. 878 (*order*); Bicyathida VOLOGDIN, 1956, p. 878 (*order*); Bicyathina VOLOGDIN, 1962, p. 117 (*superorder*); Chouberticyathida DEBRENNE, 1970, p. 25 (*order*); Archaeopharetrida DEBRENNE, 1970, p. 25 (*order*); Metaldetida DEBRENNE, 1970, p. 25; Parancycathida DEBRENNE, 1970, p. 25; Paracoscinida DEBRENNE, 1970, p. 25]

Solitary or colonial; cup cylindrical, conical or discoid, frequently of irregular outline or with outgrowths. Outer wall simply porous or partially substituted by dissepiments; inner wall commonly with one longitudinal row of simple pores to an intersept, or rarely, of annuli. In intervallum are dissepiments, rods, and bars differently orientated, or septa; septa may be constituted by curved plates (taeniae), and may be flat-sided or waved or interrupted; tabulae may occur. *L.Cam.-M.Cam.(Paradoxides oelandicus Zone)*.

Suborder ARCHAEOCYATHINA Okulitch, 1935

[*nom. transl.* ZHURAVLEVA, 1960, p. 271 (*ex* Archaeocyathida ZHURAVLEVA, 1950, p. 9, *nom. correct. pro* Archaeocyathina

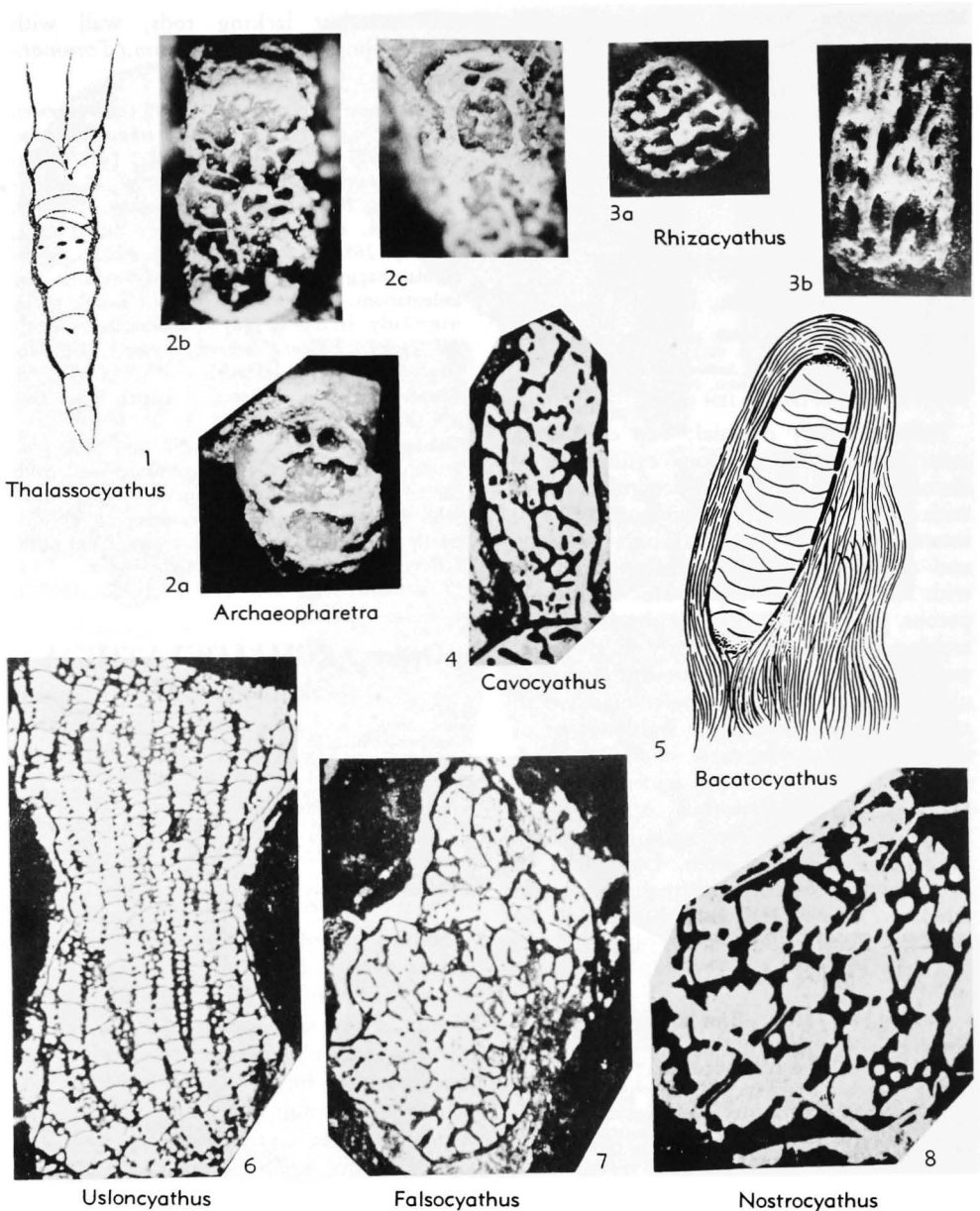


FIG. 74. Bacatocyathidae (1,5); Archaeopharetridae (2); Family Uncertain (3-4,6-8) (p. E103, E105, E132).

OKULITCH, 1935, p. 90 (order)) [=Choubertycyathida DEBRENNE, 1970, p. 25 (order); Archaeopharetrida DEBRENNE, 1970, p. 25 (order); Metaldetida DEBRENNE, 1970, p. 25 (order); Paranacyathida DEBRENNE, 1970, p. 25 (order)]

Cup cylindrical, fungoid, discoid or of irregular form; outer wall with simple pores, in some with external microporous

sheath; inner wall with simple pores or of annuli; intervallum with radial rods and tangential transverse bars, or with septa, but without tabulae (except in Anthomorphaeidae). *L. Cam.-M. Cam.* (*Paradoxides oelandicus* Zone).

Family ARCHAEOPHARETRIDAE
Debrenne, 1970

[Archaeopharetridae DEBRENNE, 1970, p. 29] [=Archaeopharetrida DEBRENNE, 1970, p. 25 (order)]

Outer wall non-porous; intervallum with irregular skeletal elements, bar- or platelike, mainly longitudinal or oblique more or less radial, and with dissepiments; inner wall defined at diameter of 2 mm., but may be obscured by presence of skeletal bars and dissepiments in the central cavity. *L.Cam.* (*Atdaban.* or *low.Botom.*).

Archaeopharetra R. BEDFORD & W. R. BEDFORD, 1936, p. 17 [**A. typica*; OD]. Small cups with an aporose outer wall; a true inner wall is defined late [at a diameter of 2 mm. in typical material], but may be obscured by dissepiments and irregular skeletal elements that are bar- or platelike, mostly placed in longitudinal or oblique positions but more or less radial; the apical part may consist of one wall and dissepiments only. *L.Cam.* (*up.Atdaban.* or *low.Botom.*), S.Australia.—FIG. 74.2. **A. typica*, holotype, S.Australia (Ajax Mine); 2a-c, 3 views, all $\times 5$ (photo courtesy of MAX DEBRENNE, Paris; negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris).

Family BICYATHIDAE Vologdin, 1937

[Bicyathidae VOLOGDIN, 1937, p. 472] [=Terektigocyathidae VOLOGDIN, 1962, p. 419]

Solitary or colonial; outer wall with simple pores or aporose; inner wall with simple pores; intervallum with dissepiments and with longitudinal discrete rods, but without septa and tabulae. *L.Cam.* (*up.Tommot.-Botom.*).

Bicyathus VOLOGDIN, 1939, p. 235 [**B. angustus*; OD] [=Bicyathus VOLOGDIN, 1937b, p. 472 (*nom. nud.*); *Potekhinocyathus* VOLOGDIN, 1957, p. 699 (type, *P. bateniensis*; M); ?*Terektigocyathus* VOLOGDIN, 1962, p. 420 (type, *T. primus*; OD); *Potekhinocyathus* ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 118 (*nom. null.*); *Terektigocyathus* ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 118 (*nom. null.*)]. Solitary or colonial; cup of cylindrical form, with strong swellings and constrictions. Outer wall with simple pores or aporose; inner wall with simple pores; dissepiments and rare short longitudinal or slightly inclined rods in the intervallum, but no septa or tabulae. *L.Cam.* (*up.Tommot.-Botom.*), USSR (S. Urals-Altay-Sayan)-Mongolia-N.Afr. (Morocco).—FIG. 75, 1a,b. **B. angustus*, Atdaban., S.Urals; 1a,b, long. and transv. secs., $\times 10$ (Vologdin, 1939).—FIG. 12, 3. *B. bateniensis* (VOLOGDIN), ?Botom., Kuznetsk Alatau; long. sec., $\times 7$ (Vologdin, 1957).—FIG. 75, 1c,d. ?*B. primus*

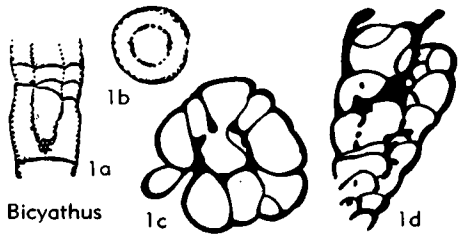


FIG. 75. Bicyathidae (p. E105).

(VOLOGDIN), ?Botom., Tuva; 1c,d, transv. and long. secs., $\times 7$ (Vologdin, 1962a).

Family DICTYOCYATHIDAE
Taylor, 1910

[Dictyocyathidae TAYLOR, 1910, p. 111] [=Chouberticyathida DEBRENNE, 1970, p. 25 (order)]

Solitary, cup of diverse form but not discoid, commonly attached; outer wall aporose or simply porous and connected to inner wall by radial or longitudinal and oblique rods; dissepiments present; synapticulae may connect radial rods; no septa or tabulae; inner wall not distinct, thin, with large pores in one longitudinal row to each interradian strip. Earliest stage with single aporose wall, followed by dissepiments and disoriented rods; central cavity appears later. *L.Cam.* (*mid.Tommot.-Botom.*).

Dictyocyathus BORNEMANN, 1891, p. 500 [**D. tenerimus*; M]. Cup conical or cylindrical, or fungoid, with dents and outgrowths and attachment processes; outer wall compact at base, in adult stages formed by densely packed and small intervallar elements; scaffolding of cylindrical or flattened rods in intervallum, reinforced at points of junction; dissepiments commonly present but subordinate; inner wall simply porous, formed by ends of intervallar rods. *L.Cam.* (*mid.Tommot.-Botom.*), Eu. (Sardinia-Spain)-N.Afr. (Morocco)-S.Australia-?Antarct.-USSR (S.Urals-Altay-Sayan-Sib.Plattf.-Transbayk.).

D. (Dictyocyathus). Fingerlike extrusions of intervallum not developed; rods of intervallar mesh without spinules. *L.Cam.* (*mid.Tommot.-Botom.*), Eu. (Sardinia-Spain)-N.Afr. (Morocco)-S.Australia-?Antarct.-USSR (S.Urals-Altay-Sayan-Sib.Plattf.-Transbayk.).—FIG. 76, 3a. *D. (D.) stipatus* DEBRENNE, Morocco; transv. sec., $\times 5$ (Debrenne, 1964).

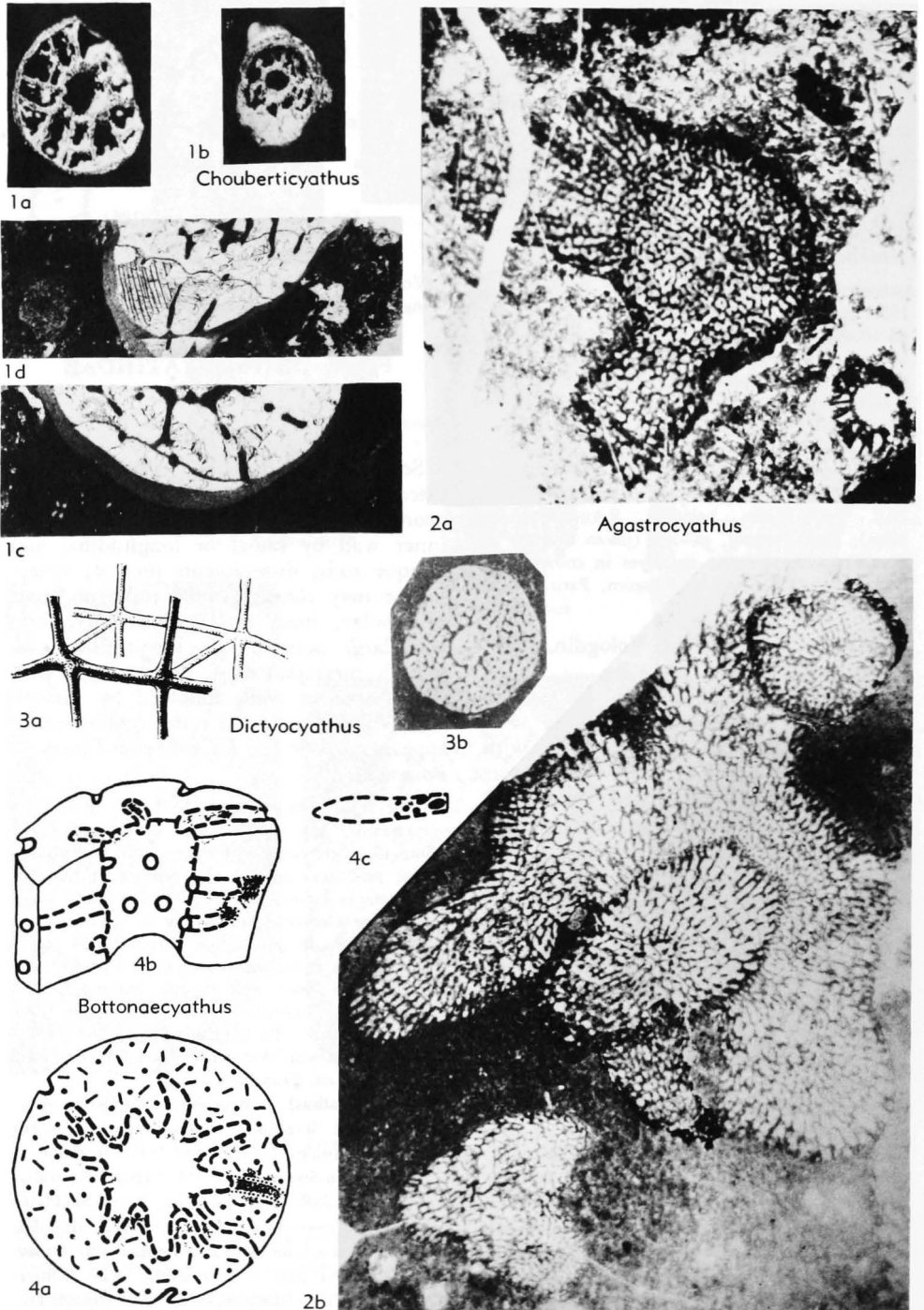


FIG. 76. Dictyocyathidae (p. E105, E107).

D. (Echinocyathus) TERMIER & TERMIER, 1950, p. 47 [**E. goundafensis*; OD] [*non Echinocyathus* VOLOGDIN, 1960, p. 424 (type, *E. bilateralis*; OD)]. With fingerlike extrusions of intervallum in the adult stages; rods of intervallar mesh without spinules. *L.Cam. (Botom.)*, N.Afr. (Morocco).

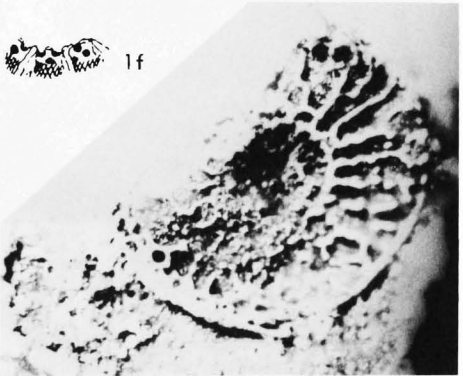
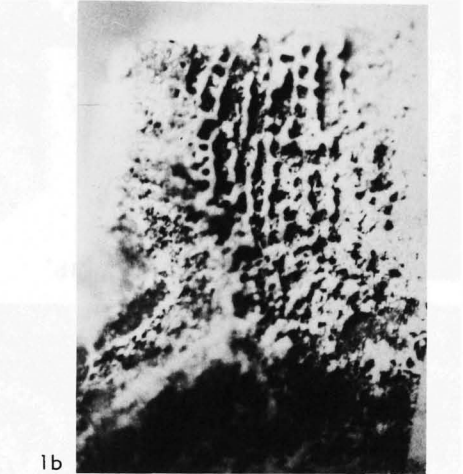
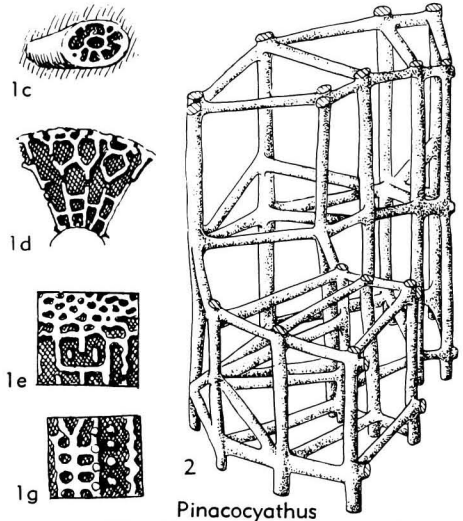
D. (Spinocyathus) ZHURAVLEVA, 1960, p. 276 (as genus) [**Spinocyathus maslennikovae*; OD]. Without fingerlike extrusions of intervallum in adult stages, but with spinules clothing rods of intervallar mesh. *L.Cam. (mid.Tommot.-low. Atdaban.)*, USSR (Sib. Platf.).

Agastrocyathus DEBRENNE, 1964, p. 209 [**Protopharethra gregaria* DEBRENNE, 1961, p. 21; OD]. Cup colonial or solitary; outer wall regular net, sheathed with outer pellis or microporous membrane; intervallar network of rods arranged in regular longitudinal rows without marked radial disposition, but with tangential and oblique connecting rods of similar diameter; such network also fills narrow central cavity, so that inner wall is indistinct and marked only by slight thickening of component rods; large subhorizontal dissepiments occur but no tabulae. *L.Cam. (Atdaban.)*, N.Afr. (Morocco)-Eu. (Sardinia-France [Montagne Noire]).—FIG. 76.2a. **A. gregarius* (DEBRENNE, Atdaban., Morocco (Talaïnt); thin sec., $\times 4$ (Debrenne, 1964)).—FIG. 76.2b. *A. chouberti* (TERMIER & TERMIER), Atdaban., Morocco; thin sec., $\times 4$ (Debrenne, 1964).

Bottonaacyathus RODIONOVA in ZHURAVLEVA, ZADOROZHNAJA, OSADCHAYA, POKROVSKAYA, RODIONOVA, & FONIN, 1967, p. 87 [**B. astraeiformis*; OD]. Solitary, rarely colonial; outer wall indistinct; in intervallum, radial rows of longitudinal and transverse rods, united tangentially by rods as in *Dictyocyathus*; subhorizontal canal-like spaces project from central cavity into or through intervallum and are lined by prolongations of simply porous inner wall. *L.Cam. (Botom.)*, USSR (Altay-Sayan)-N.Afr. (Morocco).—FIG. 76.4. **B. astraeiformis*, Tuva; 4a, transv. sec., 4b, long. sec., 4c, canal; all diagram., enl. (Zhuravleva, Zadorozhnaya, et al., 1967).

Chouberticyathus DEBRENNE, 1964, p. 208 [**C. clatratus*; OD]. Cup solitary; outer wall aporose; inner wall porous; scaffolding of longitudinal and transverse cylindrical rods in intervallum, with dissepiments. *L.Cam. (up.Atdaban.-Botom.)*, N. Afr. (Morocco)-S. Australia.—FIG. 76.1. **C. clatratus*, up.Atdaban., Morocco; 1a, b, transv. secs., holotype, $\times 3$; 1c, d, parts of transv. and long. secs. paratype, $\times 4$, $\times 3$ (Debrenne, 1964).

Pinacocyathus R. BEDFORD & W. R. BEDFORD, 1934, p. 4 [**P. spicularis*; M]. Outer wall a scaffolding of longitudinal pillars connected by horizontal or slightly oblique rods, inner wall probably a regular net; two walls connected by oblique, or radial horizontal rods; no dissepiments or tabulae observed (see Debrenne, 1970, p. 39).



1a Spirillicyathus

FIG. 77. Dictyocyathidae (2); Metacyathidae (1) (p. E107-E108, E111-E112).

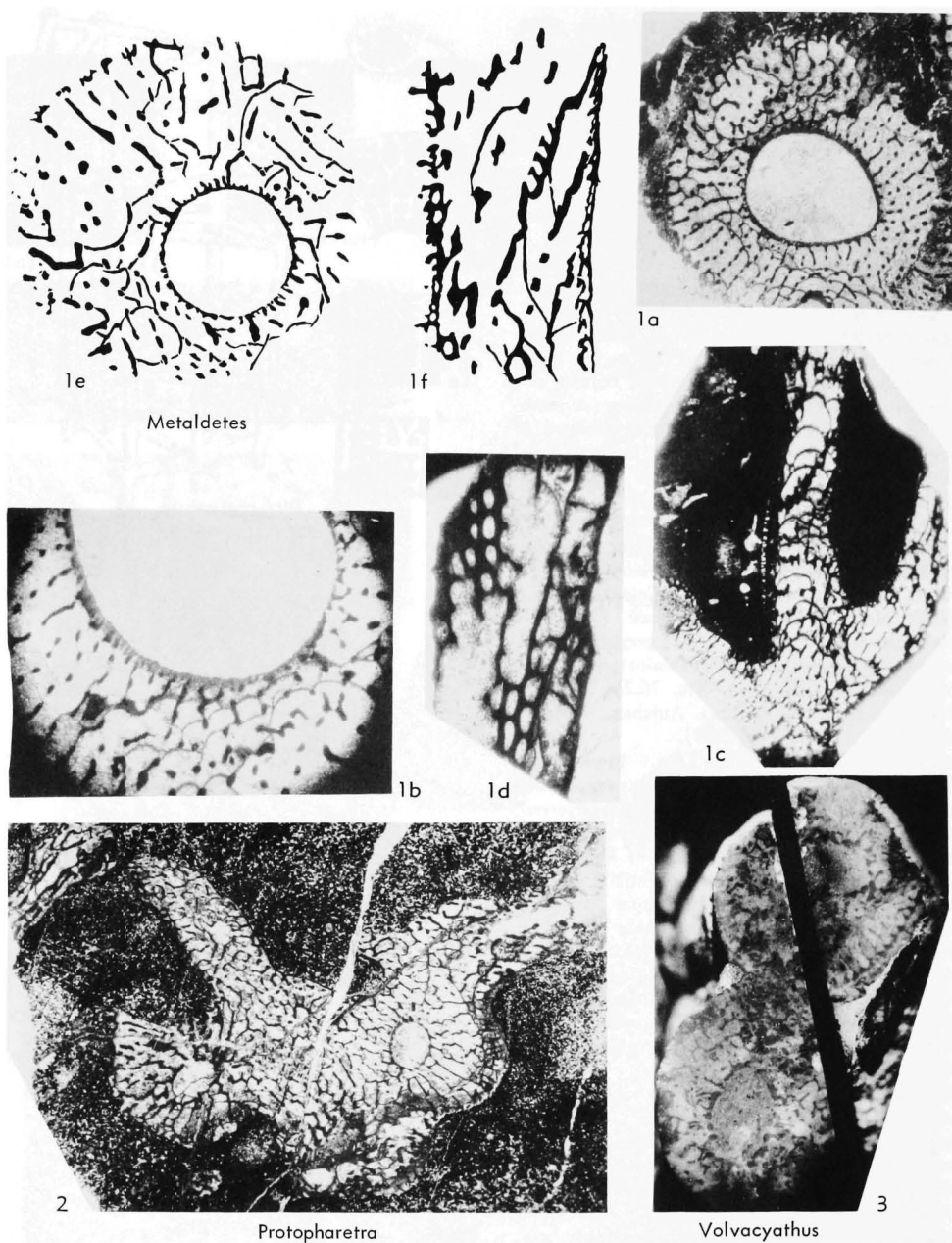


FIG. 78. Protopharettridae (2,3); Metacyathidae (1) (p. E109-E111).

