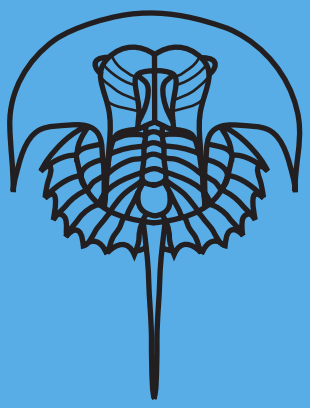

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Number 50

Part E, Revised, Volume 4, Chapter 19:

Systematic Descriptions: Archaeocyatha

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PART E, REVISED, VOLUME 4, CHAPTER 19: SYSTEMATIC DESCRIPTIONS: ARCHAEOCYATHA

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Phylum PORIFERA Grant, 1836
Class ARCHAEOCYATHA Bornemann, 1884

[*nom. correct.* Vologdin, 1937b, p. 464, *pro* Archaeocyathinae Bornemann, 1884, p. 706] [=class Archaeocyathinae Taylor, 1910, p. 105; =class Cyathospongia Okulitch, 1935, p. 88; =class Archaeocyathi R. Bedford & W. R. Bedford, 1936, p. 9; =subphylum Archaeocyatha Vologdin, 1937b, p. 464 (Porifera); =class Pleospongia Okulitch, 1943, p. 1; phylum Archaeocyatha Okulitch, 1955a, p. 8; =phylum Archaeocyathi Krasnopeeva, 1955, p. 17; =subphylum Euarchaeocyatha Zhuravleva, 1960b, p. 79, *nom. transl.* Zhuravlev & others in Sokolov & Zhuravleva, 1983, p. 6, *ex* class Euarchaeocyathi Zhuravleva, 1960b, p. 79; =Salpingidea Vologdin & Yazmir, 1967, p. 1377; =phylum Archaeocyatha Hill, 1972, p. 2; =Euarchaeocyatha Zhuravleva & Myagkova, 1979, p. 521] [equivalent to superfamily Archaeocyathaceae Simon, 1939, p. 5]

Skeleton nonspiculate, calcareous cup of microgranular microstructure and (with few exceptions) original magnesium calcite composition. Cup generally of archaeocyathan architecture with one or two porous walls bounding inner or central cavity respectively; porous to aporose septa, pseudosepta, taeniae, pseudotaeniae, pseudotaenial network, dictyonal network, syringes, and/or tabulae may form in intervallum; a minority are of chaetetid (intervallum with calicles) or thalamid architecture (cup consisting of successive chambers). Solitary or modular. Secondary calcareous skeleton may be present. [For an explanation of zonal terms used herein, see Debrenne, Zhuravlev, & Kruse, 2012, p. 64–65.] *Cambrian (Terreneuvian–Furongian).*

Order MONOCYATHIDA Okulitch, 1935

[*nom. correct.* Okulitch, 1955a, p. 9, *pro* order Monocyathina Okulitch, 1935, p. 90] [=Archaeolynthida Zhuravleva, 1957, p. 174; =Tectocyathida Vologdin in Vologdin & Yazmir, 1966, p. 948; =suborder Globosocyathina Okuneva, 1969, p. 74; =suborder Monocyathina Debrenne, 1970a, p. 24; =Tecticyathida Vologdin, 1977, p. 93]

Cup one walled, solitary or low modular; pelta may be present. [Within each (sub) order, superfamilies and constituent families are arranged in order of wall type.] *lower Cambrian (Tom.1–Bot.3).*

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

[Monocyathidae R. Bedford & W. R. Bedford, 1934, p. 2] [=Rhabdocnemidae Okulitch, 1943, p. 45, *nom. nov. pro* Rhabdocyathidae Vologdin, 1931, p. 52, invalid family-group name based on junior homonym; =Archaeolynthidae Zhuravleva, 1949, p. 550; =Monocyathinae Zhuravleva, 1963b, p. 74, *nom. transl. ex* Monocyathidae R. Bedford & W. R. Bedford, 1934, p. 2; =Rhabdocyathellidae Zhuravleva, 1963b, p. 114; =Capsolynthidae Okuneva, 1969, p. 75; =Crassicyathidae Vologdin, 1977, p. 79; =Spinicyathidae Vologdin, 1977, p. 103]

Wall with simple pores. *lower Cambrian (Tom.1–Bot.3).*

Archaeolynthus Taylor, 1910, p. 158 [**Monocyathus porosus* R. Bedford & W. R. Bedford, 1934, p. 2; SD R. Bedford & W. R. Bedford, 1936, p. 20; lectotype, R. Bedford & W. R. Bedford, 1934, fig. 1; Zhuravleva, 1963b, fig. 39d; Hill, 1965, pl. 2,*1;* Debrenne, 1969a, pl. 1,*3;* Debrenne, 1974b, pl. 19,*1;* SD Hill, 1965, p. 52, NHM S4140, London] [=*Ventriculocyathus* Vologdin, 1928, p. 31, *nom. nud.;* =*Ventriculocyathus* Vologdin, 1931, p. 51 (type, *V. caulius,* M), for discussion, see Hill, 1965, p. 63; =*Monocyathus* R. Bedford & W. R. Bedford, 1934, p. 2 (type, *M. porosus,* SD R. Bedford & W. R. Bedford, 1936, p. 20; lectotype, Hill, 1965, pl. 2,*1;* SD Hill, 1965, p. 52, S4140, NHM, London); =*Rhabdocnema* Okulitch, 1937a, p. 252, *nom. nov. pro Rhabdocyathus* von Toll, 1899, p. 45, *non* Brook, 1893, cnidarian (type, *R. sibiricus,* M), for discussion, see Hill, 1965, p. 51; =*Rhabdocyathella* Vologdin, 1937b, p. 474 (type, *R. lebedevae*, M), for discussion, see Hill, 1965, p. 53; =*Capsolynthus* Osadchaya in Zhuravleva & others, 1967, p. 26 (type, *C. helenae,* OD); =*Corticicyathus* Vologdin, 1977, p. 46 (type, *C. aequiporosus,* OD); =*Crassicyathus* Vologdin, 1977, p. 79 (type, *C. canaliculatus,* OD); =*Tegminicyathus* Vologdin, 1977, p. 98 (type, *T. simplex,* OD); =*Tytthocyathus* Vologdin, 1977, p. 98 (type, *T. jenisseicus,* OD); =*Spinicyathus* Vologdin, 1977, p. 103 (type, *S. cipis,* OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 94; Debrenne, Rozanov, & Zhuravlev, 1990, p. 133]. Wall pores of uniform size. *lower Cambrian (Tom.1–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Australia, Antarctica, Morocco, Iberia.——Fig. 1,*1a–b.* **A. porosus* (R. Bedford & W. R. Bedford), Ajax Limestone, Botoman, Ajax Mine, South Australia,

Debrenne, F., A. Yu. Zhuravlev, & P. D. Kruse. 2012. Part E, Revised, Volume 4, Chapter 19: Systematic descriptions: Archaeocyatha. Treatise Online 50:1–186, 134 fig.

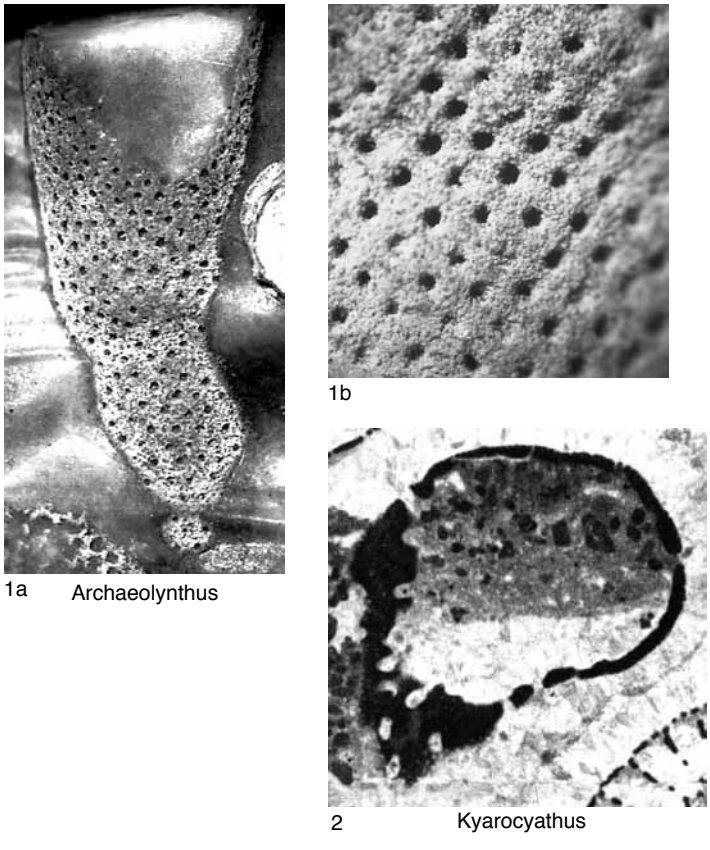


FIG. 1. Monocyathidae (p. 1–2).

Australia, lectotype, NHM S4140; *a,* external longitudinal view of cup, ×5 (Hill, 1965); *b,* detail of porosity in external tangential view, ×10 (Debrenne, 1974b).

Kyarocyathus KRUSE, 1982, p. 144 [**K. duplus*; OD; holotype, KRUSE, 1982, fig. 7H–J, AM FT.8240, FT.8244, Sydney]. Wall pores of two distinct sizes. *lower Cambrian (Bot.1–Bot.2):* Mongolia, Australia.——FIG. 1,*2. **K. duplus*, Mount Wright Volcanics, Botoman, Mt. Wright, New South Wales, Australia, AM FT.8240, FT.8244, oblique transverse section, ×10 (Kruse, 1982).

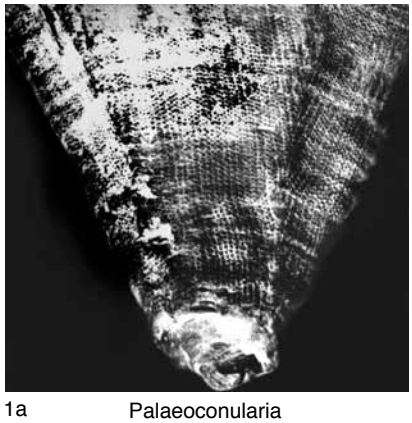
Family PALAEOCONULARIIDAE Chudinova, 1959

[Palaeoconulariidae CHUDINOVA, 1959, p. 53] [=Debrennecyathidae VOLOGDIN in VOLOGDIN & YAZMIR, 1966, p. 948, invalid family-group name based on unavailable genus name; =Debrennecyathidae VOLOGDIN, 1977, p. 100]

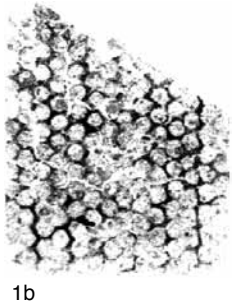
Wall with attached microporous sheath. *lower Cambrian (Atd.4–Bot.3).*

Palaeoconularia CHUDINOVA, 1959, p. 53 [**P. prima*; OD; holotype, CHUDINOVA, 1959, fig. 1–2, PIN 1577/1, Moscow] [=*Laminaecyathus* YAZMIR in VOLOGDIN & YAZMIR, 1966, p. 948 (type, *L. triangulatus*, OD); =*Debrennecyathus* VOLOGDIN in VOLOGDIN & YAZMIR, 1966, p. 948, *nom. nud.*, unavailable genus-group name without associated nominal species; =*Debrennecyathus* VOLOGDIN, 1977, p. 101 (type, *D. pulcher*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 122; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 154]. Wall with reticulate carcass pores and attached microporous sheath. *lower Cambrian (Bot.1–Bot.3):* Altay Sayan, Tuva, Mongolia, Transbaikalia.——FIG. 2,*1a–c. **P. prima*, Verkhnemonok Formation, Botoman, Karakol River, West Sayan, Altay Sayan, Russia, holotype, PIN 1577/1; *a,* external longitudinal view of cup, ×2; *b,* tangential section of microporous sheath, ×6; *c,* tangential section of carcass pores, ×11 (Chudinova, 1959).

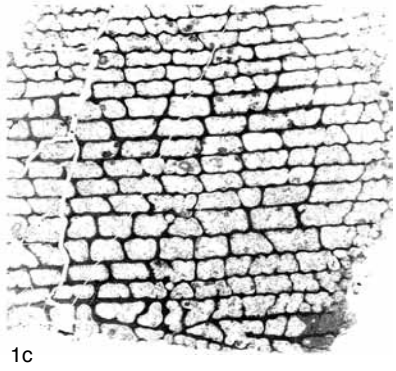
?Butakovicyathus ZHURAVLEVA, 1980, p. 175 [**B. butakovi;* OD; holotype, ZHURAVLEVA, 1980, pl.



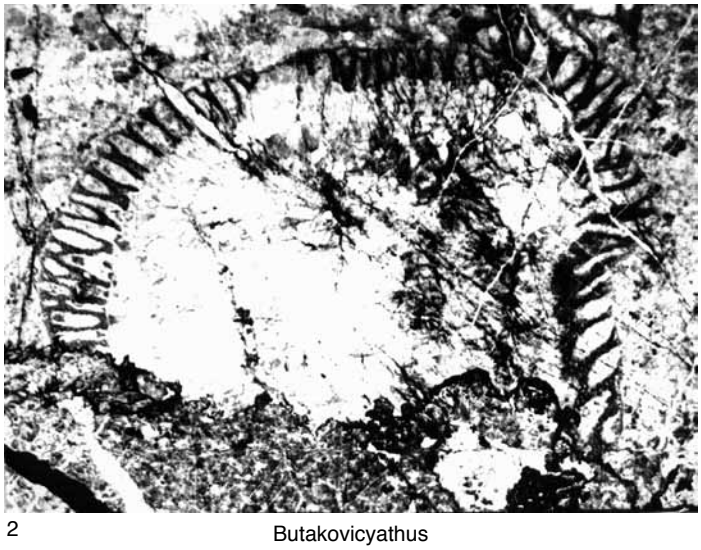
1a Palaeoconularia



1b



1c



2 Butakovicyathus

FIG. 2. Palaeoconulariidae (p. 2–4).

30,*1–2*, TsSGM 569, Novosibirsk]. Wall carcass pores of two distinct sizes with attached microporous sheath. [The single available section does not provide certainty as to wall structure.] *lower Cambrian (Atd.4–Bot.1):* Altay Sayan.——FIG. 2,*2. *B. butakovi*, Krol Formation, Atdabanian, Mana River, East Sayan, Altay Sayan, Russia, holotype, TsSGM 569, transverse section, ×12 (Zhuravleva, 1980).

Family TUMULIOLYNTHIDAE Rozanov, 1966

[Tumuliolynthidae ROZANOV in ROZANOV & MISSARZHEVSKIY, 1966, p. 77] [=Papulicyathidae VOLOGDIN, 1977, p. 62; =Verrucicyathidae VOLOGDIN, 1977, p. 63; =Orthocyathidae VOLOGDIN, 1977, p. 96]

Wall with simple tumuli. *lower Cambrian (Tom.2–Bot.3).*

Tumuliolynthus ZHURAVLEVA, 1963b, p. 101 [**Rhabdocyathus tubexternus* VOLOGDIN, 1932, p. 64; OD; holotype, VOLOGDIN, 1932, pl. 5,*1a*, TsNIGRm 209a/2957, St. Petersburg] [=*Papulicyathus* VOLOGDIN, 1977, p. 62 (type, *P. longus,* OD); =*Verrucicyathus* VOLOGDIN, 1977, p. 64 (type, *V. tumefactus,* OD), for discussion, see KRUSE, 1982, p. 144; =*Isthmocyathus* VOLOGDIN, 1977, p. 70 (type, *I. articulatus,* OD); =*Mammaticyathus* VOLOGDIN, 1977, p. 71 (type, *M. kyzasicus*, OD); =*Orthocyathus* VOLOGDIN, 1977, p. 97 (type, *O. bateniensis*, OD), *non Cyathophyllum (Orthocyathus)* MERRIAM, 1974, p. 34 (type, *Prismatophyllum flexum* STUMM, 1938, p. 483, OD), cnidarian; for discussion, see DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 165]. Wall with simple tumuli. *lower Cambrian (Tom.2–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Urals, Australia, Antarctica, Morocco, Iberia.——FIG. 3,*1. *T. tubexternus* (VOLOGDIN), Verkhneynyrga Formation, Botoman, Lebed' River, Altay Mountains, Altay Sayan, Russia, holotype, TsNIGRm 209a/2957, transverse section, ×3 (Vologdin, 1932).

Family SAJANOLYNTHIDAE Rozanov, 1989

[Sajanolynthidae ROZANOV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 79] [=Sajanolynthidae KASHINA in ROZANOV, 1973, p. 85, *nom. nud.*]

Wall with multiperforate tumuli. *lower Cambrian (Bot.1).*

Sajanolynthus VOLOGDIN & KASHINA, 1972, p. 152 [**S. desideratus;* OD; holotype, VOLOGDIN & KASHINA, 1972, pl. 20,*1*, KGU 19/1, Krasnoyarsk] [=*Pustulicyathus* VOLOGDIN, 1977, p. 94 (type, *P. tectus*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 129; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 159]. Wall with multiperforate tumuli. *lower Cambrian (Bot.1):* Altay Sayan, Far East.——FIG. 3,*2. *S. desideratus*, Torgashino Formation, Botoman, Uyar River, East Sayan, Altay Sayan, Russia, holotype, KGU 19/1, transverse section, ×15 (Vologdin & Kashina, 1972).

Family GLOBOSOCYATHIDAE Okuneva, 1969

[Globosocyathidae OKUNEVA, 1969, p. 75] [=Propriolynthidae ROZANOV, 1973, p. 85, *nom. nud.;* =Tumuloglobosidae ROZANOV, 1973, p. 85, *nom. nud.;* =?Tecticyathidae VOLOGDIN, 1977, p. 93]

Wall with bracts or scales. *lower Cambrian (Atd.2–Bot.1).*

Propriolynthus OKUNEVA, 1967, p. 133 [**Archaeolynthus vologdini* YAKOVLEV, 1956, p. 855; OD; lectotype, YAKOVLEV, 1956, pl. 1,*1,* SD OKUNEVA, 1967, p. 133, not located] [=*Globosocyathus* OKUNEVA, 1969, p. 75 (type, *G. bellus,* OD); =*Tumuloglobosus* OKUNEVA in OKUNEVA & REPINA, 1973, p. 93 (type, *T. crassus,* OD); =*Subiculicyathus* VOLOGDIN, 1977, p. 49 (type, *Archaeolynthus vologdini* YAKOVLEV, 1956, p. 855, OD); =?*Tecticyathus* VOLOGDIN, 1977, p. 93 (type, *Archaeolynthus peltathus* MASLOV, 1961, p. 121, OD); =*Propricyathus* OKUNEVA in VOLOGDIN, 1977, p. 100 (type, *P. maritimus*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 125; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 156]. Wall with pores bearing downwardly projecting, cupped bracts. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Far East.——FIG. 3,*3a–b. *P. vologdini* (YAKOVLEV), Dmitrievka Formation, Botoman, Spassk-Chernigovka area, Far East, Russia, specimen PGU 30-x_2; *a,* oblique longitudinal section, ×3; *b,* tangential section, ×15 (Okuneva, 1967).

Melkanicyathus BELYAEVA, 1969, p. 88 [**M. limitatus;* OD; holotype, BELYAEVA, 1969, pl. 38,*2–3,* DVGU 212/5, Khabarovsk] [=*Phymatocyathus* VOLOGDIN, 1977, p. 72 (type, *P. orillatus,* OD); =*Scyphocyathus* VOLOGDIN, 1977, p. 96 (type, *Rhabdocnema operculatum* MASLOV, 1960, p. 1117, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 118; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 151]. Wall with pores bearing upwardly projecting, cupped bracts. *lower Cambrian (Bot.1):* Altay Sayan, Far East.——FIG. 3,*4a–b. *M. limitatus*, Ust'toka unit, Botoman, Bol'shoy Mel'kan River, Dzhagdy Range, Far East, Russia, holotype, DVGU 212/5; *a,* oblique transverse section, ×6; *b,* longitudinal section, ×6 (Belyaeva, 1969).

Family FAVILYNTHIDAE Debrenne, 1989

[Favilynthidae DEBRENNE in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 79] [=Favilynthidae DEBRENNE, 1974b, p. 98, *nom. nud.*]

Wall with canals. *lower Cambrian (Atd.1–Bot.3).*

Favilynthus DEBRENNE in ZHURAVLEVA, 1974a, p. 138 [**Monocyathus mellifer* R. BEDFORD & W. R. BEDFORD, 1936, p. 12; OD; holotype, R. BEDFORD &

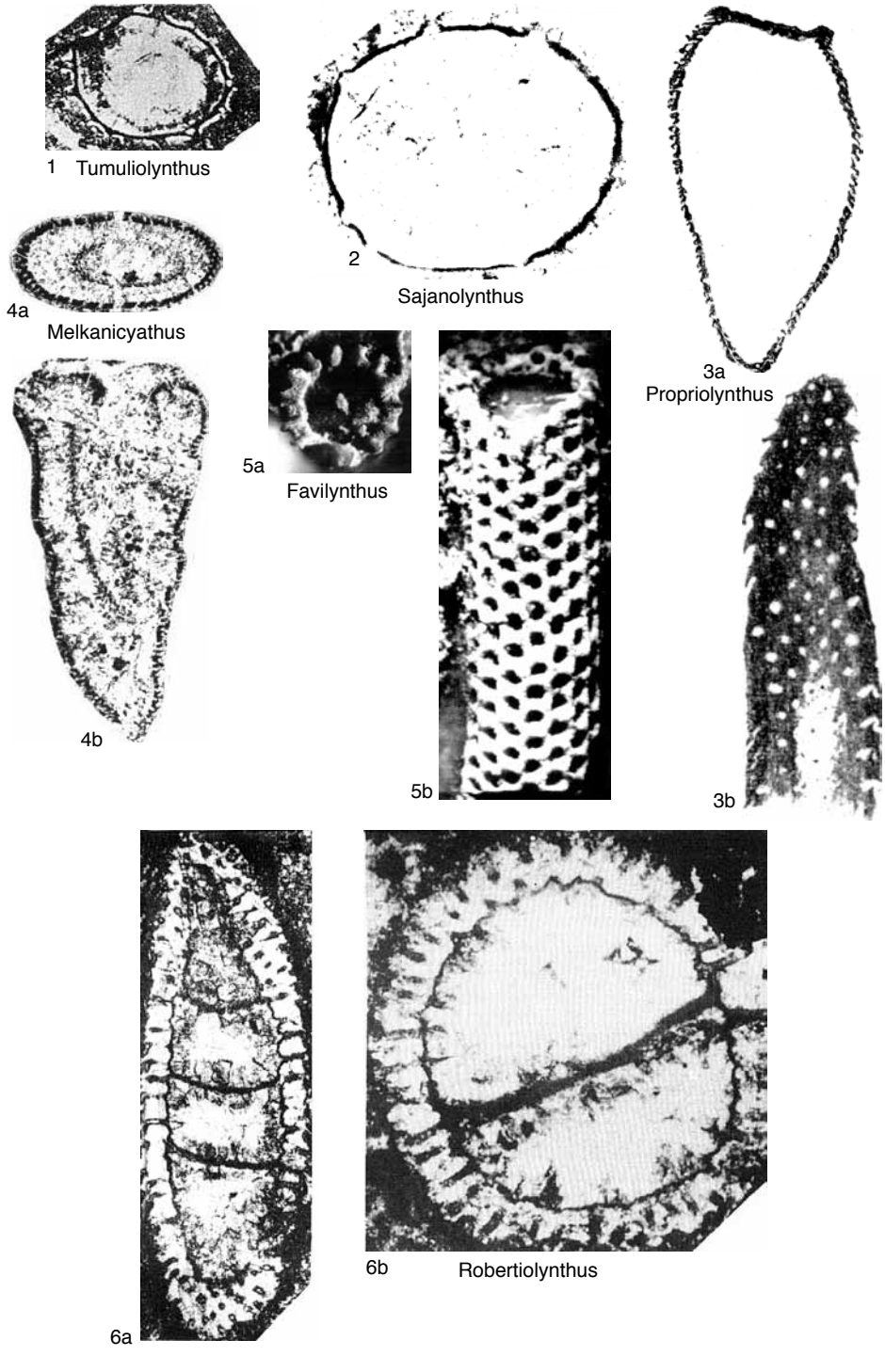


FIG. 3. Tumuliolynthidae, Sajanolynthidae, Globosocyathidae, and Favilynthidae (p. 4–6).

W. R. Bedford, 1936, fig. 49; Zhuravleva, 1963b, fig. 42; Debrenne, 1974b, pl. 19,*5–6*, SAM P932-47, Adelaide]. Wall with horizontal to upwardly projecting, straight canals. *lower Cambrian (Atd.1–Bot.3):* Altay Sayan, Tuva, Mongolia, Far East, Australia, Antarctica.——Fig. 3,*5a–b. *F. mellifer* (R. Bedford & W. R. Bedford), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia; *a,* external transverse view, holotype, SAM P932-47, ×6; *b,* external longitudinal view, topotype, USNM PU9, ×6 (Debrenne, 1974b).

Robertiolynthus Zhuravlev in Voronova and others, 1987, p. 19 [**R. handfieldi*; OD; holotype, Voronova & others, 1987, pl. 1,*1*, GSC 90116, Ottawa] [=*Veolynthus* Boyarinov & Konyaeva in Zhuravleva & others, 1997a, p. 26 (type, *V. jucundus*, OD)]. Wall with horizontal to upwardly projecting, straight canals bearing supplementary bracts externally. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Canada.——Fig. 3,*6a–b. *R. handfieldi*, Sekwi Formation, Botoman, Mackenzie Mountains, Northwest Territories, Canada; *a,* holotype, GSC 90116, longitudinal section, ×19; *b,* paratype, GSC 90117, transverse section, ×19 (Voronova & others, 1987).

Order AJACICYATHIDA R. Bedford & J. Bedford, 1939

[*nom. correct.* Okulitch, 1955a, p. 10, *pro* order Ajacicyathina R. Bedford & J. Bedford, 1939, p. 70] [=?order Somphocyathina Okulitch, 1943, p. 47, *nom. nud.;* =Somphocyathida Okulitch, 1955a, p. 19; =Nochoroicyathida Zhuravleva in Vologdin, 1956, p. 879; =Dokidocyathida Vologdin, 1957a, p. 178; =Bronchocyathida Zhuravleva in Vologdin, 1957a, p. 180; =Bosceculida Krasnopeeva, 1960, p. 41; =Ethmophyllida Vologdin, 1961, p. 178; =Cyclocyathellida Vologdin, 1961, p. 179]

Cup two walled, solitary or low modular; inner wall of centripetal type of development; intervallum with septa, with or without plate tabulae. *lower Cambrian (Tom.1–Toy.3).*

Suborder DOKIDOCYATHINA Vologdin, 1957

[*nom. transl.* Zhuravleva, 1960b, p. 95, *ex* order Dokidocyathida Vologdin, 1957a, p. 178]

Intervallum with septa bearing single longitudinal pore row. *lower Cambrian (Tom.2–Bot.3).*

Superfamily DOKIDOCYATHOIDEA R. Bedford & W. R. Bedford, 1936

[*nom. correct.* Debrenne, Zhuravlev, & Rozanov, 1989, p. 80, *pro* Dokidocyathacea Debrenne, 1970a, p. 24, *nom. transl. ex* Dokidocyathidae R. Bedford & W. R. Bedford, 1936, p. 12]

Outer wall with simple pores. *lower Cambrian (Tom.2–Bot.3).*

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

[Dokidocyathidae R. Bedford & W. R. Bedford, 1936, p. 12]

Inner wall with simple pores. *lower Cambrian (Tom.2–Bot.3).*

Dokidocyathus Taylor, 1910, p. 146 [**D. simplicissimus*; M; lectotype, Taylor, 1910, pl. 16, photos 91–92; Zhuravleva, Konyushkov, & Rozanov, 1964, pl. 4,*2–3;* Rozanov, 1973, pl. 14,*1;* Debrenne, 1974b, pl. 20,*3;* SD Debrenne, 1970a, p. 33, SAM T1589A-B, cups F-G, Adelaide] [=?*Velicyathus* Debrenne, 1964, p. 125 (type, *V. levillaini*, OD); =*Dokidolynthus* Debrenne, 1974b, p. 101 (type, *Dokidocyathus lenaicus* Rozanov in Zhuravleva, Konyushkov, & Rozanov, 1964, p. 83, OD); =?*Kamyshovaecyathus* Yazmir in Zhuravleva, 1974a, p. 183, *nom. nud.,* based on type species not then available; =?*Kamyshovaecyathus* Yazmir in Yazmir, Dalmatov, & Yazmir, 1975, p. 38 (type, *K. immanis,* OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 104; Debrenne, Rozanov, & Zhuravlev, 1990, p. 141]. Outer and inner walls with simple pores. *lower Cambrian (Tom.2–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Urals, Australia, Antarctica, Morocco, Iberia.——Fig. 4,*1. *D. simplicissimus*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM T1589A-B, cups F-G, oblique transverse view, ×2.5 (Taylor, 1910).

Family DOKIDOCYATHELLIDAE Debrenne, 1964

[Dokidocyathellidae Debrenne, 1964, p. 112]

Inner wall with bracts or scales. *lower Cambrian (Atd.2–Bot.1).*

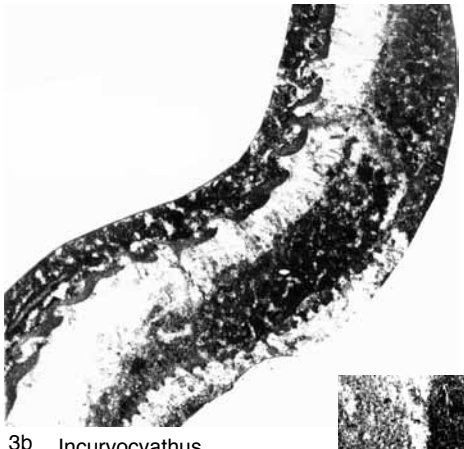
Dokidocyathella Zhuravleva, 1960b, p. 100 [**D. incognita*; OD; holotype, Zhuravleva, 1960b, fig. 73, pl. 5,*3,* TsSGM 205/8, Novosibirsk]. Inner wall with pores bearing upwardly projecting, S-shaped scales. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Far East.——Fig. 4,*2. *D. incognita*, Pestrotsvet Formation, Atdabanian, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 205/8, transverse section, ×10 (Zhuravleva, 1960b).

Incurvocyathus Rozanov in Rozanov & Missarzhevskiy, 1966, p. 50 [**I. voronovae;* OD; holotype, Rozanov & Missarzhevskiy, 1966, pl. 1,*4–5*, PIN 4597/57, Moscow]. Cup with regular transverse folds affecting both walls; inner wall with pores bearing possibly upwardly projecting, S-shaped scales. *lower Cambrian (Atd.2–Bot.1):* Altay Sayan, Tuva.——Fig. 4,*3a–b. *I. voronovae*, Shangan Formation, Botoman, East Tannu-Ola Range, Tuva, Russia, holotype, PIN 4597/57; *a,* longitudinal section (outer wall to left), ×8; *b,* detail of longitudinal section (outer wall to left), ×8 (Rozanov & Missarzhevskiy, 1966).

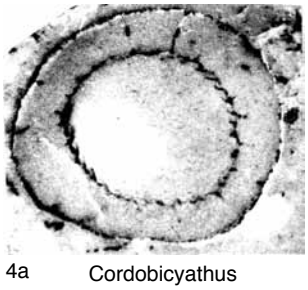
1 Dokidocyathus

2 Dokidocyathella

3a



3b Incurvocyathus



4a Cordobicyathus

4b

4c

FIG. 4. Dokidocyathidae, Dokidocyathellidae, and Cordobicyathidae (p. 6–8).

Family CORDOBICYATHIDAE Perejón, 1975

[Cordobicyathidae Perejón, 1975a, p. 136]

Inner wall with annuli. *lower Cambrian (Atd.2).*

Cordobicyathus Perejón, 1975a, p. 136 [**C. deserti*; OD; holotype, Perejón, 1975a, pl. 3,*1–3*, CE 3-74-2, Madrid]. Inner wall with upwardly projecting, S-shaped annuli. *lower Cambrian (Atd.2):* Iberia, Germany, Poland.——Fig. 4,*4a–c*. **C. deserti*, Pedroche Formation, Atdabanian, Las Ermitas, Cordoba, Andalusia, Spain, holotype, CE 3-74-2; *a,* transverse section, ×6.5 (Perejón, 1975a); *b,* oblique section, ×6.5; *c,* detail of longitudinal section (outer wall to right), ×15 (Debrenne, Zhuravlev, & Kruse, 2002).

Superfamily KIDRJASOCYATHOIDEA Rozanov, 1964

[*nom. transl.* Debrenne, Zhuravlev, & Rozanov, 1989, p. 80, *ex* Kidrjasocyathidae Rozanov in Zhuravleva, Konyushkov, & Rozanov, 1964, p. 95] [=Kidrjasocyathacea Rozanov, 1973, p. 85, *nom. nud.*]

Outer wall with independent microporous sheath. *lower Cambrian (Atd.2–Bot.1).*

Family KIDRJASOCYATHIDAE Rozanov, 1964

[Kidrjasocyathidae Rozanov in Zhuravleva, Konyushkov, & Rozanov, 1964, p. 95]

Inner wall with simple pores. *lower Cambrian (Atd.2–Bot.1).*

Kidrjasocyathus Rozanov, 1960b, p. 43 [**K. uralensis*; OD; holotype, Rozanov, 1960b, fig. 1, pl. 1,*1a–b;* Zhuravleva, Konyushkov, & Rozanov, 1964, pl. 10,*3*, PIN 4297/9, Moscow]. Inner wall with simple pores. *lower Cambrian (Atd.2–Bot.1):* Altay Sayan, Urals.——Fig. *5a–c*. **K. uralensis*, Terekla Formation, Botoman, Kidryassovo, western flank of southern Urals, Russia, holotype, PIN 4297/9; *a,* transverse section, ×9; *b,* detail of transverse section (outer wall to right), ×20 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* sketch of transverse section, ×20 (Rozanov, 1960b).

Superfamily KALTATOCYATHOIDEA Rozanov, 1964

[*nom. transl.* Debrenne, Zhuravlev, & Rozanov, 1989, p. 80, *ex* Kaltatocyathidae Rozanov in Zhuravleva, Konyushkov, & Rozanov, 1964, p. 92] [=Kaltatocyathacea Rozanov, 1973, p. 85, *nom. nud.*]

Outer wall with simple tumuli. *lower Cambrian (Atd.1–Bot.1).*

Family KALTATOCYATHIDAE Rozanov, 1964

[Kaltatocyathidae Rozanov in Zhuravleva, Konyushkov, & Rozanov, 1964, p. 92]

Inner wall with simple pores. *lower Cambrian (Atd.1–Bot.1).*

Kaltatocyathus Rozanov in Zhuravleva, Konyushkov, & Rozanov, 1964, p. 92 [**K. kaschinae*; OD; holotype, Zhuravleva, Konyushkov, & Rozanov, 1964, pl. 9,*7*, PIN 4297/47, Moscow] [=*Aroonacyathus* Gravestock, 1984, p. 46 (type, *A. gregarius*; OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 114; Debrenne, Rozanov, & Zhuravlev, 1990, p. 147]. Inner wall with simple pores. *lower Cambrian (Atd.1–Bot.1):* Altay Sayan, Transbaikalia, Far East, Australia.——Fig. 6. **K. kaschinae*, Bazaikha Formation, Atdabanian, Bazaikha River, East Sayan, Altay Sayan, Russia, holotype, PIN 4297/47, transverse section, ×19 (Zhuravleva, Konyushkov, & Rozanov, 1964).

Superfamily PAPILLOCYATHOIDEA Rozanov, 1989

[Papillocyathoidea Rozanov in Debrenne, Zhuravlev, & Rozanov, 1989, p. 80] [=Papillocyathacea Rozanov, 1973, p. 85, *nom. nud.*].

Outer wall with multiperforate tumuli. *lower Cambrian (Atd.4–Bot.1).*

Family PAPILLOCYATHIDAE Rozanov, 1989

[Papillocyathidae Rozanov in Debrenne, Zhuravlev, & Rozanov, 1989, p. 80] [=Papillocyathidae Rozanov, 1973, p. 85, *nom. nud.*]

Inner wall with simple pores. *lower Cambrian (Atd.4–Bot.1).*

Papillocyathus Rozanov in Zhuravleva, Konyushkov, & Rozanov, 1964, p. 94 [**P. vacuus*; OD; holotype, Zhuravleva, Konyushkov, & Rozanov, 1964, pl. 10,*1–2*, PIN 4297/48-2, Moscow]. Inner wall with simple pores. *lower Cambrian (Atd.4–Bot.1):* Altay Sayan.——Fig. *7a–b*. **P. vacuus*, Balakhtinson Formation, Botoman, Kazyr River, East Sayan, Altay Sayan, Russia, holotype, PIN 4297/48-2; *a,* transverse section, ×20; *b,* longitudinal section (outer wall to right), ×20 (Zhuravleva, Konyushkov, & Rozanov, 1964).

Superfamily SOANICYATHOIDEA Rozanov, 1964

[*nom. transl.* Debrenne, Zhuravlev, & Rozanov, 1989, p. 80, *ex* Soanicyathidae Rozanov in Zhuravleva, Konyushkov, & Rozanov, 1964, p. 97] [=Soanicyathacea Rozanov, 1973, p. 85, *nom. nud.*]

Outer wall with bracts or scales. *lower Cambrian (Atd.2–Bot.1).*

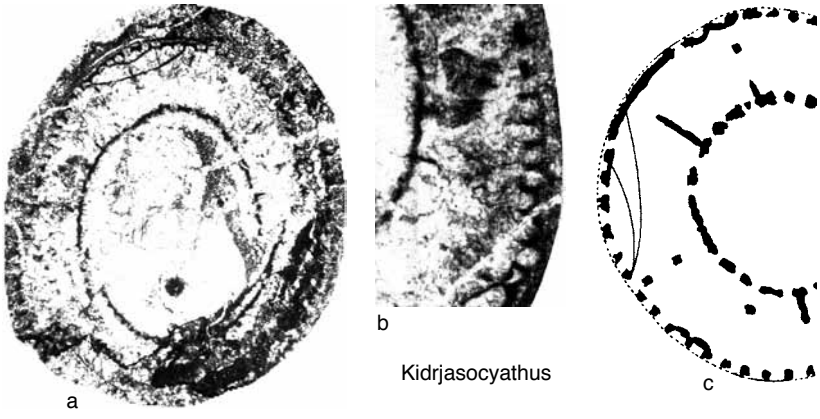


FIG. 5. Kidrjasocyathidae (p. 8).

Family SOANICYATHIDAE Rozanov, 1964

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

Inner wall with bracts or scales. *lower Cambrian (Atd.2–Bot.1).*

Subtilocyathus VOLOGDIN, 1960, p. 422 [**Archaeocyathus subtilis* VOLOGDIN, 1932, p. 41; OD; lectotype, VOLOGDIN, 1932, fig. 32a–b, pl. 7,*7,* pl. 8,*5b,* SD DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1557, TsNIGRm 50a/2957, St. Petersburg] [=*Soanicyathus* ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 98 (type, *S. admirandus,* OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 133; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 162]. Outer and inner walls with pores bearing upwardly projecting, cupped bracts. *lower Cambrian (Atd.2–Bot.1):* Altay Sayan, Tuva, Mongolia.——FIG. 8,*1a–b*. **S. subtilis* (VOLOGDIN), Verkhneynyrga Formation, Botoman, Lebed' River, Altay Mountains, Altay Sayan, Russia, lectotype, TsNIGRm 50a/2957; *a,* transverse section, ×4; *b,* detail of transverse section, ×20 (Vologdin, 1932).

Batschykicyathus ZHURAVLEV in ZHURAVLEV, ZHURAVLEVA, & FONIN, 1983, p. 23 [**B. angulosus*; OD; holotype, ZHURAVLEV, ZHURAVLEVA, & FONIN, 1983, pl. 3,*4*, PIN 3848/501, Moscow]. Outer wall regularly bulging in transverse files; outer and inner walls with pores bearing upwardly projecting, cupped bracts. *lower Cambrian (Atd.4):* Siberian Platform.——FIG. 8,*2. *B. angulosus*, Pestrotsvet Formation, Atdabanian, Bachyk Creek, Lena River, Sakha (Yakutia), Russia, holotype, PIN 3848/501, oblique longitudinal section, ×10 (Zhuravlev, Zhuravleva, & Fonin, 1983).

Family ZHURAVLEVAECYATHIDAE Rozanov, 1989

[Zhuravlevaecyathidae ROZANOV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 81] [=Zhuravlevaecyathidae ROZANOV, 1973, p. 85, *nom. nud.*]

Inner wall with annuli. *lower Cambrian (Bot.1).*

Zhuravlevaecyathus ROZANOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 98 [**Z. pulchellus*; OD; holotype, ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, pl. 11,*5–6*, PIN 4297/54, Moscow]. Outer wall with pores bearing upwardly projecting, cupped bracts; inner wall with possibly upwardly projecting, S-shaped annuli. *lower Cambrian (Bot.1):* Altay Sayan.——FIG. 8,*3a–b*. **Z. pulchellus*, Verkhnemonok Formation, Botoman, Abakan River, West Sayan, Altay Sayan, Russia; *a,* holotype, PIN 4297/54, transverse section, ×4; *b,* paratype, PIN 4297/55, detail of transverse section, ×3.5 (Zhuravleva, Konyushkov, & Rozanov, 1964).

Superfamily KYMBECYATHOIDEA Debrenne, Rozanov, & Zhuravlev, 1989

[Kymbecyathoidea DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 81]

Outer wall with canals. *lower Cambrian (Atd.4–Bot.3).*

Family KYMBECYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Kymbecyathidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 81]

Inner wall with simple pores. *lower Cambrian (Atd.4–Bot.3).*

FIG. 6. Kaltatocyathidae (p. 8).

Kymbecyathus DEBRENNE & KRUSE, 1986, p. 241 [**K. avius*; OD; holotype, DEBRENNE & KRUSE, 1986, fig. 6A–B, VU VC9, Wellington]. Outer wall with horizontal to upwardly projecting, straight canals; inner wall with simple pores. *lower Cambrian (Atd.4–Bot.3):* Australia, Antarctica.——FIG. 9*a–b*. **K. avius*, Shackleton Limestone, Botoman, Crackling Cwm, Byrd Glacier, Antarctica, holotype, VU VC9; *a,* transverse section, ×3 (Debrenne & Kruse, 1986); *b,* oblique longitudinal section, ×3 (Debrenne, Zhuravlev, & Kruse, 2002).

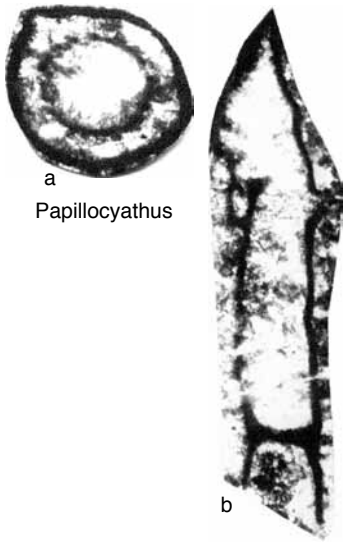


FIG. 7. Papillocyathidae (p. 8).

Suborder AJACICYATHINA R. Bedford & J. Bedford, 1939

[*nom. transl.* ZHURAVLEVA, 1960b, p. 106, *ex* order Ajacicyathina R. BEDFORD & J. BEDFORD, 1939, p. 70] [=Nochoroicyathina ZHURAVLEVA in VOLOGDIN, 1956, p. 879, *nom. transl.* ZHURAVLEVA, 1960b, p. 198, *ex* Nochoroicyathida ZHURAVLEVA in VOLOGDIN, 1956, p. 879; =Schidertycyathina KRASNOPEEVA, 1969, p. 63; =Boscekulcyathina KRASNOPEEVA, 1969, p. 63]

Intervallum with septa; pectinate tabulae or synapticulae may be present. *lower Cambrian (Tom.1–Toy.3).*

Superfamily BRONCHOCYATHOIDEA R. Bedford & J. Bedford, 1936

[*nom. transl.* ZHURAVLEV in VORONOVA & others, 1987, p. 20, *ex* Bronchocyathidae R. BEDFORD & J. BEDFORD, 1936, p. 25] [=Ajacicyathoidea R. BEDFORD & J. BEDFORD, 1939, p. 73, *nom. correct.* DEBRENNE & KRUSE, 1986, p. 242, *pro* Ajacicyathacea ZHURAVLEVA, 1960b, p. 106, *nom. transl. ex* Ajacicyathidae R. BEDFORD & J. BEDFORD, 1939, p. 73; =Nochoroicyathacea ZHURAVLEVA in VOLOGDIN, 1956, p. 879, *nom. transl.* ZHURAVLEVA, 1960b, p. 198, *ex* Nochoroicyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879; =Irinacyathacea ZHURAVLEVA in DEBRENNE, 1972, p. 174, *nom. neg.*; =Aldanocyathacea ZADOROZHNAYA, OSADCHAYA, & REPINA, 1973, p. 129, *nom. transl.* KORSHUNOV, 1983a, p. 96, *ex* Aldanocyathinae ZADOROZHNAYA, OSADCHAYA, & REPINA, 1973, p. 129; =Irinaecyathacea ZHURAVLEVA in ZHURAVLEVA & ELKINA, 1974, p. 44; =Inessocyathacea ZHURAVLEVA in ZHURAVLEVA & ELKINA, 1974, p. 45]

Outer wall with simple pores. *lower Cambrian (Tom.1–Toy.2).*

Family AJACICYATHIDAE R. Bedford & J. Bedford, 1939

[Ajacicyathidae R. BEDFORD & J. BEDFORD, 1939, p. 73] [=Nochoroicyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879; =Kisasacyathidae KONYUSHKOV, 1972, p. 137; =Aldanocyathidae ZADOROZHNAYA, OSADCHAYA, & REPINA, 1973, p. 129]

Inner wall with simple pores. *lower Cambrian (Tom.1–Toy.2).*

Ajacicyathus R. BEDFORD & J. BEDFORD, 1939, p. 73 [**Archaeocyathus ajax* TAYLOR, 1910, p. 118; OD; lectotype, TAYLOR, 1910, pl. 1, photo 1a, pl. 7, photo 39 (lower part); HILL, 1965, pl. 1,*6;* DEBRENNE, 1974b, pl. 21,*2–4;* SD DEBRENNE, 1970a, p. 27, SAM T1550A, Adelaide] [=*Loculicyathellus* DEBRENNE, 1969a, p. 310 (type, *Archaeocyathus floreus* R. BEDFORD & W. R. BEDFORD, 1934, p. 2, OD), *nom. transl.* DEBRENNE, 1974b, p. 115, *ex Loculicyathus (Loculicyathellus)* DEBRENNE, 1969a, p. 310; =*Ajacicyathus (Juricyathus)* DEBRENNE, 1974b, p. 110 (type, *Archaeocyathus aequitriens* R. BEDFORD & J. BEDFORD, 1937, p. 35, OD); =*Ambistapis* KRUSE, 1982, p. 161 (type, *A. integer*, OD)]. Inner wall with several rows of simple pores per intersept; stirrup pores may be present; septa aporose to sparsely porous. *lower Cambrian (Atd.1–Toy.2):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Far East, Australia, Antarctica, Sardinia, France, Canada.——FIG. 10,*1a–b*. **A. ajax* (TAYLOR), Ajax Limestone, Botoman, Ajax Mine, South Australia,

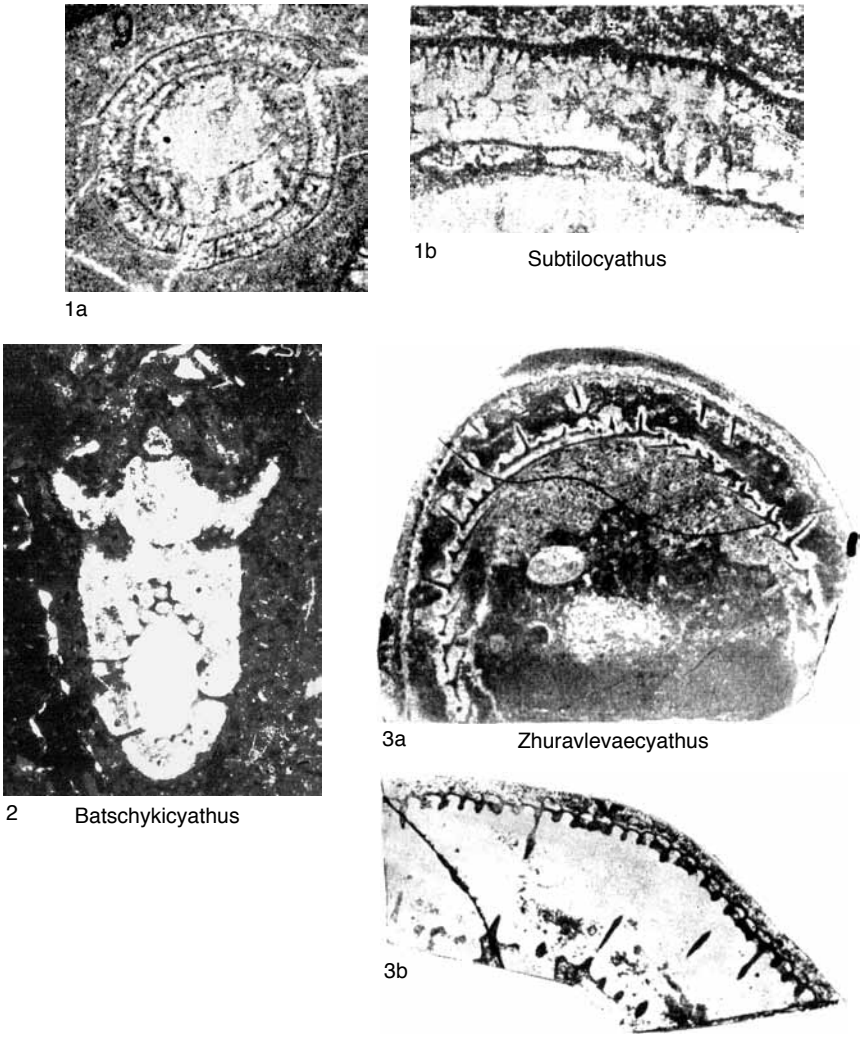


FIG. 8. Soanicyathidae and Zhuravlevaecyathidae (p. 9).

Australia, lectotype, SAM T1550A; *a,* oblique longitudinal view, ×1 (Taylor, 1910); *b,* detail of septum and inner wall in longitudinal view (outer wall to right), ×10 (Debrenne, 1974b).

Davidicyathus DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 139 [**?Loculicyathus racemiferus* GRAVESTOCK, 1984, p. 48; OD; holotype, GRAVESTOCK, 1984, fig. 32H, 32L, SAM P21452, Adelaide]. Outer wall with two sizes of pores, the smaller either isolated or clustered over the larger; inner wall with several rows of simple pores per intersept; septa completely porous. *lower Cambrian (Atd.4):* Australia.——FIG. 10,*2a–c*. **D. racemiferus* (GRAVESTOCK); *a–b,* Wilkawillina Limestone, Atdabanian, Wilkawillina Gorge, South Australia, Australia, holotype, SAM P21452, *a,* transverse section, ×4; *b,* longitudinal section, ×9.5 (Gravestock, 1984); *c,* Ajax Limestone, Atdabanian, Mount Scott Range, South Australia, Australia, SAM P21455-1, tangential section of outer wall, ×15 (M. Debrenne, new).

Dentatocyathus OKUNEVA, 1972, p. 57 [**D. maritimus*; OD; holotype, OKUNEVA, 1972, pl. 10,*7*, PGU 202, Khabarovsk]. Outer wall longitudinally plicate; inner wall with several rows of simple pores per intersept; septa completely porous. *lower Cambrian (Bot.1):* Altay Sayan, Tuva, Mongolia, Far East.——FIG. 11,*1a–b*. **D. maritimus*, Dmitrievka

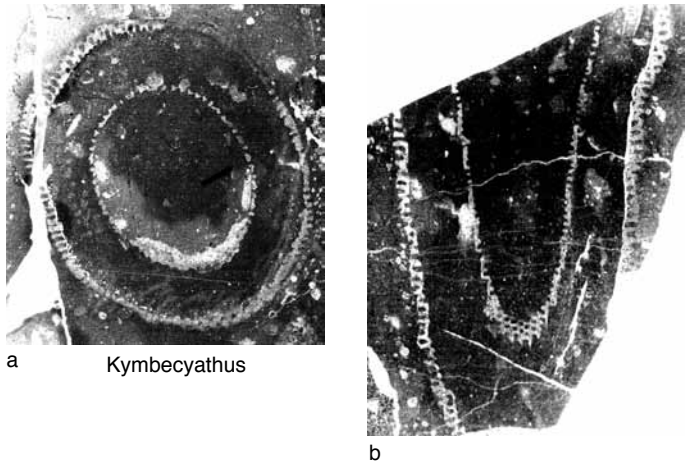


FIG. 9. Kymbecyathidae (p. 10).

Formation, Botoman, Knorring Hill, Spassk-Chernigovka area, Far East, Russia, holotype, PGU 202; *a,* transverse section, ×5; *b,* detail of transverse section (outer wall to right), ×10 (Okuneva, 1972).

Iljinicyathus ZHURAVLEVA, 1972b, p. 155 [**I. ulanbatoriensis*; OD; holotype, ZHURAVLEVA, 1972b, pl. 21,*1–3*, TsSGM 755/1, Novosibirsk]. Cup in which inner wall shows periodic transverse folds; inner wall with several rows of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.2–Atd.4):* Mongolia.——FIG. 11,*2a–b*. **I. ulanbatoriensis*, formation not known, Atdabanian, northern Mongolia, holotype, TsSGM 755/1; *a,* transverse section, ×4; *b,* longitudinal section (outer wall to right), ×5 (Zhuravleva, 1972b).

Kisasacyathus KONYUSHKOV, 1972, p. 137 [**K. microtumulatus*; OD; holotype, KONYUSHKOV, 1972, pl. 16,*1*, PIN 4755/7, Moscow] [=*Prethmophyllum* DEBRENNE, 1974c, p. 174 (type, *Archaeocyathus subacutus* R. BEDFORD & W. R. BEDFORD, 1934, p. 2, OD)]. Inner wall with one row of simple pores per intersept, formed by fluting of inner edges of septa; septa aporose to sparsely porous. *lower Cambrian (Atd.4–Bot.3):* Altay Sayan, Tuva, Mongolia, Far East, Australia, Antarctica.——FIG. 11,*3a–b*. **K. microtumulatus*, Verkhnemonok Formation, Botoman, Kizas River, West Sayan, Altay Sayan, Russia; *a,* holotype, PIN 4755/7, oblique longitudinal section, ×6; *b,* paratype, PIN 4755/8, transverse section, ×6 (Konyushkov, 1972).

Nochoroicyathus ZHURAVLEVA, 1951, p. 78 [**N. mirabilis*; OD; holotype, ZHURAVLEVA, 1951, fig. 1a–b, PIN 1168, Moscow, not located] [=*Ajacicyathellus* DEBRENNE, 1958, p. 64 (type, *A. hollardi*, M); =*Ascocyathus* VOLOGDIN, 1960, p. 422 (type, *Archaeocyathus arteintervallum* VOLOGDIN, 1931, p. 84, OD); =*Howellicyathus* VOLOGDIN, 1961, p. 180, *nom. nud.*; =*Howellicyathus* VOLOGDIN, 1962a, p. 126 (type, *Coscinocyathus howelli* VOLOGDIN, 1940b, p. 88, OD); =*Pachecocyathus* PEREJÓN, 1971, p. 81 (type, *P. cabanasi*, OD); =*Aldanocyathus* VORONIN in DEBRENNE & VORONIN, 1971, p. 30 (type, *Ajacicyathus sunnaginicus* ZHURAVLEVA, 1960b, p. 115, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 120; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 153]. Inner wall with several rows of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Tom.1–Bot.3):* Siberian Platform, Kolyma, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Urals, Kazakhstan, Tarim, Australia, Morocco, Iberia, France, Sardinia, Germany, Serbia.——FIG. 11,*4a–c*. **N. mirabilis*; *a,* Pestrotsvet Formation, Tommotian, Nokhoroy Creek, Lena River, Sakha (Yakutia), Russia, holotype, PIN 1168, transverse section, ×6 (Zhuravleva, 1951); *b–c,* Medvezh'ya Formation, Tommotian, Kotuy River, Krasnoyarsk region, Russia; *b,* TsSGM 205/87, detail of septum in longitudinal section (outer wall to left), ×6; *c,* specimen TsSGM 205/88, detail of transverse section at inner wall, ×20 (Debrenne, Zhuravlev, & Kruse, 2002).

Orbiasterocyathus ZHURAVLEVA in REPINA & others, 1964, p. 183 [**O. geri*; OD; holotype, REPINA & others, 1964, pl. 11,*6*, TsSGM 4272/5, Novosibirsk]. Cup in which both walls are longitudinally folded, resulting in stellate transverse section; inner wall with several rows of simple pores per intersept; septa completely porous. *lower Cambrian (Atd.3–Atd.4):* Altay Sayan.——FIG. 11,*5*. **O. geri*, Adiak Formation, Atdabanian, Terensu River, Gornaya Shoria, Altay Sayan, Russia, holotype, TsSGM 4272/5, transverse section, ×4 (Repina & others, 1964).

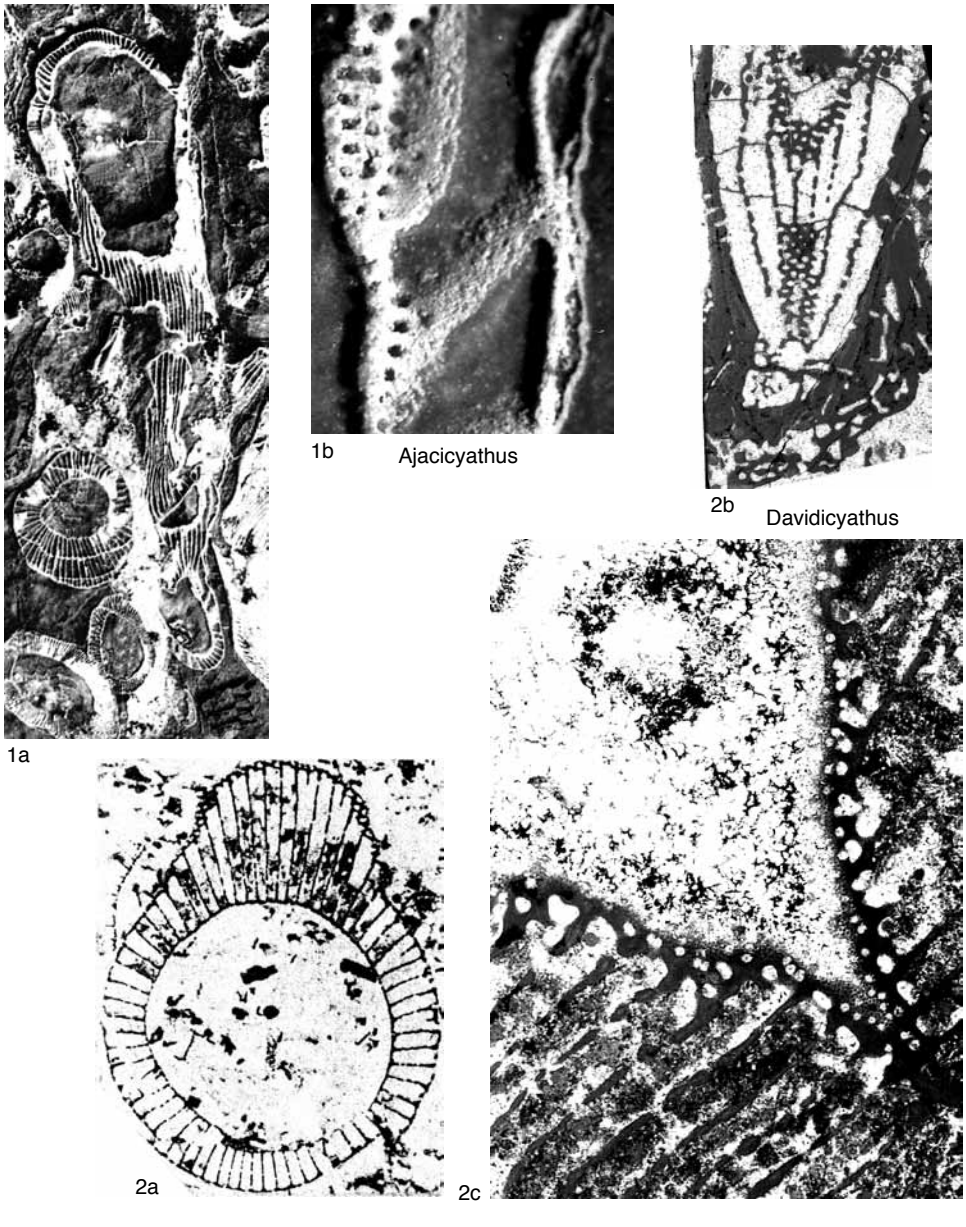


FIG. 10. Ajacicyathidae (p. 10–11).

Orbicyathellus OSADCHAYA in ZADOROZHNAYA, OSADCHAYA, & REPINA, 1973, p. 133 [**O. bogradi*; OD; holotype, ZADOROZHNAYA, OSADCHAYA, & REPINA, 1973, pl. 19,*1–2*, TsSGM 424/1, Novosibirsk]. Cup in which both walls show periodic, synchronous transverse folds; inner wall with stirrup pores only; septa aporose to sparsely porous. *lower Cambrian (Atd.1–Atd.4):* Siberian Platform, Altay Sayan, Mongolia.——FIG. 12,*1a–b*. **O. bogradi*, Usa Formation, Atdabanian, Bograd, Batenev Range, Kuznetsk Alatau, Russia, holotype, TsSGM 424/1; *a,* oblique longitudinal section, ×4.5; *b,* tangential section of inner wall, ×12 (Zadorozhnaya, Osadchaya, & Repina, 1973).

Orbicyathus VOLOGDIN, 1937b, p. 468 [**O. mongolicus*; M; holotype, VOLOGDIN, 1937b, pl. 2,*4*,

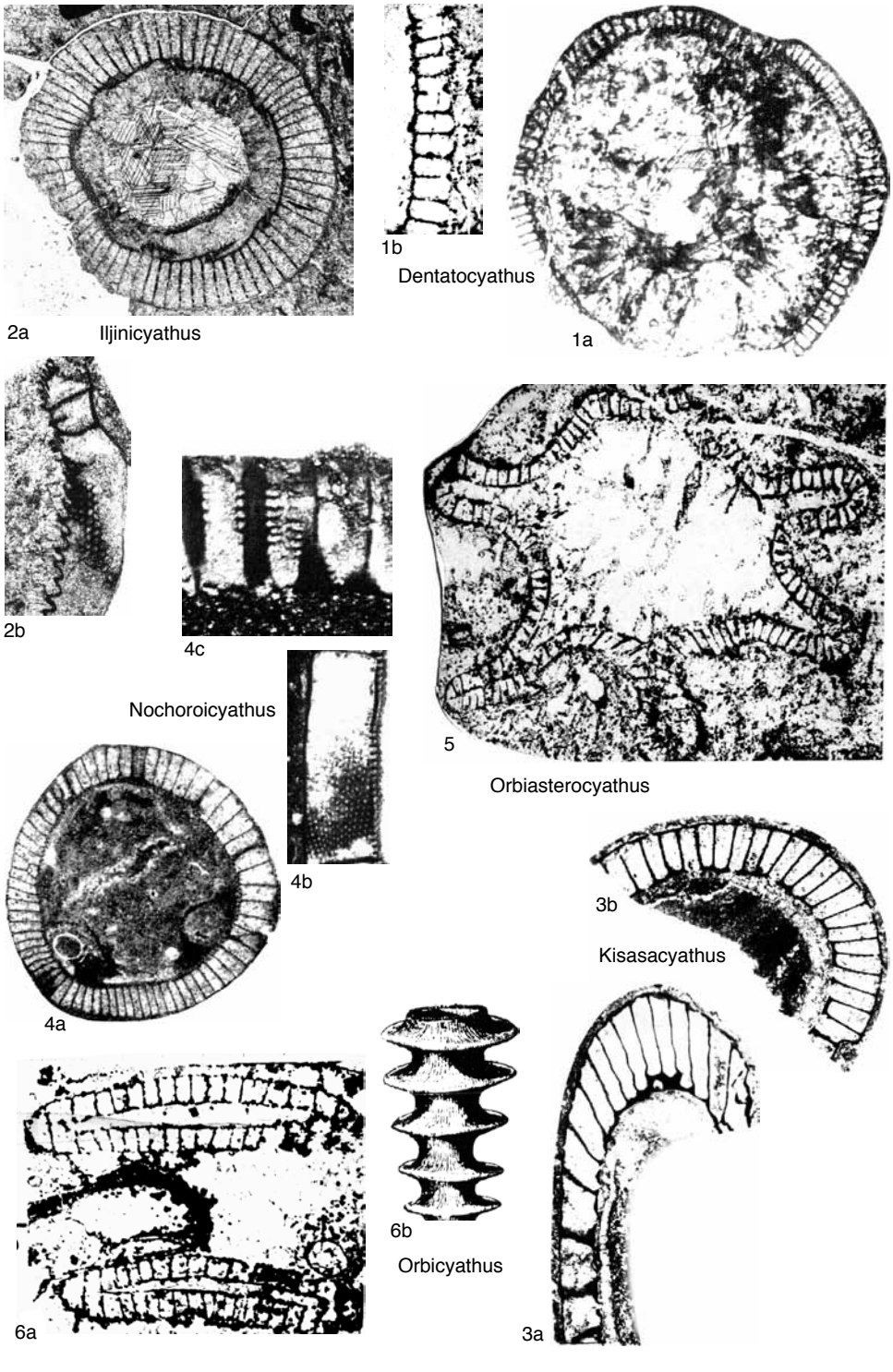


FIG. 11. Ajacicyathidae (p. 11–16).

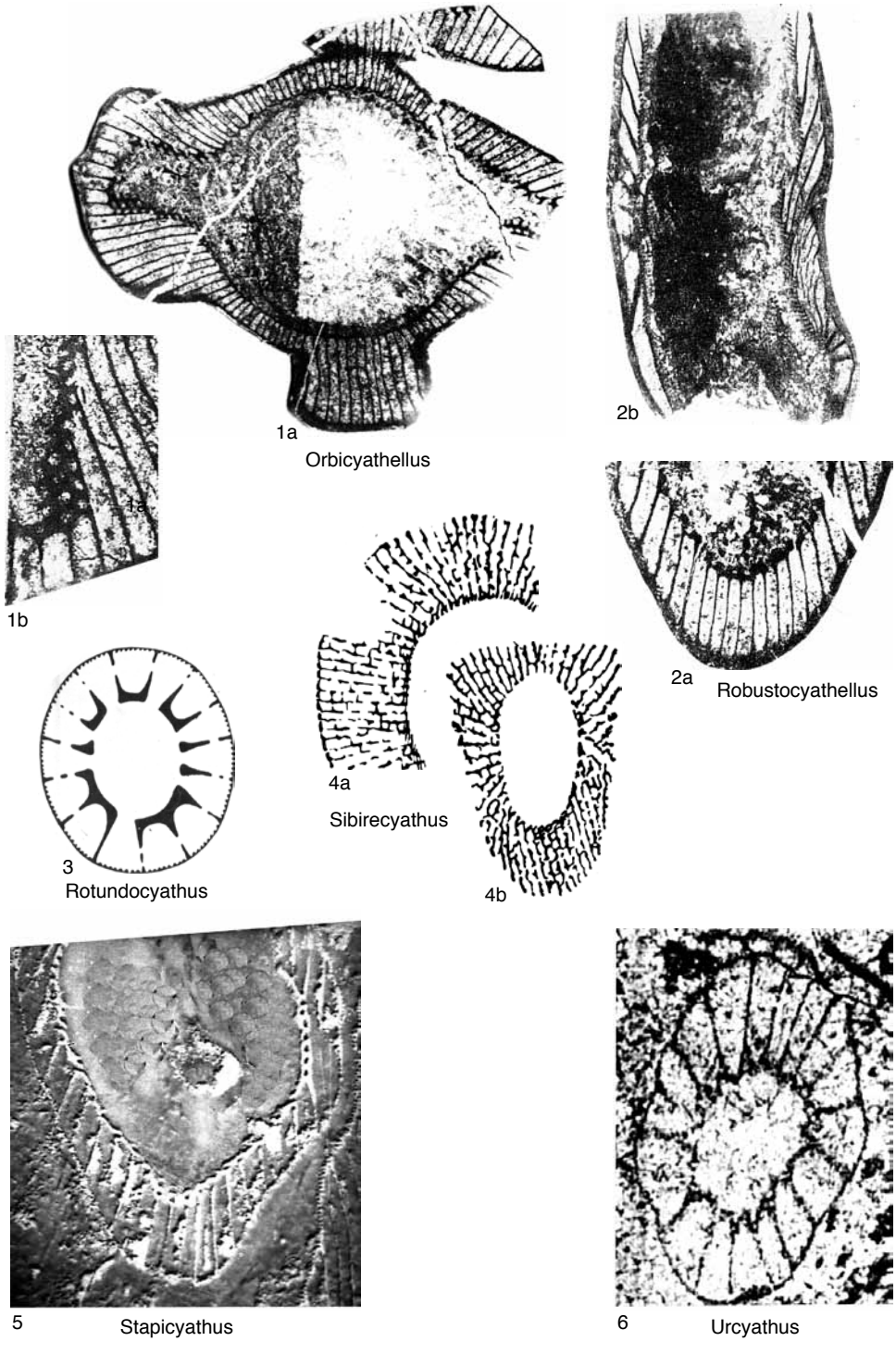


FIG. 12. Ajacicyathidae (p. 13–16).

not located]. Cup in which both walls show periodic, synchronous transverse folds; inner wall with several rows of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Tom.4–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Morocco.——Fig. 11,*6a–b*. **O. mongolicus*, Burgasutay Formation, Atdabanian, Seer' Mountains, Ikh nuuruundyn hotgor, western Mongolia, holotype; *a,* longitudinal section, ×3; *b,* schematic reconstruction of cup, ×2 (Vologdin, 1937b).

Robustocyathellus Konyushkov, 1972, p. 133 [**R. spinosus*; OD; holotype, Konyushkov, 1972, pl. 13,*1*, not located]. Inner wall with one row of simple pores per intersept; septa aporose to sparsely porous. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Tajikistan, South China, Canada.——Fig. 12,*2a–b*. **R. spinosus*, Verkhnemonok Formation, Botoman, Kizas River, West Sayan, Altay Sayan, Russia, holotype; *a,* oblique longitudinal section, ×6; *b,* longitudinal section, ×3 (Konyushkov, 1972).

Rotundocyathus Vologdin, 1960, p. 422 [**R. rotaceus*; OD; holotype, Vologdin, 1960, fig. 1zh, not located]. Inner wall with one row of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Tarim, Morocco, Iberia, France, Sardinia.——Fig. 12,*3*. **R. rotaceus*, Verkhneynyrga Formation, Botoman, Lebed' River, Altay Mountains, Altay Sayan, Russia, holotype, transverse section, ×1 (Vologdin, 1960).

Sibirecyathus Vologdin, 1937b, p. 468 [**S. naletovi*; M; holotype not designated, collection not located]. Inner wall with one row of simple pores per intersept; septa completely porous, linked by synapticulae. *lower Cambrian (Tom.3–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, South China, Morocco, Iberia, France, Sardinia, Germany.——Fig. 12,*4a–b*. **S. naletovi*, Burgasutay Formation, Botoman, Seer' Mountains, Ikh nuuruundyn hotgor, western Mongolia, *a,* unlocated syntype, transverse section, ×4; *b,* unlocated syntype, oblique longitudinal section, ×4 (Vologdin, 1937b).

Stapicyathus Debrenne, 1964, p. 127, *nom. transl.* Debrenne, 1970a, p. 43, *ex Archaeocyathellus (Stapicyathus)* Debrenne, 1964, p. 127 [**Archaeocyathus stapipora* Taylor, 1910, p. 118; OD; lectotype, Taylor, 1910, pl. 7, photos 37a, 38D, 38G; Debrenne, 1974b, pl. 24,*1;* SD Debrenne, 1970a, p. 43, SAM T1591, Adelaide] [=*Sivovicyathus* Konyushkov, 1972, p. 134 (type, *S. abakanensis,* OD); =*Nochoroicyathellus* Osadchaya in Osadchaya & others, 1979, p. 154 (type, *N. activus*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 132; Debrenne, Rozanov, & Zhuravlev, 1990, p. 161]. Inner wall with stirrup pores only; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Atd.2–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Australia, Antarctica, South Africa (allochthonous).——Fig. 12,*5*. **S. stapipora* (Taylor), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM T1591, oblique longitudinal section, ×4 (Taylor, 1910).

Urcyathus Vologdin, 1940b, p. 64 [**U. asteroides*; OD; holotype, Vologdin, 1940b, pl. 14,*5,* not located] [=*Pectenocyathus* Kashina in Repina & others, 1964, p. 211 (type, *P. torgaschinicus*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 139; Debrenne, Rozanov, & Zhuravlev, 1990, p. 166]. Inner wall longitudinally plicate, with several rows of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Atd.2):* Altay Sayan, Tuva, Mongolia, Iberia, Germany.——Fig. 12,*6*. **U. asteroides*, Gavrilovskoe Formation, Atdabanian, Gorskino, Salair, Russia, holotype, oblique transverse section, ×9 (Vologdin, 1940b).

Family DENSOCYATHIDAE Vologdin, 1937

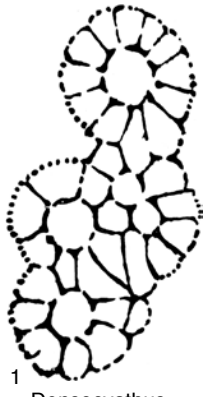
[Densocyathidae Vologdin, 1937b, p. 471] [=Leptosocyathidae Vologdin, 1961, p. 178; =Tennericyathidae Rozanov in Zhuravleva, Korshunov, & Rozanov, 1969, p. 34]

Inner wall with bracts or scales. *lower Cambrian (Atd.1–Bot.3).*

Densocyathus Vologdin, 1937b, p. 471 [**D. sanaschticolensis;* M; holotype not designated, collection not located]. Inner wall with several rows of pores per intersept, bearing upwardly projecting, S-shaped scales; septa aporose to sparsely porous. *lower Cambrian (Bot.1–Bot.3):* Altay Sayan.——Fig. 13,*1*. **D. sanaschticolensis*, Verkhnemonok Formation, Botoman, Sanashtykgol Spring, West Sayan, Altay Sayan, Russia; unlocated syntype, transverse section of modular skeleton, ×5 (Vologdin, 1937b).

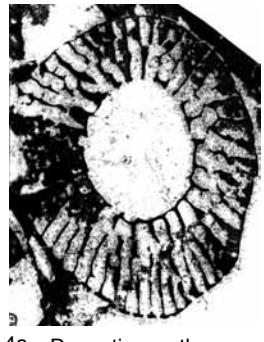
Cadniacyathus R. Bedford & J. Bedford, 1937, p. 36 [**C. asperatus;* OD; lectotype, R. Bedford & J. Bedford, 1937, fig. 152; Debrenne, 1974b, pl. 27,*2;* SD Debrenne, 1970a, p. 30, USNM PU86616(1), Washington, D.C.]. Inner wall with several rows of pores per intersept, bearing upwardly projecting, planar fused bracts; septa aporose to sparsely porous. *lower Cambrian (Bot.3):* Australia, ?Antarctica.——Fig. 13,*2*. **C. asperatus*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, USNM PU86616(1), oblique transverse view, ×3 (Debrenne, Zhuravlev, & Kruse, 2002).

Dailycyathus Debrenne, 1970a, p. 32 [**Paranacyathus margarita* R. Bedford & J. Bedford, 1937, p. 34; OD; lectotype, R. Bedford & J. Bedford, 1937, fig. 138b–c; Debrenne, 1970a, pl. 1,*5;* SD Debrenne, 1970a, p. 32, USNM



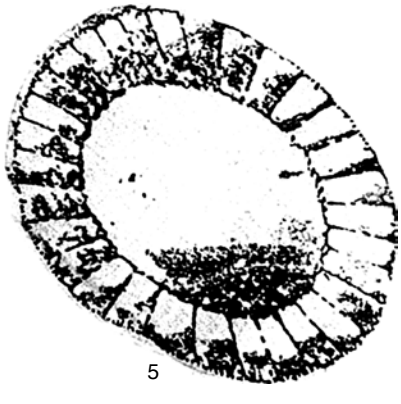
1 Densocyathus

2 Cadniacyathus



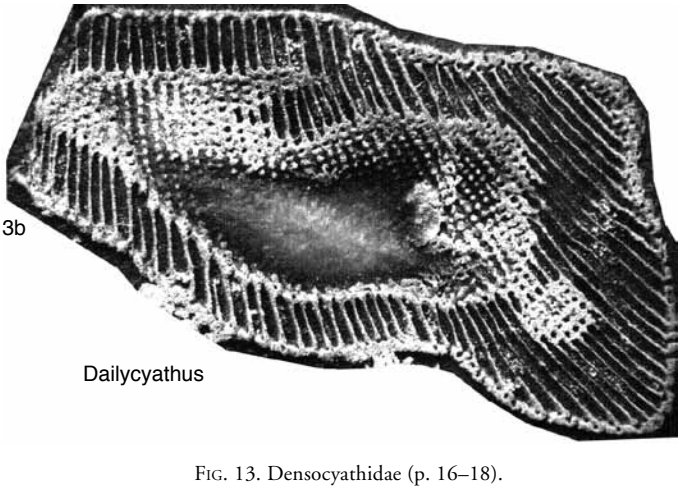
4a Deceptioncyathus

4b



5 Khirgisocyathus

3a



3b Dailycyathus

FIG. 13. Densocyathidae (p. 16–18).

PU87214, specimen 304, Washington, D.C.] [=*Joanaecyathus* GRAVESTOCK, 1984, p. 53 (type, *J. cupulosus*, OD; =*Paranacyathus margarita* R. BEDFORD & J. BEDFORD, 1937, p. 34), for discussion, see DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 139]. Inner wall with one row of pores per intersept, bearing upwardly projecting, cupped bracts; septa aporose to sparsely porous. *lower Cambrian (Atd.4–Bot.3):* Altay Sayan, Mongolia, South China, Australia.——FIG. 13,*3a–b*. **D. margarita* (R. BEDFORD & J. BEDFORD), Ajax Limestone, Atdabanian, Paint Mine, South Australia, Australia; *a,* lectotype, USNM PU87214, specimen 304, transverse view near cup base, ×5; *b,* paralectotype, USNM PU87215, tangential view of inner wall, ×5 (Debrenne, 1970a).

Deceptioncyathus GRAVESTOCK, 1984, p. 53 [**D. synapticulosus*; OD; holotype, GRAVESTOCK, 1984, fig. 34H–J, SAM P21504-1, Adelaide]. Inner wall with one row of pores per intersept, bearing upwardly projecting cupped bracts; septa completely porous, linked by synapticulae. *lower Cambrian (Atd.4):* Australia.——FIG. 13,*4a–b*. **D. synapticulosus*, Ajax Limestone, Atdabanian, Mount Scott Range, South Australia, Australia, holotype, SAM P21504-1; *a,* transverse section, ×2; *b,* longitudinal section, ×2 (Gravestock, 1984).

Khirgisocyathus VORONIN, 1988, p. 5 [**K. primus*; OD; holotype, VORONIN, 1988, pl. 2,*1*, PIN 3301/511, Moscow]. Inner wall with several rows of pores per intersept, bearing upwardly projecting cupped bracts; septa completely porous. *lower Cambrian (Atd.2):* Mongolia.——FIG. 13,5. **K. primus*, Ichituin Formation, Atdabanian, Boro-Khairkhan-Obo Mountain, Khan-Khukhiy Range, Mongolia, holotype, PIN 3301/511, oblique transverse section, ×9 (Voronin, 1988).

Leptosocyathellus OSADCHAYA in OSADCHAYA & others, 1979, p. 119 [**L. mirandus*; OD; holotype, OSADCHAYA & others, 1979, pl. 5,*3*, VSEGEI 11594, St. Petersburg]. Inner wall with stirrup pores only, bearing upwardly projecting, S-shaped scales; septa completely porous. *lower Cambrian (Atd.2–Atd.4):* Altay Sayan, Iberia.——FIG. 14,*1a–b*. **L. mirandus*; *a,* Usa Formation, Atdabanian, Krutoy Log, Batenev Range, Kuznetsk Alatau, Russia, holotype, VSEGEI 11594, transverse section, ×8.5; *b,* Usa Formation, Atdabanian, Srednyaya Mountain, Batenev Range, Kuznetsk Alatau, Russia, VSEGEI C-69, oblique longitudinal section, ×8 (Osadchaya & others, 1979).

Leptosocyathus VOLOGDIN, 1937b, p. 470 [**L. curviseptum*; OD; holotype, VOLOGDIN, 1937b, fig. 14, not located; =*Leptocyathus curviseptatus* VOLOGDIN, 1940a, p. 146] [=*Leptocyathus* VOLOGDIN, 1937b, p. 468, *nom. null.*, *non Leptocyathus* MILNE-EDWARDS & HAIME, 1850, a scleractinian; =*Halysicyathus* DEBRENNE, 1965, p. 144 (type, *H. multifurcus,* OD)]. Inner wall with one row of pores per intersept, bearing upwardly projecting, S-shaped scales; septa aporose to sparsely porous. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Tajikistan, Australia, Antarctica, Morocco, Iberia.——FIG. 14,*2a–c*. **L. curviseptus*, Burgasutay Formation, Botoman, Seer' Mountains, Ikh nuuruundyn hotgor, western Mongolia; *a,* holotype, transverse section, ×1; *b,* holotype, oblique transverse section of inner wall, ×1 (Vologdin, 1937b); *c,* topotype, PIN 3156/3000, transverse section, ×9 (Debrenne, Zhuravlev, & Kruse, 2002).