L. Cam. (up. At. daban. or low. Botom.), S. Australia.
 —FIG. 77, 2. **P. spicularis*; diagram, reconstr.,
 enl. (Debrenne, 1969a).

Family PROTOPHARETRIDAE
Vologdin, 1957

[Protopharettridae Vologdin, 1957, p. 209]

Solitary or colonial; cups conical to cylindrical; outer wall with simple or screened pores; in intervallum are dissepiments and small radial platelets connected by thin branches or by synapticulae; inner wall

with large pores. *L. Cam. (mid. Tommot.-low. Len.)*.

Protopharetta BORNEMANN, 1884, p. 705 [**P. polymorpha*; SD SIMON, 1939, p. 34]. Colonial, rarely solitary; cups conical or cylindrical, with outgrowths and adherent processes; outer wall with simple, commonly very sparse, pores; inner wall appears late in ontogeny, with 1 or 2 longitudinal rows of large pores to each intersept; in the intervallum are dissepiments and small, branching platelets connected to one another by thin branches or by little rods; these platelets are arranged in files widening slightly towards exterior, files being less persistent radially than longitudinally except near inner wall so that septa are not well-defined; the connections between neighboring files are oblique. (See Debrenne, 1964.) *L. Cam. (mid. Tommot.-low. Len.)*, Eu. (Sardinia)-N. Afr. (Morocco)-USSR (Urals-Altay-Sayan-Sib. Platf.-Transbayk.)-Mongolia-China-S. Australia-Antarct.-Can. (B.C.)-USA (Nev.).—FIG. 78.2. **P. polymorpha*, paratype, ?Botom., Sardinia; transv. sec., $\times 2$ (Debrenne, 1964).

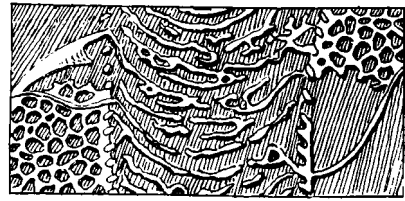
Volvacythus DEBRENNE, 1960, p. 118 [**V. proteus*; M]. Cups solitary or compound. The solitary cups have long, wide, initial conical, one-walled stage with dissepiments and disorientated rods, followed by cylindrical stage in which an inner wall and central cavity develop. Outer wall with screened pores in conical part of cup; inner wall with coarse pores arranged in quincunx. Intervallum series of conical envelopes constructed of rods, curved radial plates, synapticulae and dissepiments. Compound forms with two or more secondary cylindrical cups, each with its own central cavity, rising from primary conical cup. *L. Cam. (Atdaban.)*, N. Afr. (Morocco)-Eu. (Spain).—FIG. 78.3. **V. proteus*, Morocco; transv. sec. holotype, $\times 2$ (Debrenne, 1964).

Family METACYATHIDAE

R. Bedford & W. R. Bedford, 1934

[Metacyathidae R. BEDFORD & W. R. BEDFORD, 1934, p. 5] [\equiv Cambrocyathidae OKULITCH, 1937, p. 251; Cambrocyathinae (subfamily), *nom. transl.* DEBRENNE, 1964, p. 218; Metaldetida DEBRENNE, 1970, p. 25 (order); Metaldetinae DEBRENNE, 1964, p. 218; Paranacyathida DEBRENNE, 1970, p. 25 (order); Paranacyathidae DEBRENNE, 1970, p. 38]

Outer and inner walls simply porous, in some with pores screened by microporous sheath; septa more or less well-defined, the pores arranged in rows inclined upward and outward from inner to outer wall; no tabulae; dissepiments present; and in some, synapticulae; apical part of cups occupied by rods, plates or dissepiments, without inner wall, septa or central cavity. *L. Cam. (Tommot.-low. Len.)*.



1b

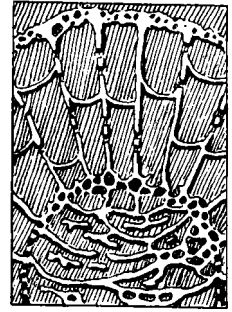


2a

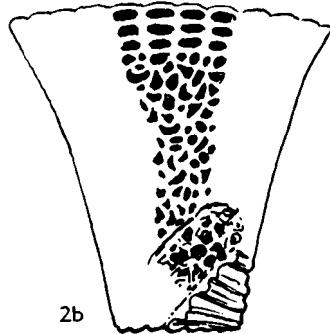
Paranacyathus



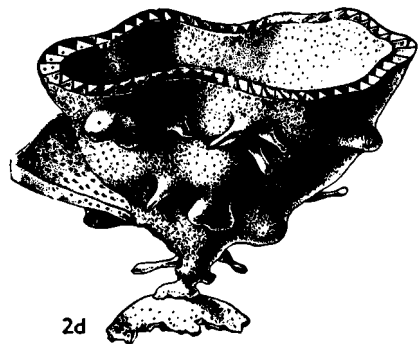
2c



1a Ardrossacyathus



2b



2d

FIG. 79. Metacyathidae (p. E111).

Metaldetes TAYLOR, 1910, p. 151 [**M. cylindricus*; M] [\equiv *Metacyathus* R. BEDFORD & W. R. BEDFORD, 1934, p. 5 (type, *M. taylori*, SD R. BEDFORD & W. R. BEDFORD, 1936, p. 20); *Bedfordcyathus* VOLOGDIN, 1957, p. 209 (type, *Metacyathus ir-*

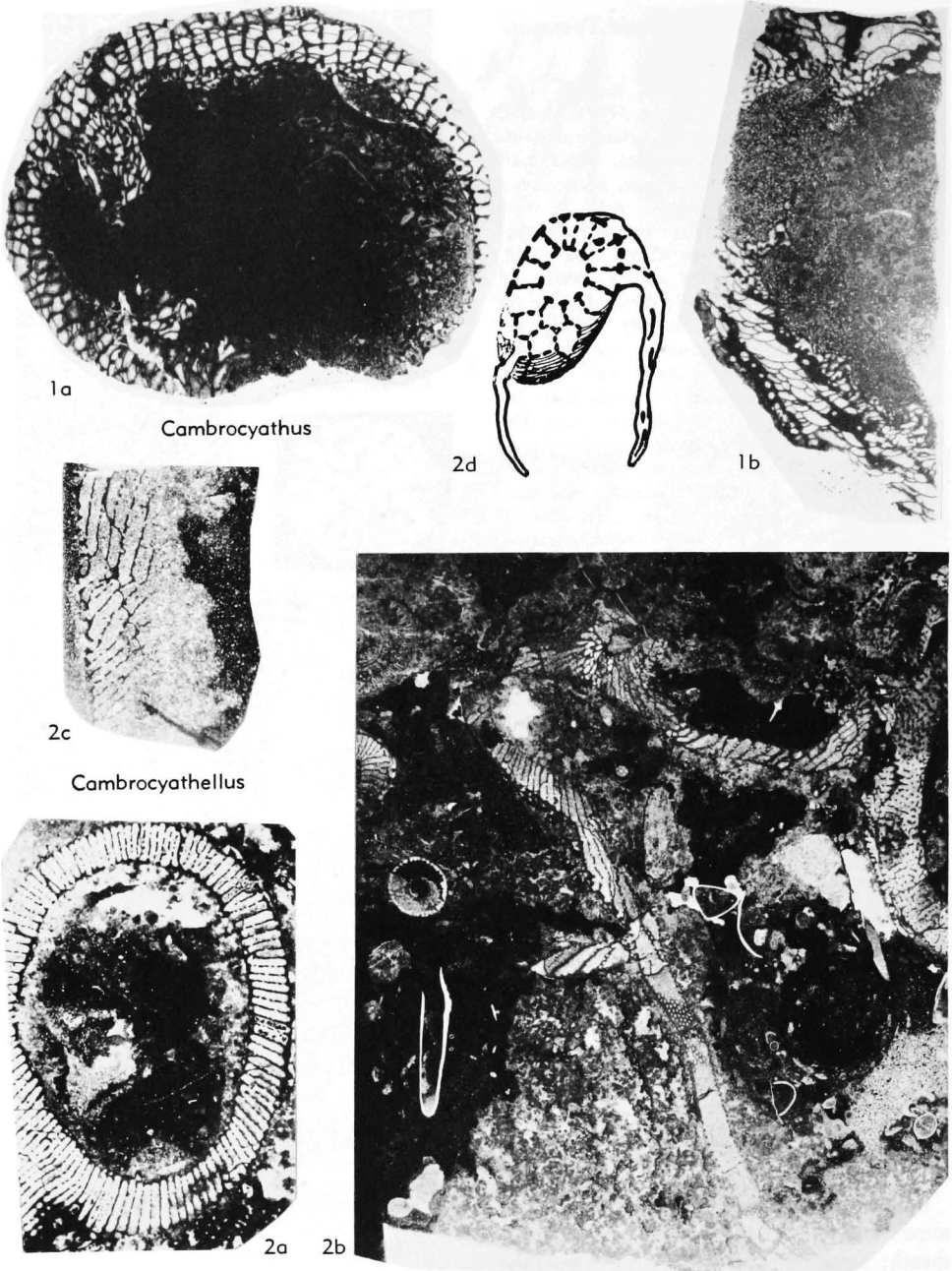


FIG. 80. Metacyathidae (p. E111).

regularis R. BEDFORD & BEDFORD, 1934, p. 6; M)]. Solitary, or rarely, colonial; outer wall an irregular framework with microporous sheath linked to the frame by rods; inner wall also of double structure, developing late in ontogeny;

apical part of cup filled with irregularly arranged bars, rods, plates and dissepiments; in intervallum developed in later stages, longitudinal skeletal elements are organized into radial septa which may be connected by dissepiments and in some

by synapticulae. [For discussion see DeBrenne, 1970, p. 36.] *L.Cam.* (up. *Atdaban.-Iow.Botom.*), S. Australia-Antarct.-Eu. (Sardinia)-N. Afr. (Morocco)-Can. (?NW.Terr.).—FIG. 78, *I*. **M. cylindricus*, *L.Cam.*, S. Australia (Wilson); *1a, b*, transv. secs. holotype, $\times 2.7$, $\times 5$; *1c*, oblique long. sec., $\times 2$; *1d*, long. sec., $\times 5$ (DeBrenne coll., Natl. History Museum, Paris); *1e, f*, parts of transv. and long. secs., $\times 4.7$ (Taylor, 1910).

Ardrossacyathus R. BEDFORD & J. BEDFORD, 1937, p. 31 [**A. endotheca*; OD]. Cup solitary with ?irregularly porous outer wall, straight septa, dissepiments and thin inner wall with short pore-tubes; central cavity filled with dissepiments and ?septal fragments. *L.Cam.*, S. Australia (Ardrossan).—FIG. 79, *I*. **A. endotheca*, Ardrossan; *1a*, part of transv. sec., *1b*, part of long. sec., both $\times 5.3$ (Bedford & Bedford, 1937).

Cambrocycathellus ZHURAVLEVA, 1960, p. 284 [**C. tschuranicus*; OD]. Outer and inner walls commonly thick, with 1 to 2 longitudinal rows pores of large rounded form and uniform size to each intersept; nap of hairlike spines may protect pores of inner wall; septa flat-sided, pores of diverse size and spacing; dissepiments sporadic, more common in young stages, extramural outgrowths from intervallum common; in early stages, intervallum with syringocnemoid structure. *L.Cam.* (mid. *Tommot.-Atdaban.*), USSR (Sib. Platf.-Far East); *L.Cam.*, Antarct.—FIG. 80, *2*. **C. tschuranicus*, up. *Tommot.*, R. Lena, Sib. Platf.; *2a*, transv. sec. holotype, $\times 6$; *2b*, long. sec., $\times 4$; *2c*, tang. sec., $\times 6$, of other specimens; *2d*, syringocnemoid early stage, $\times 20$ (Zhuravleva, 1960b).

Cambrocycathus OKULITCH, 1937, p. 251 [**Archaeocyathus profundus* BILLINGS, 1865, p. 4; OD]. Cup transversely annulated, but inner wall not affected; outer and inner walls porous, with external outgrowths from intervallum; septa branching, strong, regular, laminated, and perforated by pores in almost horizontal rows; synapticulae sparse, dissepiments copious. *L.Cam.*, Can. (Labrador).—FIG. 80, *1*. **C. profundus* (BILLINGS); *1a, b*, transv. and long. secs., $\times 3$, $\times 2$ (photo courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris).

?**Dendrocycathus** OKULITCH & ROOTS, 1947, p. 44 [**D. inexpectans*; M]. Outer wall somewhat irregularly porous; inner wall with ?simple pores; septa in intervallum that branch in dendritic manner toward the outer wall; septa connected by synapticulae; imperfectly known. *L.Cam.*, Can. (B.C.). [Type-species=*D. inexpectans* OKULITCH & ROOTS, 1947, p. 192, *nom. null.*]

Metafungia R. BEDFORD & W. R. BEDFORD, 1934, p. 5 [**M. reticulata*; M]. Cup large, conical, basally with large tersioid anchoring processes and with intervallar extrusions into central cavity in young stages; outer wall composed of elements of intervallar mesh reduced in size and compacted and covered with microporous sheath; inner wall

with one longitudinal row of pores to an intersept, each pore divided by thin longitudinal rod; septa straight, connected by synapticulae; pores of septa aligned upward and outward from inner wall; dissepiments common in basal parts. (See DeBrenne, 1970, p. 36.) *L.Cam.* (up. *Atdaban.* or *Iow.Botom.*), S. Australia.—FIG. 81, *2*. **M. reticulata*, holotype, Ajax; *2a*, transv. sec., $\times 2$; *2b*, inner wall, $\times 2.7$; *2c*, outer wall, $\times 4$ (Hill, 1965).

?**Metethmophyllum** OKULITCH, 1943, p. 78 [**Ethmophyllum meeki* WALCOTT, 1889, p. 34; OD]. Conical, outer wall with numerous irregular pores; intervallum with dissepiments and porous septa but without synapticulae and tabulae; inner wall structure not known. *L.Cam.* (?*Atdaban.*), USA (Silver Peak, Nev.)-?USSR.

Okulitchicyathus ZHURAVLEVA, 1960, p. 281 [**Ajacyathus discoformis* ZHURAVLEVA, in ZHURAVLEVA & ZELENOV, 1955, p. 68; OD]. Cup discoid; intervallum narrow with straight septa and rare synapticulae; outer and inner walls each with one longitudinal row of simple pores to intersept, early stages with dissepiments and random rods. *L.Cam.* (low. *Tommot.-Iow.Atdaban.*), USSR (Sib. Platf.-?Kuznetsk Alatau).—FIG. 4, *1, 2*; 81, *1*. **O. discoformis* (ZHURAVLEVA), *Tommot.*, R. Lena, Sib. Platf.; *4, 1, 2*, reconstr., $\times 0.3$; 81, *1a, b*, cups from above, $\times 0.7$; 81, *1c*, long. sec., $\times 1.3$ (Zhuravleva, 1960b).

Paranacyathus R. BEDFORD & J. BEDFORD, 1937, p. 34 [*nom. subst. pro Paracyathus* R. BEDFORD & W. R. BEDFORD, 1936, p. 17 (type, *P. parvus*; OD), *non Paracyathus* EDWARDS & HAIME, 1848, p. 318 (type, *P. procumbens*; SD EDWARDS & HAIME, 1850, p. xv), a coelenterate] [**Paracyathus parvus* R. BEDFORD & W. R. BEDFORD, p. 17; OD]. Solitary, or rarely colonial; outer wall with 2 longitudinal rows of irregular pores or 1 row of rectangular pores to an intersept; inner wall with one longitudinal row of large regular pores to an intersept, in quincunx; septa straight, irregularly 'porous'; dissepiments present; early stages single-walled with dissepiments and near outer wall, radially arranged plates. *L.Cam.* (mid. *Tommot.-Botom.*), S. Australia-USSR (Altay-Sayan-Sib. Platf.-Transbayk.)-Mongolia-N. Afr. (Morocco).—FIG. 79, *2a-c*. **P. parvus* (BEDFORD & BEDFORD), up. *Atdaban* or *Iow.Botom.*, S. Australia (Ajax Mine); *2a*, part of transv. sec., $\times 4$; *2b*, ext. view showing irregular pores of early stages, $\times 4$; *2c*, transv. sec. early stage, $\times 4$ (Bedford & Bedford, 1936).—FIG. 79, *2d*. *P. subartus* ZHURAVLEVA, up. *Tommot.*, Sib. Platf.; reconstr., $\times 0.67$ (Zhuravleva, 1960b). [See DEBRENNE, 1970, p. 38.]

?**Spirilicyathus** R. BEDFORD & J. BEDFORD, 1937, p. 30 [**S. tenuis*; OD] [= *Spiralicyathus* R. BEDFORD & J. BEDFORD, 1937, expl. to fig. 118, (*nom. null.*)]. Cups small, conical; outer wall microporous, covering spurs rising from outer

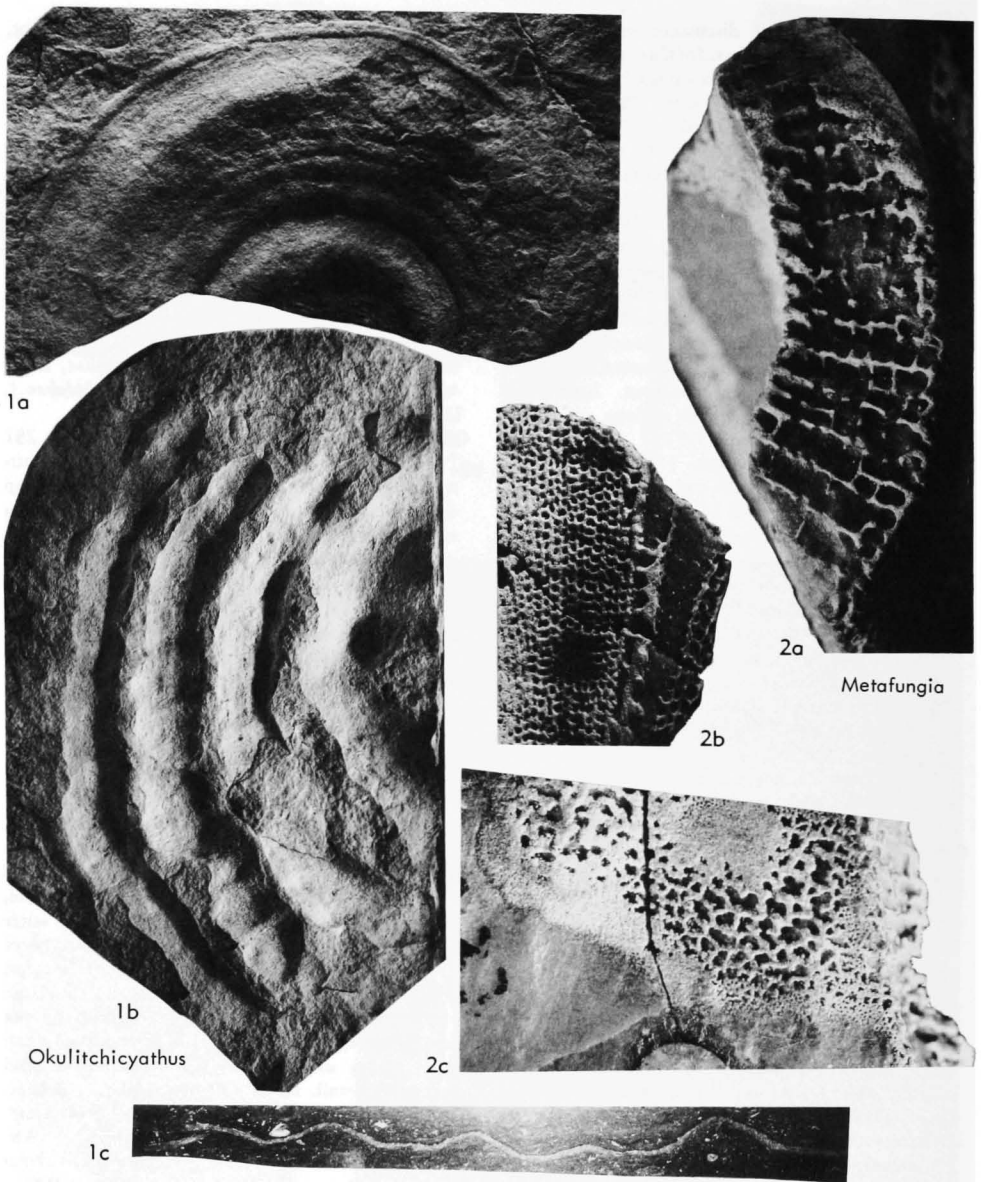


FIG. 81. Metacyathidae (p. E111).

parts of septa; inner wall simply porous, with one or two longitudinal rows of pores to an intersept; septa synapticulate and commonly radial but some branching, no dissepiments known. (See DeBrenne, 1970, p. 43.) *L. Cam. (? Botom.)*, S. Australia ("Paint Mine").—FIG. 77, 1. **S. tenuis*, Paint Mine, Beltana; *1a, b*, 2 views of holotype, $\times 8$ (photo courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris); *1c*, tip of cup, $\times 5.3$; *1d*, part

of transv. sec., $\times 5.3$; *1e*, part of oblique tang. sec. outer wall, $\times 5.3$; *1f*, view of part of inner wall from intervallum, $\times 8$; *1g*, tang. long. sec., $\times 5.3$ (Bedford & Bedford, 1937).

Family ARCHAEOFUNGIIDAE Vologdin, 1962

[*nom. correct.* HILL, 1965, p. 58 (*pro* Archaeofungiidae VOLOGDIN, 1962c, p. 90)] [= ?Beltanacyathidae DEBRENNE, 1970, p. 30]

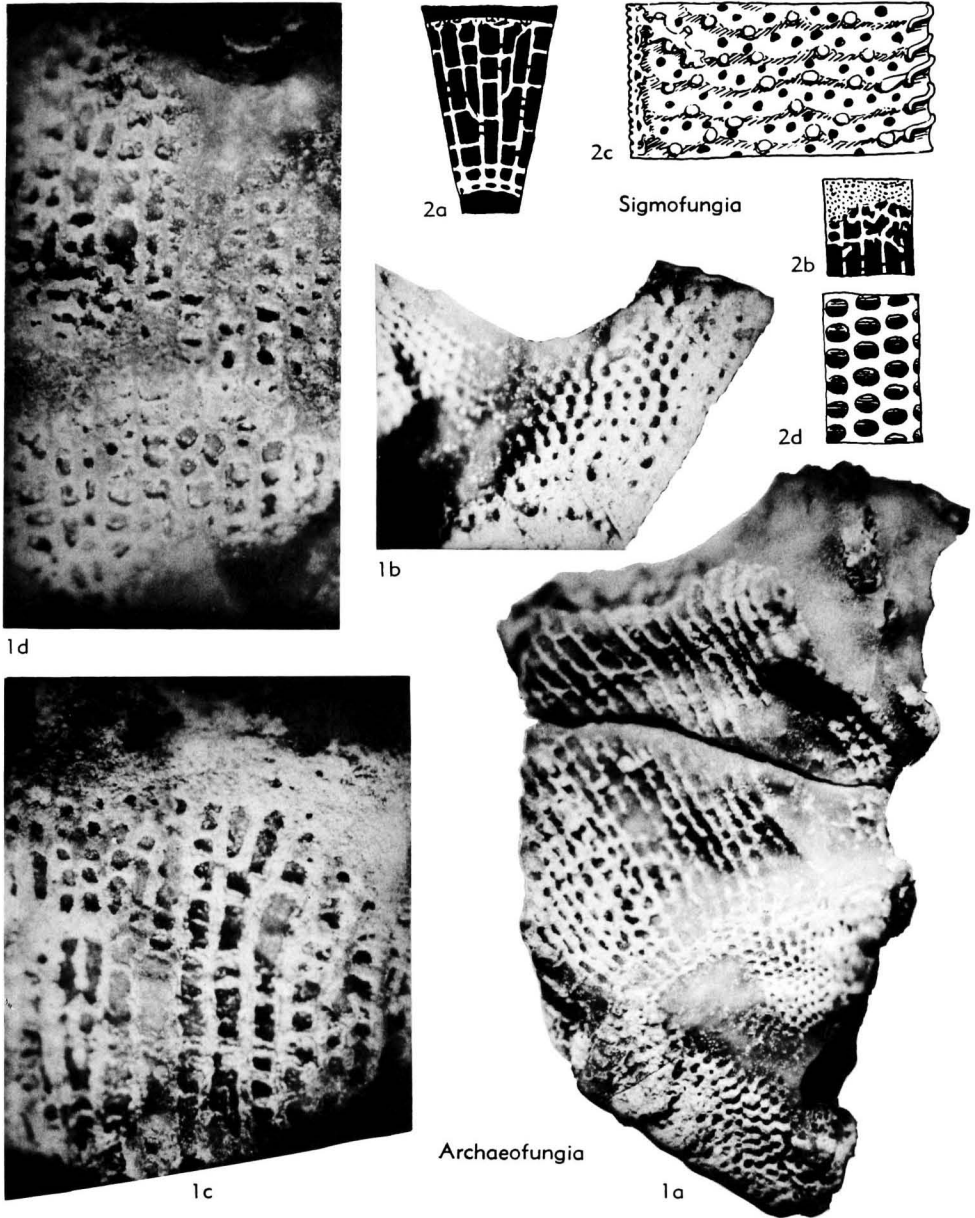


FIG. 82. Archaeofungiidae (1); Sigmofungiidae (2) (p. E113-E114, E116).