Natalijaecyathus KOTEL'NIKOV, 1995, p. 23 [**N. vadibalaensis*; OD; holotype, KOTEL'NIKOV, 1995, fig. 1d, pl. 2,*7*, TsNIGRm 12890/4, St. Petersburg]. Inner wall with stirrup pores only, bearing upwardly projecting, S-shaped scales; longitudinal bars may be present, bisecting stirrup pores; septa completely porous. *lower Cambrian (Atd.2):* Tuva.——FIG. 14,*3a–b*. **N. vadibalaensis*, Il'chir Formation, Atdabanian, Vadi-Bala Creek, Tapsa River, Tuva, Russia, holotype, TsNIGRm 12890/4; *a,* oblique transverse section, ×5.5; *b,* detail of oblique transverse section, ×9 (Kotel'nikov, 1995).

Rectannulus DEBRENNE, 1977a, p. 106 [**R. willefertae*; OD; holotype, DEBRENNE, 1977a, pl. 6,*2–3*, MNHN M80026, specimen IRH4-2b, Paris]. Inner wall with stirrup pores only, bearing horizontal to upwardly projecting, S-shaped scales; scales may be fused into pseudoannuli; septa sparsely to completely porous. *lower Cambrian (Atd.4–Bot.1):* Morocco.——FIG. 15,*1a–b*. **R. willefertae*, Issafen Formation, Botoman, Jbel Irhoud, Morocco, holotype, MNHN M80026, specimen IRH4-2b; *a,* detail of transverse section, ×5 (Debrenne, 1977a); *b,* oblique longitudinal section, ×5 (M. Debrenne, new).

Tennericyathus ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 35 (ROZANOV in ROZANOV & others, 1969, p. 182, *nom. nud.*) [**T. malycanicus*; OD; holotype, ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, pl. 4,*5;* ROZANOV, 1973, pl. 9,*4*, PIN 4297/79, Moscow, not located] [=*Memoriacyathus* YAZMIR in ZHURAVLEVA, 1974a, p. 215, *nom. nud.*; =*Memoriacyathus* YAZMIR in YAZMIR, DALMATOV, & YAZMIR, 1975, p. 47 (type, *M. burjaticus*, OD); =*Raropectinus* DEBRENNE & ROZANOV, 1983, p. 735, *nom. nov. pro Rarocyathus* OSADCHAYA in OSADCHAYA & others, 1979, p. 155, *non* VOLOGDIN & JANKAUSKAS, 1968, p. 203, cribricyath (type, *R. rarus,* OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 135; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 163]. Inner wall with several rows of pores per intersept, bearing upwardly projecting, S-shaped scales; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East.——FIG. 15,*2*. **T. malycanicus*, Pestrotsvet Formation, Atdabanian, Malykan, Lena River, Sakha (Yakutia), Russia, holotype, PIN 4297/79, detail of oblique transverse section, ×15 (Zhuravleva, Korshunov, & Rozanov, 1969).

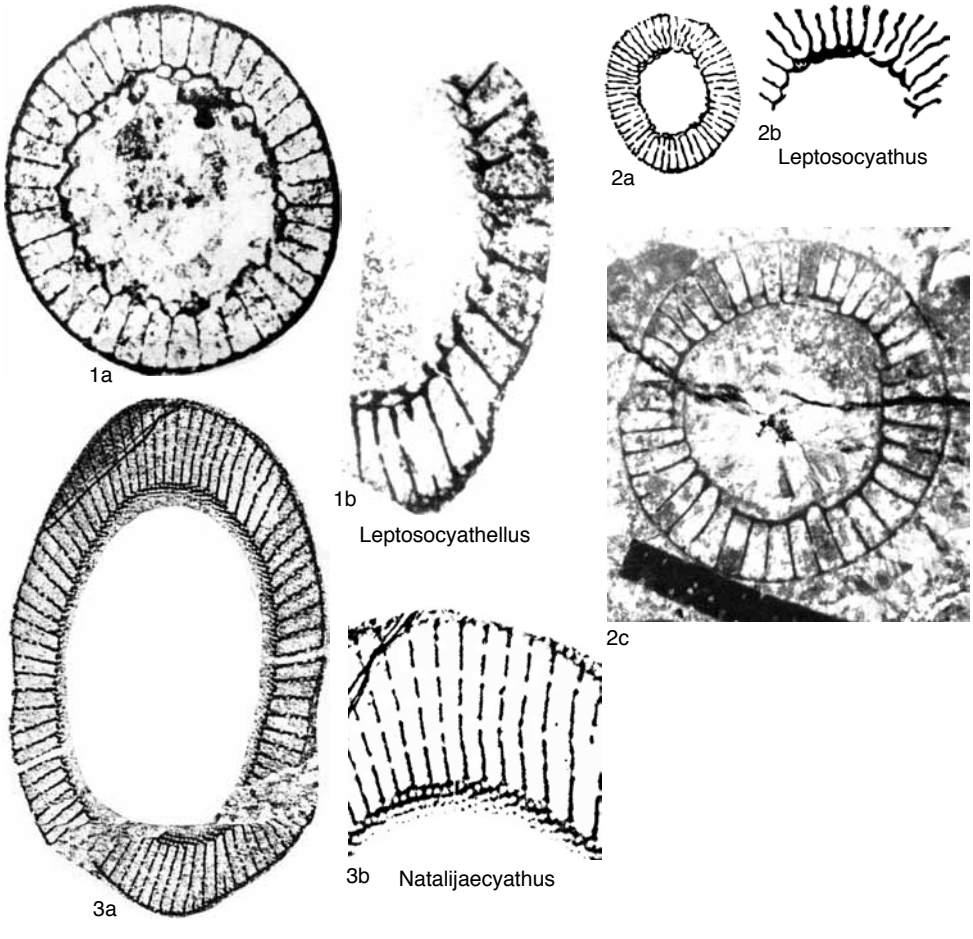


FIG. 14. Densocyathidae (p. 18).

Family BRONCHOCYATHIDAE R. Bedford & J. Bedford, 1936

[Bronchocyathidae R. BEDFORD & J. BEDFORD, 1936, p. 25] [=Stillicidocyathidae TING, 1937, p. 367; =Thalamocyathidae ZHURAVLEVA, 1954, p. 28; =Cyclocyathellidae ZHURAVLEVA, 1960c, p. 74; =Trininaecyathidae DEBRENNE, 1964, p. 114; =Compositocyathidae ZHURAVLEVA in ZHURAVLEVA & others, 1967, p. 52; =Glaessnericyathidae DEBRENNE, 1970a, p. 35]

Inner wall with annuli. *lower Cambrian (Atd.1–Bot.3).*

Thalamocyathus GORDON, 1920, p. 687 [**Archaeocyathus trachealis* TAYLOR, 1910, p. 125; SD TING, 1937, p. 368, by elimination; lectotype, TAYLOR, 1910, pl. 8, photo 47(8); HILL, 1965, pl. 7,*1*; DEBRENNE, 1973, pl. 1,*6;* SD DEBRENNE, 1969b, p. 262; SAM T1555A, Adelaide] [=*Bronchocyathus* R. BEDFORD & J. BEDFORD, 1936, p. 25 (type, *Archaeocyathus trachealis* TAYLOR, 1910, p. 125, OD); =*Thalamopectinus* DEBRENNE, 1973, p. 8 (type, *T. arterialis*, OD; =*Archaeocyathus trachealis* TAYLOR, 1910, p. 125), for discussion, see DEBRENNE & KRUSE, 1989, p. 27; =*Gordonicyathella* YAZMIR in ZHURAVLEVA, 1974a, p. 160, *nom. nud.*; =*Gordonicyathellus* YAZMIR in YAZMIR, DALMATOV, & YAZMIR, 1975, p. 48 (type, *G. solidus*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 136; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 164]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Atd.2–Bot.3):* Altay Sayan, Tuva, Mongolia, Transbaikalia, Australia, Antarctica, South Africa (allochthonous), ?Falkland Islands (allochthonous).——FIG. 16,*1a–b*. **T. trachealis* (TAYLOR), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM T1555A; *a,* transverse view, ×3.5 (Debrenne, 1973); *b,* external longitudinal view of cup, ×8 (Taylor, 1910).

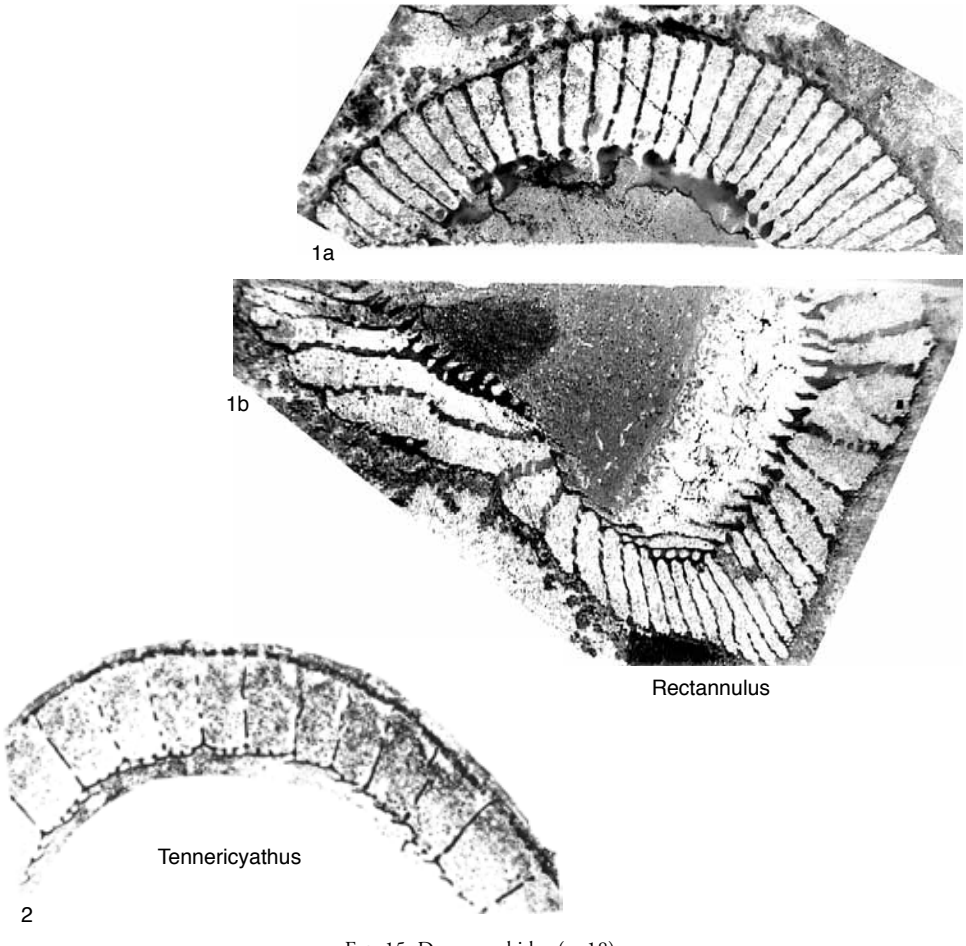


FIG. 15. Densocyathidae (p. 18).

Compositocyathus ZHURAVLEVA, 1960b, p. 159 [**Thalamocyathus muchattensis* ZHURAVLEVA in ZHURAVLEVA & ZELENOV, 1955, p. 71; OD; holotype, ZHURAVLEVA & ZELENOV, 1955, pl. 2,*1–2;* ZHURAVLEVA, 1960b, pl. 10,*3–5,* TsSGM 205/47a-b, Novosibirsk]. Inner wall with one pore row per intersept and planar annuli bearing short beams that support supplementary microporous sheath; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Transbaikalia.——FIG. 16,*2a–b*. **C. muchattensis* (ZHURAVLEVA), Pestrotsvet Formation, Atdabanian, Mukhatta River, Lena River, Sakha (Yakutia), Russia; *a,* holotype, TsSGM 205/47b, longitudinal section (outer wall to left), ×7 (Zhuravleva & Zelenov, 1955); *b,* topotype TsSGM 323, oblique transverse section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Conannulofungia YUAN in YUAN & ZHANG, 1980, p. 383 [**C. jinshaensis*; OD; holotype, YUAN & ZHANG, 1980, pl. 2,*1a–f*, NIGP 51288, Nanjing]. Inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli linked to septa by ribs; septa completely porous, linked by synapticulae. *lower Cambrian (Bot.1–Bot.2):* South China.——FIG. 17,*1a–c*. **C. jinshaensis*, Minxinsi (Minghsingssu) Formation, Botoman, Yankong, Guizhou, China; *a–b,* holotype, NIGP 51288; *a,* transverse section, ×4; *b,* longitudinal section near inner wall, ×4 (Yuan & Zhang, 1980); *c,* specimen MNHN M85006, longitudinal section near inner wall, ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

Cyathocricus DEBRENNE, 1969a, p. 318 [**Archaeocyathus tracheodentatus* R. BEDFORD & W. R. BEDFORD, 1934, p. 2; OD; lectotype, R. BEDFORD & W. R. BEDFORD, 1934, fig. 5; DEBRENNE, 1969a, pl. 5,*4–5;* SD DEBRENNE, 1969a, p. 319, NHM S4148, London; =*Ethmophyllum dentatum* TAYLOR, 1910, p. 129; lectotype, TAYLOR, 1910, pl. 16, photo 89;

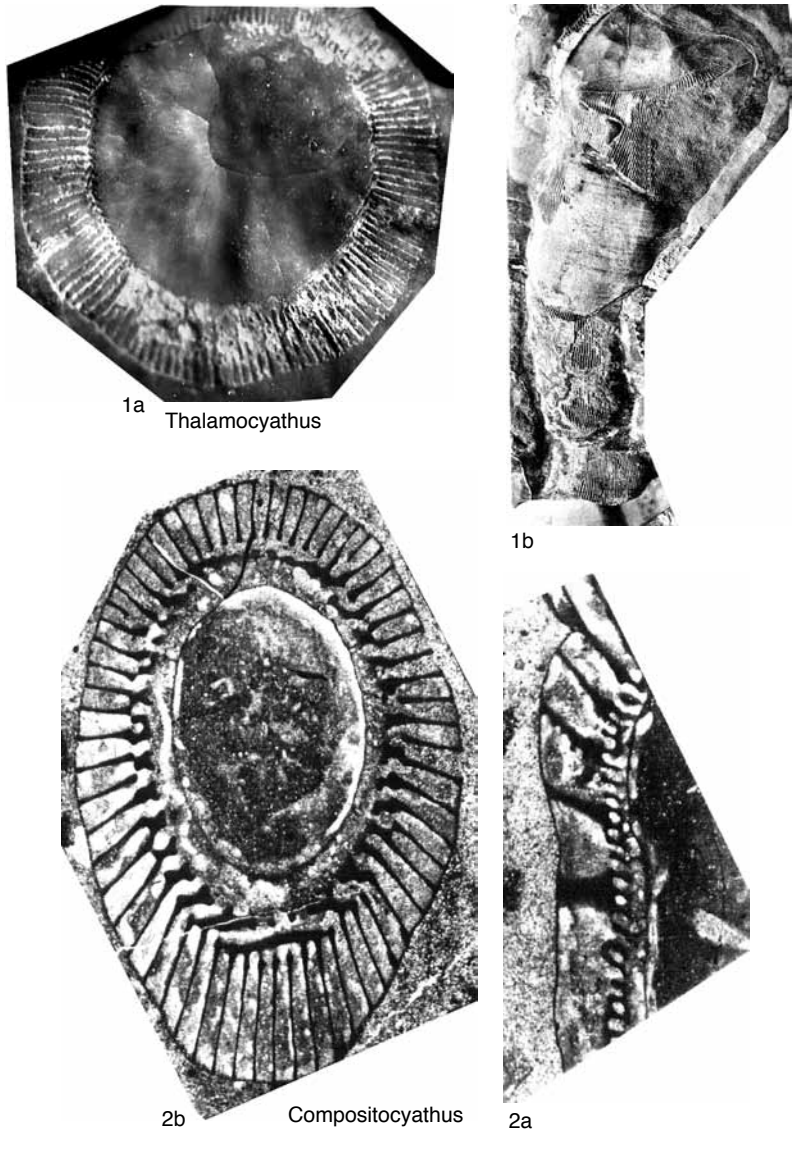
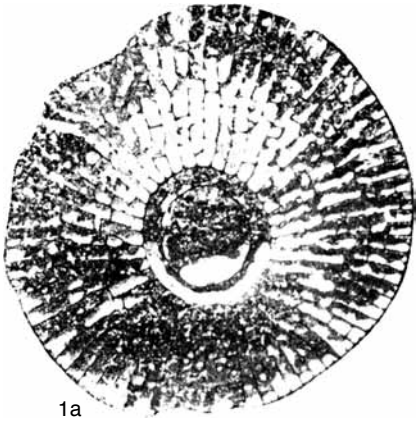


FIG. 16. Bronchocyathidae (p. 19–20).

DEBRENNE, 1970a, pl. 1,*1;* SD DEBRENNE, 1974b, p. 132, SAM T1606C-D, Adelaide] [=*Cricopectinus* DEBRENNE, 1970a, p. 32 (type, *C. dentulus*, OD)]. Inner wall with one pore row per intersept and commonly horizontally projecting waved annuli that may mutually coalesce; denticles may be present on annular rims; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (?Atd.4–Bot.3):* Altay Sayan, Tuva, Far East, Australia, Antarctica, ?Morocco.——FIG. 17,*2a–c*. **C. dentatus* (TAYLOR), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM T1606C-D; *a,* transverse view, ×6; *b,* oblique longitudinal view, ×5 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* oblique longitudinal view, ×4 (Taylor, 1910).

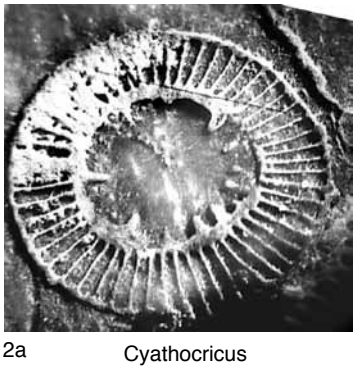
Cyclocyathella VOLOGDIN in ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA, 1960, p. 105 [**Cyclocyathus yakovlevi* VOLOGDIN, 1931, p. 49; OD; lectotype, VOLOGDIN, 1931, pl. 4,*7–8;* SD DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1569, TsNIGRm 44a/2956, St. Petersburg] [=*Cyclocyathus* VOLOGDIN, 1928, p. 30, *nom. nud.*, *non* MILNE-EDWARDS & HAIME, 1850, p. liv, scleractinian, *nec* DUNCAN &

1c



1a

1b Conannulofungia



2a Cyathocricus

2c

2b

FIG. 17. Bronchocyathidae (p. 20–21).

THOMPSON, 1867, p. 1, rugose coral; =*Cyclocyathus* SIMON, 1939, p. 27 (type, *C. yakovlevi* VOLOGDIN, 1931, p. 49)]. Inner wall with one pore row per intersept and inverted V-shaped annuli; septa completely porous. *lower Cambrian (Atd.2):* Altay Sayan, Tuva, Far East.——FIG. 18,*1a–c*. **C. yakovlevi* (VOLOGDIN), Torgashino Formation, Atdabanian, Kameshki, East Sayan, Altay Sayan, Russia; *a,* paralectotype, TsNIGRm 45/2956, transverse section, ×6; *b,* paralectotype, TsNIGRm 47a/2956, longitudinal section, ×6; *c,* schematic sketch of septum in longitudinal section (outer wall to left), ×8 (Vologdin, 1931).

Denaecyathus ZHURAVLEVA in ZHURAVLEVA & others, 1967, p. 57 [**D. biporosus*; OD; holotype, ZHURAVLEVA & others, 1967, pl. 17,*5–6*, TsSGM 325/17, Novosibirsk]. Inner wall with several pore rows per intersept and upright, V-shaped annuli; septa aporose to sparsely porous. *lower Cambrian (Bot.1)*: Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East.——FIG. 18,*2a–c*. **D. biporosus*, Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia; *a,* holotype, TsSGM 325/17, oblique transverse section, ×5; *b,* paratype, TsSGM 325/16, oblique longitudinal section (outer wall at bottom), ×5; *c,* holotype, TsSGM 325/17, oblique transverse section (outer wall to left), ×5 (Zhuravleva & others, 1967).

Gordonicyathus ZHURAVLEVA, 1959, p. 426 [**Thalamocyathus gerassimovensis* KRASNOPEEVA, 1955, p. 95; OD; holotype not designated, collection not located] [=*Sichotecyathus* OKUNEVA in OKUNEVA & REPINA, 1973, p. 138 (type, *S. orientalis*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 109; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 144]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Australia.——FIG. 18,*3*. **G. gerassimovensis* (KRASNOPEEVA), Verkhnemonok Formation, Botoman, Gerasimov Spring, Monok River, West Sayan, Altay Sayan, Russia, unlocated syntype, oblique transverse section, ×7 (Krasnopeeva, 1955).

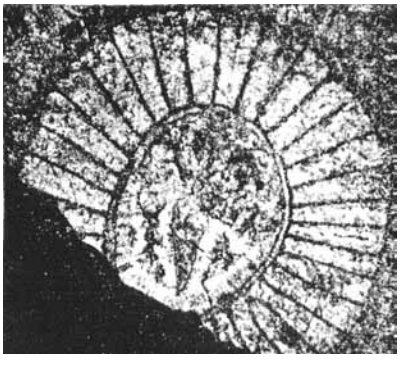
Gordonifungia ROZANOV in REPINA & others, 1964, p. 193 [**G. batinensis*; OD; holotype, REPINA & others, 1964, pl. 11,*1*, PIN 4297/24, Moscow]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous, linked by synapticulae. *lower Cambrian (Atd.3–Bot.1):* Altay Sayan, ?Morocco.——FIG. 19,*1*. **G. batinensis*, Usa Formation, Atdabanian, Verkhnyaya Erba, Batenev Range, Kuznetsk Alatau, Russia, holotype, PIN 4297/24, oblique transverse section, ×4 (Repina & others, 1964).

Morenicyathus PEREJÓN, 1975b, p. 169 [**M. arruzafai*; OD; holotype, PEREJÓN, 1975b, pl. 6,*5–6;* PEREJÓN, 1975c, pl. 6,*8–9*, CE 62-14, Madrid; =*Archaeocyathellus (Protocyathus) cordobae* SIMON, 1939, p. 74; holotype, SIMON, 1939, pl. 2,*11*, SM 26-179e, Frankfurt am Main] [=*Kellericyathus* ROZANOV, 1973, p. 61, *nom. nud.*; =*Denaecyathellus* OSADCHAYA in OSADCHAYA & others, 1979, p. 122 (type, *D. makarichus*, OD); =*Kellericyathus* ROZANOV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 114 (type, *K. altaicus*, OD)]. Inner wall with several pore rows per intersept and upright, V-shaped annuli; septa completely porous. *lower Cambrian (Atd.2–Atd.3):* Kolyma, Altay Sayan, Iberia.——FIG. 19,*2a–b*. **M. cordobae* (SIMON) [=*M. arruzafai* PEREJÓN], Pedroche Formation, Atdabanian, Las Ermitas, Cordoba, Andalusia, Spain, holotype, CE 62-14; *a,* oblique transverse section, ×4; *b,* detail of longitudinal section (outer wall to left), ×8 (Perejón, 1975c).

Pseudotennericyathellus OSADCHAYA in OSADCHAYA & others, 1979, p. 120 [**Tennericyathus latus* OSADCHAYA in ZADOROZHNAYA, OSADCHAYA, & REPINA, 1973, p. 134; OD; holotype, ZADOROZHNAYA, OSADCHAYA, & REPINA, 1973, pl. 19,*3;* OSADCHAYA & others, 1979, pl. 5,*1–2*, TsSGM IGiG424, Novosibirsk]. Inner wall with several pore rows per intersept and upwardly projecting, S-shaped annuli; septa completely porous. *lower Cambrian (Atd.2–Atd.4):* Altay Sayan, Mongolia.——FIG. 19,*3a–b*. **P. latus* (OSADCHAYA), Usa Formation, Atdabanian, Bograd, Batenev Range, Kuznetsk Alatau, Russia, holotype, TsSGM IGiG424; *a,* transverse section, ×9; *b,* longitudinal section (outer wall to left), ×9 (Osadchaya & others, 1979).

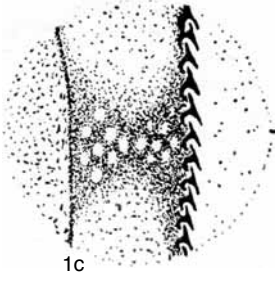
Sagacyathus KRUSE, 1982, p. 178 [**S. stonyx*; OD; holotype, KRUSE, 1982, fig. 15D–H, AM F.83576, Sydney]. Inner wall with one pore row per intersept and upright, V-shaped annuli bearing denticulate rims; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Atd.4–Bot.3):* Altay Sayan, Mongolia, Far East, Australia.——FIG. 19,*4a–c*. **S. stonyx*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia, holotype, AM F.83576; *a,* transverse section AM FT.8487, ×6; *b,* oblique longitudinal section AM FT.8486, ×4; *c,* longitudinal section AM FT.8490, ×4 (Kruse, 1982).

Stillicidocyathus TING, 1937, p. 367 [**Coscinocyathus aulax* TAYLOR, 1910, p. 139; OD; lectotype, TAYLOR, 1910, pl. 10, photo 57; SD DEBRENNE, 1969b, p. 263, SAM T1605A-B, Adelaide] [=*Glaessnericyathus* DEBRENNE, 1970a, p. 35 (type, *Bronchocyathus sigmoideus* R. BEDFORD & J. BEDFORD, 1936, p. 25, OD), for discussion, see GRAVESTOCK, 1984, p. 69; DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 133; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 162]. Inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1–Bot.3):* Altay Sayan, Tuva, Mongolia, Australia, Antarctica, Iberia, Sardinia.——FIG. 20,*1*. **C. aulax* (TAYLOR),



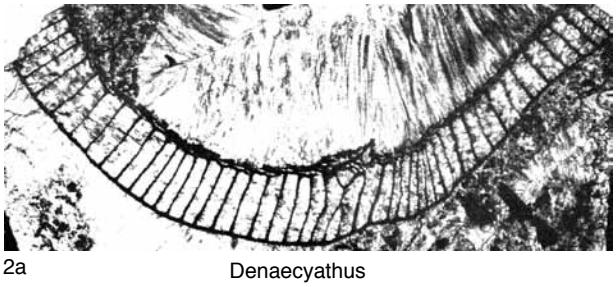
1a

1b Cyclocyathella

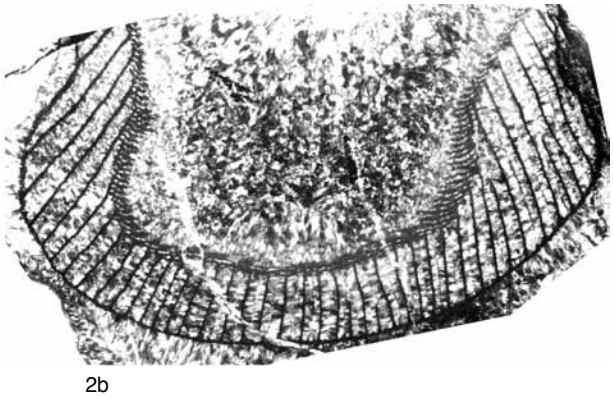


1c

2c



2a Denaecyathus



2b

3 Gordonicyathus

FIG. 18. Bronchocyathidae (p. 21–22).

Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM T1605A-B, longitudinal view, ×7 (Taylor, 1910).

Svetlanocyathus Missarzhevskiy & Rozanov, 1962, p. 43 [**S. primus*; OD; holotype, Missarzhevskiy & Rozanov, 1962, pl. 3,*2a–v;* Rozanov, 1973, pl. 1,*5*, PIN 4297/19-20, Moscow]. Outer wall with slitlike, simple pores; inner wall with one pore row per intersept and inverted V-shaped annuli; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Altay Sayan, Tuva.——Fig. 20,*2. *S. primus*, Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia, holotype, PIN 4297/19-20, oblique transverse view, ×5 (Debrenne, Zhuravlev, & Rozanov, 1989).

Taylorcyathus Vologdin, 1955, p. 143 [**Cyclocyathus subtersiensis* Vologdin, 1940b, p. 63; OD; holotype not designated, collection not located] [=*Tersicyathus* Vologdin, 1955, p. 143 (type, *Cyclocyathus tersiensis* Vologdin, 1931, p. 87, OD); =*Thalamocyathellus* Osadchaya in Osadchaya & others, 1979, p. 155 (type, *T. inclinatus*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 134; Debrenne, Rozanov, & Zhuravlev, 1990, p. 163; =*Pospelovicyathus* Konyaeva in Zhuravleva & others, 1997a, p. 49 (type, *P. gravis*, OD)]. Inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Australia, South China, Iberia, France, Sardinia.——Fig. 20,*3. *T. subtersiensis* (Vologdin), Gavrilovskoe Formation, Atdabanian, Belaya Gorka, Salair, Russia, topotype, PIN 4754/50, oblique transverse section, ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Taylorfungia Perejón, 1989, p. 180 [**Thalamocyathus synapticulosus* Zhuravleva, 1955a, p. 41; OD; holotype, Zhuravleva, 1955a, pl. 5,*1*, PIN 495, Moscow, not located]. Inner wall with one pore row per intersept and upwardly projecting, planar to S-shaped annuli; septa completely porous, linked by synapticulae. *lower Cambrian (Atd.2–Atd.3):* Altay Sayan.——Fig. 20,*4. *T. synapticulosa* (Zhuravleva), Usa Formation, Atdabanian, Bol'shaya Erba (Potekhino), Batenev Range, Kuznetsk Alatau, Russia, holotype, PIN 495, oblique transverse section, ×8 (Zhuravleva, 1955a).

Trininaecyathus Zhuravleva, 1960b, p. 218 [**T. macroporus*; OD; holotype not located; paratypes, Zhuravleva, 1960b, pl. 18,*6–8,* fig. 122, TsSGM 205/100, 205/101, Novosibirsk]. Inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli bearing denticulate rims; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1):* Siberian Platform.——Fig. 20,*5. *T. macroporus*, Perekhod Formation, Botoman, Botoma River, Sakha (Yakutia), Russia, paratype, TsSGM 205/100, oblique transverse section, ×8 (Zhuravleva, 1960b).

Family ETHMOCYATHIDAE Debrenne, 1969

[Ethmocyathidae Debrenne, 1969a, p. 322] [=Ethmopectinidae Debrenne, 1970a, p. 25; =Diplocyathidae Debrenne, 1974b, p. 123; =Zonacyathellidae Zhuravleva in Zhuravleva & Elkina, 1974, p. 65; =Baikalocyathinae Zhuravleva in Zhuravleva & Elkina, 1974, p. 68; =Inessocyathidae Zhuravleva in Zhuravleva & Elkina, 1974, p. 106; =Hyptocyathidae Kruse, 1978, p. 29; =Gnaltacyathidae Kruse, 1982, p. 166; =Baikalopectinidae Gravestock, 1984, p. 66]

Inner wall with noncommunicating canals. *lower Cambrian (Atd.1–Bot.3).*

Ethmocyathus R. Bedford & W. R. Bedford, 1934, p. 2 [**E. lineatus;* M; holotype, R. Bedford & W. R. Bedford, 1934, fig. 8; Hill, 1965, pl. 4,*2;* Debrenne, 1969a, pl. 5,*1–3;* Debrenne, 1974b, pl. 27,*1;* NHM S4149, M, London] [=*Ethmopectinus* Debrenne, 1970a, p. 34 (type, *E. walteri,* OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 106; Debrenne, Rozanov, & Zhuravlev, 1990, p. 142]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept, formed by flexure of inner edges of septa; supplementary screen of planar rings on central cavity side; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.3):* Australia, Antarctica.——Fig. 21,*1a–b. *E. lineatus*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, holotype, NHM S4149; *a,* longitudinal view of inner wall, ×7; *b,* oblique longitudinal view of inner wall (to left) and septa (to right), ×15 (Debrenne, 1969a).

Afiacyathus Voronin, 1962, p. 26 [**A. lativallum*; OD; holotype, Voronin, 1962, pl. 4,*4–5*, PIN 1914/74-80a, Moscow, not located] [=*Axiculifungia* F. Debrenne & M. Debrenne in F. Debrenne, M. Debrenne, & Rozanov, 1976, p. 102 (type, *Ajacicyathus compositus* Debrenne, 1961, p. 9, OD)]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa completely porous, linked by synapticulae. *lower Cambrian (Atd.2–Bot.1):* Tuva, Morocco, Iberia, Sardinia, ?Poland.——Fig. 21,*2a–b. *A. lativallum*, Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia, holotype, PIN 1914/74-80a; *a,* oblique transverse view, ×2; *b,* oblique longitudinal view, ×2 (Voronin, 1962).

Baikalocyathus Yazmir in Zhuravleva, 1974a, p. 55 [**Ethmophyllum rossicum* Zhuravleva, 1960b, p. 164; OD; holotype, Zhuravleva, 1960b, pl. 11,*2*, TsSGM 205/51, Novosibirsk] [=*Nochoroicyathella* Korshunov, 1983b, p. 110 (type, *N. fragilis*, OD); =*Baikalopectinus* Gravestock, 1984, p. 66 (type, *B. capulus*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 95; Debrenne, Rozanov, & Zhuravlev, 1990, p. 134]. Inner wall with one row of downwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Kolyma, Altay

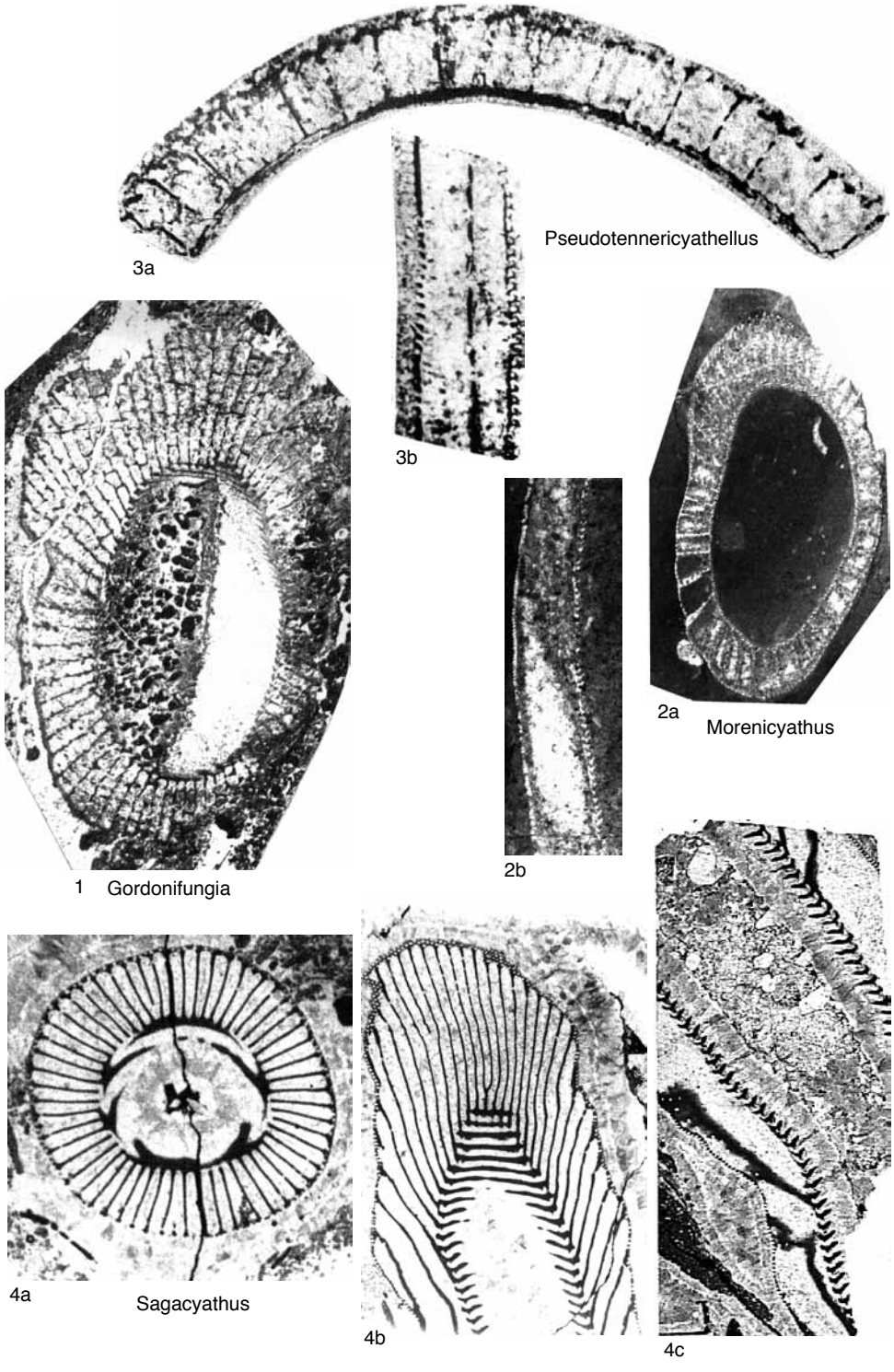
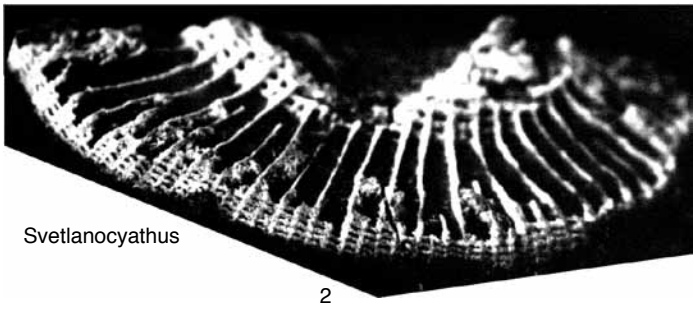
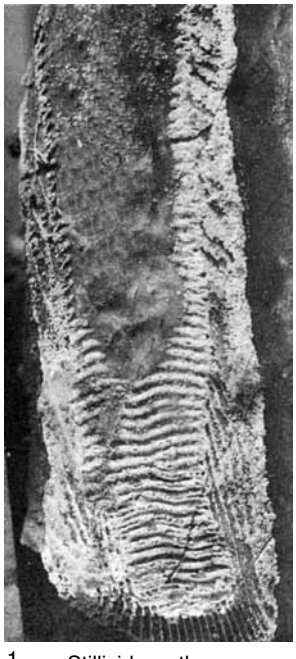


FIG. 19. Bronchocyathidae (p. 22).



Svetlanocyathus

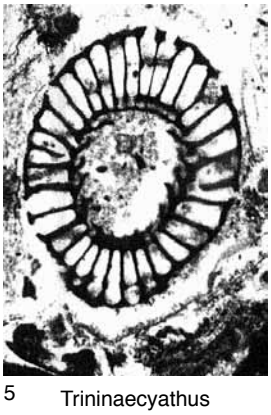
2



1 Stillicidocyathus

4 Taylorfungia

3 Taylorcyathus



5 Trininaecyathus

FIG. 20. Bronchocyathidae (p. 22–24).

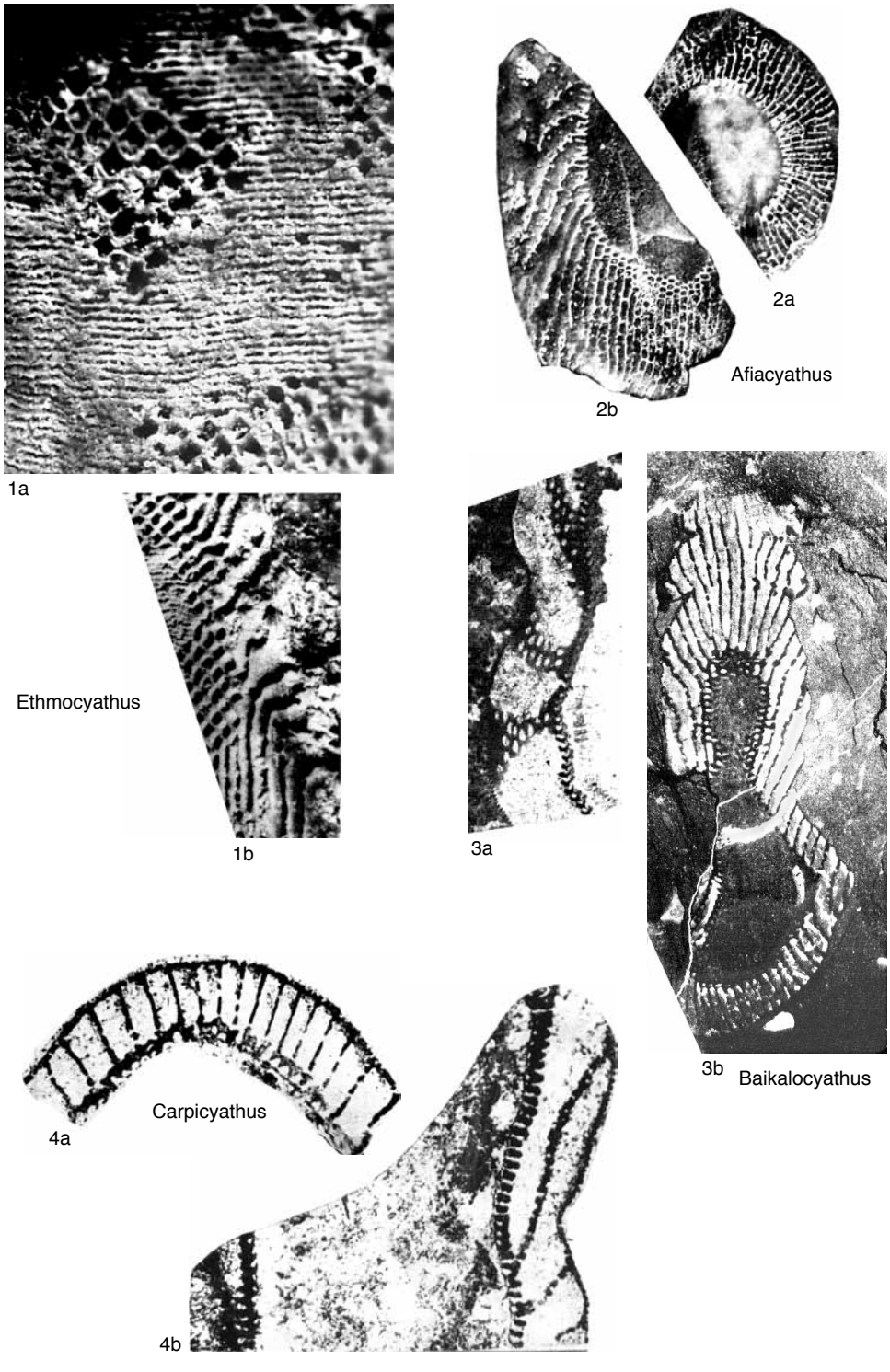


FIG. 21. Ethmocyathidae (p. 24–29).

Sayan, Tuva, Mongolia, Transbaikalia, Far East, Australia, ?Morocco.——Fig. 21,*3a–b*. **B. rossicus* (Zhuravleva); *a,* Pestrotsvet Formation, Atdabanian, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 205/51, detail of longitudinal section of septum (outer wall to left), ×10 (Zhuravleva, 1960b); *b,* Pestrotsvet Formation, Atdabanian, Mukhatta River, Lena River, Sakha (Yakutia), Russia, paratype, TsSGM 205/52, oblique longitudinal section, ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Carpicyathus Osadchaya in Zhuravleva & others, 1967, p. 51 [**C. mysticus*; OD; holotype, Zhuravleva & others, 1967, pl. 14,*3–6*, VSEGEI 9594, St. Petersburg]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa completely porous. *lower Cambrian (Atd.2–Bot.2):* Altay Sayan, Tuva, Transbaikalia, Morocco.——Fig. 21,*4a–b*. **C. mysticus*, Shangan Formation, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia, holotype, VSEGEI 9594; *a,* transverse section, ×1.5; *b,* longitudinal section, ×3.5 (Zhuravleva & others, 1967).

Degeletticyathus Zhuravleva in Zhuravleva, Korshunov, & Rozanov, 1969, p. 36 [**Ethmophyllum? galuschkoi* Zhuravleva, 1960b, p. 169; OD; holotype, Zhuravleva, 1960b, pl. 11,*7*, TsSGM 205/56, Novosibirsk] [=*Degeletticyathellus* Zhuravleva in Zhuravleva & Elkina, 1974, p. 66 (type, *D. lebedevae,* OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 103]. Inner wall with horizontal to upwardly projecting, straight stirrup canals only; septa aporose to sparsely porous. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Tajikistan, Morocco.——Fig. 22,*1a–b*. **D. galuschkoi* (Zhuravleva), Oy-Muran reef massif, Botoman, Lena River, Sakha (Yakutia), Russia; *a,* specimen TsSGM 323/40, transverse section, Oy-Muran, ×5 (Zhuravleva, Korshunov, & Rozanov, 1969); *b*, holotype, TsSGM 205/56, longitudinal section of septum (outer wall to left), Mukhatta River, ×5 (Zhuravleva, 1960b).

Diplocyathellus Debrenne, 1977b, p. 1222, *nom. nov. pro Diplocyathus* Debrenne, 1974b, p. 124, *non* Allman, 1888, p. 16, cnidarian [**Archaeocyathus retezona* Taylor, 1910, p. 121; OD; lectotype, Taylor, 1910, pl. 6, photo 31; Debrenne, 1974b, pl. 26,*4–5;* SD Debrenne, 1974b, p. 124, SAM T1577A, Adelaide]. Inner wall with horizontal to upwardly projecting, straight stirrup canals only, canals branching toward central cavity; septa aporose to sparsely porous. *lower Cambrian (Bot.3):* Australia.——Fig. 22,*2. *D. retezona* (Taylor), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, paralectotype, SAM T1591, longitudinal view, ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Frinalicyathus Debrenne, Rozanov, & Zhuravleva in Zhuravleva & Elkina, 1974, p. 73 [**Leptosocyathus altaicus* Rozanov in Repina & others, 1964, p. 190; OD; holotype, Repina & others, 1964, pl. 4,*2*, PIN 4297/21, Moscow] [=*Pseudodegeletticyathellus* Osadchaya in Osadchaya & others, 1979, p. 123 (type, *P. ladae*, OD), for discussion, see Debrenne, Rozanov, & Zhuravlev, 1990, p. 143]. Inner wall with downwardly projecting, straight stirrup canals only, bearing supplementary scales on central cavity side; septa completely porous. *lower Cambrian (Atd.1–Atd.4):* Altay Sayan, Mongolia.——Fig. 22,*3. *F. altaicus* (Rozanov), Verkhneynyrga Formation, Atdabanian, Tyrga River, Altay Mountains, Altay Sayan, Russia, holotype, PIN 4297/21, transverse section, ×2.5 (Repina & others, 1964).

Gnaltacyathus Kruse, 1982, p. 166 [**G. nodus*; OD; holotype, Kruse, 1982, pl. 3,*2–4*, AM FT.8453, 8454, 8495b, Sydney]. Inner wall with horizontal to upwardly projecting, straight canals, each canal spanning several intersepts; septa completely porous. *lower Cambrian (Bot.1–Bot.3):* Tuva, ?Mongolia, Australia.——Fig. 22,*4a–b. *G. nodus*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia, holotype, AM FT.8453, 8454, 8495b; *a,* transverse section, AM FT.8495b, ×8; *b,* longitudinal section, AM FT.8454, ×8 (Kruse, 1982).

Hyptocyathus Kruse, 1978, p. 30 [**H. licinus*; OD; holotype, Kruse, 1978, fig. 2–3, AM F.83402, Sydney]. Inner wall with downwardly projecting, straight stirrup canals only, bearing upwardly projecting, branching canals on central cavity side; septa aporose to sparsely porous. *lower Cambrian (Bot.3):* Australia.——Fig. 23,*1a–c*. **H. licinus*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia, holotype, AM F.83402; *a,* oblique transverse section, AM FT.14171, ×4; *b,* longitudinal section, AM FT.14173, ×4; *c,* tangential section of inner wall, AM FT.14174, ×15 (Kruse, 1978).

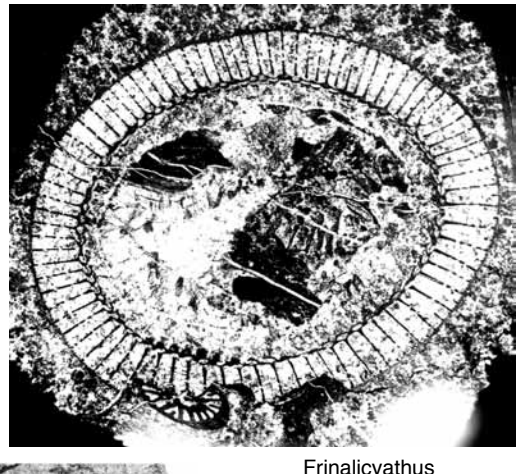
Inessocyathellus Belyaeva in Zhuravleva & Elkina, 1974, p. 78 [**I. synapticulosus*; OD; holotype, Zhuravleva & Elkina, 1974, pl. 7,*3*, DVGU, Khabarovsk]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa aporose to sparsely porous, linked by synapticulae. *lower Cambrian (Bot.3):* Far East.——Fig. 23,*2a–b*. **I. synapticulosus*, Ust'toka unit, Botoman, Verkhneurminsk Spring, Dzhagdy Range, Far East, Russia, holotype, DVGU, Khabarovsk; *a,* transverse section, ×10; *b,* oblique longitudinal section, ×10 (Zhuravleva & Elkina, 1974).

Inessocyathus Debrenne, 1964, p. 143 [**Archaeocyathus spatiosus* Bornemann, 1886, p. 59; OD; lectotype, Bornemann, 1886, pl. 15,*1a;* SD Debrenne, 1964, p. 143, not located; topotype, Debrenne, 1964, pl. 9,*1–2*, MNHN M84074, specimen SPi-13, Paris] [=*Voroninicyathus* Zhuravleva in Zhuravleva & Elkina, 1974, p. 79 (type, *Inessocyathus karakolicus* Voronin, 1969, p. 103, OD); =*Rowanpectinus* Gravestock, 1984, p. 67 (type, *R. clarus*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 112; Debrenne, Rozanov, & Zhuravlev, 1990, p. 146]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa completely

Degeletticyathus

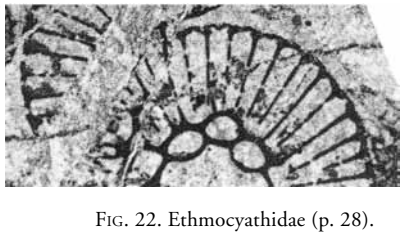
1b

2 Diplocyathellus



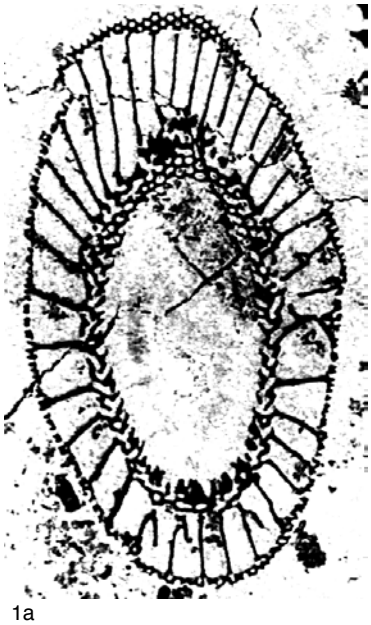
3 Frinalicyathus

4b Gnaltacyathus

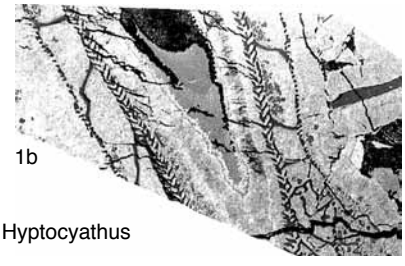


4a

FIG. 22. Ethmocyathidae (p. 28).

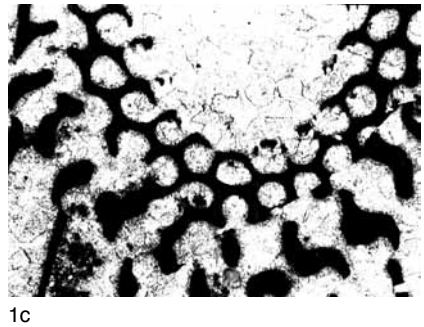


1a



1b

Hyptocyathus



1c

3a

Inessocyathus

3b

2a

2b

Inessocyathellus

FIG. 23. Ethmocyathidae (p. 28–32).

porous. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Far East, Australia, South China, Morocco, Iberia, France, Sardinia, Germany.——Fig. 23,*3a–b*. **I. spatiosus* (Bornemann), Matoppa Formation, Botoman, San Pietro, Sardinia, Italy; *a,* lectotype, transverse section, ×2.5 (Bornemann, 1886); *b,* topotype, MNHN M84074, specimen SPi-13, longitudinal section, ×2.5 (Debrenne, Zhuravlev, & Kruse, 2002).

Mackenziecyathus Handfield, 1971, p. 43 [**M. bukryi*; OD; holotype, Handfield, 1971, pl. 5,*1a–d*, GSC 25334, Ottawa] [=*Ussuricyathus* Okuneva in Okuneva & Repina, 1973, p. 113 (type, *U. kropotkini*, OD)]. Inner wall with horizontal to upwardly projecting straight stirrup canals only, bearing supplementary scales on central cavity side; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1):* Altay Sayan, Tuva, Mongolia, Far East, Canada, United States.——Fig. 24,*1a–c*. **M. bukryi*, unnamed Sekwi Formation equivalent (map unit 5 of Handfield, 1971), Botoman, Coal River, Yukon Territory, Canada, holotype, GSC 25334; *a,* transverse section, ×4; *b,* longitudinal section (outer wall to right), ×4; *c,* tangential section of inner wall, ×4 (Handfield, 1971).

Rasetticyathus Debrenne, 1971, p. 193 [**R. iglesiensis*; OD; holotype, Debrenne, 1971, fig. 1–2, not located; =*Archaeocyathus acutus* Bornemann, 1886, p. 50; holotype not designated; for discussion, see Debrenne, Rozanov, & Zhuravlev, 1990, p. 157]. Inner wall with one row of horizontal to upwardly projecting, S-shaped canals per intersept; septa aporose to sparsely porous; synapticulae may be present. *lower Cambrian (Bot.1–Bot.2):* South China, Morocco, Iberia, Sardinia.——Fig. 24,*2*. **R. acutus* (Bornemann) [=*R. iglesiensis*], Matoppa Formation, Botoman, Monte Cuccurinu, Sardinia, Italy, holotype, transverse section, ×16 (Debrenne, 1972).

Terraecyathus Zhuravleva in Zhuravleva & Elkina, 1974, p. 104 [**T. lathentis*; OD; holotype, Zhuravleva & Elkina, 1974, pl. 23,*2*, TsSGM 442/37, 38, Novosibirsk] [=*Sericyathus* Voronin, 1988, p. 7 (type, *S. tartsinicus*, OD)]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept; septa completely porous. *lower Cambrian (Atd.1–Bot.1):* Altay Sayan, Tuva, Mongolia, Morocco.——Fig. 24,*3a–b*. **T. lathentis*; *a,* Adiak Formation, Atdabanian, Tom' River, Gornaya Shoria, Altay Sayan, Russia, holotype, TsSGM 442/37, transverse section, ×5 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* Usa Formation, Botoman, Bograd, Batenev Range, Kuznetsk Alatau, Russia, paratype, TsSGM 442/38, longitudinal section of septum (outer wall to left), ×5 (Zhuravleva & Elkina, 1974).

Ussuricyathellus Voronin, 1988, p. 6 [**U. bellus*; OD; holotype, Voronin, 1988, pl. 1,*4*, PIN 3175-920/a-2, Moscow]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Mongolia.——Fig. 24,*4*. **U. bellus*, Burgasutay Formation, Botoman, Seer' Mountains, Ikh nuuruundyn hotgor, western Mongolia, holotype, PIN 3175-920/a-2, transverse section, ×5 (Voronin, 1988).

Zonacyathellus Zhuravleva in Zhuravleva & Elkina, 1974, p. 66 [**?Zonacyathus monoporosus* Zhuravleva in Zhuravleva & others, 1967, p. 66; OD; holotype, Zhuravleva & others, 1967, pl. 23,*2;* Zhuravleva & Elkina, 1974, pl. 3,*2*, TsSGM 325/35, Novosibirsk]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Tuva.——Fig. 24,*5*. **Z. monoporosus* (Zhuravleva), Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia, holotype, TsSGM 325/35, longitudinal section, ×5 (Zhuravleva & others, 1967).

Family SAJANOCYATHIDAE Vologdin, 1956

[Sajanocyathidae Vologdin, 1956, p. 879] [=Formosocyathidae Zhuravleva, 1957, p. 175; =Irinacyathidae Zhuravleva in Debrenne, 1972, p. 173, *nom. neg.*; =Irinaecyathidae Zhuravleva in Zhuravleva & Elkina, 1974, p. 67]

Inner wall with communicating canals. *lower Cambrian (Atd.1–Toy.2).*

Sajanocyathus Vologdin, 1940b, p. 81 (Vologdin, 1937b, p. 471, *nom. nud.*) [**S. ussovi*; OD; lectotype, Vologdin, 1940b, pl. 22,*8;* SD Zhuravlev, 2001a, p. 92, PIN 4754/2, Moscow] [=*Sayanocyathus* Vologdin, 1937b, p. 479, *nom. nud.* (type, *Sayanocyathus ussovi* Vologdin, 1937b, p. 479, M)]. Inner wall with several rows of anastomosing, horizontal to upwardly and laterally projecting, waved canals per intersept; septa aporose to sparsely porous. *lower Cambrian (Bot.1–Toy.2):* Siberian Platform, Altay Sayan, ?Antarctica, ?northeastern China (Hinggan), ?Sardinia, Canada, United States.——Fig. 25,*1*. **S. ussovi*, Verkhnemonok Formation, Botoman, Sanashtykgol River, West Sayan, Altay Sayan, Russia, lectotype, PIN 4754/2, transverse section of modular skeleton, ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

Chakassicyathus Zhuravleva & Osadchaya in Zhuravleva & Elkina, 1974, p. 93 [**Ethmophyllum pseudoratum* Zhuravleva in Zhuravleva & others, 1967, p. 62; OD; holotype, Zhuravleva & others, 1967, pl. 21,*2,* TsSGM 325/28b, Novosibirsk]. Inner wall with one row of downwardly projecting, straight porous canals per intersept, bearing supplementary bracts or annuli on central cavity side; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Altay Sayan, Tuva.——Fig. 25,*2*. **C. pseudoratus* (Zhuravleva), Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia, holotype, TsSGM 325/28b, oblique longitudinal section, ×5.5 (Zhuravleva & others, 1967).

Formosocyathus Vologdin, 1940b, p. 90 (Vologdin, 1937b, p. 471, *nom. nud.*) [**F. bulynnikovi*; OD;

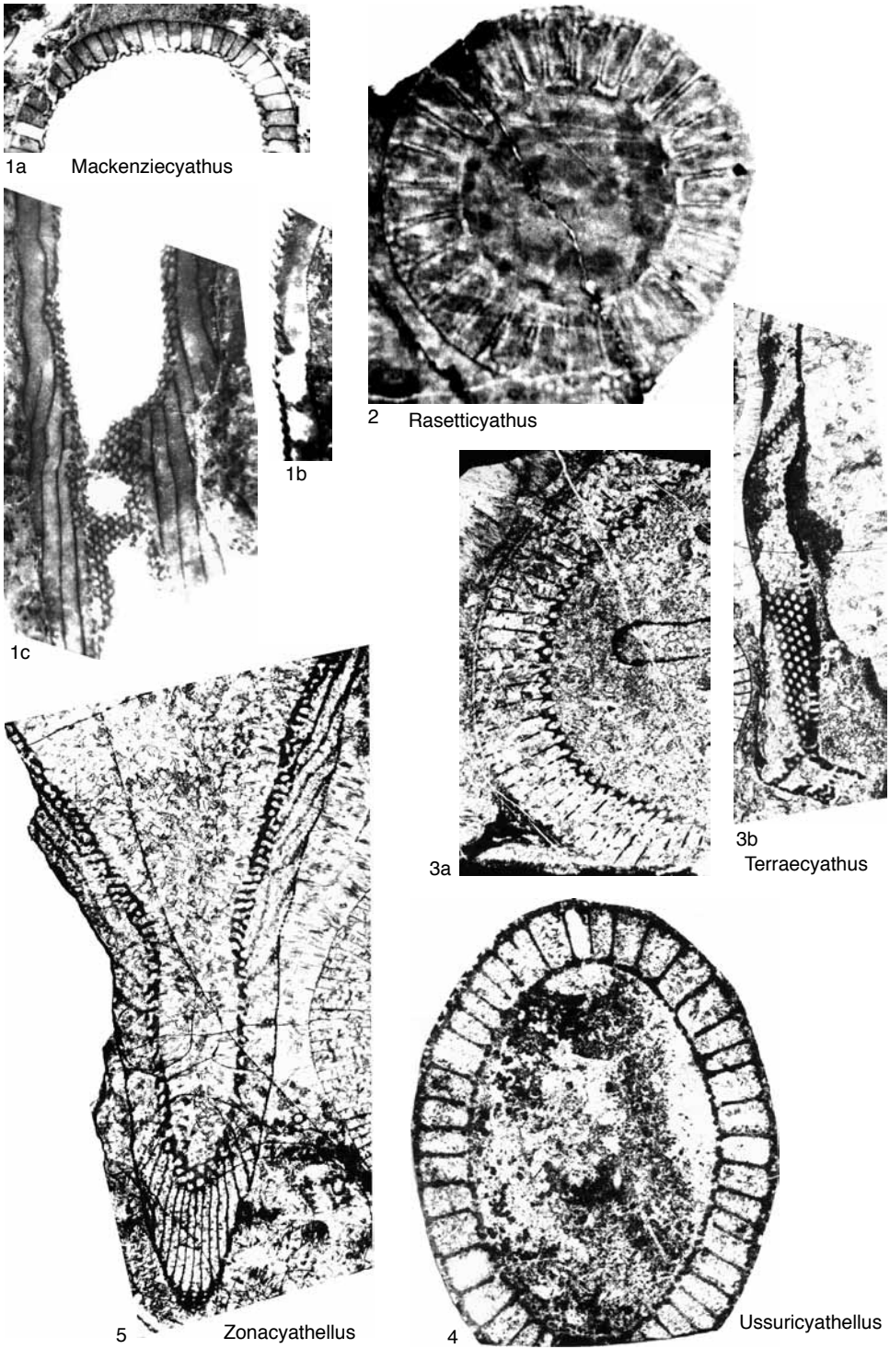


FIG. 24. Ethmocyathidae (p. 32).

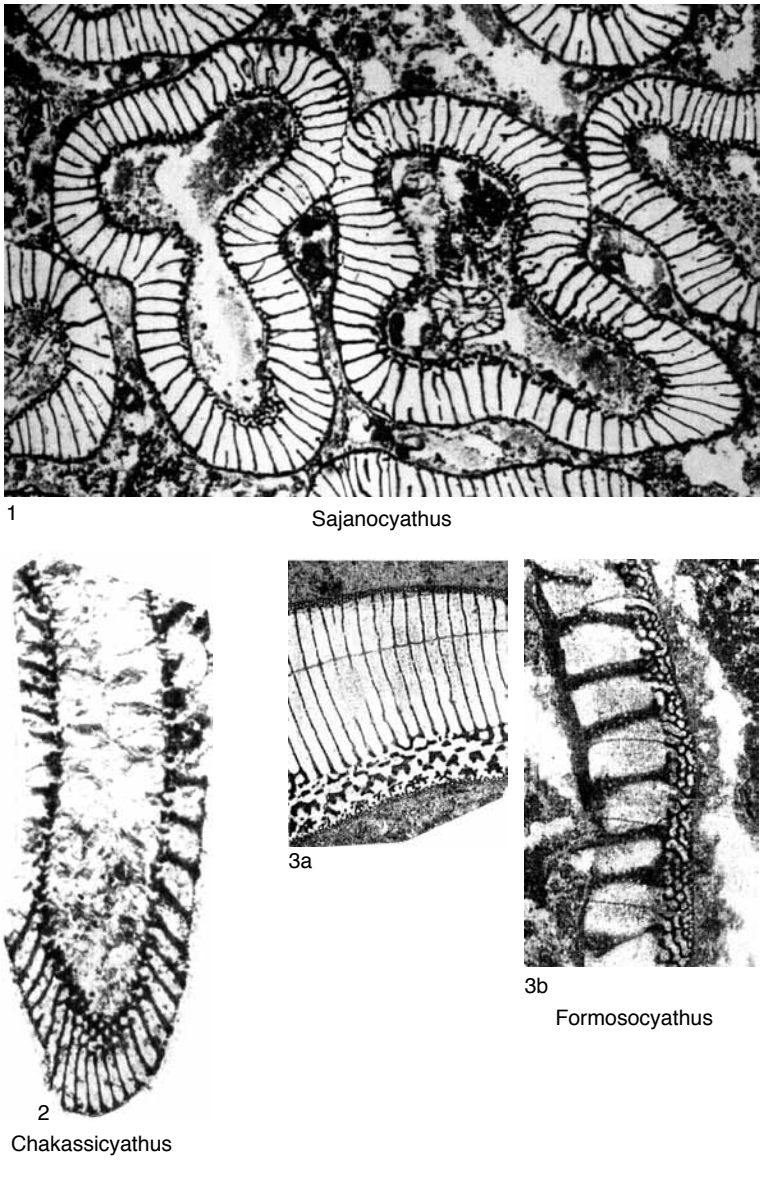


FIG. 25. Sajanocyathidae (p. 32–34).

holotype not designated, collection not located]. Inner wall with one row of anastomosing, horizontal to upwardly and laterally projecting, waved canals per intersept; supplementary spines, annular structures, and/or microporous sheath may be present on central cavity side; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.2):* Altay Sayan, Tuva, Mongolia, Transbaikalia.——FIG. 25,*3a–b*. **F. bulynnikovi*, Verkhnemonok Formation, Botoman, Sanashtykgol River, West Sayan, Altay Sayan, Russia, unlocated syntype; *a,* transverse section (outer wall at top), ×6; *b,* longitudinal section (outer wall to left), ×6 (Vologdin, 1940b).

Irinaecyathus ZHURAVLEVA in ZHURAVLEVA & ELKINA, 1974, p. 87 [**Ethmophyllum grandiperforatum* VOLOGDIN, 1940a, p. 160; OD; lectotype, VOLOGDIN, 1940a, fig. 75, pl. 46,*1,* SD ZHURAVLEVA & ELKINA, 1974, p. 88, collection not located] [=*Kandatocyathus* KASHINA in OSADCHAYA & others,

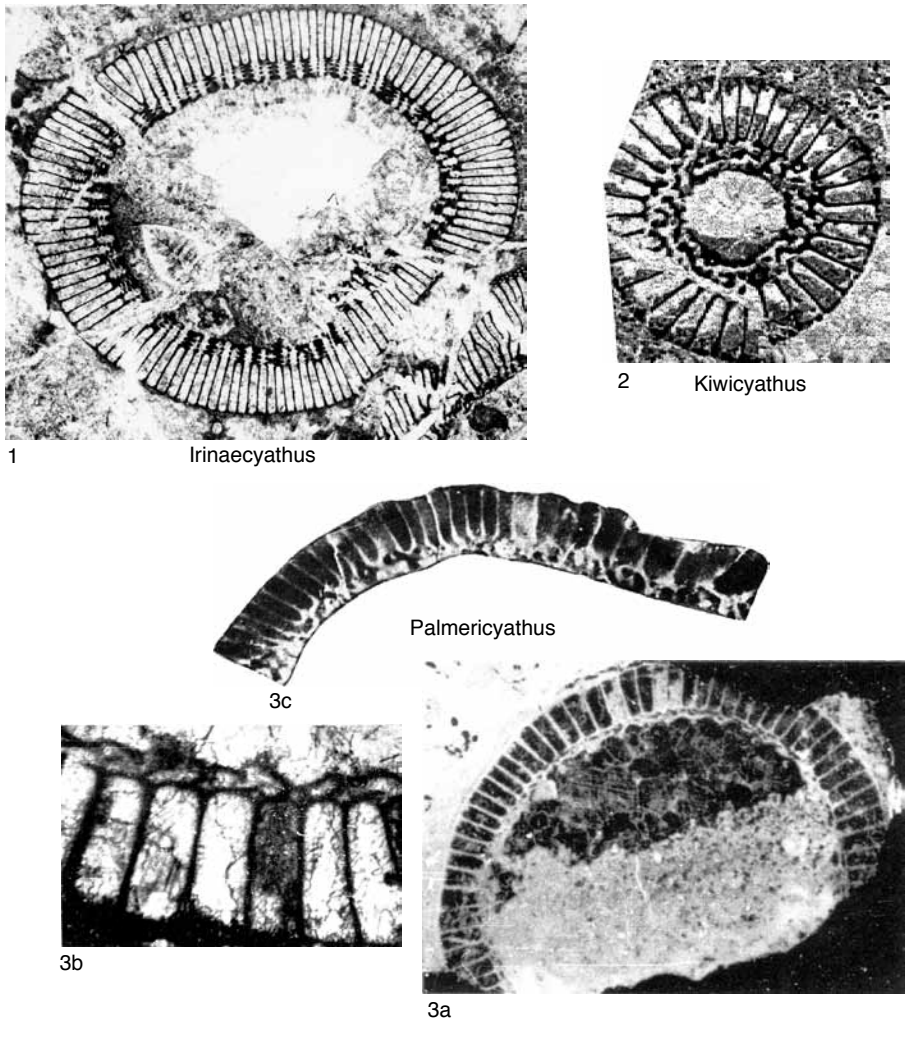


FIG. 26. Sajanocyathidae (p. 34–37).

1979, p. 156 (type, *K. kalleganovi,* OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 112; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 146]. Inner wall with one row of downwardly projecting, straight porous canals per intersept, bearing supplementary bracts or annuli on central cavity side; septa sparsely to completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1–Toy.2):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, South China.——FIG. 26,*1. *I. grandiperforatus* (VOLOGDIN), Burgasutay Formation, Botoman, Seer' Mountains, Ikh nuuruundyn hotgor, western Mongolia, topotype, PIN 4327/24-2042/5, transverse section, ×5 (Debrenne, Zhuravlev, & Kruse, 2002).

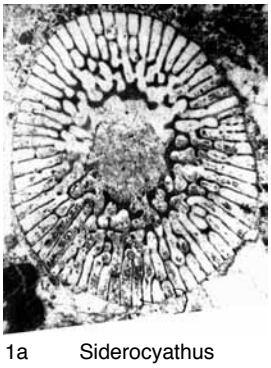
Kiwicyathus DEBRENNE & KRUSE, 1986, p. 250 [**K. nix*; OD; holotype, DEBRENNE & KRUSE, 1986, fig. 15A–B, VU VC19, Wellington]. Inner wall with horizontal to upwardly projecting, straight porous stirrup canals only; septa aporose to sparsely porous. *lower Cambrian (Bot.3):* Antarctica.——FIG. 26,*2. *K. nix*, Shackleton Limestone, Botoman, Mt. Egerton, Byrd Glacier, Antarctica, holotype, VU VC19, transverse section, ×6 (Debrenne & Kruse, 1986).

Palmericyathus HANDFIELD, 1971, p. 44 [**Ethmophyllum lineatum* GREGGS, 1959, p. 66; OD; holotype, GREGGS, 1959, pl. 14,*2*, GSC 14315, Ottawa; =*Ethmophyllum americanum* OKULITCH in COOPER & others, 1952, p. 30; holotype, COOPER & others, 1952, pl. 7,*3–4*, USNM 111816, Washington, D.C.

2a

2b Zonacyathus

2c



1a Siderocyathus

1b

FIG. 27. Sajanocyathidae (p. 37).

(for discussion, see DEBRENNE, 1987, p. 270)]. Inner wall with anastomosing, horizontal to upwardly and laterally projecting, waved stirrup canals only; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Canada, United States, Mexico.——FIG. 26,*3a–c*. **P. americanus* (OKULITCH); *a–b,* Puerto Blanco Formation, Botoman, Caborca, Sonora, Mexico, holotype, USNM 111816; *a,* transverse section, ×8; *b,* detail of transverse section (outer wall at bottom), ×25 (Cooper & others, 1952); *c,* [=*P. lineatus* (GREGGS)], Laib Formation, Botoman, Salmo, British Columbia, Canada, holotype, GSC 14315, transverse section (outer wall at top), ×6 (Greggs, 1959).

Siderocyathus DEBRENNE & GANGLOFF in DEBRENNE, GANDIN, & GANGLOFF, 1990, p. 87 [**S. duncanae*; OD; holotype, DEBRENNE, GANDIN, & GANGLOFF, 1990, pl. 1,*7,* USNM 443555, specimen IR1-3, Washington, D.C.]. Inner wall with one row of short, noncommunicating, horizontal to upwardly projecting canals per intersept, continuing into central cavity as communicating waved canals bearing supplementary bracts on central cavity side; septa aporose to sparsely porous, linked by synapticulae. *lower Cambrian (Bot.1):* United States.——FIG. 27,*1a–b*. **S. duncanae*, Valmy Formation, Botoman, Iron Canyon, Nevada, United States, holotype, USNM 443555, specimen IR1-3; *a,* transverse section, ×5; *b,* longitudinal section, ×5 (Debrenne, Gandin, & Gangloff, 1990).

Zonacyathus R. BEDFORD & J. BEDFORD, 1937, p. 36 [**Archaeocyathus retevallum* R. BEDFORD & W. R. BEDFORD, 1934, p. 2; OD; holotype, R. BEDFORD & W. R. BEDFORD, 1934, fig. 6; HILL, 1965, pl. 4,*3;* DEBRENNE, 1969a, pl. 4,*4;* NHM S4147, M, London]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept, canals branching and becoming porous toward central cavity; septa sparsely to completely porous. *lower Cambrian (?Bot.1, Bot.2–Bot.3):* ?Siberian Platform, Australia.——FIG. 27,*2a–c*. **Z. retevallus* (R. BEDFORD & W. R. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia; *a–b,* holotype, NHM S4147; *a,* oblique longitudinal view, ×5 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* tangential view of inner wall, ×5 (Hill, 1965); *c,* paratype, USNM PU86606, longitudinal view (outer wall to right), ×5 (Debrenne, 1974b).

Family BIPALLICYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Bipallicyathidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 82]

Inner wall with attached microporous sheath. *lower Cambrian (Atd.2).*

Bipallicyathus ZHURAVLEV in VORONIN & others, 1982, p. 78 [**B. manifestus*; OD; holotype, VORONIN & others, 1982, pl. 15,*6a–b,* PIN 3302/3305, Moscow] [=*Kashinaecyathus* YAROSHEVICH, 1990, p. 25 (type, *K. salairicus,* OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 173]. Inner wall with one pore row per intersept and attached microporous sheath; septa completely porous. *lower Cambrian (Atd.2):* Altay Sayan, Mongolia.——FIG. 28,*1a–c*. **B. manifestus*, Salaany Gol Formation, Atdabanian, Khasagt-Khayrkhan Range, Tsagaan Oloom province, western Mongolia; *a,* paratype, PIN 3302/3006, oblique transverse section, ×8; *b–c,* holotype, PIN 3302/3305; *b,* longitudinal section, ×7; *c,* detail of inner wall, ×17 (Voronin & others, 1982).

?Heckericyathus ZHURAVLEVA, 1960b, p. 220 [**Ethmophyllum heckeri* ZHURAVLEVA in ZHURAVLEVA & ZELENOV, 1955, p. 69; OD; holotype, PIN 1161, Moscow, not located; paratypes, ZHURAVLEVA & ZELENOV, 1955, pl. 1,*3–4,* TsSGM 205/102, 205/103, Novosibirsk] [=*Heckerocyathus* ZHURAVLEVA in VOLOGDIN, 1957a, p. 180, *nom. nud.*]. Inner wall with one pore row per intersept and independent microporous sheath, each micropore bearing a supplementary bract; septa completely porous; pectinate tabulae may be present. [Inner wall bears supplementary elements atypical of other members of family.] *lower Cambrian (Atd.1–Atd.4):* Siberian Platform, Transbaikalia, Far East.——FIG. 28,*2a–c*. **H. heckeri* (ZHURAVLEVA), Pestrotsvet Formation, Atdabanian, Oy-Muran, Lena River, Sakha (Yakutia), Russia; *a,* paratype, TsSGM 205/102, transverse section, ×8 (Zhuravleva & Zelenov, 1955); *b–c,* paratype, TsSGM 205/103; *b,* detail of septum in longitudinal section (outer wall to right), ×16; *c,* detail of inner wall in oblique longitudinal section, ×16 (Debrenne, Zhuravlev, & Kruse, 2002).

Superfamily PRETIOSOCYATHOIDEA Rozanov, 1969

[*nom. correct*. DEBRENNE, ZHURAVLEV, & KRUSE, herein, *pro* Pretiosocyathacea ROZANOV, 1969, p. 112]

Outer wall with independent microporous sheath. *lower Cambrian (Atd.1–Bot.2).*

Family ROBERTOCYATHIDAE Rozanov, 1969

[Robertocyathidae ROZANOV, 1969, p. 112]

Inner wall with simple pores. *lower Cambrian (Atd.2–Bot.1).*

Robertocyathus ROZANOV, 1969, p. 112 [**R. polaris*; OD; holotype, ROZANOV, 1969, pl. 42,*1–2*, PIN 4297/96, Moscow]. Inner wall with several rows of simple pores per intersept; septa completely porous. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Altay Sayan, Australia, Morocco, Iberia.——FIG. 29,*1. **R. polaris*, Erkeket Formation, Botoman, Khorbusuonka River, Olenek Basin,

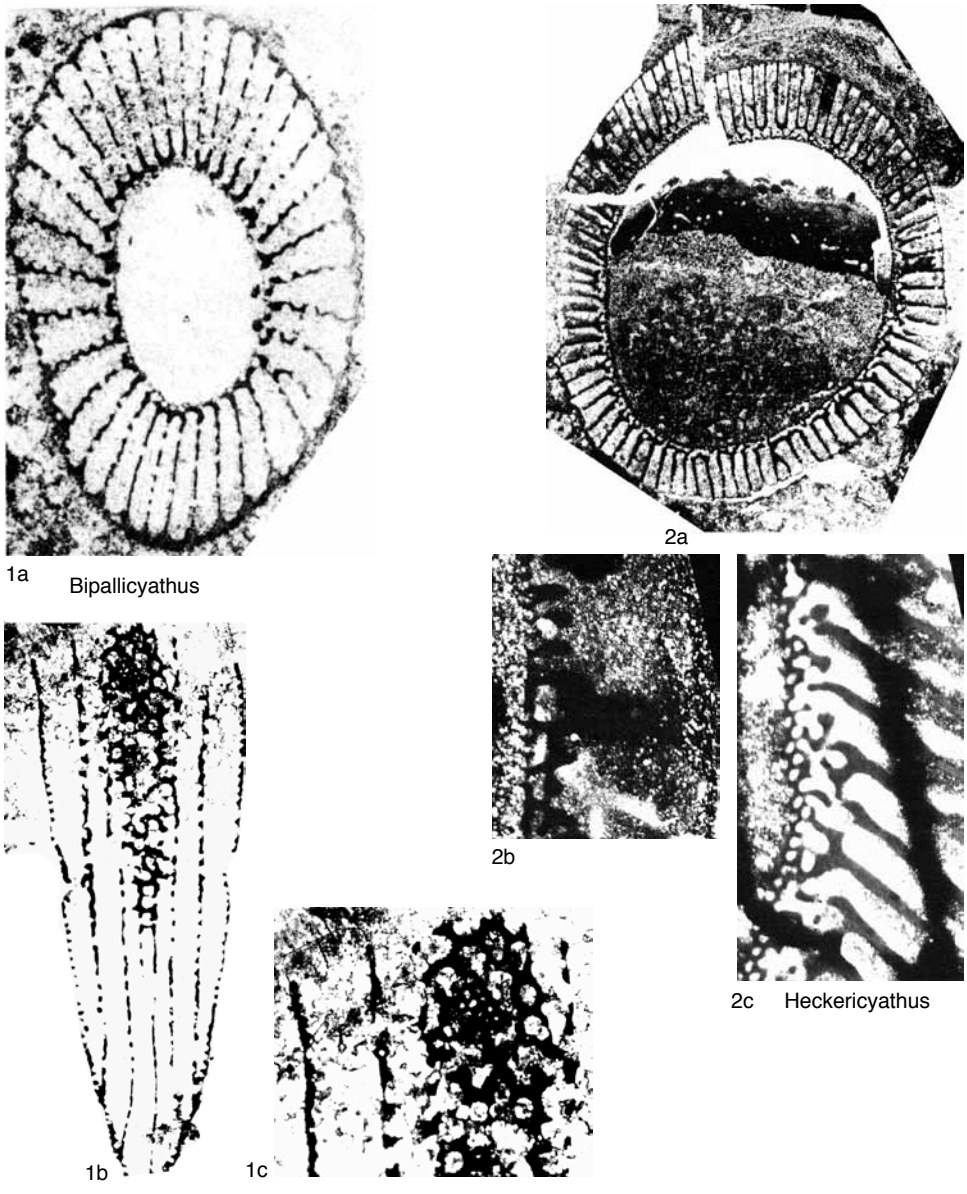
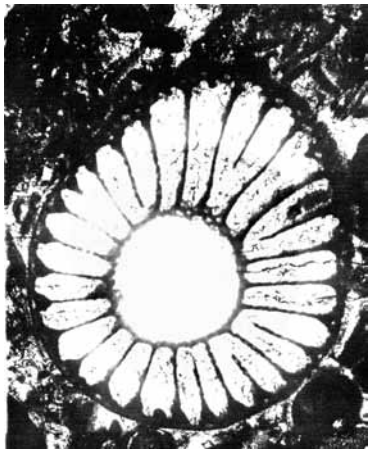


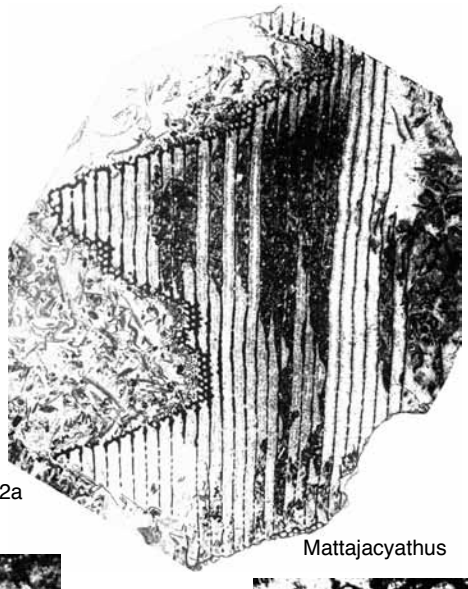
FIG. 28. Bipallicyathidae (p. 37).