Solitary; outer wall a framework with irregular pores or pore-tubes and screened with microporous sheath; septa not wavy, with few pores; synapticalae present in some; inner wall with pore-canals or of pore-tubes. *L. Cam. (up. Atadaban. or low. Botom.)*.

Archaeofungia TAYLOR, 1910, p. 131 [**A. ajax*; M]. Small, conicocylindrical; outer wall irregularly porous and externally with microporous sheath; intervallum with sparsely perforate septa connected by numerous irregularly distributed synapticalae; inner wall with 1 longitudinal row horizontal pore canals to an intersept, alternating with those of neighboring intersepts; external out-

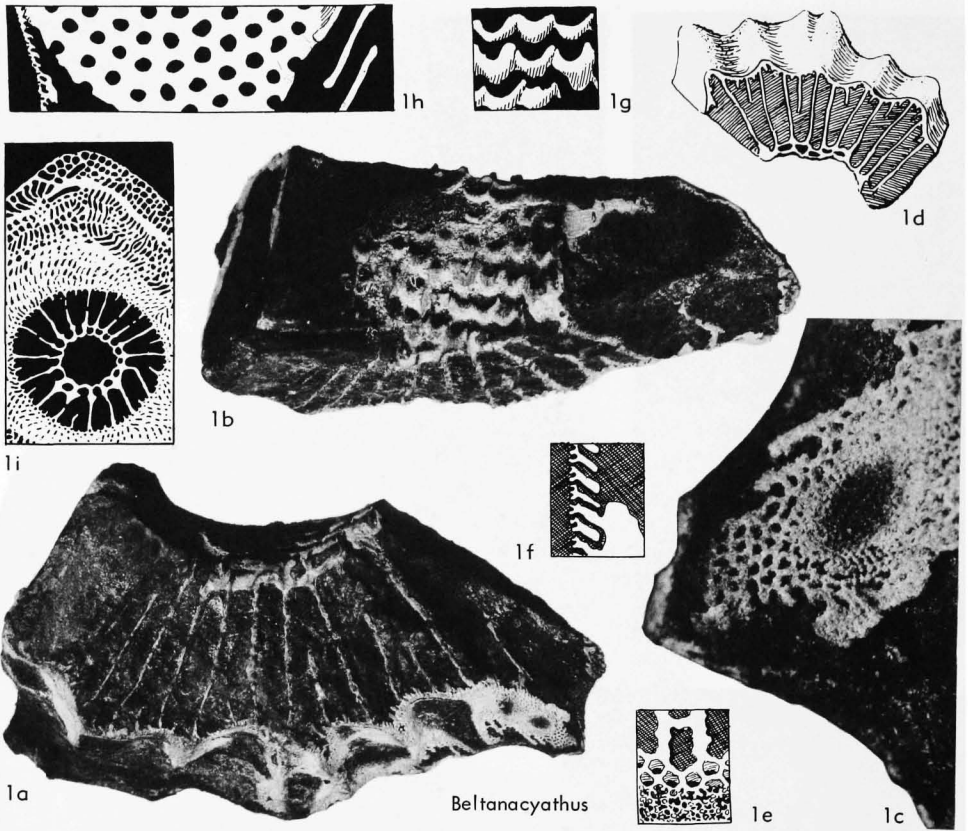


FIG. 83. Archaeofungiidae (p. E114).

growths of base of cone tersoid; basal parts of internal cavity with oblique, intercommunicating tubules, applied to inner wall. *L.Cam.(up.Atdaban. or low.Botom.)*, S.Australia.—FIG. 82,1. **A. ajax*, Ajax Mine; 1a, intervallum, inner wall and central cavity, $\times 4$; 1b, inner wall, $\times 6$; 1c, intervallum, $\times 8$; 1d, outer wall, $\times 8$ (photo courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris). [See DEBRENNE, 1970, p. 29.]

Beltanacyathus R. BEDFORD & J. BEDFORD, 1936, p. 23 [**B. ionicus*; OD]. Cups large, conical; outer wall framework of pore-tubes with irregular polygonal mouths, framework covered by independent microporous sheath; septa not waved, regularly porous; minor septa, with one longitudinal row of pores at their outer edges, alternating with septa and extending up to 0.25 radius of intersept; no tabulae or synapticalae; inner wall of pore-tubes formed by louvre-like plates between septa, 1 longitudinal row of louvres to an intersept, each such plate steeply inclined upward and inward to central cavity. (See Debrenne, 1970, p. 30.) *L.Cam.* S.Australia.—FIG. 4,7; 83,1. **B. ionicus*, holotype, Paint Mine, Beltana; 4,7, reconstr.;

$\times 0.3$; 83,1a, part of transv. sec., $\times 1.3$; 83,1b,c, view of part of inner and outer walls, $\times 1.3$, $\times 7$; 83,1d, part of transv. sec., $\times 0.7$; 83,1e,f, ext. view and radial long. sec. outer wall, $\times 5$; 83,1g, int. view inner wall, $\times 1.9$; 83,1h, long. sec. showing outer and inner walls and side view of septum, $\times 1.9$; 83,1i, transv. sec. near base showing outgrowth, $\times 1.9$ (Bedford & Bedford, 1936).

Family SIGMOFUNGIIDAE R. Bedford & W. R. Bedford, 1936

[*nom. correct.* DEBRENNE, 1970, p. 42 (*pro* Sigmofungiidae R. BEDFORD & W. R. BEDFORD, 1936, p. 16)]

Cups cylindrical; outer wall with pores outwardly restricted by upwardly direct processes; septa straight, porous and synapticalate; no tabulae; inner wall of S-shaped louvres lying at inner ends of interseptal loculi, forming pore-tubes directed toward the central cavity. *L.Cam.(up.Atdaban-low.Botom.)*.

Sigmofungia R. BEDFORD & W. R. BEDFORD, 1936, p. 16 [**S. flindersi*; M] [= *Sigmofungia* R. BED-

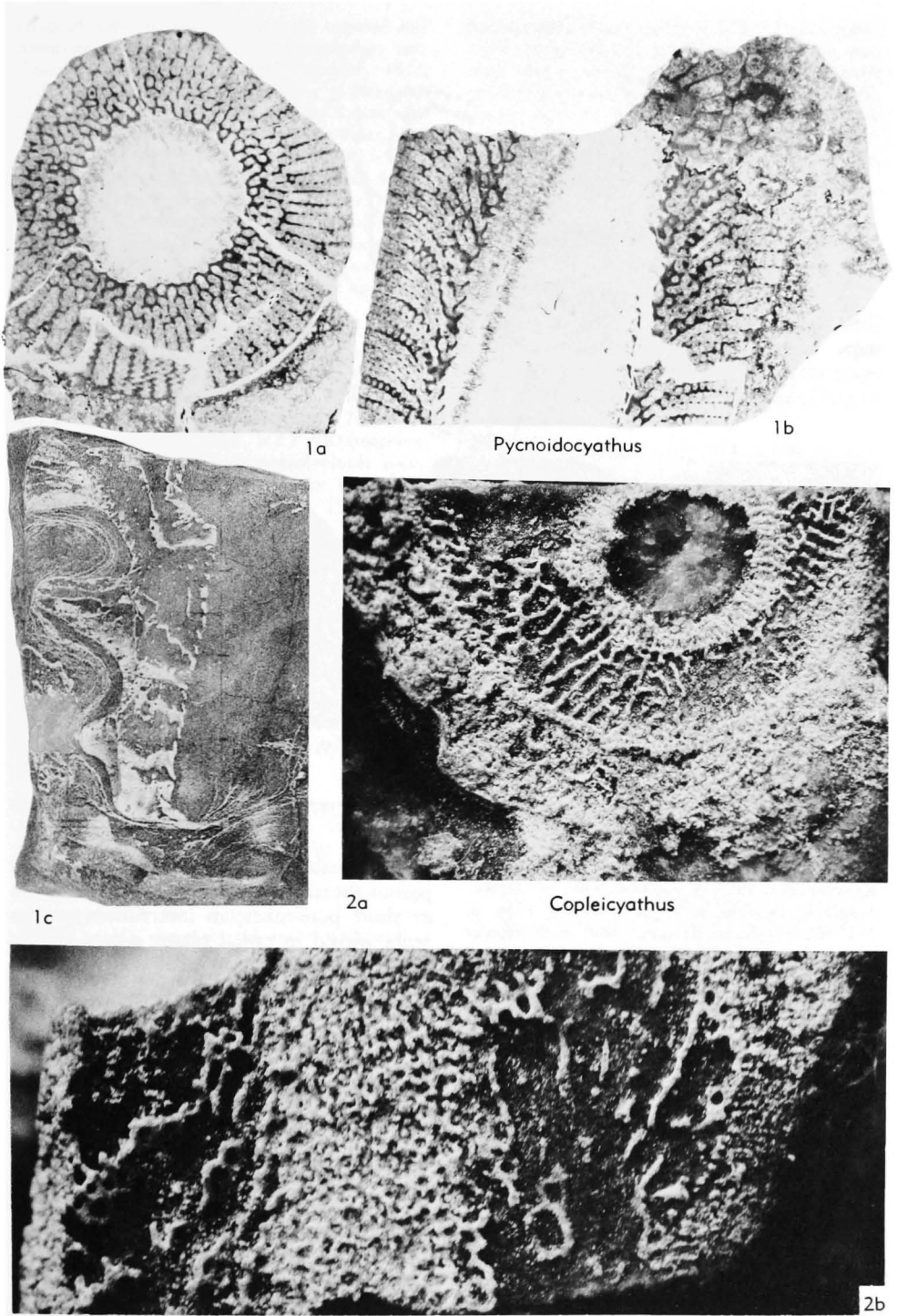


FIG. 84. Flindersicyathidae (1); Copleicyathidae (2) (p. E116-E117).

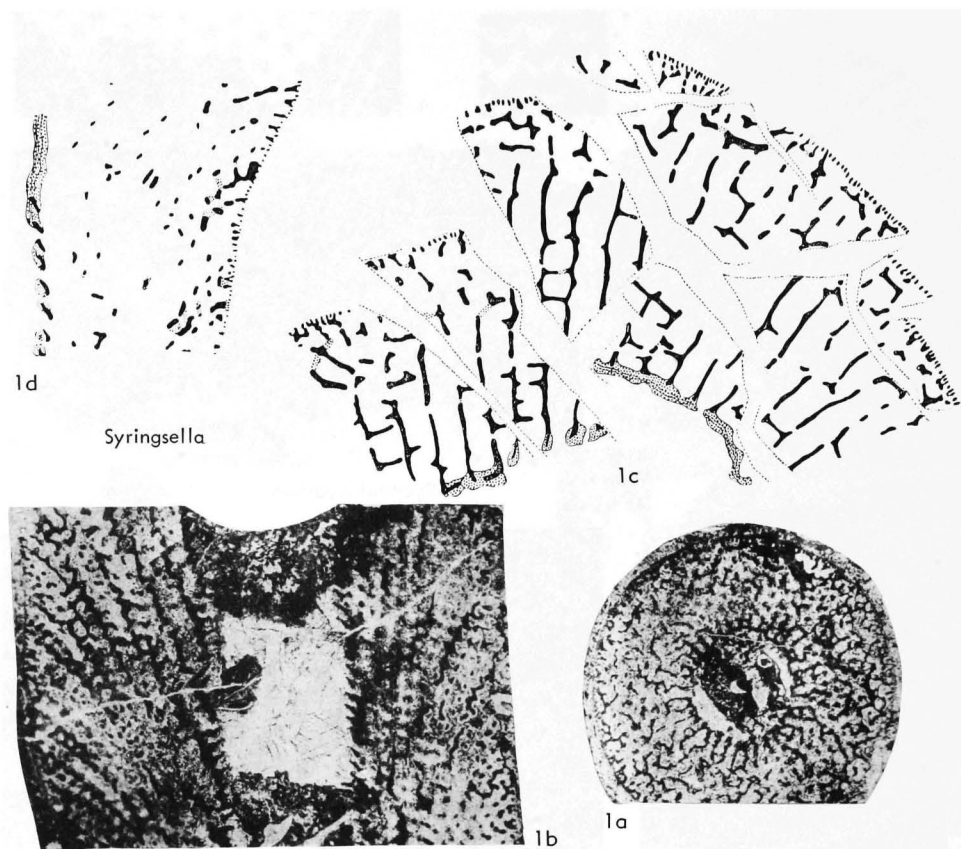


FIG. 85. Flindersicyathidae (p. E117).

FORD & W. R. BEDFORD, 1936, p. 16; *Sygmofungia* KRASNOPEEVA, 1955, p. 75, *nom. null. pro Sigmofungia* R. BEDFORD & W. R. BEDFORD, 1936, p. 16]. Cups cylindrical; outer wall with regular alveoles outwardly restricted by upwardly directed processes; septa porous and synapiculate; no tabulae; inner wall of S-shaped louvre-plates lying at inner ends of interseptal loculi, forming pore-tubes directed upward toward central cavity. (See Debrenne, 1970, p. 42.) *L.Cam.* (*up.Atdaban.* or *low.Botom.*), S.Australia.—FIG. 82,2. **S. flindersi*; 2a, part of transv. sec., $\times 2.7$; 2b, part of tang. sec. outer wall, $\times 2.7$; 2c, radial long. sec. showing side of septum and S-shaped louvre plates of inner wall, $\times 5.3$; 2d, tang. long. sec. of inner wall, $\times 5.3$ (Bedford & Bedford, 1936).

Family FLINDERSICYATHIDAE R. Bedford & J. Bedford, 1939

[Flindersicyathidae R. BEDFORD & J. BEDFORD, 1939, p. 78]
[=Pycnoidocyathidae OKULITCH, 1950, p. 394; Syringesellidae
KRASNOPEEVA, 1961, p. 248]

Solitary; outer wall simply but irregularly

porous with or without external microporous sheath; inner wall with simple pores or short pore-tubes; in intervallum porous septa waved in radial plane, waves having angulated crests and troughs, crests and troughlines curving upward and outward from inner wall; crests of neighboring septa opposed and connected by synapticulae; rare dissepiments may occur. *L.Cam.* (? *Atdaban.-Len.*).

Pycnoidocyathus TAYLOR, 1910, p. 131 [**P. synapiculostus*; SD R. BEDFORD & J. BEDFORD, 1939, p. 78] [= *Flindersicyathus* R. BEDFORD & J. BEDFORD, 1937, p. 28 (type, *F. decipiens*; SD R. BEDFORD & J. BEDFORD, 1939, p. 78); *Spiroclyathella* VOLOGDIN, 1939, p. 227 (type, *S. kyzylartauensis*; OD)]. Cup solitary; outer wall with simple pores of irregular arrangement; inner wall with one longitudinal row of short pore-tubes to each intersept, tubes opening upward into central cavity; septa coarsely porous, waved obliquely upward and outward from inner wall; angulated

crest of wave of neighboring septa opposed and connected by regularly spaced synapticalae; rare dissepiments may occur. [See Debrenne, 1970, p. 35, 41, for discussion of synonymy of *Flindersicyathus*.] *L.Cam.* (?*Atdaban*-*Len.*), S.Australia-Antarctica-USSR (S. Urals-Altay-Sayan)-Eu. (Spain)-Can.(B.C.-NW.Terr.).—FIG. 84,1c. **P. synapticulosus*, up.*Atdaban*. or low.*Botom.*, S.Australia(Ajax Mine); long. sec., $\times 1$ (Taylor, 1910).—FIG. 8,4. *P. decipiens* (BEDFORD & BEDFORD), up.*Atdaban*. or low.*Botom.*, S.Australia; long. sec., $\times 6$ (Hill, 1965).—FIG. 84,1a,b. *P. uniserialis* (HILL), *Botom.*, Antarctic; 1a,b, transv. and long. sec., $\times 5$ (Hill, 1965).

Syringsella KRASNOPEEVA, 1961, p. 248 [**S. nyrgensis*; OD]. Like *Pycnoidocyathus* but outer wall with external microporous sheath. *L.Cam.* (up. ?*Len.*), USSR(Altay-Sayan).—FIG. 85,1a,b. **S. nyrgensis*, holotype, Kuznetsk Alatau; 1a, transv. sec., 1b, long. sec., both $\times 2.7$ (Krasnopeeva, 1961).—FIG. 85,1c,d. *S. jaroshevitschi* KRASNOPEEVA, Kuznetsk Alatau; 1c, transv. sec., $\times 2.7$; 1d, long. sec., $\times 2.7$ (Krasnopeeva, 1961).

Family COPLEICYATHIDAE R. Bedford & J. Bedford, 1937

[Copleicyathidae R. BEDFORD & J. BEDFORD, 1937, p. 29]

Cup solitary, outer wall simple, but supported by short spurs from septa; septa retiform, straight, synapticalate; no tabulae; inner wall complex, a thick, felted mass opening directly into central cavity. *L.Cam.* (up.*Atdaban*. or low.*Botom.*).

Copleicyathus R. BEDFORD & J. BEDFORD, 1937, p. 29 [**C. confertus*; OD]. Solitary, conical; outer wall simply porous, but supported by short spurs from septa; septa retiform and synapticalate; no tabulae; inner wall complex, a thick, felted mass opening directly into central cavity. [DEBRENNE (1970, p. 31) compares the inner wall with a second intervallum having three times more crowded septa connected by synapticalae.] *L.Cam.* (up.*Atdaban*. or low.*Botom.*), S.Australia(Paint Mine, Beltana).—FIG. 84,2. **C. confertus*; 2a, etched transv. sec., 2b, tang. long. sec., both $\times 8$ (Hill, 1965).

Family PRISMOCYATHIDAE Fonin, 1960

[Prismocyathidae FONIN, 1960, p. 725]

Cups solitary, slenderly conical; outer wall with simple round pores; inner wall coarsely porous, ?incomplete; intervallum with coarsely porous, wavy septa, and inconstant dissepiments; central cavity with longitudinal, prismatic, porous tubes. *L.Cam.* (*Botom.*).

Prismocyathus FONIN, 1960, p. 725 [**P. praesignis*; OD]. Cups solitary, slenderly conical; outer wall with simple round pores; inner wall coarsely porous, wavy septa, and inconstant dissepiments; central cavity with longitudinal, prismatic, porous tubes. *L.Cam.* (*Botom.*), USSR(Altay-Sayan).—FIG. 86,1. **P. praesignis*, holotype, Tuva; 1a,b, transv. and long. sec., $\times 4$ (Fonin, 1960).

Family PROTOCYCLOCYATHIDAE Vologdin, 1956

[Protocyclocyathidae VOLOGDIN, 1956, p. 878]

Outer wall with simple pores; inner wall annulate; intervallum with porous septa and dissepiments; single-walled early stage with dissepiments and randomly arranged rods. *L.Cam.*

Protocyclocyathus VOLOGDIN, 1955, p. 142 [**Cyclocyathus irregularis* VOLOGDIN, 1940, p. 62; M]. Outer wall with simple pores; inner wall annulate; intervallum with porous septa and dissepiments; single-walled early stage with dissepiments and randomly arranged rods. *L.Cam.*, USSR(Salair).—FIG. 86,2. **P. irregularis* (VOLOGDIN); long. sec., $\times 5$ (Vologdin, 1957a).

Fenestrocycathus HANDFIELD, 1971, p. 72 [**F. complexus*; OD]. Cup cylindro-conical; outer wall fine irregular network of skeletal elements forming an irregular screen; septa closely spaced coarsely porous, pores square to rectangular; synapticalae common, dissepiments sparse; inner wall of annuli S-shaped in section, each annulus with hairlike projections screening pores on central cavity side. *L.Cam.* (up.*Atdaban*. or low.*Botom.*), Can.(NW.Terr.).—FIG. 86,3. **F. complexus*; 3a, med. long. and 3b, oblique long. sec., $\times 4$ (Handfield, 1971).

Family ARCHAEOCYATHIDAE Hinde, 1889

[*nom. correct.* TAYLOR, 1910, p. 105 (pro Archaeocyathinae HINDE, 1889, p. 141, family)] [=Spirocycathidae TAYLOR, 1910, p. 105]

Outer and inner wall with simple pores, may be secondarily thickened; septa irregular, with secondary thickening on sides; some septa proceed from outer to inner wall, others curve from outer wall to join others; septa wavy with coarse, irregular porosity; dissepiments present but not tabulae. *L.Cam.* (*Botom.*)-*M.Cam.* (*Paradoxides oelandicus* Zone).

Archaeocyathus BILLINGS, 1861, p. 4 [**A. atlanticus*; SD WALCOTT, 1886, p. 75] [Original spelling was *Archeocyathus* BILLINGS, with the *a* of the diphthong dropped; subsequent authors (ex-

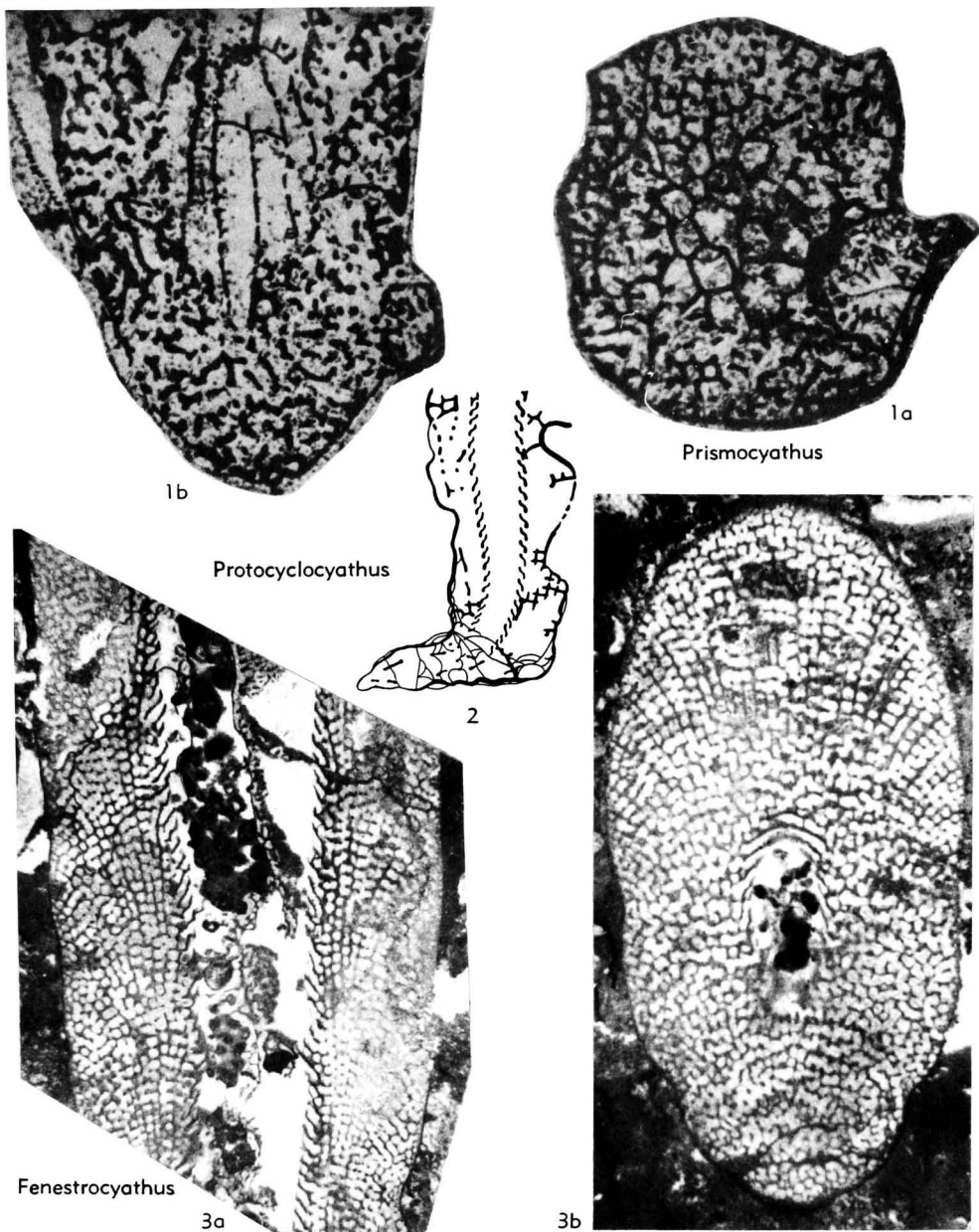


FIG. 86. Prismocyathidae (1); Protocyclocyathidae (2-3) (p. E117).

cept for MEEK, 1868) have used the diphthong] [= *Spirocyathus* HINDE, 1889, p. 136 (type, *Archaeocyathus atlanticus* BILLINGS, 1861, p. 4); *Retecyathus* SIMON, 1939, p. 36 (= *Retecyathus* VOLOGDIN, 1932, p. 20, *nom. nud.*) (type, *R. laqueus* SIMON, 1939, p. 36; OD)]. Outer and inner walls secondarily thickened and with pore-

canals, partly or completely closed by thickening; those of inner wall larger than those of outer wall; septa thick, with secondary thickening on either side; some septa extend from outer to inner wall, others shorter, with some curving from outer wall to join neighbors; septa wavy, with coarse, irregular pores; dissepiments present but not

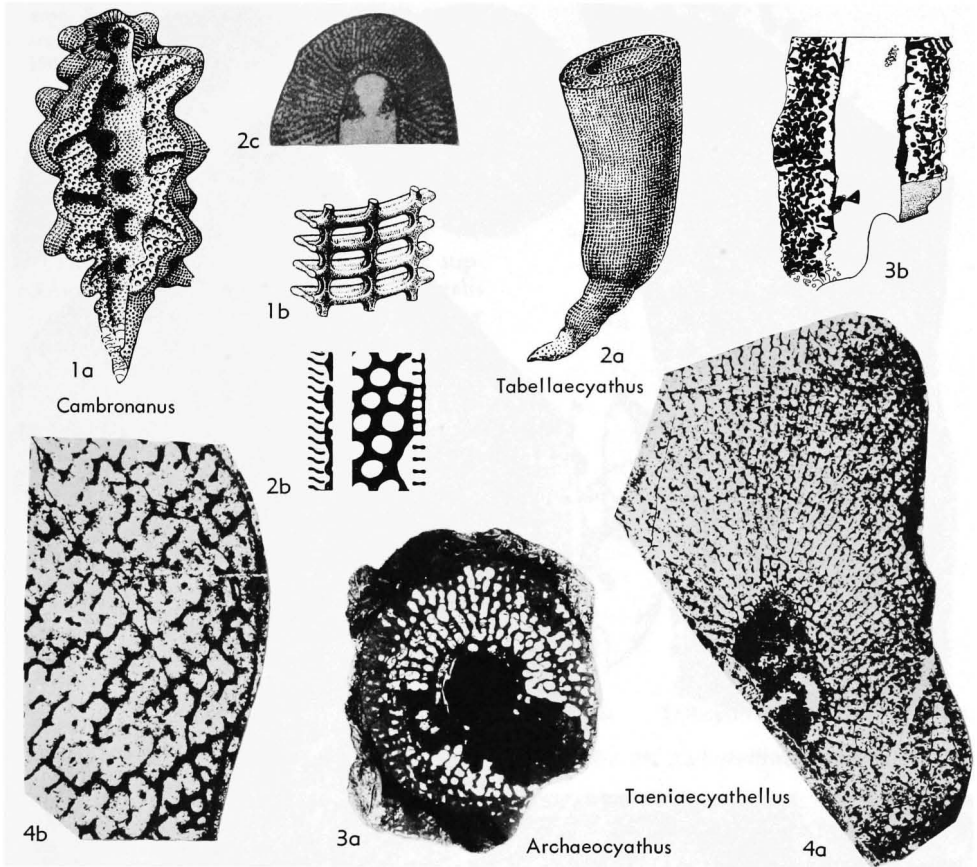


FIG. 87. Archaeocyathidae (3); Tabellaecyathidae (1-2,4) (p. E117-E121).

tabulae; synapticulae rare. *L.Cam.(Botom.-Len.)-M.Cam.*, Can.(Labrador)-Antarct.-Australia(S. and C.)-Eu.(Spain)-USSR (S.Urals-Altay-Sayan Transbayk.-Far East)-Mongolia-China.—FIG. 87,3. **A. atlanticus*, *L.Cam.*, Labrador; 3a, transv. sec., $\times 1.3$ (photo courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris); 3b, holotype, long. sec., $\times 0.7$ (Debrenne, 1964).

Family TABELLAECYATHIDAE

Fonin, 1963

[Tabellaecyathidae FONIN, 1963, p. 15]

Cup slenderly conical or of irregular external form, with abrupt distensions, deep depressions and marked constrictions; outer wall of close, fine horizontal annuli, their outer edges connected externally by close, fine, longitudinal laths (metulae); inner wall of simple pores or of straight or curved

short pore-tubes; in intervallum porous septa somewhat wavy, synapticulae and more rarely, dissepiments; central cavity may have extrusions of intervallar tissue. *L.Cam.(Botom.-low.Len.)*.

Tabellaecyathus FONIN, 1963, p. 15 [**T. totus*; OD]. Cup slenderly conical, with very slight depressions and constrictions; outer wall of close fine horizontal annuli, their outer edges connected by close, fine, longitudinal laths; inner wall of straight or slightly curved aporose pore-tubes; fairly porous septa in intervallum, wavy in young stages, straight later, pores in longitudinal rows inclined upward toward outer wall; synapticulae numerous; dissepiments common in young stages, rare later. *L.Cam.(Botom.)*, USSR(Sayan).—FIG. 87,2. **T. totus*; 2a, reconstr., $\times 1.1$; 2b, part of long. sec., $\times 16$; 2c, part of transv. sec., $\times 1.3$ (Fonin, 1963).

Cambronanus FONIN, 1963, p. 19 [**C. multicavitatus*; OD]. Cup small, irregularly conical

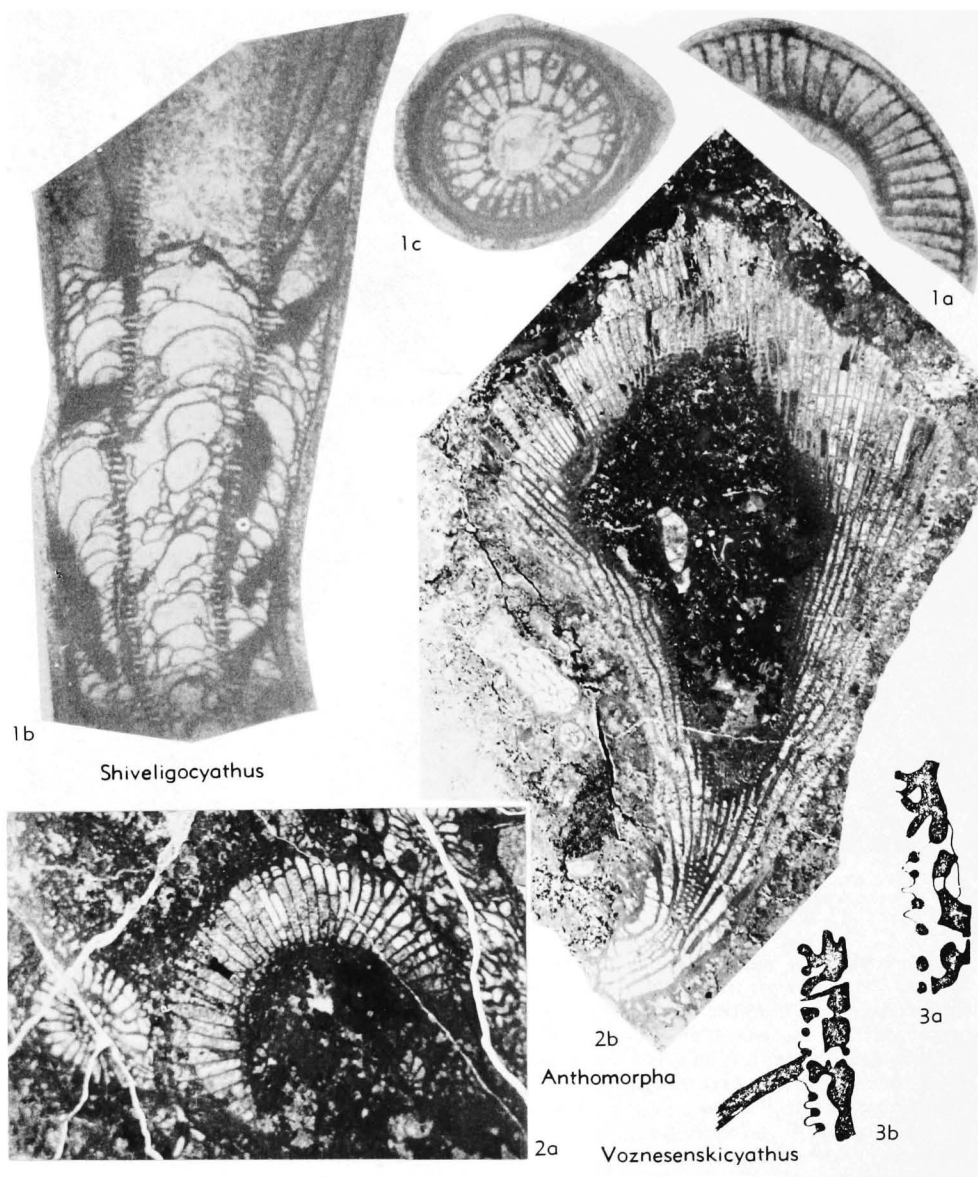


FIG. 88. Anthomorphidae (p. E121).

with marked distensions and constrictions; outer wall of fine close horizontal annuli, their outer edges connected by close, fine, longitudinal laths; wall may be replaced by films of fine dissepimental tissue; inner wall simple, 2 to 6 longitudinal rows of pores to each intersept; septa coarsely porous, thin and retiform, of curved segments, and connected by synapticulae; large fingerlike extensions of central cavity protrude into intervallum, causing it to protrude externally in sympathy. *L.Cam.*

(*Botom.*), USSR(Sayan).—FIG. 87, I. **C. multicavitatus*; 1a, reconstr. showing central cavity and extensions into intervallum, $\times 4.7$; 1b, outer wall, reconstr., $\times 40$ (Fonin, 1963).

Taeniaecyathellus ZHURAVLEVA, 1960a, p. 45 [**T. semenovi*; OD]. Outer wall of horizontal thin plates and outer sheath; inner wall of intercommunicating pore-tubes; in intervallum, dissepiments and numerous coarsely porous septa, and synapticulae. *L.Cam.(Botom.-low.Len.)*, USSR

(Altay-Sayan).—FIG. 87,4. **T. semenovi*, holotype, Botom., Sayan.; 4a, part of oblique transv. sec., $\times 4$; 4b, part of long. sec., $\times 8$ (Zhuravleva, 1960a).

Family ANTHOMORPHIDAE Okulitch, 1935

[Anthomorphidae OKULITCH, 1935, p. 97] [=Araneocyathidae VOLOGDIN, 1956, p. 878; Anthomorphida OKULITCH, 1935, p. 97 (order), *nom. correct.* OKULITCH, 1955, p. E18, ex Anthomorphina OKULITCH, 1935, p. 97 (order)]

Outer wall simply porous, may have supplementary finely porous sheath; inner walls simply porous or of intercommunicating pore-tubes; septa thick, straight, aporose or sparsely porous; dissepiments and finely porous tabulae present. *L.Cam.* (*Aidaban-low.Len.*).

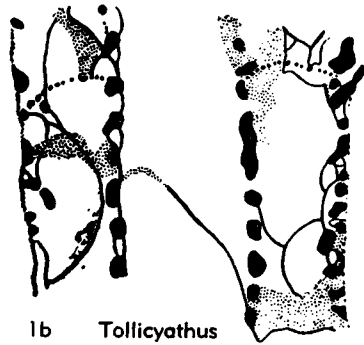
Anthomorpha BORNEMANN, 1884, p. 705 [**A. margarita*; M] [=Araneocyathus SIMON, 1941, p. 5 (=Araneocyathus VOLOGDIN, 1940, p. 59) (type, *A. curvus* SIMON, 1941, p. 5; OD); Araneocyathus VOLOGDIN, 1937, p. 493, 1940, p. 59, *nom. nud.*; Nellicyathus FONIN in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 247 (type, *N. nelliae*; OD); Nellisyathus, Nellicyathis, lapsus calami, FONIN in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 247; ?*Utukcyathus* VOLOGDIN in DEBRENNE, 1964, p. 231 (*nom. nud.*)]. Outer and inner walls strong, with simple pores or stirrup-pores, and connected by aporose or sparsely porous straight septa; dissepiments and microporous tabulae present but not constant. *L.Cam.* (*up. Aidaban-low.Len.*), Eu. (Sardinia-France [Montagne Noire])—N.Afr. (Morocco)—USSR (Altay-Sayan-Transbayk.-Far East)—Mongolia.—FIG. 88,2. **A. margarita*, Botom., Sardinia; 2a, part of transv. sec. holotype, $\times 4$; 2b, oblique long. sec. paratype, $\times 3$ (Debrenne, 1964).

Shiveligocyathus MISSARZHEVSKIY, 1961, p. 19 [**S. vesiculoides*; OD]. Cup with thin, smooth, simply porous outer wall, with radial, weakly porous to aporose septa and with thick inner wall containing two longitudinal rows of horizontal and intercommunicating pore-canals to each intersept; dissepimental tissue may be copious. *L.Cam.* (*up. Botom.*), USSR (Tuva).—FIG. 88,1. **S. vesiculoides*; 1a, b, parts of transv. and long. secs., each $\times 2$; 1c, oblique sec., $\times 2$ (Missarzhevskiy, 1961).

Tollicyathus CHERNYSHEVA, 1960, p. 77 [**T. ischensis*; OD]. Cup cylindrical; outer wall thick, with large rounded pores and microporous external sheath; septa thick, aporose except for one row of stirrup pores at outer wall; porous tabulae sparse, low domes; dissepiments present. Inner wall thick, with one longitudinal row of simple pores to an intersept. *L.Cam.* (*Botom.*), USSR (Altay-Tuva).—FIG. 89,1. **T. ischensis*, Altay;



1a



1b Tollicyathus

FIG. 89. Anthomorphidae (p. E121).

1a, b, transv. and long. secs., $\times 3.3$ (Zhuravleva, Krasnopeeva, & Chernysheva, 1960).
Voznesenskicyathus RODIONOVA in ZHURAVLEVA, ZADOROZHNYAYA, OSADCHAYA, POKROVSKAYA, RODIONOVA, & FONIN, 1967, p. 99 [**V. florens*; OD]. Large, solitary, widely conical cup, with depressions and outgrowths on the outer surface; outer wall with two to three longitudinal rows of pores to an intersept; septa almost straight, almost always aporose; tabulae sparse, irregularly spaced, rare, slightly domed, porous; dissepiments present, profuse in early stages; inner wall thick, with slightly crooked intercommunicating pore-canals, one longitudinal row to an intersept. *L.Cam.* (*up. Botom.*), USSR (Tuva).—FIG. 88,3. **V. florens*; 3a, b, inner wall in long. sec., enl. (Zhuravleva, Zadorozhnaya, et al., 1967).

Suborder ARCHAEOSYCONINA Zhuravleva, 1950

[*nom. correct.* DEBRENNE, 1964, p. 117, *pro* Archaeosyconiina ZHURAVLEVA, 1960, p. 303 (*nom. transl.* ZHURAVLEVA, 1960, p. 303, *ex* Archaeosyconida ZHURAVLEVA, 1950, p. 10, order)] [=Tabulocyathida VOLOGDIN, 1956, p. 878, *nom. correct.* HILL, herein (*pro* Tabulocyathida VOLOGDIN, 1956, p. 878); Paracoscinida DEBRENNE, 1970, p. 25]

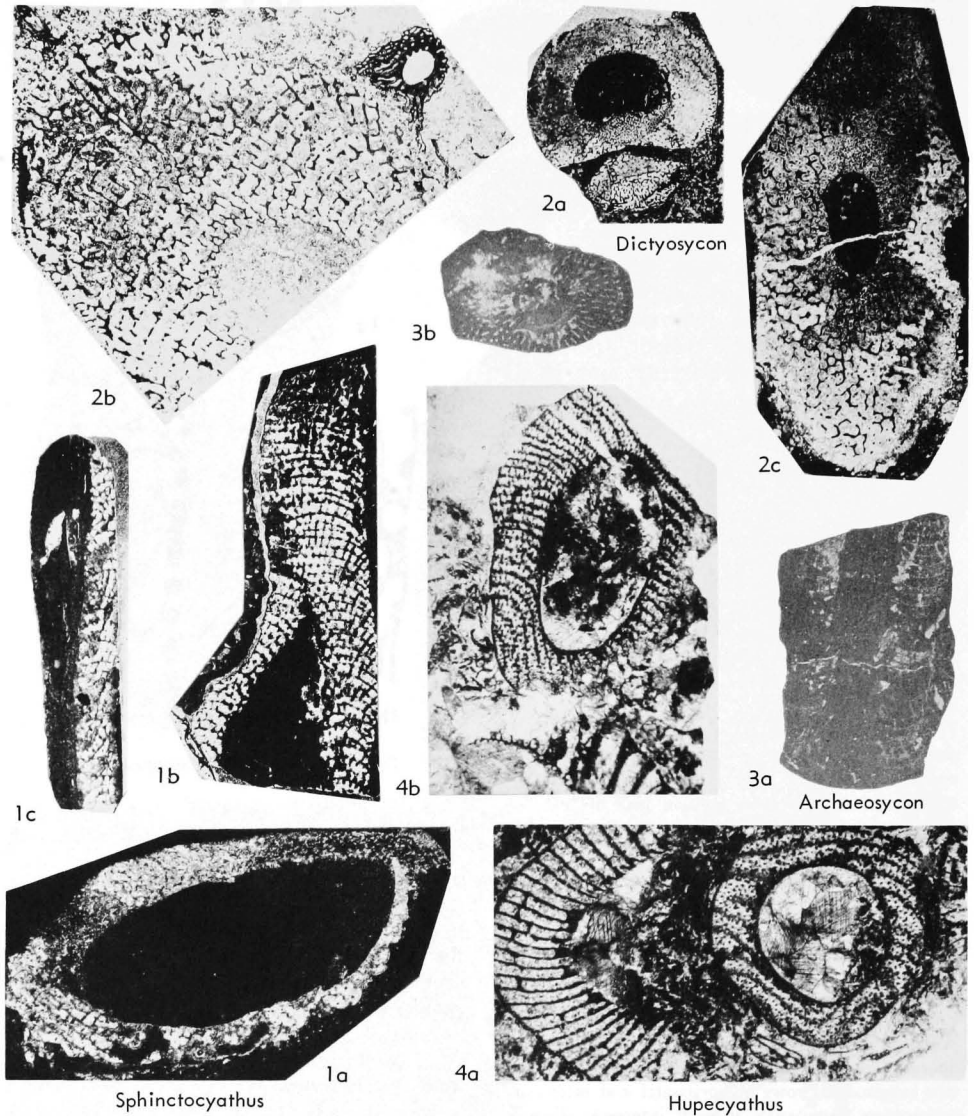


FIG. 90. Archaeosyconidae (p. E123).

Cups of diverse form but not mushroom shaped or discoid. Outer wall with simple pores, or rarely may be replaced by pellicle of dissepiments; inner wall formed by ends of intervallar elements or with simple large pores which may have protective scoops. Intervallum with strongly arched, porous tabulae, and either with rods perpendicular to tabulae or with porous septa, straight or wavy. *L.Cam.*

Family ARCHAEOSYCONIDAE Zhuravleva, 1950

[Archaeosyconidae ZHURAVLEVA, 1950, p. 10] [=Archaeosyconiidae ZHURAVLEVA, 1960, p. 304]

Cups with walls not always clearly differentiated from tabulae; intervallum with close, strongly convex porous tabulae and with longitudinal rods perpendicular to tabulae; dissepiments may occur; development of central cavity retarded. *L.Cam.*

Archaeosycon TAYLOR, 1910, p. 111 [**Archaeocyathus billingsi* WALCOTT, 1886, p. 29; M]. Solitary or colonial, cup cylindrical with wide intervallum; outer and inner walls with simple pores; intervallum with porous, domed tabulae; radial rows of longitudinal rods perpendicular to tabulae, and rudimentary septa may occur, synapticulae and dissepiments may be present. *L.Cam.(up.Tommot.-up.Len.)*, USSR (Sib.Platf.-Altay-Sayan)-N. Am.(Labrador).—FIG. 90,3. **A. billingsi* (WALCOTT), *L.Cam.*, Labrador; 3a,b, long. sec. and transv. sec., $\times 1.3$ (Okulitch, 1943).

Hupecyathus DEBRENNE, 1964, p. 198 [**H. sphinctoides*; OD]. Solitary, cup conical; outer wall of horizontal or slightly geniculate pore-tubes; inner wall of S-sectioned pore tubes, opening upward; tabulae close, arched, with rods rising from tissue between elliptical, lozenge-shaped or pentagonal pores, rods of same diameter as tissue between pores, and may reach the succeeding tabula. *L.Cam.(Atdaban.)*, N.Afr.(Morocco).—FIG. 90,4. **H. sphinctoides*, Amouslek., Oujjane, Morocco; 4a, transv. sec. holotype, $\times 2.7$; 4b, part of long. sec. of topotypes, $\times 2.7$ (Debrenne, 1964).

Sphinctocyathus ZHURAVLEVA, 1960, p. 304 [**S. (S.) oimuranicus*; OD]. Solitary or colonial; cups slenderly conical or cylindrical; outer wall with simple rounded or angular pores, inner wall formed by ends of intervallar elements; intervallum with radial longitudinal and transverse rods and strongly arched porous tabulae whose axis of curvature is in midline of intervallum; dissepiments present. *L.Cam.(mid.Tommot.-Atdaban.)*, USSR (Yakutia-Altay-Sayan).

S. (Sphinctocyathus). Pores of outer wall of one size; intervallum narrow; tabulae numerous, skeletal tissue transparent. *L.Cam.(up.Tommot.-Atdaban.)*, USSR (Sib.Platf.-Kuznetsk Alatau).—FIG. 90,1. **S. (S.) oimuranicus* ZHURAVLEVA, up.Tommot., R.Lena, Oymuran; 1a, part of transv. sec., $\times 4$; 1b, holotype, long. sec., $\times 4$; 1c, long. sec., another specimen, $\times 4$ (Zhuravleva, 1960b).

S. (Dictyosycon) ZHURAVLEVA, 1960, p. 307 [**S. (D.) gravis*; OD]. Pores of outer wall of different sizes; walls rarely preserved, may be replaced by sheath of dissepiments; skeletal tissue dark. *L.Cam.(mid.Tommot.-Atdaban.)*, USSR (Sib.Platf.).—FIG. 90,2. **S. (D.) gravis* ZHURAVLEVA, up.Tommot., R.Lena, Oymuran; 2a, transv. sec., $\times 2.7$; 2b, holotype, oblique sec., $\times 2.7$; 2c, oblique sec., another specimen, $\times 4$ (Zhuravleva, 1960b).