Sakha (Yakutia), Russia, holotype, PIN 4297/96, transverse section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

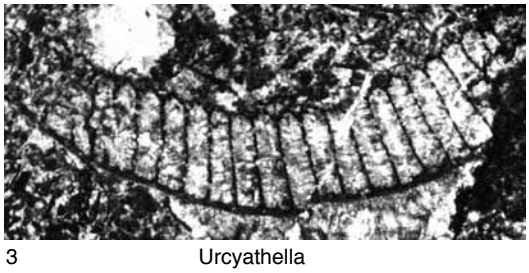
Mattajacyathus ROZANOV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 118 (ROZANOV, 1973, p. 61, *nom. nud.;* ROZANOV in DEBRENNE & ROZANOV, 1983, p. 735, *nom. nud.*) [**Robertocyathus arduus* ROZANOV, 1969, p. 113; OD; holotype, ROZANOV, 1969, pl. 42,*3–4;* ROZANOV, 1973, pl. 5,*1*, PIN 4297/97, Moscow]. Cup in which both walls show periodic, synchronous transverse folds; inner wall with several rows of simple pores per intersept; septa completely porous. *lower Cambrian (Bot.1):* Siberian Platform.——FIG. 29,*2a–b*. **M. arduus* (ROZANOV), Erkeket Formation, Botoman, Khorbusuonka River, Olenek Basin, Sakha (Yakutia), Russia, holotype, PIN 4297/97; *a,* longitudinal section, ×7; *b,* detail of outer wall in tangential section, ×15 (Debrenne, Zhuravlev, & Kruse, 2002).



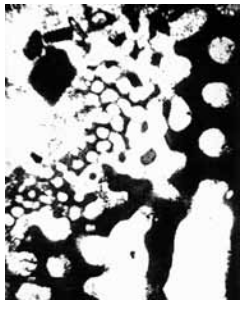
1 Robertocyathus



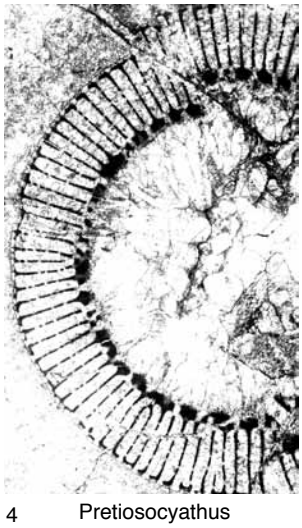
2a Mattajacyathus



3 Urcyathella

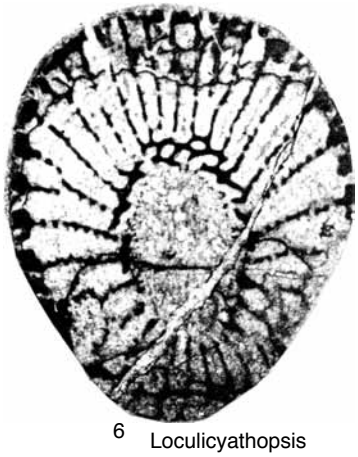


2b



4 Pretiosocyathus

5 Jangudacyathus



6 Loculicyathopsis

FIG. 29. Robertocyathidae and Pretiosocyathidae (p. 37–40).

Urcyathella Zhuravleva in Musatov & others, 1961, p. 25 [**U. tercyathoides*; OD; holotype, Musatov & others, 1961, pl. 3,*8–9*, TsSGM 264/26, Novosibirsk]. Inner wall longitudinally plicate, with several rows of simple pores per intersept; septa completely porous. *lower Cambrian (Atd.4–Bot.1):* Altay Sayan.——Fig. 29,*3*. **U. tercyathoides*, Balakhtinson Formation, Atdabanian, Kazyr River, East Sayan, Altay Sayan, Russia, holotype, TsSGM 264/26, transverse section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Family PRETIOSOCYATHIDAE Rozanov, 1969

[Pretiosocyathidae Rozanov, 1969, p. 112]

Inner wall with noncommunicating canals. *lower Cambrian (Atd.1–Bot.1).*

Pretiosocyathus Rozanov in Rozanov & Missarzhevskiy, 1966, p. 55 [**P. subtilis*; OD; holotype, Rozanov & Missarzhevskiy, 1966, pl. 4,*4;* Rozanov, 1973, pl. 11,*3*, PIN 4297/65, Moscow] [=*Cosmocyathus* Yazmir in Zhuravleva, 1974a, p. 96, *nom. nud.*; =*Cosmocyathus* Yazmir in Yazmir, Dalmatov, & Yazmir, 1975, p. 63 (type, *C. perforatus*, OD); =*Pretiosocyathellus* Osadchaya in Osadchaya & others, 1979, p. 133 (type, *P. toltschiensis*, OD); =*Grandicyathus* Korshunov, 1983b, p. 109 (type, *G. lectus*; OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 125; Debrenne, Rozanov, & Zhuravlev, 1990, p. 156]. Inner wall with horizontal to upwardly projecting, straight stirrup canals only; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Tajikistan.——Fig. 29,*4*. **P. subtilis*, Usa Formation, Atdabanian, Bol'shaya Erba, Batenev Range, Kuznetsk Alatau, Russia, holotype, PIN 4297/65, transverse section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Jangudacyathus Yazmir in Yazmir, Dalmatov, & Yazmir, 1975, p. 62 (Yazmir in Zhuravleva, 1974a, p. 180, *nom. nud.*) [**J. simplex*; OD; holotype, Yazmir, Dalmatov, & Yazmir, 1975, pl. 23,*5*, BGU 0138/21, Ulan-Ude]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Transbaikalia.——Fig. 29,*5*. **J. simplex*, Uran Formation, Botoman, Yanguda River, Vitim Highlands, Transbaikalia, Russia, holotype, BGU 0138/21, transverse section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Loculicyathopsis Boyarinov in Zhuravleva & others, 1997a, p. 61 [**L. septospinosus;* OD; holotype, Zhuravleva & others, 1997a, pl. 11,*9*, ZSGGU 2329/62, Novokuznetsk]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa completely porous. *lower Cambrian (Atd.2):* Altay Sayan.——Fig. 29,*6*. **L. septospinosus*, Usa Formation, Atdabanian, Malaya Belokamenka River, Kiya River, Kuznetsk Alatau, Russia, holotype, ZSGGU 2329/62, oblique transverse section, ×5 (Zhuravleva & others, 1997a).

Superfamily ERBOCYATHOIDEA Vologdin & Zhuravleva, 1956

[*nom. correct*. Debrenne & Kruse, 1986, p. 251, *pro* Erbocyathacea Zhuravleva, 1960b, p. 187, *nom. transl. ex* Erbocyathidae Vologdin & Zhuravleva in Vologdin, 1956, p. 879] [=Bosceculcyathacea Krasnopeeva, 1959, p. 7, *nom. transl.* Hill, 1972, p. 77, *ex* Bosceculcyathidae Krasnopeeva, 1959, p. 7; =Kordecyathoidea Missarzhevskiy, 1961, p. 21, *nom. transl.* Missarzhevskiy in Repina & others, 1964, p. 218, *ex* Kordecyathidae Missarzhevskiy, 1961, p. 21, *nom. correct. pro* Kordecyathacea Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 82]

Outer wall with attached microporous sheath. *lower Cambrian (Atd.1–Toy.3).*

Family ERBOCYATHIDAE Vologdin & Zhuravleva, 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]

Inner wall with simple pores. *lower Cambrian (Atd.1–Toy.3).*

Pluralicyathus Okulitch, 1950c, p. 503, *nom. nov. pro Polycyathus* Vologdin, 1928, p. 32, *non* Duncan, 1876, p. 433, cnidarian] [**Polycyathus heterovallum* Vologdin, 1928, p. 36; SD Simon, 1939, p. 34; lectotype, Vologdin, 1928, pl. 2,*1,2,4,5;* SD Debrenne, Zhuravlev, & Kruse, 2002, p. 1586, TsNIGRm 1/a-t/2617, St. Petersburg] [=*Erbocyathus* Zhuravleva, 1950, p. 857, *nom. nud.; =Erbocyathus* Zhuravleva, 1955a, p. 44, *nom. nov. pro Polycyathus* Vologdin, 1928, p. 32 (type, *Polycyathus heterovallum,* SD Simon, 1939, p. 34), *non* Duncan, 1876, p. 433, cnidarian; application by Debrenne, Zhuravlev, and Kruse (2003) to suppress *Pluralicyathus* and conserve *Erbocyathus* rejected by ICZN (2005); =*Neocyathus* Vologdin, 1960, p. 422 (type, *Archaeocyathus laevus* Vologdin, 1940b, p. 57, OD)]. Inner wall with several rows of simple pores per intersept; septa aporose to sparsely porous. *lower Cambrian (Bot.1–Toy.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Far East, Uzbekistan.——Fig. 30,*1a–b*. **P. heterovallum* (Vologdin); *a,* Torgashino Formation, Toyonian, Uyar River, East Sayan, Altay Sayan, Russia, unlocated specimen, transverse section, ×8.5 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* Khomustakh Formation, Toyonian, Amga River, Sakha (Yakutia), Russia, specimen TsSGM 205/71, section of modular skeleton, ×1 (Zhuravleva, 1960b).

Ladaecyathus Zhuravleva, 1960a, p. 43 [**Tegerocyathus limbatus* Zhuravleva, 1955a, p. 46; OD; holotype, Zhuravleva, 1955a, pl. 5,*3–4*, PIN 494,

Moscow, not located]. Inner wall with several rows of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.4–Bot.3):* Siberian Platform, Kolyma, Altay Sayan, Transbaikalia, Far East, Australia, Antarctica, Morocco.——Fig. 30,*2a–b*. **L. limbatus* (Zhuravleva), Usa Formation, Botoman, Mt. Martyukhina, Batenev Range, Kuznetsk Alatau, Russia; *a,* holotype, PIN 494, transverse section, ×6.5 (Zhuravleva, 1955a); *b,* TsSGM 273/4d, longitudinal section of septum (outer wall to left), ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Milaecyathus Debrenne & Zhuravlev, 2000, p. 49 [**Ladaecyathus melnikovae* Zhuravlev in Voronin & others, 1982, p. 79; OD; holotype, Voronin & others, 1982, pl. 16,*2,5*, PIN 3302/300v, Moscow]. Inner wall with stirrup pores only; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Atd.2):* Altay Sayan, Mongolia.——Fig. 30,*3a–b*. **M. melnikovae* (Zhuravlev), Salaany Gol Formation, Atdabanian, Salaany-Gol River, Khasagt-Khairkhan Range, Tsagaan Oloom province, western Mongolia, holotype, PIN 3302/300v; *a,* transverse section, ×5 (Voronin & others, 1982); *b,* detail of outer wall in tangential section, ×25 (Debrenne, Zhuravlev, & Kruse, 2002).

Family PEREGRINICYATHIDAE Zhuravleva, 1967

[Peregrinicyathidae Zhuravleva in Zhuravleva & others, 1967, p. 74]

Inner wall with annuli. *lower Cambrian (Bot.1–Bot.2).*

Peregrinicyathus Zhuravleva in Zhuravleva & others, 1967, p. 75 [**P. dorotheae*; OD; holotype, Zhuravleva & others, 1967, pl. 28,*1,* TsSGM 325/54, Novosibirsk]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Tuva.——Fig. 31,*1a–b*. **P. dorotheae*, Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia; *a,* holotype, TsSGM 325/54, transverse section, ×4.5 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* paratype, TsSGM 325, specimen 1, thin section 1, sample 314-7, OR-64, detail of oblique transverse section (outer wall to left), ×8 (Zhuravleva & others, 1967).

Family VOLOGDINOCYATHIDAE Yaroshevich, 1957

[Vologdinocyathidae Yaroshevich, 1957, p. 1015] [=Bosceculcyathidae Krasnopeeva, 1959, p. 7; =Kordecyathidae Missarzhevskiy, 1961, p. 21; =Schidertycyathidae Krasnopeeva, 1969, p. 63; =Gumbycyathidae Debrenne & Kruse, 1986, p. 253]

Inner wall with noncommunicating canals. *lower Cambrian (Bot.1–Toy.2).*

Vologdinocyathus Yaroshevich, 1957, p. 1015 [**V. erbiensis*; OD; holotype, Yaroshevich, 1957, fig. 1a–v, TsSGM 499/1a-b, Novosibirsk] [=*Tegerocyathella* Konyushkov, 1967, p. 109 (type, *T. borovikovi*, OD); =*Larecyathus* Kashina, 1979, p. 46, *nom. nud.*; =*Larecyathus* Kashina in Osadchaya & others, 1979, p. 145 (type, *L. infinitus,* OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 139; Debrenne, Rozanov, & Zhuravlev, 1990, p. 167]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa aporose to sparsely porous. *lower Cambrian (Bot.3–Toy.2):* Altay Sayan, Tuva, Mongolia, Kazakhstan, Uzbekistan, Antarctica, Greenland.——Fig. 31,*2a–b*. **V. erbiensis*, Usa Formation, Toyonian, Bol'shaya Erba, Batenev Range, Kuznetsk Alatau, Altay Sayan, Russia, holotype, TsSGM 499/1a-b; *a,* detail of transverse section, ×30; *b,* detail of septum in longitudinal section (outer wall to left), ×50 (Debrenne, Zhuravlev, & Kruse, 2002).

Gumbycyathus Kruse, 1982, p. 168 [**G. pythoni;* OD; holotype, Kruse, 1982, pl. 4,*1–5,* AM F.83930, Sydney]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa completely porous. *lower Cambrian (Bot.1–Bot.3):* Mongolia, Australia.——Fig. 32,*1a–d*. **G. pythoni,* Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia, holotype, AM F.83930; *a,* transverse section (outer wall to right), AM FT.8457, ×6; *b,* detail of longitudinal section (outer wall to left), AM FT.8455, ×8; *c,* detail of outer wall in tangential section, AM FT.8458, ×8; *d,* detail of inner wall in tangential section, AM FT.8456, ×8 (Kruse, 1982).

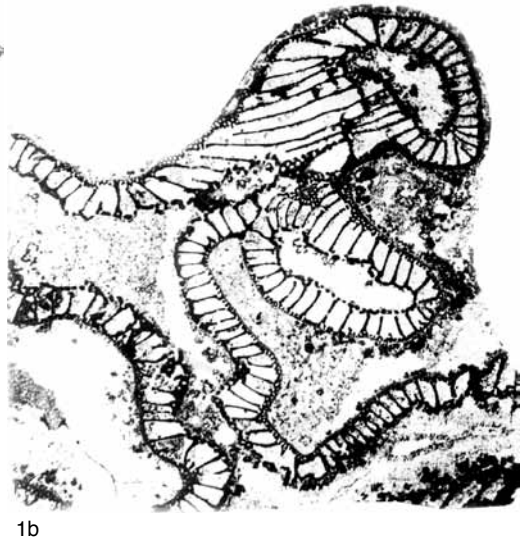
Inacyathella Debrenne, 1977a, p. 109 [**I. pulchra*; OD; holotype, Debrenne, 1977a, pl. 8,*3–4*, MNHN M80037, Paris]. Inner wall with one row of horizontal to upwardly projecting, S-shaped canals per intersept; septa completely porous. *lower Cambrian (Bot.1):* Morocco.——Fig. 31,*3a–b*. **I. pulchra*, Issafen Formation, Botoman, Jbel Irhoud, Morocco, holotype, MNHN M80037; *a,* oblique transverse section, ×3.5 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* detail of septum in longitudinal section (outer wall to left), ×10 (Debrenne, 1977a).

Kordecyathus Missarzhevskiy, 1961, p. 21 [**K. shiveligensis;* OD; holotype, Missarzhevskiy, 1961, pl. 1,*3*, PIN 1914/73M/1, Moscow, not located]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept, bearing downwardly projecting cupped bracts on central cavity side; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1–Bot.2):* Tuva, Mongolia.——Fig. 31,*4a–b*. **K. shiveligensis*, Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia, holotype, PIN 1914/73M/1; *a,* detail of transverse section (outer wall at top), ×8 (Missarzhevskiy, 1961); *b,* oblique longitudinal section, ×3 (Debrenne, Zhuravlev, & Kruse, 2002).

Sanarkophyllum Debrenne & Kruse, 1986, p. 254 [**Formosocyathus antarcticus* Hill, 1964c, p. 616; OD; holotype, Hill, 1964c, fig. 1(4a), An 62/1B/p, not located]. Inner wall with one row

1a

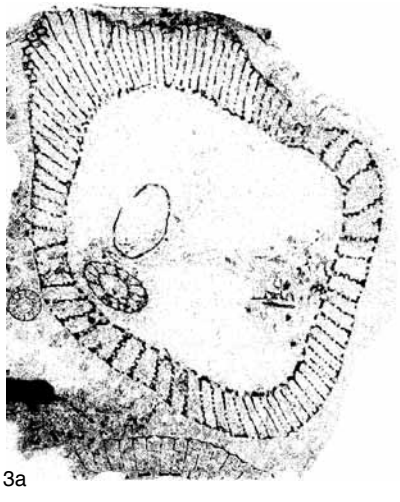
Pluralicyathus



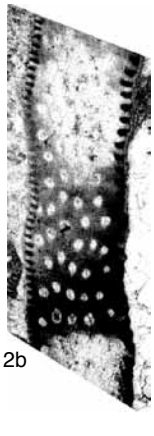
1b

2a

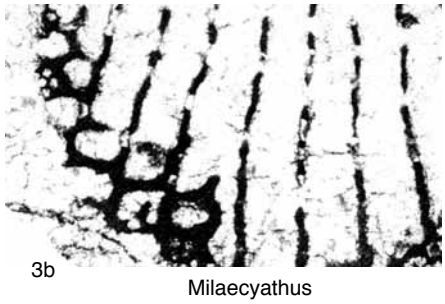
Ladaecyathus



3a



2b



3b

Milaecyathus

FIG. 30. Erbocyathidae (p. 40–41).

of downwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa aporose to sparsely porous. *lower Cambrian (Bot.3):* Antarctica.——Fig. 32,*2a–d*. **S. antarcticum* (Hill), Shackleton Limestone, Botoman; *a,* Plunket Point, Beardmore Glacier, Antarctica, holotype, An 62/1B/p, oblique transverse section, ×2 (Hill, 1964c); *b–d,* Holyoake Range, Nimrod Glacier, Antarctica, specimen GNS MG509; *b,* transverse section, ×4; *c,* oblique longitudinal section, ×3.5; *d,* detail of repeated longitudinal section (outer wall to left), ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Syringocyathus Vologdin, 1940b, p. 82 (Vologdin, 1937b, p. 471, *nom. nud.*) [**S. aspectabilis;* OD; lectotype, Vologdin, 1940b, pl. 23,*3;* SD Zhuravlev, 2001a, p. 92, PIN 4754/3, Moscow] [=*Schidertycyathus* Krasnopeeva, 1959, p. 3 (type, *S. borucaevi,* M); =?*Bosceculcyathus* Krasnopeeva, 1959, p. 7 (type, *B. agyrekensis,* OD); =?*Boscekulcyathus* Krasnopeeva, 1959, p. 7, *nom. null.;* =*Schidertycyathellus* Konyushkov, 1967, p. 108 (type, *S. borukaevi,* OD); =*Syringocyathellus* Kashina in Osadchaya & others, 1979, p. 149 (type, *S. kazachstani,* OD), for discussion, see Debrenne, Rozanov, & Zhuravlev, 1990, p. 162]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept; septa completely porous, linked by interseptal plates. *lower Cambrian (Bot.3–Toy.2):* Altay Sayan, Tuva, Kazakhstan, Uzbekistan.——Fig. 32,*3*. **S. aspectabilis*, Verkhnemonok Formation, Botoman, Abakan River, West Sayan, Altay Sayan, Russia, lectotype, PIN 4754/3, oblique transverse section, ×5 (Vologdin, 1940b).

Family TEGEROCYATHIDAE Krasnopeeva, 1972

[Tegerocyathidae Krasnopeeva, 1972, p. 145]

Inner wall with communicating canals. *lower Cambrian (Bot.1–Toy.3).*

Tegerocyathus Krasnopeeva, 1955, p. 90 (Krasnopeeva, 1953, p. 52, 56, *nom. nud.*) [**Ethmophyllum abakanensis* Vologdin, 1940b, p. 69; holotype not designated, collection not located; Zhuravleva, 1960b, p. 192, invalidly nominated *Ethmophyllum edelsteini* Vologdin, 1931, p. 47, as type species] [=*Tegerocoscinus* Krasnopeeva, 1972, p. 145 (type, *T. tchesnokovensis*, OD); =*Alexandricyathus* Kashina in Osadchaya & others, 1979, p. 142 (type, *A. ultrus*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 134; Debrenne, Rozanov, & Zhuravlev, 1990, p. 163]. Inner wall with one row of horizontal to upwardly projecting, straight porous canals per intersept; septa sparsely to completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1–Toy.3):* Siberian Platform, Altay Sayan, Mongolia, Uzbekistan, Antarctica, Greenland, United States.——Fig. 33,*1a–b*. **T. abakanensis* (Vologdin), Verkhnemonok Formation, Botoman, Abakan River, West Sayan, Altay Sayan, Russia, unlocated syntype; *a,* transverse section, ×5; *b,* longitudinal section, ×5 (Vologdin, 1940b).

Krasnopeevaecyathus Rozanov in Repina & others, 1964, p. 208 [**K. tyrgaensis*; OD; holotype, Repina & others, 1964, pl. 21,*3–4*), PIN 4297/26-27, Moscow] [=*Krishnanicyathus* Vologdin, 1964b, p. 358 (type, *K. elegans*, OD); =*Ethmosyringocyathus* Konyushkov, 1972, p. 138 (type, *E. primus*, OD)]. Inner wall longitudinally plicate, with several rows of anastomosing, horizontal to upwardly projecting, waved canals per intersept; septa completely porous. *lower Cambrian (Bot.2):* Altay Sayan, United States.——Fig. 33,*2*. **K. tyrgaensis*, Verkhneynyrga Formation, Botoman, Tyrga River, Altay Mountains, Altay Sayan, Russia, holotype, PIN 4297/26-27, oblique transverse section, ×3.5 (Repina & others, 1964).

Superfamily TUMULOCYATHOIDEA Krasnopeeva, 1953

[*nom. correct*. Zhuravlev & Rozanov in Voronova & others, 1987, p. 21, *pro* Tumulocyathacea Debrenne, 1964, p. 113, *nom. transl. ex* Tumulocyathidae Krasnopeeva, 1953, p. 56] [=Geocyathacea Debrenne, 1964, p. 114, *nom. nud., nom. transl.* Rozanov, 1973, p. 86 *ex* Geocyathidae Debrenne, 1964, p. 114]

Outer wall with simple tumuli. *lower Cambrian (Tom.2–Bot.3).*

Family TUMULOCYATHIDAE Krasnopeeva, 1953

[Tumulocyathidae Krasnopeeva, 1953, p. 56] [=Kotuyicyathidae Rozanov in Rozanov & others, 1969, p. 186, *nom. nud.*]

Inner wall with simple pores. *lower Cambrian (Tom.2–Bot.3).*

Tumulocyathus Vologdin, 1937b, p. 470 [**T. pustulatus*; M; holotype not designated, collection not located] [=*Kotuyicyathus* Zhuravleva, 1960b, p. 226 (type, *K. kotuyikensis*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 138; Debrenne, Rozanov, & Zhuravlev, 1990, p. 165; =*Tumulocyathoides* Boyarinov & Konyaeva in Zhuravleva & others, 1997b, p. 123 (type, *T. kiyaensis*, OD)]. Inner wall with one row of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Tom.2–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Australia.——Fig. 34,*1*. **T. pustulatus*; Salaany Gol Formation, Atdabanian, Salaany Gol, Khasagt-Khayrkhan Range, Tsagaan Oloom province, western Mongolia, specimen PIN

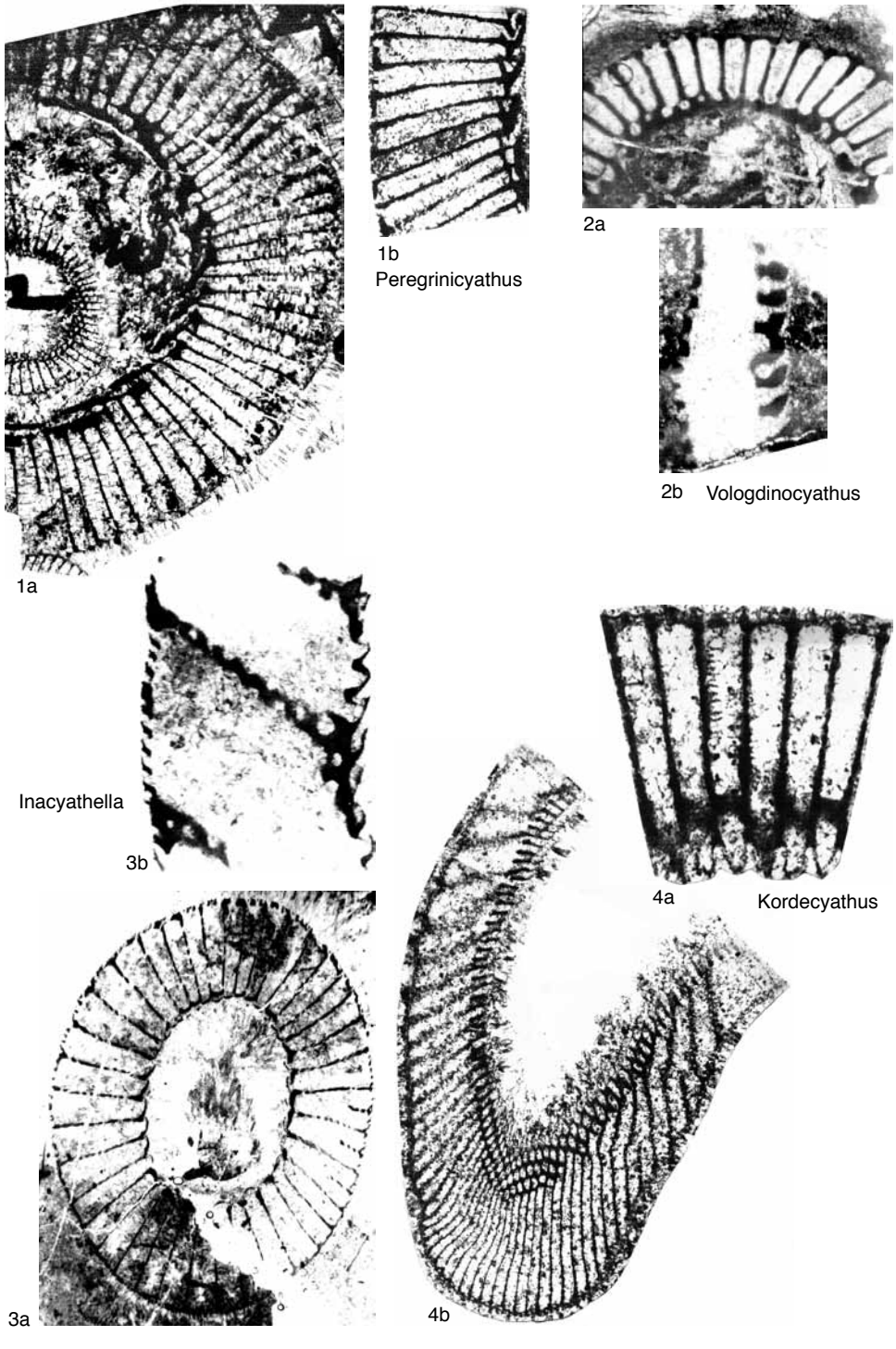
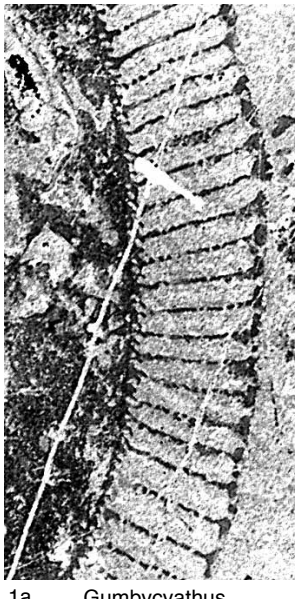
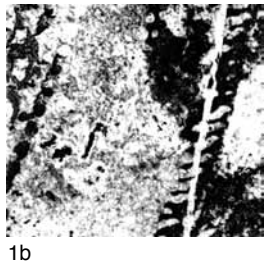


FIG. 31. Peregrinicyathidae and Vologdinocyathidae (p. 41).



1a Gumbycyathus

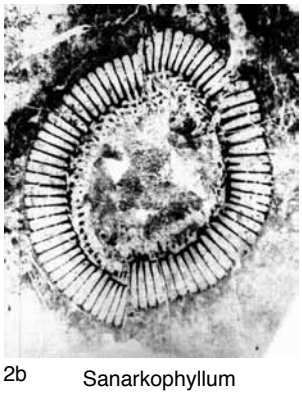


1b

1c

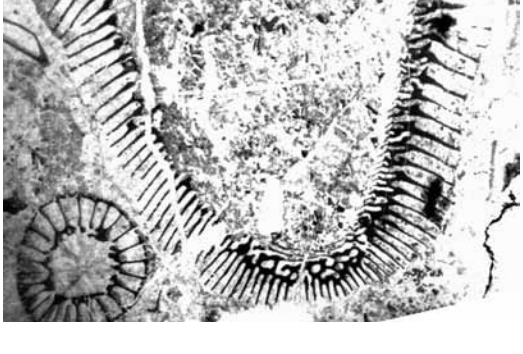
1d

2a

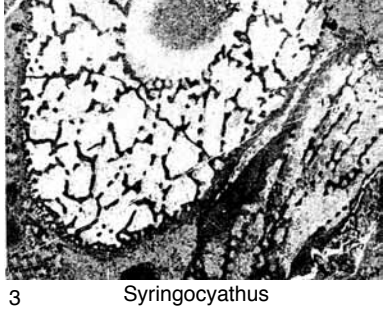


2b Sanarkophyllum

2d



2c



3 Syringocyathus

Fig. 32. Vologdinocyathidae (p. 41–43).

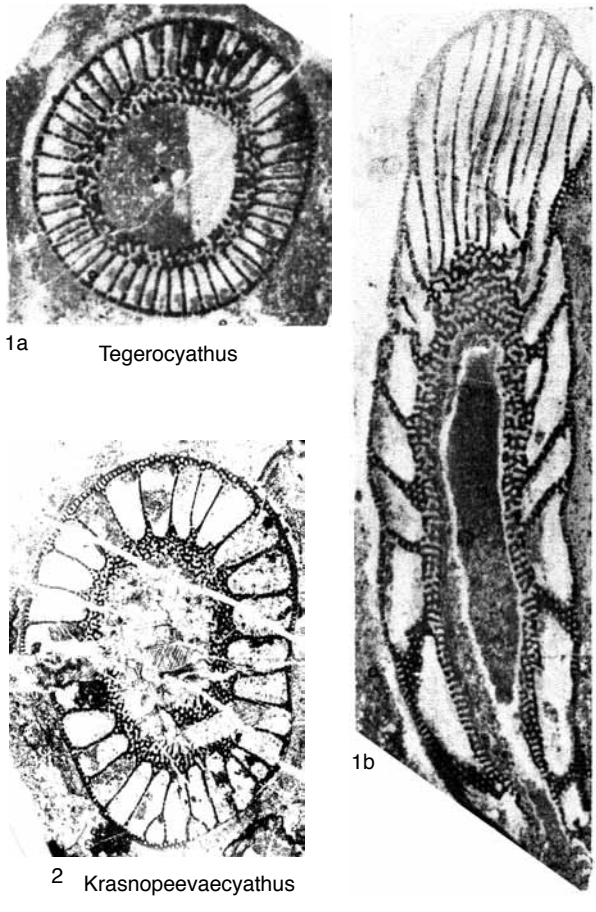


FIG. 33. Tegerocyathidae (p. 43).

3302/710, oblique transverse section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Isiticyathus KORSHUNOV, 1972, p. 60 [**?Tumulifungia ultra* KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 38; OD; holotype, ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, pl. 10,*2;* KORSHUNOV, 1972, pl. 8,*6*, TsSGM 323/45, Novosibirsk]. Inner wall with one row of simple pores per intersept; septa completely porous, linked by synapticulae. *lower Cambrian (Atd.4–Bot.1):* Siberian Platform, Transbaikalia.——FIG. 34,*2a–b*. **I. ultra* (KORSHUNOV), Oy-Muran reef massif, Atdabanian, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 323/45; *a,* transverse section, ×8 (Zhuravleva, Korshunov, & Rozanov, 1969); *b,* detail of transverse section (outer wall at bottom), ×13 (Debrenne, Zhuravlev, & Kruse, 2002).

Kotuyicyathellus OSADCHAYA in OSADCHAYA & others, 1979, p. 157 [**K. minus*; OD; holotype, OSADCHAYA & others, 1979, pl. 25,*5*, VSEGEI 11594, St. Petersburg] [=*Borocyathus* VORONIN, 1988, p. 8 (type, *B. khairkhanicus,* OD)]. Inner wall with several rows of simple pores per intersept; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform, Altay Sayan, Mongolia, Far East.——FIG. 34,*3*. **K. minus*, Usa Formation, Atdabanian, Krutoy Log, Batenev Range, Kuznetsk Alatau, Russia, holotype, VSEGEI 11594, transverse section, ×15 (Osadchaya & others, 1979).

Plicocyathus VOLOGDIN, 1960, p. 424 [**P. krassnyi*; OD; holotype, VOLOGDIN, 1960, fig. 1m, PIN 4754/45, Moscow] [=*Tumulocyathellus* ZHURAVLEVA, 1960b, p. 174, *nom. transl.* REPINA & others, 1964, p. 194, *ex Tumulocyathus (Tumulocyathellus)* ZHURAVLEVA, 1960b, p. 174 (type, *Tumulocyathus admirabilis* VOLOGDIN, 1940b, p. 72, OD); for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 123; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 155; =*Torosocyathellus* OSADCHAYA in OSADCHAYA & others, 1979, p. 128 (type, *T. torosus*, OD)]. Outer wall longitudinally plicate; inner wall with stirrup pores only; septa aporose to sparsely porous; pectinate

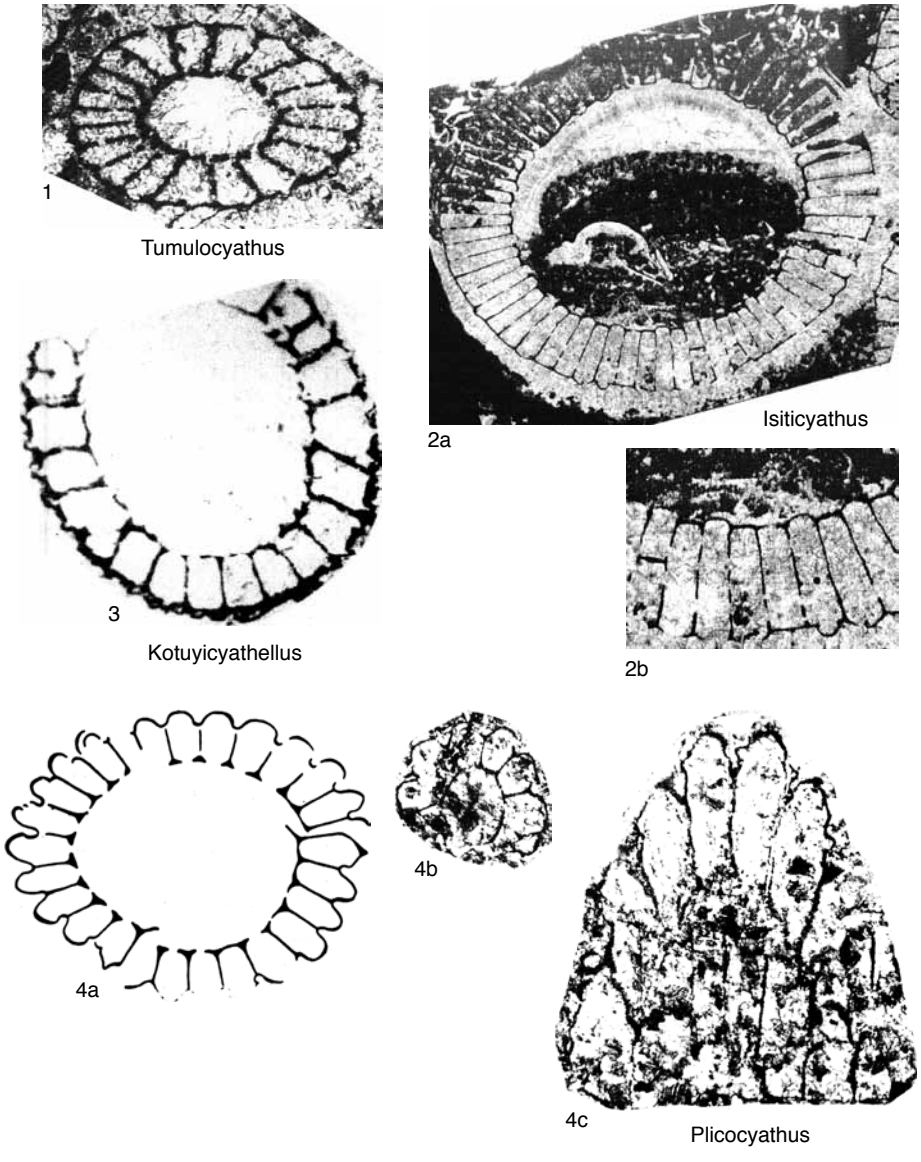


FIG. 34. Tumulocyathidae (p. 43–47).

tabulae may be present. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Kolyma, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Morocco, Iberia, Canada, United States, Mexico.——FIG. 34,*4a–c*. **P. krassnyi*; *a,* Ust'toka unit, Botoman, Gerbikan River, Dzhagdy Range, Far East, Russia, holotype, PIN 4754/45, sketch of transverse section, ×5 (Vologdin, 1960); *b–c,* Ust'toka unit, Botoman, Onnetok River, Dzhagdy Range, Far East, Russia, specimen DVGU 6M; *b,* transverse section, ×10; *c,* oblique transverse section, ×10 (Belyaeva & others, 1975).

Family SANARKOCYATHIDAE Hill, 1972

[Sanarkocyathidae HILL, 1972, p. 79] [=Sanaricyathidae ROZANOV, 1969, p. 107, name based on invalid generic name *Sanaricyathus* ROZANOV, 1969, p. 108, *nom. null. pro Sanarkocyathus* ZHURAVLEVA, 1963a, p. 118]

Inner wall with bracts or scales. *lower Cambrian (Atd.3–Bot.1).*

Sanarkocyathus ZHURAVLEVA, 1963a, p. 118 [**S. mamaevi;* OD; holotype, ZHURAVLEVA, 1963a,

fig. 2, TsSGM 99/1, Novosibirsk] [=*Sanaricyathus* ROZANOV, 1969, p. 108, *nom. null.*]. Inner wall with one row of pores per intersept, bearing possibly upwardly projecting, S-shaped scales; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Urals, Altay Sayan.——FIG. 35,*1*. **S. mamaevi,* Sanarka Formation, Botoman, Sanarka River, eastern flank of southern Urals, Russia, holotype, TsSGM 99/1, oblique transverse section, ×6 (Zhuravleva, 1963a).

Neokolbicyathus KONYAEVA in ZHURAVLEVA & others, 1997b, p.131 [**N. azhuravlevi;* OD; holotype, ZHURAVLEVA & others, 1997b, pl. 4,*3*, ZSGGU 2329/83, Novokuznetsk]. Inner wall with stirrup pores only, bearing upwardly projecting, S-shaped scales; septa aporose to sparsely porous. *lower Cambrian (Atd.4–Bot.1):* Altay Sayan, Far East, Canada.——FIG. 35,*2*. **N. azhuravlevi*, Usa Formation, Atdabanian, Malaya Belokamenka River, Kiya River, Kuznetsk Alatau, Russia, holotype, ZSGGU 2329/83, oblique transverse section, ×8 (Zhuravleva & others, 1997b).

Ringifungia KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 38 [**R. vavilovi;* OD; holotype, ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, pl. 10,*4–5*, TsSGM 323/47, Novosibirsk]. Inner wall with one row of pores per intersept, bearing upwardly projecting, S-shaped scales; septa completely porous, linked by synapticulae. *lower Cambrian (Atd.3):* Siberian Platform.——FIG. 35,*3*. **R. vavilovi*, Perekhod Formation, Atdabanian, Ulakhan-Taryng Creek, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 323/47, oblique transverse section, ×8 (Zhuravleva, Korshunov, & Rozanov, 1969).

Family GEOCYATHIDAE Debrenne, 1964

[Geocyathidae DEBRENNE, 1964, p. 114] [=Jakutocyathidae KORSHUNOV, 1972, p. 65; =Eladicyathidae PEREJÓN, 1977, p. 550]

Inner wall with annuli. *lower Cambrian (Atd.1–Bot.1).*

Geocyathus ZHURAVLEVA, 1960b, p. 234 [**Thalamocyathus botomanensis* ZHURAVLEVA in ZHURAVLEVA & ZELENOV, 1955, p. 71; OD; holotype, ZHURAVLEVA & ZELENOV, 1955, pl. 2,*3–4*, TsSGM 205/115a-b, Novosibirsk; =*T. botomaensis* ZHURAVLEVA, 1960b, p. 234, *nom. null.*] [=*Jakutocyathus (Jakutocyathus)* ZHURAVLEVA, 1960b, p. 230 (type, *J. (J.) latini*, OD); =*Eladicyathus* PEREJÓN, 1977, p. 550 (type, *E. beticus*, OD); for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 108; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 144]. Inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Altay Sayan, Transbaikalia, Far East, Iberia.——FIG. 35,*4a–b*. **G. botomanensis* (ZHURAVLEVA), Perekhod Formation, Atdabanian, Botoma River, Sakha (Yakutia), Russia, holotype, TsSGM 205/115a-b; *a,* transverse section, ×15; *b,* longitudinal section, ×15 (Zhuravleva & Zelenov, 1955).

Family KONJUSCHKOVICYATHIDAE Debrenne & Zhuravlev, 2000

[Konjuschkovicyathidae DEBRENNE & ZHURAVLEV, 2000, p. 49]

Inner wall with noncommunicating canals. *lower Cambrian (Bot.1–Bot.3).*

Konjuschkovicyathus DEBRENNE & ZHURAVLEV, 2000, p. 49 [**Jakutocyathus spinosus* KONYUSHKOV, 1972, p. 140; OD; holotype, KONYUSHKOV, 1972, pl. 14,*6*, not located; paratypes, KONYUSHKOV, 1972, pl. 14,*5*, PIN 4755/5; KONYUSHKOV, 1972, pl. 16,*3*, PIN 4755/6, Moscow]. Inner wall with downwardly projecting, straight stirrup canals only, bearing supplementary bracts on central cavity side; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1–Bot.3):* Altay Sayan, Transbaikalia.——FIG. 35,*5a–b*. **K. spinosus* (KONYUSHKOV), Verkhnemonok Formation, Botoman, Malyy Karakol River, West Sayan, Altay Sayan, Russia; *a,* holotype, transverse section, ×10; *b,* paratype, PIN 4755/6, oblique longitudinal section, ×10 (Konyushkov, 1972).

Superfamily LENOCYATHOIDEA Zhuravleva, 1956

[*nom. correct.* DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 83, *pro* Lenocyathacea ZHURAVLEVA, 1960b, p. 224, *nom. transl. ex* Lenocyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879] [=Rewardocyathacea ROZANOV, 1973, p. 86, *nom. nud.*]

Outer wall with multiperforate tumuli. *lower Cambrian (Atd.1–Bot.1).*

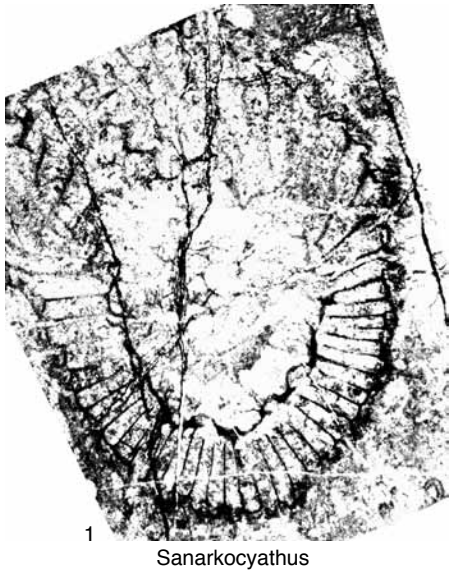
Family TOROSOCYATHIDAE Debrenne, Zhuravlev, & Kruse, 2002

[Torosocyathidae DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1594] [=Rewardocyathidae ROZANOV, 1973, p. 86, *nom. nud.*; =Rewardocyathidae ROZANOV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 83, *nom. nud.*, based on unavailable genus-group name]

Inner wall with simple pores. *lower Cambrian (Atd.1–Bot.1).*

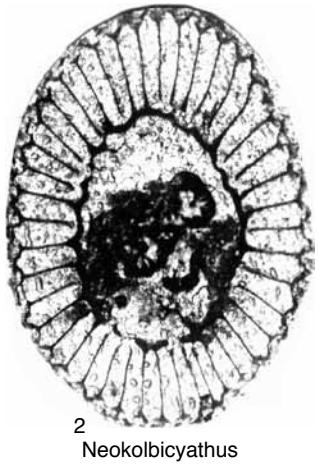
Torosocyathus KASHINA in VOLOGDIN & KASHINA, 1972, p. 153 [**T. provisus;* OD; holotype, VOLOGDIN & KASHINA, 1972, pl. 20a,*1*, KGU 19/729a, Krasnoyarsk] [=*Rewardocyathus* ROZANOV, 1973, p. 59, 75, 161, *nom. nud.*]. Inner wall with stirrup pores only; septa completely porous. *lower Cambrian (Atd.1–Bot.1):* Altay Sayan, Mongolia.——FIG. 36,*1*. **T. provisus*, Balakhtinson Formation, Atdabanian, Uyar River, East Sayan, Altay Sayan, Russia, holotype, KGU 19/729a, detail of transverse section, ×12 (Vologdin & Kashina, 1972).

Torosocyathella KOTEL'NIKOV, 1995, p. 27 [**T. osadchajae*; OD; holotype, KOTEL'NIKOV, 1995, pl. 2,*5*, TsNIGRm 12890/9, St. Petersburg]. Inner wall with several rows of simple pores per intersept;

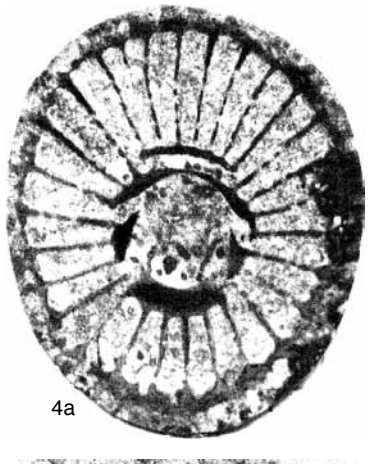


1
Sanarkocyathus

3
Ringifungia

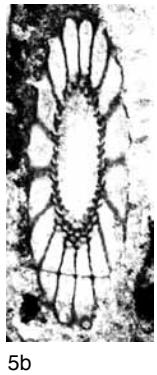


2
Neokolbicyathus

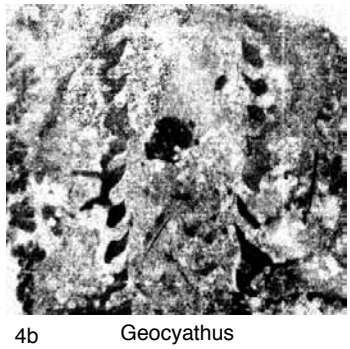


4a

5a
Konjuschkovicyathus

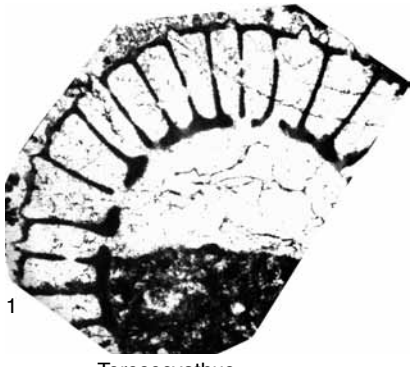


5b



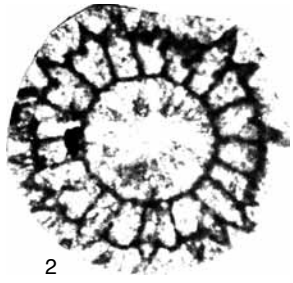
4b
Geocyathus

FIG. 35. Sanarkocyathidae, Geocyathidae, and Konjuschkovicyathidae (p. 47–48).



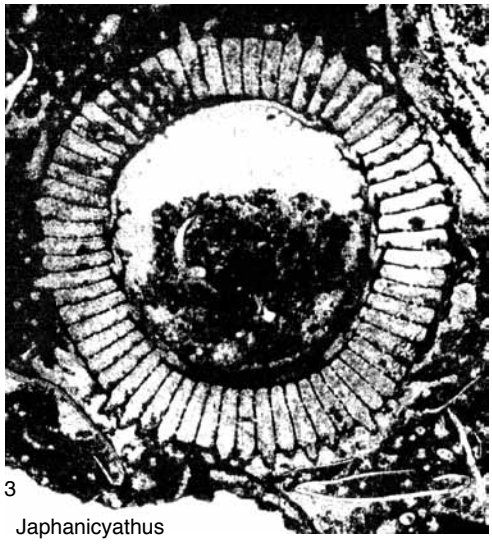
1

Torosocyathus



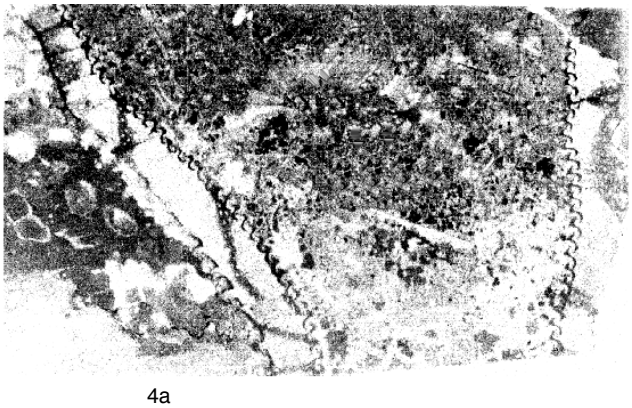
2

Torosocyathella



3

Japhanicyathus



4a

4b

Lenocyathus

FIG. 36. Torosocyathidae, Japhanicyathidae, and Lenocyathidae (p. 48–51).

septa completely porous. *lower Cambrian (Atd.2):* Tuva.——Fig. 36,*2. *T. osadchajae*, Il'chir Formation, Atdabanian, Vadi-Bala, Tapsa River, Tuva, Russia, holotype, TsNIGRm 12890/9, transverse section, ×20 (Kotel'nikov, 1995).

Family JAPHANICYATHIDAE Rozanov, 1989

[Japhanicyathidae Rozanov in Debrenne, Zhuravlev, & Rozanov, 1989, p. 83] [=Japhanicyathidae Rozanov, 1973, p. 86, *nom. nud.*]

Inner wall with annuli. *lower Cambrian (Atd.2–Bot.1).*

Japhanicyathus Korshunov in Zhuravleva, Korshunov, & Rozanov, 1969, p. 45 [**J. genurosus*; OD; holotype, Zhuravleva, Korshunov, & Rozanov, 1969, pl. 17,*1–2*, TsSGM 323/67, Novosibirsk]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform, Far East.——Fig. 36,*3. **J. genurosus*, Oy-Muran reef massif, Atdabanian, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 323/67, transverse section, ×8 (Zhuravleva, Korshunov, & Rozanov, 1969).

Family LENOCYATHIDAE Zhuravleva, 1956

[Lenocyathidae Zhuravleva in Vologdin, 1956, p. 879]

Inner wall with noncommunicating canals. *lower Cambrian (Atd.2–Bot.1).*

Lenocyathus Zhuravleva in Zhuravleva & Zelenov, 1955, p. 73 (Zhuravleva, 1954, p. 12, *nom. nud.*) [**L. lenaicus*; OD; holotype, Zhuravleva & Zelenov, 1955, pl. 2,*5–6*, TsSGM 205/117, Novosibirsk]. Inner wall with one row of horizontal to upwardly projecting, S-shaped canals per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform, Far East, Morocco.——Fig. 36,*4a–b. **L. lenaicus*, Pestrotsvet Formation, Atdabanian, Yudyay, Botoma River, Sakha (Yakutia), Russia, holotype, TsSGM, 205/117; *a,* longitudinal section, ×7; *b,* detail of transverse section (outer wall at top), ×20 (Debrenne, Zhuravlev, & Kruse, 2002).

Superfamily ANNULOCYATHOIDEA Krasnopeeva, 1953

[*nom. correct.* Debrenne, Zhuravlev, & Rozanov, 1989, p. 83, *pro* Annulocyathacea Zhuravleva, 1960b, p. 171, *nom. transl. ex* Annulocyathidae Krasnopeeva, 1953, p. 56]

Outer wall with bracts or scales. *lower Cambrian (Tom.2–Bot.3).*

Family TUMULIFUNGIIDAE Rozanov, 1989

[Tumulifungiidae Rozanov in Debrenne, Zhuravlev, & Rozanov, 1989, p. 83] [=Tumulifungiidae Rozanov, 1973, p. 85, *nom. nud.*]

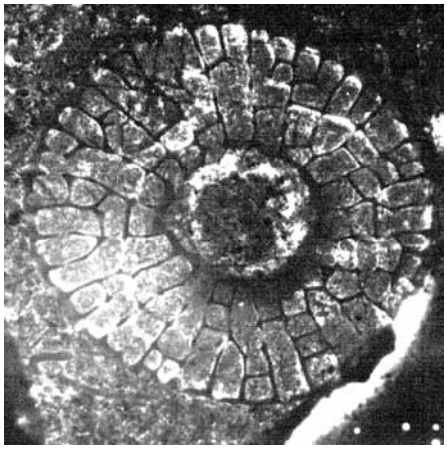
Inner wall with simple pores. *lower Cambrian (Tom.2–Bot.3).*

Tumulifungia Zhuravleva in Datsenko & others, 1968, p. 144 (Zhuravleva in Zhuravleva & others, 1967, p. 68, *nom. nud.*) [**T. datzenkoi*; OD; holotype, Datsenko & others, 1968, pl. 4,*2–3*, TsSGM 277/30, Novosibirsk]. Outer wall with upwardly projecting cupped bracts; inner wall with one row of simple pores per intersept; septa completely porous, linked by synapticulae. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Far East, Morocco, Iberia.——Fig. 37,*1. **T. datzenkoi*, Shumnoy Formation, Botoman, Sukharikha River, Krasnoyarsk region, Russia, holotype, TsSGM 277/30, transverse section, ×11 (Datsenko & others, 1968).

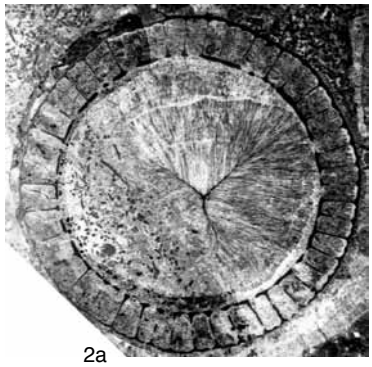
Sclerocyathus Vologdin, 1960, p. 424 [**S. scrofulosus*; OD; holotype, Vologdin, 1960, fig. 1z-i, PIN 4754/1, Moscow]. Outer wall with upwardly projecting, cupped bracts; inner wall with one row of simple pores per intersept; septa completely porous. *lower Cambrian (Tom.2–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Far East, Iberia.——Fig. 37,*2a–b. **S. scrofulosus*, Bayan-Kol Formation, Atdabanian, Yenisey River, Shagonar Mountains, Tuva, Russia, holotype, PIN 4754/1; *a,* transverse section, ×4; *b,* detail of transverse section, ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

Subtumulocyathellus Osadchaya in Osadchaya & others, 1979, p. 129 [**S. vulgaris*; OD; holotype, Osadchaya & others, 1979, pl. 11,*1*, VSEGEI 11594, St. Petersburg] [=*Arturocyathus* Rozanov, 1973, p. 61, 162, *nom. nud.*; =*Arturocyathus* Rozanov in Debrenne, Zhuravlev, & Rozanov, 1989, p. 95 (type, *A. borisovi* Rozanov, 1973, p. 162, OD)]. Outer wall with upwardly projecting, cupped bracts; inner wall with stirrup pores only; septa aporose to sparsely porous. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Far East.——Fig. 37,*3. **S. vulgaris*, Usa Formation, Atdabanian, Krutoy Log, Batenev Range, Kuznetsk Alatau, Russia, holotype, VSEGEI 11594, oblique transverse section, ×10 (Osadchaya & others, 1979).

Tologoicyathus Voronin, 1988, p. 9 [**T. ichituinicus*; OD; holotype, Voronin, 1988, pl. 2,*3*, PIN 3301/516, Moscow]. Outer wall with upwardly projecting, cupped bracts; inner wall with several rows of simple pores per intersept; septa completely porous. *lower Cambrian (Tom.4–Bot.1):* Mongolia, Far East.——Fig. 37,*4. **T. ichituinicus*, Ichituin Formation, Atdabanian, Boro-Khairkhan-Obo Mountain, Khan-Khukhiy Range, Mongolia, paratype, PIN 3301/515, transverse section, ×5 (Voronin, 1988).

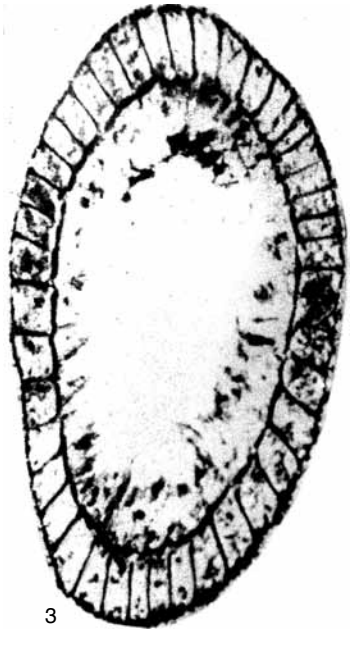


1 Tumulifungia



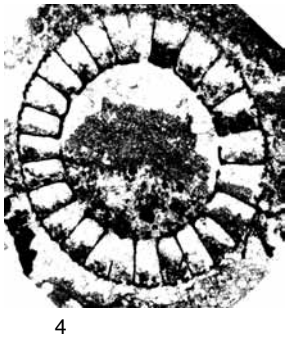
2a

2b Sclerocyathus



3

Subtumulocyathellus



4

Tologoicyathus

FIG. 37. Tumulifungiidae (p. 50).

Family ANNULOCYATHIDAE Krasnopeeva, 1953

[Annulocyathidae KRASNOPEEVA, 1953, p. 56]

Inner wall with annuli. *lower Cambrian (Atd.2–Bot.3).*

Annulocyathus VOLOGDIN, 1937b, p. 468 [**A. pulcher*; M; lectotype, DEBRENNE, ZHURAVLEV, & KRUSE, 2002, fig. 32E; SD DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1597, PIN 4754/5, Moscow]. Outer wall with upwardly projecting, cupped bracts; inner wall with one pore row per intersept and upright V-shaped annuli; septa completely porous. *lower Cambrian (Bot.1):* Altay Sayan, Far East.——FIG. 38,*1a–b. *A. pulcher*, Verkhnemonok Formation, Botoman, Sanashtykgol River, West Sayan, Altay Sayan, Russia, lectotype, PIN 4754/5;

a, transverse section, ×11 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* sketch of longitudinal section (outer wall to left), ×5.5 (Vologdin, 1937b).

Annulocyathella Vologdin, 1962a, p. 123 [**Annulocyathus lavrenovae* Krasnopeeva, 1955, p. 99; OD; holotype, Krasnopeeva, 1955, pl. 3,*2;* Vologdin, 1962a, fig. 86, not designated; =*Anulocyathus lavrenovi* Krasnopeeva, 1937, p. 33; holotype, Krasnopeeva, 1937, pl. 4,*38–39,41,43–44;* pl. 16,*109;* pl. 19,*118*, not designated]. Outer wall with upwardly projecting, cupped bracts; inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa aporose to sparsely porous. *lower Cambrian (Atd.4–Bot.3):* Altay Sayan.——Fig. 38,*2a–b*. **A. lavrenovae* (Krasnopeeva), Usa Formation, Botoman, Bol'shaya Erba, Batenev Range, Kuznetsk Alatau, Russia; *a,* unlocated syntype, oblique transverse section, ×8; *b,* unlocated syntype, sketch of longitudinal section (outer wall to left), ×8 (Krasnopeeva, 1955).

Annulofungia Krasnopeeva, 1955, p. 99 (Krasnopeeva, 1953, p. 56, *nom. nud.*) [**Anulocyathus taylori* Krasnopeeva, 1937, p. 34; OD; holotype, Krasnopeeva, 1937, pl. 4,*46–47;* pl. 18,*115–116;* pl. 22,*130;* pl. 24,*137*, not designated, collection not located] [=*Kiyafungia* Boyarinov in Zhuravleva & others, 1997b, p. 130 (type, *K. concinna,* OD)]. Outer wall with upwardly projecting, cupped bracts; inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous, linked by synapticulae. *lower Cambrian (Atd.4–Bot.1):* Altay Sayan.——Fig. 38,*3a–b*. **A. taylori* (Krasnopeeva), Usa Formation, Botoman, Mt. Aydachikha, Batenev Range, Kuznetsk Alatau, Russia, unlocated specimen; *a,* longitudinal section, ×6; *b,* transverse section, ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Hemithalamocyathus Ting, 1937, p. 367 [**Archaeocyathus sibiricus* Toll, 1899, p. 40; M; lectotype, Toll, 1899, pl. 6,*5;* SD Debrenne, Zhuravlev, & Kruse, 2002, p. 1598, TsNIGRm 24a/11533, St. Petersburg]. Outer wall with upwardly projecting, cupped bracts; inner wall with several pore rows per intersept and upright, V-shaped annuli; septa completely porous. *lower Cambrian (Atd.4–Bot.1):* Altay Sayan.——Fig. 38,*4*. **H. sibiricus* (Toll), Torgashino Formation, Torgashino, Krasnoyarsk region, East Sayan, Altay Sayan, Russia, unnumbered paralectotype, oblique longitudinal section (outer wall to left), ×10 (Toll, 1899).

Family JAKUTOCARINIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Jakutocarinidae Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 83]

Inner wall with noncommunicating canals. *lower Cambrian (Atd.1–Bot.3).*

Jakutocarinus Zhuravleva, 1960b, p. 232 [**Jakutocyathus (Jakutocarinus) jakutensis*; OD; holotype, Zhuravleva, 1960b, pl. 20,*2*, TsSGM 205/113, Novosibirsk]. Outer wall with upwardly projecting, cupped bracts; inner wall with several rows of downwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia.——Fig. 39,*1*. **J. jakutensis*, Pestrotsvet Formation, Atdabanian, Mukhatta River, Sakha (Yakutia), Russia, holotype, TsSGM 205/113, detail of oblique transverse section (outer wall at top), ×15 (Debrenne, Zhuravlev, & Kruse, 2002).

Kosticyathus Debrenne & Zhuravlev, 2000, p. 49 [**Porocyathus sheglovi* Konyushkov, 1972, p. 138; OD; holotype, Konyushkov, 1972, pl. 16,*4–5*, PIN 4755/9, Moscow]. Outer wall with upwardly projecting, cupped bracts; inner wall with one row of downwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa completely porous. *lower Cambrian (Bot.1–Bot.3):* Altay Sayan.——Fig. 39,*2*. **K. sheglovi* (Konyushkov), Verkhnemonok Formation, Botoman, Malyy Karakol River, West Sayan, Altay Sayan, Russia, holotype, PIN 4755/9, longitudinal section, ×6 (Konyushkov, 1972).

Kruseicyathus Boyarinov & Konyaeva in Zhuravleva & others, 1997b, p. 134 [**K. notabilis*; OD; holotype, Zhuravleva & others, 1997b, pl. 4,*5*, ZSGGU 2329/86, Novokuznetsk]. Outer wall with upwardly projecting, cupped bracts; inner wall with horizontal to upwardly projecting, S-shaped canals, each canal spanning several intersepts; septa completely porous. *lower Cambrian (Bot.1):* Altay Sayan.——Fig. 39,*3a–b*. **K. notabilis*, Usa Formation, Botoman, Malaya Belokamenka River, Kiya River, Kuznetsk Alatau, Russia; *a,* paratype, ZSGGU 2329/85, transverse section, ×10; *b,* holotype, ZSGGU 2329/86, oblique longitudinal section, ×10 (Zhuravleva & others, 1997b).

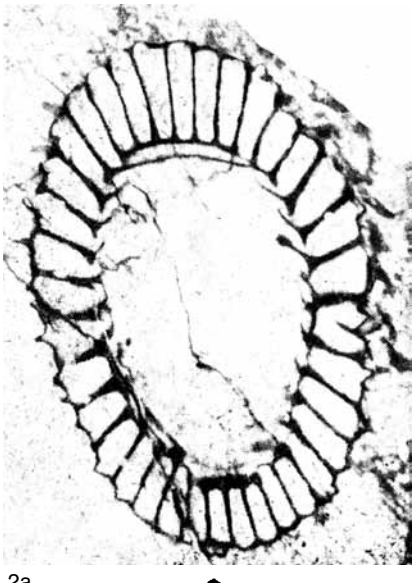
Rossocyathella Zhuravleva, 1960b, p. 178 [**R. ninaekosti*; OD; holotype, Zhuravleva, 1960b, pl. 12,*5*, PIN 1038, Moscow, not located]. Outer wall with upwardly projecting, cupped bracts; inner wall with one row of downwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Siberian Platform, Altay Sayan, Tuva.——Fig. 39,*4a–b*. **R. ninaekosti*, Perekhod Formation, Botoman, Botoma River, Sakha (Yakutia), Russia, holotype, PIN 1038; *a,* sketch of longitudinal section (outer wall to left), ×40; *b,* detail of transverse section (outer wall at bottom), ×15 (Zhuravleva, 1960b).

?Russocyathus Zhuravleva, 1955b, p. 628 [**R. basaichensis*; OD; holotype, Zhuravleva, 1955b, fig. 1E, 2v; Repina & others, 1964, pl. 19,*2*, PIN 1039, Moscow, not located]. Outer wall with probable upwardly projecting, cupped bracts; inner wall with one row of probable horizontal to upwardly projecting, S-shaped canals per intersept; septa aporose to sparsely porous. [Limited type material does not provide certainty as to orientation of cup and hence as to presence or absence of canals and/or

1a

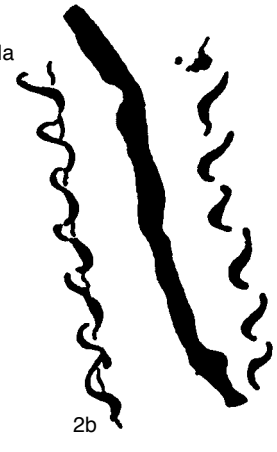
1b

Annulocyathus



2a

Annulocyathella



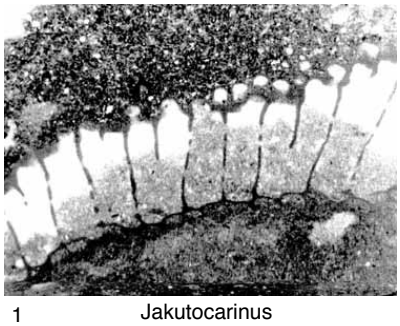
2b

3a

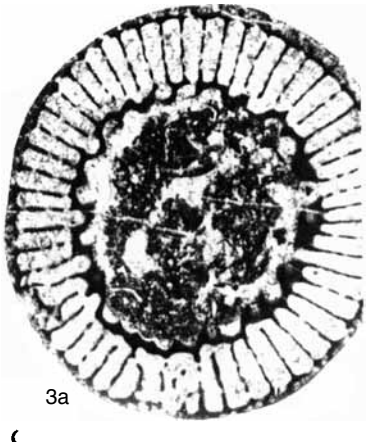
3b Annulofungia

4 Hemithalamocyathus

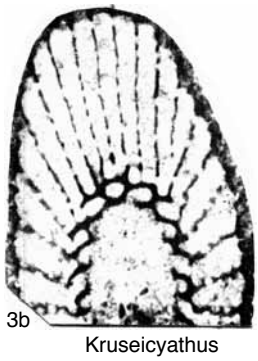
FIG. 38. Annulocyathidae (p. 52–53).



1 Jakutocarinus

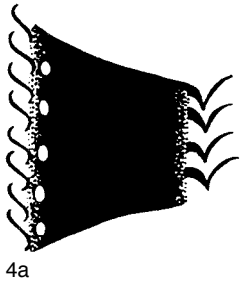


3a

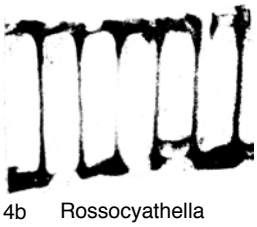


3b Kruseicyathus

2 Kosticyathus

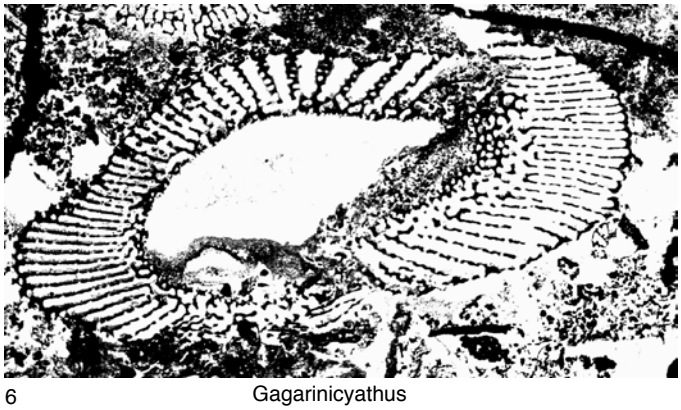


4a



4b Rossocyathella

5 Russocyathus



6 Gagarinicyathus

FIG. 39. Jakutocarinidae and Gagarinicyathidae (p. 53–56).

bracts in walls.] *lower Cambrian (Atd.3–Bot.1):* Altay Sayan, Tuva.——FIG. 39,*5*. **R. basaichensis*, Torgashino Formation, Atdabanian, Torgashino, Krasnoyarsk region, East Sayan, Altay Sayan, Russia, holotype, PIN 1039, sketch of oblique longitudinal section, ×20 (Zhuravleva, 1955b).

Family GAGARINICYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Gagarinicyathidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 84]

Inner wall with communicating canals. *lower Cambrian (Atd.3–Bot.1).*

Gagarinicyathus ZHURAVLEVA in DATSENKO & others, 1968, p. 146 [**G. ethmophylloides*; OD; holotype, DATSENKO & others, 1968, pl. 5,*1*, TsSGM 277/36, Novosibirsk]. Outer wall with upwardly projecting, cupped bracts; inner wall with one row of horizontal to upwardly projecting, straight porous canals per intersept; septa completely porous. *lower Cambrian (Atd.3–Bot.1):* Siberian Platform.——FIG. 39,*6*. **G. ethmophylloides*, Shumnoy Formation, Botoman, Sukharikha River, Krasnoyarsk region, Russia, holotype, TsSGM 277/36, oblique longitudinal section, ×4.5 (Datsenko & others, 1968).

Superfamily ETHMOPHYLLOIDEA Okulitch, 1937

[*nom. transl.* ZHURAVLEV in VORONOVA & others, 1987, p. 23, *ex* Ethmophyllidae OKULITCH, 1937b, p. 358] [=Carinacyathoidea KRASNOPEEVA, 1953, p. 52, *nom. transl.* ZHURAVLEV in VORONOVA & others, 1987, p. 23, *ex* Carinacyathidae ZHURAVLEVA, 1960b, p. 240, *nom. correct. pro* Carinocyathidae KRASNOPEEVA, 1953, p. 52; =Fansycyathacea KORSHUNOV & ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 46; =Hupecyathelloidea ROZANOV, 1969, p. 111, *nom. correct.* DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 84, *pro* Hupecyathellacea ROZANOV, 1969, p. 111]

Outer wall with canals. *lower Cambrian (Atd.1–Toy.1).*

Family FALLOCYATHIDAE Rozanov, 1969

[Fallocyathidae ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 47] [=Sekwicyathidae ROZANOV, 1973, p. 85, *nom. nud.*]

Inner wall with simple pores. *lower Cambrian (Bot.1–Bot.2).*

Fallocyathus ROZANOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 47 [**F. dubius*; OD; holotype, ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, pl. 18,*5–6;* pl. 19,*2*, PIN 4297/84, Moscow]. Outer wall with horizontal to upwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with several rows of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1):* Siberian Platform, Iberia.——FIG. 40,*1*. **F. dubius*, Oy-Muran reef massif, Atdabanian, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, PIN 4297/84, oblique transverse section, ×12 (Zhuravleva, Korshunov, & Rozanov, 1969).

Sekwicyathus HANDFIELD, 1971, p. 34 [**S. nahanniensis*; OD; holotype, HANDFIELD, 1971, p. 34, pl. 2,*5*, GSC 25317, Ottawa; ?=*Archaeocyathus nevadensis* OKULITCH, 1935, p. 101]. Outer wall with subspherical chambered canals each with base commencing in intervallum, canals subdivided by stipules (imparting overall inverted V-shaped appearance to outer wall); inner wall with several rows of simple pores per intersept; septa aporose to sparsely porous. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Iberia, Canada, United States.——FIG. 40,*2a–c*. **S. nahanniensis*; *a,* Sekwi Formation, Botoman, Mackenzie Mountains, Northwest Territories, Canada, holotype, GSC 25137, oblique longitudinal section, ×15 (Handfield, 1971); *b,* Atan Group, Botoman, Gataga River, British Columbia, Canada, specimen GSC 69260, transverse section, ×10 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* Sekwi Formation, Botoman, Mackenzie Mountains, Northwest Territories, Canada, specimen GSC 90132, longitudinal section, ×10 (Voronova & others, 1987).

Yukonocyathus HANDFIELD, 1971, p. 51 [**Y. francesi*; OD; holotype, HANDFIELD, 1971, pl. 8,*1a–c*, GSC 25351, Ottawa]. Outer wall with horizontal to upwardly projecting, S-shaped canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of simple pores per intersept, formed by fluting of inner edges of septa; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Canada, United States.——FIG. 40,*3a–b*. **Y. francesi*, Sekwi Formation, Botoman, Frances Lake, Yukon Territory, Canada, holotype, GSC 25351; *a,* transverse section, ×6; *b,* longitudinal section (outer wall to left), ×6 (Handfield, 1971).

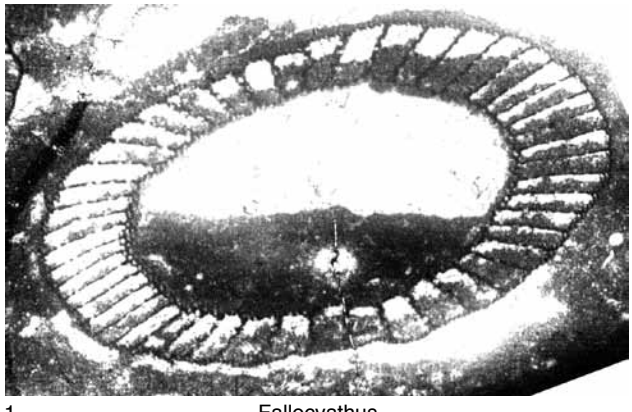
Family GLORIOSOCYATHIDAE Rozanov, 1969

[Gloriosocyathidae ROZANOV, 1969, p. 108]

Inner wall with bracts or scales. *lower Cambrian (Atd.1–Bot.1).*

Gloriosocyathus ROZANOV, 1969, p. 108 [**G. permultus*; OD; holotype, ROZANOV, 1969, pl. 40,*3*, PIN 4297/95, Moscow]. Outer wall with horizontal to upwardly projecting, S-shaped canals; inner wall with one row of pores per intersept, bearing upwardly projecting, S-shaped scales; septa completely porous. *lower Cambrian (Bot.1):* Siberian Platform, Iberia.——FIG. 41,*1*. **G. permultus*, Erkeket Formation, Botoman, Khorbusuonka River, Olenek Basin, Sakha (Yakutia), Russia, holotype, PIN 4297/95, oblique transverse section, ×10 (Debrenne, Zhuravlev, & Kruse, 2002).

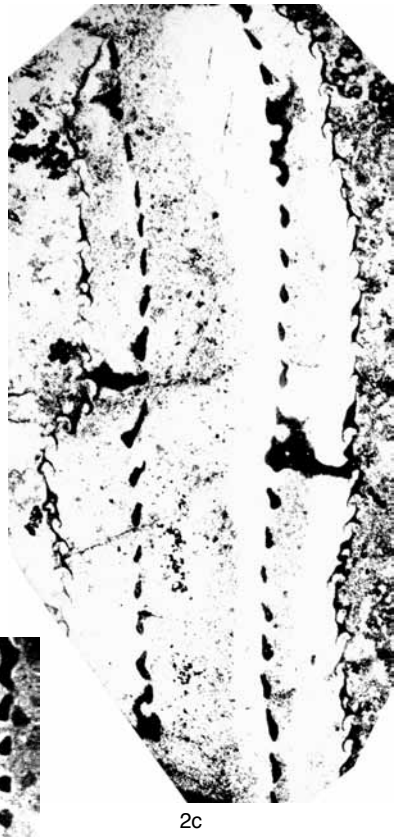
Gandinocyathus F. DEBRENNE & M. DEBRENNE in GANDIN, F. DEBRENNE, & M. DEBRENNE, 2007, p. 41 [**G. gravestocki*, OD; holotype, F. DEBRENNE,



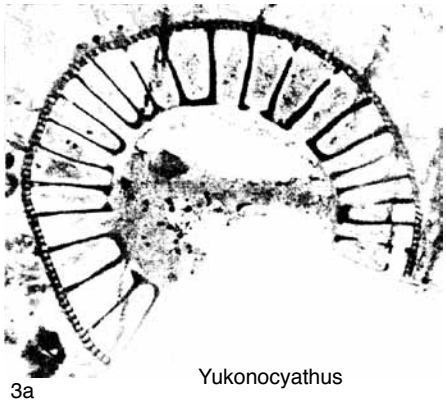
1 Fallocyathus

2a

2b Sekwicyathus



2c



3a Yukonocyathus

3b

FIG. 40. Fallocyathidae (p. 56).

Gandin, & M. Debrenne, 1993, pl. 3,*1*, MNHN M84234, Paris]. Outer wall with horizontal to upwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of pores per intersept, bearing upwardly projecting, cupped bracts; septa completely porous. *lower Cambrian (Bot.1)*: Sardinia.——Fig. 41,*2. *G. gravestocki*, Matoppa Formation, Botoman, Matoppa Valley, Sardinia, Italy, holotype, MNHN M84234, oblique longitudinal section, ×10 (F. Debrenne, Gandin, & M. Debrenne, 1993).

Nalivkinicyathus Boyarinov & Osadchaya in Osadchaya & Ganachkova, 1986, p. 170 [**Porocyathellus cyroflexus* Boyarinov & Osadchaya in Osadchaya & others, 1979, p. 132; OD; holotype, Osadchaya & others, 1979, pl. 8,*1–2;* Osadchaya & Ganachkova, 1986, pl. 18,*1–2*, VSEGEI 11594, St. Petersburg] [=*Nalivkinicyathus* Osadchaya in Debrenne & Rozanov, 1983, p. 735, *nom. nud.*, *nom. nov. pro Porocyathellus* Boyarinov & Osadchaya in Osadchaya & others, 1979, p. 131, *non* Debrenne, 1977a, p. 107, archaeocyath]. Outer wall with downwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall upright V-shaped appearance to outer wall); inner wall with one row of pores per intersept, bearing upright, V-shaped scales; septa completely porous. *lower Cambrian (Atd.1–Bot.1):* Altay Sayan, Iberia.——Fig. 41,*3a–b*. **N. cyroflexus* (Boyarinov & Osadchaya), Usa Formation, Atdabanian, Krutoy Log, Batenev Range, Kuznetsk Alatau, Russia, holotype, VSEGEI 11594; *a,* transverse section, ×4; *b,* detail of septum in longitudinal section (outer wall to right), ×12 (Osadchaya & others, 1979).