Family TABULACYATHIDAE
Vologdin, 1956

[*nom. correct.* HILL, *herein* (pro Tabulathyathidae VOLOGDIN in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 249, *nom. correct. et lapsus calami* pro Tabulocyathidae VOLOGDIN, 1956, p. 878)]

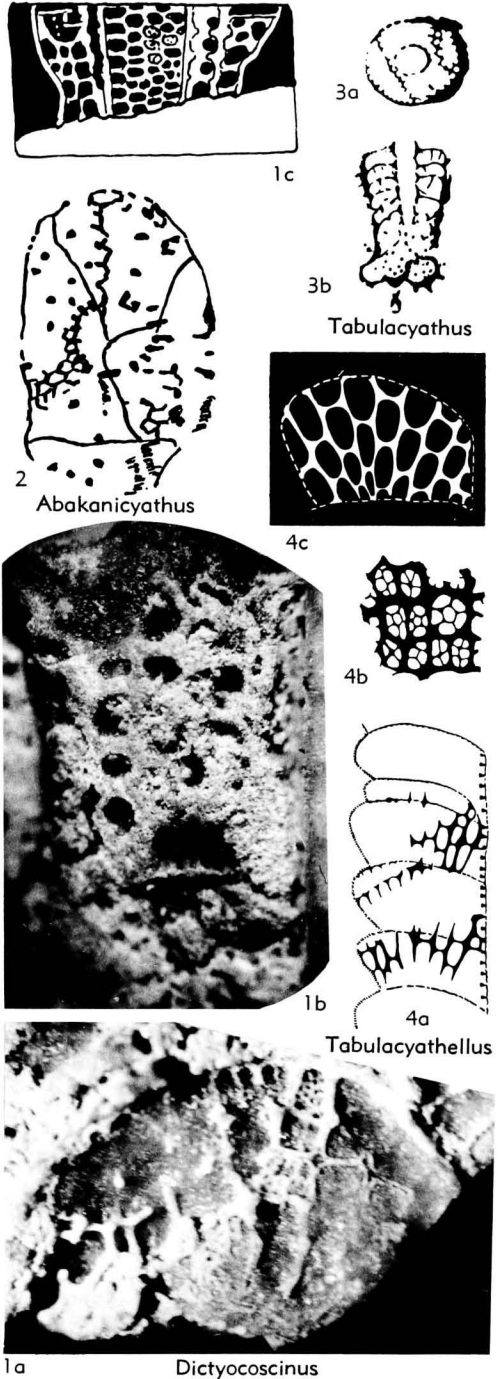


FIG. 91. Tabulacyathidae (2-4); Dictyosyconinae (1) (p. E124).

Solitary, slenderly conical with coarsely but regularly porous tabulae, flat or slightly domed; outer and sometimes inner wall formed by downturned edges of tabulae, or outer wall may be independent, porous wall with finely porous external sheath; inner wall may be independent of tabulae and simply porous; in intervallum rare radial longitudinal rods perpendicular to tabulae, or porous septa; dissepiments may be present. *L.Cam.(Atdaban.-Botom.)*.

Tabulocyathus VOLOGDIN, 1932, p. 31 [**T. taylori*; M] [= *Tabulocyathus* VOLOGDIN, 1956, p. 878 (*nom. null.*)]. Solitary, slenderly conical with coarsely but regularly porous tabulae, flat or slightly domed; rare radial longitudinal rods or short segments of septa perpendicular to tabulae and not proceeding beyond limits of single intertabular chamber; outer and sometimes inner wall may be formed of downturned edges of tabulae, both walls with simple rounded pores. *L.Cam.?(up.Atadaban.-Botom.)*, USSR(S.Urals-Altay-Far East.—FIG. 91,3. **T. taylori*, Botom., Altay; 3*a,b*, transv. and long. secs., $\times 6.7$ (Vologdin, 1957a).

Abakanicyathus KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV & ROZANOV, 1964, p. 127 [**A. karakolensis*; OD]. Cup solitary, conical or cylindrical. Outer wall simple; inner wall has longitudinal ribs on intervallar side; tabulae porous; longitudinal rods developed within the limits of single intertabular loculus; dissepiments present. *L.Cam.(Botom.)*, USSR(Sayan).—FIG. 91,2. **A. karakolensis*; transv. sec., $\times 10$ (Zhuravleva, Konyushkov, & Rozanov, 1964).

Tabulacyathellus MISSARZHEVSKIY in REPINA, KHOMENTOVSKIY, ZHURAVLEVA, & ROZANOV, 1964, p. 249 [**T. bidzhaensis*; OD]. Outer wall coarsely porous with reticular external sheath; inner wall of downturned edges of tabulae; septa coarsely porous. *L.Cam.(Atdaban.)*, USSR(Kuznetsk Alatau).—FIG. 91,4. **T. bidzhaensis*, Bazaikh., Sukhie Solontsy; 4*a*, part of long. sec., $\times 10$; 4*b*, part of outer wall, $\times 10$; 4*c*, part of a septum between 2 tabulae, $\times 14$ (Repina, Khomentovskiy, et al., 1964).

Family DICTYOCOSCINIDAE R. Bedford & W. R. Bedford, 1936

[Dictyocoscinidae R. BEDFORD & W. R. BEDFORD, 1936, p. 14]

Cup irregularly conical; outer wall apore; intervallum with retiform septa connected by synapticalae, and with tabulae formed by fine screens developed between synapticalae that are arranged in curved, floorlike rows; inner wall with pore-tubes. [DEBRENNE (1970, p. 26, 33), places this

family in her order Metaldetida.] *L.Cam.(up.Atadaban. or low.Botom.)*.

Dictyocoscinus R. BEDFORD & W. R. BEDFORD, 1936, p. 14 [**D. beltana*; M]. Cup irregularly conical; outer wall apore; septa retiform, connected by synapticalae; each tabula formed by fine screens developed between synapticalae that are arranged in floorlike rows; inner wall with pore-tubes leading upward into central cavity. *L.Cam.(up.Atadaban. or low.Botom.)*, S.Australia.—FIG. 91,1. **D. beltana*, holotype, S.Australia(Ajax Mine); 1*a*, transv. sec., $\times 8$; 1*b*, septum, $\times 10$ (photos courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris); 1*c*, tang. long. sec., $\times 3$ (Bedford & Bedford, 1936).

Family METACOSCINIDAE R. Bedford & W. R. Bedford, 1936

[Metacoscinidae R. BEDFORD & W. R. BEDFORD, 1936, p. 18]
[=?Paracoscinidae DEBRENNE, 1970, p. 38]

Cup with distinct walls; outer wall may have finely porous external sheath; tabulae porous, arched, with axis of curvature commonly in central cavity, rarely in intervallum; dissepiments present; septa porous, straight, or wavy and ramifying; early stages with dissepiments and rods, not septa. *L.Cam.(up.Atadaban. or low.Botom.-up.Len.)*.

Metacoscinus R. BEDFORD & W. R. BEDFORD, 1934, p. 6 [**M. reteseptatus* (= *Archaeocyathus retesepta* TAYLOR, 1910, p. 120, see DEBRENNE, 1970, p. 36); M]. Solitary, conical, with transverse swellings and constrictions not affecting inner wall; outer wall with short funnel-shaped pore-canals; inner wall thin with two longitudinal rows of large pores to an intersept; septa straight and coarsely retiform; tabulae distant, porous; no synapticalae; early stages with dissepiments. *L.Cam.(up.Atadaban.-low.Botom.)*, S.Australia.—FIG. 92,1. **M. retesepta* (TAYLOR), Ajax Mine; 1*a*, part of outer wall, $\times 4$; 1*b*, part of transv. sec., showing tabula, $\times 4$; 1*c*, part of inner wall, $\times 6.7$; 1*d*, septum, $\times 4$ (Debrenne, 1969a).

Batenevia KRASNOPEEVA, 1961, p. 249 [**B. pellisi*; OD]. Solitary or colonial; outer wall with pore-canals and an external finely porous sheath; inner wall with short pore-tubes; intervallum with porous arched tabulae; coarsely porous, imperfect, wavy septa and radial longitudinal rods, are joined by synapticalae so that a flindersicyathoid structure is attained. *L.Cam.(up.Len.)*, USSR(Kuznetsk Alatau).—FIG. 92,3. **B. pellisi*; holotype, 3*a*, part of transv. sec., $\times 6$; 3*b*, part of long. sec., $\times 10$ (Krasnopeeva, 1961).

Claruscoscinus HANDFIELD, 1971, p. 74 [**Claruscyathus billingsi* VOLOGDIN; OD]. Cup cylindrical; outer wall with simple pores; septa straight, pores

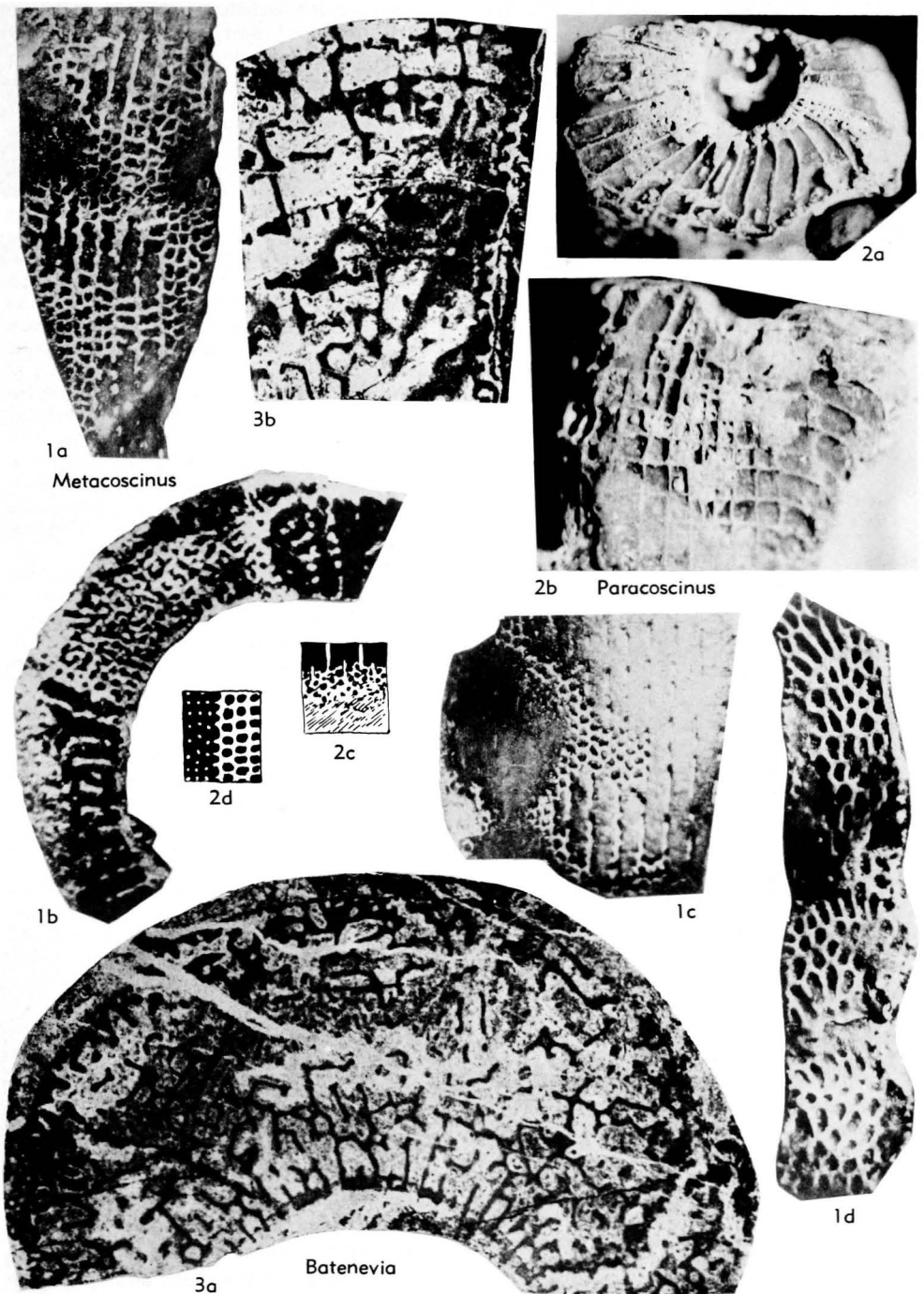


FIG. 92. Metacoscinidae (p. E124, E126).

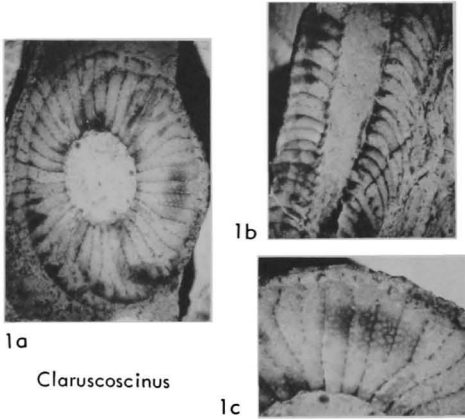


FIG. 93. Metacoscinidae (p. E124, E126).

in upward and outward curving longitudinal rows; tabulae convex upward; inner wall of single longitudinal row of oblique straight or slightly S-curved pore-tubes to an intersept. *L. Cam. (Botom.-up.Len.)*, USSR (Altay-Sayan-Sib. Platf.)-Can. (NW.Terr.-B.C.).—FIG. 93, 1. **C. billingsi* (VOLOGDIN), ?up.Atdaban. or low. Botom., NW.Terr. or B.C.; 1a, transv. sec., $\times 2.5$; 1b, med. long. sec., $\times 2$; 1c, transv. sec. showing tabula, $\times 4.3$ (Handfield, 1971).

Claruscycathus VOLOGDIN, 1932, p. 25 [**C. cumfundus*; M] [= *Eucyathus* SIMON, 1939, p. 29 (= *Eucyathus* VOLOGDIN, 1937, *nom. nud.*) (type, *Claruscycathus cumfundus* VOLOGDIN, 1932, p. 25); ?*Coscinoocyathella* VOLOGDIN, 1957, p. 699 (type, *C. nikitini*; M), non *Coscinoocyathellus* VOLOGDIN, 1937, p. 471; 1940, p. 91 (type, *C. parvus*; M)]. Solitary or colonial; cup slenderly conical; surface with dents and protrusions; outer wall tightly connected to tabulae and with 2 to 4 longitudinal rows of simple pores to an intersept; inner wall with 1 longitudinal row of simple pores to an intersept; septa straight or wavy, splintering at their outer edges; tabulae numerous, arched so that their axis of curvature coincides with axis of cup; dissepiments common. *L. Cam. (Botom.-up.Len.)*, USSR (Altay-Sayan-Sib. Platf.-Transbayk.)-W. Can.-Antarct.—FIG. 94, 1. **C. cumfundus*, Botom. or Len., R. Karagan, Altay; 1a, b, transv. and long. secs., $\times 2.67$ (Vologdin, 1932).

Flindersicosinus DEBRENNE, 1970, p. 34 [**Flindersicyathus tabulatus* R. BEDFORD & J. BEDFORD, 1937, p. 29; OD]. Outer wall irregular; septa porous, connected by synapticulae; tabulae each a curved floor of synapticulae with secondary connections and thickening but no sieves; inner wall with one longitudinal row of pores to an intersept. [DEBRENNE (1970, p. 34) referred this genus doubtfully to the Pycnoidocyathidae OKULITCH, 1950, p. 394, but because of its tabulae it is here referred to the Archaeosyconina.] *L. Cam. (up.*

Atdaban. or low.Botom.), S.Australia (Ajax Mine). **Gabrielsocycathus** DEBRENNE, 1964, p. 248 [**Metacoscinus gabrielsensis* OKULITCH, 1955, p. 61; OD]. Outer and inner walls thin, with simple pores; tabulae numerous, regularly spaced, simply porous; septa with rounded pores; dissepiments abundant; central cavity partially or totally filled with intervallar elements. *L. Cam.*, Can. (B.C.-Yukon).—FIG. 94, 3. **G. gabrielsensis* (OKULITCH), B.C.; 3a, b, parts of transv. and long. secs., $\times 15$ (photo courtesy of MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris).

Palmericyathellus DEBRENNE, 1970, p. 37 [**Sigmofungia tabularis* R. BEDFORD & J. BEDFORD, 1937, p. 29; OD]. Outer wall with irregular polygonal pores, several longitudinal rows to an intersept; septa straight, finely porous, synapticulate; tabulae numerous but irregularly spaced; inner wall of S-shaped pore-tubes, their apertures more or less hexagonal. [DEBRENNE, 1970b, p. 38, described the tabulae as consisting "of microporous sieves developed between septa and special synapticulae arranged in horizontal planes, instead of along quincuncial lines as all the others," and placed this genus in the Sigmofungidae.] *L. Cam. (up. Atdaban. or low.Botom.)*, S.Australia (Ajax Mine).

Paracosinus R. BEDFORD & W. R. BEDFORD, 1936, p. 18 [**P. mirabilis*; M]. Small, solitary, conical; outer wall aporese in tip, in adult stages a framework with coarse rectangular to polygonal pores, covered by microporous sheath; inner wall with simple, rectangular pores in transverse and longitudinal rows, 2 rows to an intersept; septa straight, thick, finely porous; tabulae numerous, thick, nearly flat at inner wall, curved outward and downward, finely porous; no synapticulae; some dissepiments. (See DeBrenne, 1970, p. 38.) *L. Cam. (up. Atdaban. or low.Botom.)*, S.Australia.—FIG. 92, 2. **P. mirabilis*, holotype, S.Australia (Ajax Mine); 2a, transv. sec., $\times 4$; 2b, radial long. sec., $\times 4$ (photos courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris); 2c, tang. sec. outer wall, 2d, tang. sec. inner wall, both $\times 3$ (Bedford & Bedford, 1936).

Family PYCNOIDOCOSCINIDAE DeBrenne, 1970

[Pycnoidocosciniidae DEBRENNE, 1970, p. 40]

Outer wall with somewhat irregular pores; outwardly screened by a microporous sheath; inner wall with rectangular pores in one longitudinal row to an intersept, may be subdivided by longitudinal or oblique rods; septa porous; tabulae curved with slit-like pores that may have additional partitions parallel to the septa; no synapticulae. *L. Cam. (up. Atdaban. or low.Botom.)*.

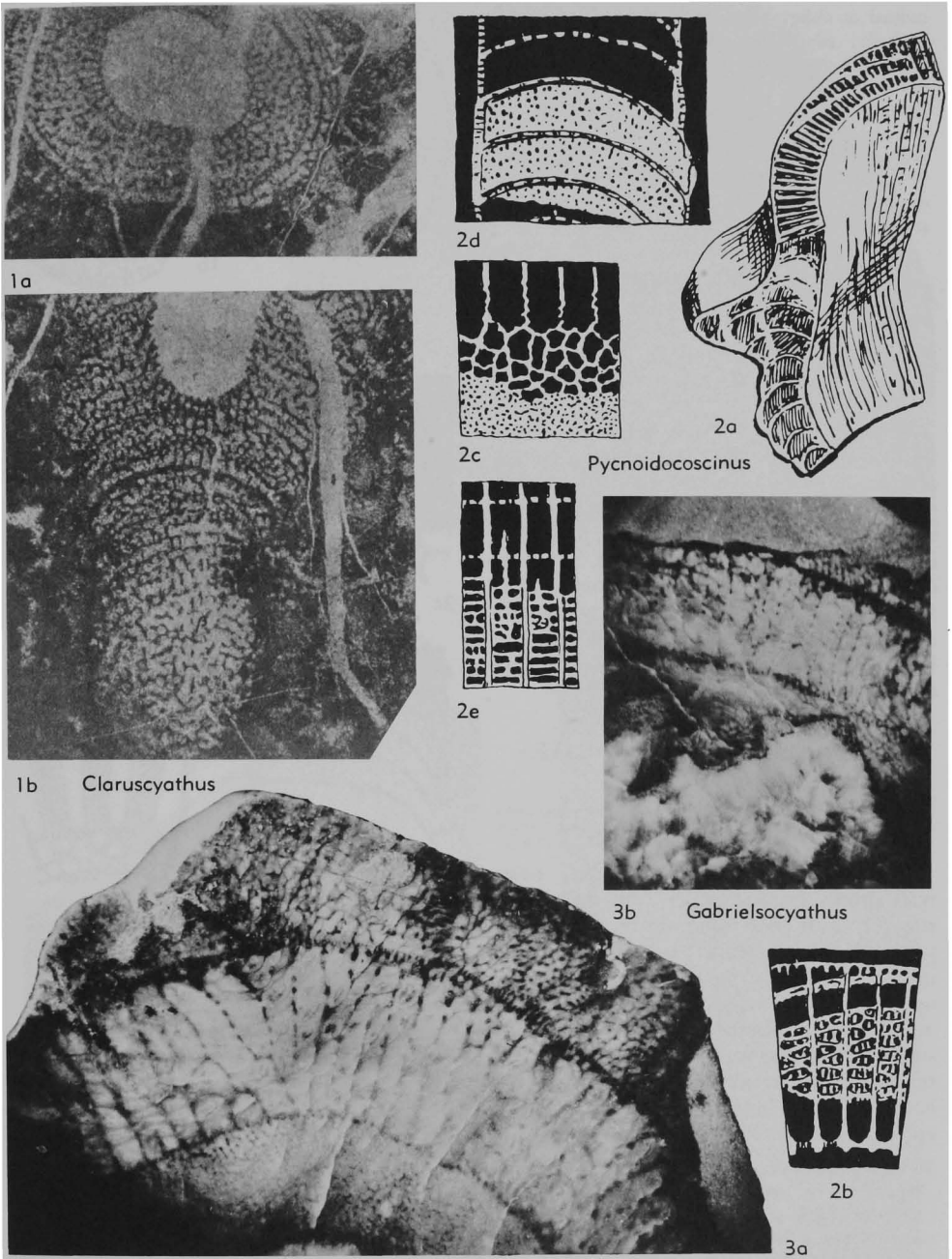


FIG. 94. Metacoscinidae (1,3); Pycnoidocoscinae (2) (p. E126-E128).

Pycnoidocoscinus R. BEDFORD & W. R. BEDFORD, 1936, p. 19 [**P. pycnoideum*; OD]. Cup solitary with annular bulges not affecting inner wall; outer wall with two or three irregular longitudinal

rows of pores to an intersept, outwardly screened by a microporous sheath; inner wall with rectangular pores that are in one longitudinal row to an intersept but may be subdivided by longi-

tudinal or oblique rods; septa thinner and porous medially; tabulae strongly arched, with slit-like pores that may be subdivided by radial partitions; no synapticalae. *L.Cam.*(*up.Atdaban.* or *low.Botom.*), S.Australia-Can.(Yukon).—FIG. 94,2. **P. pycnoideum*, S.Australia(Ajax Mine); 2a, fragment of cup, $\times 1$; 2b, part of transv. sec., $\times 4$; 2c, tang. sec. outer wall, $\times 4$; 2d, radial long. sec., $\times 4$; 2e, tang. sec. inner wall, $\times 4$ (Bedford & Bedford, 1936).

Order SYRINGOCNEMIDIDA
Okulitch, 1935

[*nom. correct.* DEBRENNE, 1964, p. 117, *pro* Syringocnematida ZHURAVLEVA, 1960, p. 51 (*pro* Syringocnemina OKULITCH, 1935, p. 98, and Syringocnemida ZHURAVLEVA, 1950, p. 10, orders)]

Solitary, conical Archaeocyatha; outer wall simply porous; inner wall simply porous or with pore-tubes; intervallum with prismatic, porous-walled tubuli, alternating in position in superimposed rows, and curving upward and outward from inner to outer wall; without septa or tabulae; in early stages, first a one-walled cup in which dissepiments and randomly disposed rods and bars arise, then inner wall, and finally tubuli appear. *L.Cam.*

Family SYRINGOCNEMIDIDAE
Taylor, 1910

[*nom. correct.* DEBRENNE, 1964, p. 117, *pro* Syringocnematidae OKULITCH, 1955, p. 49 (*pro* Syringocnemidae TAYLOR, 1910, p. 153, Syringocnemitidae TING, 1937, p. 370)]

Solitary, conical Archaeocyatha; outer wall simply porous; inner wall simply porous or with pore-tubes; intervallum with prismatic, porous-walled tubuli, alternating in position in superposed rows, and curving upward and outward from inner to outer wall; without septa or tabulae; in early stages first a one-walled cup in which dissepiments and randomly disposed rods and bars arise, then inner wall and finally tubuli appear. *L.Cam.*(?*up.Atdaban.-Botom.*).