Family KIJACYATHIDAE Zhuravleva, 1964

[Kijacyathidae Zhuravleva in Repina & others, 1964, p. 195] [=Fansycyathidae Korshunov & Rozanov in Zhuravleva, Korshunov, & Rozanov, 1969, p. 47]

Inner wall with annuli. *lower Cambrian (Atd.2–Bot.3).*

Kijacyathus Zhuravleva, 1959, p. 424 [**K. chomentovskii*; OD; holotype, Zhuravleva, 1959, fig. 2b–g, PIN 1431, Moscow, not located]. Outer wall with horizontal to upwardly projecting, S-shaped canals; inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous. *lower Cambrian (Atd.3–Bot.1):* Altay Sayan, Mongolia, Far East.——Fig. 42,*1a–b*. **K. chomentovskii*, Usa Formation, Atdabanian, Kiya River, Kuznetsk Alatau, Russia, holotype, PIN 1431; *a,* transverse section, ×8 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* detail of septum in longitudinal section (outer wall to left), ×13 (Zhuravleva, 1959).

Aporosocyathus Kruse, 1978, p. 32 [**A. mucroporus*; OD; holotype, Kruse, 1978, fig. 4A–B, AM FT.15203, 15204, Sydney]. Outer wall with horizontal to upwardly projecting, S-shaped canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one pore row per intersept and upright, V-shaped annuli; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.2–Bot.3):* ?Mongolia, Australia, Antarctica, ?Canada.——Fig. 42,*2a–b*. **A. mucroporus*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia, holotype, AM FT.15203, 15204; *a,* oblique transverse section, AM FT.15204, ×6 (Kruse, 1978); *b,* detail of longitudinal section (outer wall to right) AM FT.15203, ×8 (Kruse, 1982).

Fansycyathus Korshunov & Rozanov in Zhuravleva, Korshunov, & Rozanov, 1969, p. 48 [**F. lermontovae*; OD; holotype, Zhuravleva, Korshunov, & Rozanov, 1969, pl. 17,*7;* Rozanov, 1973, pl. 20,*2*, PIN 4297/83, Moscow]. Outer wall with horizontal to upwardly projecting, S-shaped canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform.——Fig. 42,*3. *F. lermontovae*, Oy-Muran reef massif, Atdabanian, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, PIN 4297/83, longitudinal section, ×12 (Zhuravleva, Korshunov, & Rozanov, 1969).

Flexanulus Debrenne, 1975, p. 335 [**F. oosthuizeni*; OD; holotype, Debrenne, 1975, fig. 3a–b, SAM(C) K4495 B-12a, Cape Town]. Outer wall with horizontal to upwardly projecting, S-shaped canals, each with base commencing in intervallum, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa aporose to sparsely porous. *lower Cambrian (Bot.3):* Antarctica, South Africa (allochthonous).——Fig. 43,*1a–b*. **F. oosthuizeni*, Dwyka Subgroup, Botoman (allochthonous in Permian), Zwartskraal, South Africa, holotype, SAM(C) K4495 B-12a; *a,* transverse section, ×10; *b,* longitudinal section, ×10 (Debrenne, 1975).

Protocyathus Ford, 1878, p. 124 [**P. rarus*; M; holotype, Ford, 1878, fig. 1a–b, NYSM 52, Albany]. Outer wall with horizontal to upwardly projecting, straight stirrup canals only; inner wall with stirrup pores only, bearing horizontal planar to waved annuli, one per several horizontal pore files; septa aporose to sparsely porous. *lower Cambrian (Bot.1–Bot.2):* Canada, United States.——Fig. 43,*2a–b*. **P. rarus*, Brown's Pond Formation, Botoman, Troy, New York, United States, holotype, NYSM 52; *a,* detail of septum and inner wall in longitudinal view (outer wall to left), ×15; *b,* longitudinal view of outer wall, ×15 (Debrenne, Zhuravlev, & Kruse, 2002).

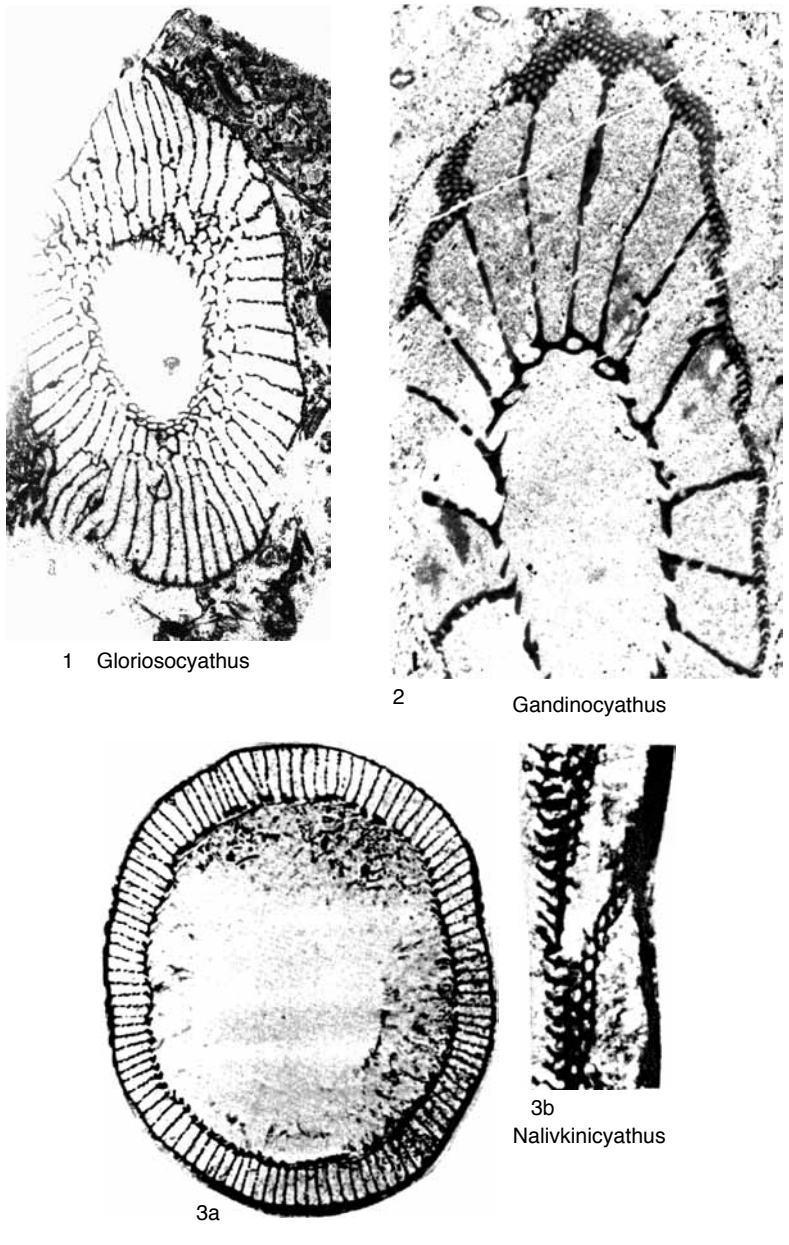
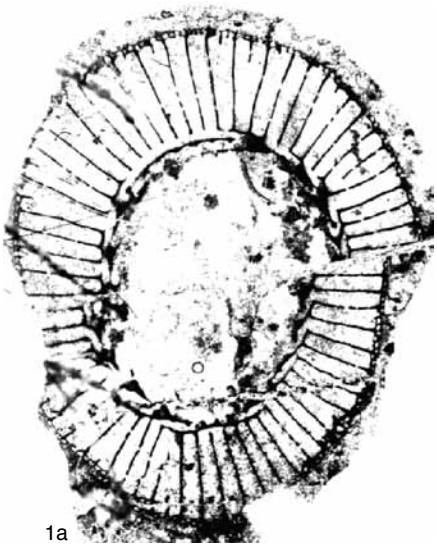
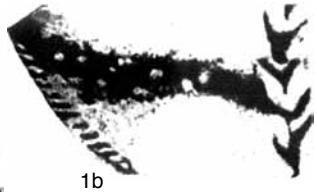


FIG. 41. Gloriosocyathidae (p. 56–58).

Yudjaicyathus ZHURAVLEV in ZHURAVLEV, ZHURAVLEVA, & FONIN, 1983, p. 25 [**Y. astashkini*; OD; holotype, ZHURAVLEV, ZHURAVLEVA, & FONIN, 1983, pl. 4,*1*, PIN 3848/505, Moscow]. Outer wall with horizontal to upwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.3–Atd.4):* Siberian Platform.——FIG. 43,*3. *Y. astashkini*, Pestrotsvet Formation, Atdabanian, Bachyk Creek, Lena River, Sakha (Yakutia), Russia, holotype, PIN 3848/505, oblique longitudinal section, ×14 (Zhuravlev, Zhuravleva, & Fonin, 1983).



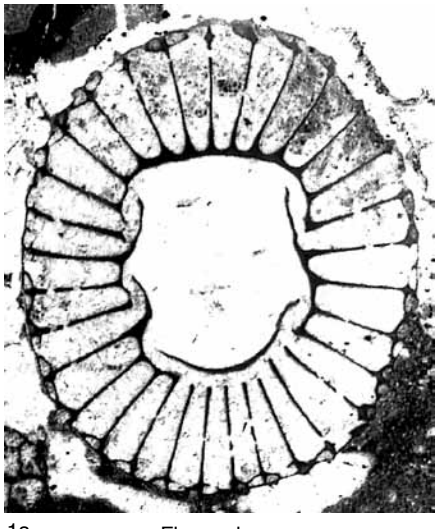


Kijacyathus

3 Fansycyathus

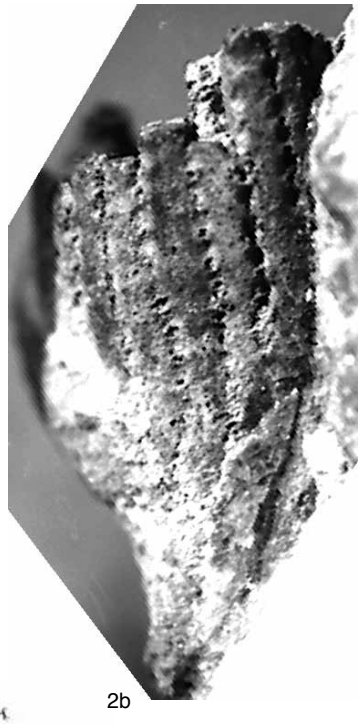
Aporosocyathus

FIG. 42. Kijacyathidae (p. 58).



1a Flexanulus

1b



2b

2a Protocyathus

3 Yudjaicyathus

FIG. 43. Kijacyathidae (p. 58–59).

Family CARINACYATHIDAE Krasnopeeva, 1953

[*nom. correct*. Zhuravleva, 1960b, p. 240, *pro* Carinocyathidae Krasnopeeva, 1953, p. 56] [=Porocyathidae Zhuravleva in Vologdin, 1957a, p. 179; =Hupecyathellidae Rozanov, 1969, p. 111]

Inner wall with noncommunicating canals. *lower Cambrian (Atd.1–Bot.3).*

Carinacyathus Vologdin, 1932, p. 37 [**C. loculatus*; M; holotype, Vologdin, 1932, fig. 28, pl. 10,*5;* M; Vologdin, 1940b, fig. 77, pl. 27,*7*, TsNIGRm 45a/2957, St. Petersburg] [=*Carinocyathus* Vologdin, 1937b, p. 471, *nom. null.*; =*Porocyathus* Zhuravleva in Vologdin, 1957a, p. 179, *nom. nud.*; =*Porocyathus* Zhuravleva, 1960b, p. 180 (type, *P. pinus*, OD); =*Fossilicyathus* Korshunov, 1983b, p. 111 (type, *F. evidens*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 98; Debrenne, Rozanov, & Zhuravlev, 1990, p. 136]. Outer wall with downwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall upright V-shaped appearance to outer wall); inner wall with one row of downwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Kolyma, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East.——Fig. 44,*1a–b*. **C. loculatus*, Verkhneynyrga Formation, Botoman, Lebed' River, Altay Mountains, Altay Sayan, Russia, holotype, TsNIGRm 45a/2957; *a,* transverse section (outer wall at top), ×10; *b,* longitudinal section (outer wall to right), ×10 (Vologdin, 1932).

Hupecyathellus Rozanov in Datsenko & others, 1968, p. 149 [**H. schuberti*; OD; holotype, Datsenko & others, 1968, pl. 14,*1–3;* Rozanov, 1973, pl. 7,*1*, PIN 4297/75, Moscow]. Outer wall with downwardly projecting, S-shaped canals, bearing supplementary independent microporous sheath externally; inner wall with several rows of horizontal to upwardly projecting, S-shaped canals per intersept; septa completely porous. *lower Cambrian (Bot.1):* Siberian Platform.——Fig. 44,*2a–c*. **H. schuberti*, Shumnoy Formation, Botoman, Sukharikha River, Krasnoyarsk region, Russia, holotype, PIN 4297/75; *a,* oblique longitudinal section, ×5; *b,* detail of septum in longitudinal section (outer wall to right), ×7; *c,* detail of outer wall in tangential section, ×17 (Datsenko & others, 1968).

Porocyathellus Debrenne, 1977a, p. 107 [**P. bouddi*; OD; holotype, Debrenne, 1977a, pl. 6,*1*, MNHN M80025, IRH 2 1aL, Paris]. Outer wall with horizontal to upwardly projecting, S-shaped canals; inner wall with several rows of horizontal to upwardly projecting, S-shaped canals per intersept; septa completely porous. *lower Cambrian (Bot.1):* Morocco.——Fig. 44,*3*. **P. bouddi*, Issafen Formation, Botoman, Jbel Irhoud, holotype, MNHN M80025, IRH 2 1aL, oblique longitudinal section, ×10 (Debrenne, 1977a).

Vologdinocyathellus Konyushkov, 1972, p. 136 [**V. schischlovi*; OD; holotype, Konyushkov, 1972, pl. 15,*2*, not located]. Outer wall with horizontal to upwardly projecting, S-shaped canals; inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa completely porous. *lower Cambrian (Bot.1):* Altay Sayan.——Fig. 44,*4a–b*. **V. schischlovi*, Verkhnemonok Formation, Botoman, Bol'shoy Karakol River, West Sayan, Russia; *a,* holotype, transverse section, ×4; *b,* unnumbered paratype, oblique longitudinal section, ×4 (Konyushkov, 1972).

Family ETHMOPHYLLIDAE Okulitch, 1937

[Ethmophyllidae Okulitch, 1937b, p. 358] [=Archaeocyathellidae Simon, 1939, p. 73; =Dupliporocyathidae Yazmir in Yazmir, Dalmatov, & Yazmir, 1975, p. 58; =Kolbicyathidae Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1988, p. 97]

Inner wall with communicating canals. *lower Cambrian (Atd.4–Toy.1).*

Ethmophyllum Meek, 1868a, p. 64 [**E. whitneyi*; OD; lectotype, Okulitch, 1943, pl. 3,*15;* Hill, 1965, pl. 4,*1;* SD Okulitch, 1943, p. 66, USNM 15307 1,1b, thin sections A, Washington, D.C.]. Outer wall with subspherical, chambered canals, each with base commencing in intervallum, canals subdivided by stipules (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of anastomosing, horizontal to upwardly and laterally projecting, waved canals per intersept, arising from fluted inner edges of septa; septa aporose to sparsely porous. *lower Cambrian (Atd.4–Bot.2):* Canada, United States.——Fig. 45,*1a–c*. **E. whitneyi*, Poleta Formation, Botoman, Silver Peak, Nevada, United States; *a–b,* lectotype, USNM 15307 1,1b, thin sections A; *a,* longitudinal section, ×5; *b,* transverse section, ×5; *c,* topotype, MCZ 9314, detail of septum in longitudinal section (outer wall to left), ×9 (Debrenne, Zhuravlev, & Kruse, 2002).

Angaricyathus Zhuravleva, 1965, p. 7 [**A. cyrenovi*; OD; holotype, Zhuravleva, 1965, pl. 2,*1*, TsSGM 215, specimen 2, thin section 1, Novosibirsk]. Outer wall with horizontal to upwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of anastomosing, horizontal to upwardly and laterally projecting, straight to waved canals per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Toy.1):* Transbaikalia, ?Sardinia.——Fig. 45,*2a–b*. **A. cyrenovi*, Kacha Formation, Toyonian, Kookta River, Transbaikalia, Russia; *a,* holotype, TsSGM 215, specimen 2, oblique longitudinal section, ×6; *b,* paratype, TsSGM 215, specimen 4, transverse section, ×6 (Zhuravleva, 1965).

Aulocricus Debrenne, 1987, p. 270 [**A. arellani*; OD; holotype, Debrenne, 1987, pl. 1,*7*, USNM 111823, Washington, D.C.]. Outer wall with

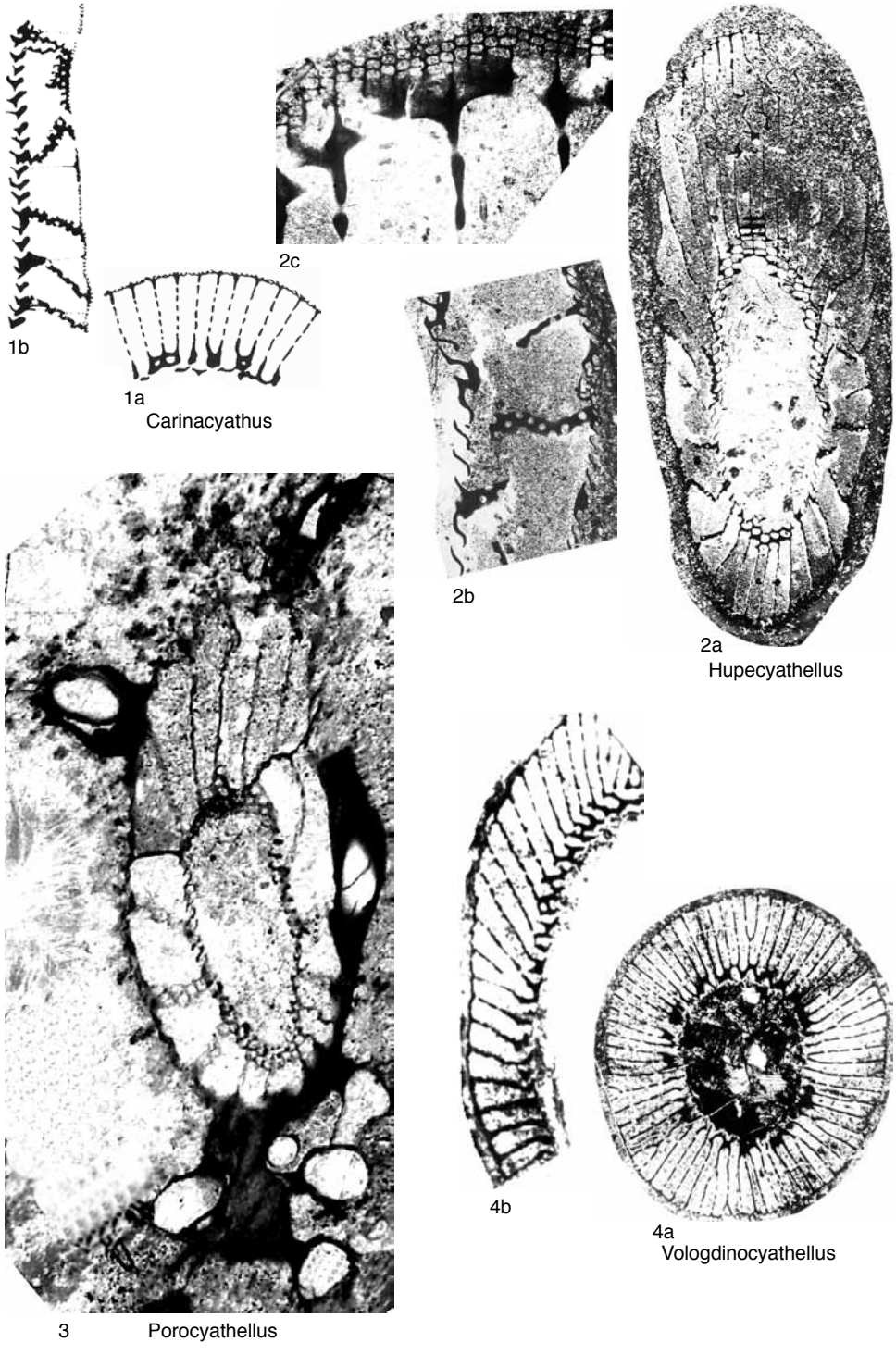


FIG. 44. Carinacyathidae (p. 62).

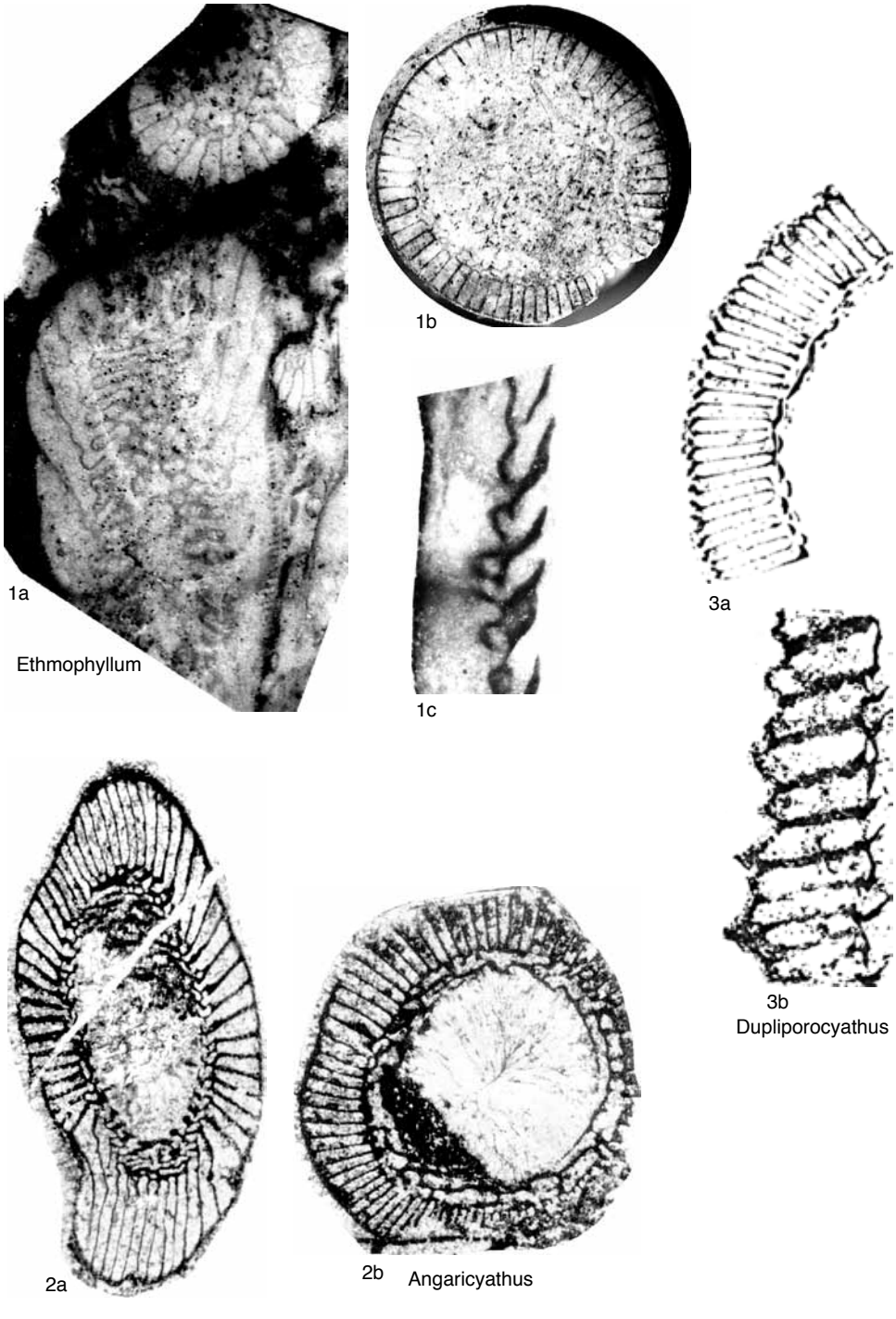


FIG. 45. Ethmophyllidae (p. 62–65).

horizontal to upwardly projecting, straight canals, subdivided by stipules and bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with anastomosing, horizontal to upwardly and laterally projecting, straight stirrup canals only, bearing supplementary planar annuli on central cavity side; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* Canada, United States, Mexico.——Fig. 46,*1a–b*. **A. arellani*, Puerto Blanco Formation, Botoman, Caborca, Sonora, Mexico; *a,* holotype, USNM 111823, transverse section, ×10; *b,* paratype, USNM 414812, longitudinal section, ×10 (Debrenne, 1987).

Cordilleracyathus Handfield, 1971, p. 49 [**C. blussoni*; OD; holotype, Handfield, 1971, pl. 7,*2*, GSC 25345, Ottawa]. Outer wall with horizontal to upwardly projecting, S-shaped canals, subdivided by stipules and bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of anastomosing, horizontally to upwardly and laterally projecting, S-shaped canals per intersept, formed by fluting of inner edges of septa, bearing supplementary scales on central cavity side; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Atd.4–Bot.2):* Koryakia, Canada, United States, Mexico, ?Greenland.——Fig. 46,*2a–c*. **C. blussoni*, Sekwi Formation, Botoman, Caribou Pass, Northwest Territories, Canada; *a,* holotype, GSC 25345, detail of tangential section (outer wall at bottom, inner wall at top), ×12; *b,* paratype, GSC 25348, transverse section, ×10; *c,* paratype, GSC 25347, detail of longitudinal section (outer wall to right), ×12 (Handfield, 1971).

?Dupliporocyathus Yazmir in Yazmir, Dalmatov, & Yazmir, 1975, p. 59 (Yazmir in Zhuravleva, 1974a, p. 119, *nom. nud.*) [**D. tumulosus*; OD; holotype, Yazmir, Dalmatov, & Yazmir, 1975, pl. 21,*5–7*, BGU 0138/17, Ulan-Ude]. Outer wall longitudinally plicate, canal shape and orientation uncertain; inner wall with one row of downwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa aporose to sparsely porous. [Limited type material does not provide certainty as to inner wall structure: canals with supplementary bracts, or V-shaped scales.] *lower Cambrian (Atd.4):* Transbaikalia.——Fig. 45,*3a–b*. **D. tumulosus*, Oldyndy Formation, Atdabanian, Ul'dzuytuy Creek, Vitim Highlands, Russia, holotype, BGU 0138/17; *a,* transverse section, ×10; *b,* oblique longitudinal section, ×10 (Yazmir, Dalmatov, & Yazmir, 1975).

Kolbicyathus Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1988, p. 97 [**Vologdinocyathus kolbiensis* Zhuravleva, 1959, p. 425; OD; holotype, Zhuravleva, 1959, fig. 2d; TsSGM 282/2, Novosibirsk]. Outer wall with horizontal to upwardly projecting, S-shaped canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with horizontal to upwardly projecting, straight stirrup canals only, bearing supplementary bracts on central cavity side; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1):* Altay Sayan, Mongolia.——Fig. 47,*1a–b*. **K. kolbiensis* (Zhuravleva), Usa Formation, Botoman, Petrovka, Kiya River, Kuznetsk Alatau, Russia, holotype, TsSGM 282/2; *a,* transverse section, ×5; *b,* detail of same, ×15 (Debrenne, Zhuravlev, & Kruse, 2002).

Parethmophyllum Debrenne, 1987, p. 270 [**Ethmophyllum cooperi* Okulitch in Cooper & others, 1952, p. 29; OD; holotype, Cooper & others, 1952, pl. 7,*1–2;* Debrenne, 1987, pl. 1,*2,4*, USNM 111814, Washington, D.C.]. Outer wall with horizontal to upwardly projecting, straight canals; inner wall with one row of anastomosing, horizontal to upwardly and laterally projecting, straight to waved canals per intersept, formed by fluting of inner edges of septa, bearing supplementary bracts on central cavity side; septa aporose to sparsely porous. *lower Cambrian (Bot.1):* United States, Mexico.——Fig. 47,*2a–c*. **P. cooperi* (Okulitch), Puerto Blanco Formation, Botoman, Caborca, Sonora, Mexico; *a,* paratype, USNM 111813, oblique longitudinal section, ×6 (Debrenne, Zhuravlev, & Kruse, 2002); *b–c,* holotype, USNM 111814; *b,* transverse section, ×6; *c,* longitudinal section, ×6 (Debrenne, 1987).

Squamosocyathus Zhuravleva, 1960b, p. 183 [**S. taumatus*; OD; holotype, Zhuravleva, 1960b, pl. 13,*5a–b*, TsSGM 205/66a-b, Novosibirsk]. Outer wall with horizontal to upwardly projecting straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of horizontal to upwardly projecting, straight porous canals per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.3–Bot.1):* Siberian Platform, ?Altay Sayan.——Fig. 46,*3a–c*. **S. taumatus*, Perekhod Formation, Atdabanian; *a,* Botoma River, Sakha (Yakutia), Russia, paratype, TsSGM 205/67, longitudinal section, ×6 (Zhuravleva, 1960b); *b–c,* Yudyay, Lena River, Sakha (Yakutia), Russia; *b,* holotype, TsSGM 205/66a-b, detail of septum in longitudinal section (outer wall to left), ×12 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* paratype, TsSGM 205/68, transverse section, ×6 (Zhuravleva, 1960b).

Stephenicyathus Zhuravlev in Voronova & others, 1987, p. 26 [**S. rowlandi*; OD; holotype, Voronova & others, 1987, pl. 6,*1*, GSC 90145, Ottawa]. Outer wall with horizontal to upwardly projecting, straight canals, subdivided by stipules and bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of anastomosing, horizontal to upwardly projecting, waved canals per intersept, formed by fluting of inner edges of septa; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1):* Canada, United States.——Fig. 47,*3a–b*. **S. rowlandi*, Sekwi Formation, Botoman, Mackenzie Mountains, Northwest Territories, Canada; *a,*

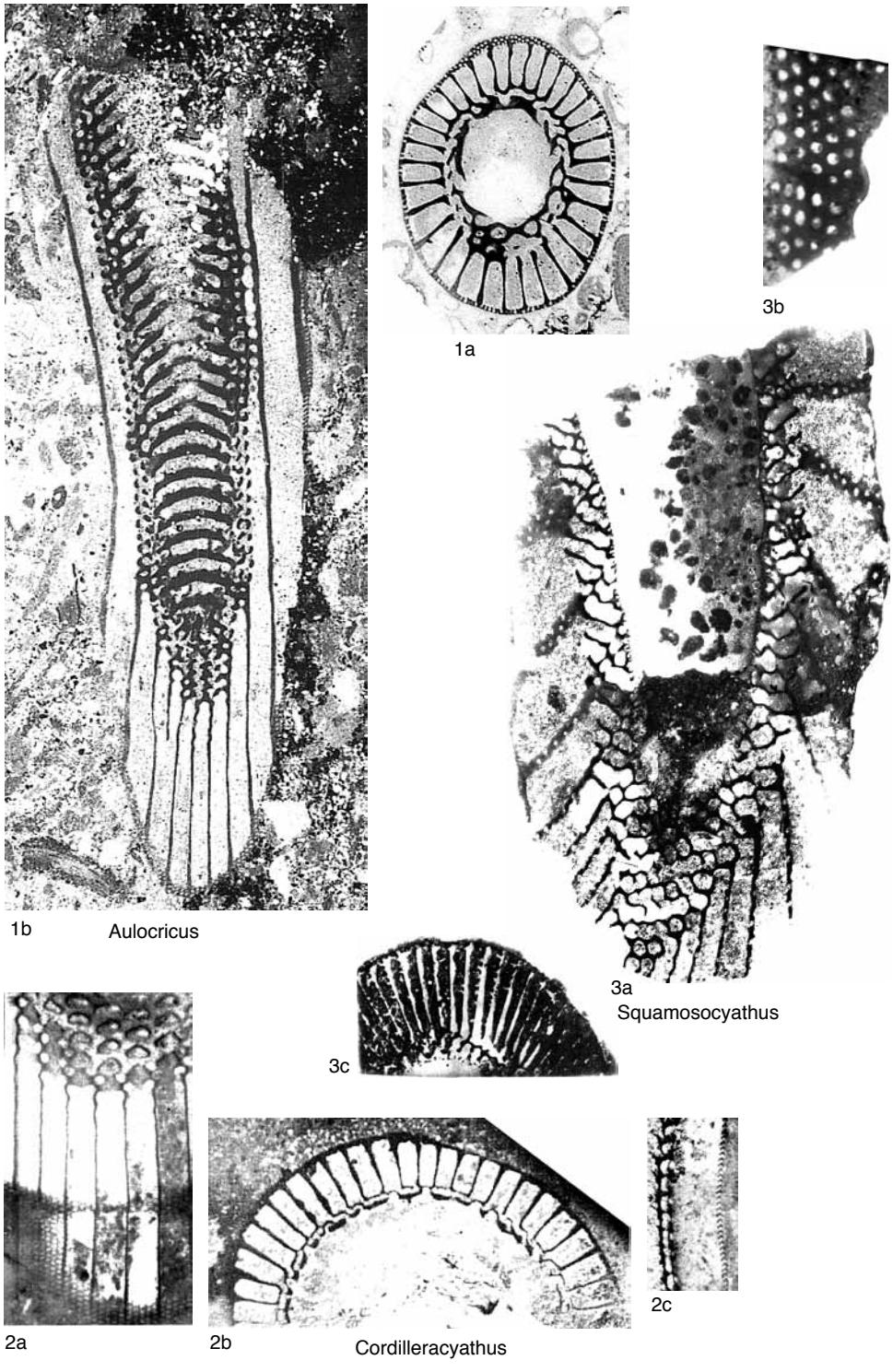


FIG. 46. Ethmophyllidae (p. 62–65).

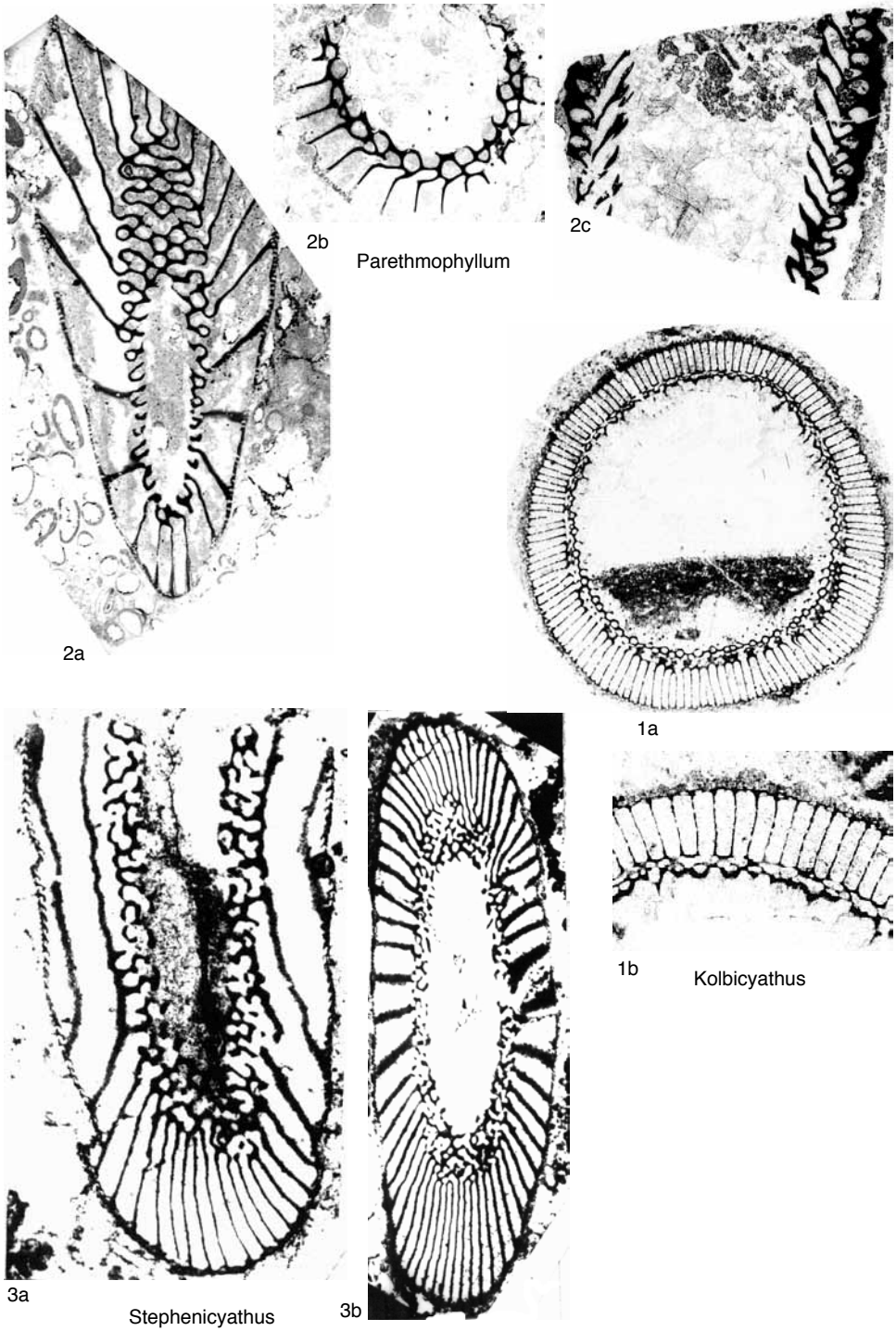


FIG. 47. Ethmophyllidae (p. 65–68).

paratype, GSC 90146, longitudinal section, ×12; *b,* holotype, GSC 90145, oblique longitudinal section, ×5 (Voronova & others, 1987).

Superfamily TERCYATHOIDEA Vologdin, 1939

[*nom. correct*. Debrenne & Kruse, 1986, p. 256, *pro* Tercyathacea Zhuravleva, 1960b, p. 184, *nom. transl. ex* Tercyathidae Vologdin in Simon, 1939, p. 11] [=Piamaecyathacea Zhuravleva, 1960a, p. 44, *nom. transl.* Zhuravleva, 1960b, p. 50, *ex* Piamaecyathidae Zhuravleva, 1960a, p. 44]

Outer wall clathrate. *lower Cambrian (Atd.4–Toy.1).*

Family PIAMAECYATHELLIDAE Rozanov, 1974

[Piamaecyathellidae Rozanov in Borodina, 1974, p. 157] [=Piamaecyathellidae Rozanov, 1973, p. 86, *nom. nud.*]

Inner wall with simple pores. *lower Cambrian (Bot.2).*

Piamaecyathellus Rozanov in Repina & others, 1964, p. 217 [**P. simplex*; OD; holotype, Repina & others, 1964, pl. 23,*5*, PIN 4297/28, Moscow]. Inner wall with several rows of simple pores per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.2):* Altay Sayan.——Fig. 48,*1*. **P. simplex*, Verkhneynyrga Formation, Botoman, Kyzyl-Tash, Bol'shaya Isha River, Altay Mountains, Altay Sayan, Russia, holotype, PIN 4297/28, transverse section, ×5 (Repina & others, 1964).

Family BOTOMOCYATHIDAE Zhuravleva, 1955

[Botomocyathidae Zhuravleva, 1955b, p. 628] [=Botomacyathidae Zhuravleva in Vologdin, 1956, p. 879, *nom. null.*]

Inner wall with annuli. *lower Cambrian (Atd.4–Bot.3).*

Botomocyathus Zhuravleva, 1955b, p. 629 (Zhuravleva, 1954, p. 12, *nom. nud.*) [**B. zelenovi*; OD; holotype, Zhuravleva, 1955b, fig. 2e, TsSGM 205/69, Novosibirsk] [=*Botomacyathus* Zhuravleva in Vologdin, 1956, p. 879, *nom. null.*]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Atd.4–Bot.1):* Siberian Platform, Altay Sayan, Far East.——Fig. 48,*2a–c*. **B. zelenovi*, Perekhod Formation, Botoman, Botoma River, Sakha (Yakutia), Russia; *a–b,* holotype, TsSGM 205/69; *a,* oblique longitudinal section, ×6; *b,* detail of outer wall in tangential section, ×16; *c,* paratype TsSGM 205/70, detail of longitudinal section (outer wall to right), ×10 (Debrenne, Zhuravlev, & Kruse, 2002).

Clathrithalamus Debrenne & Kruse, 1986, p. 256 [**C. mawsoni*; OD; holotype, Debrenne & Kruse, 1986, fig. 21A–C, GNS MG511, Lower Hutt]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.3):* Antarctica.——Fig. 48,*3a–c*. **C. mawsoni*, Shackleton Limestone, Botoman, Holyoake Range, Nimrod Glacier, holotype, GNS MG511; *a,* transverse section, ×5 (Debrenne & Kruse, 1986); *b,* detail of outer wall in tangential section, ×16 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* detail of oblique longitudinal section, ×7 (Debrenne & Kruse, 1986).

Family OLGAECYATHIDAE Borodina, 1974

[Olgaecyathidae Borodina, 1974, p. 158]

Inner wall with noncommunicating canals. *lower Cambrian (Bot.2).*

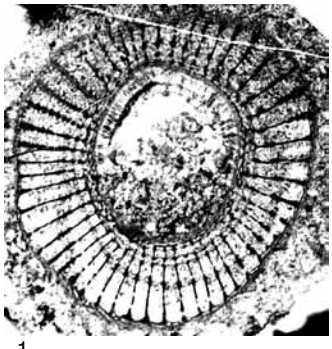
Olgaecyathus Borodina, 1974, p. 158 [**O. fistulosus*; OD; holotype, Borodina, 1974, pl. 16,*8*, TsSGM 429/2, Novosibirsk]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.2):* Altay Sayan.——Fig. 49. **O. fistulosus*, Verkhnemonok Formation, Botoman, Kazly River, West Sayan, Russia, holotype, TsSGM 429/2, oblique longitudinal section, ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

Family TERCYATHIDAE Vologdin, 1939

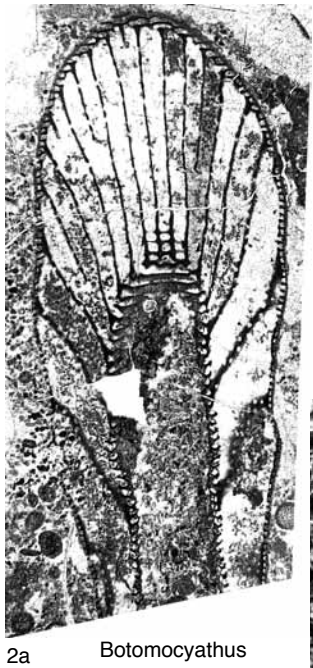
[Tercyathidae Vologdin in Simon, 1939, p. 11] [=Tercyathidae Vologdin, 1937b, p. 459, *nom. nud.*, invalid family-group name based on unavailable genus name; =Piamaecyathidae Zhuravleva, 1960a, p. 44]

Inner wall with communicating canals. *lower Cambrian (Bot.1–Toy.1).*

Tercyathus Vologdin in Simon, 1939, p. 40 (Vologdin, 1932, p. 55, *nom. nud.*, without designated type species) [**T. duplex* Vologdin, 1932, p. 56; OD; lectotype, Vologdin, 1932, pl. 13,*2;* SD Borodina, 1974, p. 154, TsNIGRm 71a-g/2957, St. Petersburg] [=*Piamaecyathus* Zhuravleva, 1960a, p. 45 (type, *P. sajanicus*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 135; Debrenne, Rozanov, & Zhuravlev, 1990, p. 164; =*Rugocyathus* Vologdin, 1962d, p. 13 (type, *R. venustus*, M), *nom. nud.*]. Inner wall with one row of anastomosing, horizontal to upwardly and laterally projecting, straight to waved canals per intersept; supplementary spines, annular structures and/or microporous sheath may be present on central cavity side; septa sparsely to completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.1–Toy.1):* Altay Sayan.——Fig. 50,*1a–c*. **T. duplex*, Verkhneynyrga Formation, Botoman, Lebed' River, Altay Mountains, Russia; *a,* lectotype, TsNIGRm 71a-g/2957, longitudinal section of inner wall (central cavity to right), ×6 (Vologdin, 1932); *b,* unlocated specimen,

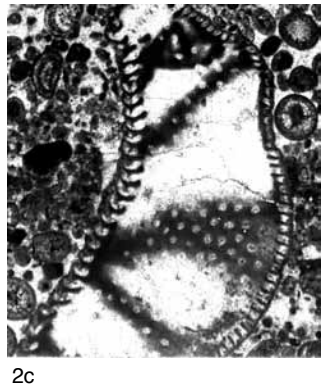


1 Piamaecyathellus

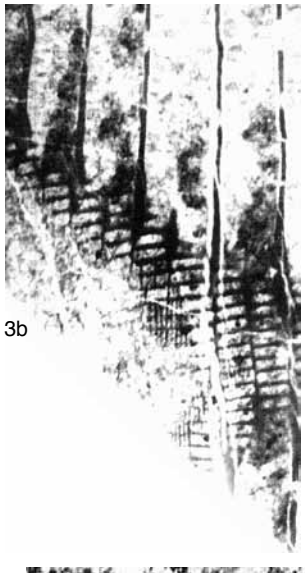


2a Botomocyathus

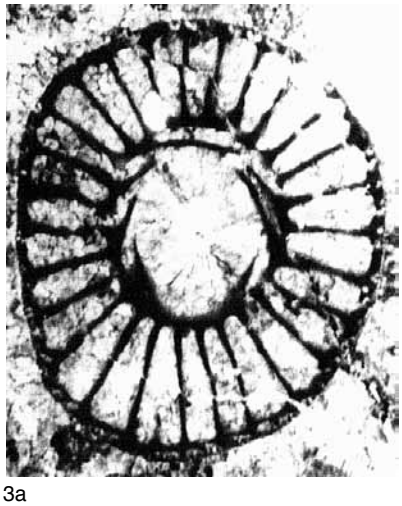
2b



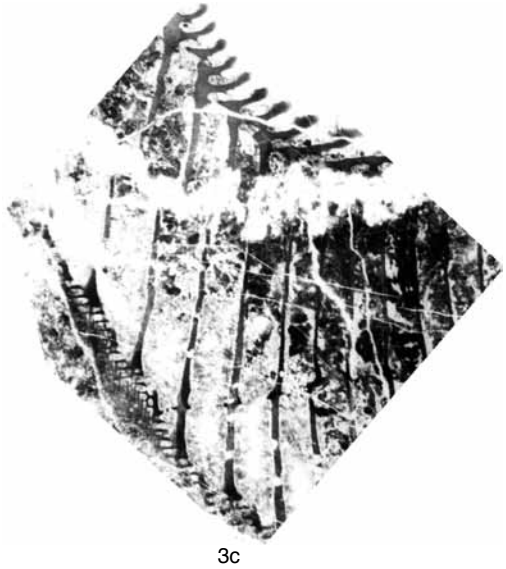
2c



3b



3a



3c Clathrithalamus

FIG. 48. Piamaecyathellidae and Botomocyathidae (p. 68).

FIG. 49. Olgaecyathidae (p. 68).

longitudinal section, ×6; *c,* unlocated specimen, transverse section, ×6 (Repina & others, 1964).

Clathricyathellus BORODINA, 1974, p. 150 [**Clathricyathus robustus* VOLOGDIN, 1932, p. 53; OD; lectotype, VOLOGDIN, 1932, pl. 12,*6;* SD BORODINA, 1974, p. 151, TsNIGRm 68a/2957, St. Petersburg] [=*Lebedicyathus* BORODINA, 1974, p. 164 (type, *L. duplicatus*, OD)]. Inner wall with one row of downwardly projecting, straight porous canals per intersept; supplementary spines, annular structures, and/or microporous sheath may be present on central cavity side; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.3):* Altay Sayan.——FIG. 50,*2a–b*. **C. robustus* (VOLOGDIN), Verkhneynyrga Formation, Botoman, Lebed' River, Altay Mountains, Russia; *a,* lectotype, TsNIGRm 68a/2957, oblique transverse section, ×4; *b,* paralectotype, TsNIGRm 69a/2957, longitudinal section, ×4 (Vologdin, 1932).

Clathricyathus VOLOGDIN in SIMON, 1939, p. 25 (VOLOGDIN, 1932, p. 50, *nom. nud.*, without designated type species) [**C. firmus* VOLOGDIN, 1932, p. 50; OD; lectotype, VOLOGDIN, 1932, pl. 10,*12;* SD BORODINA, 1974, p. 150, TsNIGRm 65, 65a-v/2957, St. Petersburg] [=*Clathrocyathus* VOLOGDIN, 1937b, p. 469, *nom. null.*]. Inner wall with one row of amalgamating, downwardly projecting, straight canals per intersept, continuing into larger, horizontal to upwardly projecting, confluent canal system on central cavity side; septa completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.3):* Altay Sayan.——FIG. 51,*1a–b*. **C. firmus*, Verkhneynyrga Formation, Botoman, Lebed' River, Altay Mountains, Russia, lectotype, TsNIGRm 65, 65a-v/2957; *a,* transverse section, ×7; *b,* oblique longitudinal section, ×7 (Vologdin, 1932).

Tercyathellus BORODINA, 1974, p. 155 [**T. capisterium*; OD; holotype, BORODINA, 1974, fig. 13, pl. 10,*3*, TsSGM 429/1, Novosibirsk] [=*Kazlycyathus* BORODINA, 1974, p. 163 (type, *K. flexuosus,* OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 135; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 164]. Inner wall with several rows of anastomosing, horizontal to upwardly and laterally projecting, straight to waved canals per intersept, continuing into larger, horizontal to upwardly projecting, confluent canal system on central cavity side; septa sparsely to completely porous; pectinate tabulae may be present. *lower Cambrian (Bot.2):* Altay Sayan.——FIG. 51,*2*. **T. capisterium*, Verkhnemonok Formation, Botoman, Kazly River, West Sayan, Russia, holotype, TsSGM 429/1, oblique transverse section, ×8 (Borodina, 1974).

Superfamily SIGMOCYATHOIDEA Krasnopeeva, 1953

[*nom. correct*. DEBRENNE & KRUSE, 1986, p. 255, *pro* Sigmocyathacea DEBRENNE, 1970a, p. 25, *nom. transl. ex* Sigmocyathidae KRASNOPEEVA, 1953, p. 56, as Sygmocyathidae, *nom. null.*]

Outer wall with annuli. *lower Cambrian (Bot.3).*

Family SIGMOCYATHIDAE Krasnopeeva, 1953

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

Inner wall with annuli. *lower Cambrian (Bot.3).*

Sigmocyathus R. BEDFORD & J. BEDFORD, 1936, p. 23 [**Coscinocyathus didymoteichus* TAYLOR, 1910, p. 140; OD; lectotype, TAYLOR, 1910, pl. 10, photo 58; DEBRENNE & ROZANOV, 1972, pl. 43,*1,3*; ROZANOV, 1973, pl. 4,*3;* SD DEBRENNE, 1970a, p. 42, SAM T1606B-D, Adelaide] [=*Hemistillicidocyathus* TING, 1937, p. 368 (type, *Coscinocyathus didymoteichus* TAYLOR, 1910, p. 140, OD)]. Outer wall with upwardly projecting, S-shaped annuli; inner wall with one pore row

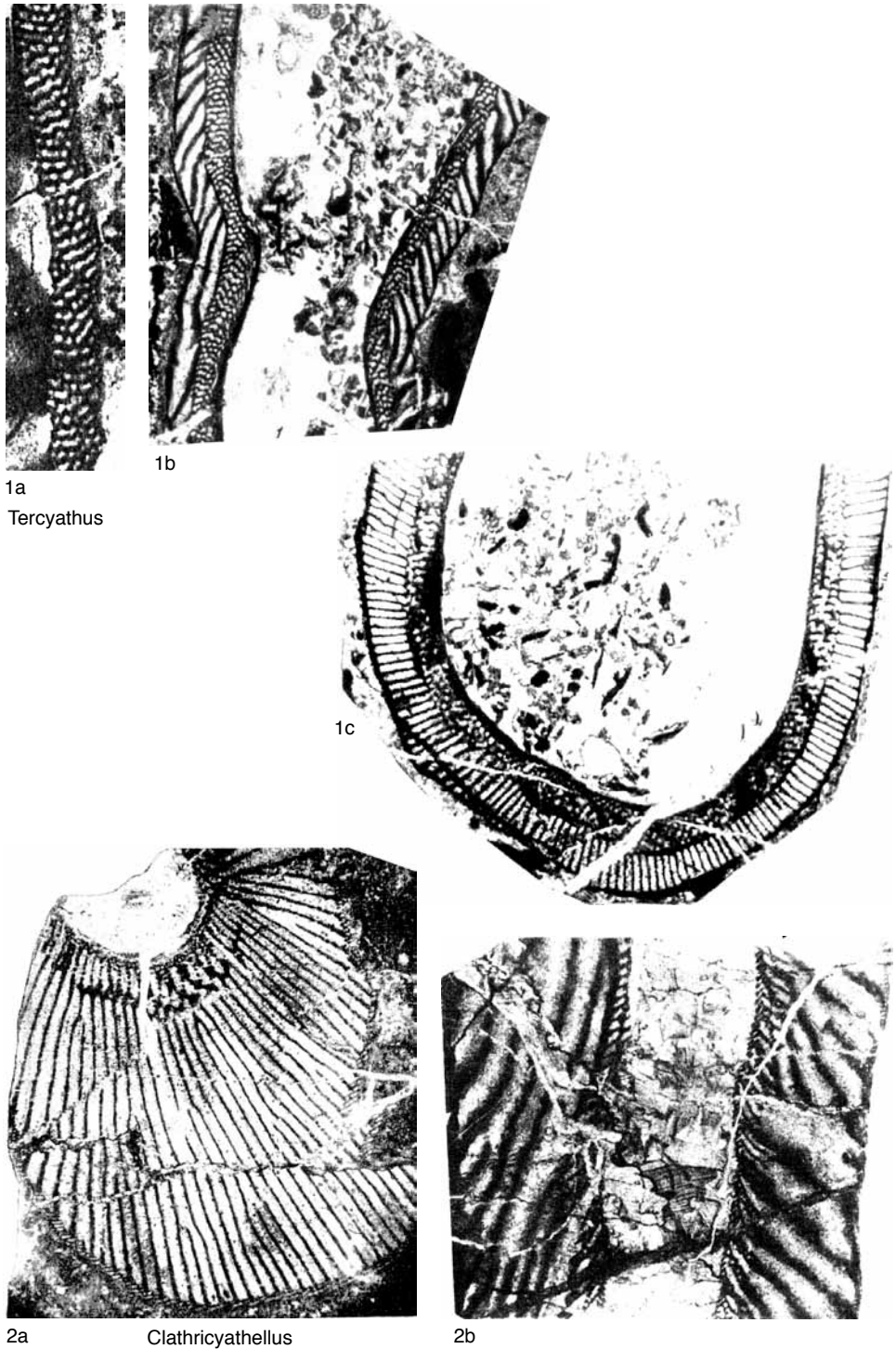


FIG. 50. Tercyathidae (p. 68–70).

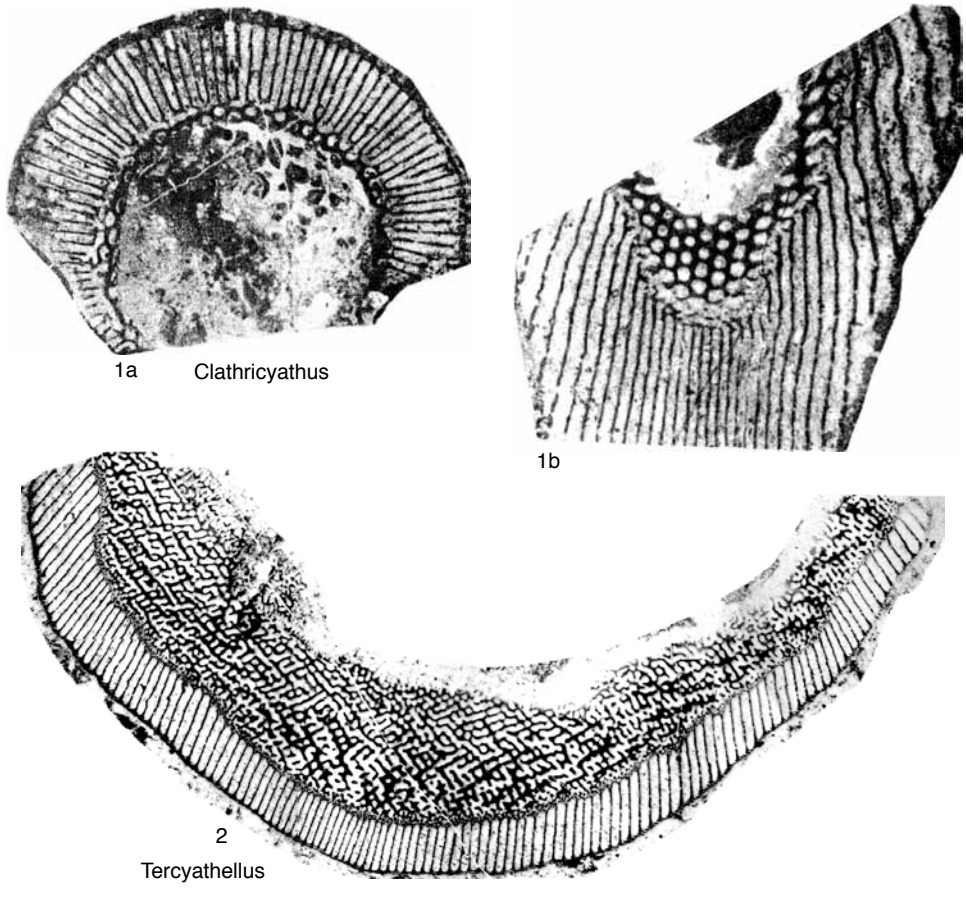


FIG. 51. Tercyathidae (p. 70).

per intersept and upwardly projecting, S-shaped annuli; septa aporose to sparsely porous. *lower Cambrian (Bot.3):* Australia, ?Antarctica.——FIG. 52*a–c*. **S. didymoteichus* (TAYLOR), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM T1606B-D; *a,* longitudinal view of septum (outer wall to left), ×8; *b,* external view of outer wall, ×8 (Debrenne & Rozanov, 1972); *c,* transverse view, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Didymocyathus DEBRENNE & ROZANOV, 1972, p. 236 [**D. hillae*; OD; holotype, DEBRENNE & ROZANOV, 1972, pl. 42,*2–3;* pl. 43,*2;* pl. 44,*1*, USNM PU299, Washington, D.C.]. Outer wall with upwardly projecting, S-shaped annuli; inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa completely porous. *lower Cambrian (Bot.3):* Australia, ?Antarctica.——FIG. 53*a–c*. **D. hillae*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia; *a,* holotype, USNM PU299, longitudinal view of septum (outer wall to left), ×5 (Debrenne, Zhuravlev, & Kruse, 2002); *b–c,* topotype, USNM PU296; *b,* longitudinal view of outer wall, ×5; *c,* longitudinal view of inner wall, ×5 (Debrenne & Rozanov, 1972).

Family WRIGHTICYATHIDAE Kruse, 1978

[Wrighticyathidae KRUSE, 1978, p. 34]

Inner wall with communicating canals. *lower Cambrian (Bot.3).*

Wrighticyathus KRUSE, 1978, p. 34 [**W. nexus*; OD; holotype, KRUSE, 1978, fig. 7A–E, AM F.83298, Sydney]. Outer wall with upwardly projecting, S-shaped annuli; inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa completely porous. *lower Cambrian (Bot.3):* Australia.——FIG. 54*a–c*. **W. nexus*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia, holotype, AM F.83298; *a,* transverse section, AM FT.8268,

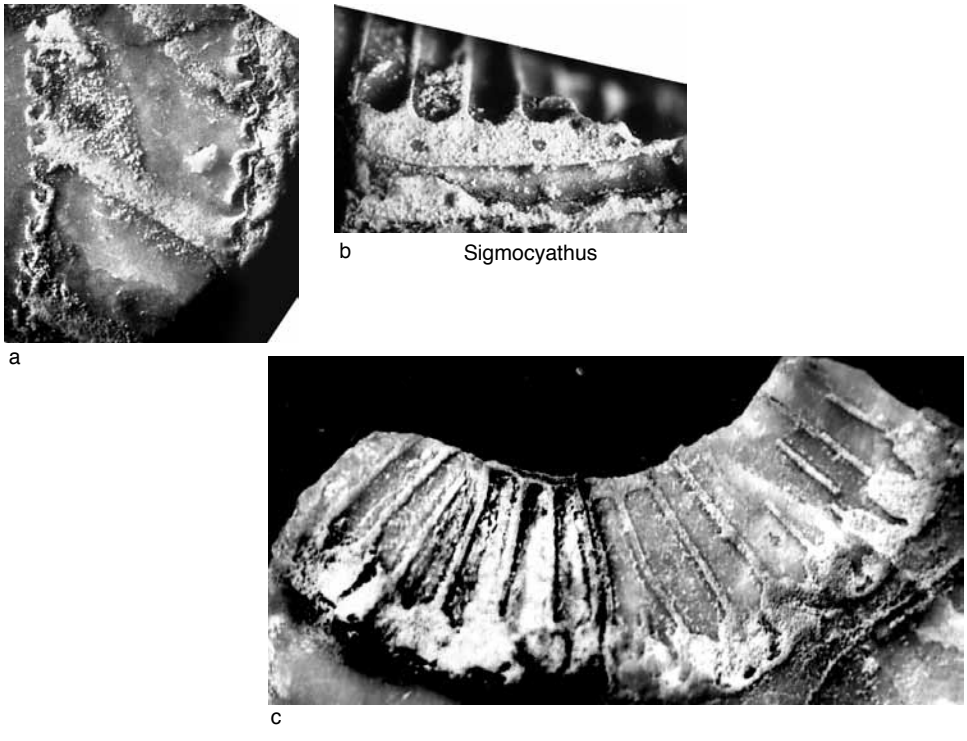


FIG. 52. Sigmocyathidae (p. 70–72).

×4 (Kruse, 1978); *b,* longitudinal section, AM FT.8265, ×4 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* detail of outer wall in longitudinal section, AM FT.8264, ×10 (Kruse, 1978).

Suborder ERISMACOSCININA Debrenne, Rozanov, & Zhuravlev, 1989

[Erismacoscinina DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 85] [?=Erismacoscinina ZHURAVLEV, 1988, p. 105, *nom. nud.*]

Intervallum with septa and plate tabulae; synapticulae may be present. *lower Cambrian (Tom.2–Bot.3).*

Superfamily SALAIROCYATHOIDEA Zhuravleva, 1956

[*nom. transl.* ZHURAVLEV, 1988, p. 105, *ex* Salairocyathidae ZHURAVLEVA in VOLOGDIN, 1956, p. 879] [=Erismacoscinacea DEBRENNE, 1964, p. 166, *nom. transl.* DEBRENNE, 1970a, p. 25, *ex* Erismacoscinidae DEBRENNE, 1964, p. 166]

Outer wall with simple pores. *lower Cambrian (Tom.2–Bot.3).*

Family ASTEROCYATHIDAE Vologdin, 1956

[Asterocyathidae VOLOGDIN, 1956, p. 879] [=Erismacoscinidae DEBRENNE, 1964, p. 166; =Syringocoscinidae VOLOGDIN & YAZMIR, 1967, p. 1375]

Inner wall with simple pores. *lower Cambrian (Tom.2–Bot.3).*

Asterocyathus VOLOGDIN, 1940b, p. 92 [**A. salairicus*; OD; holotype not designated, collection not located]. Inner wall longitudinally plicate, with several rows of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.1–Atd.2):* Altay Sayan, Tuva, Mongolia.——FIG. 55,*1. *A. salairicus*, Gavrilovskoe Formation, Atdabanian, Belaya Gorka, Gorskino, Salair, Russia, unlocated syntype, oblique transverse section, ×5 (Vologdin, 1940b).

Antoniocoscinus ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1988, p. 98 [**Coscinocyathus vsevolodi* KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 51; OD; holotype, ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, pl. 20,*2,4;* KORSHUNOV, 1972, pl. 15,*5;* pl. 16,5), TsSGM 323/84, Novosibirsk]. Inner wall with one row of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.4–Bot.3):* Siberian Platform, Tuva, Transbaikalia, Morocco, Iberia, Sardinia.——FIG. 55,*2a–b*.

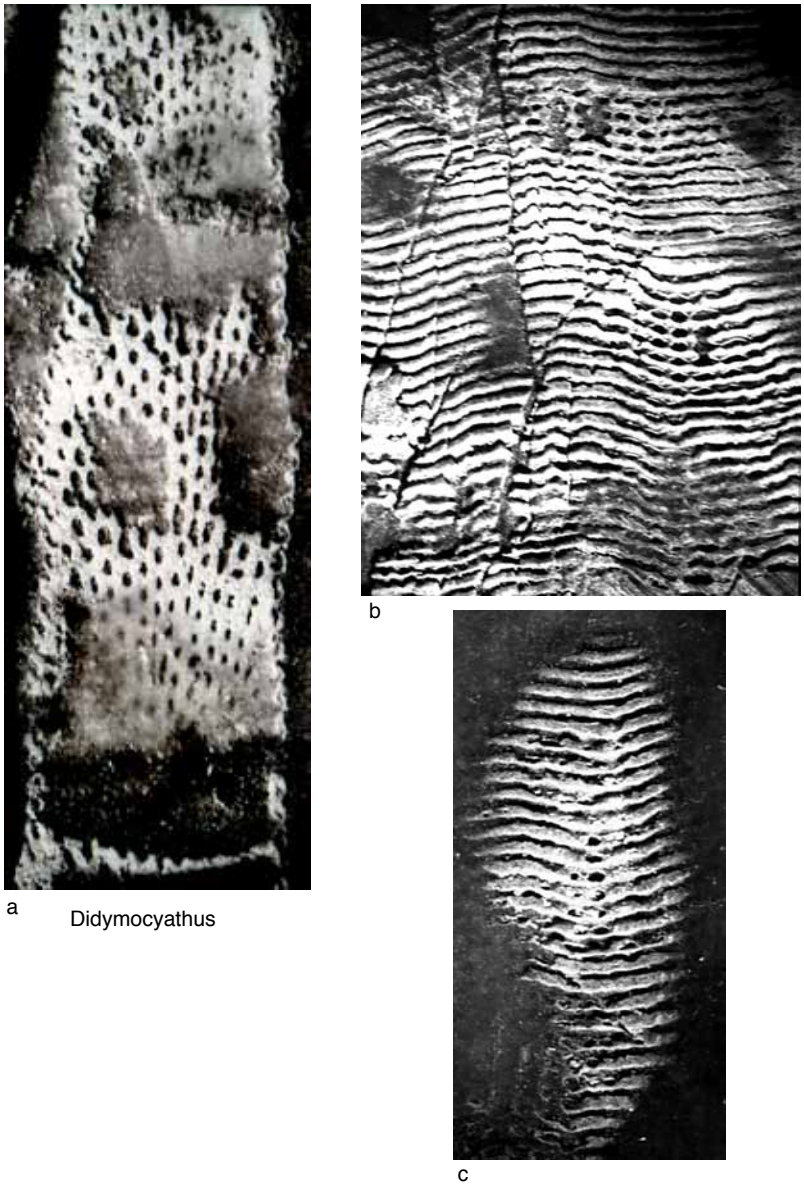


FIG. 53. Sigmocyathidae (p. 72).

**A. vsevolodi* (KORSHUNOV), Oy-Muran reef massif, Botoman, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 323/84; *a,* transverse section, ×4 (M. Debrenne, new); *b,* detail of longitudinal section (outer wall to left), ×10 (Korshunov, 1972).

Erismacoscinus DEBRENNE, 1958, p. 65 [**E. marocanus*; M; holotype, DEBRENNE, 1958, pl. 3,*12,14–16;* DEBRENNE, 1964, pl. 20,*1–2*, MNHN M80139, specimen H2, Paris] [=*Pluralicoscinus* DEBRENNE, 1963b, p. 135 (type, *P. alanisensis*, OD); =*Syringocoscinus* YAZMIR in VOLOGDIN & YAZMIR, 1967, p. 1376 (type, *S. angulatus*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 105; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 141; =*Churanocyathus* SUNDUKOV, 1984, p. 14 (type, *C. aculeatus*, OD)]. Inner wall with several rows of simple pores per intersept; septa completely

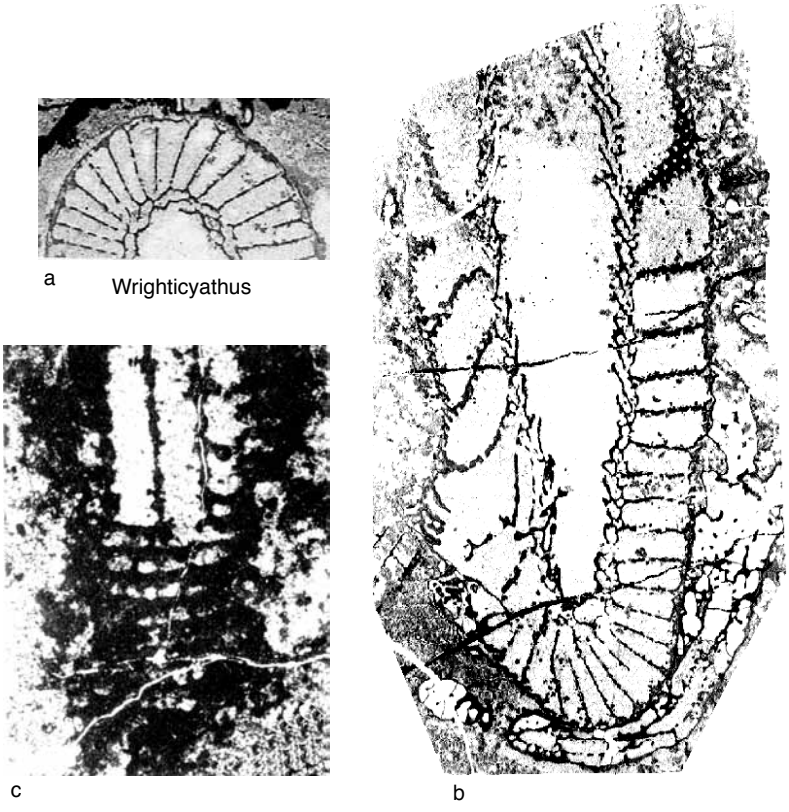


FIG. 54. Wrighticyathidae (p. 72–73).

porous; tabulae with normal pores. *lower Cambrian (Tom.2–Bot.3):* Siberian Platform, Kolyma, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Urals, Tajikistan, Australia, Antarctica, Tarim, South China, Morocco, Iberia, France, Sardinia, Germany.——FIG. 55,*3a–b*. **E. marocanus*, Amouslek Formation, Atdabanian, Jbel Taïssa, Morocco, holotype, MNHN M80139, specimen H2; *a,* longitudinal section (outer wall to left), ×4; *b,* transverse section, ×4 (Debrenne, 1958).

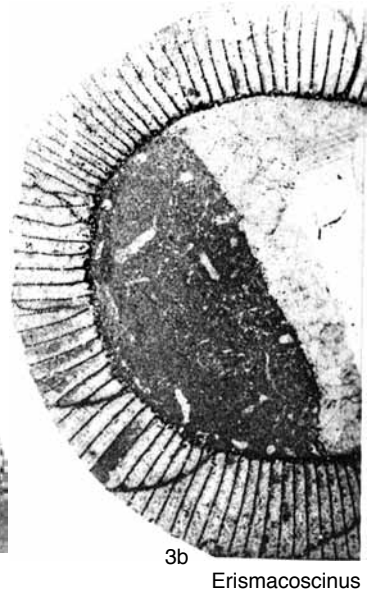
Ichnusocyathus DEBRENNE, 1977a, p. 103 [**Archaeocyathus ichnusae* MENEGHINI, 1881, p. 201; OD; lectotype, BORNEMANN, 1886, pl. 13,*3–4;* SD DEBRENNE, 1964, p. 129, not located]. Inner wall with several rows of simple pores per intersept; septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Morocco, Sardinia.——FIG. 56*a–b*. **I. ichnusae* (MENEGHINI), Matoppa Formation, Botoman, Monte Gloria, Canal Grande, Sardinia, Italy; *a,* lectotype, oblique section, ×4 (Bornemann, 1886); *b,* topotype, MNHN M84258, specimen RFB 14/1, transverse section, ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Retecoscinus ZHURAVLEVA, 1960b, p. 247 [**Coscinocyathus retetabulae* VOLOGDIN, 1931, p. 75; OD; lectotype, VOLOGDIN, 1931, pl. 22,*1e;* SD DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1617, TsNIGRm 94a/2956, St. Petersburg]. Inner wall with several rows of simple pores per intersept; septa completely porous; tabulae with slitlike pores. *lower Cambrian (Tom.3–Bot.1):* Siberian Platform, Altay Sayan, Far East, Morocco, Iberia, France, Germany.——FIG. 57,*1a–b*. **R. retetabulae* (VOLOGDIN), Usa Formation, Atdabanian, Nizhnyaya Ters' River, Kuznetsk Alatau, Russia, lectotype, TsNIGRm 94a/2956; *a,* transverse section, ×2; *b,* unlocated specimen TsNIGRm, sketch of oblique transverse section, ×2.5 (Vologdin, 1931).

Rozanovicoscinus DEBRENNE, 1970a, p. 41 [**R. fonini*; OD; holotype, DEBRENNE, 1970a, pl. 2,*1*, USNM PU86614, Washington, D.C.]. Outer wall longitudinally plicate; inner wall with several rows of simple pores per intersept; septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Atd.4–Bot.3):* Australia.——FIG. 57,*2. *R. fonini*, Ajax Limestone, Botoman, Ajax Mine, South Australia, holotype, USNM PU86614, transverse view, ×5 (Debrenne, 1970a).

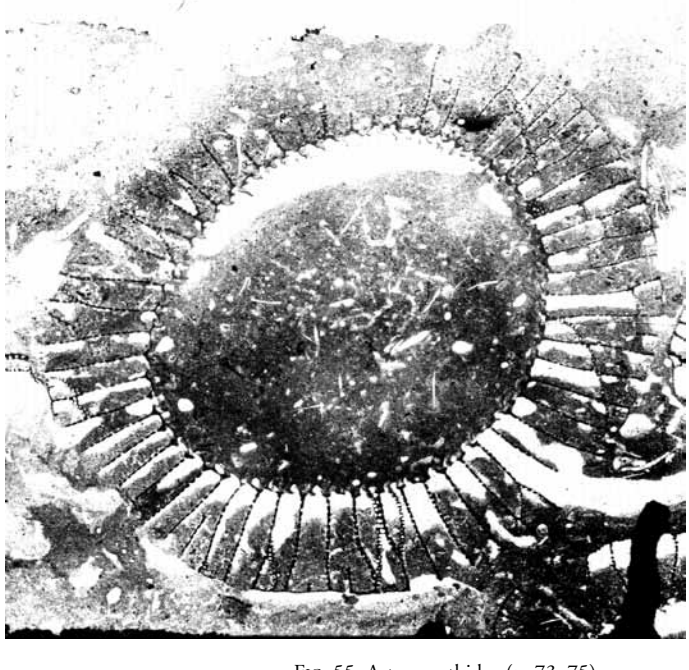
1
Asterocyathus

3a



3b
Erismacoscinus

2b
Antoniocoscinus



2a

FIG. 55. Asterocyathidae (p. 73–75).

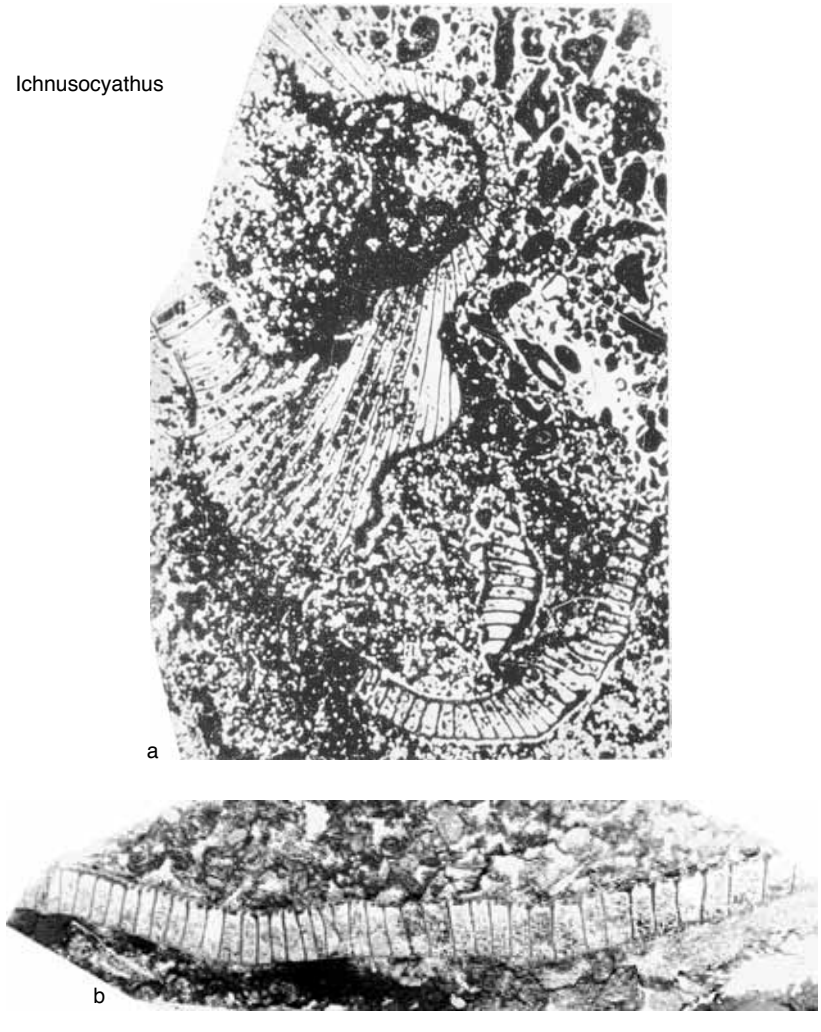


FIG. 56. Asterocyathidae (p. 75).

Family RUDANULIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Rudanulidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 85]

Inner wall with bracts or scales. *lower Cambrian (Bot.1–Bot.3).*

Rudanulus DEBRENNE in ZHURAVLEVA, 1974b, p. 79 [**Coscinocyathus petersi* R. BEDFORD & W. R. BEDFORD, 1934, p. 3; OD; holotype, R. BEDFORD & W. R. BEDFORD, 1934, fig. 13; DEBRENNE, 1969a, pl. 10,*4–5;* M, NHM S4158, London]. Outer wall longitudinally plicate; inner wall with several rows of pores per intersept, bearing upwardly projecting, S-shaped scales; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1–Bot.3):* Australia, South China.——FIG. 58,*1a–c*. **R. petersi* (R. BEDFORD & W. R. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, holotype, NHM S4158; *a,* transverse view, ×8 (Debrenne, 1969a); *b,* longitudinal view, ×8; *c,* detail of transverse view, ×16 (M. Debrenne, new).

Pilodicoscinus DEBRENNE & JIANG, 1989, p. 826 [**P. yuani*; OD; holotype, DEBRENNE & JIANG, 1989, pl. 2,*6*, MNHN M85002, specimen 2-13, Paris]. Cup in which outer wall shows periodic transverse folds; inner wall with several rows of pores per intersept, bearing upwardly projecting, cupped

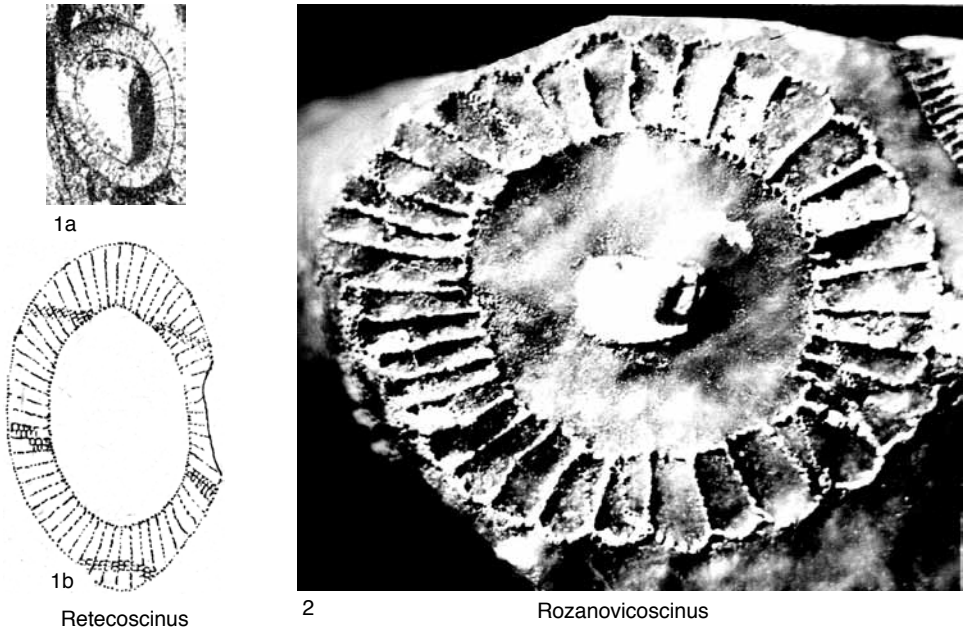


FIG. 57. Asterocyathidae (p. 75).

bracts; septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* South China.——FIG. 58,*2. *P. yuani*, Tsanglangpu Formation, Botoman, Yangchang, Yunnan, holotype, MNHN M85002, specimen 2-13, longitudinal section, ×7.5 (Debrenne & Jiang, 1989).

Yhecyathus BELYAEVA & YUAN, 1995, p. 140 [**Y. futchinensis*; OD; holotype, BELYAEVA & YUAN, 1995, fig. 1d, NIGP NF_6H_1, Nanjing]. Cup with regular transverse folds affecting both walls; inner wall with several rows of pores per intersept, bearing upwardly projecting, cupped bracts; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* South China.——FIG. 58,*3. *Y. futchinensis*, Xiannudong Formation, Botoman, Fuchin, Shaanxi, holotype, NIGP NF_6H_1, oblique longitudinal section, ×2 (Belyaeva & Yuan, 1995).