Syringocnema TAYLOR, 1910, p. 153 [**S. favus*; M]. Solitary, conical; two-walled; intervallum with prismatic horizontal tubuli that may be downturned at inner ends; tubuli alternating in position in superposed rows, walls of tubuli with simple, round pores; outer wall porous, pores may be at centers of conical outer covers to tubuli; the covers formed by rods rising from angles and edges of ends of tubuli; inner wall of pore-tubes, each with short louvres directed steeply upward and inward; central cavity empty; no known processes of attachment. *L.Cam.*(?*up.Atdaban.-*

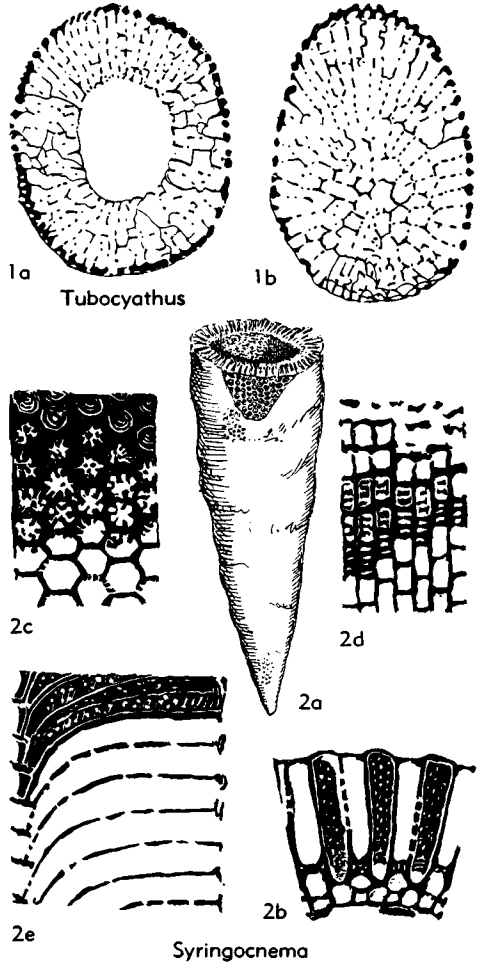


FIG. 95. Syringocnemididae (p. E128, E130).

Botom.), S.Australia-Antarct.-?N.Am.(Washington)-USSR (Altay-Sayan-Transbayk.).—FIG. 11,14; 95,2. **S. favus*, *up.Atdaban.* or *low.Botom.*, S.Australia(Ajax Mine); 11,14, series of tang. long. secs. of one tubulus, $\times 6$; 95,2a, ext. view, $\times 0.5$; 95,2b-e, $\times 4$; 95,2b, transv. sec.; 95,2c, tang. long. sec. outer wall; 95,2d, tang. long. sec. inner wall; 95,2e, radial long. sec. (Bedford & Bedford, 1936). ?*Beticocyathus* SIMON, 1939, p. 73 [**B. beticus*; OD]. Mushroom-shaped. Intervallum filled with polygonal tubuli, but in addition septa occur among tubuli at definite distances, including between them 5 to 8 vertical series of radial, 6-sided tubuli. Insufficiently known. *L.Cam.*, Eu. (Spain). *Fragilicyathus* BELYAEVA, 1969, p. 98 [**F. zhuravlevae*; OD]. Colonial; outer wall with horizontal pore-canals; intervallum with radially orientated

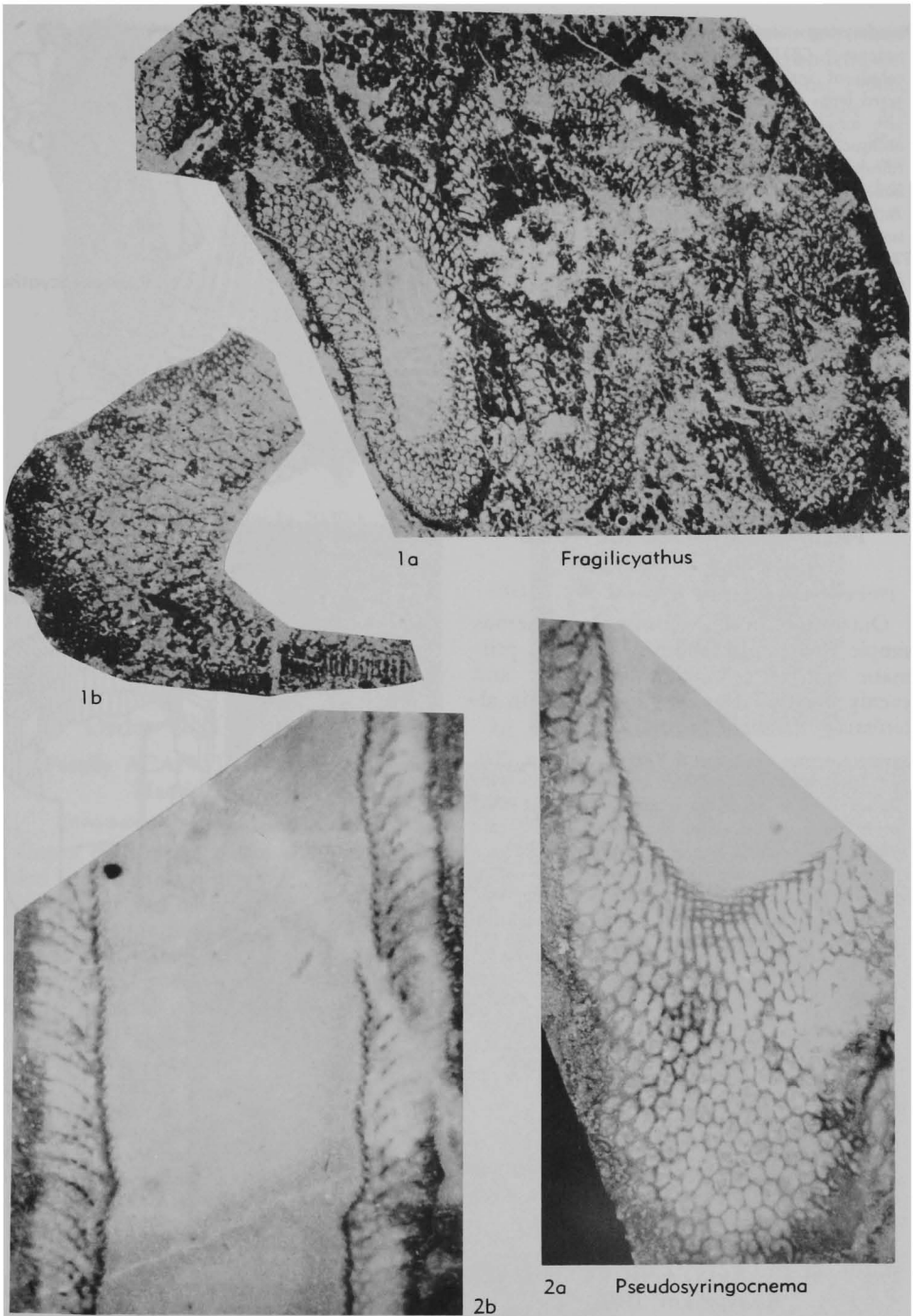


FIG. 96. Syringocnemididae (p. E128-E130).

prismatic tubuli with porous walls; inner wall with geniculate pore-canals. *L. Cam. (Botom.)*, USSR (Far East).—FIG. 96, 1. **F. zhuravlevae*,

R.B. Melkan, Far East; holotype, 1a, oblique secs., $\times 5$; 1b, oblique transv. sec., $\times 10$ (Belyaeva, 1969).

Pseudosyringocnema HANDFIELD, 1971, p. 76 [**P. uniporus*; OD]. Solitary or colonial; hexagonal tubuli of intervallum inclined upward and outward from intervallum, each face of tubulus with one longitudinal row of pores; inner wall of oblique, S-shaped pore-tubes, 2 or 3 to each tubulus in vertical arrangement. *L.Cam.*(?*Atadaban.*), Can.(Yukon).—FIG. 96.2. **P. uniporus*; 2a, oblique long. sec., $\times 24$; 2b, med. long. sec., now $\times 24$ (Handfield, 1971).

?**Tubocyathus** VOLOGDIN, 1937, p. 473 [**T. smolianinovae*; M] [= *Tubicyathus* VOLOGDIN, 1940, p. 114, *nom. null.*; *Tubulocyathus* VOLOGDIN, 1956, p. 880, *nom. null.*]. Solitary, conical; outer wall thick, intervallum with prismatic tubuli in which pores are large; with dissepiments. [Genus insufficiently known; =? *Prismocyathus* FONIN, 1960, p. 725 (type, *P. praesignis*; OD).] *L.Cam.*, Mongolia.—FIG. 95.1. **T. smolianinovae*, Tayshir-Ula Range; 1a,b, transv. secs., $\times 3.3$ (Vologdin, 1937b).

Family SYRINGOCOSCINIDAE Vologdin & Yazmir, 1967

[Syringocoscinidae VOLOGDIN & YAZMIR, 1967, p. 1375]

Outer and inner walls with numerous simple pores; intervallum of six-sided prismatic transverse tubuli, with finely and evenly porous faces; tubuli arranged in alternating transverse series. *L.Cam.*

Syringocoscinus VOLOGDIN & YAZMIR, 1967, p. 1376 [**S. angulatus*; OD]. Outer and inner walls with numerous simple pores; intervallum of six-sided prismatic transverse tubuli, with finely and evenly porous faces; tubuli arranged in alternating transverse series. *L.Cam.*, USSR(Transbayk.).—FIG. 97.4. **S. angulatus*; 4a, diagram; 4b, tang. sec., $\times 10$; 4c, oblique transv. sec., $\times 3.6$ (Vologdin & Yazmir, 1967).

Class UNCERTAIN

Order KAZAKHSTANICYATHIDA Konyushkov, 1967

[Kazakhstanicyathida KONYUSHKOV, 1967, p. 105]

Solitary, one-walled cups; in the inner cavity, only porous tabulae are present, with some rods. *Up.L.Cam.*-?base *M.Cam.*

Family KAZAKHSTANICYATHIDAE Konyushkov, 1967

[Kazakhstanicyathidae KONYUSHKOV, 1967, p. 106]

Solitary, one-walled cups; in inner cavity, only porous tabulae and some rods are present. *Up.L.Cam.*-?base *M.Cam.*

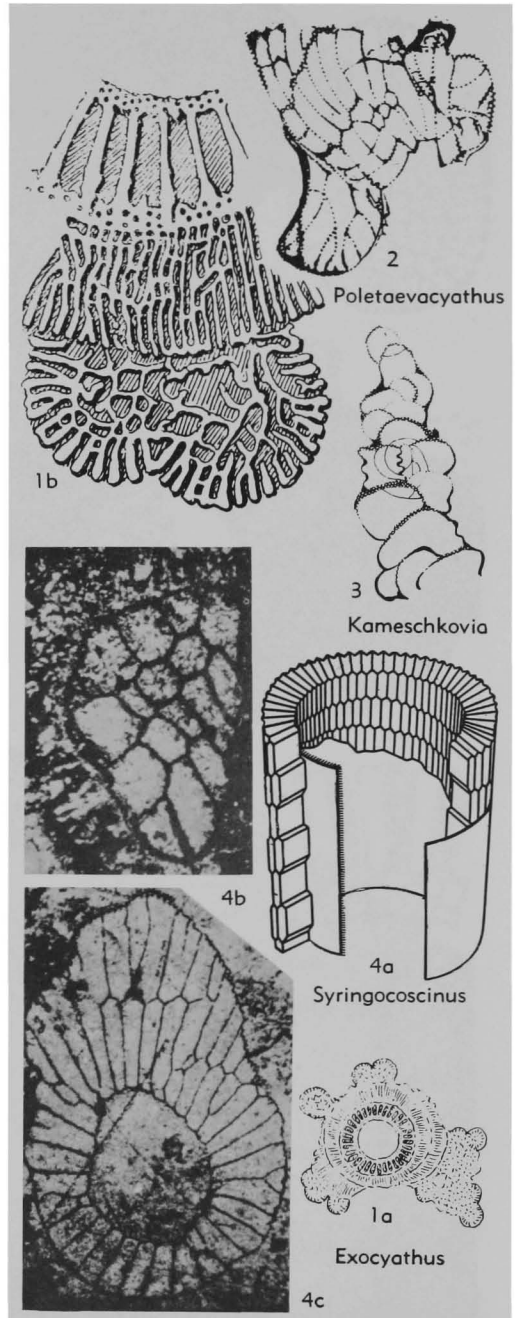


FIG. 97. Syringocoscinidae (4); Order and Family uncertain (1-3) (p. E130, E132).

Kazakhstanicyathus KONYUSHKOV, 1967, p. 106 [**K. fistulatus*; OD]. Solitary one-walled, conical or cylindrical cups; wall aporose or with simple,

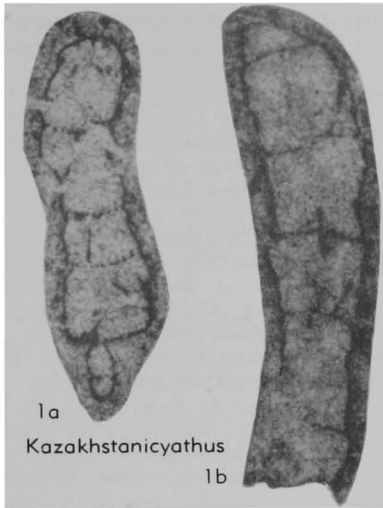


FIG. 98. Kazakhstanicyathidae (p. E130-E131).

sparse pores; inner cavity with porous tabulae and longitudinally orientated rods. *Up.L.Cam.-?base M.Cam.*, USSR (Kazakhstan, Mt. Agyre).—FIG. 98, 1. **K. fistulatus*; 1a, long. sec., $\times 10$; 1b, holotype, long. sec., $\times 10$ (Konyushkov, 1967).

Order UNCERTAIN

Family ACANTHOPYGRIDAE Handfield, 1971

[Acanthopyrigidae HANDFIELD, 1971, p. 31]

Cup a double-walled cylindrical tube divided into distinct segments by whorls of spines; inner and outer walls perforated by pores in longitudinal rows; spines, linked by a calcified weblike membrane, join proximally forming collar about outer wall; skeletal material is calcite. *L.Cam.*

Acanthopyrgus HANDFIELD, 1967, p. 209 [**A. yukonensis*; OD]. Characters of family. *L.Cam.*, N.Am. (Yukon Terr.-Can.).—FIG. 99, 1; 100, 1. **A. yukonensis*; 99, 1a, partial whorl of spines showing striations on spines and web, $\times 8$; 99, 1b, two segments showing raised outer pores and size differences in segments, $\times 8$; 100, 1a, b, radial secs., 100, 1c, ext. view, enl. (Handfield, 1967).

Family UNCERTAIN

GENERA CONSIDERED TO BE EXTRAVALLAR OUTGROWTHS OF ARCHAEOCYATHA, OR POSSIBLY ENCRUSTING ARCHAEOCYATHA WITHOUT INNER WALL OR CENTRAL CAVITY

Controversy over the forms included

herein is long-standing. Views expressed range from 1) that they are independent, encrusting Archaeocyatha (VOLOGDIN, 1940b, 1959d, 1962b), through 2) that they are one of a symbiotic or parasitic pair (MASLOV, 1958, p. 699), to 3) that they are outgrowths from the intervallum of either the cup that is surrounded, or from another



1b Acanthopyrgus

FIG. 99. Acanthopyrigidae (p. E131).

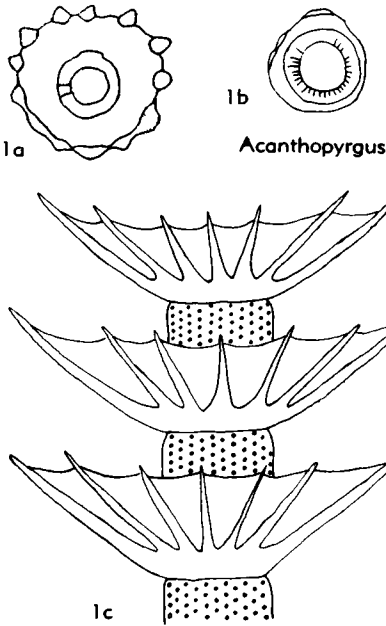


FIG. 100. Acanthopyrgidae (p. E131).

(OKULITCH, 1946a; ZHURAVLEVA, 1960b). A fourth view is also expressed that some are extravallar outgrowths, and others separate, encrusting genera (VOLOGDIN, 1962d).

Listed below are the systematic names given to these problematic forms with localities of their type-species, and references to illustrations of type-species in this *Treatise*.

Cavocyathus FONIN in VOLOGDIN & FONIN, 1966, p. 189 [**C. pusilis*; OD]. ?Tersioid outgrowth. *L.Cam.*(*up.Atdaban.* or *Botom.*), USSR(Transbayk.).—FIG. 74,4. **C. pusilis*; oblique long. sec., $\times 10$ (Vologdin & Fonin, 1966).

Exocyathus R. BEDFORD & J. BEDFORD, 1937, p. 32 [**E. australis*; OD]. *L.Cam.*(*Botom.*), S.Australia.—FIG. 97,1. **E. australis* on *Coscinoocyathus australis* TAYLOR, Ardrossan; 1a, $\times 1$; 1b, $\times 5.3$ (Bedford & Bedford, 1937).

Falsocyathus FONIN in VOLOGDIN & FONIN, 1966, p. 189 [**F. vastulus*; OD]. ?Tersioid outgrowth. *L.Cam.*(*up.Atdaban.* or *Botom.*), USSR(Transbayk.).—FIG. 74,7. **F. vastulus*; oblique transv. sec., $\times 10$ (Vologdin & Fonin, 1966).

Kameschkovia VOLOGDIN, 1957, p. 210 [**K. perforata*; M] [= *Kameschkovia* VOLOGDIN, 1956, p. 880, *nom. nud.*]. Doubtfully archaeocyathan. *L.Cam.*(*up.-Botom.*), USSR(R. Sanashtykgol, Sayan).—FIG. 97,3. **K. perforata*; $\times 5$ (Vologdin, 1957a).

Labyrinthomorpha VOLOGDIN, 1931, p. 35 [**L.*

tollii; M]. *L.Cam.*, USSR(Kameshki, Sayan).—FIG. 101,1. **L. tollii*, on *Coscinoocyathus taylori* VOLOGDIN; $\times 1.3$ (Vologdin, 1931).

Metaldetimorpha R. BEDFORD & J. BEDFORD, 1937, p. 31 [**M. yorkei*; OD]. *L.Cam.*(? *Botom.*), S.Australia(Paint Mine, Beltana).—FIG. 101,2. **M. yorkei*; 2a, $\times 0.5$; 2b-d, enl. of facets marked b,c,d, on type specimen (2a), $\times 2.67$; 2e, $\times 5$ (Bedford & Bedford, 1937).

Nostrococyathus FONIN in VOLOGDIN & FONIN, 1966, p. 189 [**N. aculeatus*; OD]. ?Tersioid outgrowth. *L.Cam.*(*up.Atdaban.* or *Botom.*), USSR(Transbayk.).—FIG. 74,8. **N. aculeatus*; tang. sec., $\times 20$ (Vologdin & Fonin, 1966).

Poletaevocyathus VOLOGDIN, 1959, p. 88 [**P. obrutchevi*; M]. Doubtfully archaeocyathan. [A figure was given but no formal description. A diagnosis was given by VOLOGDIN, 1962, p. 125.] *L.Cam.*(*up.Len.*), USSR(Kuznetsk Alatau).—FIG. 97,2. **P. obrutchevi*; $\times 6.7$ (Vologdin, 1959c).

Rhizocyathus R. BEDFORD & J. BEDFORD, 1939, p. 69 [**Protopharetra radix* R. BEDFORD & J. BEDFORD, 1937, p. 28; OD]. Small conical form, the interior occupied by longitudinally oriented bars with connections, as in "Tersia." *L.Cam.*(*up.Atdaban.* or *low.Botom.*), S.Australia.—FIG. 74,3. **R. radix* (BEDFORD & BEDFORD); 3a,b, transv. and long. secs., $\times 5$ (photo courtesy MAX DEBRENNE, Paris, negatives in coll. Dr. F. DEBRENNE, Natl. History Museum, Paris).

Tersia VOLOGDIN, 1931, p. 70 [**T. filiformis*; M]. *L.Cam.*, USSR(R. Lower Tersi, Kuznetsk Alatau).—FIG. 101,3. **T. filiformis*; $\times 2$ (Vologdin, 1931).

Tersiella VOLOGDIN, 1962, p. 129 [**Tersia nodosa* VOLOGDIN, 1940a, p. 33; OD]. *L.Cam.*, Mongolia (Tayshiri-ula Range).—FIG. 101,4. **T. nodosa* (VOLOGDIN), on *Bicyathus crassimurus* VOLOGDIN; 4a-i, random secs., $\times 2$ (Vologdin, 1940a).

Usloncyathus FONIN in VOLOGDIN & FONIN, 1966, p. 188 [**U. miculus*; OD]. ?Tersioid outgrowth. *L.Cam.*(*up.Atdaban.* or *Botom.*), USSR(Transbayk.).—FIG. 74,6. **U. miculus*; median long. sec., $\times 8$ (Vologdin & Fonin, 1966).

[The history of the suprageneric placing of these forms is as follows: VOLOGDIN (1931, p. 34) erected the Family Vesiculoidae (an invalid family name) to contain *Labyrinthomorpha* and the problematical *Yakovlevia* (VOLOGDIN, 1931, p. 36) (*non* FREDERICKS, 1925). VOLOGDIN rejected his *Yakovlevia* (type, *Y. granulosa*; M) from the Archaeocyatha in 1940 (VOLOGDIN, 1940a, p. 25) and again in 1962 (VOLOGDIN, 1962c, p. 7) when he considered it a siphonate alga. In 1956 he placed *Labyrinthomorpha* together with *Tersia* in the Family Exocyathidae which R. BEDFORD & J. BEDFORD (1939, p. 82) had erected for *Exocyathus*, *Ajacia* (an ?alga), and *Metaldetimorpha* and had placed in a new order Crommyocyathina (VOLOGDIN, 1956). Later VOLOGDIN (1957a, p. 210) transferred *Kameschkovia* to the family Palaeoschadidae MYAGKOVA. In 1962 (135, p. 129) VOLOGDIN founded the Order Tersiida to include the Exocyathidae and Rhizocyathidae, and in the Exocyathidae he placed *Exocyathus*, *Tersia*, *Tersiella*, and *Metaldetimorpha*. At the same time (135, VOLOGDIN, 1962, p. 125) he founded the Order Labyrinthomorpha to include the Labyrinthomorphae (135, VOLOGDIN, 1962, p. 125), (*nom. subst. pro* Vesiculoidae VOLOGDIN, 1931, p. 34) with *Labyrinthomorpha* and *Kameschkovia*,

and the Poletaevacyathidae (135, VOLOGDIN, 1962, p. 125), with *Poletaevacyathus* the sole genus. The superorder Labyrinthomorpha he founded to embrace his order Labyrinthomorpha and the Coscinocyathida. R. BEDFORD & J. BEDFORD (1939, p. 69) founded the family Rhizacyathidae for *Protopharetra radix* (R. BEDFORD & J. BEDFORD, 1937, p. 28), and ZHURAVLEVA (1955, p. 629) founded the order Rhizacyathida to include the Rhizacyathidae and the Bicyathidae (VOLOGDIN, 1937b, p. 472). However, DEBRENNE (1970, p. 41) concluded that the slenderly [3 mm. diam.] cylindrical *R. radix* may be a tersioid outgrowth and thus only part of an unknown species. FONIN in VOLOGDIN & FONIN (1966, p. 187) founded the family Usloncyathidae for *Usloncyathus*, *Cavocyathus*, *Falsocyathus*, and *Nostrocyathus*, but it seems to me that these were based on tersioid outgrowths.]

Family UNCERTAIN

**SUPPOSED PLANKTONIC OR LARVAL
ARCHAEOCYATHA**

In his early works VOLOGDIN (1932, p. 10; 1937b, p. 459) described and figured certain minute calcareous bodies as larval and planktonic stages of Archaeocyatha passed through prior to attachment. Roelike hollow calcareous bodies 0.1 to 0.2 mm. in diameter he called the "sphaerion" larval stage; bodies of tubular form, diameter 0.1 or 0.15 mm. to 0.5 mm. he considered a "fistula" stage; bodies 0.4 to 0.8 mm. in diameter with traces of an inner wall were the "conosimilis" stage; barrel-like to cylindrical double-walled bodies 0.2 to 0.3 mm. or more in diameter he called the "dolium" stage.

ZHURAVLEVA (1951, p. 100; 1960, p. 40) suggested that the diameter of the cone of attachment of an archaeocyathan cup was smaller than that of the "larva" and that the "larval" stages were not unlike fragments of epiphyton flora; in her opinion the "larvae" were not Archaeocyatha, and she regarded them as organic problematica.

VOLOGDIN (1957c, p. 493) considered two of the "dolium" cylinders from the Lower Cambrian of the Altay to be planktonic Archaeocyatha Septaidea, referred them to two new genera, *Szeczyathus* (type, *S. cylindricus*; OD) and *Lucyathus* (type, *L. elegans*; OD), and placed them in his family Tabulacyathidae. BOYARINOV (1962, p. 14) considered that the two genera are synonymous, and that their external form and the structure of the wall suggest that they may be coelenterates like *Conularia*. YANKAUSKAS (1969, p. 131) considered that they may be Cribricyathida.

Calcareous microfossils from the upper Middle Cambrian Tankhai Suite of the R. Amga, Yakutia, herein regarded as organic

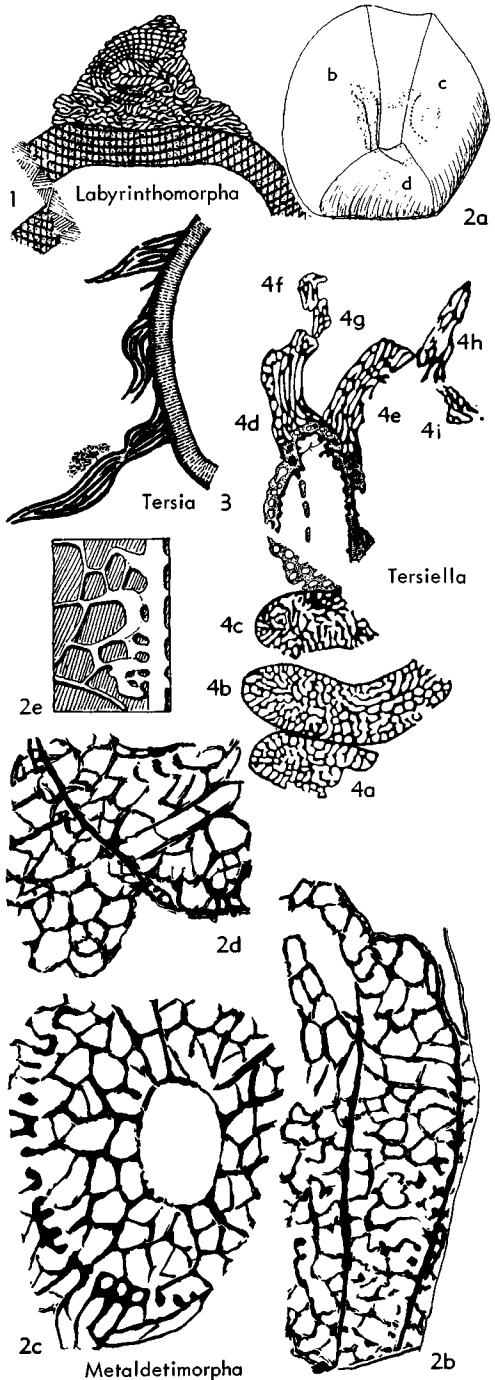


FIG. 101. Order and Family uncertain (p. E132).

Problematica, were considered archaeocyathan by VOLOGDIN (1963, p. 946). VOLOGDIN referred one new species of the genus *Monocyathus* to the family Rhabdocyathidae; to the family Flindersicyathidae he assigned *Tanchocyathus* VOLOGDIN, 1963, p. 947 (type, *T. amgaensis*; OD). One species was assigned to the genus *Archaeocyathus* of the family Archaeocyathidae, and one to *Binatocyathus* VOLOGDIN, 1963, p. 948 (type, *B. obliquiseptatus*; OD) of the Ajacicyathidae.

The conical microfossil 3 mm. long and 1 mm. wide described as *Tunkia* R. BEDFORD & J. BEDFORD, 1936, p. 21 (type, *T. incerta*; M), L.Cam.(Botom.), S.Australia (Ajax Mine, Beltana), has been restudied by HANDFIELD & HANSMAN (1967, p. 1002) and considered not to have archaeocyathan relationships, but to be *incertae sedis*.

Phylum UNCERTAIN, probably not Archaeocyatha

Class APHROSALPINGOIDA Myagkova, 1955

[Aphrosalpingoidea MYAGKOVA, 1955, p. 478] [=Aphrosalpingoidea VOLOGDIN & MYAGKOVA, 1962, p. 134]

Order APHROSALPINGIDA Myagkova, 1955

[*nom. correct.* VOLOGDIN, 1956, p. 880 (*pro* Aphrosalpingiformes MYAGKOVA, 1955, p. 478)]

This class and order possibly encompass codiacean algae (ZIEGLER & RIETSCHHEL, 1970, p. 35).

Family APHROSALPINGIDAE Myagkova, 1955

[Aphrosalpingidae MYAGKOVA, 1955, p. 478, 639]

Aphrosalpinx MYAGKOVA, 1955, p. 639 [**A. textilis*; OD]. *U.Sil.*(Ludlow), USSR(N.Urals).

Family NEMATOSALPINGIDAE Myagkova in Vologdin, 1956

[Nematosalpingidae MYAGKOVA in VOLOGDIN, 1956, p. 880]

Nematosalpinx MYAGKOVA, 1955, p. 478 [**N. dichotomica*; M]. *U.Sil.*(Ludlow), USSR(Urals).

Order PALAEOSCHADIDA Myagkova, 1955

[*nom. correct.* VOLOGDIN, 1956, p. 880 (*pro* Palaeoschadiformes MYAGKOVA, 1955, p. 480)]

Family PALAEOSCHADIDAE Myagkova, 1955

[Palaeoschadidae MYAGKOVA, 1955, p. 480]

Palaeoschada MYAGKOVA, 1955, p. 480 [**P. crassimuralis*; M]. *U.Sil.*(Ludlow), USSR(Urals).

PROBLEMATICAL MICROFOSSILS, CLASS CRIBRICYATHEA VOLOGDIN, 1961

VOLOGDIN (1962c, p. 44; 1964a, p. 1391; 1966, p. 16) grouped a number of calcareous microfossils from the Lower Cambrian of the USSR(Sayano-Altay) into his new class Cribricyathaea, composed of three orders, Conoidocyathida (VOLOGDIN, 1964a, p. 1392), Cribricyathida (VOLOGDIN, 1964a, p. 1392), and Pterocyathida (YANKAUSKAS, 1965, p. 438). The class comprises oblong or isometric cups, one-walled or two-walled. The order of size is up to 5 mm. long and 1.5 mm. wide, the majority being smaller, a few larger. The outer wall is constructed of transversely oriented ribbon-like plates (peripteratae, Fig. 102, 103) conjoined at the inner edges with longitudinal rod-like elements (baculae), so that porosity of lattice type may result. An inner wall when present is thin and porous; neither rods nor septa are present in the intervallum, but aporose dissepiments (or ?porous tabulae?) may occur. VOLOGDIN refers some of the species to the Middle Cambrian; these species are found in the Upper Monok Suite of the valley of the R. Abakan in Yakutia, and this suite (*vide* YANKAUSKAS & ZHURAVLEVA, 1969, p. 8) contains a faunal complex not younger than the Sanashtykgol faunal complex of Lower Cambrian age. In all probability, therefore, the range of the class as at present known is Lower Cambrian only. VOLOGDIN considers the class to be overwhelmingly planktonic.

It does not seem to me that these microfossils can reasonably be referred to the Archaeocyatha, and I prefer to regard them as organic Problematica.

Class CRIBRICYATHEA Vologdin, 1961

[Cribricyathaea VOLOGDIN, 1961, p. 177 (unseen by author; *vide* VOLOGDIN, 1966, p. 16); Cribricyathaea VOLOGDIN, 1964, p. 1392] [=Cribrocyaethaea VOLOGDIN, 1962, p. 44, as class

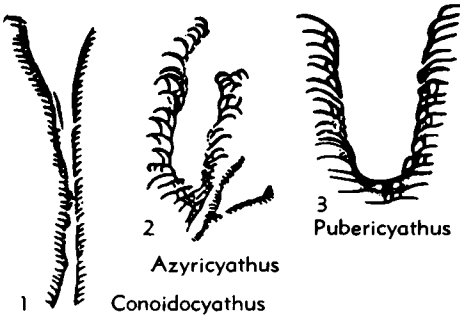


FIG. 102. Conoidocyathidae (p. E135).

of Archaeocyatha; ?Protoarchaeocyatha RADUGIN, 1964, p. 145, footnote]

Cups very small, elongate or isometric, one-walled or two-walled; wall constructed of transversely orientated ribbons (peripteratae) and conjugate with them, longitudinal rods (baculae), giving a lattice-like porosity. Probably planktonic. *L.Cam.*

Order CONOIDOCYATHIDA Vologdin, 1964

[Conoidocyathida VOLOGDIN, 1964, p. 1392]

Cups commonly of conical form, single-walled with wall of peripterate structure. *L.Cam.*

Family CONOIDOCYATHIDAE Vologdin, 1964

[Conoidocyathidae VOLOGDIN, 1964, p. 1392]

Cups more or less conical, opening upward; with one wall of peripteratae and baculi giving quadrate or rounded pores. *L.Cam.*

Conoidocyathus VOLOGDIN, 1964, p. 1392 [**C. artus*; M; genus diagnosed but species figured only (VOLOGDIN, 1964, p. 1392); VOLOGDIN (1966, p. 18) described as new *C. artus* and *C. plumosus* and invalidly named *C. plumosus* as type-species]. Cup conical, opening upward, one-walled, lacking holdfasts; wall with peripteratae and baculi, pores subquadrate. *L.Cam. (Botom.-Len.)*, USSR (Altay-Sayan).—FIG. 102, 1. **C. artus*, Kuznetsk Alatau; holotype, long. sec., $\times 8$ (or ?; Vologdin, 1964a, 1966, gave different magnifications) (Vologdin, 1964a).

Azyricyathus VOLOGDIN, 1964, p. 1392 [**A. transeptatus*; OD; genus diagnosed, but species figured only; VOLOGDIN, 1966, p. 23] [= *Azyrocyathus*, *Azyrcyathys*, VOLOGDIN, 1966, p. 23, *nom. null.*].

Cups conical or slenderly conical, one-walled; peripteratae successively developing from simple forms to asymmetrically curved with supplementary reversed peripteratae; baculae rounded; pores subquadrate. *L.Cam. (Len.)*, USSR (Kuznetsk Alatau).—FIG. 102, 2. **A. transeptatus*; holotype, long. sec., $\times 6$ (or ?; see above) (Vologdin, 1964a).

Pubericyathus VOLOGDIN, 1964, p. 1392 [**P. phialiformis*; OD; genus diagnosed but species figured only; VOLOGDIN, 1966, p. 20]. Cups slenderly conical and tubular, one-walled; peripteratae regularly spaced, separate, curved in section; at outer edge of cup peripteratae may be in contact by their inner pectinate edges. *L.Cam. (Botom.-Len.)*, USSR (Altay-Sayan).—FIG. 102, 3. **P. phialiformis*, low. Len.; Kuznetsk Alatau; holotype, long. sec., $\times 8$ (or ?; see above) (Vologdin, 1964a).

Order CRIBRICYATHIDA Vologdin, 1964

[Cribricyathida VOLOGDIN, 1964, p. 1392]

Cups two-walled with peripterate outer wall and striate inner wall. *L.Cam.*

Family CRIBRICYATHIDAE Vologdin, 1964

[Cribricyathidae VOLOGDIN, 1964, p. 1392]

Outer wall closed or open upward, formed of peripteratae and baculae; inner wall transversely striate. *L.Cam. (Botom.-Solontsov)*.

Cribricyathus VOLOGDIN, 1964, p. 1392 [**C. longus*, OD; genus diagnosed, but species illustrated only; VOLOGDIN, 1966, p. 26]. Outer wall peripterate, pores subquadrate; inner wall striate. *L.Cam. (Botom.-Solontsov)*, USSR (Altay-Sayan).—FIG. 103, 1. **C. longus*, Solontsov, Kuznetsk Alatau; holotype, 1a, almost tang. long. sec., $\times 4$; 1b, long. sec. oblique below, $\times 4$ (or ?; Vologdin, 1964a, 1966, gave different magnifications) (Vologdin, 1964a).

Apocyathus VOLOGDIN, 1964, p. 1394 [**A. ovalis*, OD; genus diagnosed, species illustrated only; species described by VOLOGDIN, 1966, p. 34]. Cup oval or a short cylinder closed at its ends. *L.Cam. (Botom.)*, USSR (W.Sayan).—FIG. 103, 5. **A. ovalis*, R. Abakan, W.Sayan; holotype, somewhat oblique long. sec., $\times 6$ (or ?; see above) (Vologdin, 1964a).

Dolichocyathus VOLOGDIN, 1964a, p. 1394 [**D. effiguratus*, OD; genus diagnosed, but species illustrated only; species described by VOLOGDIN, 1966, p. 38]. Cups more or less regularly, slenderly conical, walls latticed; peripteratae and striae conjoin with longitudinal baculae. *L.Cam. (Solontsov)*, USSR (Kuznetsk Alatau).—FIG.

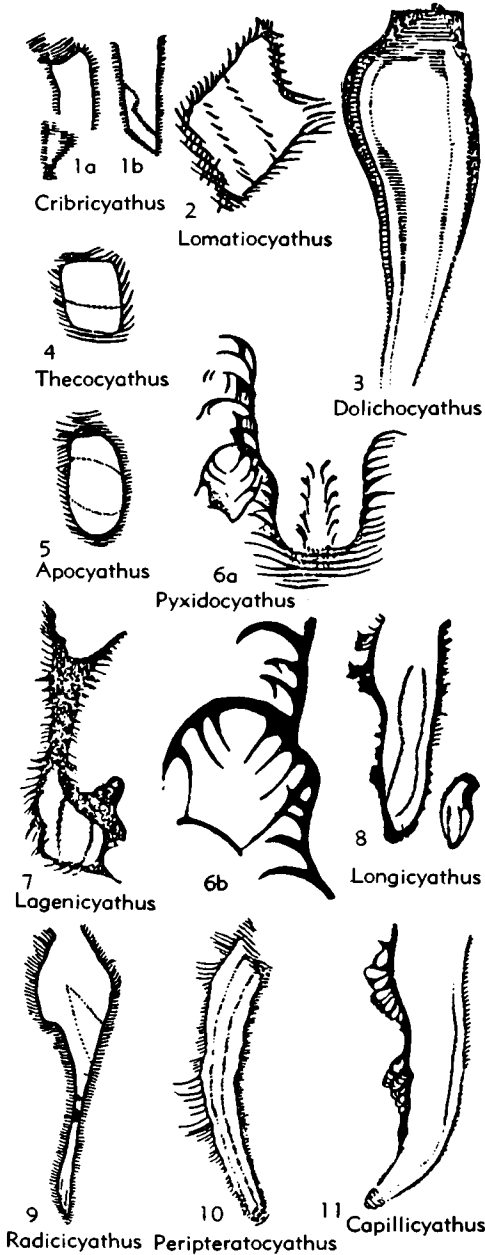


FIG. 103. Cribricyathidae (1-5,7); Pyxidocyathidae (6,8-10); Capillicyathidae (11) (p. E135-E137).

103,3. **D. effiguratus*, Solontsov; long. sec., $\times 10$ (or ?; see above) (Vologdin, 1964a).

Lagenicyathus VOLOGDIN, 1964, p. 1394 [**L. lamellifer*, OD; genus diagnosed, but species illustrated only; species described by VOLOGDIN,

1966, p. 36] [= *Lagenicyathus* VOLOGDIN, 1964, p. 1394, *nom. null.*]. Cups two-walled, irregular in form, both ends expanded; each wall a peripertate lattice. *L.Cam. (Botom.)*, USSR (W.Sayan). —FIG. 103,7. **L. lamellifer*, R.Abakan, W. Sayan; holotype, long. sec., $\times 8$ (or ?; see above) (Vologdin, 1964a).

Lomatiocyathus VOLOGDIN, 1964, p. 1392 [**L. clathratus*, OD; genus diagnosed, but species illustrated only; species described by VOLOGDIN, 1966, p. 27] [= *Lematiocyathus* and *Lomatiocyathus* VOLOGDIN, 1966, p. 16, p. 28, *nom. null.*]. Inner wall irregularly orientated with respect to axis of cup. *L.Cam. (Solontsov)*, USSR (Altay-Sayan). —FIG. 103,2. **L. clathratus*, Kuznetsk Alatau; long. sec., $\times 10$ (or ?; see above) (Vologdin, 1964a).

Thecoocyathus VOLOGDIN, 1964, p. 1392 [**T. tetragonus*, OD; genus diagnosed, species illustrated only; species described by VOLOGDIN, 1966, p. 32] [= *Thecoyathys* VOLOGDIN, 1964, p. 1393; *Theciocyathus* VOLOGDIN, 1966, p. 31, *nom. null.*]. Cup slenderly conical, rounded or subquadrate in section especially in late stages; inner chamber commonly closed, arranged excentrically. *L.Cam. (Botom., up. Monok Suite)*, USSR (W.Sayan). —FIG. 103,4. **T. tetragonus*, Botom., R.Kyzas, W. Sayan; oblique sec., $\times 10$ (or ?; see above) (Vologdin, 1964a).

Family PYXIDOCYATHIDAE Vologdin, 1964

[Pyxidocyathidae VOLOGDIN, 1964, p. 1394] [= *Pixidocyathidae* VOLOGDIN, 1966, p. 16, *nom. null.*]

Cups two-walled, conical or tubular. Outer wall peripertate, but inner wall with simple porosity, with rounded pores. *L.Cam. (Botom.-Solontsov)*.

Pyxidocyathus VOLOGDIN, 1964, p. 1394 [**P. gracilis*, M; genus diagnosed, species illustrated only; species described by VOLOGDIN, 1966, p. 40; VOLOGDIN (1966, p. 39) invalidly named *P. plumosus* VOLOGDIN, 1966, p. 39, as type-species] [= *Pixidocyathus* VOLOGDIN, 1966, p. 16, *nom. null.*; *Puxidocyathus* VOLOGDIN, 1966, p. 40, *nom. null.*]. Cups funnel or goblet-like; inner wall exaxial. *L.Cam. (Botom.)*, USSR (W.Sayan). —FIG. 103,6. **P. gracilis*, R.Kyzas, W.Sayan; 6a, long. sec., $\times 10$ (or ?; Vologdin, 1964a, 1966, gave different magnifications); 6b, part of the same showing bud further enlarged (Vologdin, 1964a).

Longicyathus VOLOGDIN, 1964, p. 1394 [**L. pubescens*; OD; genus diagnosed, species illustrated only; species described by VOLOGDIN, 1966, p. 42]. Cups slenderly conical, some curved; outer wall peripertate, inner wall with round simple pores. Central cavity has lateral position. *L.Cam. (Botom.)*, USSR (Altay-Sayan). —FIG. 103,8. **L. pubescens*, R. Sanashtykgol, W.Sayan; holo-

type, long. sec., $\times 8$ (or ?; see above) (Vologdin, 1964a).

Peripterocyathus VOLOGDIN, 1964, p. 1394 [**P. cirratus*; OD; genus diagnosed, species illustrated only; species described by VOLOGDIN, 1966, p. 47]. Cups slenderly conical or tubular, commonly crooked. Inner wall exaxial, developed the whole length of the cup. *L.Cam.(Solontsov)*, USSR (Kuznetsk Alatau).—FIG. 103,10. **P. cirratus*, Solontsov, Kuznetsk Alatau; holotype, long. sec., $\times 8$ (or ?; see above) (Vologdin, 1964a).

Radicicyathus VOLOGDIN, 1964, p. 1393 [**R. canaliculatus*; OD; genus diagnosed, species illustrated only; species described by VOLOGDIN, 1966, p. 48] [= *Redicicyathus* and *Radiacicyathus* VOLOGDIN, 1964, p. 1394, *nom. null.*]. Cups tubular with distal distension in which is sited oblique central cavity. *L.Cam.(Solontsov)*, USSR (Kuznetsk Alatau).—FIG. 103,9. **R. canaliculatus*; holotype, long. sec., $\times 10$ (or ?; see above) (Vologdin, 1964a).

Sunicyathus VOLOGDIN, 1964, p. 1394 [**S. pulcher*, OD; genus diagnosed, species neither described nor illustrated; species described and illustrated by VOLOGDIN, 1966, p. 44]. Cup short, more or less isometric, closed. *L.Cam.(Botom.)*, USSR (W. Sayan).

Turricyathus VOLOGDIN, 1964, p. 1394 [**T. procerulus*, OD; genus diagnosed, species neither described nor figured; VOLOGDIN, 1966, p. 45, named *T. turris* VOLOGDIN, 1966, p. 45, type-species]. Cup short, subquadrate in section; inner wall orientated more or less regularly longitudinally, but somewhat exaxial. *L.Cam.(Botom.)*, USSR (W. Sayan).

Family CAPILLICYATHIDAE Vologdin, 1964

[Capillicyathidae VOLOGDIN, 1964, p. 1394]

Cups two-walled, slenderly conical outer wall with flat double peripteratae; inner wall with simple round pores. *L.Cam.(Botom.)*.

Capillicyathus VOLOGDIN, 1964, p. 1394 [**C. fimbriatus*; OD; genus diagnosed, single species illustrated only; species described by VOLOGDIN, 1966, p. 50]. Cup slenderly conical, peripterate outer wall in little transverse folds, with slitlike pores; development of inner wall lags behind growth of outer wall. *L.Cam.(Botom.)*, USSR (W. Sayan).—FIG. 103,11. **C. fimbriatus*, R. Kyzas, W. Sayan; holotype, long. sec., $\times 10$ (or ?; Vologdin, 1964a, 1966, gave different magnifications) (Vologdin, 1964a).

Order VOLOGDINOPHYLLIDA Radugin, 1964

[*nom. correct.* HILL, herein, *pro* Vologdinophylloidea RADUGIN, 1964, p. 145] [= Akademiophylloidea RADUGIN,

1964, p. 145; Pterocyathida YANKAUSKAS, 1969, p. 134, *nom. correct. pro* Pterocyathidae YANKAUSKAS, 1965, p. 439 (order)]

Two-walled or one-walled, bilaterally symmetrical, slenderly conical or cylindrical, very small cups (order of diameter 0.5 mm.), straight or cornute; outer wall consists of separate laminar transverse elements (peripteratae, Fig. 104), in general infundibuliform; inner wall transversely annulate or monolithic. *L.Cam.(Aldan.)*.

Superfamily VOLOGDINOPHYLLACEA Radugin, 1964

[*nom. transl.* YANKAUSKAS, 1969, p. 134 (*ex* Vologdinophyllidae RADUGIN, 1964, p. 145)]

Conical or cylindrical cups, one-walled, constructed of peripteratae of the first, second, and third types (see Fig. 104). *L.Cam.(Aldan.)*.

Family LEIBAELLIDAE Yankauskas, 1965

[Leibaellidae YANKAUSKAS, 1965, p. 439]

One-walled slenderly conical and cylindrical cups with straight orifices and oval or round-loaf transverse section. Walls consist of peripteratae of first or second type (Fig. 104). *L.Cam.(Aldan.)*.

Leibaella YANKAUSKAS, 1964 (unseen by HILL); 1965, p. 439 [**L. elovica*; OD; in 1965 genus diagnosed, single species illustrated only; species described by YANKAUSKAS, 1969, p. 138] [= *Coscinophyllina*, *Coscinophyllum* RADUGIN, 1966 (unseen), *vide* YANKAUSKAS, 1969, p. 138]. One-walled cups straight or weakly curved, the wall formed of peripteratae of the second type (see Fig. 104). *L.Cam.(Aldan.)*, USSR (Altay-Sayan).—FIG. 105,3. **L. elovica*, R. Mana, E. Sayan; 3a-e, transv. and long. secs., $\times 18$ (Yankauskas, 1969).

Dubius YANKAUSKAS, 1969, p. 135 [**D. uncatus*; OD]. Cups with very thin aporose wall, rarely with obscurely displayed peripteratae, straight or bent, in some at an obtuse angle to the longitudinal axis. *L.Cam.(Aldan.)*, USSR (E. Sayan).—FIG. 105,1. **D. uncatus*, R. Mana, E. Sayan; holotype, 1a,b, long. and transv. secs., $\times 16$ (Yankauskas, 1969).

Ramifer YANKAUSKAS, 1965, p. 439 [**R. giratus*; M; genus diagnosed, single species illustrated only; species described by YANKAUSKAS, 1969, p. 136]. One-walled with single wall formed by peripteratae of the first type (Fig. 104). *L.Cam.(Aldan.)*, USSR (Altay-Sayan).—FIG. 105,2. **R. giratus*, R. Mana, E. Sayan; holotype, 2a,b, long. and transv. secs., $\times 16$ (Yankauskas, 1969).

Family **VOLOGDINOPHYLLIDAE**
Radugin, 1964

[Vologdinophyllidae RADUGIN, 1964, p. 145] [=Vologdinophyllidae YANKAUSKAS, 1965, p. 439, *nom. null.*]

One-walled cups with chambered, ring-chambered or subchambered wall; periprateratae of third and fourth types (see Fig. 104). *L. Cam. (Aldan.)*.