Family SALAIROCYATHIDAE Zhuravleva, 1956

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

Inner wall with annuli. *lower Cambrian (Atd.2–Bot.1).*

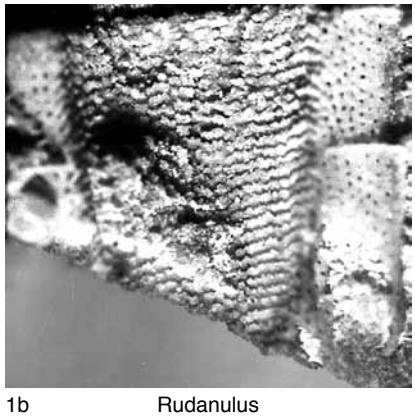
Salairocyathus VOLOGDIN, 1940b, p. 89 [**S. zenkovae*; OD; holotype not designated, collection not located] [=*Rimotabulocyathus* YAROSHEVICH, 1990, p. 26 (type, *R. bulynnikovi*, OD)]. Inner wall with one pore row per intersept and upright V-shaped annuli; septa completely porous; tabulae with slitlike pores. *lower Cambrian (Atd.2):* Altay Sayan.——FIG. 59,*1. *S. zenkovae*, Gavrilovskoe Formation, Atdabanian, Belaya Gorka, Salair, Russia, unlocated syntype, oblique longitudinal section, ×6 (Vologdin, 1940b).

Kotuyicoscinus SUNDUKOV, 1983, p. 16 [**K. minaevae*; OD; holotype, SUNDUKOV, 1983, pl. 1,*7*, SNIIGGiMS 1580/2, Novosibirsk]. Inner wall with several pore rows per intersept and upwardly projecting, S-shaped annuli; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.2–Atd.3):* Siberian Platform.——FIG. 59,*2a–b. *K. minaevae*, Kyndyn Formation, Chomp-Yurekh Creek, Kotuy River, Krasnoyarsk region, Russia; *a,* holotype, SNIIGGiMS 1580/2, oblique longitudinal section, ×9; *b,* paratype, SNIIGGiMS 1580/1, longitudinal section, ×9 (Sundukov, 1983).

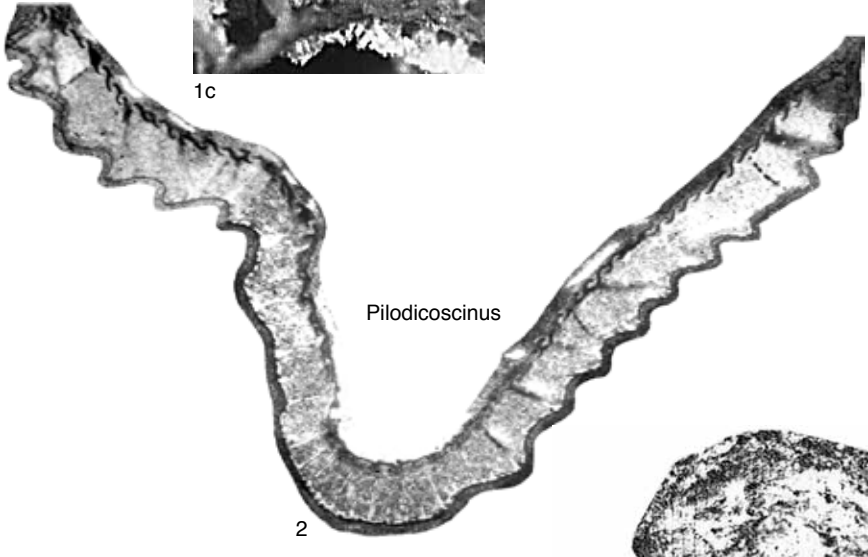
Polystillicidocyathus DEBRENNE, 1959a, p. 14 [**P. erbosimilis*; OD; holotype, DEBRENNE, 1959a, fig. 1; DEBRENNE, 1964, pl. 17,*1–2*, MNHN M80166, specimen Ki140, Paris]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Altay Sayan, Morocco.——FIG. 59,*3a–b. *P. erbosimilis*, Issafen Formation, Botoman, Tizi Oumeslema, Morocco; holotype, MNHN M80166, specimen Ki140, modular skeleton; *a,* oblique transverse view, ×4; *b,* longitudinal view, ×3 (Debrenne, 1964).

1a

1c

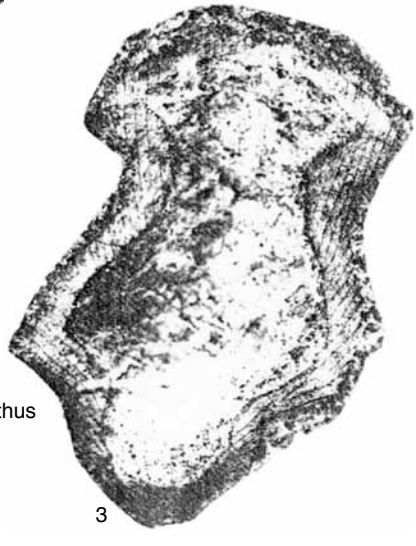


1b Rudanulus



Pilodicoscinus

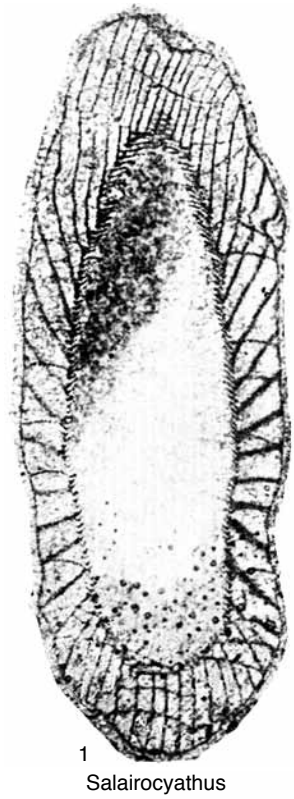
2



Yhecyathus

3

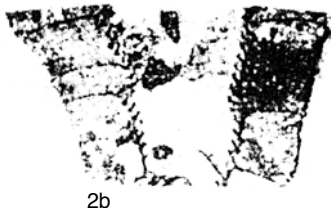
FIG. 58. Rudanulidae (p. 77–78).



1

Salairocyathus

2a



2b

Kotuyicoscinus

3a

Polystillicidocyathus

3b

FIG. 59. Salairocyathidae (p. 78).

Family CRASSICOSCINIDAE Debrenne, Rozanov, & Zhuravlev, 1988

[Crassicoscinidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1988, p. 98]

Inner wall with noncommunicating canals. *lower Cambrian (Atd.4–Bot.1).*

Crassicoscinus ROZANOV & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1988, p. 98 [**Coscinocyathellus vulgaris* ROZANOV in REPINA & others, 1964, p. 227; OD; holotype, REPINA & others, 1964, pl. 24,*2*, PIN 4297/29, Moscow]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.4–Bot.1):* Altay Sayan.——FIG. 60,*1. *C. vulgaris* (ROZANOV), Uba Formation, Atdabanian, Verkhnyaya Tyrga River, Altay Mountains, Russia, holotype, PIN 4297/29, transverse section, ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

Crucicyathus GRAVESTOCK, 1984, p. 74 [**C. repandus*; OD; holotype, GRAVESTOCK, 1984, fig. 42A–B, D, SAM P21585, Adelaide]. Outer wall longitudinally plicate; inner wall with several rows of horizontal to upwardly projecting, S-shaped canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.4):* Australia.——FIG. 60,*2a–b*. **C. repandus*, Ajax Limestone, Atdabanian, Mount Scott Range, South Australia, holotype, SAM P21585; *a,* longitudinal section, ×3.5; *b,* transverse section, ×3 (Gravestock, 1984).

Dentatocoscinus ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1988, p. 98 [**Asterotumulus sektensis* KORSHUNOV & ZHURAVLEVA, 1967, p. 10; OD; holotype, KORSHUNOV & ZHURAVLEVA, 1967, pl. 2,*5*, TsSGM 247/11, Novosibirsk]. Outer wall longitudinally plicate; inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept, bearing supplementary bracts on central cavity side; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Siberian Platform.——FIG. 60,*3. *D. sektensis* (KORSHUNOV & ZHURAVLEVA), Sekten Formation, Botoman, Tuora-Sis Range, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 247/11, detail of oblique transverse section, ×9 (Korshunov & Zhuravleva, 1967).

Superfamily KASYRICYATHOIDEA Zhuravleva, 1961

[*nom. transl.* DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1620, *ex* Kasyricyathidae ZHURAVLEVA in MUSATOV & others, 1961, p. 29]

Outer wall with independent microporous sheath. *lower Cambrian (Atd.1–Bot.3).*

Family AGYREKOCYATHIDAE Konyushkov, 1967

[Agyrekocyathidae KONYUSHKOV, 1967, p. 110]

Inner wall with simple pores. *lower Cambrian (Atd.1–Bot.1).*

Agyrekocyathus KONYUSHKOV, 1967, p. 110 [**A. malovi*; OD; holotype, KONYUSHKOV, 1967, pl. 1,*10*, TsNIGRm 8722/6, St. Petersburg] [=*Mennericyathus* DEBRENNE & ROZANOV in ZHURAVLEVA, 1974a, p. 216 (type, *Tomocyathus kundatus* ROZANOV in ROZANOV & MISSARZHEVSKIY, 1966, p. 63, OD)]. Inner wall with several rows of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Altay Sayan, Mongolia, Far East, Kazakhstan, Tajikistan, Australia, Antarctica, Morocco, Iberia, Sardinia.——FIG. 61,*1. *A. malovi*, Boshchekul' Formation, Atdabanian, Agyrek Mountains, northern Kazakhstan, holotype, TsNIGRm 8722/6, transverse section, ×5 (Debrenne, Zhuravlev, & Kruse, 2002).

Family XESTECYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Xestecyathidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 86]

Inner wall with bracts or scales. *lower Cambrian (Bot.3).*

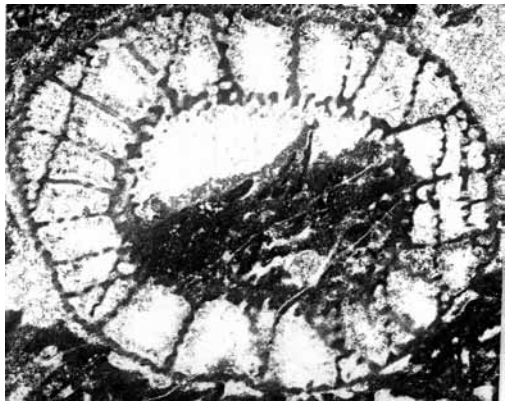
Xestecyathus KRUSE, 1982, p. 193 [**X. zigzag*; OD; holotype, KRUSE, 1982, pl. 14,*1–7*, AM F.83405, Sydney]. Inner wall with several rows of pores per intersept, bearing upwardly projecting, S-shaped scales; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* Australia.——FIG. 62*a–c*. **X. zigzag*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, holotype, AM F.83405; *a,* tangential section of inner wall, AM FT.8526, ×5; *b,* transverse section, AM FT.8527, ×5; *c,* longitudinal section, AM FT.12793, ×5 (Kruse, 1982).

Family KASYRICYATHIDAE Zhuravleva, 1961

[Kasyricyathidae ZHURAVLEVA in MUSATOV & others, 1961, p. 29]

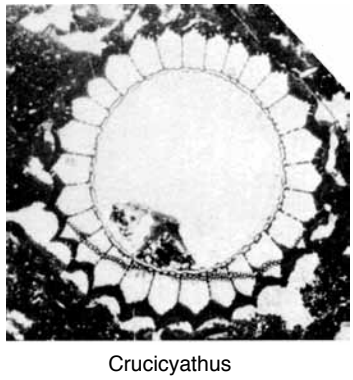
Inner wall with communicating canals. *lower Cambrian (Bot.1).*

Kasyricyathus ZHURAVLEVA in MUSATOV & others, 1961, p. 30 [**K. schirokovae*; OD; holotype, MUSATOV & others, 1961, pl. 6,*3–4*, TsSGM 264/36, Novosibirsk]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Altay Sayan.——FIG. 61,*2. *K. schirokovae*, Balakhtinson Formation, Botoman, Kazyr River, East Sayan,

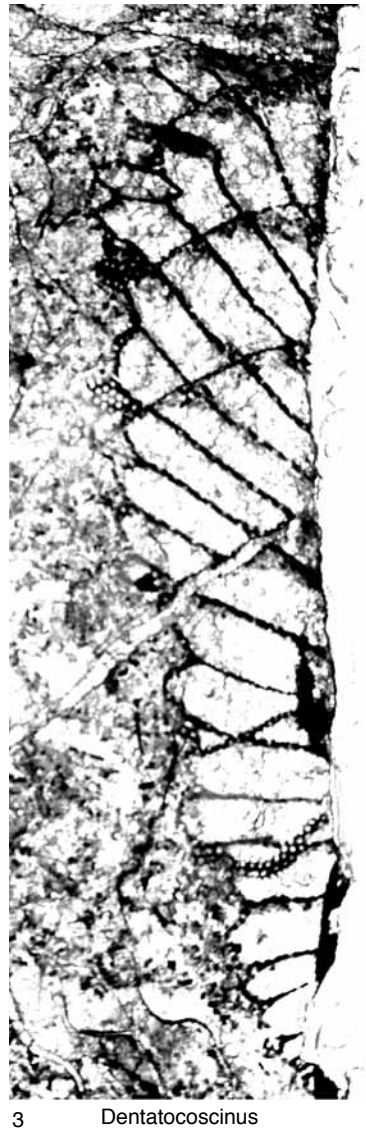


1 Crassicoscinus

2a



2b Crucicyathus



3 Dentatocoscinus

FIG. 60. Crassicoscinidae (p. 81).

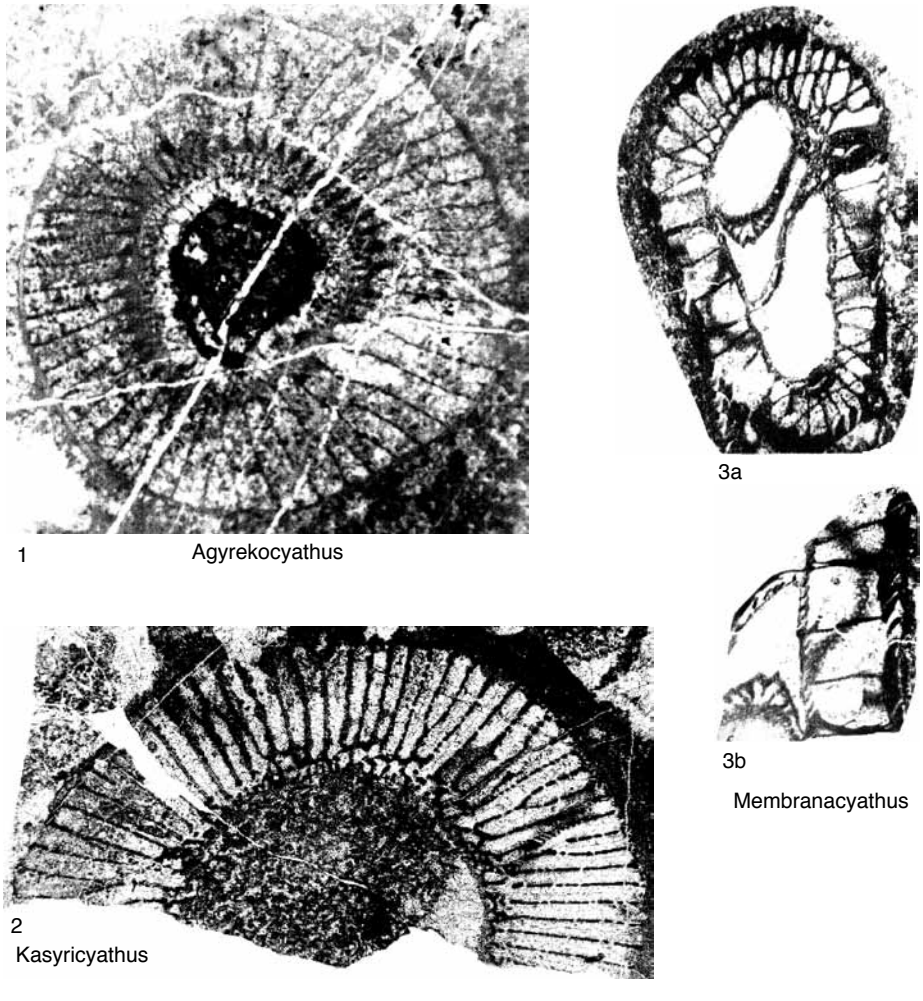


FIG. 61. Agyrekocyathidae, Kasyricyathidae, and Membranacyathidae (p. 81–83).

Russia, holotype, TsSGM 264/36, transverse section, ×8 (Musatov & others, 1961).

Family MEMBRANACYATHIDAE Debrenne, Zhuravlev, & Kruse, 2002

[Membranacyathidae DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1622]

Inner wall with microporous sheath. *lower Cambrian (Atd.1–Atd.2).*

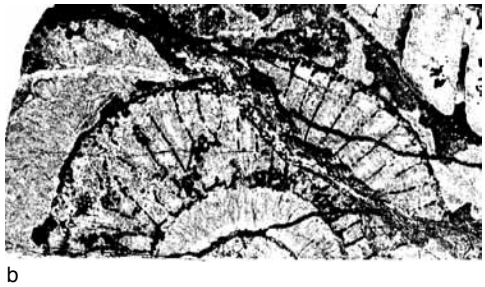
Membranacyathus ROZANOV, 1960a, p. 664 [**M. repinae*; OD; holotype, ROZANOV, 1960a, fig. 1zh-z; ROZANOV, 1973, pl. 13,*2*, PIN 4297/15, Moscow]. Inner wall with several rows of pores per intersept and continuous microporous sheath; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.1–Atd.2):* Altay Sayan.—— FIG. 61,*3a–b*. **M. repinae*, Adiak Formation, Atdabanian, Mrassu River, Gornaya Shoria, Russia, holotype, PIN 4297/15; *a,* oblique transverse section, ×4.5 (Rozanov, 1960a); *b,* detail of longitudinal section (outer wall to left), ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

Superfamily POLYCOSCINOIDEA Debrenne, 1964

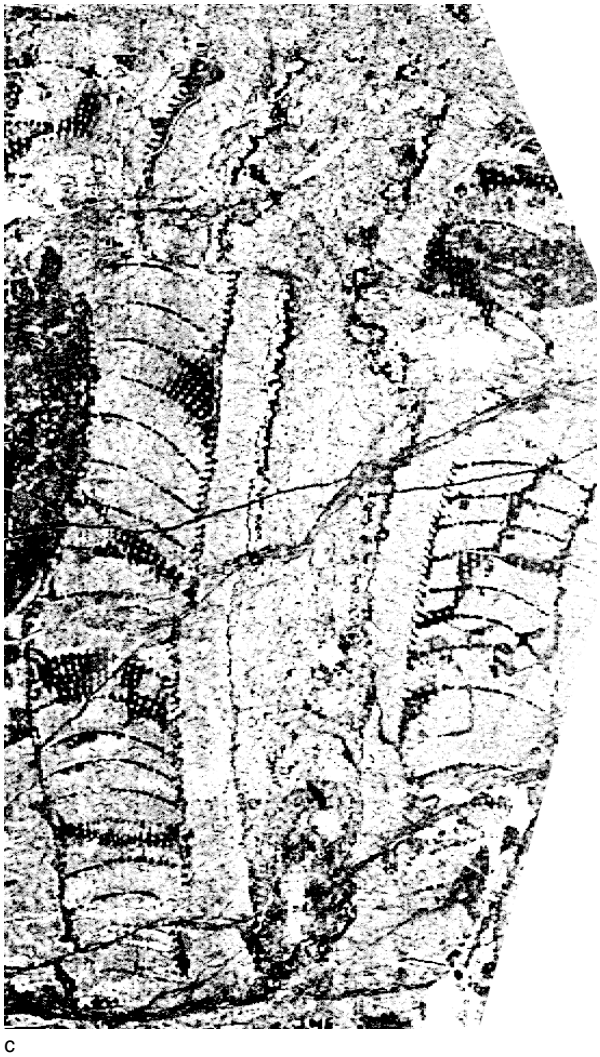
[*nom. transl.* DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1623, *ex* Polycoscinidae DEBRENNE, 1964, p. 194] [=Anaptyctocyathoidea DEBRENNE, 1970a, p. 25, *nom. correct*. DEBRENNE & KRUSE, 1986, p. 260, *pro* Anaptyctocyathacea DEBRENNE, 1970a, p. 25; =Lunulacyathacea DEBRENNE, 1973, p. 18, *nom. nud.*; =Lunulacyathoidea DEBRENNE in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 87]

Outer wall with attached microporous sheath. *lower Cambrian (Atd.3–Bot.3).*

a Xestecyathus



b



c

FIG. 62. Xestecyathidae (p. 82).

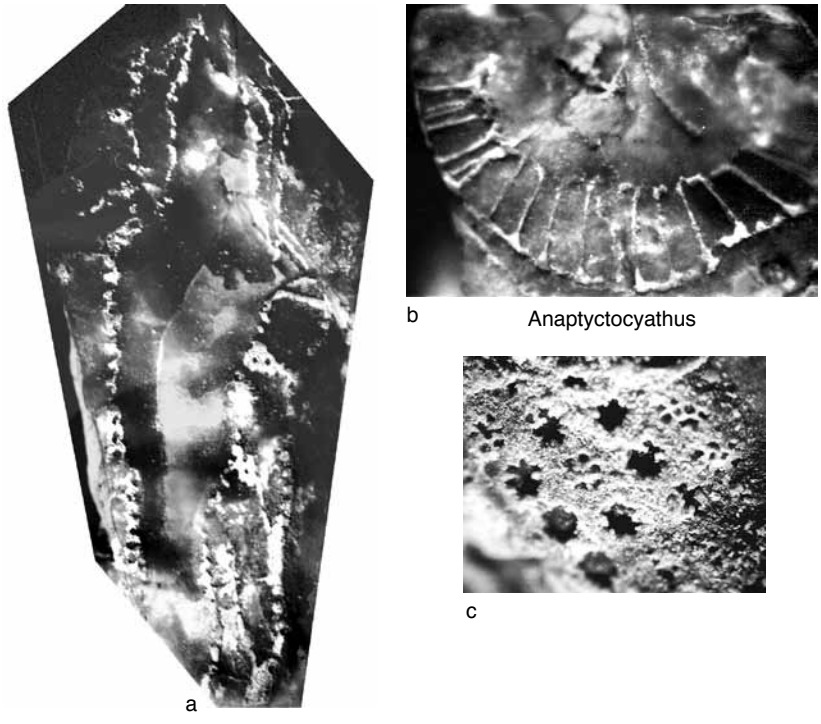


FIG. 63. Anaptyctocyathidae (p. 85).

Family ANAPTYCTOCYATHIDAE Debrenne, 1970

[Anaptyctocyathidae DEBRENNE, 1970a, p. 25]

Inner wall with simple pores. *lower Cambrian (Atd.4–Bot.3).*

Anaptyctocyathus DEBRENNE, 1969a, p. 340, *nom. transl.* DEBRENNE, 1970a, p. 28, *ex Alataucyathus (Anaptyctocyathus)* DEBRENNE, 1969a, p. 340 [**Coscinocyathus cribripora* R. BEDFORD & W. R. BEDFORD, 1934, p. 3; OD; lectotype, R. BEDFORD & W. R. BEDFORD, 1934, fig. 15; DEBRENNE, 1969a, pl. 11,*1,3;* DEBRENNE, 1973, pl. 2,*6;* SD DEBRENNE, 1969a, p. 340, NHM S4160, London]. Inner wall with several rows of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.4–Bot.3):* Australia, Antarctica.——FIG. 63*a–c*. **A. cribripora* (R. BEDFORD & W. R. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, NHM S4160; *a,* longitudinal view, ×5; *b,* transverse view, ×5; *c,* detail of outer wall, ×15 (Debrenne, Zhuravlev, & Kruse, 2002).

Family POLYCOSCINIDAE Debrenne, 1964

[Polycoscinidae DEBRENNE, 1964, p. 194] [=Lunulacyathidae DEBRENNE, 1973, p. 18, *nom. nud.*; =Lunulacyathidae DEBRENNE in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 87]

Inner wall with bracts or scales. *lower Cambrian (Atd.3–Bot.3).*

Polycoscinus R. BEDFORD & J. BEDFORD, 1937, p. 37 [**P. contortus*; OD; holotype, R. BEDFORD & J. BEDFORD, 1937, fig. 157; DEBRENNE, 1973, pl. 3,*7;* M; USNM PU87217, specimen 222, Washington, D.C.] [=*Erugatocyathus* DEBRENNE, 1969a, p. 334 (type, *Coscinocyathus papillatus* R. BEDFORD & W. R. BEDFORD, 1934, p. 3, OD), *nom. transl.* DEBRENNE, 1970a, p. 33, *ex Tomocyathus (Erugatocyathus)* DEBRENNE, 1969a, p. 334)]. Inner wall with several rows of pores per intersept, bearing downwardly projecting, cupped bracts; septa sparsely to completely porous; tabulae with normal pores. *lower Cambrian (Atd.3–Bot.3):* Australia, Antarctica.——FIG. 64*a–c*. **P. contortus*, Ajax Limestone, Atdabanian, Paint Mine, South Australia, Australia, holotype, USNM PU87217, specimen 222; *a,* transverse view of modular skeleton, ×3; *b,* detail

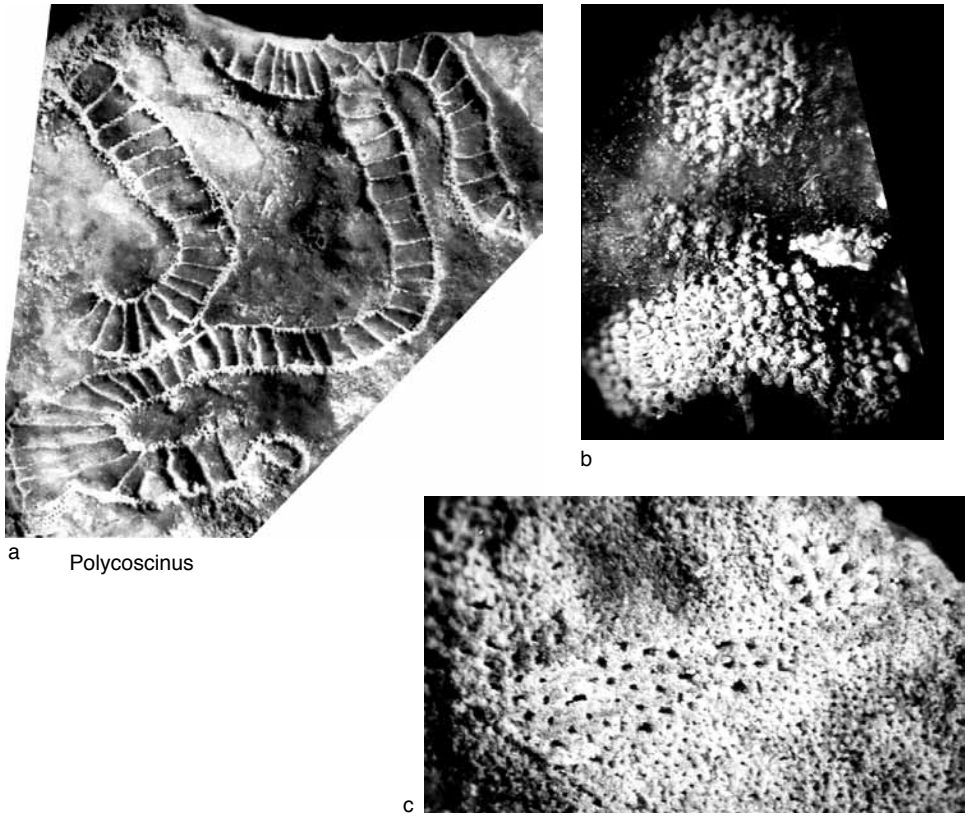


FIG. 64. Polycoscinidae (p. 85–86).

of inner wall, tangential view, ×9; *c,* detail of outer wall, tangential view, ×15 (Debrenne, Zhuravlev, & Kruse, 2002).

Lunulacyathus DEBRENNE, 1973, p. 17 [**Coscinocyathus minimiporus* R. BEDFORD & J. BEDFORD, 1937, p. 37; OD; lectotype, R. BEDFORD & J. BEDFORD, 1937, fig. 155; DEBRENNE, 1973, pl. 4,*6;* SD DEBRENNE, 1973, p. 17, USNM PU86705, Washington, D.C.]. Outer wall with attached microporous sheath and supplementary cupped bracts; inner wall with several rows of pores per intersept, bearing downwardly projecting, cupped bracts; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* Australia.——FIG. 65*a–c.* **L. minimiporus* (R. BEDFORD & J. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, USNM PU86705; *a,* transverse view, ×8; *b,* detail of outer wall in longitudinal view, ×30 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* longitudinal view (outer wall to right), ×8 (M. Debrenne, new).

Family VERONICACYATHIDAE Debrenne, Zhuravlev, & Kruse, 2002

[Veronicacyathidae DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1625]

Inner wall with noncommunicating canals. *lower Cambrian (Atd.4–Bot.3).*

Veronicacyathus DEBRENNE, 1973, p. 19 [**V. frondeus* DEBRENNE, 1973, p. 20; OD; holotype, DEBRENNE, 1973, pl. 2,*4–5;* pl. 3,*1;* pl. 4,*8*, USNM PU86731, specimen 200, Washington, D.C.; =*Coscinocyathus tatei* ETHERIDGE, 1890, p. 18; lectotype, ETHERIDGE, 1890, pl. 3,*2–4;* DEBRENNE, ZHURAVLEV, & GRAVESTOCK, 1993, fig. 3–4; SD DEBRENNE, ZHURAVLEV, & GRAVESTOCK, 1993, p. 182, choice following elimination of all other specimens by TATE, 1892, p. 188, SAM T1245, Adelaide]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept, bearing spines projecting radially across orifice to form screen;

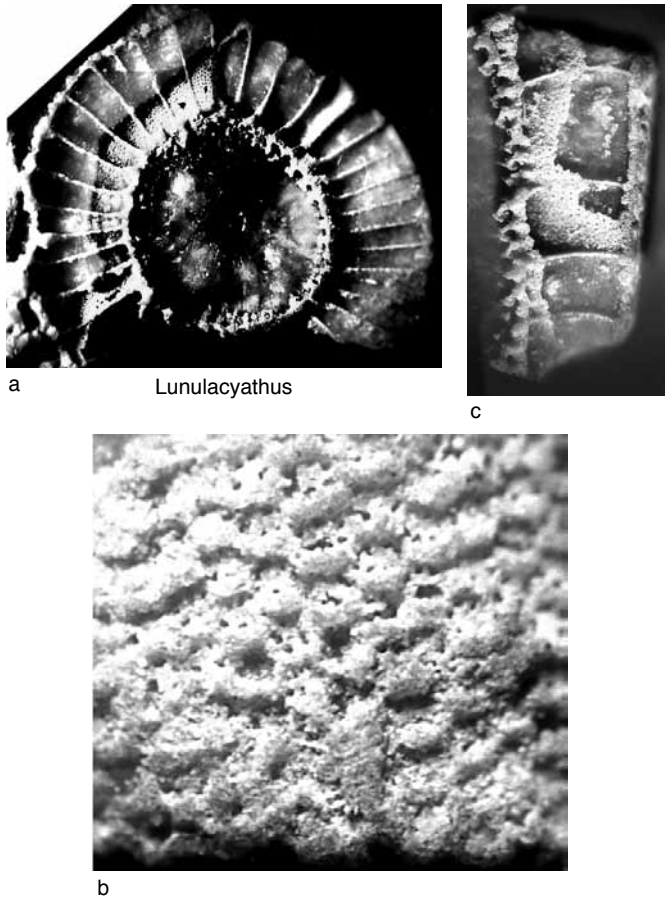


FIG. 65. Polycoscinidae (p. 86).

septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Atd.4–Bot.3):* Australia, Antarctica.——FIG. 66,*1a–b*. **V. tatei* (ETHERIDGE), Parara Limestone, Botoman, Pavy Gully, Ardrossan, South Australia, Australia, lectotype, SAM T1245; *a,* transverse section, ×3; *b,* longitudinal section (outer wall to left), ×3 (Debrenne, Zhuravlev, & Gravestock, 1993).

Bractocyathus KRUSE, 1978, p. 41 [**B. labiosus*; OD; holotype, KRUSE, 1978, fig. 11A–E, AM F.83335, Sydney]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept; upwardly projecting, planar bract arises within each canal, supporting spines projecting radially to form screen; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.4–Bot.3):* Australia, Antarctica.——FIG. 66,*2a–d*. **B. labiosus*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia; *a–b,* holotype, AM F.83335; *a,* transverse section, AM FT.8302, ×4; *b,* longitudinal section, AM FT.8303, ×4 (Kruse, 1978); *c,* paratype AM F.83278, detail of outer wall, tangential section, AM FT.8317, ×10; *d,* topotype, detail of inner wall, tangential section, AM FT.10077, ×6 (Kruse, 1982).

Family ZONACOSCINIDAE Debrenne, 1971

[Zonacoscinidae DEBRENNE, 1971, p. 194]

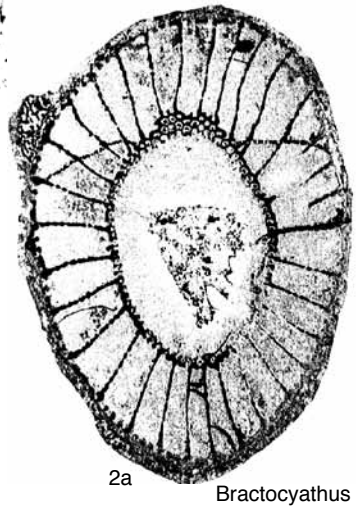
Inner wall with communicating canals. *lower Cambrian (Bot.1).*

Zonacoscinus DEBRENNE, 1971, p. 194 [**Z. tumulosus*; OD; holotype, DEBRENNE, 1971, fig. 3; DEBRENNE, 1972, pl. 4,*5–6*, MNHN M84037, specimen Ci 15U 21-2, Paris]. Inner wall with several rows of horizontal to upwardly projecting,

1b

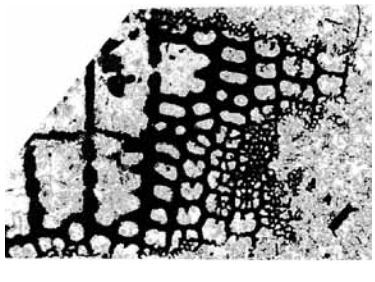
Veronicacyathus

1a

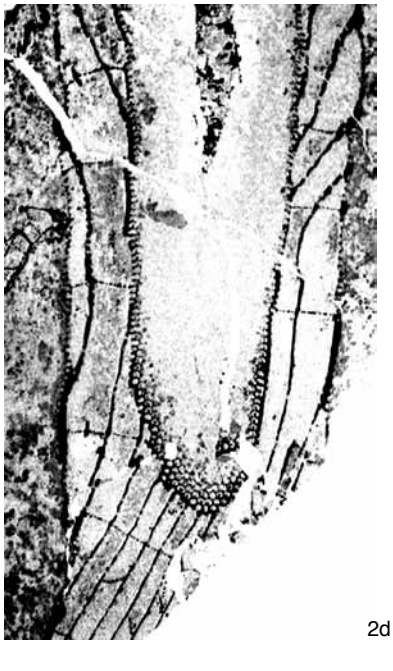


2a

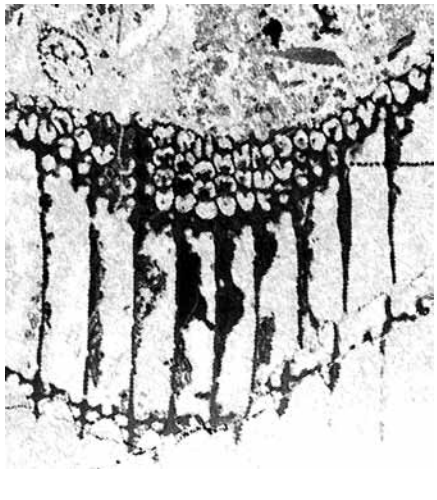
Bractocyathus



2c



2b



2d

FIG. 66. Veronicacyathidae (p. 86–87).

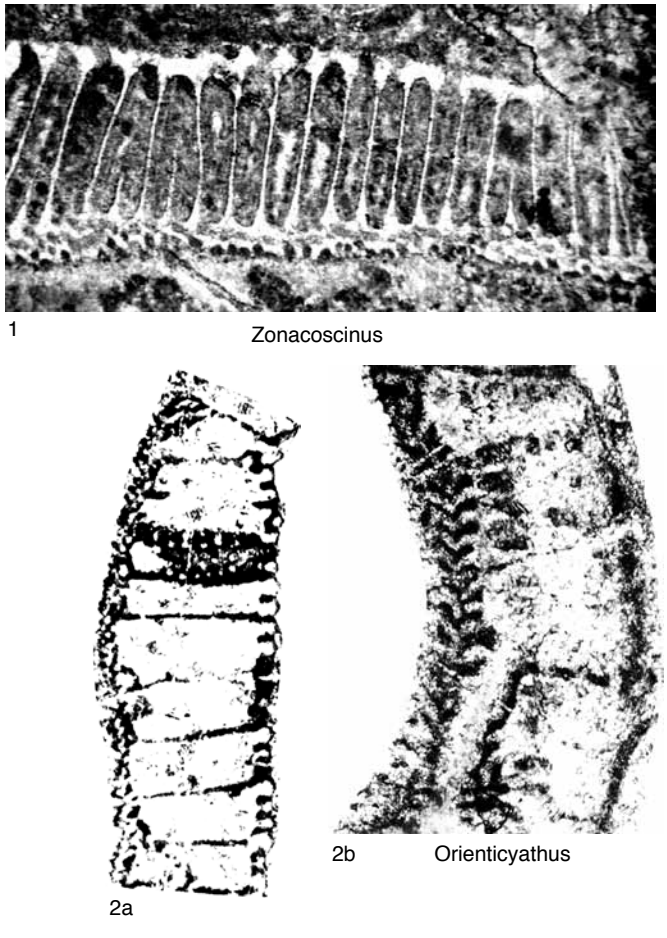


FIG. 67. Zonacoscinidae (p. 87–89).

straight canals per intersept, canals branching toward central cavity; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Sardinia.——FIG. 67,*1*. **Z. tumulosus*, Matoppa Formation, Botoman, Monte Cuccurinu, Sardinia, Italy, holotype, MNHN M84037, specimen Ci 15U 21-2, transverse section (outer wall at top), ×10 (Debrenne, 1972).

Orienticyathus BELYAEVA, 1969, p. 95 [**O. mamontovi*; OD; holotype, BELYAEVA, 1969, pl. 36,*1–2*, DVGU 6M, Khabarovsk]. Inner wall with several rows of upright, V-shaped canals per intersept; septa completely porous; tabulae with normal pores; synapticulae may be present. *lower Cambrian (Bot.1):* Far East.——FIG. 67,*2a–b*. **O. mamontovi*, Ust'toka unit, Botoman, Gerbikan River, Dzhagdy Range, Far East, Russia; *a,* holotype, DVGU 6M/K8/3-3, detail of transverse section (outer wall to right), ×13; *b,* paratype, DVGU 6M/K8/3-2, detail of longitudinal section (outer wall to right), ×13 (Debrenne, Zhuravlev, & Kruse, 2002).

Superfamily ETHMOCOSCINOIDEA Zhuravleva, 1957

[*nom. transl.* DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 87, *ex* Ethmocoscinidae ZHURAVLEVA in VOLOGDIN, 1957a, p. 181] [=Tumulocoscinacea ZHURAVLEVA, 1960b, p. 265, *nom. nud., nom. transl.* ROZANOV, 1973, p. 86, *ex* Tumulocoscininae ZHURAVLEVA, 1960b, p. 265; =Tumulocoscinoidea ZHURAVLEVA, 1960b, p. 265, *nom. transl.* ROZANOV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 86, *ex* Tumulocoscininae ZHURAVLEVA, 1960b, p. 265]

Outer wall with simple tumuli. *lower Cambrian (Atd.2–Bot.3).*

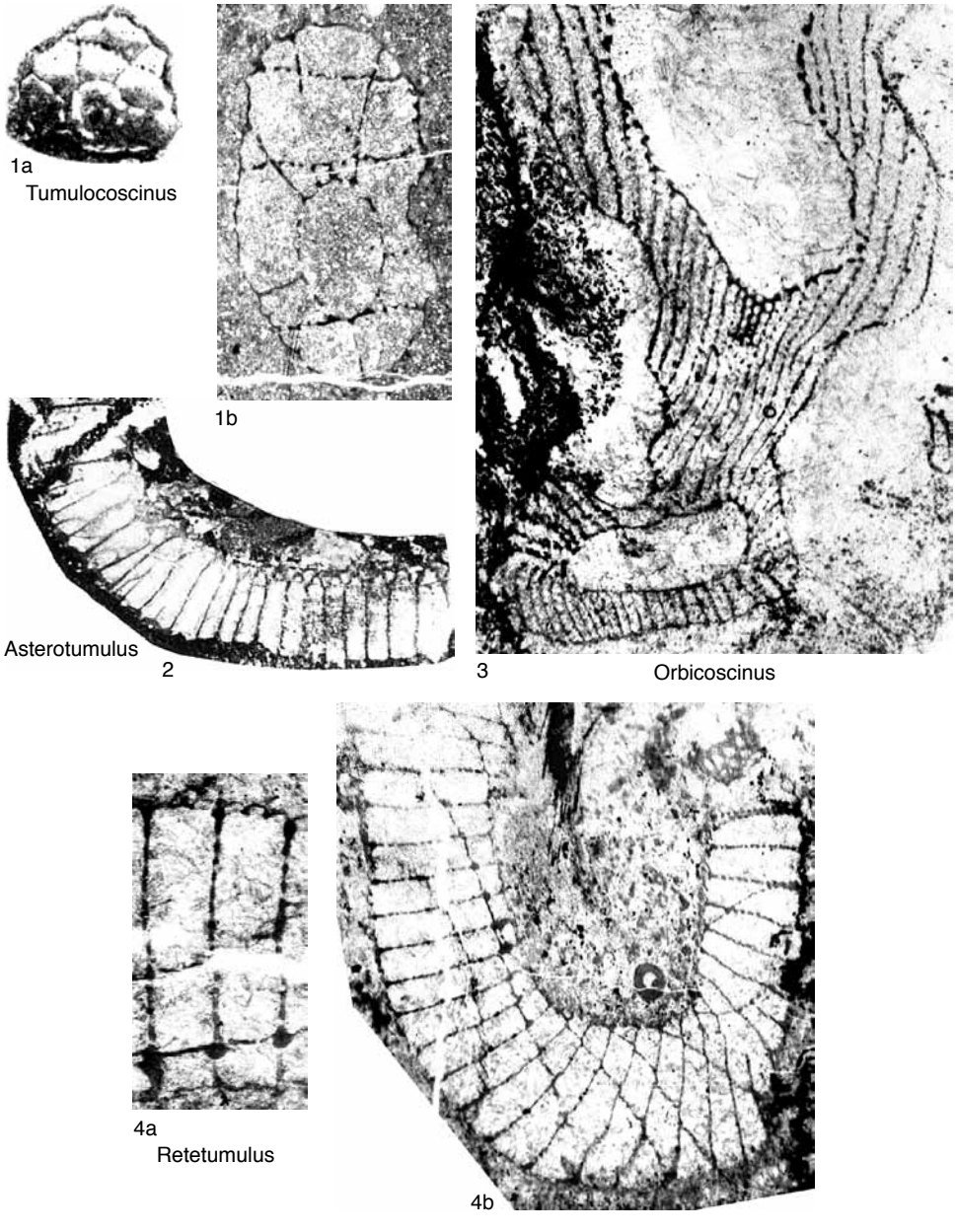


FIG. 68. Tumulocoscinidae (p. 90–91).

Family TUMULOCOSCINIDAE Zhuravleva, 1960

[*nom. transl.* DEBRENNE, 1970a, p. 25, *ex* Tumulocoscininae ZHURAVLEVA, 1960b, p. 265]

Inner wall with simple pores. *lower Cambrian (Atd.2–Bot.1).*

Tumulocoscinus ZHURAVLEVA, 1960b, p. 265 [**T. atdabanensis*; OD; holotype, ZHURAVLEVA, 1960b, pl. 3,*3b;* pl. 23,*10*, PIN 1161, Moscow, not located]. Inner wall with several rows of simple pores per intersept; septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Atd.2–Bot.1):* Siberian Platform, Altay Sayan.——FIG. 68,*1a–b.* **T. atdabanensis*,

Perekhod Formation, Atdabanian; *a,* Yudyay, Lena River, Sakha (Yakutia), Russia, holotype, PIN 1161, transverse section, ×12 (Zhuravleva, 1960b); *b,* Achagyy-Taryng Creek, Lena River, Sakha (Yakutia), Russia, specimen TsSGM 323/91, oblique longitudinal section, ×15 (Zhuravleva, Korshunov, & Rozanov, 1969).

?Asterotumulus Kashina in Repina & others, 1964, p. 229 [**A. receptori*; OD; holotype, Repina & others, 1964, pl. 15,*3*, TsSGM KGU1313/61, Novosibirsk]. Outer wall with probable tumuli; inner wall longitudinally plicate, with several rows of simple pores per intersept; septa completely porous; tabulae with normal pores. [Limited type material does not provide certainty as to which wall is outer and which inner, thereby creating uncertainty as to whether accepted outer wall bears tumuli or bracts.] *lower Cambrian (Atd.3–Bot.1):* Altay Sayan.——Fig. 68,*2. *A. receptori*, Bazaikha Formation, Atdabanian, Bazaikha River, East Sayan, Russia, holotype, TsSGM KGU1313/61, transverse section, ×7 (Repina & others, 1964).

Orbicoscinus Debrenne, 1977a, p. 111 [**O. schaerti*; OD; holotype, Debrenne, 1977a, pl. 10,*4*, MNHN M80045, specimen IRH24-1c, Paris]. Cup in which both walls show periodic, synchronous transverse folds; inner wall with one row of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Morocco.——Fig. 68,*3. *O. schaerti*, Issafen Formation, Botoman, Jbel Irhoud, holotype, MNHN M80045, specimen IRH24-1c, longitudinal section, ×5 (Debrenne, 1977a).

Retetumulus Debrenne, 1977a, p. 112 [**R. dutuiti*; OD; holotype, Debrenne, 1977a, pl. 10,*1*, MNHN M80042, specimen IRH34-3f, Paris]. Inner wall with several rows of simple pores per intersept; septa completely porous; tabulae with slitlike pores. *lower Cambrian (Bot.1):* Morocco.——Fig. 68,*4a–b. *R. dutuiti*, Issafen Formation, Botoman, Jbel Irhoud, Morocco, holotype, MNHN M80042, specimen IRH34-3f; *a,* detail of outer wall (at top) in transverse section, ×20 (Debrenne, 1977a); *b,* oblique transverse section, ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Family ETHMOCOSCINIDAE Zhuravleva, 1957

[Ethmocoscinidae Zhuravleva in Vologdin, 1957a, p. 181]

Inner wall with noncommunicating canals. *lower Cambrian (Bot.3).*

Ethmocoscinus Simon, 1939, p. 28 [**Coscinocyathus papillipora* R. Bedford & W. R. Bedford, 1934, p. 4; OD; holotype, R. Bedford & W. R. Bedford, 1934, fig. 18; Hill, 1965, pl. 8,*7;* Debrenne, 1969a, pl. 3,*3,* NHM S4164, M, London]. Inner wall with one row of horizontal to upwardly projecting, S-shaped canals per intersept; septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* Australia.——Fig. 69,*1a–b. *E. papillipora* (R. Bedford & W. R. Bedford), Ajax Limestone, Botoman, Ajax Mine, South Australia, holotype, NHM S4164; *a,* detail of outer wall in longitudinal view, ×7; *b,* transverse view, ×4 (Hill, 1965).

Superfamily COSCINOPTYCTOIDEA Debrenne, Rozanov, & Zhuravlev, 1989

[Coscinoptyctoidea Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 86]

Outer wall with multiperforate tumuli. *lower Cambrian (Atd.1–Bot.3).*

Family GEYERICOSCINIDAE Debrenne & Zhuravlev, 2000

[Geyericoscinidae Debrenne & Zhuravlev, 2000, p. 50]

Inner wall with simple pores. *lower Cambrian (Atd.1–Bot.1).*

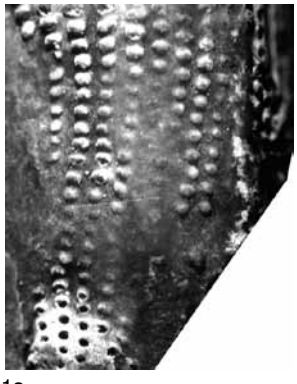
Geyericoscinus Debrenne & Zhuravlev, 2000, p. 50 [**Coscinocyathus equiporus* Debrenne, 1959b, p. 8; OD; lectotype, Debrenne, 1959b, pl. 1,*4;* Debrenne, 1964, pl. 28,*4;* SD Debrenne, 1963a, p. 23, MNHN M80081, specimen TAI 1-5-4T, Paris]. Inner wall with several rows of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.1–Bot.1):* Morocco.——Fig. 69,*2a–b. *G. equiporus* (Debrenne), Amouslek Formation, Atdabanian, Jbel Taïssa, lectotype, MNHN M80081, specimen TAI 1-5-4T; *a,* transverse section, ×5 (Debrenne, 1959b); *b,* detail of transverse section (outer wall at bottom), ×15 (Debrenne, 1964).

Family COSCINOPTYCTIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Coscinoptyctidae Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 86]

Inner wall with bracts or scales. *lower Cambrian (Bot.3).*

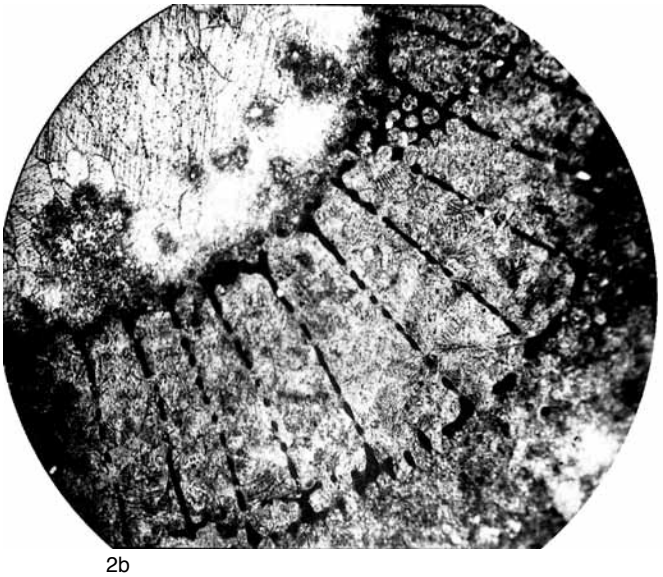
Coscinoptycta Broili, 1915, p. 121 [**Coscinoptycha convoluta* Taylor, 1910, p. 141; SD Simon, 1939, p. 26; lectotype, Taylor, 1910, fig. 7–8, pl. 11, photo 60; SD Debrenne, Zhuravlev, & Kruse, 2002, p. 1630, SAM T1594-6, Adelaide] [=*Coscinoptycha* Taylor, 1910, p. 141 (type, *C. convoluta,* SD Simon, 1939, p. 26), *non* Meyrick, 1881, p. 700, insect]. Cup in which both walls show synchronous transverse folds; inner wall with several rows of pores per intersept, bearing probably downwardly projecting, cupped bracts; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.3):*



1a Ethmocoscinus

1b

2a Geyericoscinus



2b

FIG. 69. Ethmocoscinidae and Geyericoscinidae (p. 91).

Australia, Antarctica.——FIG. 70*a–c*. **C. convoluta* (TAYLOR), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM T1594-6; *a,* detail of outer wall in tangential section, ×7; *b,* transverse section (outer wall at bottom), ×4; *c,* detail of transverse section (outer wall at top), ×9 (Debrenne, Zhuravlev, & Kruse, 2002).

Family JEBILETICOSCINIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Jebileticoscinidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 86]

Inner wall with noncommunicating canals. *lower Cambrian (Bot.1).*

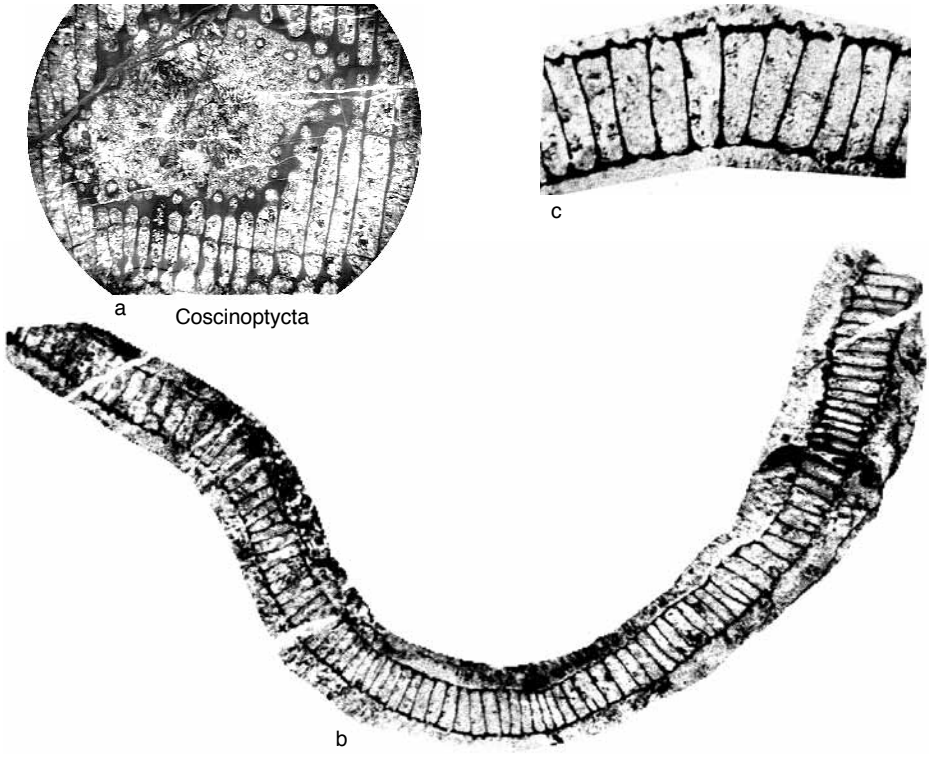


FIG. 70. Coscinoptyctidae (p. 91–92).

Jebileticoscinus DEBRENNE, 1977a, p. 114 [**J. huvelini*; OD; holotype, DEBRENNE, 1977a, pl. 11,*2*, MNHN M80048, specimen IRH4-1d, Paris] [=*Pachycoscinus* DEBRENNE, 1977a, p. 117 (type, *P. hollardi*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1630]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Morocco.——FIG. 71,*1.* **J. huvelini*, Issafen Formation, Botoman, Jbel Irhoud, Morocco, holotype, MNHN M80048, specimen IRH4-1d, longitudinal section, ×4 (Debrenne, 1977a).

Irhoudicoscinus DEBRENNE, 1977a, p. 117 [**I. destombesi;* OD; holotype, DEBRENNE, 1977a, pl. 12,*3–4*, MNHN M80052, specimen IRH2-1a, Paris]. Inner wall with one row of horizontal to upwardly projecting, straight canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Morocco.——FIG. 71,*2.* **I. destombesi*, Issafen Formation, Botoman, Jbel Irhoud, Morocco, holotype, MNHN M80052, specimen IRH2-1a, oblique transverse section, ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Superfamily SIGMOCOSCINOIDEA R. Bedford & J. Bedford, 1939

[*nom. correct.* DEBRENNE & KRUSE, 1986, p. 264, *pro* Sigmocoscinacea DEBRENNE, 1970a, p. 25, *nom. transl. ex* Sigmocoscinidae R. BEDFORD & J. BEDFORD, 1939, p. 76]

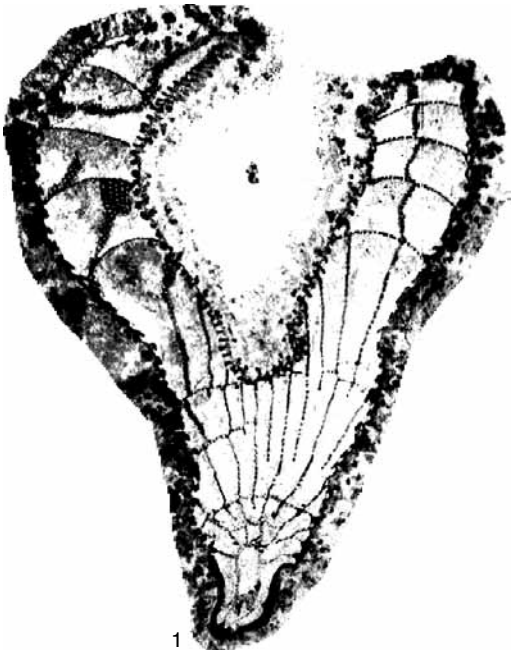
Outer wall with bracts or scales. *lower Cambrian (Bot.1–Bot.3).*

Family SYLVIACOSCINIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Sylviacoscinidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 87]

Inner wall with simple pores. *lower Cambrian (Bot.1–Bot.3).*

Sylviacoscinus DEBRENNE in ZHURAVLEVA, 1974b, p. 119 [**Coscinocyathus sylvia* R. BEDFORD & J. BEDFORD, 1937, p. 37; OD; holotype, R. BEDFORD & J. BEDFORD, 1937, fig. 156, USNM PU86706, specimen 221, M, Washington, D.C.]. Outer wall with upwardly projecting, denticulate, curved



1 Jebileticoscinus

2 Irhoudicoscinus

FIG. 71. Jebileticoscinidae (p. 93).

scales; inner wall with one row of simple pores per intersept; septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* Australia.——FIG. 72*a–c*. **S. sylvia* (R. BEDFORD & J. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, holotype, USNM PU86706, specimen 221; *a,* detail of outer wall, longitudinal view, ×15; *b,* transverse view, ×7; *c,* detail of inner wall, internal longitudinal view, ×9 (Debrenne, Zhuravlev, & Kruse, 2002).

Family SIGMOCOSCINIDAE R. Bedford & J. Bedford, 1939

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

Inner wall with annuli. *lower Cambrian (Bot.3).*

Sigmocoscinus R. BEDFORD & J. BEDFORD, 1936, p. 24 [**S. sigma*; OD; lectotype, R. BEDFORD & J. BEDFORD, 1936, fig. 98; SD HILL, 1965, p. 111, USNM PU86686, specimen 235, Washington, D.C.]. Outer wall with upwardly projecting, S-shaped scales; inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* Australia, Antarctica.——FIG. 73,*1a–d*. **S. sigma*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, USNM PU86686, specimen 235; *a,* transverse view, ×8; *b,* detail of inner wall, internal longitudinal view, ×11; *c,* detail of outer wall, longitudinal view, ×11; *d,* longitudinal view, ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

?Statanulocyathus DEBRENNE, 1975, p. 342 [**S. oosthuizeni*; OD; holotype, DEBRENNE, 1975, fig. 7a–b, SAM(C) K44945, Cape Town]. Outer wall with upwardly projecting, cupped bracts; inner wall with one row of pores per intersept, bearing upwardly projecting, cupped bracts; upwardly projecting, arcuate annuli at each tabula; septa completely porous; tabulae with normal pores. [Inner wall structure comprises bracts together with unusual, hypertrophied annuli, the appropriate taxonomic treatment of which is uncertain.] *lower Cambrian (Bot.3):* South Africa (allochthonous).——FIG. 73,*2*. **S. oosthuizeni*, Dwyka Subgroup, Botoman (allochthonous in Permian), Zwartskraal, South Africa, holotype, SAM(C) K44945, oblique longitudinal section, ×10 (Debrenne, 1975).

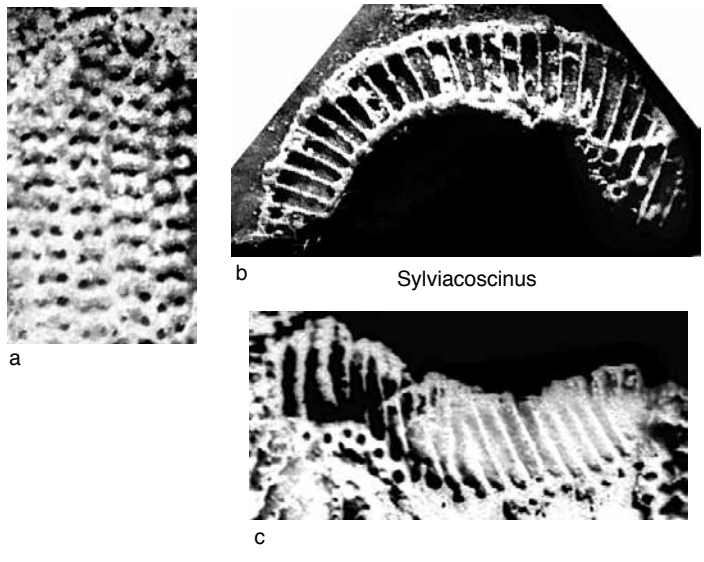


FIG. 72. Sylviacoscinidae (p. 93–94).

Superfamily POROCOSCINOIDEA Debrenne, 1964

[*nom. transl.* DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1633, *ex* Porocoscinidae DEBRENNE, 1964, p. 190] [=Rozanovicyathacea KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 54; =Schumnyicyathoidea DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 87, *nom. transl.* DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1635, *ex* Schumnyicyathidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 87]

Outer wall with canals. *lower Cambrian (Atd.1–Bot.3).*

Family ROZANOVICYATHIDAE Korshunov, 1969

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

Inner wall with simple pores. *lower Cambrian (Bot.1).*

Rozanovicyathus KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 54 [**R. alexi*; OD; holotype, ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, pl. 23,*1,3*, TsSGM 323/93, Novosibirsk]. Outer wall with horizontal to upwardly projecting, S-shaped canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of simple pores per intersept; septa completely porous; tabulae with slitlike pores. *lower Cambrian (Bot.1):* Siberian Platform.——FIG. 74,*1.* **R. alexi*, Mukhatta Formation, Botoman, Mukhatta River, Sakha (Yakutia), Russia, holotype, TsSGM 323/93, transverse section, ×5 (Zhuravleva, Korshunov, & Rozanov, 1969).

Family TATIJANAECYATHIDAE Korshunov, 1976

[Tatijanaecyathidae KORSHUNOV, 1976, p. 149] [=Schumnyicyathidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 87]

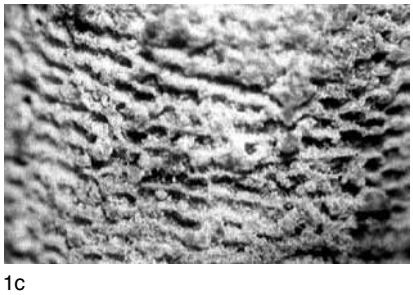
Inner wall with annuli. *lower Cambrian (Bot.1).*

Muchattocyathus ROZANOV in F. DEBRENNE, M. DEBRENNE, & ROZANOV, 1976, p. 103 (ROZANOV, 1973, p. 61, *nom. nud.*) [**M. sibiricus*; OD; holotype, F. DEBRENNE, M. DEBRENNE, & ROZANOV, 1976, pl. 1,*5*, PIN 4597/142, Moscow] [=*Tatijanaecyathus* KORSHUNOV, 1976, p. 149 (type, *T. laetus,* OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 120; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 152]. Outer wall with downwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall upright V-shaped appearance to outer wall); inner wall with one pore row per intersept and upwardly projecting, S-shaped annuli; septa completely porous, linked by synapticulae; tabulae with normal pores. *lower Cambrian (Bot.1):* Siberian Platform.——FIG. 74,*2.* **M. sibiricus*, Oy-Muran reef massif, Botoman, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, PIN 4597/142, oblique transverse section, ×7 (F. Debrenne, M. Debrenne, & Rozanov, 1976).

Schumnyicyathus ZHURAVLEVA in DATSENKO & others, 1968, p. 164 [**S. validus*; OD; holotype, DATSENKO &

1a Sigmocoscinus

1b



1c

1d

2 Statanulocyathus

FIG. 73. Sigmocoscinidae (p. 94).

others, 1968, pl. 9,*3*, TsSGM 278/72, Novosibirsk]. Outer wall with horizontal to upwardly projecting, S-shaped canals and supplementary attached microporous sheath; inner wall with several pore rows per intersept and upwardly projecting, S-shaped annuli; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Siberian Platform.——Fig. 74,*3a–b*. **S. validus*, Shumnoy Formation, Botoman, Sukharikha River, Krasnoyarsk region, Russia; *a,* holotype, TsSGM 278/72, transverse section, ×12; *b,* paratype, TsSGM 278/73, oblique longitudinal section, ×12 (Datsenko & others, 1968).

Family POROCOSCINIDAE Debrenne, 1964

[Porocoscinidae Debrenne, 1964, p. 190]

Inner wall with noncommunicating canals. *lower Cambrian (Atd.3–Bot.3).*

Porocoscinus Debrenne, 1964, p. 190 [**P. flexibilis*; OD; holotype, Debrenne, 1964, pl. 28,*1–3*, MNHN M84108, specimen S Sc 5-4b, Paris] [=*Coscinoteichus* Debrenne, 1964, p. 180 (type, *C. minimiporus*, OD); =*Chengkoucyathus* Yuan, 1974, p. 81 (type, *C. shabaensis*, OD); =*Flexicyathus* Kruse, 1978, p. 40 (type, *F. rudens*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 124; Debrenne, Rozanov, & Zhuravlev, 1990, p. 155; Debrenne, Zhuravlev, & Kruse, 2002, p. 1635]. Outer wall with horizontal to upwardly projecting, S-shaped canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with several rows of inverted V-shaped canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1–Bot.3):* Australia, Antarctica, South China, Iberia, Sardinia.——Fig. 75,*1a–b*. **P. flexibilis*, Matoppa Formation, Botoman, Serra Scoris, Sardinia, Italy, holotype, MNHN M84108, specimen S Sc 5-4b; *a,* transverse section (outer wall at top), ×8 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* longitudinal section (outer wall to left), ×8 (Debrenne, 1964).

Geniculicyathus Debrenne, 1960, p. 118 [**G. varius*; M; holotype, Debrenne, 1960, fig. A, MNHN M80154, specimen HD40, Paris]. Outer wall with horizontal to upwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with several rows of horizontal to upwardly projecting, S-shaped canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.3):* Morocco.——Fig. 75,*2a–b*. **G. varius*, Amouslek Formation, Atdabanian, Jbel Taïssa, Morocco, holotype, MNHN M80154, specimen HD40; *a,* transverse section, ×4; *b,* longitudinal section, ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Tubicoscinus Debrenne in Debrenne, Zhuravlev, & Rozanov, 1989, p. 137 (Debrenne, 1970b, p. 207, *nom. nud.*, proposed conditionally, ICZN Art. 15) [**Coscinocyathus tuba* Bornemann, 1884, p. 704; OD; holotype, Bornemann, 1886, pl. 15,*2a;* Debrenne, 1964, pl. 18,*1–2*, GML 930, Halle]. Outer wall with horizontal to upwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of horizontal to upwardly projecting, slightly S-shaped canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Iberia, Sardinia.——Fig. 75,*3a–b*. **T. tuba* (Bornemann), Matoppa Formation, Botoman, San Pietro, Sardinia, Italy, holotype, GML 930; *a,* longitudinal section, ×7 (Bornemann, 1886); *b,* detail of same, ×14 (Debrenne, 1964).

Superfamily MOOTWINGEECYATHOIDEA Kruse, 1982

[*nom. transl.* Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 87, *ex* Mootwingeecyathidae Kruse, 1982, p. 194]

Outer wall clathrate. *lower Cambrian (Bot.3).*

Family MOOTWINGEECYATHIDAE Kruse, 1982

[Mootwingeecyathidae Kruse, 1982, p. 194]

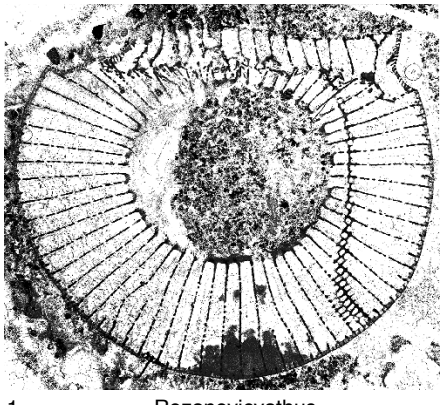
Inner wall with bracts or scales. *lower Cambrian (Bot.3).*

Mootwingeecyathus Kruse, 1982, p. 195 [**M. mootwingeensis*; OD; holotype, Kruse, 1982, fig. 20–21, pl. 15,*4–11*, AM F.83344, Sydney]. Inner wall with several rows of pores per intersept, bearing upwardly projecting, S-shaped scales; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* Australia.——Fig. 76*a–d*. **M. mootwingeensis*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia, holotype, AM F.83344; *a,* oblique longitudinal section, AM FT.14162, ×8; *b,* detail of outer wall in tangential section, AM FT.8175, ×30; *c,* transverse section, AM FT.14163, ×7; *d,* detail of inner wall, transverse section, AM FT.14163, ×30 (Kruse, 1982).

Order PUTAPACYATHIDA Vologdin, 1961

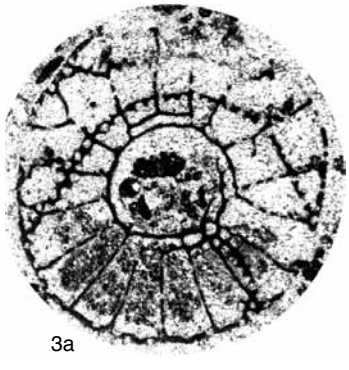
[Putapacyathida Vologdin, 1961, p. 177]

Intervallum with plate tabulae; redimiculi may be present on intervallum side of either or both walls. *lower Cambrian (Bot.1–Bot.3).*

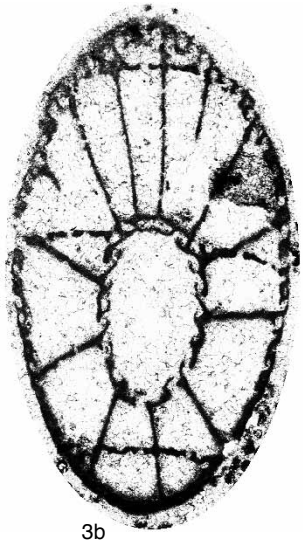


1 Rozanovicyathus

2 Muchattocyathus



3a Schumnyicyathus



3b

FIG. 74. Rozanovicyathidae and Tatijanaecyathidae (p. 95–97).

Superfamily PUTAPACYATHOIDEA R. Bedford & J. Bedford, 1936

[*nom. correct*. DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1638, *pro* Putapacyathacea DEBRENNE, 1970a, p. 24, *nom. transl. ex* Putapacyathidae R. BEDFORD & J. BEDFORD, 1936, p. 24] [=Alphacyathoidea R. BEDFORD & J. BEDFORD, 1939, p. 72, *nom. transl*. DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 88, *ex* Alphacyathidae R. BEDFORD & J. BEDFORD, 1939, p. 72; =Aptocyathacea KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 102, *nom. nud., nom. transl*. ROZANOV, 1973, p. 85, *ex* Aptocyathidae KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 102]

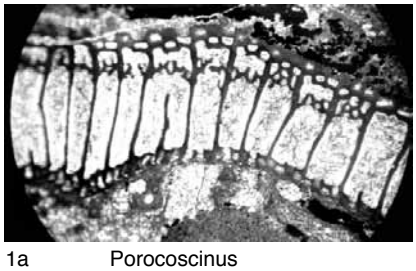
Outer wall with simple pores. *lower Cambrian (Bot.1–Bot.3).*

Family ALPHACYATHIDAE R. Bedford & J. Bedford, 1939

[Alphacyathidae R. BEDFORD & J. BEDFORD, 1939, p. 72] [=Aptocyathidae KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 102]

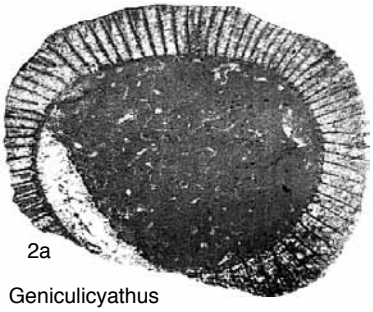
Inner wall with simple pores. *lower Cambrian (Bot.1–Bot.3).*

Alphacyathus R. BEDFORD & J. BEDFORD, 1939, p. 72 [**Dictyocyathus annularis* R. BEDFORD & W. R. BEDFORD, 1936, p. 13; OD; lectotype, R. BEDFORD & W. R. BEDFORD, 1936, fig. 55; ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, fig. 53; SD DEBRENNE, 1969a, p. 305, SAM P942, Adelaide; =*Dictyocyathus simplex* TAYLOR,



1a Porocoscinus

1b



2a

Geniculicyathus

2b

3a

Tubicoscinus

3b

FIG. 75. Porocoscinidae (p. 97).

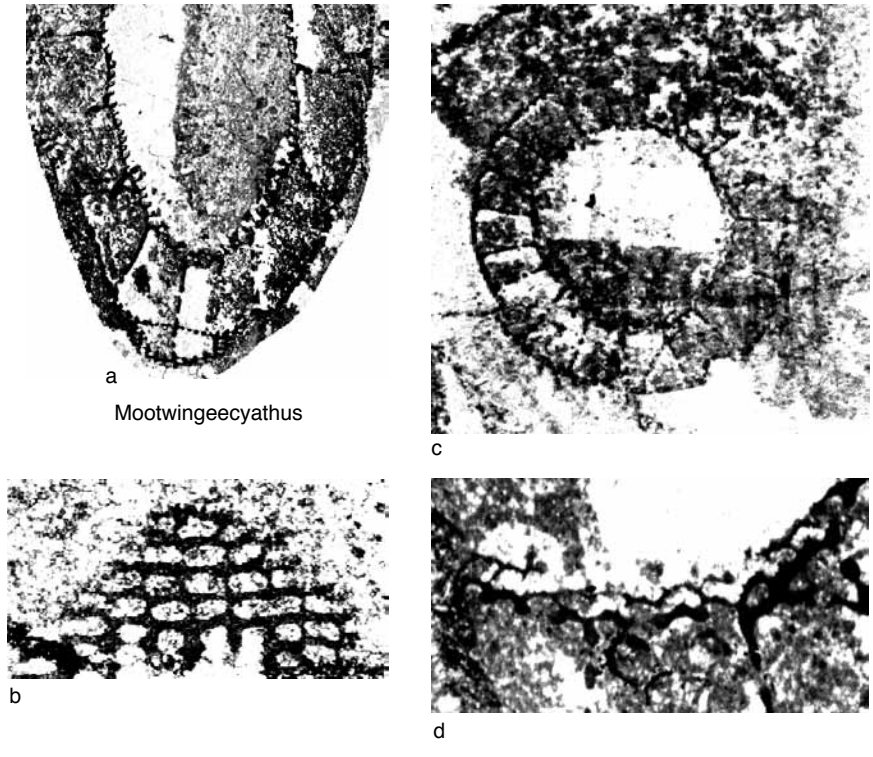


FIG. 76. Mootwingeecyathidae (p. 97).

1910, p. 144; lectotype, TAYLOR, 1910, fig. 34; SD DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1638, SAM T1598A, B, Adelaide]. Inner wall with stirrup pores at each tabula and one file of simple, intertabular pores; tabulae with normal pores; longitudinal lintels form septumlike plates in some intertabulae. *lower Cambrian (Bot.3):* Australia.——FIG. 77,*1a–c*. **A. simplex* (TAYLOR), Ajax Limestone, Botoman, Ajax Mine, South Australia; *a,* lectotype, SAM T1598, longitudinal view, ×12; *b,* paralectotype, USNM PU86714, specimen 225, transverse view, ×12 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* paralectotype, NHM S4822, longitudinal view, ×12 (M. Debrenne, new).

Aptocyathus VOLOGDIN, 1937b, p. 471 [**A. gordoni*; M; lectotype, SD ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 106, collection IK Bazhenova, specimen 28-4048, thin section 3/10, not located] [=*Aptocyathella* KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 111 (type, *A. prima*, OD); =*Galinaecyathus* KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 102 (type, *G. lebedensis*, OD); =*Arthrocyathus* VOLOGDIN, 1977, p. 61 (type, *A. articulatus,* OD)]. Inner wall with several files of simple pores per intertabulum; tabulae with normal pores. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Urals, Australia, Iberia, Sardinia.——FIG. 77,*2a–b*. **A. gordoni*, Verkhnemonok Formation, Botoman, Sanashtykgol River, West Sayan, Altay Sayan, Russia; *a,* topotype, possibly of type series, PIN 4754/42, transverse section of modular skeleton, ×10 (Vologdin, 1940b); *b,* unlocated syntype, sketch of transverse and longitudinal sections of modular skeleton, ×10 (Vologdin, 1937b).

Family PUTAPACYATHIDAE R. Bedford & J. Bedford, 1936

[Putapacyathidae R. BEDFORD & J. BEDFORD, 1936, p. 24]

Inner wall with bracts or scales. *lower Cambrian (Bot.3).*

Putapacyathus R. BEDFORD & J. BEDFORD, 1936, p. 24 [**P. regularis*; OD; holotype, R. BEDFORD & J. BEDFORD, 1936, fig. 97; ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, fig. 68; HILL, 1965, pl. 9,*1,* USNM PU86699-115, M, Washington, D.C.]. Inner wall with several files of pores per intertabulum, bearing downwardly projecting cupped bracts; tabulae with normal pores; sporadic septa may be present. *lower Cambrian (Bot.3):* Australia.——FIG. 78*a–c*. **P. regularis*, Ajax Limestone, Botoman, Ajax Mine, South Australia,

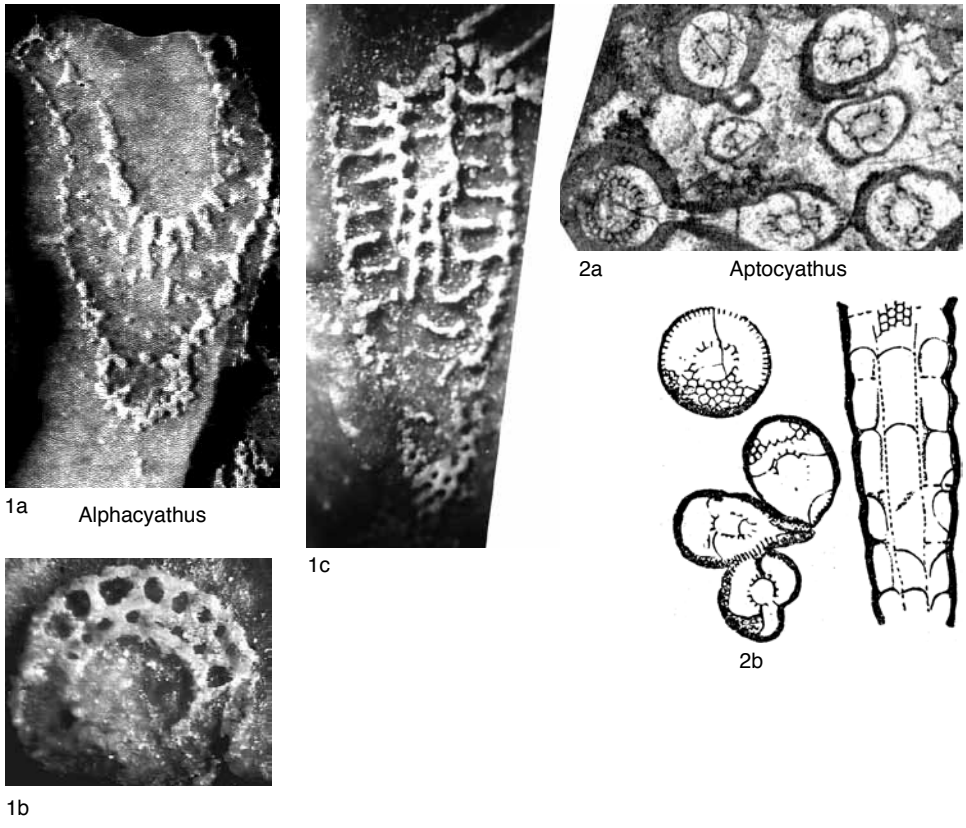


FIG. 77. Alphacyathidae (p. 98–100).

holotype, USNM PU86699-115; *a,* transverse view, ×6; *b,* oblique longitudinal view, ×6 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* internal longitudinal view of inner wall, ×4.5 (Hill, 1965).

Superfamily HUPECYATHOIDEA Debrenne, Rozanov, & Zhuravlev, 1990

[Hupecyathoidea DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 121]

Outer wall with canals. *lower Cambrian (Atd.4).*

Family HUPECYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1990

[Hupecyathidae DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 121]

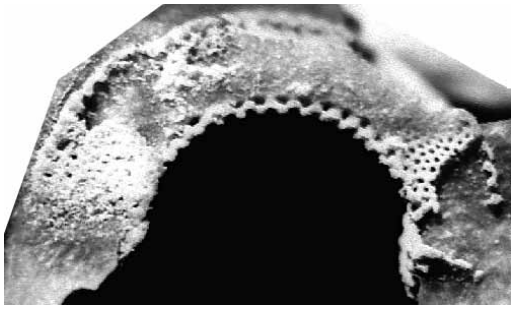
Inner wall with bracts or scales. *lower Cambrian (Atd.4).*

Hupecyathus DEBRENNE, 1964, p. 198 [**H. sphinctoides*; OD; holotype, DEBRENNE, 1964, pl. 15,*7*, MNHN M80258, specimen Ki135, Paris]. Outer wall with horizontal to upwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with several files of pores per intertabulum, bearing upwardly projecting, cupped bracts; tabulae with normal pores, linked by pillars. *lower Cambrian (Atd.4):* Morocco.——FIG. 79*a–b*. **H. sphinctoides*, Amouslek Formation, Atdabanian, Ouijane, holotype, MNHN M80258, specimen Ki135; *a,* transverse section, ×6; *b,* detail of longitudinal section (outer wall to right), ×13 (Debrenne, 1964).