Vologdinophyllum RADUGIN, 1962, p. 8; 1966 (unseen by HILL) [**V. chachlovi*; OD] [=*Hemiphyllum*, *Miophyllum*, *Ophyllum*, *Mesophyllum*, *Ellipsophyllum*, *Monophyllum*, *Vandophyllum*, *Costophyllum*, *Anomalophyllum*, *Dephyllum*, *Laphyllum*, *Nefrophyllum*, *Rombophyllum*, *Ellipsophyllina*, *Gonophyllum*, *Eophyllum*, *Hemiphyllina*, *Linsophyllum*, *Kaphyllum*, *Thephyllum*, *Esphyllum*, *Quadriphyllum*, *Trapecephyllum*, *Trigonophyllum*, *Monstrophyllum*, *Circophyllum*, all of RADUGIN, 1966 (unseen by HILL); synonymy *vide* YANKAUSKAS, 1969, p. 141]. Cups one-walled, the wall constructed of periprateratae of the third and fourth types (see Fig. 104); walls chambered, or ring-chambered, or very rarely subchambered. Cups characteristically bilaterally symmetrical, elliptical, oval, round-loaf shaped, reniform in transverse section. Inner cavity oval or predominantly reniform in section. *L. Cam. (Aldan.)*, USSR (Altay-Sayan).—FIG. 106, 4. **V. chachlovi*; 4a-e, oblique long. sec., transv. and long. secs., $\times 20$ (Yankauskas, 1969). [= *Vologdinophyllum* YANKAUSKAS, 1965, p. 439, *nom. null.*]

[Of these new genera, RADUGIN, 1964, p. 146 gave figures of transverse sections of the following designated (new) type-species, but without diagnoses or descriptions: *Miophyllum biconvexum*, *Ophyllum planoconvexum*, *Mesophyllum ordinare*, *Ellipsophyllum typicum*, *Vandophyllum khalfini*, *Dephyllum tadasi*, *Laphyllum ordinare*, *Nefrophyllum vasi*, *Rombophyllum primum*, *Ellipsophyllina rara*, *Linsophyllum (sic) asimmetricum*, *Kaphyllum irregulare*, *Thephyllum (sic) mirabile*, *Esphyllum originale*, *Quadriphyllum koptevi*, *Trapecephyllum unicum*, *Trigonophyllum inexpectum*. All of these species except *N. vasi*, *R. primum*, *E. rara* and *T. inexpectum* were placed by YANKAUSKAS (1969, p. 141) in synonymy with *V. chachlovi*. For the following generic names, senior homonyms exist for taxa in the animal kingdom: *Circophyllum*, *Mesophyllum*, *Rombophyllum* (as *Rombophylla*) and *Trigonophyllum* (as *Trigonophylla*); *Monophyllum*, *Hemiphyllum* and *Anomalophyllum* (as *Anomalophylla*).]

Cardiophyllum RADUGIN, 1964, p. 146 [**C. kelleri*; OD, but figured only; and *vide* YANKAUSKAS, 1969, p. 143] [= *Cardiophyllina*, *Stapephyllum*, *Aphyl-*

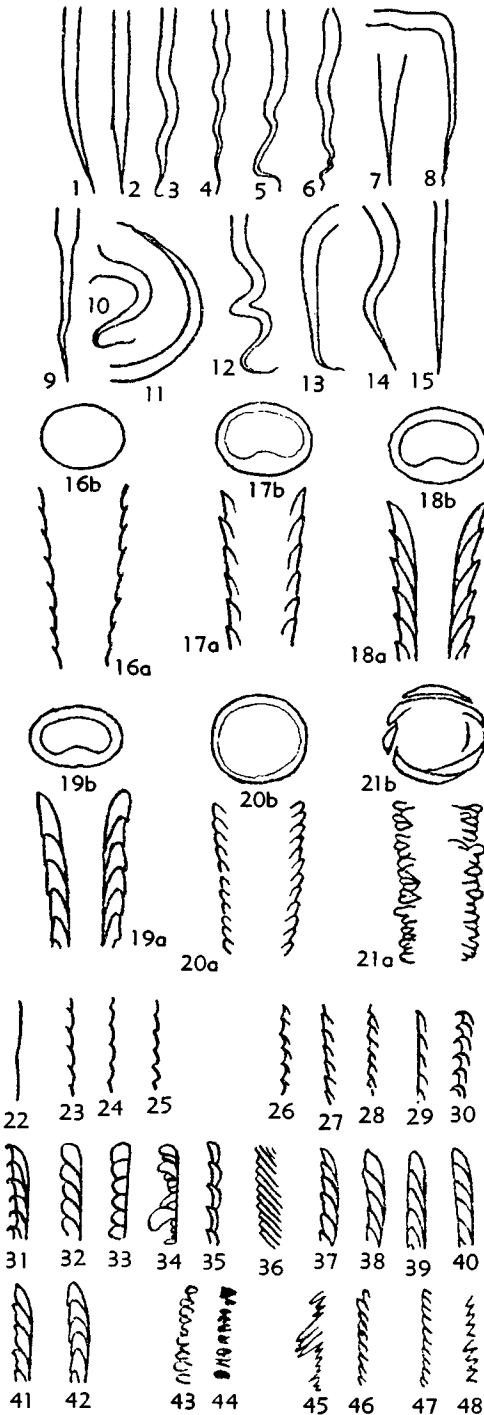


FIG. 104. Morphology of Vologdinophyllida (Yankauskas, 1969).—1-15. Form of cup in long. sec.—16-21. Types of periprateratae in long.

(a views) and transv. (b views) secs.; 16a,b, first type; 17a,b, second type; 18a,b, third type; 19a,b, fourth type; 20a,b, fifth type; 21a,b, sixth (manacyathid) type.—22-48. Morphological variety in periprateratae in radial long. sec., inner surface of wall to right; 22-25, in first type; 26-30, in second type; 31-41, in third type; 42, in fourth type; 43-44, in Manacyathidae (sixth type); 45-48, in fifth type.

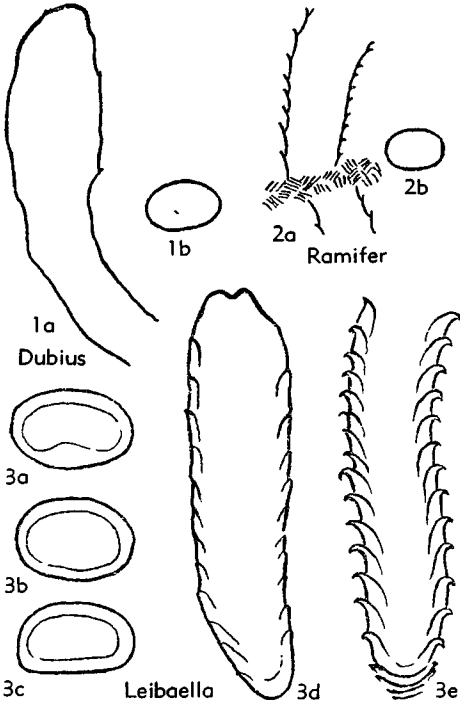


FIG. 105. Leibaellidae (p. E137).

lum, *Bephyllum*, *Cephyllum* all of RADUGIN, 1964, p. 146, 1966 (unseen); type new species of these genera named and figured as *C. mani*, *S. cerskii*, *A. lomonsovi*, *B. lermontovae*, and *C. costatum* but not described by RADUGIN, 1964, p. 146, and all were considered synonyms of *C. kelleri* by YANKAUSKAS, 1969, p. 143; there is a senior homonym in the animal kingdom for *Aphyllum*; *Manaella* YANKAUSKAS, 1964 (unseen), 1965, p. 439, only species named and figured, not described, *M. basaika* YANKAUSKAS, 1964]. Cups one-walled, third type. *L.Cam.*(*Aldan.*), USSR(E.Sayan).—FIG. 106,1. **C. kelleri*, R.Mana, E.Sayan; 1a-f, transv. and long. secs., $\times 16$ (Yankauskas, 1969). **Crispus** YANKAUSKAS, 1965, p. 439 [*C. subdimidiatus*; M; genus diagnosed; single species illustrated only; type-species described by YANKAUSKAS, 1969, p. 145]. One-walled cups, the wall chambered or ring-chambered, formed of peripateratae of third type (see Fig. 104), upper edges of the peripateratae on the one side rounded, on the other, sharply pointed. *L.Cam.*(*Aldan.*), USSR (E.Sayan).—FIG. 106,3. **C. subdimidiatus*, R. Mana, E.Sayan; 3a, sec. through initial and early stages; 3b,c, oblique sec., 3d, oblique long. sec., all $\times 16$ (Yankauskas, 1969).

Longaevus YANKAUSKAS, 1965, p. 439 [*L. vitalis*, M; genus diagnosed; single species illustrated only; species described by YANKAUSKAS, 1969, p. 144].

Slenderly conical cups, oval in transverse section, with simple, cameratae wall; peripateratae asymmetrically positioned, their axial edges on the one side free, on the other side conjunct. *L.Cam.* (*Aldan.*), USSR(E.Sayan).—FIG. 106,2. **L. vitalis*, R.Mana, E.Sayan; holotype, oblique sec. of orifice region, $\times 16$ (Yankauskas, 1969).

Superfamily
AKADEMIOPHYLLACEA
Radugin, 1964

[*nom. transl.* HILL, herein (*ex* Akademiophyllidae RADUGIN, 1964, p. 145)] [=Pterocyathacea YANKAUSKAS, 1969, p. 146]

Conical or cylindrical cups, two-walled;

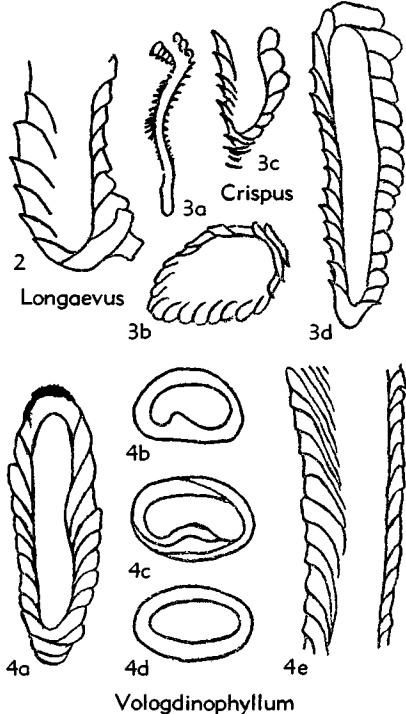
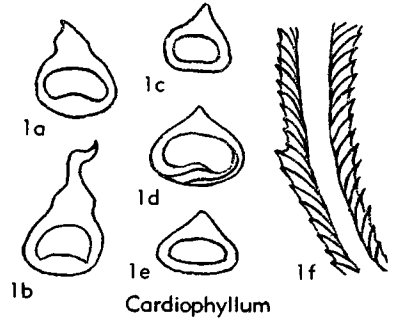


FIG. 106. Vologdinophyllidae (p. E138).

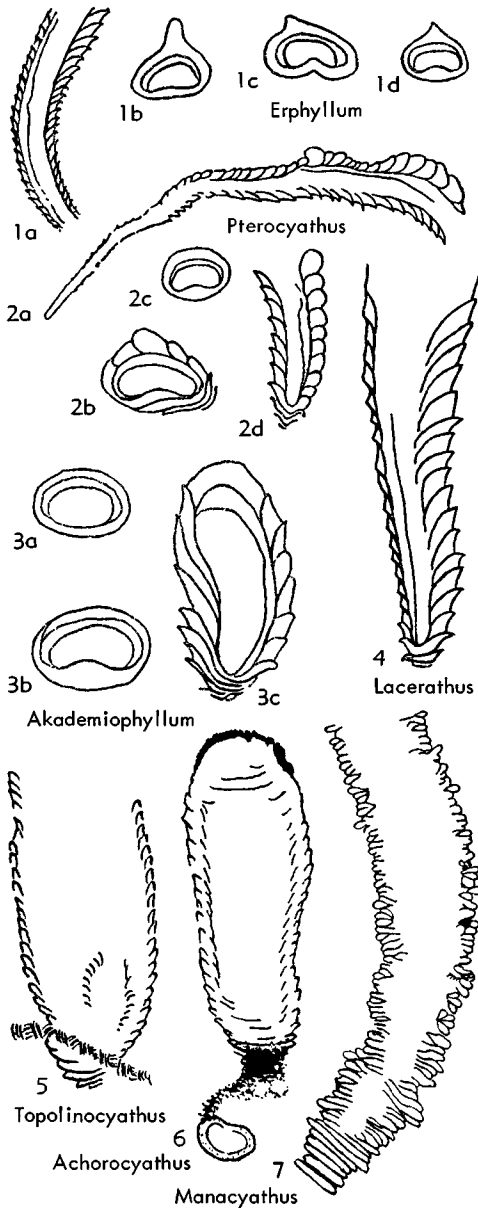


FIG. 107. Akademiophyllidae (1-4); Achorocyathidae (5-6); Manacyathidae (7) (p. E140-E141).

outer wall peripertate, inner wall monolithic or striate. *L.Cam.(Aldan.)*.

Family AKADEMIOPHYLLIDAE Radugin, 1964

[Akademiophyllidae RADUGIN, 1964, p. 145] [=Pterocyathidae YANKAUSKAS, 1965, p. 440]

Cup two-walled; outer wall chambered or ring-chambered, peripertate of third type (see Fig. 104); inner wall monolithic. *L.Cam.(Aldan.)*.

Akademiophyllum RADUGIN, 1964, p. 145 [**A. coniforme*, OD]. Cup two-walled; outer wall peripertate, chambered or ring-chambered, peripertate of third type (see Fig. 104); inner wall monolithic, trough-formed. *L.Cam.(Aldan.)*, USSR (R. Mana, E. Sayan).—FIG. 107, 3. **A. corniforme*; 3a, b, transv. secs., 3c, long. sec., all $\times 13$ (Yankauskas, 1969).

Erphyllum RADUGIN, 1964, p. 146 [**E. bephylliforme*; OD (figured only); described by YANKAUSKAS, 1969, p. 148] [= *Archaeobullathus* YANKAUSKAS, 1965, p. 440 (type, *A. cereiformis* YANKAUSKAS, 1965, p. 438; M; figured only, but genus diagnosed); *Archaeobullathus* VOLOGDIN, 1966, p. 16, *nom. null.*]. Like *Akademiophyllum*, but cup heart-shaped in transverse section. *L.Cam.(Aldan.)*, USSR (R. Mana, E. Sayan).—FIG. 107, 1. **E. bephylliforme*, R. Mana, E. Sayan; 1a, long. sec., 1b, c, d, transv. secs., all $\times 13$ (Yankauskas, 1969).

Lacerathus YANKAUSKAS, 1965, p. 440 [**L. cuneatus*; M; genus diagnosed, single species illustrated only; species described YANKAUSKAS, 1969, p. 149] [= *Laceratus* YANKAUSKAS, 1964, p. 438; 1969, p. 149, *nom. null.*]. Outer wall peripertate, chambered, asymmetry of peripertate as in *Longaeus*; inner wall monolithic, trough-formed. *L.Cam.(Aldan.)*, USSR (E. Sayan).—FIG. 107, 4. **L. cuneatus*, R. Mana, E. Sayan; oblique long. sec., $\times 20$ (Yankauskas, 1969).

Pterocyathus YANKAUSKAS, 1965, p. 440 [**P. glaucus*; M; genus diagnosed, single species illustrated only; species described YANKAUSKAS, 1969, p. 150, as *P. glaucus* (*nom. null.*)]. Two-walled cups; outer wall peripertate, chambered or ring-chambered; inner wall monolithic; upper edge of peripertate on "ventral" side acute, on "spinal" side rounded. *L.Cam.(Aldan.)*, USSR (Altay-Sayan).—FIG. 107, 2. **P. glaucus*, R. Mana, E. Sayan; 2a, long. sec., $\times 13$; 2b, c, transv. sec., $\times 13$; 2d, oblique long. sec., $\times 10$ (Yankauskas, 1969).

Family ACHOROCYATHIDAE Yankauskas, 1965

[Achorocyathidae YANKAUSKAS, 1965, p. 440]

Cups two-walled, large (1.5 to 2 mm. diameter), straight, slenderly conical with rounded, rarely oval transverse section; outer wall subcamerate, composed of peripertate of the fifth type (see Fig. 104); inner wall striate. Porosity rarely observed. *L.Cam.(Aldan.)*.

Achorocyathus YANKAUSKAS, 1965, p. 440 [**A. perbellus*, M; genus diagnosed, single species illustrated only; species described YANKAUSKAS, 1969, p. 152]. Cups long, straight, conical two-walled; outer wall peripterate, subcamerate, composed of peripteratae of fifth type; inner wall striate, developed for entire length of adult stages. Gyrate peripteratae have uneven lower edges, causing short transverse chink-like openings performing role of pores. *L.Cam.(Aldan.)*, USSR(E.Sayan). —FIG. 107,6. **A. perbellus*, R.Mana, E.Sayan; oblique long. sec., $\times 13$ (Yankauskas, 1969).

Topolinocyathus YANKAUSKAS, 1965, p. 440 [**T. popovi*; M; genus diagnosed, single species illustrated only; species described YANKAUSKAS, 1969, p. 153]. Outer wall as in *Achorocyathus*; inner wall striate, barrel-shaped. *L.Cam.(Aldan.)*, USSR(E.Sayan). —FIG. 107,5. **T. popovi*, R.Mana, E.Sayan; holotype, oblique sec., $\times 13$ (Yankauskas, 1969).

Class UNCERTAIN

Order ARCHAEPHYLLIDA

Okulitch, 1943

[*nom. correct.* OKULITCH, 1955, p. E10 (pro *Archaeophyllina* OKULITCH, 1943, p. 46)] [= *Archaeophylloidea* RADUGIN, 1964, p. 147]

Family ARCHAEPHYLLIDAE

Vologdin, 1931

[*Archaeophyllidae* VOLOGDIN, 1931, p. 60]

Archaeophyllum SIMON, 1939, p. 21 [**A. edelsteini*; OD SIMON, 1939, p. 21]. ?*L.Cam.(up.Atdaban.)*, USSR(Kameshki, Kuznetsk Alatau).

Butovia VOLOGDIN, 1931, p. 63 [**B. serrata*; M]. ?*L.Cam.(up.Atdaban.)*, USSR(Kameshki, Kuznetsk Alatau).

Order UNCERTAIN

Family MANACYATHIDAE

Yankauskas, 1969

[*Manacyathidae* YANKAUSKAS, 1969, p. 154]

One-walled, radially symmetrical, conical or cylindrical cups, the wall composed of connecting peripteratae of the sixth type (see Fig. 104). *L.Cam.(Aldan.)*.

Manacyathus YANKAUSKAS, 1969, p. 154 [**M. mikroporosus*; OD]. Cups radially symmetrical, one-walled; wall composed of a system of peripteratae each doubled back on itself (sixth type) forming an annular ruffle. Some skeletal elements microporous. *L.Cam.(Aldan.)*, USSR(E.Sayan). —FIG. 107,7. **M. mikroporosus*, R.Mana, E.Sayan; holotype, part of long. sec., $\times 13$ (Yankauskas, 1969).

Class RADIOCYATHA

Debrenne, H. Termier, &

G. Termier, 1971

[*Radiocyatha* DEBRENNE, H. TERMIER, & G. TERMIER, 1971, p. 120]

DEBRENNE, *et al.*, 1971, p. 124, drew attention to morphological similarities of this class to *Archaeocyatha* and *Echinodermata*. *L.Cam.(up.Atdaban-low.Botom.)*.

Order HETAIRACYATHIDA

R. Bedford & J. Bedford, 1937

[*nom. correct.* OKULITCH, 1955, p. E18 pro *Hetairacyathina* R. BEDFORD & J. BEDFORD, 1937, p. 27 (*nom. subst. pro Heterocyathina* OKULITCH, 1935, p. 90, based on invalid generic name)]

Family HETAIRACYATHIDAE

R. Bedford & J. Bedford, 1934

[*nom. subst.* R. BEDFORD & J. BEDFORD, 1937, p. 27 (pro *Heterocyathidae* R. BEDFORD & W. R. BEDFORD, 1934, p. 6)]

Radiocyathus OKULITCH, 1937 (April), p. 252 [*nom. subst.* OKULITCH, 1937, p. 252, pro *Heterocyathus* R. BEDFORD & W. R. BEDFORD, 1934, p. 6 (type, *H. minor*; SD BEDFORD & W. R. BEDFORD, 1936, p. 20), non *Heterocyathus* EDWARDS & HAIME, 1848, p. 323 (type, *H. aequicostatus*; SD EDWARDS & HAIME, 1850, p. xv)] [**Heterocyathus minor* R. BEDFORD & W. R. BEDFORD, 1934, p. 7; OD] [= *Hetairacyathus* R. BEDFORD & J. BEDFORD, 1937 (Sept.), p. 27, *nom. subst. pro Heterocyathus* R. BEDFORD & W. R. BEDFORD, 1934, p. 6, non *Heterocyathus* EDWARDS & HAIME, 1848, p. 323 (type, *H. aequicostatus*; SD EDWARDS & HAIME, 1850, p. xv)]. *L.Cam.(up.Atdaban. or low.Botom.)*, S.Australia(Ajax Mine, Beltana).

Class UNCERTAIN, PROBABLY NOT ARCHAEOCYATHA

Order UNCERTAIN

Family MATTHEWCYATHIDAE

Okulitch, 1943

[*Matthewcyathidae* OKULITCH, 1943, p. 48]

Matthewcyathus OKULITCH, 1940, p. 84 [**Archaeocyathus pavonoides* MATTHEW, 1886, p. 29; OD]. *M.Cam.*, Can.(N.B.).

Family KOROVINELLIDAE

Khalfina, 1960

[*Korovinellidae* KHALFINA, 1960, p. 80]

Members of this family, together with *Praeactinostroma* and *Cambrostroma* were

considered to be the earliest stromatoporoids by YAWORSKY (1932, p. 613), ZHURAVLEVA (1955, p. 17; 1960, p. 312), KHALFINA (1960, p. 79), VLASOV (1961, p. 22; 1967, p. 120), KHALFINA & YAVORSKIY (1967, p. 133) and VOLOGDIN (1940b, p. 102; 1966, p. 7), but NESTOR (1966, p. 3) considered them to be archaeocyathans of the Order Archaeosyconida. Herein they are considered probably not archaeocyathans. *L.Cam.(up. Botom.)*.

Altaicyathus VOLOGDIN, 1932, p. 27 [**A. notabilis*; M] [= *Korovinella* RADUGIN (MS in KHALFINA), 1960, p. 81 (type, *Clathrodictyon sajanicum* YAWORSKY, 1932, p. 614; OD)]. *L.Cam.(up. Botom.)*, USSR (Sayano-Altay).

Family UNCERTAIN

Atikokania WALCOTT, 1912, p. 6 [**A. lawsoni*; OD]. ?*Precam.(Steepproçk Series)*, Can.

Cambrostroma VLASOV, 1961, p. 29 [**C. rossicum*; OD]. *L.Cam.(up.Botom.)*, USSR (Sayano-Altay).

Miassocyathus FOMIN, 1963, p. 17 [**M. lobanovae*; OD]. *M.Dev.*, USSR (S.Urals).

Misracyathus VOLOGDIN, 1959, p. 82 [**M. vindhianus*; M]. *U.Proteroz.(Vindhyan)*, India.

Orlinocyathus KRASNOPEEVA in VOLOGDIN, 1957, p. 212 [**O. olgae*; M]. *U.Cam.*, USSR (Salair). Probably a sponge of the family Archaeoscyphidae RAUFF.

Praeactinostroma KHALFINA, 1960, p. 81 [**Actinostroma vologdini* YAWORSKY, 1932, p. 613; OD]. *L.Cam.(up.Botom.)*, USSR (Sayano-Altay).

Spongiosicyathus ZHURAVLEVA, 1968, p. 174 [**Dicyathus translucidus* ZHURAVLEVA, 1960, p. 275; OD]. Solitary or colonial, cups in form like a round loaf, or commonly conical; skeletal walls absent; intervallum a framework of regularly spaced spicules arranged at right angles in three planes—radial longitudinal, radial horizontal and tangential; adherent outgrowths form shapeless carbonate mass. *L.Cam.(up.Tommot.-low.Botom.)*, USSR (Sib.Plattf.).

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