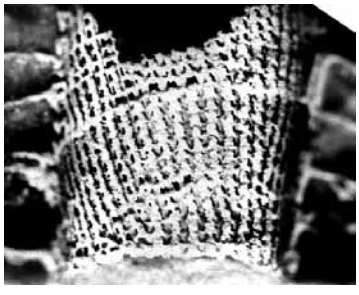
Superfamily CHABAKOVICYATHOIDEA Rozanov, 2002

[Chabakovicyathoidea ROZANOV in DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1639] [=Chabakovicyathacea ROZANOV, 1973, p. 85, *nom. nud.*]

Outer wall pustular. *lower Cambrian (Bot.1).*



a



c

Putapacyathus

b

FIG. 78. Putapacyathidae (p. 100–101).

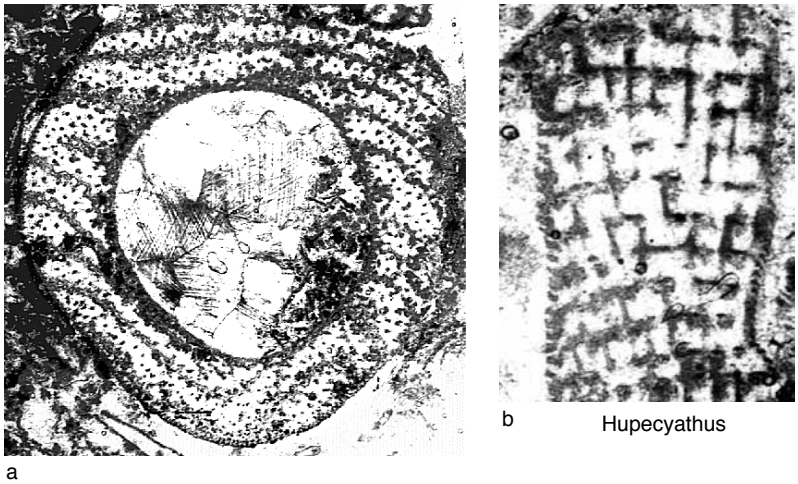


FIG. 79. Hupecyathidae (p. 101).

Family CHABAKOVICYATHIDAE Rozanov, 2002

[Chabakovicyathidae ROZANOV in DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1639] [=Chabakovicyathidae ROZANOV, 1973, p. 85, *nom. nud.*]

Inner wall with simple pores. *lower Cambrian (Bot.1).*

Chabakovicyathus KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 114 [**C. tumulatus*; OD; holotype, ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, pl. 14,*6,* not located]. Inner wall with several files of simple pores per intertabulum; tabulae with normal pores. *lower Cambrian (Bot.1):* Urals.——FIG. 80*a–b*. **C. tumulatus*, Terekla Formation, Botoman, Terekla River, western flank of southern Urals, Russia; *a,* longitudinal section, specimen PIN 4327/80, ×16 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* holotype, oblique transverse section, ×28 (Zhuravleva, Konyushkov, & Rozanov, 1964).

Order CAPSULOCYATHIDA Zhuravleva, 1964

[*nom. transl.* ZHURAVLEV & ROZANOV in VORONOVA & others, 1987, p. 29, *ex* Capsulocyathina ZHURAVLEVA in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 59] [=Coscinocyathida ZHURAVLEVA, 1955a, p. 10; =Clavicyathida VOLOGDIN, 1977, p. 110]

Thalamid cup, single or multichambered; inner wall of invaginal type of development; septa and/or plate tabulae may be present in intervallum of multichambered cups. *lower Cambrian (Tom.1–Bot.3).*

Suborder CAPSULOCYATHINA Zhuravleva, 1964

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

Cup single chambered and subspherical, or multichambered without septa. *lower Cambrian (Tom.1–Bot.3).*

Family CRYPTOPOROCYATHIDAE Zhuravleva, 1960

[Cryptoporocyathidae ZHURAVLEVA, 1960b, p. 92] [=Cryptaporocyathidae ZHURAVLEVA, 1963b, p. 117, *nom. null.*; =Capsulocyathidae ZHURAVLEVA in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 60; =Gerbicanicyathidae BELYAEVA, 1969, p. 90; =Vasicyathidae VOLOGDIN, 1977, p. 104; =Clavicyathidae VOLOGDIN, 1977, p. 110; ?=Complicatocyathidae YAROSHEVICH, 1990, p. 23]

Outer wall with simple pores. *lower Cambrian (Tom.1–Bot.3).*

Cryptoporocyathus ZHURAVLEVA, 1960b, p. 92 [**C. junicanensis*; OD; holotype, ZHURAVLEVA, 1960b, pl. 4,*9;* ZHURAVLEVA, 1963b, pl. 12,*3*), not located; paratype, TsSGM 205/6, Novosibirsk] [=*Cryptaporocyathus* ZHURAVLEVA, 1963b, p. 117, *nom. null.*]. Cup single chambered; outer wall pores of two distinct sizes; inner wall simple. *lower Cambrian (Tom.1–Tom.4):* Siberian Platform.——FIG. 81,*1a–b*. **C. junicanensis*; *a,* Medvezh'ya Formation, Tommotian, Moyero River, Krasnoyarsk region, Russia, holotype, oblique section, ×20; *b,* Pestrotsvet Formation, Tommotian, Aldan River, Sakha (Yakutia), Russia, paratype, TsSGM 205/6, section of outer wall (inner cavity at bottom), ×16 (Debrenne, Zhuravlev, & Kruse, 2002).

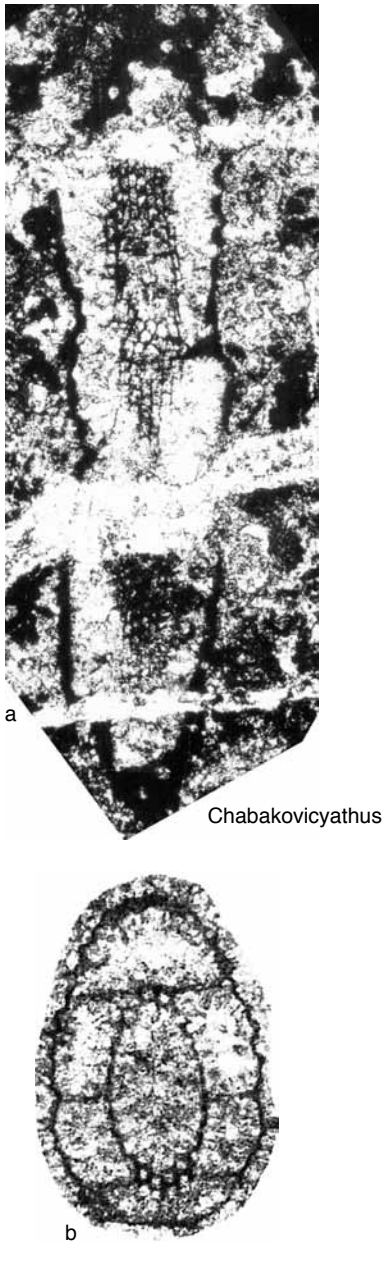


FIG. 80. Chabakovicyathidae (p. 103).

Capsulocyathus VOLOGDIN in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 61 (VOLOGDIN, 1962c, p. 75 [type, *C. capsulifer*, OD], *nom. nud.*, not described, figured or separately diagnosed until VOLOGDIN, 1977, p. 76, fig. 44, wherein a holotype was invalidly nominated from material other than type or topotype material) [**C. subcallosus* ZHURAVLEVA in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 62; OD; holotype, ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, pl. 1,*8(3),* TsSGM 283/5, Novosibirsk] [=*Capsulicyathus* VOLOGDIN, 1977, p. 75 (type, *C. capsulifer*, OD), *nom. van.*; =*Mesocyathus* VOLOGDIN, 1977, p. 95 (type, *M. plasticus*, OD); =*Vasicyathus* VOLOGDIN, 1977, p. 104 (type, *V. urniformis*, OD); =*Clavicyathus* VOLOGDIN, 1977, p. 110 (type, *C. clavellatus*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 97; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 135]. Cup single chambered; outer and inner walls with simple pores. *lower Cambrian (Tom.3–Bot.3):* Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Urals, Morocco, Iberia, Sardinia.——FIG. 81,*2.* **C. subcallosus*, Bazaikha Formation, Atdabanian, Bazaikha River, East Sayan, Altay Sayan, Russia, holotype, TsSGM 283/5, longitudinal section, ×6 (Zhuravleva, Konyushkov, & Rozanov, 1964).

?Complicatocyathus YAROSHEVICH, 1990, p. 23 [**C. rozanovi*; OD; holotype, YAROSHEVICH, 1990, pl. 12,*1*, TsSGM 901/5a, Novosibirsk]. Cup with regular transverse folds affecting both walls, forming empty multichambered cups; outer and inner walls with simple pores. [Limited type material does not provide certainty as to whether cup is multichambered.] *lower Cambrian (Atd.2):* Altay Sayan.——FIG. 81,*3.* **C. rozanovi*, Gavrilovskoe Formation, Atdabanian, Gavrilovskoe, Salair, Russia, holotype, TsSGM 901/5a, longitudinal section, ×3 (Yaroshevich, 1990).

Gerbicanicyathus BELYAEVA, 1969, p. 90 [**G. emili*; OD; holotype, BELYAEVA, 1969, pl. 37,*1*, DVGU 55/68, Khabarovsk]. Cup multichambered; outer and inner walls with simple pores. *lower Cambrian (Bot.1–Bot.2):* Far East.——FIG. 82,*1.* **G. emili*, Ust'toka unit, Botoman, Gerbikan River, Dzhagdy Range, Far East, Russia, holotype, DVGU 55/68, oblique longitudinal section, ×8 (Belyaeva, 1969).

Mirandocyathus BELYAEVA, 1974, p. 121 [**M. artus*; OD; holotype, BELYAEVA, 1974, pl. 3,*8*, DVGU 13M/572/3, Khabarovsk]. Cup multichambered; outer wall with simple pores; inner wall with pores bearing downwardly projecting, cupped bracts. *lower Cambrian (Bot.1):* Far East.——FIG. 82,*2.* **M. artus*, Ust'toka unit, Botoman, Gerbikan River, Dzhagdy Range, Russia, holotype, DVGU 13M/572/3, longitudinal section, ×7 (Belyaeva, 1974).

Polythalamia DEBRENNE & WOOD, 1990, p. 436 [**P. americana*; OD; holotype, DEBRENNE & WOOD, 1990, fig. 1B, USNM 434924, specimen GA5.18F, Washington, D.C.]. Cup multichambered, globose chambers propagating linearly or glomerately; outer wall with few or no pores; inner wall with simple pores. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Tuva, Mongolia, United States.——FIG. 82,*3.* **P. americana*, Valmy Formation, Botoman, Galena Canyon, Nevada, United States, holotype, USNM 434924, specimen GA5.18F, longitudinal section, ×20 (Debrenne & Wood, 1990; copyright Cambridge University Press).

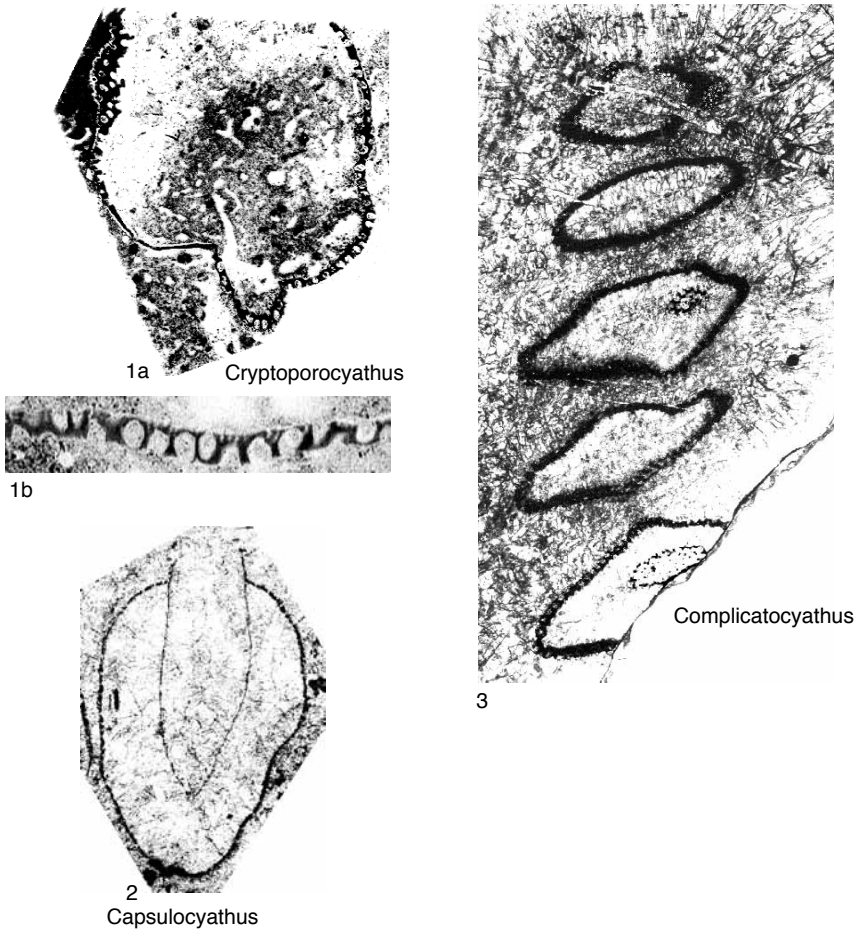


FIG. 81. Cryptoporocyathidae (p. 103–104).

Family URALOCYATHELLIDAE Zhuravleva, 1964

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

Outer wall with independent microporous sheath. *lower Cambrian (Bot.1).*

Rhabdolynthus ZHURAVLEVA, 1960b, p. 91 [**R. conicus*; OD; holotype, ZHURAVLEVA, 1960b, pl. 4,*8;* ZHURAVLEVA, 1963b, pl. 9,*11–12*, TsSGM 205/5, Novosibirsk] [=*Uralocyathella* ZHURAVLEVA in ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA, 1960, p. 99 (type, *U. repinae*, OD); =*Miricyathus* VOLOGDIN, 1977, p. 88 (type, *M. aseptatus*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 127; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 157]. Cup single chambered; outer wall with independent microporous sheath; inner wall with simple pores. *lower Cambrian (Bot.1):* Siberian Platform, Altay Sayan.—— FIG. 82,*4a–b*. **R. conicus*, Perekhod Formation, Botoman, Atdaban, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 205/5; *a,* longitudinal section, ×4; *b,* detail of wall in longitudinal section (inner cavity to right), ×7.5 (Zhuravleva, 1963b).

Family TYLOCYATHIDAE Zhuravlev, 1988

[Tylocyathidae ZHURAVLEV, 1988, p. 106]

Outer wall with attached microporous sheath. *lower Cambrian (Tom.4–Bot.3).*

Tylocyathus VOLOGDIN, 1977, p. 102 (VOLOGDIN in VOLOGDIN & YAZMIR, 1966, p. 948, *nom. nud.*) [**T. inaequilateralis;* OD; holotype, VOLOGDIN, 1977, pl. 1,*7*, PIN 1924-41, Moscow; =*Uralocyathella bullata* ZHURAVLEVA in MUSATOV &

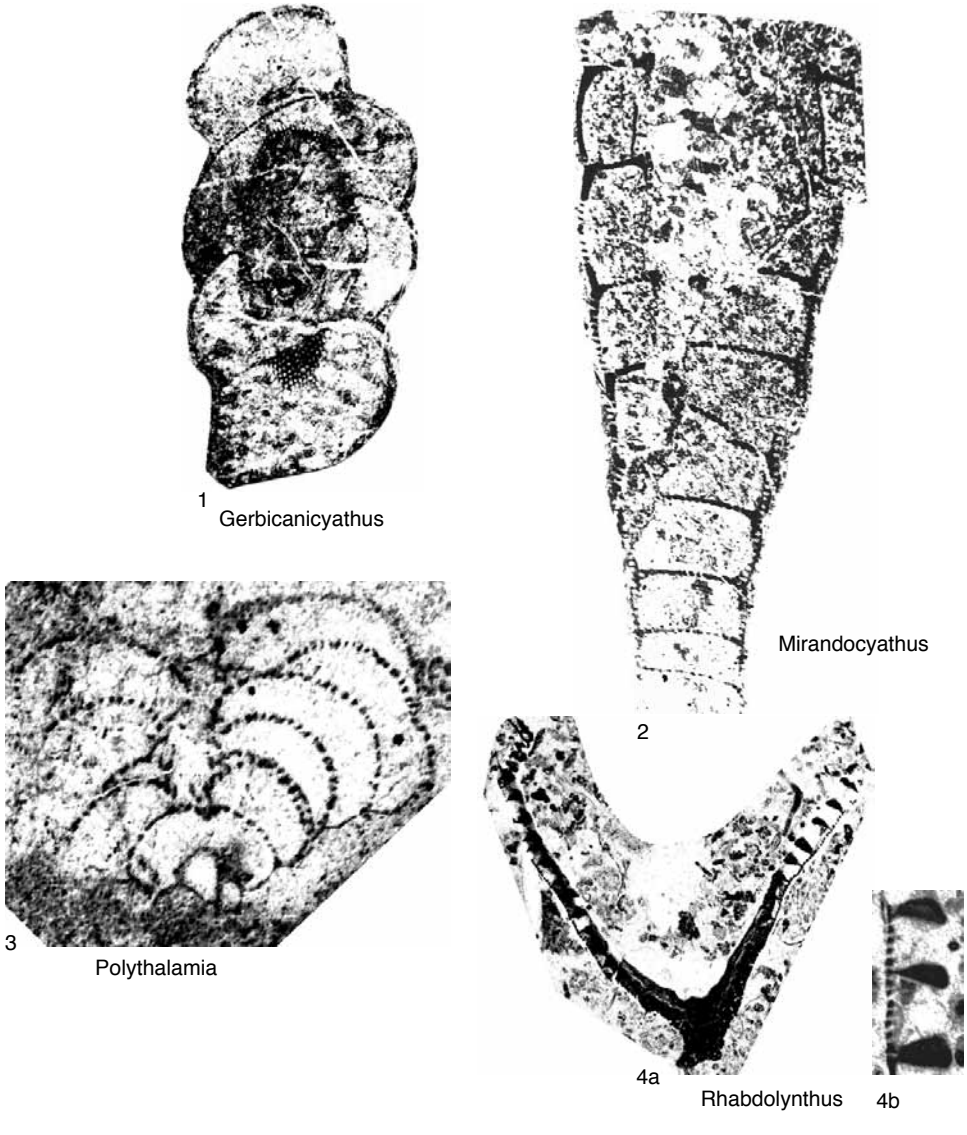


FIG. 82. Cryptoporocyathidae and Uralocyathellidae (p. 104–105).

others, 1961, p. 19; OD; holotype, MUSATOV & others, 1961, pl. 1,*7*, TsSGM 264/7, Novosibirsk]. Cup single chambered; outer wall with attached microporous sheath, each micropore bearing a supplementary bract; inner wall with simple pores. *lower Cambrian (Bot.1–Bot.3):* Altay Sayan, Far East.——FIG. 83,*1*. **T. bullatus* (ZHURAVLEVA), Balakhtinson Formation, Botoman, Kazyr River, East Sayan, Altay Sayan, Russia, holotype, TsSGM 264/7, oblique longitudinal section, ×5.5 (Musatov & others, 1961).

Korshunovicyathus ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1988, p. 99 [**Cryptaporocyathus melnikovi* KORSHUNOV & ZHURAVLEVA, 1967, p. 5; OD; holotype, KORSHUNOV & ZHURAVLEVA, 1967, pl. 1,*1*, TsSGM 247/1, Novosibirsk]. Cup single chambered; outer wall with attached microporous sheath; inner wall with simple pores. *lower Cambrian (Tom.4–Atd.1):* Siberian Platform.——FIG. 83,*2a–b*. **K. melnikovi* (KORSHUNOV & ZHURAVLEVA); *a,* Tyuser Formation, Atdabanian, Ulakhan-Ald'arkhay Creek, Lena River, Tuora-Sis Range, Sakha (Yakutia), Russia, holotype, TsSGM 247/1, detail of transverse section, ×20 (Korshunov & Zhuravleva, 1967); *b,* Pestrotsvet Formation, Atdabanian, Isit', Lena River, Sakha (Yakutia),

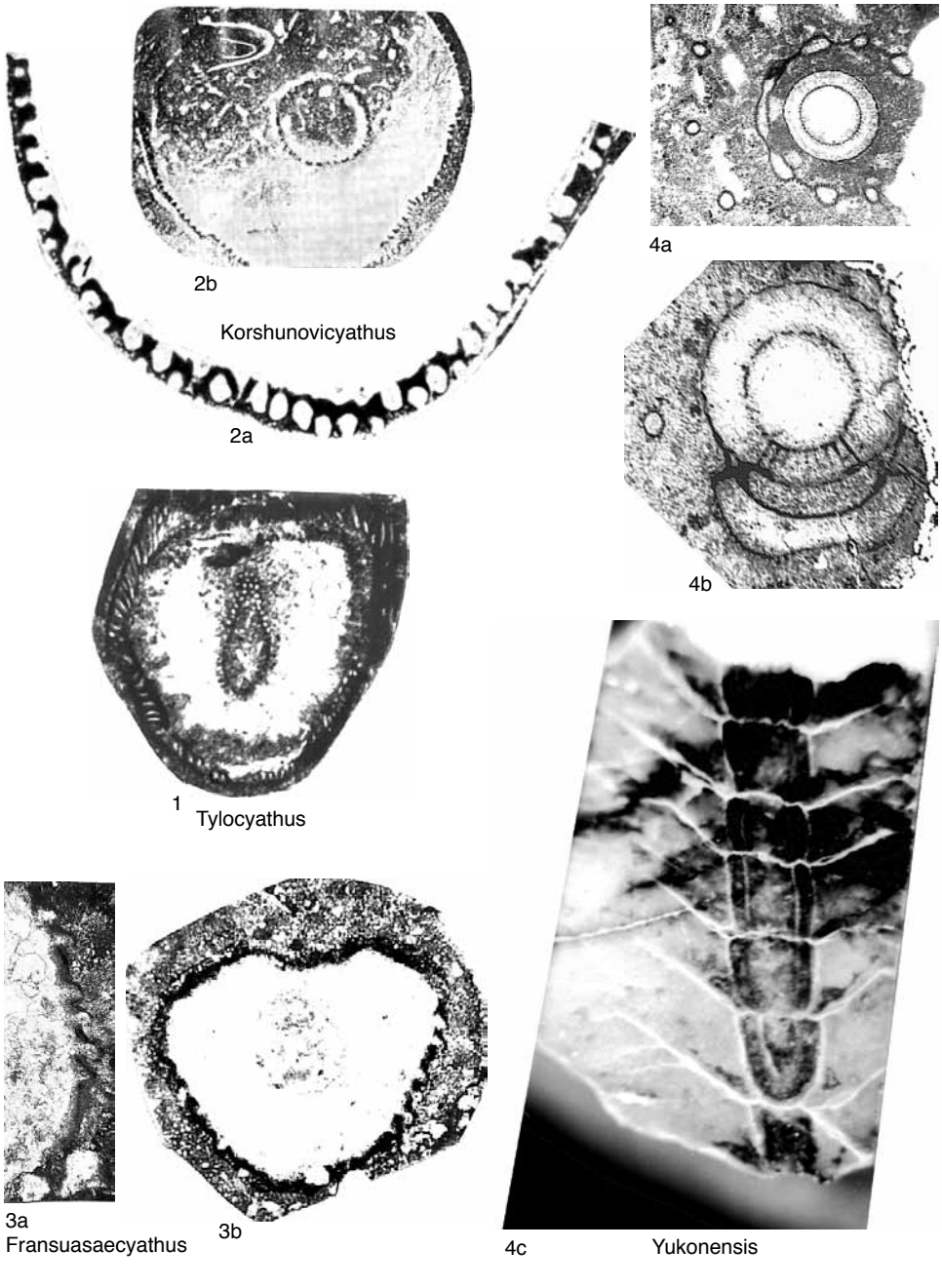


FIG. 83. Tylocyathidae and Fransuasaecyathidae (p. 105–108).

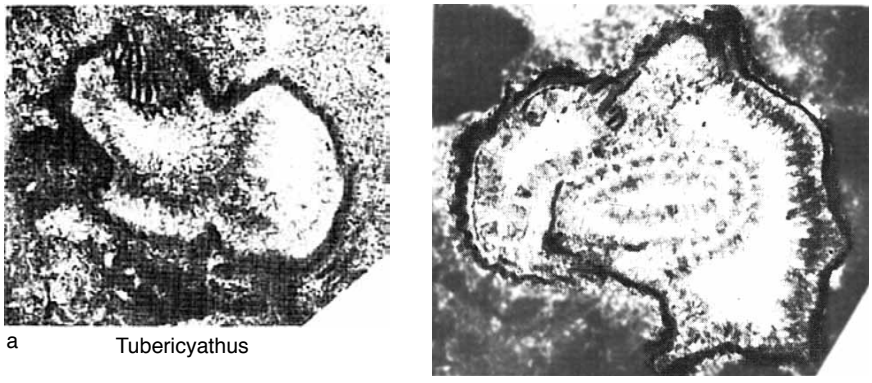


FIG. 84. Tubericyathidae (p. 108).

Russia, specimen PIN 4220/117, transverse section, ×8 (Debrenne, Zhuravlev, & Rozanov, 1988).

Family FRANSUASAECYATHIDAE Debrenne, 1964

[Fransuasaecyathidae DEBRENNE, 1964, p. 113] [=Acanthopyrgidae HANDFIELD, 1971, p. 31]

Outer wall with simple tumuli. *lower Cambrian (Atd.1–Bot.3).*

Fransuasaecyathus ZHURAVLEVA, 1960b, p. 103 [**F. subtumulatus*; OD; holotype, ZHURAVLEVA, 1960b, pl. 5,*5*, TsSGM 205/10, Novosibirsk] [=*Bullicyathus* VOLOGDIN, 1977, p. 105 (type, *B. pyxidatus*, OD); =*Marginicyathus* VOLOGDIN, 1977, p. 107 (type, *M. cardiosimilis*, OD)]. Cup single chambered; outer wall with simple tumuli; inner wall with simple pores. *lower Cambrian (Atd.1–Bot.3):* Siberian Platform, Mongolia, Transbaikalia, Far East.——FIG. 83,*3a–b*. **F. subtumulatus*, Perekhod Formation, Atdabanian, Yudyay, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 205/10; *a,* detail of wall in oblique longitudinal section, ×20; *b,* oblique longitudinal section, ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

Yukonensis ÖZDIKMEN, 2009, p. 216, *nom. nov. pro Acanthopyrgus* HANDFIELD, 1967, p. 209, *non* DESCAMPS & WINTREBERT, 1966, p. 28 (type, *Geloius finoti* BOLIVAR, 1905, p. 285, OD), insect [**Acanthopyrgus yukonensis* HANDFIELD, 1967, p. 209; OD; holotype, HANDFIELD, 1967, pl. 23,*1,4*, GSC 21059, Ottawa]. Cup multichambered with a tabula of rods linked by synapticulae and an external thorny corolla at each chamber junction; outer wall with simple tumuli; inner wall with simple pores. *lower Cambrian (Bot.1):* Canada, United States.——FIG. 83,*4a–c*. **Y. yukonensis* (HANDFIELD); *a–b,* Adams Argillite, Botoman, Tatonduk River, Alaska, United States; *a,* transverse section, specimen USGS 5156-CO (A1), ×6 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* transverse section, specimen USGS 5156-CO (A4), ×10 (Nitecki & Debrenne, 1979); *c,* Sekwi Formation, Botoman, Mackenzie Mountains, Yukon Territory, Canada, holotype, GSC 21059, longitudinal section, ×4.5 (M. Debrenne, new).

Family TUBERICYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Tubericyathidae DEBRENNE, ROZANOV, & ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 89] [=Tubericyathidae VOLOGDIN, 1977, p. 31, *nom. nud.*]

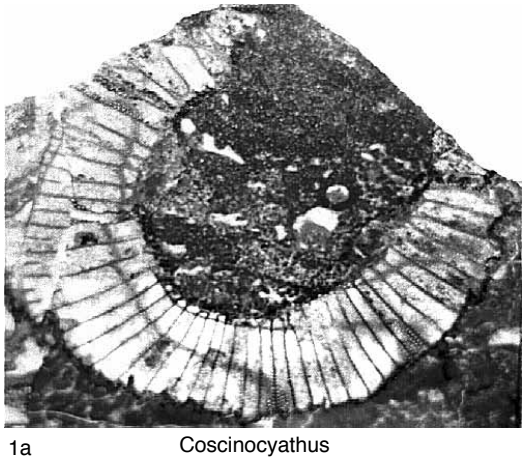
Outer wall with bracts or scales. *lower Cambrian (Bot.1).*

Tubericyathus VOLOGDIN, 1977, p. 90 [**T. clathratus*; OD; holotype, VOLOGDIN, 1977, fig. 57, pl. 13,*9*, PIN 1924/38, Moscow] [=*Arminocyathus* VOLOGDIN, 1977, p. 113 (type, *A. fungiformis*, OD)]. Cup single chambered; outer wall with pores bearing upwardly projecting, cupped bracts; inner wall with simple pores. *lower Cambrian (Bot.1):* Altay Sayan, Mongolia.——FIG. 84*a–b*. **T. clathratus*, Usa Formation, Botoman, Sukhie Solontsy Valley, Batenev Range, Kuznetsk Alatau, Russia; *a,* holotype, PIN 1924/38, oblique longitudinal section, ×10; *b,* paratype, PIN 1924/39, oblique transverse section, ×10 (Vologdin, 1977).

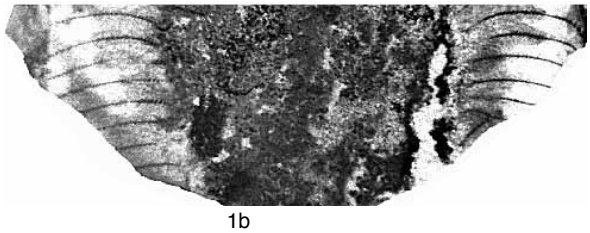
Suborder COSCINOCYATHINA Zhuravleva, 1955

[*nom. transl.* ZHURAVLEVA, 1960b, p. 245, *ex* order Coscinocyathida ZHURAVLEVA, 1955a, p. 25]

Cup multichambered; intervallum with septa. *lower Cambrian (Atd.1–Bot.3).*



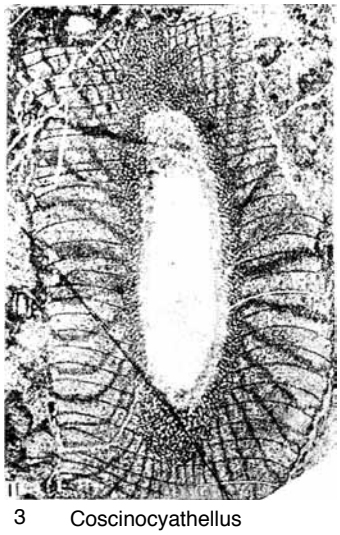
1a Coscinocyathus



1b

2b Mawsonicoscinus

2a



3 Coscinocyathellus

FIG. 85. Coscinocyathidae, Mawsonicoscinidae, and Coscinocyathellidae (p. 110).

Superfamily COSCINOCYATHOIDEA Taylor, 1910

[*nom. correct*. Debrenne, Zhuravlev, & Rozanov, 1989, p. 89, *pro* Coscinocyathacea Zhuravleva, 1960b, p. 245, *nom. transl. ex* Coscinocyathidae Taylor, 1910, p. 137] [=Mawsonicoscinoidea Debrenne & Kruse, 1986, p. 258]

Outer wall tabular with simple pores. *lower Cambrian (Atd.2–Bot.3).*

Family COSCINOCYATHIDAE Taylor, 1910

[Coscinocyathidae Taylor, 1910, p. 137] [=Poletaevacyathidae Vologdin, 1962a, p. 125].

Inner wall with simple pores. *lower Cambrian (Atd.2–Bot.3).*

Coscinocyathus Bornemann, 1884, p. 704 [**C. dianthus*; SD by exercise of ICZN plenary powers by Melville, 1974, p. 155, following application by Debrenne, 1970b, p. 207, negating SD of *C. tuba* Bornemann, 1884, p. 704 by Ting, 1937, p. 360 (now type of *Tubicoscinus* Debrenne in Debrenne, Zhuravlev, & Rozanov, 1989, p. 137); lectotype, Bornemann, 1886, pl. 17,*2–7;* Debrenne, 1964, pl. 21,*1–2;* SD Debrenne, 1964, p. 169, GML An597, Halle] [=*Poletaevacyathus* Vologdin, 1959b, p. 88 (type, *P. obrutchevi*, M)]. Inner wall with several rows of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.2–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Tajikistan, Morocco, Iberia, Sardinia.——Fig. 85,*1a–b*. **C. dianthus*, Matoppa Formation, Botoman, Canal Grande, Sardinia, Italy, lectotype, GML An597; *a,* transverse section, ×4; *b,* longitudinal section, ×4 (Bornemann, 1886).

Family MAWSONICOSCINIDAE Debrenne & Kruse, 1986

[Mawsonicoscinidae Debrenne & Kruse, 1986, p. 258]

Inner wall with noncommunicating canals. *lower Cambrian (Bot.3).*

Mawsonicoscinus Debrenne & Kruse, 1986, p. 259 [**M. sigmoides*; OD; holotype, Debrenne & Kruse, 1986, fig. 22, GNS MG513, Lower Hutt]. Inner wall with one row of horizontal to upwardly projecting, S-shaped canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* Antarctica.——Fig. 85,*2a–b*. **M. sigmoides*, Shackleton Limestone, Holyoake Range, Nimrod Glacier, holotype, GNS MG513; *a,* longitudinal section (outer wall to right), ×3.5; *b,* transverse section, ×3.5 (Debrenne & Kruse, 1986).

Family COSCINOCYATHELLIDAE Zhuravleva, 1956

[Coscinocyathellidae Zhuravleva in Vologdin, 1956, p. 879]

Inner wall with communicating canals. *lower Cambrian (Bot.1–Bot.3).*

Coscinocyathellus Vologdin, 1940b, p. 91 (Vologdin, 1937b, p. 471, *nom. nud.*) [**C. parvus*; OD; lectotype, Vologdin, 1940b, pl. 29,*1;* SD Zhuravlev, 2001a, p. 92, PIN 4754/4, Moscow]. Inner wall with several rows of horizontal to upwardly projecting, straight to waved canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1–Bot.3):* Altay Sayan.——Fig. 85,*3*. **C. parvus*, Verkhnemonok Formation, Botoman, Sanashtykgol River, West Sayan, Russia, lectotype, PIN 4754/4, oblique longitudinal section, ×8 (Vologdin, 1940b).

Superfamily CALYPTOCOSCINOIDEA Debrenne, 1964

[*nom. correct*. Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 89, *pro* Calyptocoscinacea Debrenne, 1964, p. 115]

Outer wall tabular with independent microporous sheath. *lower Cambrian (Atd.1–Bot.1).*

Family TOMOCYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Tomocyathidae Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 89]

Inner wall with simple pores. *lower Cambrian (Atd.1–Atd.3).*

Coscinocyathella Vologdin, 1959b, p. 87–88 (Vologdin, 1957d, p. 699, *nom. nud.*) [**C. nikitini*; M; holotype, Vologdin, 1957d, fig. 1(11), PIN 1800/1,1a, M, Moscow] [=*Tomocyathus* Rozanov, 1960a, p. 664 (type, *T. operosus*, OD), for discussion, see Debrenne, Zhuravlev, & Rozanov, 1989, p. 100; Debrenne, Rozanov, & Zhuravlev, 1990, p. 138]. Inner wall with several rows of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.1–Atd.3):* Altay Sayan, Tuva, Mongolia.——Fig. 86*a–b*. **C. nikitini*, Usa Formation, Atdabanian, Kiya River, Kuznetsk Alatau, Russia, holotype, PIN 1800/1,1a; *a,* transverse section, ×4; *b,* longitudinal section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Family CALYPTOCOSCINIDAE Debrenne, 1964

[Calyptocoscinidae Debrenne, 1964, p. 115]

Inner wall with independent microporous sheath. *lower Cambrian (Bot.1).*

Calyptocoscinus Debrenne, 1964, p. 196 [**Coscinocyathus cornucopiae* Bornemann, 1884, p. 704; OD; lectotype, Bornemann, 1886, pl. 16,*1;* SD Debrenne, 1964, p. 196, GML block B, Halle, requires restudy]. Inner wall with several rows of pores per intersept and independent microporous sheath; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Sardinia.——Fig. 87*a–e*. **C. cornucopiae* (Bornemann), Matoppa Formation, Botoman, Monte Gloria, Canal Grande, Italy, topotype, MNHN M84106; *a,* oblique transverse section, ×6; *b,* transverse section, ×5; *c,* detail of inner wall, longitudinal section (central cavity to right), ×30; *d,* detail of transverse section (outer wall at bottom), ×10; *e,* longitudinal section, ×5 (Debrenne, 1964).

Superfamily ALATAUCYATHOIDEA Zhuravleva, 1955

[*nom. correct*. Debrenne, Zhuravlev, & Rozanov, 1989, p. 89, *pro* Alataucyathacea Zhuravleva, 1960b, p. 264, *nom. transl. ex* Alataucyathidae Zhuravleva, 1955b, p. 626] [=Mrassocyathoidea Vologdin, 1960, p. 130, *nom. correct*. Debrenne, Zhuravlev, & Rozanov, 1989, p. 85, *pro* Mrassucyathacea Zhuravleva & Rozanov in Repina & others, 1964, p. 230, *nom. transl. ex* Mrassocyathidae Vologdin in Zhuravleva, Krasnopeeva, & Chernysheva, 1960, p. 130, as Mrassucyathidae *nom. null*.]

Outer wall tabular with multiperforate tumuli. *lower Cambrian (Atd.1–Atd.2).*

Family ALATAUCYATHIDAE Zhuravleva, 1955

[Alataucyathidae Zhuravleva, 1955b, p. 626] [=Mrassocyathidae Vologdin, 1956, p. 879, *nom. nud.*; =Alataucyathinae Zhuravleva, 1955b, p. 626, *nom. transl.* Zhuravleva, 1960b, p. 264, *ex* Alataucyathidae Zhuravleva, 1955b, p. 626; =Mrassocyathidae Vologdin in Zhuravleva, Krasnopeeva, & Chernysheva, 1960, p. 130, *nom. correct*. Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 86 *pro* Mrassucyathidae Vologdin in Zhuravleva, Krasnopeeva, & Chernysheva, 1960, p. 130]

Inner wall with simple pores. *lower Cambrian (Atd.1–Atd.2).*

Alataucyathus Zhuravleva, 1955b, p. 626 [**A. jaroschevitschi*; OD; holotype, Zhuravleva, 1955b, fig. 1a, 2g–d, PIN 1040, Moscow, not located] [=*Mrassocyathus* Krasnopeeva in Vologdin, 1956, p. 879, *nom. nud.*; =*Mrassocyathus* Krasnopeeva, 1960, p. 43 (type, *M. micropora*, OD); =*Mrassucyathus* Krasnopeeva in Zhuravleva, Krasnopeeva, & Chernysheva, 1960, p. 130 (type, *M. schoriensis*, OD), *nom. null.*]. Inner wall with several rows of simple pores per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Atd.1–Atd.2):* Altay Sayan, Tuva, Mongolia.——Fig. 88*a–b*. **A. jaroschevitschi*; *a,* Usa Formation, Atdabanian, Mt. Martyukhina, Kuznetsk Alatau, Russia, holotype, PIN 1040, oblique longitudinal section, ×4; *b,* Usa Formation, Atdabanian, Sukhie Solontsy Valley, Batenev Range, Kuznetsk Alatau, Russia, unlocated specimen, neither holding institution nor collection number known, transverse section, ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Fig. 86. Tomocyathidae (p. 110).

Superfamily CLATHRICOSCINOIDEA Rozanov, 1964

[*nom. correct*. Zhuravlev, 1988, p. 105, *pro* Clathricoscinacea Debrenne, 1964, p. 115, *nom. transl. ex* Clathricoscinidae Rozanov in Repina & others, 1964, p. 223]

Outer wall tabular and pseudoclathrate. *lower Cambrian (Bot.1–Toy.1).*

Family CLATHRICOSCINIDAE Rozanov, 1964

[Clathricoscinidae Rozanov in Repina & others, 1964, p. 223]

Inner wall with simple pores. *lower Cambrian (Bot.1–Toy.1).*

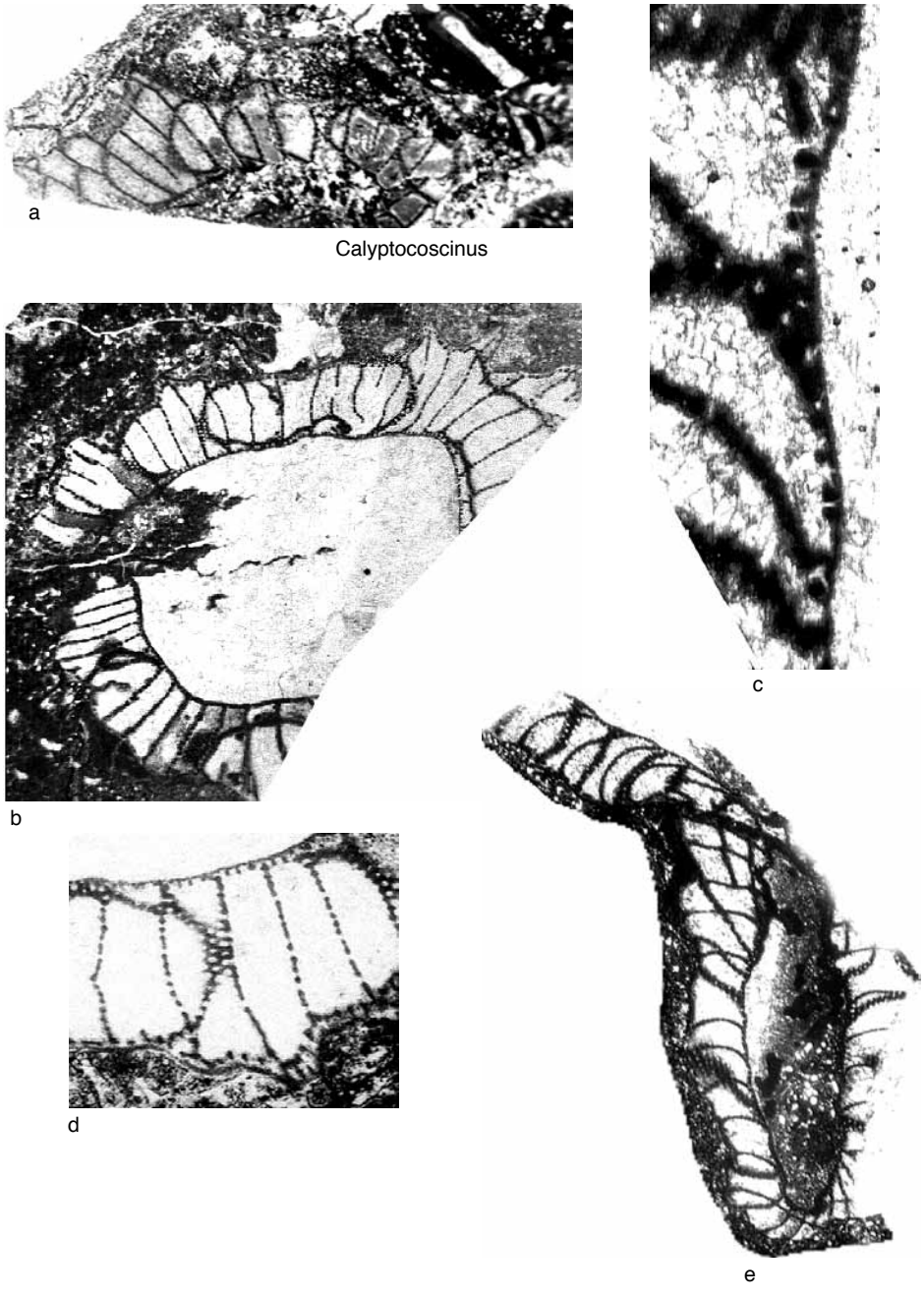


FIG. 87. Calyptocoscinidae (p. 111).

Clathricoscinus ZHURAVLEVA, 1955b, p. 627 [**Coscinocyathus infirmus* VOLOGDIN in ZHURAVLEVA, 1955b, p. 627; OD; holotype, ZHURAVLEVA, 1955b, fig. 2a, PIN 1040, Moscow; collection not located] [=*Asterocyathellus* VOLOGDIN, 1962a, p. 126 (type, *A. compositus*, OD), for discussion, see DEBRENNE, ZHURAVLEV, & ROZANOV, 1989, p. 99; DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 136]. Inner wall with several rows of simple pores per intersept;

septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1–Toy.1):* Kolyma, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, South China.——Fig. 89,*1a–b*. **C. infirmus* (Vologdin), Usa Formation, Botoman, Bol'shaya Erba, Batenev Range, Kuznetsk Alatau, Russia, syntype, PIN 1040; *a,* transverse section, ×10; *b,* tangential section of outer wall (at top), ×10 (Debrenne, Zhuravlev, & Kruse, 2002).

Family LANICYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1989

[Lanicyathidae Debrenne, Rozanov, & Zhuravlev in Debrenne, Zhuravlev, & Rozanov, 1989, p. 90]

Inner wall with noncommunicating canals. *lower Cambrian (Bot.1).*

Lanicyathus Belyaeva in Belyaeva & others, 1975, p. 87 [**L. albus*; OD; holotype, Belyaeva & others, 1975, pl. 19,*3;* pl. 37,*2–3*, PIN DVIMS5157/6, Moscow]. Inner wall with several rows of horizontal to upwardly projecting, straight to waved canals per intersept; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Far East.——Fig. 89,*2a–b*. **L. albus*, Ust'toka unit, Botoman, Lan River, Dzhagdy Range, Far East, Russia, holotype, PIN DVIMS5157/6; *a,* longitudinal section, ×7; *b,* transverse section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Order ARCHAEOCYATHIDA Okulitch, 1935

[*nom. correct*. Zhuravleva, 1955a, p. 11, *pro* order Archaeocyathina Okulitch, 1935, p. 90] [=Anthomorphida Okulitch, 1935, p. 90, *nom. correct*. Okulitch, 1955a, p. 18, *pro* order Anthomorphina Okulitch, 1935, p. 90; =Syringocnemidida Okulitch, 1935, p. 90, *nom. correct*. Debrenne, 1964, p. 117, *pro* order Syringocnemina Okulitch, 1935, p. 90; =Spirocyathida R. Bedford & W. R. Bedford, 1936, p. 13, *nom. correct*. Hill, 1972, p. 103, *pro* order Spirocyathina R. Bedford & W. R. Bedford, 1936, p. 13; =Metacyathida R. Bedford & W. R. Bedford, 1936, p. 16, *nom. correct*. Okulitch, 1955a, p. 14, *pro* order Metacyathina R. Bedford & W. R. Bedford, 1936, p. 16; =order Dictyocyanthina (*sic*) R. Bedford & J. Bedford, 1937, p. 37, *nom. nud.,* proposed conditionally; =Archaeosyconida Zhuravleva, 1955a, p. 12; =superorder Loculicyathina Zhuravleva, 1955a, p. 9, *nom. transl*. Vologdin, 1962a, p. 118, ex order Loculicyathida Zhuravleva, 1955a, p. 9, *nom. correct*. Vologdin, 1961, p. 178, *pro* Loculocyathida Zhuravleva, 1955a, p. 9, invalid name based on *nom. null*.; =Rhizacyathida Zhuravleva, 1955b, p. 629, for discussion, see Hill, 1972, p. 103, 133; =Bicyathida Vologdin, 1956, p. 878; =Syringocnematida Zhuravleva in Zhuravleva, Krasnopeeva, & Chernysheva, 1960, p. 139; =Thalassocyathida Vologdin, 1961, p. 177; =Tersiida Vologdin, 1961, p. 181; = superorder Bicyathina Vologdin, 1962a, p. 117; =Archaeopharetrida Debrenne, 1970a, p. 25; =Metaldetida Debrenne, 1970a, p. 25; =Paranacyathida Debrenne, 1970a, p. 25; =Paracoscinida Debrenne, 1970a, p. 25, for discussion, see Debrenne & Zhuravlev, 1992b, p. 111; =Metacoscinida Debrenne, 1974a, p. 187]

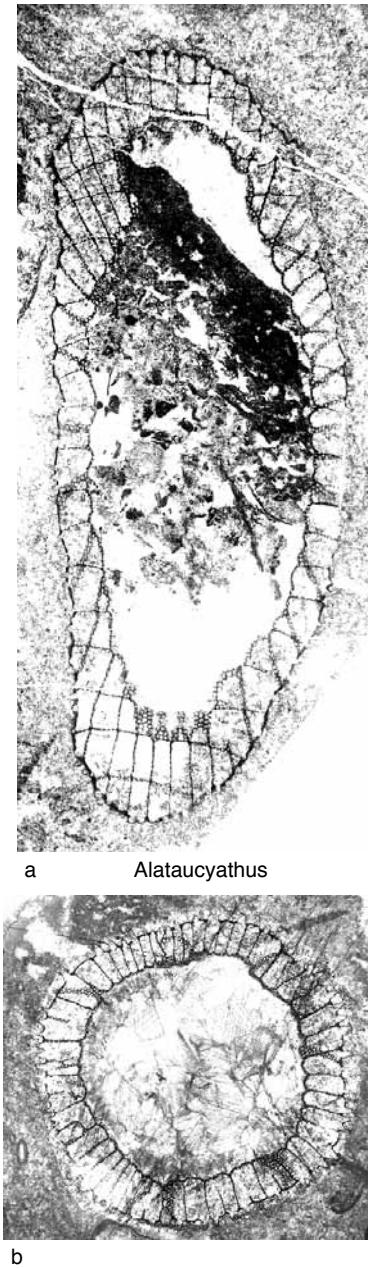


Fig. 88. Alataucyathidae (p. 111).

Cup two walled, of solitary or low- to high-modular organization, with septal type of development; inner wall of centripetal type; intervallum with taeniae, pseudosepta, pseudotaenial network, dictyonal network, calicles, or syringes; segmented or independent (membrane and plate) tabulae may be present. *lower Cambrian (Tom.1–Toy.3), middle Cambrian, upper Cambrian (Furongian).*

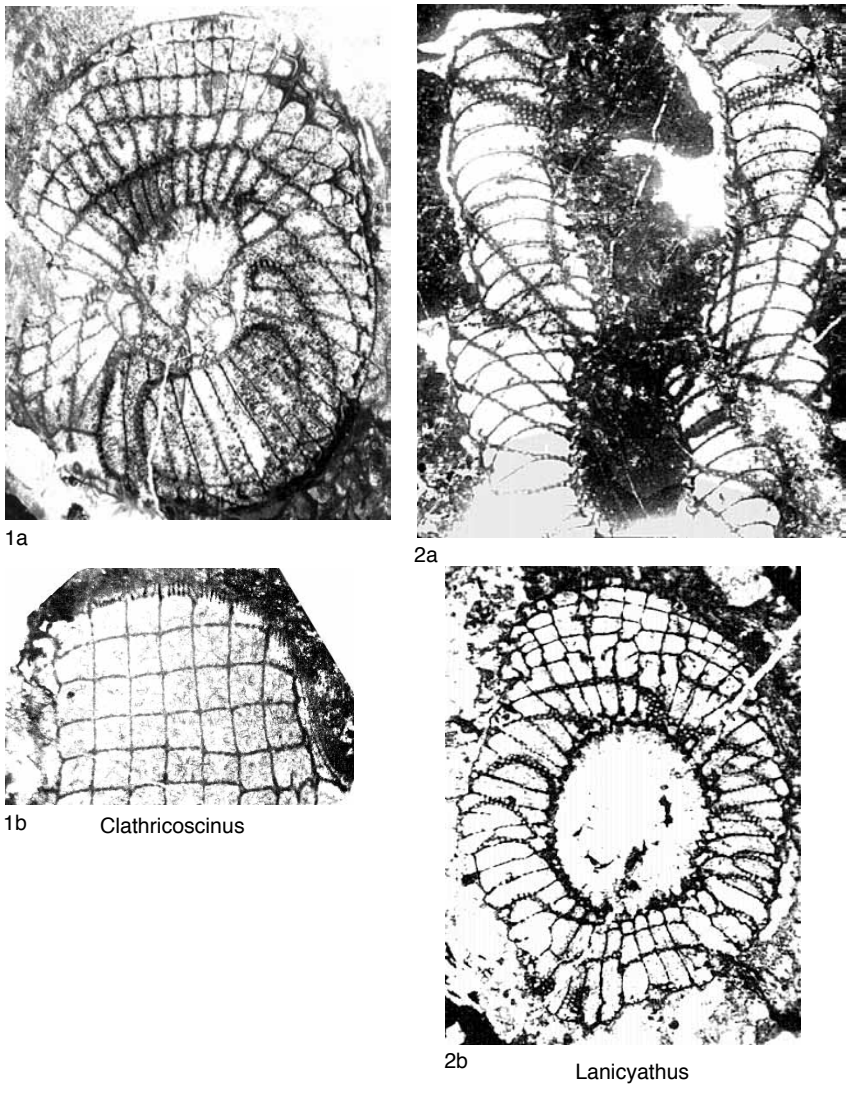


FIG. 89. Clathricoscinidae and Lanicyathidae (p. 112–113).

Suborder LOCULICYATHINA Zhuravleva, 1955

[*nom. transl.* DEBRENNE, 1991, p. 219, *ex* superorder Loculicyathina ZHURAVLEVA, 1955a, p. 9, *nom. transl.* VOLOGDIN, 1962a, p. 118, *ex* order Loculicyathida VOLOGDIN, 1961, p. 178, *nom. correct. pro* Loculocyathida ZHURAVLEVA, 1955a, p. 9, invalid name based on *nom. null.*]

Cup modular (pseudocolonies formed by interparietal budding) or rarely solitary; intervallum with pseudosepta; synapticulae and plate tabulae may be present. *lower Cambrian (Tom.1–Bot.3), upper Cambrian (Furongian).*

Superfamily LOCULICYATHOIDEA Zhuravleva, 1954

[*nom. transl. et correct.* DEBRENNE & ZHURAVLEV, 1992b, p.112, *ex* Loculocyathidae ZHURAVLEVA, 1954, p. 27, invalid name based on *nom. null.*]

Outer wall simple, with pores of cambroid type. *lower Cambrian (Tom.1–Bot.3); upper Cambrian (Furongian).*

Family LOCULICYATHIDAE Zhuravleva, 1954

[*nom. correct*. Zhuravleva, 1960b, p.107, *pro* Loculocyathidae Zhuravleva, 1954, p. 27, invalid name based on *nom. null.*] [=Robustocyathidae Debrenne, 1964, p. 113; =Paranacyathidae Debrenne, 1970a, p. 38, *nom. nud.*; =Ardrossacyathidae Gravestock, 1984, p. 109]

Inner wall with simple pores. *lower Cambrian (Tom.1–Bot.3), upper Cambrian (Furongian).*

Loculicyathus Vologdin, 1931, p. 54 (Vologdin, 1928, p. 30, *nom. nud.*) [**L. tolli*; M; lectotype, Vologdin, 1931, pl. 19,*1;* SD Debrenne, Zhuravlev, & Kruse, 2002, p. 1651, TsNIGRm 58a/2956, St. Petersburg] [=*Loculocyathus* Vologdin, 1937b, p. 468, *nom. null.*]. Inner wall with one row of simple pores per intersept; pseudosepta finely porous. *lower Cambrian (Atd.2–Bot.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Urals, Australia, Iberia, Sardinia, United States, Mexico.——Fig. 90,*1a–b*. **L. tolli*, Torgashino Formation, Atdabanian, Kameshki, East Sayan, Altay Sayan, Russia; *a,* lectotype, TsNIGRm 58a/2956, transverse section, ×8.5; *b,* paralectotype, TsNIGRm 57a/2956, longitudinal section, ×6 (Vologdin, 1931).

?Antarcticocyathus Debrenne, Rozanov, & Webers, 1984, p. 298 [**A. webersi*; OD; holotype, Debrenne, Rozanov, & Webers, 1984, fig. 5.1–5.2, 6.3, USNM 333901, specimen Ant-1, Washington, D.C.]. Outer wall pores in irregular, undulating quasitransverse (or less commonly quasilongitudinal) rows over entire wall plate; inner wall with one row of simple pores per intersept; pseudosepta coarsely porous. [Genus is otherwise typical of suborder, but bears a continuous outer wall of distinctive porosity, the appropriate taxonomic treatment of which is uncertain.] *upper Cambrian (Furongian: Paibian):* Antarctica.——Fig. 90,*2a–b*. **A. webersi*, Minaret Formation, Springer Peak, Heritage Range, Ellsworth Mountains; *a,* holotype, USNM 333901, specimen Ant-1, longitudinal section, ×4.5 (Debrenne, Rozanov, & Webers, 1984); *b,* paratype, USNM 333906, specimen Ant-2, oblique transverse section, ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Ardrossacyathus R. Bedford & J. Bedford, 1937, p. 31 [**A. endotheca*; OD; holotype, R. Bedford & J. Bedford, 1937, fig. 125, M, USNM PU86766, specimen 354, Washington, D.C.] [=*Metaldetimorpha* R. Bedford & J. Bedford, 1937, p. 31 (type, *M. yorkei*, OD), for discussion, see Zhuravlev & Gravestock, 1994, p. 31; =*Dzhagdycyathus* Belyaeva in Belyaeva & others, 1975, p. 102 (type, *D. crinitus*, OD); =*Egiinocyathus* Fonin, 1983, p. 12 (type, *E. ornatus*, OD), for discussion, see Debrenne & Zhuravlev, 1992b, p. 121; Zhuravlev & Gravestock, 1994, p. 31]. Inner wall with several rows of simple pores per intersept; pseudosepta finely porous. *lower Cambrian (Bot.1–Bot.3):* Mongolia, Far East, Australia.——Fig. 90,*3*. **A. endotheca*, Botoman, Parara Limestone, Ardrossan, South Australia, Australia, topotype, SAM P32041, tangential section of outer wall, ×7 (Zhuravlev & Gravestock, 1994).

Cambrocyathellus Zhuravleva, 1960b, p. 284 [**C. tschuranicus*; OD; holotype, Zhuravleva, 1960b, pl. 28,*3*, PIN 1161, Moscow, not located] [=*Robustocyathus* Zhuravleva, 1960b, p. 133 (type, *Archaeocyathus robustus* Vologdin, 1937a, p. 25, OD); =*Ramuscyathus* (*Ramuscyathus*) Fonin in Voronin & others, 1982, p. 101 (type, *Loculocyathus tuberculatus* Vologdin, 1940a, p. 87, OD; =*R. (R.) artus* Fonin in Voronin & others, 1982, p. 102); =*Ramuscyathus* (*Parvuscyathus*) Fonin in Voronin & others, 1982, p. 103 (type, *R. (P.) pannonicus*, OD), for discussion, see Debrenne & Zhuravlev, 1992b, p. 122]. Outer wall pores restricted to interseptal areas; inner wall with one row of simple pores per intersept; pseudosepta coarsely porous. *lower Cambrian (Tom.1–Atd.4):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Far East, Kazakhstan, Australia.——Fig. 91,*1a–b*. **C. tschuranicus*, Pestrotsvet Formation, Tommotian; *a,* Churan, Lena River, Sakha (Yakutia), Russia, holotype, PIN 1161, transverse section, ×5.5; *b,* Krestyakh, Lena River, Sakha (Yakutia), Russia, specimen PIN 1161, longitudinal section of modular skeleton (outer wall to right), ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Mikhnocyathus Maslov, 1957, p. 307 [**M. zolaensis*; OD; lectotype, Maslov, 1957, fig. 2; Debrenne & Zhuravlev, 1992b, pl. 5,*6;* SD Debrenne & Zhuravlev, 1992b, pl. 5, fig. 6 caption, PIN 2038(1), Moscow] [=*Zolacyathus* Vologdin, 1962d, p. 10 (type, *Z. loculosus*, M)]. Inner wall with several rows of simple pores per intersept; pseudosepta coarsely porous; rare plate tabulae. *lower Cambrian (Atd.2–Atd.3):* Altay Sayan, Tuva, Mongolia, Transbaikalia, ?Sardinia.——Fig. 91,*2a–b*. **M. zolaensis*, Bystraya Formation, Atdabanian, Zola Valley, Transbaikalia, Russia, lectotype, PIN 2038(1); *a,* transverse section, ×3.5; *b,* longitudinal section, ×3.5 (Maslov, 1957).

Neoloculicyathus Voronin, 1974, p. 134 [**N. primus*; OD; holotype, Voronin, 1974, pl. 6,*4;* Voronin, 1979, pl. 12,*5;* Debrenne & Zhuravlev, 1992b, pl. 1,*5*, PIN 2742/4, Moscow]. Inner wall with several rows of simple pores per intersept; pseudosepta coarsely porous. *lower Cambrian (Atd.1–Bot.1):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Urals, Australia, Morocco, Iberia, Germany.——Fig. 91,*3a–b*. **N. primus*, Bazaikha Formation, Atdabanian, Bazaikha River, East Sayan, Altay Sayan, Russia; *a,* paratype, PIN 2742/3, longitudinal section, ×6; *b,* holotype, PIN 2742/4, longitudinal section, ×4 (Voronin, 1974).

Okulitchicyathus Zhuravleva, 1960b, p. 281 [**Ajacicyathus discoformis* Zhuravleva in Zhuravleva & Zelenov, 1955, p. 68; OD; holotype, Zhuravleva & Zelenov, 1955, pl. 1,*1*, PIN 100(1), Moscow, not located] [=*Lermontovaecyathus* Korshunov, 1972, p. 59 (type, *L. isiti*, OD; =*Ajacicyathus discoformis* Zhuravleva in Zhuravleva & Zelenov, 1955, p. 68, for discussion, see Debrenne & Zhuravlev, 1992b,

1a Loculicyathus

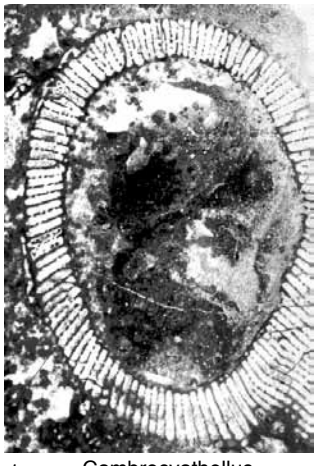
1b

3 Ardrossacyathus

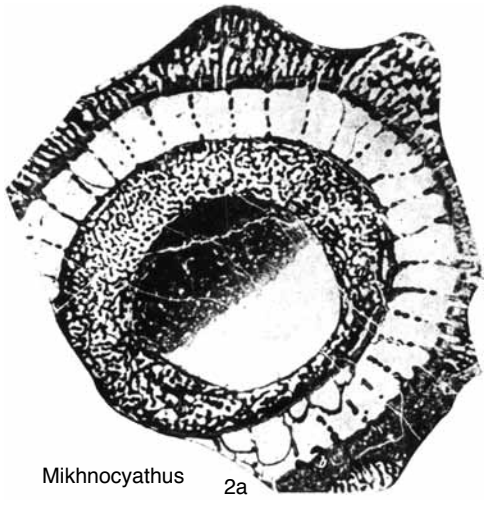
2a

2b
Antarcticocyathus

FIG. 90. Loculicyathidae (p. 115).

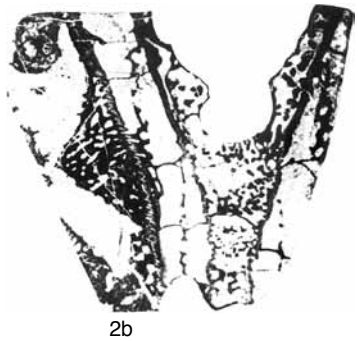


1a Cambrocyathellus

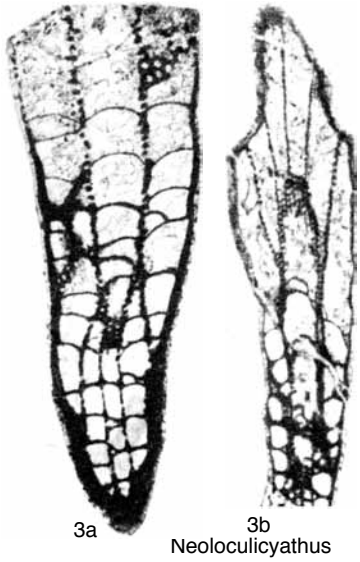


Mikhnocyathus 2a

1b



2b

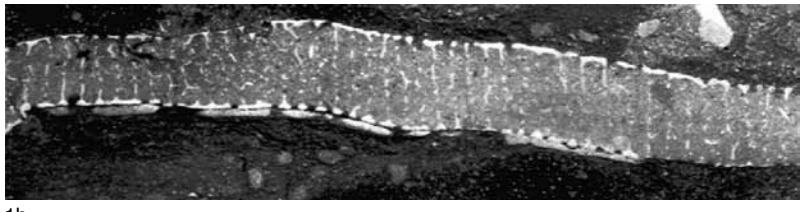


3a 3b
Neoloculicyathus

FIG. 91. Loculicyathidae (p. 115).

1a

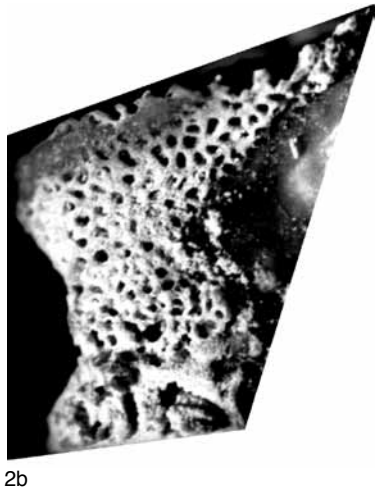
Okulitchicyathus



1b

2a

Paranacyathus



2b

FIG. 92. Loculicyathidae (p. 115–119).

p. 128); =*Alconeracyathus* PEREJÓN, 1973, p. 185 (type, *A. melendezi*, OD; =*Archaeocyathellus (Archaeofungia) andalusicus* SIMON, 1939, p. 76); =*Andalusicyathus* PEREJÓN in DEBRENNE, 1975, p. 352, *nom. nud.*; =*Andalusicyathus* PEREJÓN, 1976, p. 17 (type, *Archaeocyathellus (Archaeofungia) andalusicus* SIMON, 1939, p. 76, OD); =*Urdacyathus* PEREJÓN & MORENO, 1978, p. 201 (type, *U. pradoanus*, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 119]. Inner wall with several rows of simple pores per intersept; pseudosepta coarsely porous; plate tabulae and synapticulae may be present. *lower Cambrian (Tom.1–Atd.4):* Siberian Platform, Mongolia, Kazakhstan, ?Australia, Iberia.——FIG. 92,*1a–b*. **O. discoformis* (ZHURAVLEVA), Pestrotsvet Formation, Tommotian; *a,* Aldan River, Sakha (Yakutia), Russia, specimen PIN 1162, external view, ×0.6 (Zhuravleva, 1960b); *b,* Churan-Zhurinskiy Mys area, Lena River, Sakha (Yakutia), Russia, specimen MNHN M810058, transverse section (outer wall at top), ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Paranacyathus R. BEDFORD & J. BEDFORD, 1937, p. 34, *nom. nov. pro Paracyathus* R. BEDFORD & W. R. BEDFORD, 1936, p. 17, *non* MILNE-EDWARDS & HAIME, 1848, p. 318 (type, *P. procumbens*, SD MILNE-EDWARDS & HAIME, 1850, p. xv), cnidarian [**Paracyathus parvus* R. BEDFORD & W. R. BEDFORD,

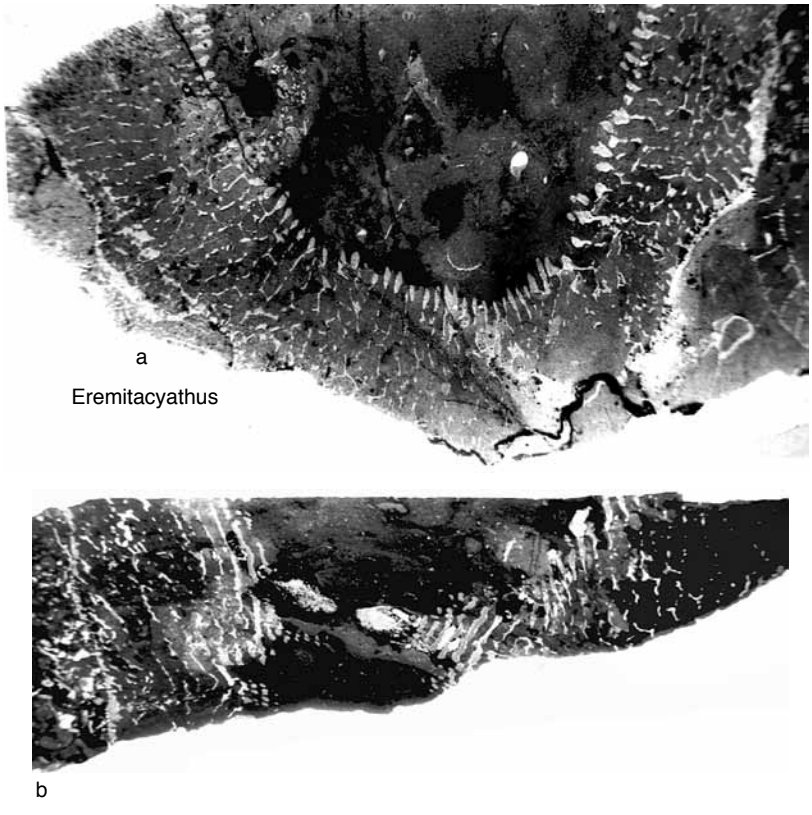


FIG. 93. Eremitacyathidae (p. 119).

1936, p. 17; OD; holotype, R. BEDFORD & W. R. BEDFORD, 1936, fig. 76; DEBRENNE, 1974c, pl. 19,*1–4;* DEBRENNE & ZHURAVLEV, 1992b, pl. 1,*6*, SAM P992-134, -135, M, Adelaide]. Inner wall with one, rarely two rows of simple pores per intersept; pseudosepta finely porous. *lower Cambrian (Bot.1–Bot.3):* ?Altay Sayan, ?Canada, Australia, Antarctica, Morocco.——FIG. 92,*2a–b*. **P. parvus* (R. BEDFORD & W. R. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, holotype, SAM P992; *a,* detail of intervallum, longitudinal view (outer wall to left), ×10 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* external longitudinal view of outer wall, ×6 (Debrenne, 1974c).

Family EREMITACYATHIDAE Debrenne, 1992

[Eremitacyathidae DEBRENNE in DEBRENNE & ZHURAVLEV, 1992b, p. 112]
[=Eremitacyathidae ZAMARREÑO & DEBRENNE, 1977, p. 55, *nom. nud.*]

Inner wall with canals. *lower Cambrian (Atd.2).*

Eremitacyathus ZAMARREÑO & DEBRENNE, 1977, p. 55 [**E. fissus*; OD; holotype, ZAMARREÑO & DEBRENNE, 1977, pl. 5*a–b;* DEBRENNE & ZHURAVLEV, 1992b, pl. 3,*4*, MNHN M84016, specimen Spe 10-1a, Paris]. Inner wall with one canal-like opening per intersept, longitudinally continuous along entire cup, bounded by longitudinal plates bearing denticulate rims and lacking transverse partitions; pseudosepta coarsely porous; synapticulae may be present. *lower Cambrian (Atd.2):* Iberia.——FIG. 93*a–b*. **E. fissus*, Pedroche Formation, Atdabanian, Las Ermitas, Cordoba, Andalusia, Spain, holotype, MNHN M84016, specimen Spe 10-1a; *a,* transverse section, ×2.5; *b,* longitudinal section, ×2.5 (Zamarreño & Debrenne, 1977).

Superfamily SAKHACYATHOIDEA Debrenne & Zhuravlev, 1990

[*nom. transl.* DEBRENNE & ZHURAVLEV, 1992b, p. 112, *ex* Sakhacyathidae DEBRENNE & ZHURAVLEV, 1990, p. 302]

Outer wall pustular. *lower Cambrian (Tom.2–Atd.2).*

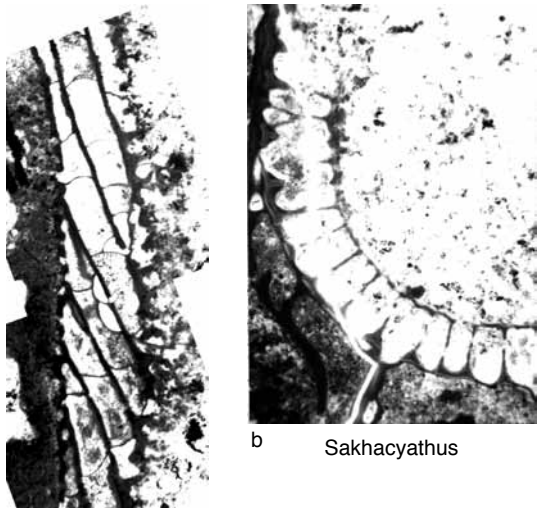


FIG. 94. Sakhacyathidae (p. 120).

Family SAKHACYATHIDAE Debrenne & Zhuravlev, 1990

[Sakhacyathidae DEBRENNE & ZHURAVLEV, 1990, p. 302]

Inner wall with simple pores. *lower Cambrian (Tom.2–Atd.2).*

Sakhacyathus DEBRENNE & ZHURAVLEV, 1990, p. 302 [**Paranacyathus subartus* ZHURAVLEVA, 1960b, p. 291; OD; holotype, ZHURAVLEVA, 1960b, pl. 28,*6,* TsSGM 205/149, Novosibirsk] [=*Orbiparanocyathus* BELYAEVA, 1996, p. 109 (type, *O. zolaensis*, OD)]. Inner wall with one, rarely two rows of simple pores per intersept; pseudosepta finely porous. *lower Cambrian (Tom.2–Atd.2):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia.——FIG. 94*a–b*. **S. subartus* (ZHURAVLEVA), Pestrotsvet Formation, Atdabanian, Mukhatta River, Sakha (Yakutia), Russia; *a,* holotype, TsSGM 205/149, longitudinal section (outer wall to left), ×7 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* transverse section, specimen PIN 4451/9, ×15 (Debrenne & Zhuravlev, 1992b; copyright Publications Scientifiques du Muséum national d'Histoire naturelle, Paris).

Superfamily CHANKACYATHOIDEA Yakovlev, 1959

[*nom. transl.* DEBRENNE & ZHURAVLEV, 1992b, p. 112, *ex* Chankacyathidae YAKOVLEV, 1959, p. 93]

Outer wall with canals. *lower Cambrian (Atd.4–Bot.3).*

Family CHANKACYATHIDAE Yakovlev, 1959

[Chankacyathidae YAKOVLEV, 1959, p. 93]

Inner wall with simple pores. *lower Cambrian (Bot.1–Bot.3).*

Chankacyathus YAKOVLEV, 1959, p. 91, fig. 1 [**C. strachovi*; OD; *nom. correct*. OKUNEVA, 1969, p. 82, *pro C. strachovii*; holotype not designated, collection not located]. Outer wall with horizontal to upwardly projecting, straight canals, bearing supplementary bracts externally (imparting overall inverted V-shaped appearance to outer wall); inner wall with one row of simple pores per intersept; pseudosepta finely porous. *lower Cambrian (Bot.1–Bot.3):* Far East, ?Australia.——FIG. 95,*1a–b*. **C. strachovi*, Dmitrievka Formation, Botoman, Kar'ernaya, Far East, Russia, specimen PGU 202 133/52; *a,* transverse section of modular skeleton, ×7; *b,* longitudinal section, ×6.5 (Okuneva, 1969).

Family TCHOJACYATHIDAE Debrenne & Zhuravlev, 1992

[Tchojacyathidae DEBRENNE & ZHURAVLEV, 1992b, p. 113]

Inner wall with canals. *lower Cambrian (Atd.4).*

Tchojacyathus ROZANOV, 1960b, p. 46 [**T. validus*; OD; holotype, ROZANOV, 1960b, pl. 1,*3* (*non* fig. 2); ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, pl. 11,*1*, PIN 4297/11, Moscow]. Outer wall with horizontal to upwardly projecting, S-shaped canals; inner wall with one row of horizontal to upwardly projecting, S-shaped canals per intersept; pseudosepta coarsely porous. *lower Cambrian (Atd.4):*

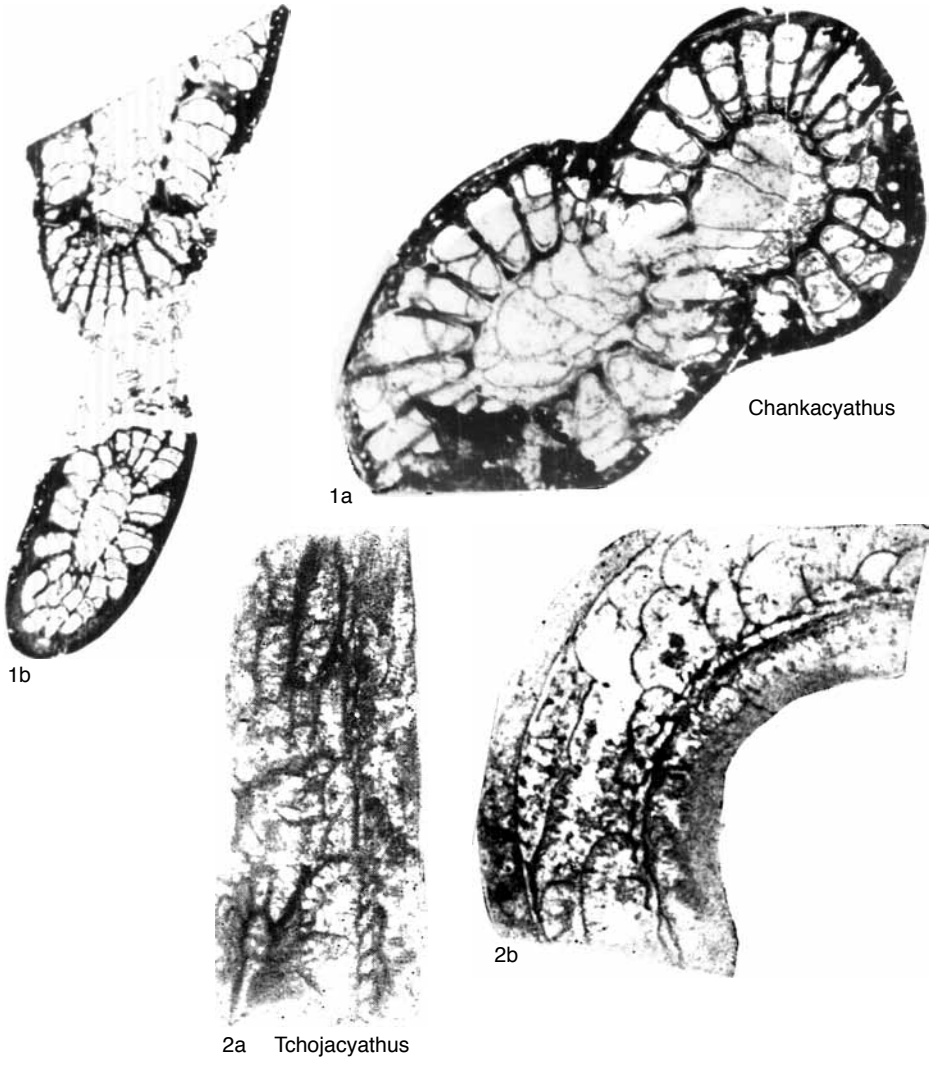


FIG. 95. Chankacyathidae and Tchojacyathidae (p. 120–121).

Altay Sayan.——FIG. 95,*2a–b*. **T. validus*, Uba Formation, Atdabanian, Tyrga River, Altay Mountains, Russia, holotype, PIN 4297/11; *a,* longitudinal section (outer wall to left), ×6; *b,* transverse section, ×6 (Rozanov, 1960b).

Suborder ANTHOMORPHINA Okulitch, 1935

[*nom. transl.* DEBRENNE, 1991, p. 219, *ex* Anthomorphida OKULITCH, 1955a, p. 18, *nom. correct. pro* order Anthomorphina OKULITCH, 1935, p. 90] [=subclass Anthocyatha OKULITCH, 1943, p. 46; =Araneocyathida VOLOGDIN, 1961, p. 182]

Cup solitary or modular (pseudocolonies formed by external budding); intervallum with pseudosepta and membrane tabulae. *lower Cambrian (Bot.1).*

Superfamily ANTHOMORPHOIDEA Okulitch, 1935

[*nom. transl.* DEBRENNE & ZHURAVLEV, 1992b, p. 113, *ex* Anthomorphidae OKULITCH, 1935, p. 97]

Outer wall simple, with pores of anthoid type; microporous membranes of similar structure to tabulae may be present. *lower Cambrian (Bot.1).*

Family ANTHOMORPHIDAE Okulitch, 1935

[Anthomorphidae Okulitch, 1935, p. 97] [=Anthomorphinae Okulitch, 1935, *nom. transl.* Fonin, 1985, p. 121, *ex* Anthomorphidae Okulitch, 1935, p. 97; =Araneocyathidae Vologdin, 1956, p. 878; =Serligocyathidae Vologdin, 1959a, p. 670; =Rudicyathinae Fonin in Zhuravlev, Zhuravleva, & Fonin, 1983, p. 26; =Vertocyathinae Fonin, 1985, p. 110]

Inner wall with simple pores. *lower Cambrian (Bot.1).*

Anthomorpha Bornemann, 1884, p. 705 [**A. margarita*; M; lectotype, Bornemann, 1886, pl. 28,*1a,4–6;* Debrenne, 1964, pl. 45,*1;* SD Debrenne, 1964, p. 233, GML 897a, Halle]. Inner wall with one row of simple pores per intersept; pseudosepta aporose even in early ontogenetic stages; membrane tabulae may be present. *lower Cambrian (Bot.1):* Tuva, ?Far East, Morocco, Iberia, France, Sardinia.——Fig. 96,*1a–b*. **A. margarita*, Matoppa Formation, Botoman; *a,* Cuccuru Contu, Sardinia, Italy, lectotype, GML 897a, transverse section, ×4 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* Gonnesa, Sardinia, Italy, paralectotype, MNHN M84133, specimen C GON 3-7, longitudinal section, ×3 (Debrenne, 1964).

Tollicyathus Chernysheva, 1960, p. 77 [**T. ishensis*; OD; holotype, Chernysheva, 1960, pl. 4,*1*, ZSGGU 503/1, Novokuznetsk] [=*Nellicyathus* Fonin in Repina & others, 1964, p. 247 (type, *N. nelliae*, OD); =*Rudicyathus* Fonin in Zhuravlev, Zhuravleva, & Fonin, 1983, p. 26 (type, *R. tersus*, OD); =*Vertocyathus* Fonin, 1985, p. 110 (type, *V. reduncus*, OD), for discussion, see Debrenne & Zhuravlev, 1992b, p. 67]. Inner wall with one row of simple pores per intersept; pseudosepta with pores restricted to outer wall area, but coarsely porous in early ontogenetic stages; membrane tabulae may be present. *lower Cambrian (Bot.1):* Altay Sayan, Tuva, Mongolia.——Fig. 96,*2a–b*. **T. ishensis*, Verkhneynyrga Formation, Botoman, Bol'shaya Isha River, Altay Mountains, Altay Sayan, Russia, holotype, ZSGGU 503/1; *a,* longitudinal section, ×5; *b,* transverse section, ×5 (Chernysheva, 1960).

Family SHIVELIGOCYATHIDAE Fonin, 1983

[*nom. transl.* Debrenne & Zhuravlev, 1992b, p. 113, *ex* Shiveligocyathinae Fonin, 1983, p. 12]

Inner wall with canals. *lower Cambrian (Bot.1).*

Shiveligocyathus Missarzhevskiy, 1961, p. 19 [**S. vesiculoides*; OD; holotype, Missarzhevskiy, 1961, pl. 1,*1*, PIN 1914/75M/44, Moscow, not located] [=*Voznesenskicyathus* Rodionova in Zhuravleva & others, 1967, p. 99 (type, *V. florens*, OD), for discussion, see Debrenne & Zhuravlev, 1992b, p. 130]. Inner wall with several rows of horizontal to upwardly projecting, straight communicating canals per intersept; pseudosepta finely porous; membrane tabulae may be present. *lower Cambrian (Bot.1):* Altay Sayan, Tuva, Mongolia.——Fig. 97*a–b*. **S. vesiculoides*, Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Tuva, Russia, paratype, PIN 1914/75M/00; *a,* longitudinal section, ×2 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* oblique transverse section, ×2 (Missarzhevskiy, 1961).

Suborder ARCHAEOCYATHINA Okulitch, 1935

[*nom. transl.* Zhuravleva, 1960b, p. 271, *ex* Archaeocyathida Zhuravleva, 1955a, p. 17, *nom. correct. pro* order Archaeocyathina Okulitch, 1935, p. 90] [=Archaeosyconina Zhuravleva, 1955a, p. 12, *nom. transl.* Zhuravleva, 1960b, p. 303, *ex* order Archaeosyconida Zhuravleva, 1955a, p. 12, *nom. correct.* Debrenne, 1964, p. 117, *pro* Archaeosyconiina Zhuravleva, 1960b, p. 303; =Dictyocyathina Vologdin, 1956, p. 878, *nom. transl.* Fonin in Voronin & others, 1982, p. 83, *ex* Dictyocyathida Vologdin, 1956, p. 878; =Chouberticyathina Debrenne, 1970a, p. 25, *nom. transl.* Fonin in Voronin & others, 1982, p. 83, *ex* Chouberticyathida Debrenne, 1970a, p. 25]

Cup solitary or modular (latter by external budding and/or longitudinal subdivision; encrusting forms develop by addition of new central cavities); intervallum with taeniae, pseudosepta, or pseudotaenial or dictyonal network; segmented tabulae may be present. *lower Cambrian (Tom.2–Toy.3), middle Cambrian*.

Superfamily DICTYOCYATHOIDEA Taylor, 1910

[*nom. transl.* Wood, Evans, & Zhuravlev, 1992, p. 492, *ex* Dictyocyathidae Taylor, 1910, p. 111]

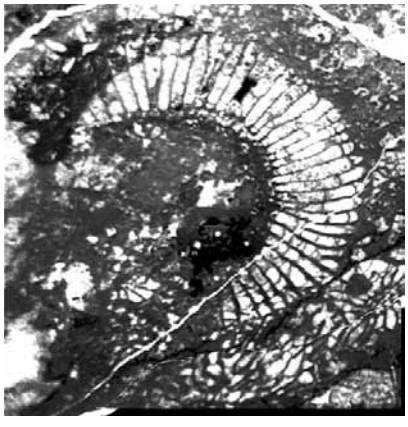
Outer wall simple, either rudimentary (of marginal intervallar elements only) or basic (of marginal intervallar elements with additional linking lintels); segmented tabulae may be present. *lower Cambrian (Tom.2–Toy.1), middle Cambrian*.

Family DICTYOCYATHIDAE Taylor, 1910

[Dictyocyathidae Taylor, 1910, p. 111] [=subfamily Dictyocyathinea Hernández-Sampelayo, 1933, p. 159; =Prismocyathidae Fonin, 1960, p. 725; =Paracoscinidae Debrenne, 1970a, p. 38, *nom. nud.*; =Paracoscinidae Debrenne, 1974a, p. 252; =Chouberticyathidae Debrenne, 1974a, p. 192; =Graphoscyphiidae Debrenne, 1974a, p. 204, *nom. correct.* Kruse, 1982, p. 196, *pro* Graphoscyphidae Debrenne, 1974a, p. 204]

Inner wall with simple pores. *lower Cambrian (Tom.2–Toy.1), middle Cambrian.*

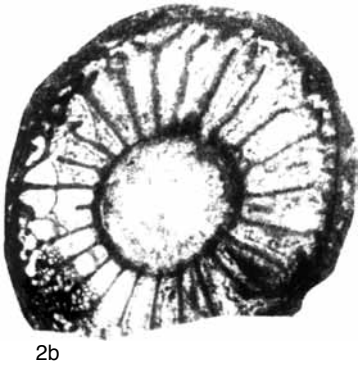
Dictyocyathus Bornemann, 1891a, p. 500 [**D. tenerrimus*; M; lectotype, Bornemann, 1891a, pl. 42,*5;* pl. 43,*4–6;* SD Debrenne, 1964, p. 200, not



1a Anthomorpha

2a Tollicyathus

1b



2b

FIG. 96. Anthomorphidae (p. 122).

located; =*Coscinocyathus verticillus* BORNEMANN, 1886, p. 65; lectotype, BORNEMANN, 1886, pl. 15,*3g;* DEBRENNE, 1964, pl. 34,*5;* SD DEBRENNE, 1964, p. 205, GML 899c, Halle] [=*Prismocyathus* FONIN, 1960, p. 725 (type, *P. praesignis*, OD); =*Spongiosicyathus* ZHURAVLEVA in DATSENKO & others, 1968, p. 174 (type, *Dictyocyathus translucidus* ZHURAVLEVA, 1960b, p. 275, OD); =*Prismocyathellus* FONIN, 1990, p. 152 (type, *Prismocyathus verisimilis* FONIN, 1960, p. 726, OD; =*Prismocyathus praesignis* FONIN, 1960, p. 725)]. Outer wall basic; inner wall with one row of simple pores per intersept; dictyonal network. *lower Cambrian (Tom.2–Bot.1), middle Cambrian (Guzhangian):* Siberian Platform, Kolyma, Altay Sayan, Tuva, Mongolia, Far East, Kazakhstan, Morocco, Iberia, Sardinia, Germany, *Tom.2–Bot.1;* Antarctica, *Guzhangian.*——FIG. 98,*1a–b.* **D. verticillus* (BORNEMANN), Matoppa Formation, Botoman, Cuccuru Contu, Sardinia, Italy; *a,* topotype,

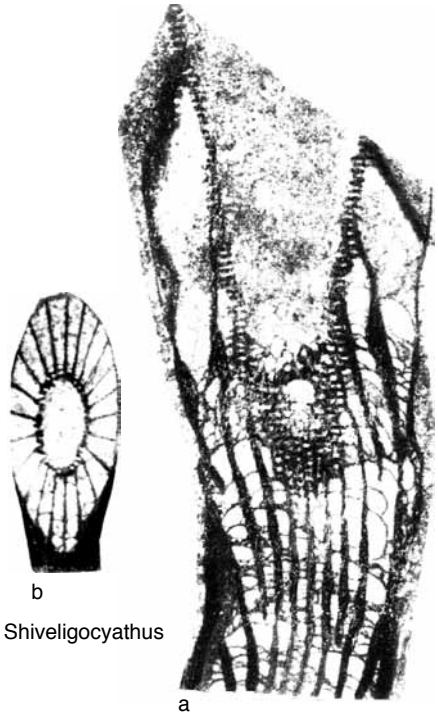


FIG. 97. Shiveligocyathidae (p. 122).

MNHN M84248, specimen CCC 9-1a, oblique longitudinal section, ×6 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* lectotype, GML 899c, transverse section, ×6 (Debrenne, 1964).

Cellicyathus DEBRENNE & ZHURAVLEV, 1990, p. 300 [**Maturocyathus ornatus* FONIN, 1985, p. 118; OD; holotype, FONIN, 1985, pl. 22,*2*, PIN 1915/280, Moscow]. Outer wall basic, tabular; inner wall tabular, with one row of simple pores per intersept; taeniae coarsely porous; synapticulae and simply porous segmented tabulae may be present. *lower Cambrian (Bot.2–Toy.1):* Siberian Platform, Altay Sayan, Tuva.——FIG. 98,*2a–b*. **C. ornatus* (FONIN), Shangan Formation, Botoman, Ulug-Shangan River, East Tannu-Ola Range, Tuva, Russia; *a,* holotype, PIN 1915/280, transverse section, ×5; *b,* paratype, PIN 1915/300, longitudinal section (outer wall to right), ×3.5 (Fonin, 1985).

Chouberticyathus DEBRENNE, 1964, p. 208 [**C. clatratus*; OD; holotype, DEBRENNE, 1964, pl. 32,*1–3*, MNHN M80272, specimen Ki 140 P-6, Paris]. Outer wall imperforate (possibly rudimentary); inner wall with one row of simple pores per intersept; taeniae coarsely porous. *lower Cambrian (Bot.1):* South China, Morocco, Iberia, Sardinia.——FIG. 98,*3a–b*. **C. clatratus*, Issafen Formation, Botoman, Tizi Oumeslema, Morocco, holotype, MNHN M80272, specimen Ki 140 P-6; *a,* transverse view, ×6; *b,* longitudinal view, ×6 (Debrenne & Zhuravlev, 1992b; copyright Publications Scientifiques du Muséum national d'Histoire naturelle, Paris).

Graphoscyphia DEBRENNE in ZHURAVLEVA, 1974a, p. 164 [**Protopharetra graphica* R. BEDFORD & W. R. BEDFORD, 1934, p. 4; OD; lectotype, R. BEDFORD & W. R. BEDFORD, 1934, fig. 22; DEBRENNE, 1969a, pl. 12,*5;* SD DEBRENNE, 1969a, p. 346, NHM S4170, London]. Outer wall basic; inner wall with one row of simple pores per intersept; pseudosepta coarsely porous, linked by synapticulae. *lower Cambrian (Atd.4–Bot.3):* Altay Sayan, Australia, Antarctica, Mexico.——FIG. 98,*4a–b*. **G. graphica* (R. BEDFORD & W. R. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, NHM S4170; *a,* internal longitudinal view of inner wall, ×6; *b,* transverse view, ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Molybdocyathus DEBRENNE & GANGLOFF in DEBRENNE, GANDIN, & GANGLOFF, 1990, p. 92 [**M. juvenilis*; OD; holotype, DEBRENNE, GANDIN, & GANGLOFF, 1990, pl. 2,*13*, USNM 443573, specimen IR 23.7a', Washington, D.C.]. Outer wall rudimentary; inner wall with one row of simple pores per intersept; dictyonal network. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Tuva, Mongolia, United States.——FIG. 99,*1a–b*. **M. juvenilis*, Valmy Formation, Botoman, Iron Canyon, Nevada, United States; *a,* holotype, USNM 443573, specimen IR 23.7a', transverse and and longitudinal sections of modular skeleton, ×8; *b,* paratype, USNM 443568, specimen IR 14.2, and longitudinal section of modular skeleton, ×8 (Debrenne, Gandin, & Gangloff, 1990).

Paracoscinus R. BEDFORD & W. R. BEDFORD, 1936, p. 18 [**P. mirabile*; OD; holotype, R. BEDFORD & W. R. BEDFORD, 1936, fig. 85; DEBRENNE, 1974a, fig. 37a–b, SAM P988-169, -170, -171, Adelaide]. Outer wall basic, tabular; inner wall with one row of simple pores per intersept, each pore subdivided by median longitudinal rod; pseudosepta finely porous; segmented tabulae. *lower Cambrian (Bot.3–Toy.1):* Altay Sayan, Australia.——FIG. 99,*2a–d*. **P. mirabile*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia; *a,* holotype, SAM P988-169, -170, -171, transverse view, ×6 (Debrenne & Zhuravlev, 1992b; copyright Publications Scientifiques du Muséum national d'Histoire naturelle, Paris); *b,* paratype, USNM PU86680, specimen 241A, external view of outer wall, ×6 (Debrenne, Zhuravlev, & Kruse, 2002); *c–d,* holotype, SAM P988-169, -170, -171; *c,* longitudinal view, ×4; *d,* internal view of inner wall, ×7 (Debrenne, 1974a).

?Retilamina DEBRENNE & JAMES, 1981, p. 370 [**R. amourensis*; OD; holotype, DEBRENNE & JAMES, 1981, pl. 54,*4*, GSC 62128, specimen 169-5acT1, Ottawa]. Encrusting, domelike cup;

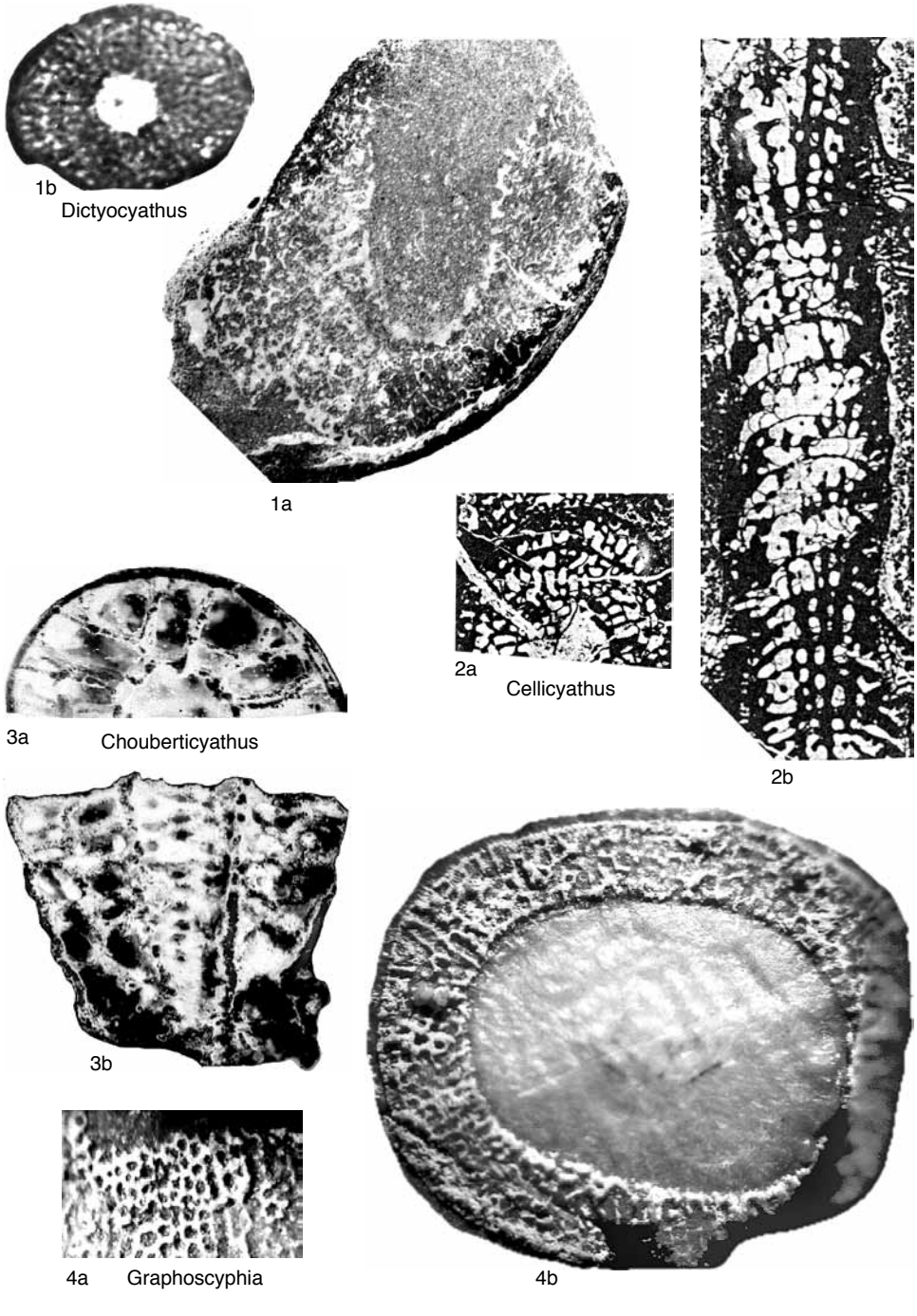
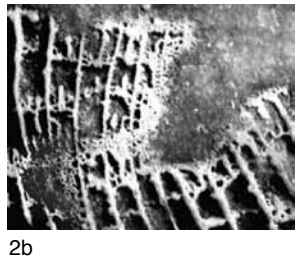


FIG. 98. Dictyocyathidae (p. 122–124).

1a Molybdocyathus

1b



2b

2c

2a

2d Paracoscinus

Fig. 99. Dictyocyathidae (p. 124).

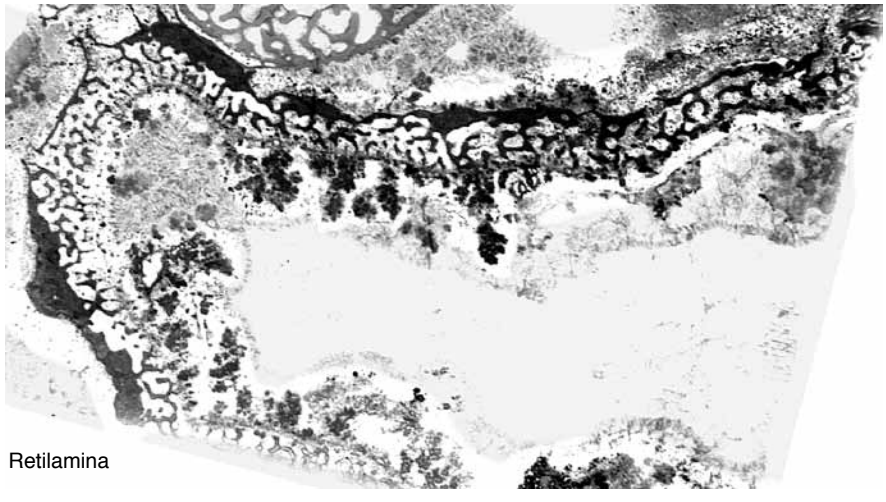


FIG. 100. Dictyocyathidae (p. 124–127).

upper wall (interpreted as outer) with pores regularly arranged but not at each intertaenia; pores commonly produced as chimneys; lower (possibly inner) wall rudimentary; dictyonal or more probably pseudotaenial network. [Atypical cup shape does not provide certainty as to which wall is outer and which inner, and nature of intervallar elements and accepted inner wall remain doubtful.] *lower Cambrian (Bot.2):* Canada, United States, Mexico.——FIG. 100. **R. amourensis*, Forteau Formation, Botoman, Mount St. Margaret, Newfoundland, Canada, holotype, GSC 62128, specimen 169-5acT1, oblique section, ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Family CLARUSCOSCINIDAE Debrenne & Zhuravlev, 1992

[Claruscoscinidae DEBRENNE & ZHURAVLEV, 1992b, p. 114] [=Claruscoscinidae DEBRENNE in DEBRENNE, GANDIN, & ROWLAND, 1989, p. 167, *nom. nud.*]

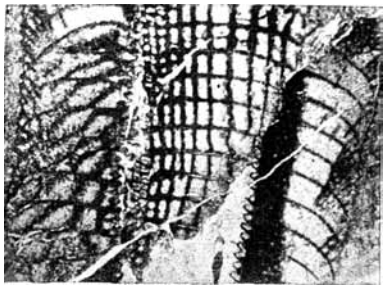
Inner wall with bracts, fused bracts, or pore tubes. *lower Cambrian (Bot.1–Toy.1).*

Claruscoscinus HANDFIELD, 1971, p. 74 [**Eucyathus billingsi* VOLOGDIN, 1940b, p. 48; OD; holotype not designated, collection not located] [=*Monstricyathus* VOLOGDIN, 1977, p. 60 (type, *M. tubiformis*, OD); =*Arisacyathus* KASHINA in OSADCHAYA & others, 1979, p. 166 (type, *A. diligens*, OD; =*Eucyathus billingsi* VOLOGDIN, 1940b, p. 48); =*Maturocyathus* FONIN, 1985, p. 114 (type, *M. makarovi*, OD; =*Eucyathus billingsi* VOLOGDIN, 1940b, p. 48); =*Costocyathus* FONIN, 1985, p. 119 (type, *C. mactus*, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 123]. Outer wall basic, tabular; inner wall with one row of pores per intersept, bearing upwardly projecting, straight to S-shaped pore tubes; pseudosepta finely porous; segmented tabulae. *lower Cambrian (Bot.1–Toy.1):* Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Canada, United States.——FIG. 101,*1a–c*. **C. billingsi* (VOLOGDIN), Verkhnemonok Formation, Botoman, Berezovaya River, Abakan River, West Sayan, Altay Sayan, Russia; *a,* unlocated syntype, longitudinal section, ×4 (Vologdin, 1940b); *b,* transverse section, syntype PIN 4754/6, ×5 (Debrenne, Zhuravlev, & Kruse, 2002); *c,* unlocated syntype, longitudinal section, ×4 (Vologdin, 1940b).

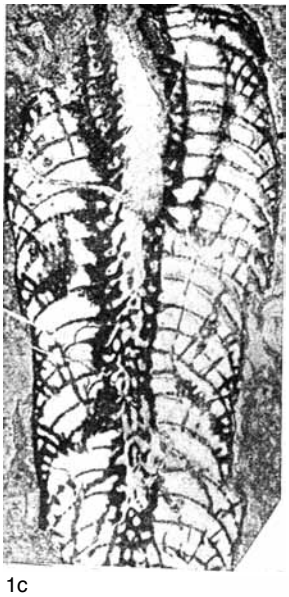
Fenestrocyathus HANDFIELD, 1971, p. 72 [**F. complexus*; OD; holotype, HANDFIELD, 1971, pl. 14,*5;* pl. 15,*1*, GSC 25388, Ottawa]. Outer wall basic; inner wall with one row of pores per intersept, bearing upwardly projecting, S-shaped bracts or fused bracts; dictyonal network. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Mongolia, Canada, United States.——FIG. 101,*2*. **F. complexus*, Sekwi Formation, Botoman, Mackenzie Mountains, Northwest Territories, Canada, holotype, GSC 25388, transverse section of modular skeleton, ×5 (Debrenne, Zhuravlev, & Kruse, 2002).

Landercyathus DEBRENNE & GANGLOFF in DEBRENNE, GANDIN, & GANGLOFF, 1990, p. 91 [**L. lewandowskii*; OD; holotype, DEBRENNE, GANDIN, & GANGLOFF, 1990, pl. 1,*13*, USNM 443571, specimen IR 23a, Washington, D.C.]. Outer wall simple; inner wall with one row of horizontal to upwardly projecting, straight to waved canals per intersept; canals may penetrate intervallum forming astrorhizae; dictyonal network. *lower Cambrian (Bot.2):* United States.——FIG. 101,*3*. **L. lewandowskii*, Valmy Formation, Botoman, Iron Canyon, Nevada, United States, holotype, USNM 443571, specimen IR 23a, oblique longitudinal section, ×4 (Debrenne, Gandin, & Gangloff, 1990).

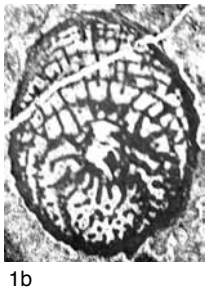
Stevocyathus DEBRENNE in DEBRENNE, GANDIN, & ROWLAND, 1989, p. 166 [**S. elictus*; OD; holotype,



1a



1c



1b

Claruscoscinus

3

Landercyathus

2

Fenestrocyathus

4a

Stevocyathus

4b

FIG. 101. Claruscoscinidae (p. 127–129).

DEBRENNE, GANDIN, & ROWLAND, 1989, pl. 12,*1*, MNHN M83100, specimen CR2-8, Paris]. Outer wall basic; inner wall with one row of pores per intersept, bearing upwardly projecting, S-shaped bracts or fused bracts; taeniae coarsely porous, linked by synapticulae; simple segmented tabulae may be present. *lower Cambrian (Bot.2):* United States, Mexico.——FIG. 101,*4a–b*. **S. elictus*, Puerto Blanco Formation, Botoman, Caborca, Sonora, Mexico; *a,* paratype, MNHN M83107, specimen CR2*1-8, transverse section, ×6 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* holotype, MNHN M83100, specimen CR2-8, oblique longitudinal section, ×6 (Debrenne, Gandin, & Rowland, 1989).

Family PYCNOIDOCOSCINIDAE Debrenne, 1974

[Pycnoidocoscinidae DEBRENNE, 1974a, p. 256] [=Pycnoidocoscinidae DEBRENNE, 1970a, p. 40, *nom. nud.*]

Inner wall compound. *lower Cambrian (Bot.3).*

Pycnoidocoscinus R. BEDFORD & W. R. BEDFORD, 1936, p. 19 [**P. pycnoideum*; OD; lectotype, R. BEDFORD & W. R. BEDFORD, 1936, fig. 87; SD DEBRENNE, 1970a, p. 40, SAM P990-175, -176, -177, Adelaide]. Outer wall basic; inner wall compound consisting of wall carcass and additional microporous sheath formed by tabulae; pseudosepta finely porous; segmented tabulae. *lower Cambrian (Bot.3):* Australia, ?Canada.——FIG. 102*a–b*. **P. pycnoideum*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM P990-175, -176, -177; *a,* transverse view (outer wall at top), ×4; *b,* tangential view of inner wall, ×6 (Debrenne, Zhuravlev, & Kruse, 2002).

Superfamily ARCHAEOCYATHOIDEA Hinde, 1889

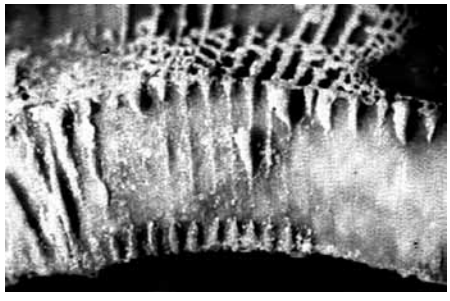
[*nom. correct*. ZHURAVLEV in VORONOVA & others, 1987, p. 32, *pro* Archaeocyathacea SIMON, 1939, p. 6, *nom. transl. ex* Archaeocyathidae TAYLOR, 1910, p. 105, *nom. correct*. *pro* family Archaeocyathinae HINDE, 1889, p. 141] [=Flindersicyathoidea R. BEDFORD & J. BEDFORD, 1939, p. 78, *nom. correct*. DEBRENNE & KRUSE, 1986, p. 268, *pro* Flindersicyathacea GRAVESTOCK, 1984, p. 115, *nom. transl. ex* Flindersicyathidae R. BEDFORD & J. BEDFORD, 1939, p. 78; =Vadimocyathacea KASHINA in OSADCHAYA & others, 1979, p. 160]

Outer wall concentrically porous. *lower Cambrian (Atd.1–Toy.3).*

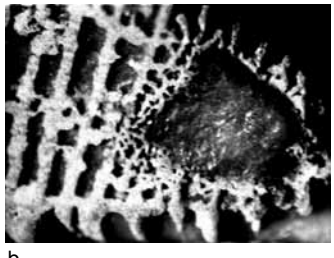
Family ARCHAEOPHARETRIDAE R. Bedford & W. R. Bedford, 1936

[Archaeopharetridae R. BEDFORD & W. R. BEDFORD, 1936, p. 17] [=Dictyocoscinidae R. BEDFORD & W. R. BEDFORD, 1936, p. 14, for discussion, see ZHURAVLEV & GRAVESTOCK, 1994, p. 34; =Protopharetridae VOLOGDIN, 1957a, p. 182; =Flindersicoscinidae DEBRENNE, 1974a, p. 246; =Salanycyathidae FONIN in VORONIN & others, 1982, p. 95; =Hawkercyathidae GRAVESTOCK, 1984, p. 115]

Inner wall with simple pores. *lower Cambrian (Atd.1–Bot.3).*



a



b Pycnoidocoscinus

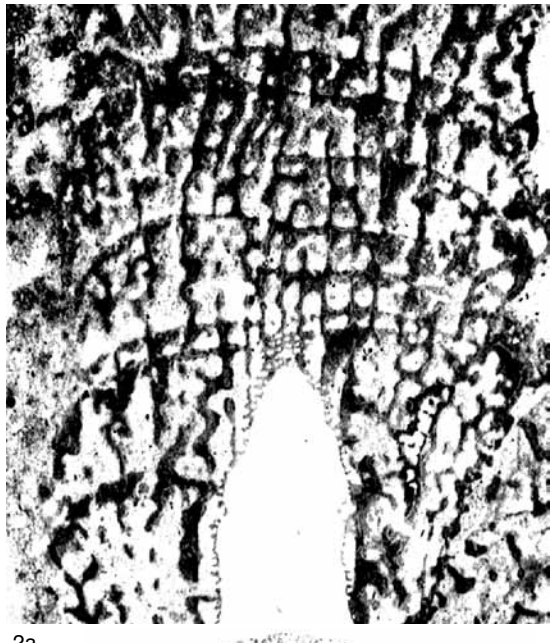
FIG. 102. Pycnoidocoscinidae (p. 129).

Archaeopharetra R. BEDFORD & W. R. BEDFORD, 1936, p. 17 [**A. typica*; OD; holotype, R. BEDFORD & W. R. BEDFORD, 1936, fig. 75; ZHURAVLEVA, 1963b, fig. 67a; DEBRENNE, 1974a, fig. 3b; SD HILL, 1965, p. 115, SAM P969, Adelaide; =*Dictyocyathus irregularis* TAYLOR, 1910, p. 145; lectotype, TAYLOR, 1910, pl. 12, photo 66; SD DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1665, SAM T1590, Adelaide] [=*Dictyocoscinus* R. BEDFORD & W. R. BEDFORD, 1936, p. 14 (type, *D. beltana*, OD; =*Dictyocyathus irregularis* TAYLOR, 1910, p. 145, for discussion, see ZHURAVLEV & GRAVESTOCK, 1994, p. 34); =*Tubocyathus* VOLOGDIN, 1937b, p. 473 (type, *T. smolianinovae*, M); =*Tubicyathus* VOLOGDIN, 1940a, p. 114, *nom. null.*; =*Tubulocyathus* VOLOGDIN, 1956, p. 880, *nom. null.*; =*Flindersicoscinus* DEBRENNE, 1970a, p. 34 (type, *Flindersicyathus tabulatus* R. BEDFORD & J. BEDFORD, 1937, p. 29, OD); =*Salanycyathus* FONIN in VORONIN & others, 1982, p. 95 (type, *S. marginatus*, OD); =*Hawkercyathus* GRAVESTOCK, 1984, p. 115 (type, *H. insculptus*, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 120]. Inner wall with one row of simple pores per intersept; pseudotaeniae coarsely porous; concentrically porous segmented tabulae may be present. *lower Cambrian (Atd.1–Bot.3):* Altay Sayan, Tuva, Mongolia, Far East, Australia, Antarctica, South Africa (allochthonous), South China, ?Iberia.——FIG. 103,*1a–b*. **A. irregularis* (TAYLOR), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia; *a,* lectotype,

1a

1b

Archaeopharetra



2a

2b

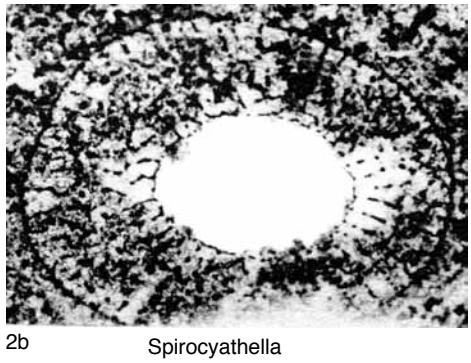
Markocyathus

FIG. 103. Archaeopharetridae (p. 129–133).

1 Dictyosycon

2a

2c



2b Spirocyathella

FIG. 104. Archaeopharetridae (p. 132–133).

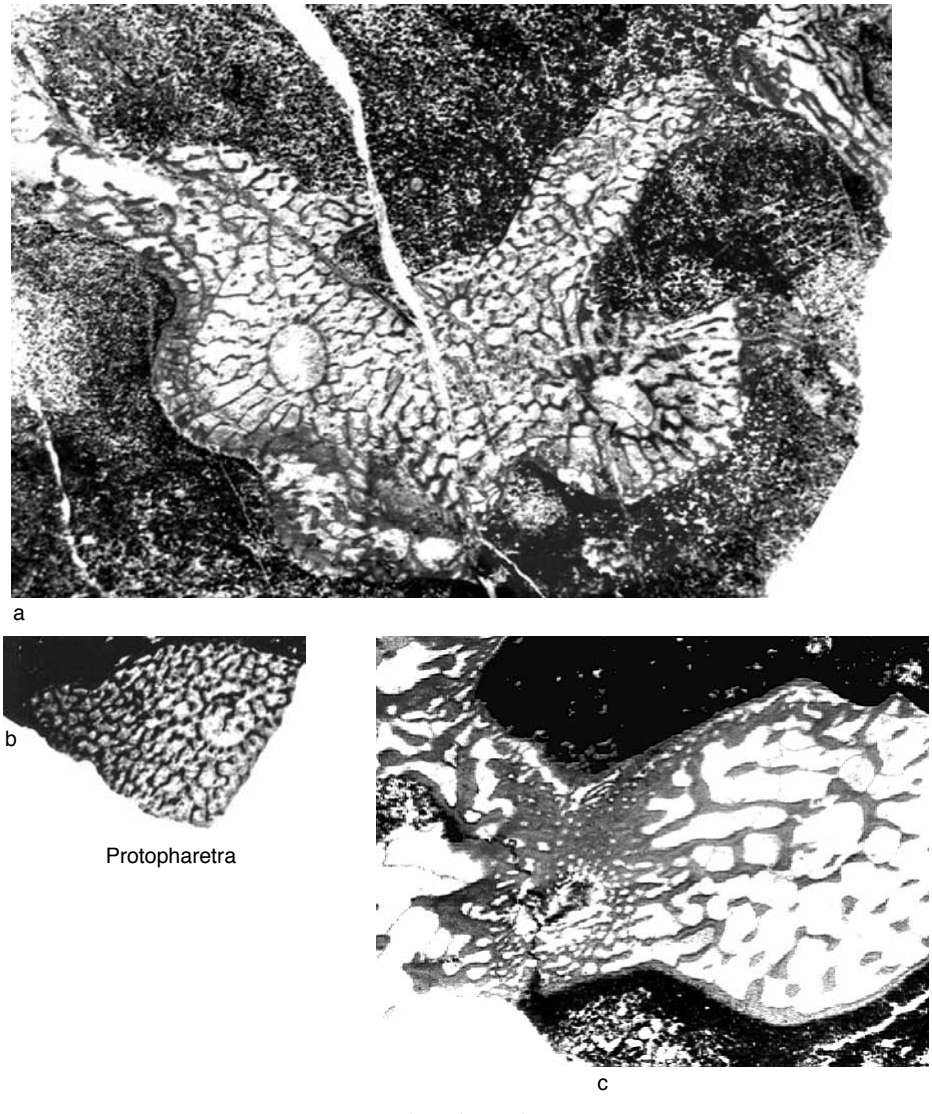


FIG. 105. Archaeopharetridae (p. 133).

SAM T1590, oblique longitudinal view, ×5 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* holotype [=*A. typica* R. BEDFORD & W. R. BEDFORD], SAM P969, longitudinal view, ×8 (Debrenne, 1974a).

Dictyosycon ZHURAVLEVA, 1960b, p. 307, *nom. transl.* DEBRENNE & ZHURAVLEV, 1992b, p. 124, *ex Sphinctocyathus (Dictyosycon)* ZHURAVLEVA, 1960b, p. 307 [**Sphinctocyathus (Dictyosycon) gravis*; OD; holotype, ZHURAVLEVA, 1960b, pl. 31,*7*, TsSGM 205/169, Novosibirsk]. Inner wall with one row of simple pores per intersept; dictyonal network; simple or concentrically porous segmented tabulae may be present. *lower Cambrian (Atd.1–Atd.4):* Siberian Platform, Altay Sayan, Tuva, Iberia.——FIG. 104,1. **D. gravis*, Pestrotsvet Formation, Atdabanian, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 205/169, oblique longitudinal section, ×4 (Zhuravleva, 1960b).

Markocyathus DEBRENNE in DEBRENNE, GANDIN, & ROWLAND, 1989, p. 165 [**M. clementensis*; OD; holotype, DEBRENNE, GANDIN, & ROWLAND, 1989, pl. 11,*1–2*, MNHN M83096, specimen

CL-1e, Paris]. Inner wall with several rows of simple pores per intersept; taeniae coarsely porous; concentrically porous segmented tabulae. *lower Cambrian (Bot.2):* Canada, Mexico.——FIG. 103,*2a–b*. **M. clementensis*, Puerto Blanco Formation, Botoman, Caborca, Sonora, Mexico, holotype, MNHN M83096, specimen CL-1e; *a,* detail of inner wall in tangential section, ×12 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* transverse and longitudinal sections of modular skeleton, ×3 (Debrenne, Gandin, & Rowland, 1989).

Protopharetra BORNEMANN, 1884, p. 705 (BORNEMANN, 1883, p. 274, *nom. nud.*) [**P. polymorpha* BORNEMANN, 1886, p. 46; SD SIMON, 1939, p. 34; lectotype, BORNEMANN, 1886, pl. 5, fig. 4 bottom; SD SIMON, 1939, p. 35, not located; topotypes, MNHN M84120, specimens CGR3/3, GLA3.3, GLC10.II.1b, Paris] [=*Volvacyathus* DEBRENNE, 1960, p. 118 (type, *V. proteus*, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 128]. Inner wall with one row of simple pores per intersept; taeniae coarsely porous, linked by rare synapticulae. *lower Cambrian (Atd.1–Bot.3):* Altay Sayan, Tuva, Far East, Tajikistan, Canada, United States, South China, Morocco, Iberia, France, Sardinia, Germany.——FIG. 105*a–c*. **P. polymorpha*, Matoppa Formation, Botoman, Canal Grande, Sardinia, Italy; *a,* topotype, MNHN M84120, transverse section of modular skeleton, ×3 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* lectotype, transverse section, ×3 (Bornemann, 1886); *c,* topotype, MNHN M84120, detail of outer wall in tangential section, ×7 (Debrenne, Zhuravlev, & Kruse, 2002).

Spirocyathella VOLOGDIN, 1939, p. 227 [**S. kyzlartauensis*; OD; holotype not designated, collection not located] [=*Aruntacyathus* KRUSE in WALTER, 1980, chart, *nom. nud.*; =*Amadedcyathus* KRUSE in WALTER, 1980, chart, *nom. nud.*; =*Aruntacyathus* KRUSE in KRUSE & WEST, 1980, p. 172 (type, *A. toddi*, OD); =*Spirocyathellus* FONIN in VORONIN & others, 1982, p. 98, *lapsus calami pro Spirocyathella* VOLOGDIN, 1939, p. 227, for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 131]. Inner wall with several rows of simple pores per intersept; pseudotaenial network coarsely porous; concentrically porous segmented tabulae. *lower Cambrian (Atd.4–Bot.2):* Altay Sayan, Urals, Canada, United States, Mexico, Australia, Antarctica, South Africa (allochthonous), France.——FIG. 104,*2a–c*. **S. kyzlartauensis*, Terekla Formation, Botoman, Mt. Kizlar-Tau, western flank of southern Urals, Russia; *a,* topotype, PIN 4451/26, longitudinal section, ×8 (Debrenne & Zhuravlev, 1992b; copyright Publications Scientifiques du Muséum national d'Histoire naturelle, Paris); *b–c,* unlocated syntype, 4-M, thin section 4; *b,* transverse section, ×6; *c,* longitudinal section, ×6 (Vologdin, 1939).

Family ARCHAEOCYATHIDAE Hinde, 1889

[*nom. correct*. TAYLOR, 1910, p. 105, *pro* family Archaeocyathinae HINDE, 1889, p. 141] [=Spirocyathidae TAYLOR, 1910, p. 112; =Archaeocyathinae HERNÁNDEZ-SAMPELAYO, 1933, p. 158, *nom. correct*. FONIN, 1985, p. 69, *pro* Archaeocyathinea HERNÁNDEZ-SAMPELAYO, 1933, p. 158; =Sigmofungiidae R. BEDFORD & W. R. BEDFORD, 1936, p. 16, *nom. correct*. DEBRENNE, 1970a, p. 42, *pro* Sigmofungidae R. BEDFORD & W. R. BEDFORD, 1936, p. 16; =Flindersicyathidae R. BEDFORD & J. BEDFORD, 1939, p. 78; =Flindersicyathinae R. BEDFORD & J. BEDFORD, 1939, p. 78, *nom. transl.* FONIN, 1985, p. 93, *ex* Flindersicyathidae R. BEDFORD & J. BEDFORD, 1939, p. 78; =Pycnoidocyathidae OKULITCH, 1950b, p. 394; ?=Protocyclocyathidae VOLOGDIN, 1956, p. 878; ?=Protocyclocyathellidae VOLOGDIN, 1956, p. 878, *lapsus calami* DEBRENNE & JAMES, 1981, p. 366, *pro* Protocyclocyathidae VOLOGDIN, 1956, p. 878; =Syringsellidae KRASNOPEEVA, 1961, p. 248; =Archaeofungiidae VOLOGDIN, 1962c, p. 90, *nom. correct*. HILL, 1965, p. 58, *pro* Archaeofungidae VOLOGDIN, 1962c, p. 90; =Vadimocyathidae KASHINA in OSADCHAYA & others, 1979, p. 161; =Claruscyathinae FONIN in ZHURAVLEVA & FONIN, 1983, p. 49]

Inner wall with bracts, fused bracts, or pore tubes. *lower Cambrian (?Atd.4, Bot.2–Toy.3).*

Archaeocyathus BILLINGS, 1861, p. 3 [**A. atlanticus* BILLINGS, 1861, p. 5; SD WALCOTT, 1886, p. 75; holotype, BILLINGS, 1861, fig. 5; HINDE, 1889, pl. 5,*8–10;* OKULITCH, 1943, pl. 5,*1–2*, GSC 369, Ottawa] [Original spelling was *Archeocyathus* BILLINGS; subsequent authors have used the diphthong] [=*Spirocyathus* HINDE, 1889, p. 136 (type, *Archeocyathus atlanticus* BILLINGS, 1861, p. 5, M); =*Retecyathus* VOLOGDIN, 1932, p. 20, *nom. nud.*; =*Claruscyathus* VOLOGDIN, 1932, p. 25 (type, *C. cumfundus*, M); =*Eucyathus* VOLOGDIN, 1937b, p. 466, *nom. nud.*; =*Flindersicyathus* R. BEDFORD & J. BEDFORD, 1937, p. 28, *nom. nud.*; =*Flindersicyathus* R. BEDFORD & J. BEDFORD, 1939, p. 78 (type, *F. decipiens*, OD); =*Eucyathus* VOLOGDIN in SIMON, 1939, p. 29 (type, *Claruscyathus cumfundus* VOLOGDIN, 1932, p. 25, OD); =*Retecyathus* VOLOGDIN in SIMON, 1939, p. 36 (type, *R. laqueus* VOLOGDIN, 1932, p. 20, SD SIMON, 1939, p. 36, =*Claruscyathus cumfundus* VOLOGDIN, 1932, p. 25); =*Syringsella* KRASNOPEEVA, 1961, p. 248 (type, *S. ynyrgensis*, OD); =*Batenevia* KRASNOPEEVA, 1961, p. 249 (type, *B. pellisi*, OD); =*Sanxiacyathus* YUAN & ZHANG, 1977, p. 8 (type, *S. hubeiensis*, OD); =*Bijacyathus* KRASNOPEEVA, 1978, p. 81 (type, *Archaeocyathus regularis* KRASNOPEEVA in ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA, 1960, p. 135, M, =*Retecyathus kusmini* VOLOGDIN, 1932, p. 21); =*Retecyathus (Pararetecyathus)* YUAN & ZHANG, 1978, p. 139 (type, *R. (P.) curvatus,* OD); =*Vadimocyathus* KASHINA in OSADCHAYA & others, 1979, p. 161 (type, *V. chikinevae*, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 120]. Inner wall with one row of pores per intersept, bearing upwardly projecting, straight pore tubes; pseudotaenial network coarsely porous; concentrically porous segmented tabulae. *lower Cambrian (?Atd.4, Bot.2–Toy.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Uzbekistan, Canada, United States, Mexico, Australia, Antarctica, South China,

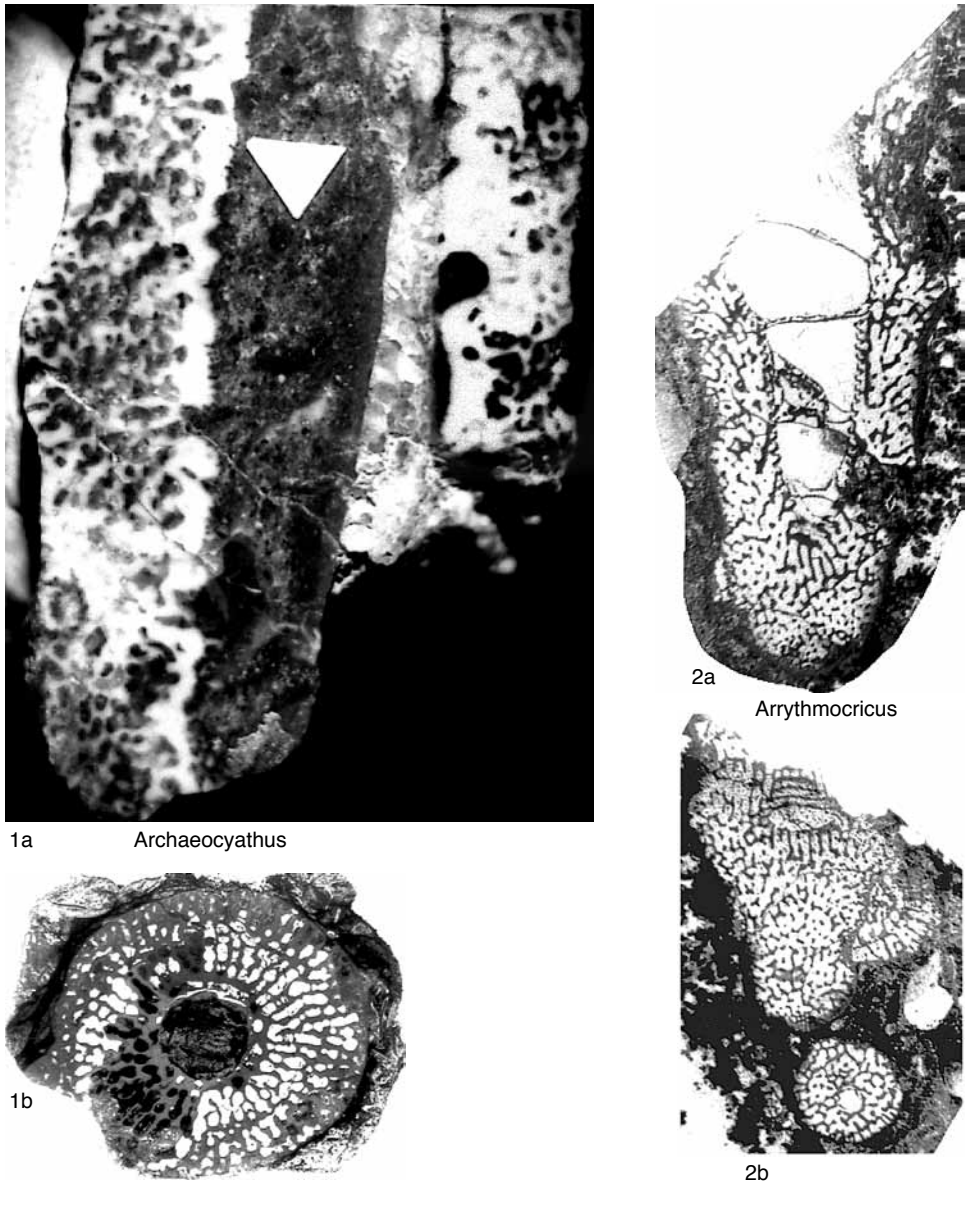


FIG. 106. Archaeocyathidae (p. 133–134).

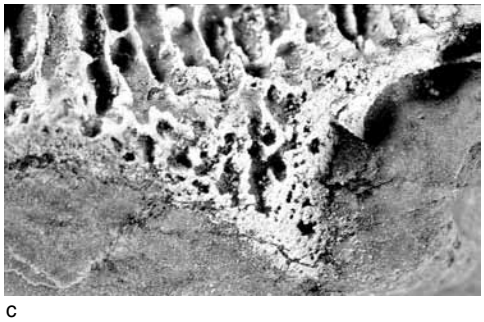
Iberia, Sardinia.——FIG. 106,*1a–b*. **A. atlanticus*, Forteau Formation, Botoman, Anse au Loup, Labrador, Canada, holotype, GSC 369; *a,* longitudinal section, ×2.5 (Okulitch, 1943); *b,* transverse section, ×3 (Debrenne, Zhuravlev, & Kruse, 2002).

Arrythmocricus DEBRENNE & JAMES, 1981, p. 366 [**A. kobluki*; OD; holotype, DEBRENNE & JAMES, 1981, pl. 53,*3–4*, GSC 62123, Ottawa]. Inner wall with one row of pores per intersept, bearing upwardly projecting, S-shaped bracts or fused bracts; pseudotaenial network coarsely porous. *lower Cambrian (Bot.1–Bot.3):* Canada, United States, Mexico.——FIG. 106,*2a–b*. **A. kobluki*, Forteau Formation, Botoman, Fox Cove, Labrador, Canada, holotype, GSC 62123; *a,* longitudinal section of modular skeleton, ×5; *b,* longitudinal section (inner wall at top), ×5 (Debrenne & James, 1981).

a

b

Pycnoidocyathus



c

FIG. 107. Archaeocyathidae (p. 135–136).

Pycnoidocyathus TAYLOR, 1910, p. 131 [**P. synapticulosus*; SD R. BEDFORD & J. BEDFORD, 1939, p. 78; lectotype, TAYLOR, 1910, pl. 12, photo 69; DEBRENNE, 1974a, fig. 13a–b; SD DEBRENNE, 1970a, p. 40, SAM T1587A,B,C, Adelaide] [=*Archaeofungia* TAYLOR, 1910, p. 131 (type, *A. ajax*, M); =*Batenevicyathus* YAROSHEVICH, 1962, p. 117, 122 (type, *B. zhuravlevae*, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 129]. Inner wall with one row of

pores per intersept, bearing upwardly projecting, straight pore tubes; taeniae coarsely porous, linked at base by synapticulae; during ontogeny, taeniae become progressively less porous, more planar and without synapticulae. *lower Cambrian (Bot.2–Toy.3):* Altay Sayan, Tuva, Mongolia, Far East, Australia, Antarctica, South China, Iberia, Sardinia, Greenland, Canada, United States, Mexico.——Fig. 107*a–c*. **P. synapticulosus*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM T1587A–C; *a,* transverse view, ×1; *b,* longitudinal view, ×1; *c,* detail of outer wall in tangential view, ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Sigmofungia R. Bedford & W. R. Bedford, 1936, p. 16 [**S. flindersi*; M; lectotype, R. Bedford & W. R. Bedford, 1936, fig. 82; Hill, 1965, pl. 6,*1–2;* Debrenne, 1974a, fig. 30a–b; SD Hill, 1965, p. 89, SAM P963-115, -116, Adelaide] [=*Palmericyathellus* Debrenne, 1970a, p. 37 (type, *Sigmofungia tabularis* R. Bedford & J. Bedford, 1937, p. 29, OD, =*Sigmofungia flindersi* R. Bedford & W. R. Bedford, 1936, p. 16), for discussion, see Debrenne & Zhuravlev, 1992b, p. 130; =*Palmericyathus* Debrenne in Zhuravleva, 1974b, p. 15 (type, *Ethmophyllum lineatus* Greggs, 1959, p. 66, OD), *nom. null.*, *non* Handfield, 1971, p. 44, archaeocyath]. Inner wall with one row of pores per intersept, bearing upwardly projecting, S-shaped pore tubes; taeniae finely porous, linked by synapticulae; concentrically porous, segmented tabulae. *lower Cambrian (Bot.2–Bot.3):* Australia, Antarctica, Mexico.——Fig. 108*a–c*. **S. flindersi*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM P963-115, -116; *a,* transverse and longitudinal views, ×3 (Hill, 1965); *b,* detail of inner wall in oblique view, ×11 (Debrenne, 1974a); *c,* detail of outer wall in tangential view, ×10 (Debrenne, Zhuravlev, & Kruse, 2002).

Family ARCHAEOSYCONIDAE Zhuravleva, 1954

[Archaeosyconidae Zhuravleva, 1954, p. 30]

Inner wall compound. *lower Cambrian (Bot.1–Bot.3).*

Archaeosycon Taylor, 1910, p. 111 [**Archaeocyathus billingsi* Walcott, 1886, p. 74; M; holotype, Walcott, 1886, pl. 3,*3a–c;* Okulitch, 1943, pl. 14,*2–3*, USNM 15302, Washington, D.C.] [=*Pustulacyathellus* Debrenne & Gangloff in Voronova & others, 1987, p. 42 (type, *P. copulatus*, OD), for discussion, see Debrenne & Zhuravlev, 1992b, p. 121]. Outer wall tabular; inner wall compound, comprising wall carcass and tabulae; taeniae coarsely porous; concentrically porous segmented tabulae. *lower Cambrian (Bot.1–Bot.3):* Canada, United States.——Fig. 109*a–b*. **A. billingsi* (Walcott), Forteau Formation, Botoman, Anse au Loup, Labrador, Canada, holotype, USNM 15302; *a,* longitudinal section, ×3; *b,* transverse section, ×3 (Okulitch, 1943).

Superfamily METACYATHOIDEA R. Bedford & W. R. Bedford, 1934

[*nom. correct*. Debrenne & Kruse, 1986, p. 266, *pro* Metacyathacea Fonin, 1983, p. 11, *nom. transl. ex* Metacyathidae R. Bedford & W. R. Bedford, 1934, p. 5] [=Spirillicyathacea Gravestock, 1984, p. 111]

Outer wall compound. *lower Cambrian (Tom.2–Bot.3).*

Family COPLEICYATHIDAE R. Bedford & J. Bedford, 1937

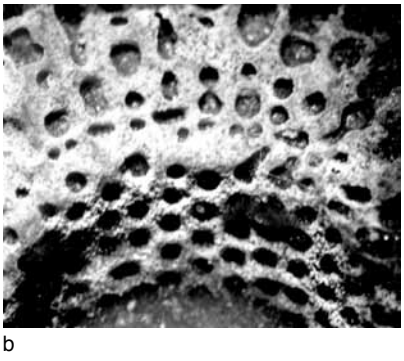
[Copleicyathidae R. Bedford & J. Bedford, 1937, p. 29] [=Tabulacyathellidae Fonin in Voronin & others, 1982, p. 86; =Spirillicyathidae Gravestock, 1984, p. 111].

Inner wall with simple pores. *lower Cambrian (Tom.2–Bot.3).*

Copleicyathus R. Bedford & J. Bedford, 1937, p. 29 [**C. confertus*; OD; holotype, R. Bedford & J. Bedford, 1937, fig. 116; Hill, 1965, pl. 10,*4;* Debrenne, 1974a, fig. 27, USNM PU86741-783, Washington, D.C.]. Outer wall compound with completely subdivided pores; inner wall with several rows of simple pores per intersept; pseudotaenial network coarsely porous. *lower Cambrian (Atd.3–Atd.4):* Australia.——Fig. 110*a–b*. **C. confertus*, Ajax Limestone, Atdabanian, Paint Mine, South Australia, holotype, USNM PU86741-783; *a,* transverse view, ×5; *b,* longitudinal view, ×5 (Hill, 1965).

Agastrocyathus Debrenne, 1964, p. 209 [**Protopharetra gregaria* Debrenne, 1961, p. 21; OD; holotype, Debrenne, 1961, pl. 2,*5–6*, MNHN M80138, HD71, Paris]. Outer wall compound with incipient subdivision of intervallar cells; inner wall with one row of simple pores per intersept; taeniae coarsely porous, linked by synapticulae. *lower Cambrian (Atd.2–Atd.4):* Morocco, Iberia.——Fig. 111*a–c*. **A. gregarius* (Debrenne), Amouslek Formation, Atdabanian, Jbel Taïssa, Morocco, holotype, MNHN M80138, HD71; *a,* longitudinal section of modular skeleton, ×3; *b,* transverse section of modular skeleton, ×4; *c,* detail of outer wall in tangential section, ×10 (Debrenne, Zhuravlev, & Kruse, 2002).

Gabrielsocyathus Debrenne, 1964, p. 248 [**Metacoscinus gabrielsensis* Okulitch, 1955b, p. 61; OD; holotype, Okulitch, 1955b, pl. 1,*1,2,5*, GSC 12357, Ottawa]. Outer wall compound with completely subdivided pores; inner wall with several rows of simple pores per intersept; taeniae finely porous, linked by synapticulae; simple segmented tabulae. *lower Cambrian (Bot.2):* Canada, United States.——Fig. 112,*1a–c*. **G. gabrielsensis* (Okulitch), Atan Group, Botoman, McDame Lake, British Columbia, Canada, holotype, GSC 12357; *a,* transverse section, ×2.5; *b,* longitudinal section, ×2.5; *c,* transverse section (outer wall at


b

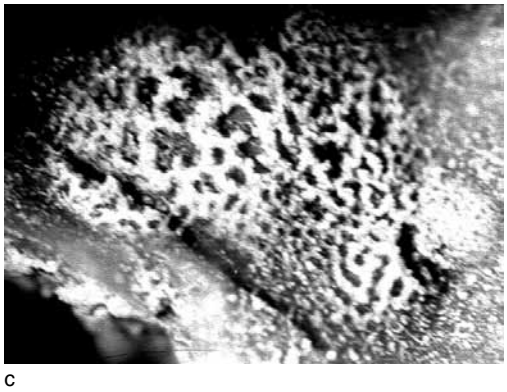

c

FIG. 108. Archaeocyathidae (p. 136).

FIG. 109. Archaeosyconidae (p. 136).

bottom), ×2.5 (Debrenne, Zhuravlev, & Kruse, 2002).

Metacyathellus DEBRENNE & ZHURAVLEV, 1990, p. 302 [**Metaldetes? caribouensis* HANDFIELD, 1971, p. 64; OD; holotype, HANDFIELD, 1971, pl. 11,*2*, GSC 25367, Ottawa]. Outer wall compound with completely subdivided pores; inner wall with one to two rows of simple pores per intersept; taeniae coarsely porous; compound segmented tabulae. *lower Cambrian (Atd.4–Bot.3):* Australia, Antarctica, Canada, United States.——FIG. 112,*2a–c*. **M. caribouensis* (HANDFIELD), Sekwi Formation, Botoman; *a,* Caribou Pass, Northwest Territories, Canada, holotype, GSC 25367, transverse section, ×4 (Handfield, 1971; reproduced with the permission of the Minister of Public Works and Government Services Canada, 2006 and courtesy of Natural Resources Canada, Geological Survey of Canada); *b,* Mackenzie Mountains, Northwest Territories, Canada, specimen GSC 90187, detail of outer wall in tangential section, ×10 (Voronova & others, 1987); *c,* Caribou Pass, Northwest Territories, Canada, holotype, GSC 25367, longitudinal section, ×6 (Handfield, 1971; reproduced with the permission of the Minister of Public Works and Government Services Canada, 2006 and courtesy of Natural Resources Canada, Geological Survey of Canada).

Spinosocyathus ZHURAVLEVA, 1960b, p. 276 [**S. maslennikovae*; OD; holotype, ZHURAVLEVA, 1960b, pl. 25,*1b*, TsSGM 205/134, Novosibirsk]. Outer wall compound with incipient pore subdivision; inner wall with one row of simple pores per intersept; pseudotaenial network coarsely porous; compound segmented tabulae. *lower Cambrian (Tom.2–Atd.2):* Siberian Platform, Mongolia, Iberia.——FIG. 113,*1a–b*. **S. maslennikovae*, Pestrotsvet Formation, Tommotian, Churan, Lena River, Sakha (Yakutia), Russia; *a,* holotype, TsSGM 205/134, transverse section (outer wall at bottom), ×8 (Zhuravleva, 1960b); *b,* oblique longitudinal section of modular skeleton, specimen TsSGM 144-32/4, ×3 (Debrenne, Zhuravlev, & Kruse, 2002).

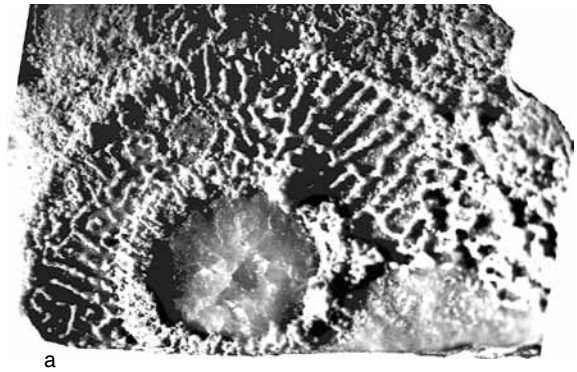
Spirillicyathus R. BEDFORD & J. BEDFORD, 1937, p. 30 [**S. tenuis*; OD; holotype, R. BEDFORD & J. BEDFORD, 1937, fig. 118; DEBRENNE, 1974a, fig. 10, USNM PU493967, specimen 358, Washington, D.C.] [=*Spiralicyathus* R. BEDFORD & J. BEDFORD, 1937, fig. 118 caption, *nom. null.*]. Outer wall compound with completely subdivided pores; inner wall with one to two rows of simple pores per intersept; pseudotaenial network coarsely porous. *lower Cambrian (Atd.4–Bot.1):* Australia, South China.——FIG. 113,*2a–c*. **S. tenuis*, Ajax Limestone, Atdabanian, Paint Mine, South Australia, Australia; *a–b,* holotype, USNM PU493967, specimen 358; *a,* transverse view, ×9; *b,* longitudinal view, ×9 (Debrenne, 1974a); *c,* Wilkawillina Limestone, Atdabanian, Wilkawillina Gorge, South Australia, Australia, specimen SAM P21741, tangential section of outer wall, ×10 (Gravestock, 1984).

Tabulacyathellus MISSARZHEVSKIY in REPINA & others, 1964, p. 249 [**T. bidzhaensis*; OD; holotype, REPINA & others, 1964, pl. 7,*4–6*, PIN 4297/22, Moscow]. Outer wall compound with completely subdivided pores; inner wall tabular with several rows of simple pores per intersept; pseudotaenial network coarsely porous; compound segmented tabulae. *lower Cambrian (Atd.2):* Altay Sayan, Tuva, Mongolia.——FIG. 114*a–c*. **T. bidzhaensis*, Usa Formation, Atdabanian, Sukhie Solontsy Valley, Batenev Range, Kuznetsk Alatau, Russia, holotype, PIN 4297/22; *a,* tangential section of outer wall, ×5; *b,* longitudinal section (outer wall to left), ×5; *c,* transverse section, ×5 (Repina & others, 1964).

Family JUGALICYATHIDAE Gravestock, 1984

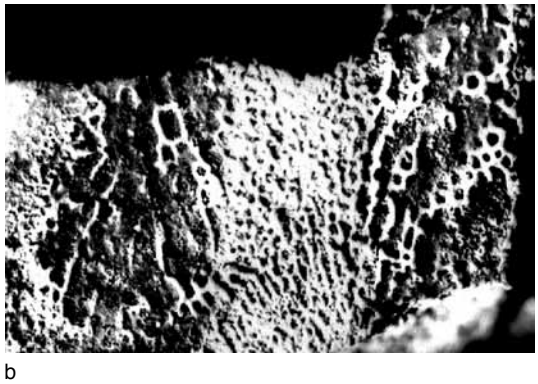
[Jugalicyathidae GRAVESTOCK, 1984, p. 114]

Inner wall with bracts, fused bracts or pore tubes. *lower Cambrian (Atd.4–Bot.2).*



a

Copleicyathus



b

FIG. 110. Copleicyathidae (p. 136).

Jugalicyathus GRAVESTOCK, 1984, p. 114 [**J. tardus*; OD; holotype, GRAVESTOCK, 1984, fig. 56H–I, SAM P21747, Adelaide]. Outer wall compound with incipient subdivision of intervallar cells; inner wall with one row of pores per intersept, bearing upwardly projecting, straight pore tubes; pseudosepta finely porous. *lower Cambrian (Atd.4):* Australia.——FIG. 115,*1a–b*. **J. tardus*; *a,* Wilkawillina Limestone, Atdabanian, Wilkawillina Gorge, South Australia, Australia, paratype, SAM P21749, oblique transverse section, ×8 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* Ajax Limestone, Atdabanian, Mount Scott Range, South Australia, Australia, holotype, SAM P21747, longitudinal section, ×1 (Gravestock, 1984).

Alaskacoscinus DEBRENNE, GANGLOFF, & ZHURAVLEV in DEBRENNE & ZHURAVLEV, 1990, p. 300 [**A. tatondukensis*; OD; holotype, DEBRENNE & ZHURAVLEV, 1990, pl. 1,5, UAM UA2534, 2535, Fairbanks]. Outer wall tabular, compound with completely subdivided pores; inner wall tabular with one row of pores per intersept, bearing upwardly projecting, S-shaped pore tubes; pseudosepta finely porous; segmented tabulae with subdivided pores. *lower Cambrian (Bot.2):* United States.——FIG. 115,*2a–b*. **A. tatondukensis*, Adams Argillite, Botoman, Tatonduk River, Alaska, United States; *a,* holotype, UAM UA2534, longitudinal section (outer wall to right), ×4; *b,* paratype, UAM UA2536, longitudinal section, ×5 (Debrenne & Zhuravlev, 1990).

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

[Metacyathidae R. BEDFORD & W. R. BEDFORD, 1934, p. 5] [=Metacoscinidae R. BEDFORD & W. R. BEDFORD, 1936, p. 18; =Cambrocyathidae OKULITCH, 1937a, p. 251; =Cambrocyathinae OKULITCH, 1937a, p. 251, *nom. transl.* DEBRENNE, 1964, p. 218, *ex* Cambrocyathidae OKULITCH, 1937a, p. 251; =Metaldetinae DEBRENNE, 1964, p. 218; =Metafungiidae DEBRENNE, 1974a, p. 216]

Inner wall compound. *lower Cambrian (Atd.4–Bot.3).*

Metaldetes TAYLOR, 1910, p. 151 [**M. cylindricus*; M; holotype, TAYLOR, 1910, pl. 15, photo 86–88, fig. 11, 37, 38; DEBRENNE, 1974a, fig. 21a–b, M, SAM T1592A, Adelaide] [=*Metafungia* R. BEDFORD & W. R. BEDFORD, 1934, p. 5 (type, *M. reticulata*, M); =*Metacyathus* R. BEDFORD & W. R. BEDFORD, 1934, p. 5 (type, *M. taylori*, M, =*Archaeocyathus dissepimentalis* TAYLOR, 1910,

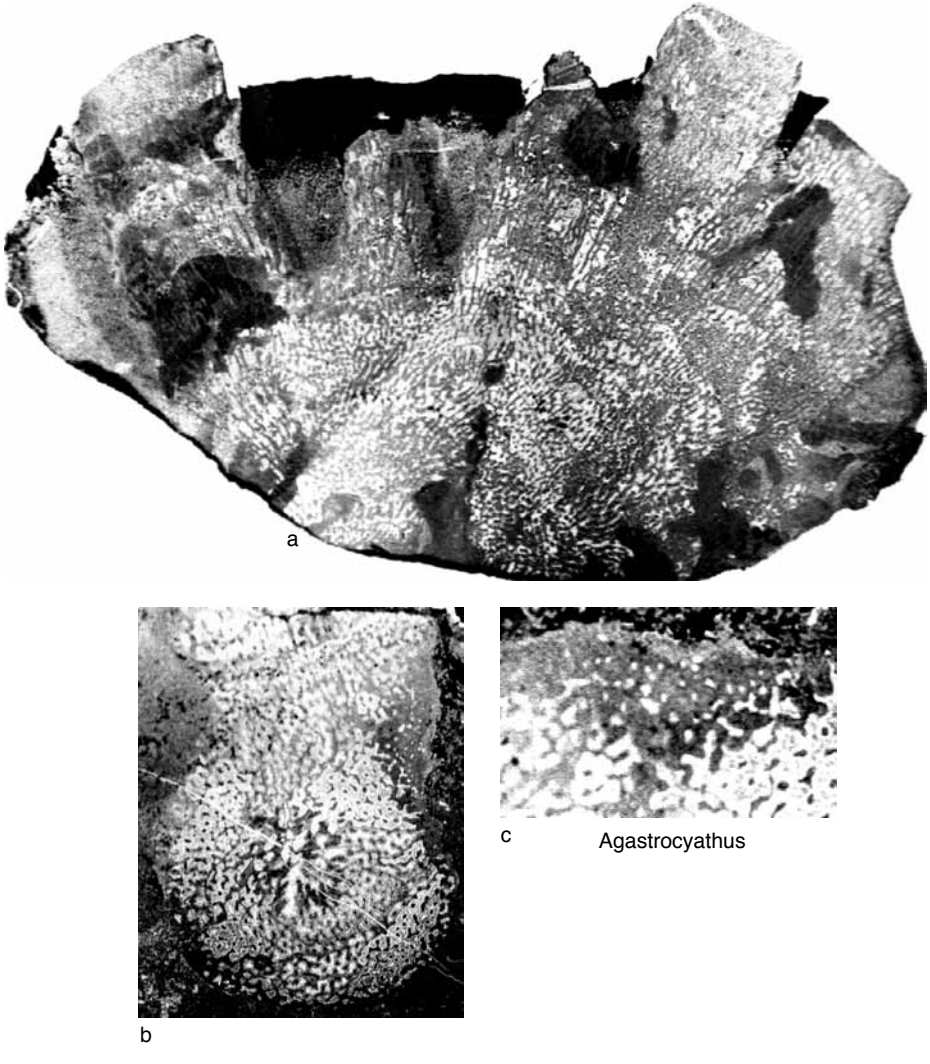
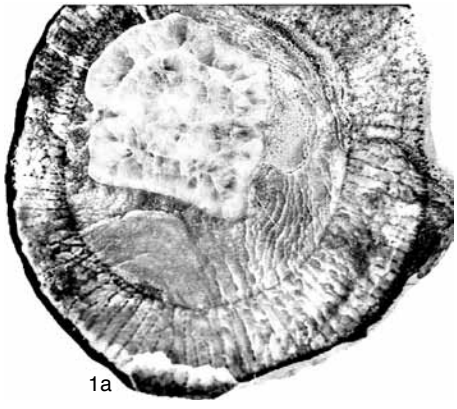


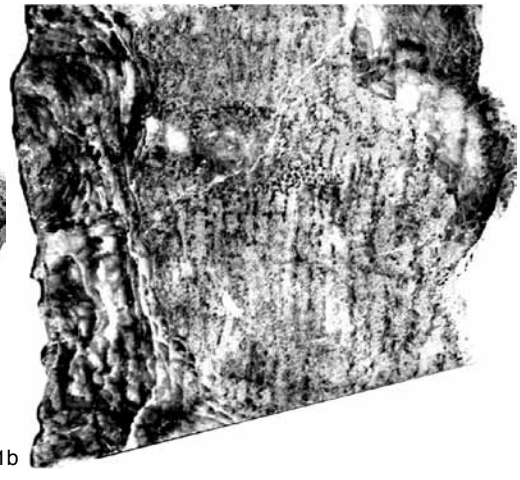
FIG. 111. Copleicyathidae (p. 136).

p. 128); =*Metacoscinus* R. BEDFORD & W. R. BEDFORD, 1934, p. 6 (type, *M. reteseptatum*, M, =*Archaeocyathus retesepta* TAYLOR, 1910, p. 120); =*Cambrocyathus* OKULITCH, 1937a, p. 251 (type, *Archaeocyathus profundus* BILLINGS, 1861, p. 4, OD); =*Metethmophyllum* OKULITCH, 1943, p. 78 (type, *Ethmophyllum meeki* WALCOTT, 1889, p. 34, OD); =*Bedfordcyathus* VOLOGDIN, 1957a, p. 182 (type, *Metacyathus irregularis* R. BEDFORD & W. R. BEDFORD, 1934, p. 6, M, =*Archaeocyathus dissepimentalis* TAYLOR, 1910, p. 128); =*Praefungia* DEBRENNE in ZHURAVLEVA, 1974b, p. 42, *nom. correct*. DEBRENNE, 1974a, p. 227, *pro Pruefungia, lapsus calami* (type, *Metaldetes superbus* R. BEDFORD & W. R. BEDFORD, 1936, p. 18, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 127]. Outer wall compound with completely subdivided pores; inner wall compound with several rows of completely subdivided pores per intersept; taeniae coarsely porous, linked by synapticulae in early ontogenetic stages but rarely so in mature cups; compound segmented tabulae. *lower Cambrian (Atd.4–Bot.3):* Far East, Australia, Antarctica, Canada, United States, Mexico.——FIG. 116*a–e*. **M. cylindricus*, Wilkawillina Limestone, Botoman, Wilson, South Australia, Australia, holotype, SAM T1592A; *a,* transverse section, ×4; *b,* detail of inner wall in transverse section, ×8; *c,* detail of outer wall in transverse section, ×8; *d,* detail of taenia in longitudinal section, ×8; *e,* longitudinal section



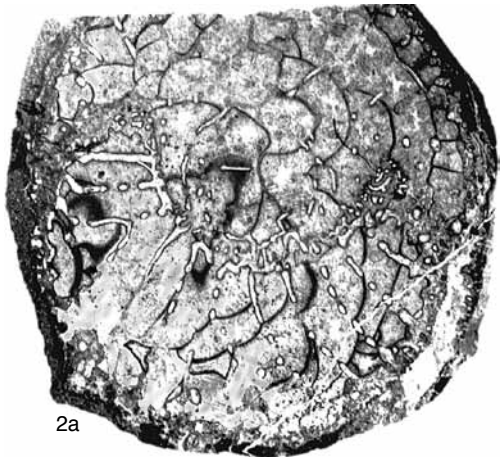
1a

Gabrielsocyathus

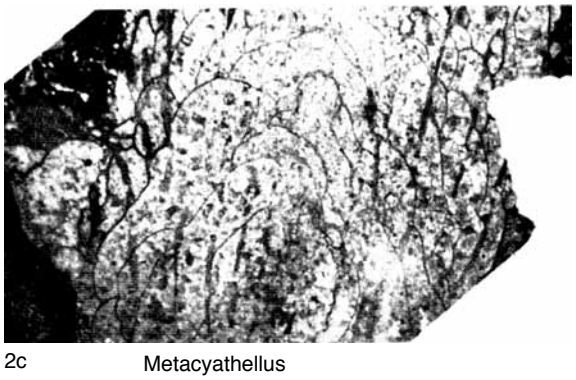


1b

1c

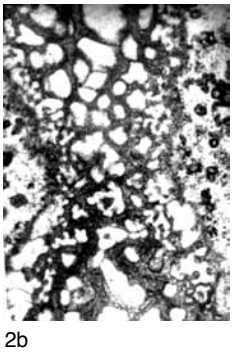


2a



2c

Metacyathellus



2b

Fig. 112. Copleicyathidae (p. 136–138).

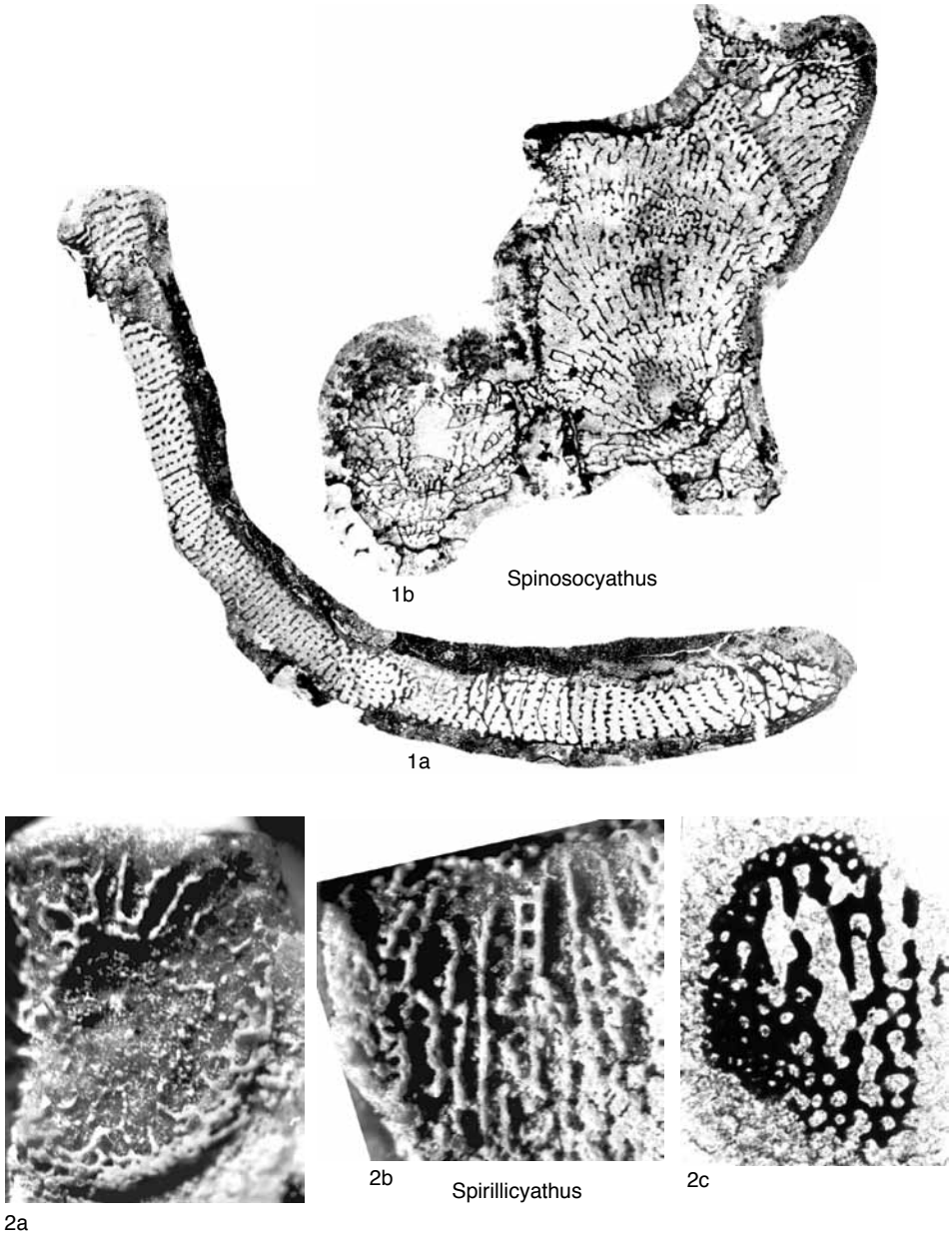


FIG. 113. Copleicyathidae (p. 138).

of modular skeleton, ×4 (Debrenne, Zhuravlev, & Kruse, 2002).

Changicyathus DEBRENNE & ZHURAVLEV, 1990, p. 301 [**Cambrocyathellus tenuicaulus* ZHANG & YUAN, 1985, p. 523; OD; holotype, ZHANG & YUAN, 1985, pl. 2,*6;* DEBRENNE & ZHURAVLEV, 1990, pl. 1,*7*, NIGP 82277, specimen 17f(10-14), Nanjing]. Outer wall compound with completely subdivided pores; inner wall compound with incipient pore subdivision; taeniae coarsely porous; compound segmented tabulae. *lower Cambrian (Bot.1):* ?Tajikistan, South China.——FIG. 117. **C. tenuicaulus* (ZHANG & YUAN), Xiannudong Formation,

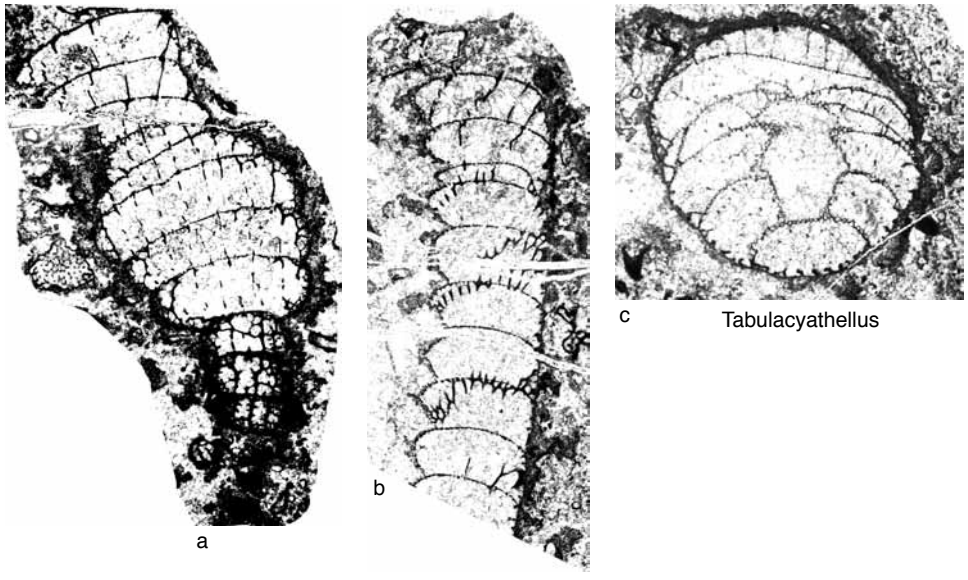


FIG. 114. Copleicyathidae (p. 138).

Botoman, Nanzhen, Sichuan, China, holotype, NIGP 82277, specimen 17f(10-14), oblique longitudinal section of modular skeleton, ×6 (Debrenne & Zhuravlev, 1990).

Superfamily NAIMARKCYATHOIDEA Wrona & Zhuravlev, 1996

[Naimarkcyathoidea WRONA & ZHURAVLEV, 1996, p. 28]

Outer wall pustular. *lower Cambrian (Bot.3).*

Family NAIMARKCYATHIDAE Wrona & Zhuravlev, 1996

[Naimarkcyathidae WRONA & ZHURAVLEV, 1996, p. 29]

Inner wall with bracts, fused bracts or pore tubes. *lower Cambrian (Bot.3).*

Naimarkcyathus WRONA & ZHURAVLEV, 1996, p. 29 [**N. elenae*; OD; holotype, WRONA & ZHURAVLEV, 1996, pl. 7,*2*, ZPAL Ac.I/M10DI, Warsaw]. Inner wall with one row of pores per intersept, bearing upwardly projecting, straight pore tubes; pseudotaenial network coarsely porous. *lower Cambrian (Bot.3):* Antarctica.——FIG. 118*a–b*. **N. elenae*, Polonez Cove Formation (allochthonous), Botoman, Mazurek Point, King George Island, southern Shetland Islands, Antarctica; *a,* holotype, ZPAL Ac.I/M10DI, transverse section, ×5; *b,* paratype, ZPAL Ac.I/M10CI, longitudinal section, ×5 (Wrona & Zhuravlev, 1996).

Superfamily WARRIOOTACYATHOIDEA Debrenne & Zhuravlev, 1992

[Warriootacyathoidea DEBRENNE & ZHURAVLEV, 1992b, p. 115]

Outer wall with canals. *lower Cambrian (Atd.3–Atd.4).*

Family WARRIOOTACYATHIDAE Debrenne & Zhuravlev, 1992

[Warriootacyathidae DEBRENNE & ZHURAVLEV, 1992b, p. 115]

Inner wall with bracts, fused bracts or pore tubes. *lower Cambrian (Atd.3–Atd.4).*

Warriootacyathus GRAVESTOCK, 1984, p. 126 [**W. wilkawillinensis*; OD; holotype, GRAVESTOCK, 1984, fig. 62A,D–F, SAM P21806-1, Adelaide]. Outer wall with horizontal to upwardly projecting, straight canals; inner wall with one row of pores per intersept, bearing upwardly projecting, straight to waved pore tubes; pseudosepta coarsely porous. *lower Cambrian (Atd.3–Atd.4):* Australia.——FIG. 119*a–c*. **W. wilkawillinensis*, Wilkawillina Limestone, Atdabanian, Wilkawillina Gorge, South Australia, Australia, holotype, SAM P21806-1; *a,* tangential section of outer wall, ×7; *b,* tangential section of inner wall, ×3; *c,* longitudinal section of septum (outer wall to right), ×3 (Gravestock, 1984).

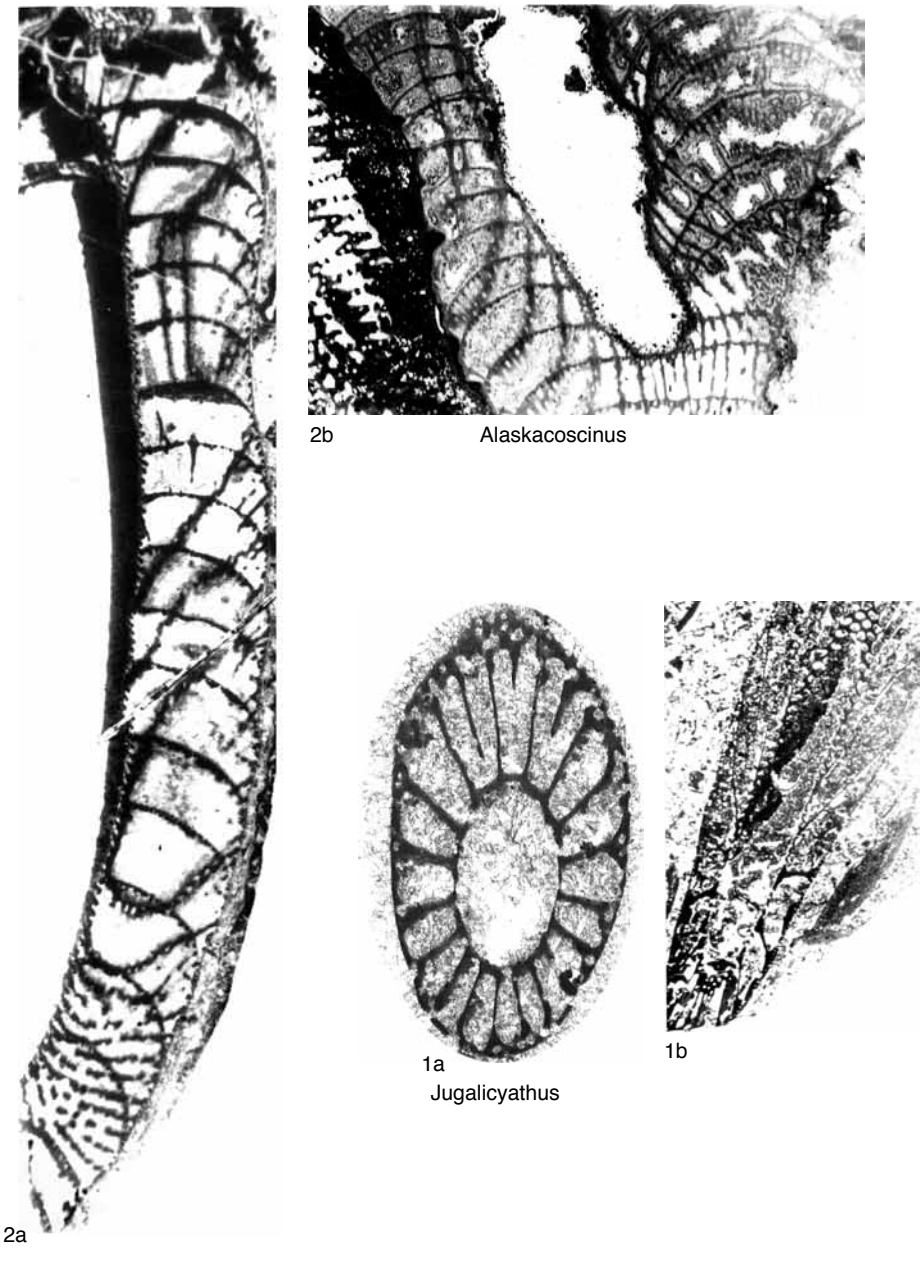


FIG. 115. Jugalicyathidae (p. 139).

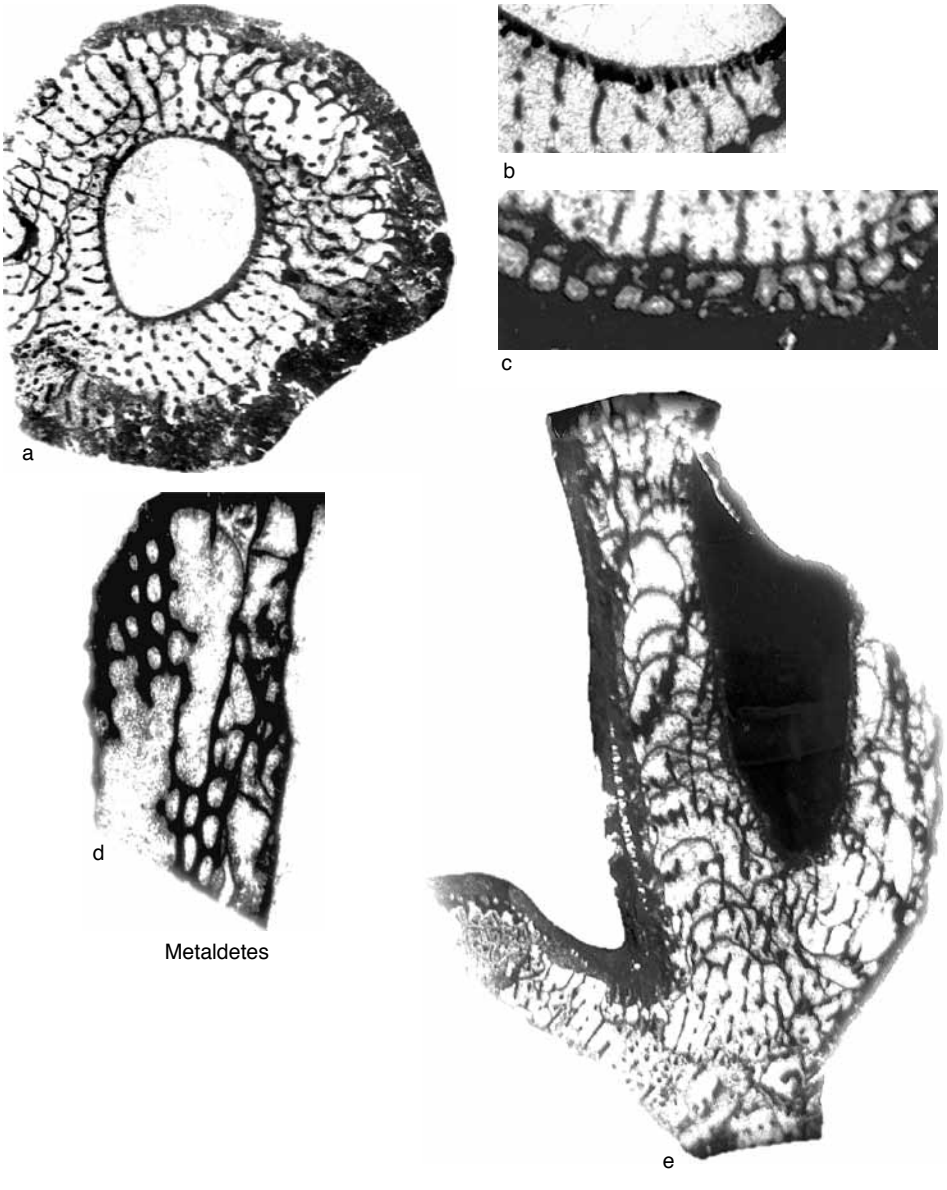
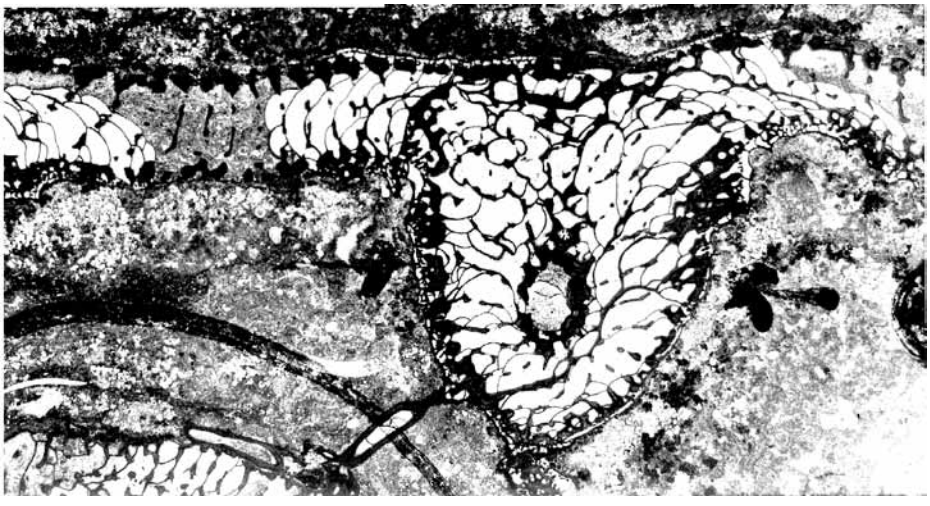


FIG. 116. Metacyathidae (p. 139–142).



Changicyathus

FIG. 117. Metacyathidae (p. 142–143).

Superfamily BELTANACYATHOIDEA Debrenne, 1974

[*nom. correct.* DEBRENNE & ZHURAVLEV, 1992b, p. 115, *pro* Beltanacyathacea GRAVESTOCK, 1984, p. 123, *nom. transl. ex* Beltanacyathidae DEBRENNE, 1974a, p. 243] [=Beltanacyathidae DEBRENNE, 1970a, p. 30, *nom. nud.*]

Outer wall with subdivided canals. *lower Cambrian (Atd.3–Bot.3).*

Family MAIANDROCYATHIDAE Debrenne, 1974

[Maiandrocyathidae DEBRENNE, 1974a, p. 235]

Inner wall with simple pores. *lower Cambrian (Bot.3).*

Maiandrocyathus DEBRENNE in ZHURAVLEVA, 1974a, p. 209 [**Metacoscinus insigne* R. BEDFORD & W. R. BEDFORD, 1936, p. 18; OD; holotype, R. BEDFORD & W. R. BEDFORD, 1936, fig. 84; DEBRENNE, 1974a, fig. 28, M, SAM P986-167, -168, Adelaide]. Inner wall with one to two rows of simple pores per intersept; taeniae coarsely porous. *lower Cambrian (Bot.3):* Australia.——FIG. 120,*1a–b*. **M. insigne* (R. BEDFORD & W. R. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, holotype, SAM P986-167, -168; *a,* tangential view of outer wall, ×3; *b,* longitudinal view of septum and exocyathoid buttress (outer wall to right), ×3 (Debrenne, Zhuravlev, & Kruse, 2002).

Ataxiocyathus DEBRENNE in ZHURAVLEVA, 1974a, p. 52 [**Paranacyathus grandis* R. BEDFORD & J. BEDFORD, 1937, p. 34; OD; holotype, R. BEDFORD & J. BEDFORD, 1937, fig. 140; DEBRENNE, 1974c, pl. 20,*3–4,* M, USNM PU86821, specimen 311, Washington, D.C.]. Inner wall with one row of simple pores per intersept; pseudosepta finely porous. *lower Cambrian (Bot.3):* Australia.——FIG. 120,*2a–c*. **A. grandis* (R. BEDFORD & J. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, holotype, USNM PU86821, specimen 311; *a,* transverse view, ×5 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* longitudinal view of septum (outer wall to left), ×6 (M. Debrenne, new); *c,* tangential view of outer wall, ×6 (Debrenne, 1974c).

Family BELTANACYATHIDAE Debrenne, 1974

[Beltanacyathidae DEBRENNE, 1974a, p. 243] [=Beltanacyathidae DEBRENNE, 1970a, p. 30, *nom. nud.*]

Inner wall with bracts, fused bracts, or pore tubes. *lower Cambrian (Atd.3–Atd.4).*

Beltanacyathus R. BEDFORD & J. BEDFORD, 1936, p. 23 [**B. ionicus*; OD; lectotype, R. BEDFORD & J. BEDFORD, 1936, fig. 95–96; HILL, 1965, pl. 6,*3;* SD HILL, 1965, p. 89, USNM PU86716-271, Washington, D.C.; =*Archaeocyathus wirrialpensis* TAYLOR, 1910, p. 124; holotype, TAYLOR, 1910, pl. 8, photo 43–44; DEBRENNE, 1974a, fig. 33b; M, SAM T1581A-E, Adelaide] [=*Fridaycyathus* GRAVESTOCK, 1984, p. 125 (type, *F. biserialis*, OD); =*Bayleicyathus* GRAVESTOCK, 1984, p. 131 (type, *B. bowmani*, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 122]. Inner wall with one row of pores per intersept, bearing upwardly projecting, straight pore tubes; pseudosepta finely porous; segmented tabulae.

lower Cambrian (Atd.3–Atd.4): Australia.——FIG. 121*a–d*. **B. wirrialpensis* (TAYLOR); *a–b,* holotype, Wilkawillina Limestone, Atdabanian, Wirrealpa Mine, South Australia, Australia, SAM T1581A-E; *a,* transverse section (outer wall at top), ×2; *b,* longitudinal section (outer wall to left), ×2.5 (Taylor, 1910); *c–d,* lectotype [=*B. ionicus*], Ajax Limestone, Atdabanian, Paint Mine, South Australia, Australia, USNM PU86716-271; *c,* transverse view, ×2; *d,* longitudinal view, ×2 (Hill, 1965).

Superfamily TABELLAECYATHOIDEA Fonin, 1963

[*nom. transl.* DEBRENNE & ZHURAVLEV, 1992b, p. 116, *ex* Tabellaecyathidae FONIN, 1963, p. 15] [=Taeniaecyathellacea KONYUSHKOV, 1972, p. 141]

Outer wall tabellar. *lower Cambrian (Bot.2–Bot.3).*

Family TABELLAECYATHIDAE Fonin, 1963

[Tabellaecyathidae FONIN, 1963, p. 15] [=Taeniaecyathellidae KONYUSHKOV, 1972, p. 142; =Karakolocyathidae KONYUSHKOV, 1972, p. 142]

Inner wall with bracts, fused bracts, or pore tubes. *lower Cambrian (Bot.2–Bot.3).*

Taeniaecyathellus ZHURAVLEVA, 1960a, p. 45 [**T. semenovi*; OD; holotype, ZHURAVLEVA, 1960a, fig. 1i–k, TsSGM 273/7, Novosibirsk] [=*Tabellaecyathus* FONIN, 1963, p. 15 (type, *T. totus*, OD); =*Cambronanus* FONIN, 1963, p. 19 (type, *C. multicavitatus*, OD); =*Karakolocyathus* KONYUSHKOV, 1972, p. 142 (type, *K. loculatus*, OD; =*Tabellaecyathus totus* FONIN, 1963, p. 16), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 131]. Inner wall with several rows of pores per intersept, bearing upwardly projecting, straight pore tubes; dictyonal network. *lower Cambrian (Bot.2–Bot.3):* Altay Sayan.——FIG. 122*a–b*. **T. semenovi*, Verkhnemonok Formation, Botoman, Malyy Karakol River, West Sayan, Russia, holotype, TsSGM 273/7; *a,* oblique longitudinal section, ×5; *b,* detail of outer wall in tangential section, ×21 (Debrenne, Zhuravlev, & Kruse, 2002).

Suborder DICTYOFAVINA Debrenne, 1991

[Dictyofavina DEBRENNE, 1991, p. 219]

Skeleton solitary or modular, latter as branching or massive pseudocolonies (both by intercalicular budding); intervallum with calicles. *lower Cambrian (Atd.1–Bot.2).*

FIG. 118. Naimarkcyathidae (p. 143).

Superfamily USLONCYATHOIDEA Fonin, 1966

[*nom. transl.* DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1679, *ex* Usloncyathidae FONIN in VOLOGDIN & FONIN, 1966, p. 187] [=Dictyofavoidea DEBRENNE & ZHURAVLEV, 1992a, p. 596]

Outer wall simple. *lower Cambrian (Atd.1–Bot.2).*

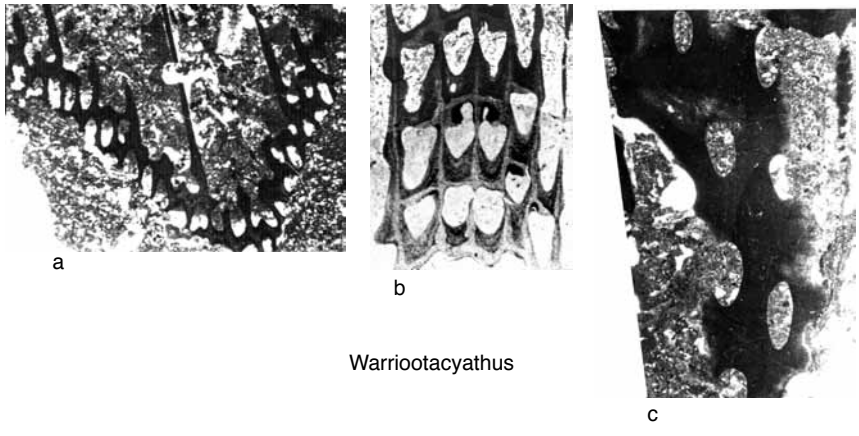


FIG. 119. Warriootacyathidae (p. 143).

Family USLONCYATHIDAE Fonin, 1966

[Usloncyathidae FONIN in VOLOGDIN & FONIN, 1966, p. 187] [=Dictyofavidae DEBRENNE & ZHURAVLEV, 1992a, p. 596]

Inner wall with simple pores. *lower Cambrian (Atd.1–Bot.2).*

Usloncyathus FONIN in VOLOGDIN & FONIN, 1966, p. 188 [**U. miculus*; OD; holotype, VOLOGDIN & FONIN, 1966, fig. 1a, PIN 2486/143, Moscow] [=*Falsocyathus* FONIN in VOLOGDIN & FONIN, 1966, p. 189 (type, *F. vastulus*, OD; =*U. miculus* FONIN in VOLOGDIN & FONIN, 1966, p. 188); =*Nostrocyathus* FONIN in VOLOGDIN & FONIN, 1966, p. 189 (type, *N. aculeatus*, OD; =*U. miculus* FONIN in VOLOGDIN & FONIN, 1966, p. 188); =*Cavocyathus* FONIN in VOLOGDIN & FONIN, 1966, p. 189 (type, *C. pusilus*; OD; =*U. miculus* FONIN in VOLOGDIN & FONIN, 1966, p. 188), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 132; =*Dictyofavus* GRAVESTOCK, 1984, p. 98 (type, *D. obtusus*, OD)]. Outer and inner walls rudimentary; calicles hexagonal in cross section with several pore rows per facet. *lower Cambrian (Atd.1–Atd.4):* Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Australia.——FIG. 123,*1.* **U. miculus*, Bystraya Formation, Atdabanian, Uslon Valley, Transbaikalia, Russia, holotype, PIN 2486/143, longitudinal section, ×8 (Vologdin & Fonin, 1966).

Kechikacyathus DEBRENNE & ZHURAVLEV, 1992a, p. 598 [**K. natlaensis*; OD; holotype, DEBRENNE & ZHURAVLEV, 1992a, pl. 1,*3*, GSC 90166, Ottawa]. Outer wall basic; inner wall rudimentary; calicles hexagonal in cross section with one pore row per facet. *lower Cambrian (Bot.1–Bot.2):* Canada.——FIG. 123,*2a–b*. **K. natlaensis*, Sekwi Formation, Botoman; *a,* Kechika River, British Columbia, paratype, GSC 103939, GAM-78-G, detail of outer wall in tangential section, ×10; *b,* Natla, Mackenzie Mountains, Northwest Territories, Canada, holotype, GSC 90166, longitudinal section, ×5 (Debrenne & Zhuravlev, 1992a).

Zunyicyathus DEBRENNE, KRUSE, & ZHANG, 1991, p. 286 [**Agastrocyathus grandis* YUAN & ZHANG, 1980, p. 387; OD; *nom. correct*. DEBRENNE, KRUSE & ZHANG, 1991, p. 286, *pro Agastrocyathus grandus* YUAN & ZHANG, 1980, p. 387; holotype, YUAN & ZHANG, 1980, pl. 1,*3*, NIGP 56292, Nanjing]. Outer and inner walls rudimentary; calicles tetragonal in cross section with one pore row per facet. *lower Cambrian (Bot.1–Bot.2):* Tajikistan, South China, United States.——FIG. 124. **Z. grandis* (YUAN & ZHANG), Jindingshan (Chintingshan) Formation, Botoman, Jindingshan, Guizhou, China, specimen MNHN 85103, longitudinal section of modular skeleton, ×5 (Debrenne, Kruse, & Zhang, 1991).

Superfamily KERIOCYATHOIDEA Debrenne & Gangloff, 1992

[Keriocyathoidea DEBRENNE & GANGLOFF in DEBRENNE & ZHURAVLEV, 1992a, p. 598]

Outer wall concentrically porous. *lower Cambrian (Bot.1–Bot.2).*

Family KERIOCYATHIDAE Debrenne & Gangloff, 1992

[Keriocyathidae DEBRENNE & GANGLOFF in DEBRENNE & ZHURAVLEV, 1992a, p. 598] [=Keriocyathidae DEBRENNE & GANGLOFF in DEBRENNE, GANDIN, & GANGLOFF, 1990, p. 93, *nom. nud.*]

Inner wall with simple pores. *lower Cambrian (Bot.1–Bot.2).*

Keriocyathus DEBRENNE & GANGLOFF in DEBRENNE, GANDIN, & GANGLOFF, 1990, p. 93 [**K. arachnaius*; OD; holotype, DEBRENNE, GANDIN, & GANGLOFF, 1990, pl. 1,*9*, USNM 443557, specimen IR24.10,

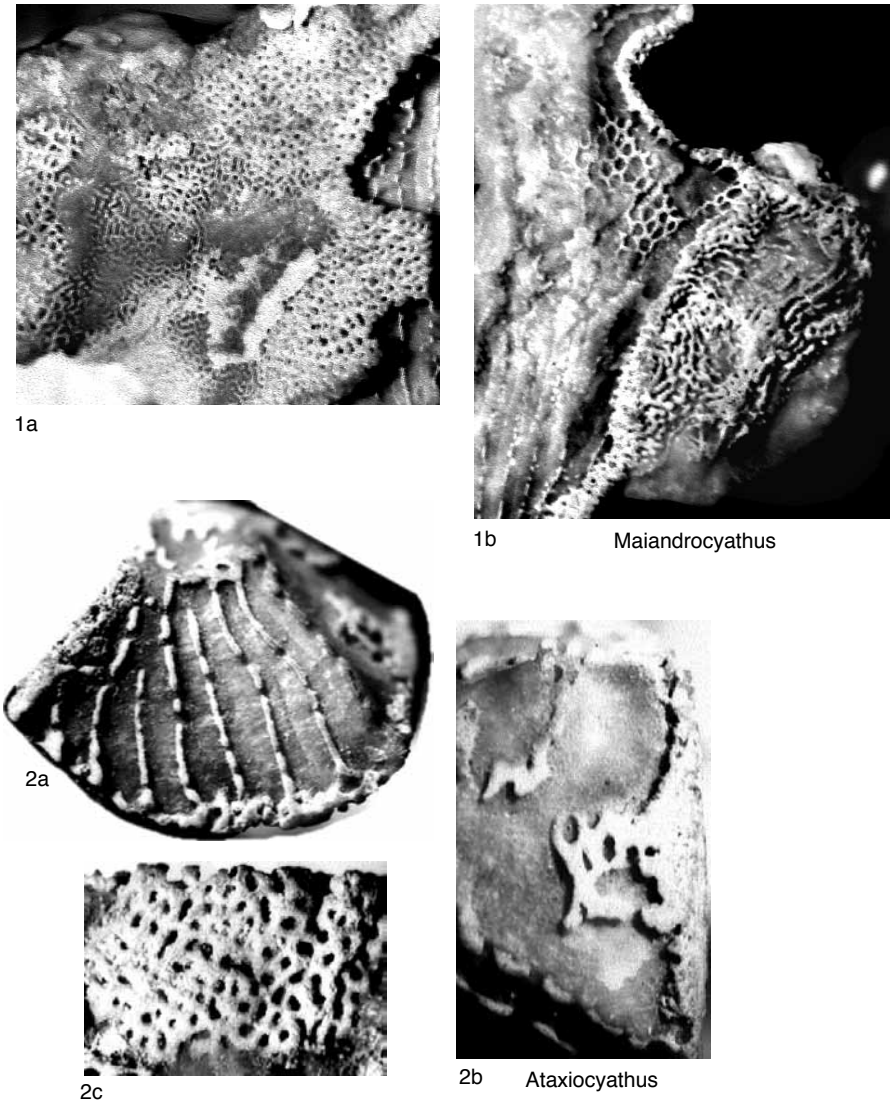


FIG. 120. Maiandrocyathidae (p. 146).

Washington, D.C.]. Inner wall basic; calicles tetragonal in cross section with one pore row per facet. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Far East, United States.——FIG. 125*a–b*. **K. arachnaius*, Valmy Formation, Botoman, Iron Canyon, Nevada, United States; *a,* holotype, USNM 443557, specimen IR24.10, transverse section, ×7.5; *b,* paratype, USNM 443572, longitudinal section, ×7.5 (Debrenne, Gandin, & Gangloff, 1990).

Superfamily GATAGACYATHOIDEA Debrenne & Zhuravlev, 1992

[Gatagacyathoidea DEBRENNE & ZHURAVLEV, 1992a, p. 598]

Outer wall compound. *lower Cambrian (Bot.2).*

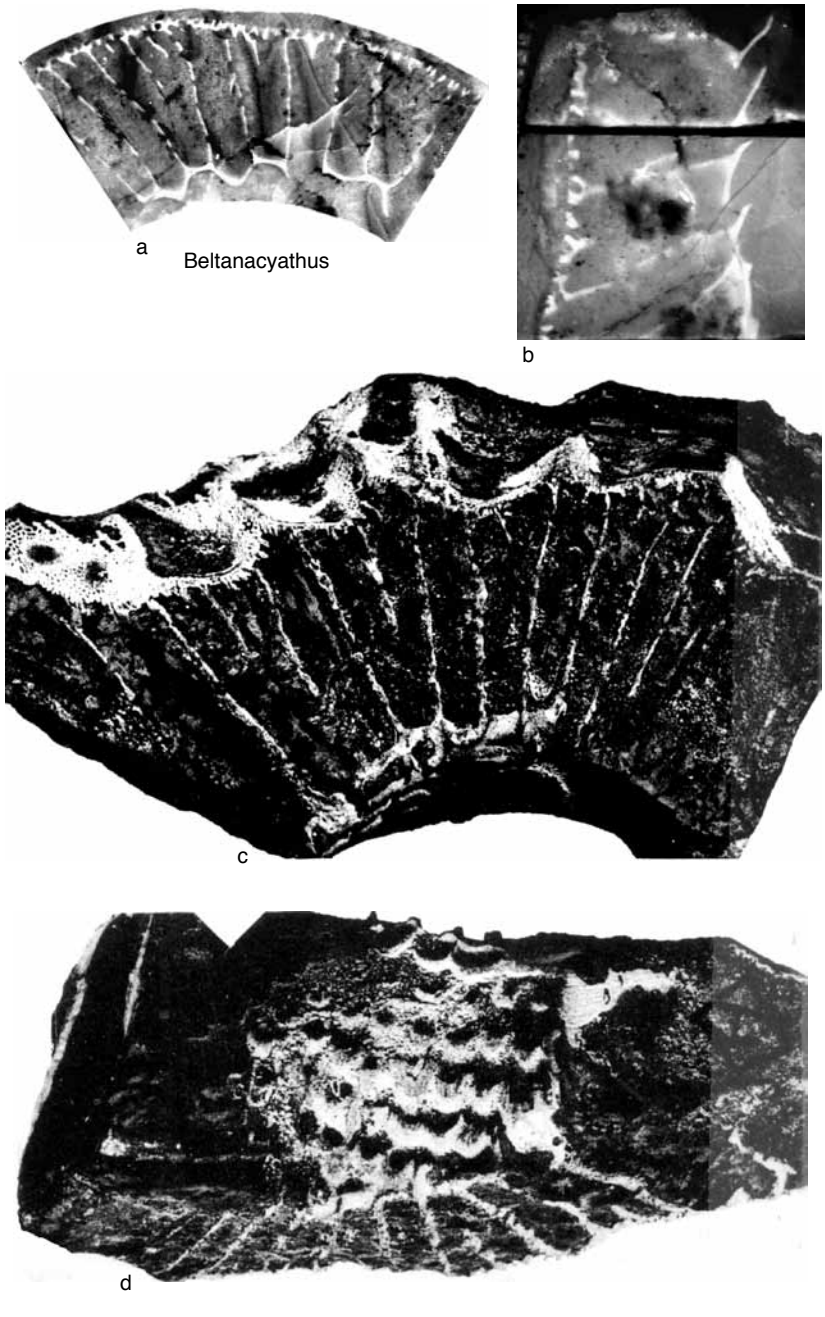


FIG. 121. Beltanacyathidae (p. 146–147).

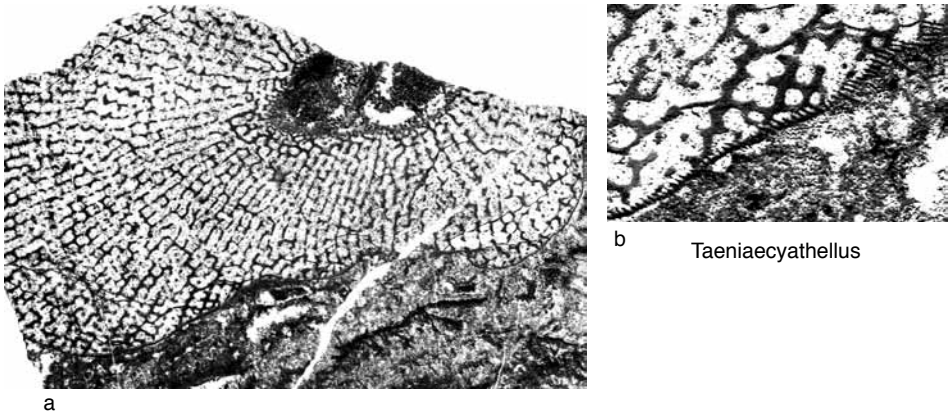


FIG. 122. Tabellaecyathidae (p. 147).

Family GATAGACYATHIDAE Debrenne & Zhuravlev, 1992

[Gatagacyathidae DEBRENNE & ZHURAVLEV, 1992a, p. 598]

Inner wall with simple pores. *lower Cambrian (Bot.2).*

Gatagacyathus DEBRENNE & ZHURAVLEV, 1992a, p. 598 [**G. mansyi*; OD; holotype, DEBRENNE & ZHURAVLEV, 1992a, pl. 1,*4,* GSC 103942, specimen GAM76.8G.XI.3L, Ottawa]. Outer wall compound with incipient pore subdivision; inner wall rudimentary; calicles hexagonal in cross section with one pore row per facet. *lower Cambrian (Bot.2):* Canada, United States.——FIG. 126. **G. mansyi*, Rosella Formation, Botoman, Kechika River, British Columbia, Canada, holotype, GSC 103942, specimen GAM76.8G.XI.3L, longitudinal section, ×3.5 (Debrenne, Zhuravlev, & Kruse, 2002).

Suborder SYRINGOCNEMINA Okulitch, 1935

[*nom. correct.* DEBRENNE, ZHURAVLEV, & KRUSE, herein, *pro* Syringicnemidina KRASNOPEEVA, 1980, p. 159, *nom. transl. ex* order Syringocnemina OKULITCH, 1935, p. 90] [=Syringocyathina DEBRENNE, 1991, p. 219]

Skeleton solitary or modular, latter as branching pseudocolonies (by longitudinal fission); intervallum with syringes. *lower Cambrian (Atd.4–Bot.3).*

Superfamily AULISCOCYATHOIDEA Debrenne & Zhuravlev, 1992

[Auliscocyathoidea DEBRENNE & ZHURAVLEV, 1992b, p. 117]

Outer wall simple. *lower Cambrian (Atd.4–Bot.3).*

Family AULISCOCYATHIDAE Debrenne & Zhuravlev, 1992

[Auliscocyathidae DEBRENNE & ZHURAVLEV, 1992b, p. 117]

Inner wall with simple pores. *lower Cambrian (Atd.4–Bot.3).*

Auliscocyathus DEBRENNE in ZHURAVLEVA, 1974a, p. 53 [**Spirocyathus multifidus* R. BEDFORD & W. R. BEDFORD, 1936, p. 14; OD; lectotype, R. BEDFORD & W. R. BEDFORD, 1936, fig. 65; DEBRENNE, 1974a, fig. 8a; SD DEBRENNE, 1974a, p. 199, SAM P950-81, Adelaide]. Outer and inner walls rudimentary; syringes tetragonal in cross section with one pore row per facet. *lower Cambrian (Atd.4–Bot.3):* Tuva, Australia, Antarctica.——FIG. 127*a–c.* **A. multifidus* (R. BEDFORD & W. R. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, lectotype, SAM P950-81; *a*, longitudinal view, ×5 (Debrenne, 1974a); *b,* oblique longitudinal view, ×5; *c,* detail of syringes in longitudinal intervallar view, ×8 (Debrenne, Zhuravlev, & Kruse, 2002).

Superfamily SYRINGOCNEMOIDEA Taylor, 1910

[*nom. correct.* DEBRENNE, ZHURAVLEV, & KRUSE, herein, *pro* Syringocnemidoidea DEBRENNE & ZHURAVLEV, 1992b, p. 117, *nom. transl. ex* Syringocnemidae TAYLOR, 1910, p. 113]

Outer wall concentrically porous. *lower Cambrian (Bot.1–Bot.3).*

Family TUVACNEMIDAE Debrenne & Zhuravlev, 1990

[*nom. correct.* DEBRENNE, ZHURAVLEV, & KRUSE, herein, *pro* Tuvacnemididae DEBRENNE & ZHURAVLEV, 1990, p. 300]

Inner wall with simple pores. *lower Cambrian (Bot.1–Bot.3).*

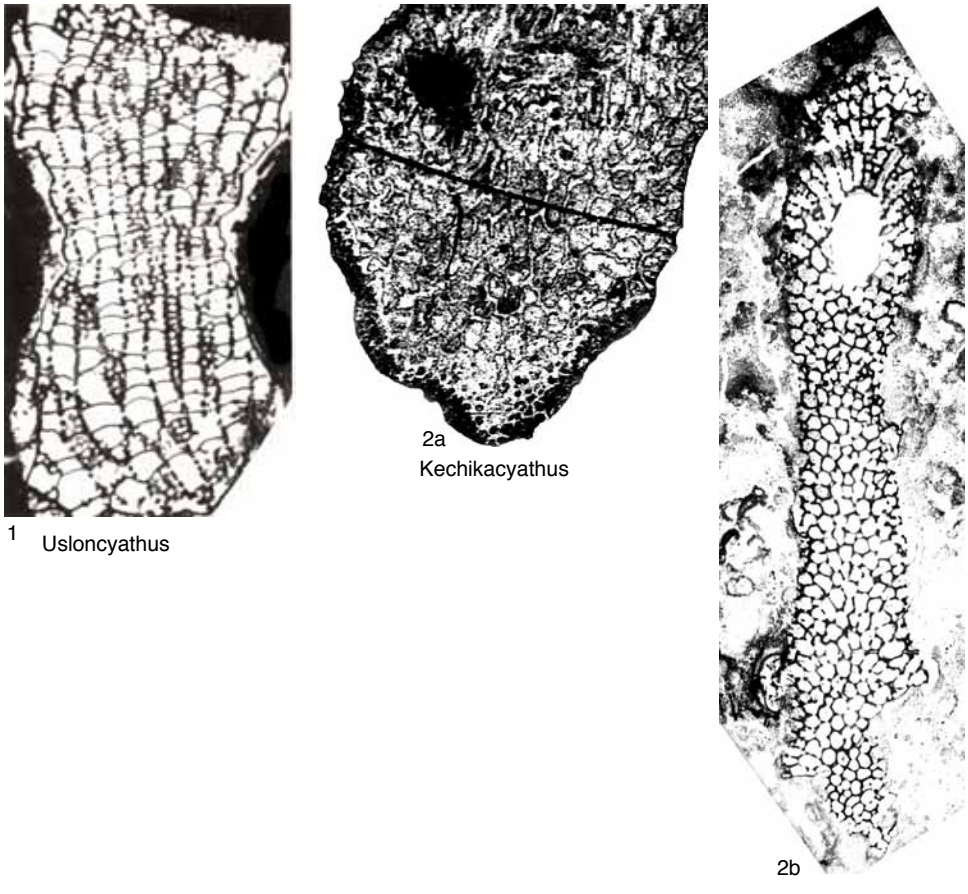


FIG. 123. Usloncyathidae (p. 148).

Tuvacnema DEBRENNE & ZHURAVLEV, 1990, p. 301 [**Syringocnema tannuolensis* RODIONOVA in ZHURAVLEVA & others, 1967, p. 106; OD; holotype, ZHURAVLEVA & others, 1967, pl. 58,*4*, VSEGEI 9594, St. Petersburg, not located]. Inner wall with several rows of pores per syrinx; syringes hexagonal in cross section with several pore rows per facet. *lower Cambrian (Bot.1–Bot.3):* Tuva.——FIG. 128. **T. tannuolensis* (RODIONOVA), Shangan Formation, Botoman, Shivelig-Khem River, East Tannu-Ola Range, Russia, holotype, VSEGEI 9594, transverse section, ×7 (Zhuravleva & others, 1967).

Family SYRINGOCNEMIDAE Taylor, 1910

[Syringocnemidae TAYLOR, 1910, p. 113] [=Syringocnematidae VOLOGDIN, 1928, p. 31; =Syringocnemitidae TING, 1937, p. 370; =Syringocnemidae DEBRENNE, 1964, p. 117; =Pseudosyringocnemididae DEBRENNE, 1975, p. 355]

Inner wall with bracts, fused bracts, or pore tubes. *lower Cambrian (Bot.1–Bot.3).*

Syringocnema TAYLOR, 1910, p. 153 [**S. favus*; M; holotype, TAYLOR, 1910, pl. 14, photos 78–79, M, SAM T1597A,B,E, Adelaide]. Inner wall with one row of pores per syrinx, bearing upwardly projecting, S-shaped pore tubes; syringes hexagonal in cross section with several pore rows per facet. *lower Cambrian (Bot.3):* Australia, Antarctica.——FIG. 129*a–d*. **S. favus*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia; *a–c,* holotype, SAM T1597A,B,E; *a,* transverse view, ×3; *b,* oblique longitudinal view, ×3.5; *c,* detail of syringes in longitudinal view (outer wall to left), ×5; *d,* paratype, SAM T1558, detail of syringes in oblique transverse view, ×5 (Debrenne, Zhuravlev, & Kruse, 2002).

Pseudosyringocnema HANDFIELD, 1971, p. 76 [**P. uniporus*; OD; holotype, HANDFIELD, 1971, pl. 15,*3*, GSC 25392, Ottawa]. Inner wall with one row of pores per syrinx, bearing upwardly projecting, S-shaped pore tubes; syringes hexagonal in cross section with one pore row per transverse facet and several pore rows per lateral

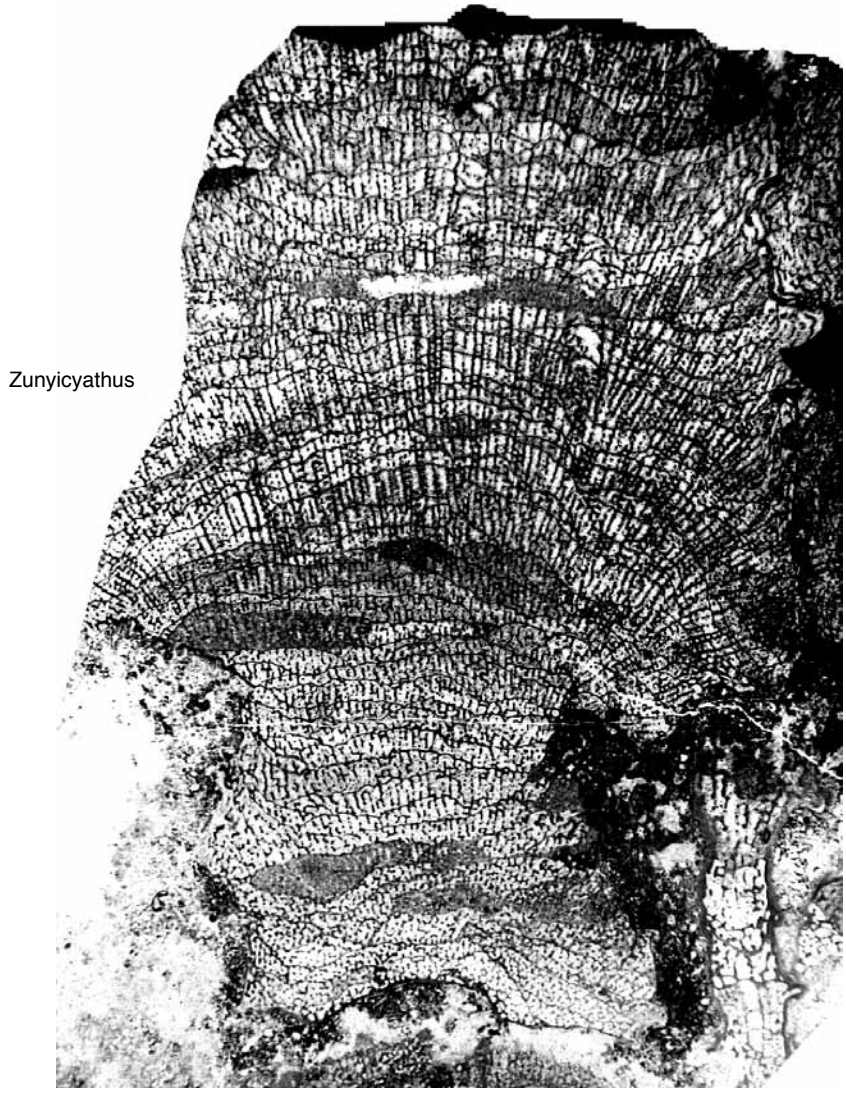


FIG. 124. Usloncyathidae (p. 148).

facet. *lower Cambrian (Bot.2–Bot.3):* Altay Sayan, Antarctica, Canada, United States.——FIG. 130,*1a–b*. **P. uniporus*, unnamed Sekwi Formation equivalent (map unit 5 of HANDFIELD, 1971), Botoman, Coal River, Yukon Territory, Northwest Territories, Canada, holotype, GSC 25392; *a,* longitudinal section, ×4 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* oblique longitudinal section, ×4 (Handfield, 1971; reproduced with the permission of the Minister of Public Works and Government Services Canada, 2006 and courtesy of Natural Resources Canada, Geological Survey of Canada).

Syringothalamus DEBRENNE, GANGLOFF, & ZHURAVLEV in DEBRENNE & ZHURAVLEV, 1990, p. 301 [**S. crispus*; OD; holotype, DEBRENNE & ZHURAVLEV, 1990, pl. 1,*1*, UCMP D6610, Berkeley]. Inner wall with one row of pores per syrinx, bearing upwardly projecting, S-shaped fused bracts; syringes hexagonal in cross section with one pore row per facet. *lower Cambrian (Bot.1):* United States.——FIG. 130,*2a–c*. **S. crispus*, Poleta Formation, Botoman, Lida, Palmetto Mountains, Nevada; *a,* holotype, UCMP D6610, detail of outer wall in tangential section, ×11 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* paratype, UCMP D6620, transverse

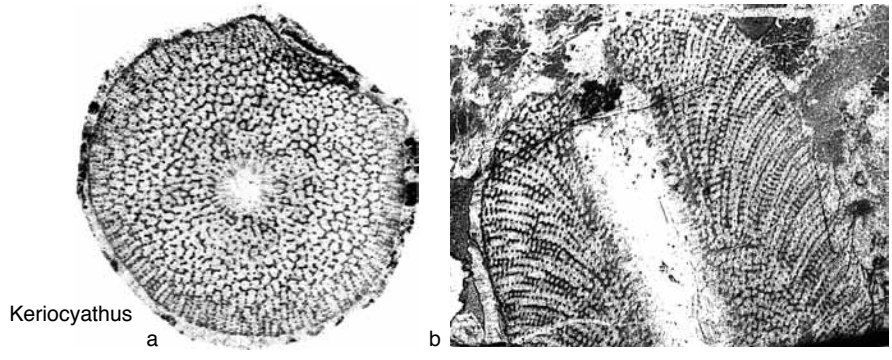


FIG. 125. Keriocyathidae (p. 148–149).

section, ×5; *c,* holotype, UCMP D6610, oblique longitudinal section, ×5 (Debrenne & Zhuravlev, 1990).

Williamicyathus ZHURAVLEV in VORONOVA & others, 1987, p. 34 [**Syringocnema colvillensis* GREGGS, 1959, p. 72; OD; holotype, GREGGS, 1959, pl. 13,*6,* GSC 14317, Ottawa]. Inner wall with one row of pores per syrinx, bearing upwardly projecting, planar, fused bracts; syringes hexagonal in cross section with one pore row per transverse facet and several pore rows per lateral facet. *lower Cambrian (Bot.1–Bot.2):* Canada, United States.——FIG. 131*a–c*. **W. colvillensis* (GREGGS); *a,* Sekwi Formation, Botoman, Mackenzie Mountains, Northwest Territories, Canada, specimen GSC 90169, transverse section, ×7 (Voronova & others, 1987); *b,* Maitlen Formation, Botoman, Colville, Washington, United States, holotype, GSC 14317, transverse section, ×7.5 (Greggs, 1959); *c,* Sekwi Formation, Botoman, Mackenzie Mountains, Northwest Territories, Canada, specimen GSC 90170, oblique transverse section, ×7.5 (Voronova & others, 1987).

FIG. 126. Gatagacyathidae (p. 151).

Superfamily KRUSEICNEMOIDEA Debrenne & Zhuravlev, 1990

[*nom. correct.* DEBRENNE, ZHURAVLEV, & KRUSE, herein, *pro* Kruseicnemidoidea DEBRENNE & ZHURAVLEV, 1992b, p. 117, *nom. transl. ex* Kruseicnemididae DEBRENNE & ZHURAVLEV, 1990, p. 301]

Outer wall pustular. *lower Cambrian (Bot.3).*

Family KRUSEICNEMIDAE Debrenne & Zhuravlev, 1990

[*nom. correct.* DEBRENNE, ZHURAVLEV, & KRUSE, herein, *pro* Kruseicnemididae DEBRENNE & ZHURAVLEV, 1990, p. 301]

Inner wall with bracts, fused bracts or pore tubes. *lower Cambrian (Bot.3).*

Kruseicnema DEBRENNE, GRAVESTOCK, & ZHURAVLEV in DEBRENNE & ZHURAVLEV, 1990, p. 301 [**Syringocnema gracilis* GORDON, 1920, p. 699; OD; holotype, GORDON, 1920, pl. 4,*43,46,* NHM S10412, London]. Outer wall pustules bearing supplementary multiperforate tumuli; inner wall with one row of pores per syrinx, bearing upwardly projecting, S-shaped pore tubes; syringes hexagonal in cross section with several pore rows per facet. *lower Cambrian (Bot.3):* Australia, Antarctica, South Africa (allochthonous), Falkland Islands (allochthonous).——FIG. 132,*1a–b*. **K. gracilis* (GORDON), allochthonous, Botoman, Weddell Sea, Antarctica, holotype, NHM S10412; *a,* oblique

FIG. 127. Auliscocyathidae (p. 151).

longitudinal section, ×9; *b,* transverse section, ×9 (Gordon, 1920).

Superfamily FRAGILICYATHOIDEA Belyaeva, 1975

[*nom. transl.* DEBRENNE & ZHURAVLEV, 1992b, p. 117, *ex* Fragilicyathidae BELYAEVA in BELYAEVA & others, 1975, p. 117]

Outer wall with canals. *lower Cambrian (Bot.1).*

Family FRAGILICYATHIDAE Belyaeva, 1975

[Fragilicyathidae BELYAEVA in BELYAEVA & others, 1975, p. 117]

Inner wall with bracts, fused bracts, or pore tubes. *lower Cambrian (Bot.1).*

Fragilicyathus BELYAEVA, 1969, p. 98 [**F. zhuravlevae*; OD; holotype, BELYAEVA, 1969, pl. 37,*7*, DVGU 6M/212/15-3, Khabarovsk]. Outer wall with horizontal to upwardly projecting, straight canals; inner wall with one row of pores per syrinx, bearing upwardly projecting, S-shaped pore tubes; syringes hexagonal in cross section with several pore rows per facet. *lower Cambrian (Bot.1):* Far East.——FIG. 132,*2.* **F. zhuravlevae*, Ust'toka unit, Botoman, Gerbikan River, Dzhagdy Range, Far East, Russia, holotype, DVGU 6M/212/15-3, oblique longitudinal section, ×5.5 (Debrenne, Zhuravlev, & Kruse, 2002).

Order KAZACHSTANICYATHIDA Konyushkov, 1967

[Kazachstanicyathida KONYUSHKOV, 1967, p. 105]

Cup multichambered, solitary or modular, with massive modular types by individualization of modules around new central cavities; development of thalamid type, with stromatoporoid growth pattern; chambers of subspherical to laterally

FIG. 128. Tuvacnemidae (p. 152).

elongate shape, with pillars. *lower Cambrian (Bot.1–Bot.3).*

Suborder KAZACHSTANICYATHINA Konyushkov, 1967

[*nom. transl.* DEBRENNE & ZHURAVLEV, 1992b, p. 118, *ex* Kazachstanicyathida KONYUSHKOV, 1967, p. 105] [=Kazakhstanicyathida HILL, 1972, p. 130, *nom. null.*; =Korovinellina DEBRENNE, 1991, p. 219]

Initial chambers hollow and elongate; pillars developed in subsequent chambers; inner wall invaginal. *lower Cambrian (Bot.1–Bot.3).*

Family KOROVINELLIDAE Khalfina, 1960

[Korovinellidae KHALFINA, 1960, p. 80] [=Kazachstanicyathidae KONYUSHKOV, 1967, p. 106; =Kazakhstanicyathidae HILL, 1972, p. 130, *nom.null.*]

Outer and inner walls with simple pores. *lower Cambrian (Bot.1–Bot.3).*

Korovinella RADUGIN in KHALFINA, 1960, p. 80 [**Clathrodictyon sajanicum* YAVORSKY, 1932, p. 614; OD; holotype, YAVORSKY, 1932, fig. 4–5, M, TsNIGRm 4a,b/4070, St. Petersburg] [=*Kazachstanicyathus* KONYUSHKOV, 1967, p. 106 (type, *K. fistulatus,* OD); =*Kazakhstanicyathus* HILL, 1972, p. 130, *nom. null.*]. Outer and inner walls tabular; chambers of simple segmented tabulae and pillars. *lower Cambrian (Bot.3):* Altay Sayan, Kazakhstan.——FIG. 133,*1a–b*. **K. sajanica* (YAVORSKY), Verkhnemonok Formation, Botoman, Sanashtykgol Spring, West Sayan, Altay Sayan, Russia; *a,* oblique transverse section, topotype, PIN 4754/10, ×10 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* holotype, TsNIGRm 4a,b/4070, transverse section of modular skeleton, ×10 (Yavorsky, 1932).

Bicoscinus DEBRENNE, 1977a, p. 127 [**B. sdzuyi*; OD; holotype, DEBRENNE, 1977a, pl. 14,*2*, MNHN M80058, specimen IRH13-1d, Paris]. Outer wall aporose (possibly rudimentary); inner wall simple; tabulae. *lower Cambrian (Bot.1):* Morocco.——FIG. 133,*2*. **B. sdzuyi*, Issafen Formation, Botoman, Jbel Irhoud, holotype, MNHN M80058, specimen IRH13-1d, oblique longitudinal section, ×5 (Debrenne, 1977a).

Suborder ALTAICYATHINA Debrenne, 1991

[Altaicyathina DEBRENNE, 1991, p. 219]

Initial chambers subspherical; pillars present in initial and subsequent chambers. *lower Cambrian (Bot.1–Bot.2).*

Family ALTAICYATHIDAE Debrenne & Zhuravlev, 1992

[Altaicyathidae DEBRENNE & ZHURAVLEV, 1992b, p. 118]

Outer and inner walls with simple pores. *lower Cambrian (Bot.1–Bot.2).*

Altaicyathus VOLOGDIN, 1932, p. 26 [**A. notabilis*; M; lectotype, VOLOGDIN, 1932, pl. 1,*5;* SD DEBRENNE & ZHURAVLEV, 1992b, p. 48, TsNIGRm 290/2957, St. Petersburg] [=*Praeactinostroma* KHALFINA, 1960, p. 81 (type, *Actinostroma vologdini* YAVORSKY, 1932, p. 613, OD); =*Cambrostroma* VLASOV, 1961, p. 29 (type, *C. rossicum*, OD); =*Abakanicyathus* KONYUSHKOV in ZHURAVLEVA, KONYUSHKOV, & ROZANOV, 1964, p. 127 (type, *A. karakolensis*, OD), for discussion, see DEBRENNE & ZHURAVLEV, 1992b, p. 119; =*Altaicyathus notabilis* VOLOGDIN, 1932, p. 26)]. Outer and inner walls tabular; chambers of simple segmented tabulae and pillars; exaules and astrorhizae may be present. *lower Cambrian (Bot.1–Bot.2):* Altay Sayan, Mongolia, Far East, United States.——FIG. 134. **A. notabilis*, Verkhneynyrga Formation, Botoman, Lebed' River, Altay Mountains, Altay Sayan, Russia, lectotype, TsNIGRm 290/2957, longitudinal section, ×9 (Vologdin, 1932).

NOMINA DUBIA

Adaecyathus FONIN in ZHURAVLEV, ZHURAVLEVA, & FONIN, 1983, p. 28 (FONIN in KRASNOPEEVA, 1978, p. 81, *nom. nud.*) [**A. gravis*; OD].

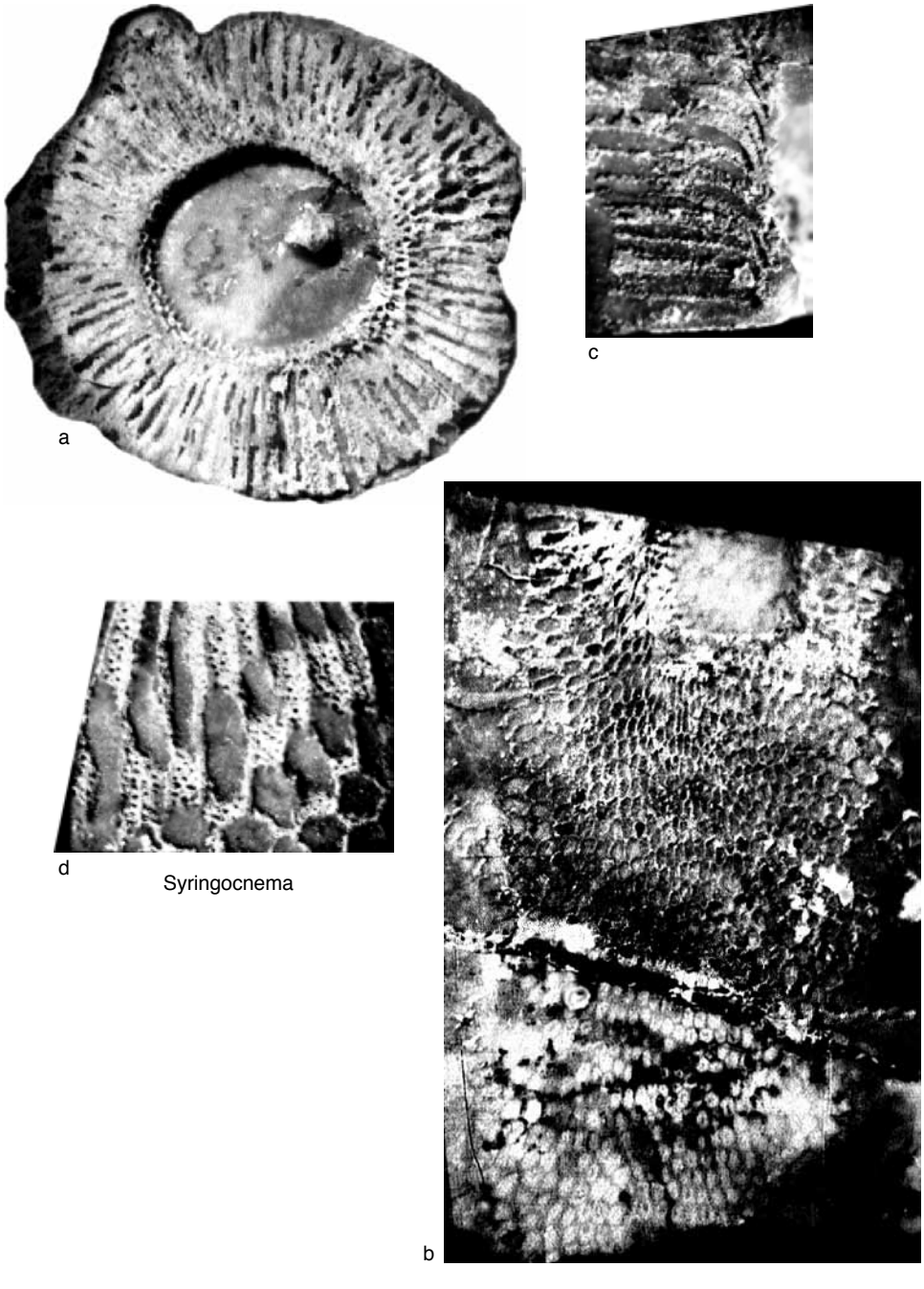


FIG. 129. Syringocnemidae (p. 152).

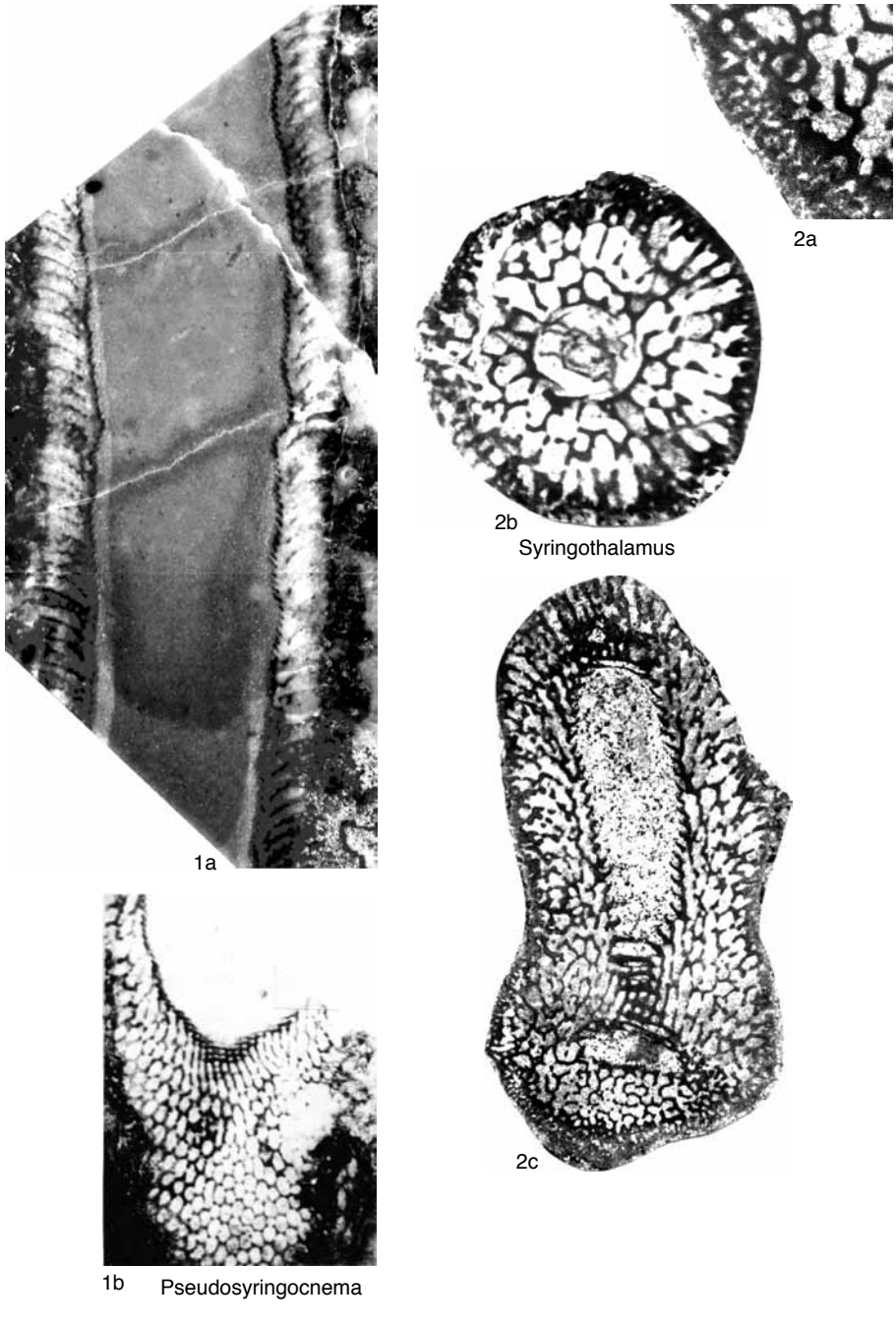


FIG. 130. Syringocnemidae (p. 152–154).

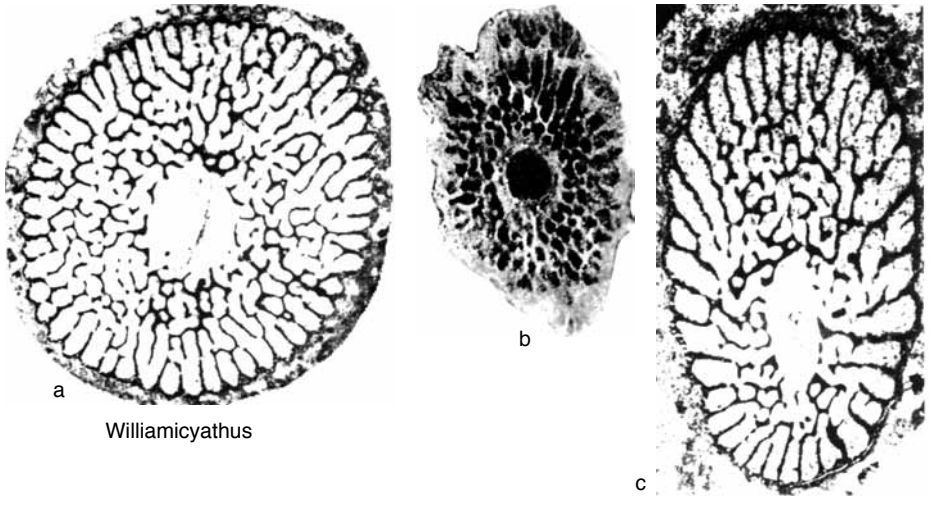


FIG. 131. Syringocnemidae (p. 154).

Araneocyathus VOLOGDIN in SIMON, 1941, p. 5 (VOLOGDIN, 1937b, p. 466, *nom. nud.*) [**A. curvus* VOLOGDIN, 1940a, p. 64; SD SIMON, 1941, p. 5].

Archaeocyathellus FORD, 1873b, p. 135 [**Archaeocyathus? rensselaericus* FORD, 1873a, p. 211; M].

ARCHAEOCYATHOSPONGIA VOLOGDIN, 1940a, p. 27 (class).

Archaeofungiella ZHURAVLEVA in ZHAUTIKOV & others, 1976, p. 137 [**A. chingisiensis*; OD].

ARCHAEOPHYLLIDA OKULITCH, 1943, p. 46, *nom. correct*. OKULITCH, 1955a, p. 10, *pro* order Archaeophyllina OKULITCH, 1943, p. 46.

ARCHAEOPHYLLIDAE VOLOGDIN, 1940b, p. 97 [=Archaeophyllidae VOLOGDIN, 1931, p. 60, *nom. nud.*].

Archaeophyllum VOLOGDIN in SIMON, 1939, p. 21 (VOLOGDIN, 1931, p. 61, *nom. nud.*) [**A. edelsteini* VOLOGDIN, 1931, p. 62; SD SIMON, 1939, p. 21].

BACATOCYATHIDAE ZHURAVLEVA, 1960b, p. 268, *nom. correct*. HILL, 1965, p. 116, *pro* Batchatocyathidae ZHURAVLEVA, 1960b, p. 268.

Bacatocyathus VOLOGDIN, 1940b, p. 95, *nom. correct*. HILL, 1965, p. 116, *pro Bačatocyathus* VOLOGDIN, 1940b, p. 95 [**B. kazakevici*; OD] [=*Batschatocyathus* VOLOGDIN, 1956, p. 878, *nom. null.*; =*Batchatocyathus* ZHURAVLEVA, 1960b, p. 268, *nom. null.*].

Beticocyathus SIMON, 1939, p. 73 [**B. beticus*; OD].

BICYATHIDAE VOLOGDIN, 1937b, p. 472.

Bicyathus VOLOGDIN, 1939, p. 235 (VOLOGDIN, 1937b, p. 472, *nom. nud.*) [**B. angustus*; OD].

Butovia VOLOGDIN, 1931, p. 63 [**B. serrata*; M].

CROMMYOCYATHINA R. BEDFORD & J. BEDFORD, 1939, p. 79 (order).

Dendrocyathus OKULITCH & ROOTS, 1947, p. 44 [**D. unexpectans*; M].

Echinocyathus H. TERMIER & G. TERMIER, 1950, p. 47 [**E. goundafensis*; OD] [=*Dictyocyathus (Echinocyathus)* H. TERMIER & G. TERMIER, 1950, p. 47, *nom. transl.* DEBRENNE, 1964, p. 207, *ex Echinocyathus* H. TERMIER & G. TERMIER, 1950, p. 47].

Echinocyathus VOLOGDIN, 1960, p. 424, *non* H. TERMIER & G. TERMIER, 1950, p. 47 (type, *E. goundafensis,* OD) [**E. bilateralis*; OD].

ETHMOLYNTHIDAE ZHURAVLEVA, 1963b, p. 112, *nom. transl.* HILL, 1972, p. 51, *ex* Ethmolynthinae ZHURAVLEVA, 1963b, p. 112.

Ethmolynthus ZHURAVLEVA, 1963b, p. 112 [**E. rosanovi*; OD].

EXOCYATHA OKULITCH, 1943, p. 42 (subclass).

EXOCYATHIDAE R. BEDFORD & J. BEDFORD, 1939, p. 82.

Exocyathus R. BEDFORD & J. BEDFORD, 1937, p. 32 [**E. australis*; OD].

Gorskinocyathus VOLOGDIN, 1960, p. 422 [**Archaeocyathus gorskinensis* VOLOGDIN, 1940b, p. 60; OD].

Kameschkovia VOLOGDIN, 1957a, p. 183 (VOLOGDIN, 1956, p. 880, *nom. nud.*) [**Labyrinthomorpha perforata* VOLOGDIN, 1940b, p. 40; M].

LABYRINTHOCYATHIDAE YAROSHEVICH, 1962, p. 117.

Labyrinthocyathus YAROSHEVICH, 1962, p. 117 [**L. grandiporosus*; M].

Labyrinthomorpha VOLOGDIN, 1931, p. 35 [**L. tolli*; M] [=*Labirinthomorpha* VOLOGDIN, 1928, p. 32, *nom. nud.*].

LABYRINTHOMORPHIDA VOLOGDIN, 1961, p. 180 (order).

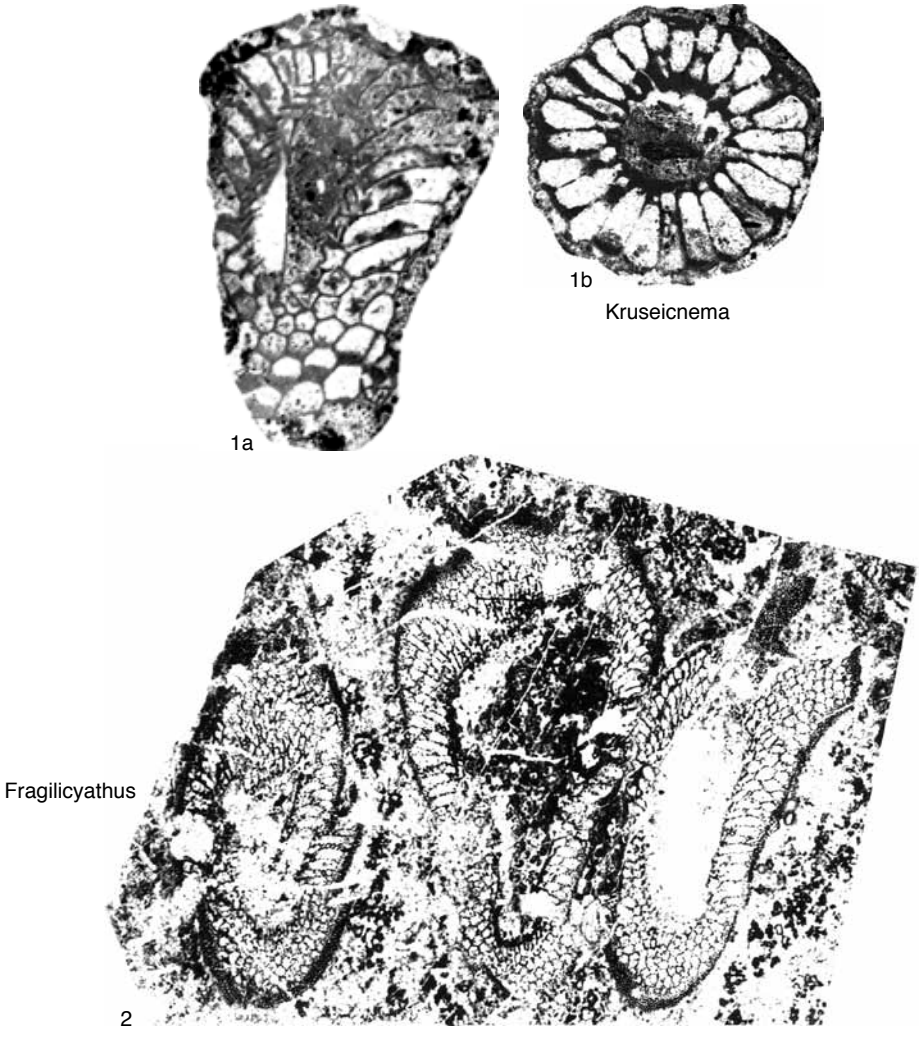


FIG. 132. Kruseicnemidae and Fragilicyathidae (p. 154–155).

LABYRINTHOMORPHIDAE VOLOGDIN, 1962a, p. 125 [=Labirinthomorphidae VOLOGDIN, 1928, p. 32, *nom. nud.*].

LABYRINTHOMORPHINA VOLOGDIN, 1961, p. 180 (superorder), *nom. transl.* VOLOGDIN, 1962a, p. 125, *ex* order Labyrinthomorphida VOLOGDIN, 1961, p. 180].

LEECYATHIDAE VOLOGDIN, 1957c, p. 495 [=Leecyathidae VOLOGDIN, 1956, p. 879, *nom. nud.*].

Leecyathus VOLOGDIN, 1957c, p. 495 [**Archaeocyathus yavorskii* VOLOGDIN, 1931, p. 86; OD] [=*Zeecyathus* VOLOGDIN, 1956, p. 879, *nom. nud., lapsus calami pro Leecyathus*].

Leiocyathus VOLOGDIN, 1959a, p. 671 [**L. inaequitaenialis*; OD].

Nevadacyathus OKULITCH, 1943, p. 59 [**Archaeocyathus septaporus* OKULITCH, 1935, p. 101; M].

Pinacocyathus R. BEDFORD & W. R. BEDFORD, 1934, p. 4 [**P. spicularis*; M].

Potekhinocyathus VOLOGDIN, 1957d, p. 699 [**P. bateniensis*; M].

Protocyclocyathus VOLOGDIN, 1955, p. 142 [**Cyclocyathus irregularis* VOLOGDIN, 1940b, p. 62; M].

RHIZACYATHIDAE R. BEDFORD & J. BEDFORD, 1939, p. 69.

Rhizacyathus R. BEDFORD & J. BEDFORD, 1939, p. 69 [**Protopharetra radix* R. BEDFORD & J. BEDFORD, 1937, p. 28; OD].

Salopicyathus VOLOGDIN, 1962c, p. 86 [**S. complanatoporosus*; OD].

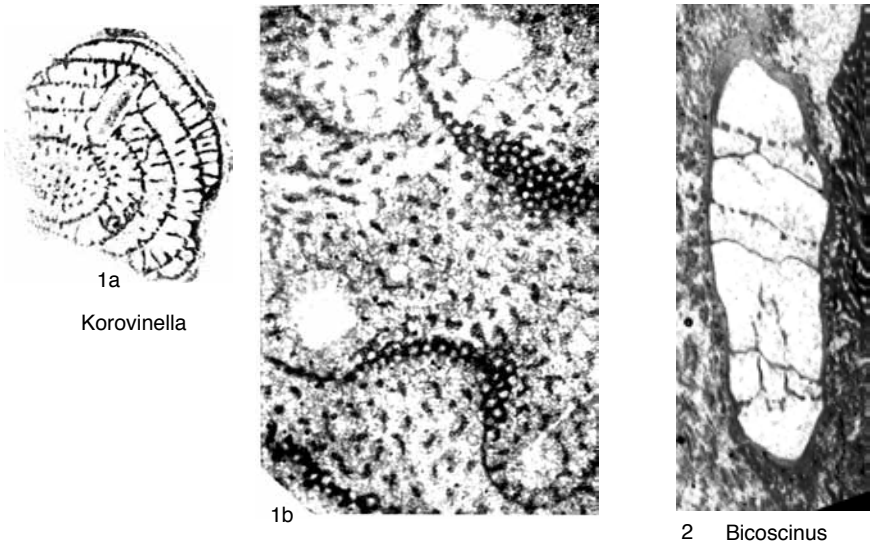


FIG. 133. Korovinellidae (p. 156).

Septocyathus VOLOGDIN, 1937b, p. 468 [**S. pedaschenkoi*; M].
Serligocyathus VOLOGDIN, 1959a, p. 671 [**S. lukashevi*; OD].
SOMPHOCYATHIDAE OKULITCH, 1935, p. 98.
Somphocyathus TAYLOR, 1910, p. 134 [**S. coralloides*; M].
Sphinctocyathus (Sphinctocyathus) ZHURAVLEVA, 1960b, p. 304 [**S. (S.) oimuranicus*; OD].
Squamella VOLOGDIN, 1977, p. 75, *non* BORY DE SAINT-VINCENT, 1826, p. 90 (type, *S. limulina,* M), rotifer [**S. prima*; OD] [=*Squamellicyathus* VOLOGDIN, 1977, p. 22, *nom. nud.*].
TABULACYATHIDA VOLOGDIN, 1956, p. 878 (order), *nom. correct.* HILL, 1972, p. 121 *pro* Tabulocyathida VOLOGDIN, 1956, p. 878, *lapsus calami.*
TABULACYATHIDAE VOLOGDIN, 1956, p. 878, *nom. correct.* HILL, 1972, p. 123, *pro* Tabulathyathidae VOLOGDIN in REPINA & others, 1964, p. 249, *nom. correct. pro* Tabulocyathidae VOLOGDIN, 1956, p. 878, *lapsus calami.*
Tabulacyathus VOLOGDIN, 1932, p. 30 [**T. taylori;* M] [=*Tabulocyathus* VOLOGDIN, 1937b, p. 471, *nom. null.*].
TABULOIDEA VOLOGDIN, 1957a, p. 183 (class).
TANNUOLACYATHIDAE DEBRENNE, 1964, p. 188.
Tannuolacyathus VOLOGDIN, 1957c, p. 496 [**T. multiplex;* OD].
TEREKTIGOCYATHIDAE VOLOGDIN, 1962b, p. 419.
Terektigocyathus VOLOGDIN, 1962b, p. 420 [**T. primus*; OD].
Tersia VOLOGDIN, 1931, p. 70 [**T. filiforma*; M].
Tersiella VOLOGDIN, 1962a, p. 129 [**Tersia nodosa* VOLOGDIN, 1940a, p. 34; OD].
THALASSOCYATHIDAE VOLOGDIN, 1962a, p. 116.
Thalassocyathus VOLOGDIN, 1957d, p. 699 [**T. acutatus*; M].
Torgaschinocyathus VOLOGDIN, 1957d, p. 699 [**T. spinosus*; M].
Turgidocyathus VOLOGDIN, 1960, p. 422 [**T. ippolitovensis*; OD].

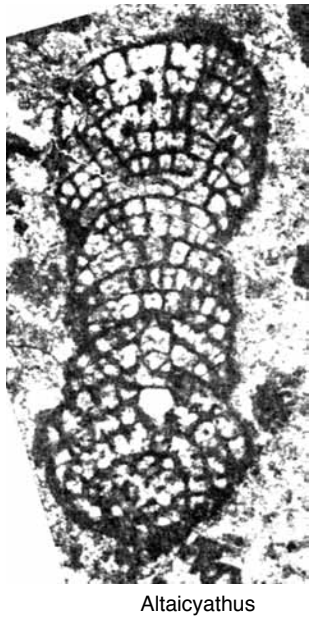


FIG. 134. Altaicyathidae (p. 156).

Tuvacyathus Vologdin, 1940a, p. 112 (Vologdin, 1937b, p. 471, *nom. nud.*) [**T. mollimurus*; M].

URALOCYATHIDAE Vologdin & Zhuravleva in Vologdin, 1956, p. 878 [=Vacuocyathidae Vologdin, 1962c, p. 77].

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