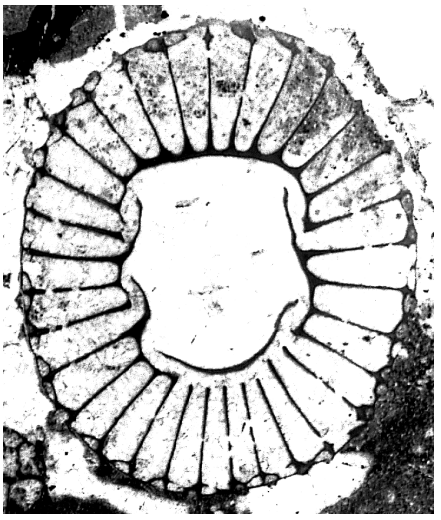
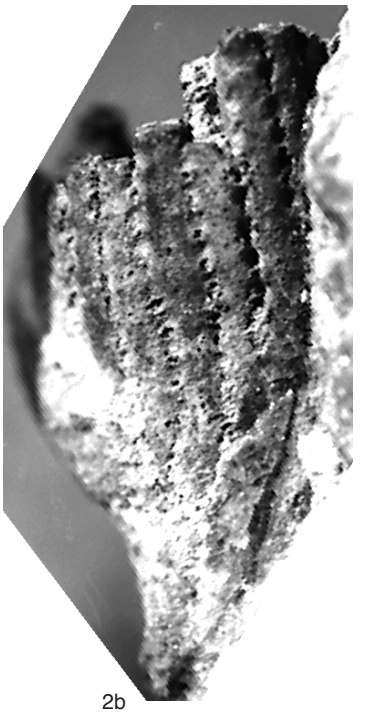
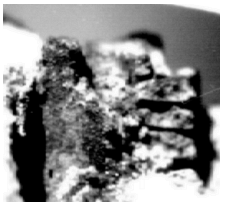


1a Flexanulus

1b



2b



2a Protocyathus

3 Yudjaicyathus

FIG. 566. Kijacyathidae (p. 981–984).

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, Falkland Islands (allochthonous), South Africa (allochthonous).——Fig. 566,*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. 566,*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).

Qinlingocyathus Yang & Yuan, 2012, p. 599 [**Q. astomus*; OD; holotype, Yang & Yuan, 2012, fig. 7B–E, NIGP FVI-1a (8)a,b, Nanjing]. 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 aporose to sparsely porous. *lower Cambrian (Atd.3):* South China.——Fig. 565,*4a–b*. **Q. astomus*, Xiannudong Formation, Fucheng, Nanzhen, Shaanxi, China, holotype, NIGP FVI-1a (8)a,b; *a,* longitudinal section, ×5; *b,* transverse section, ×6 (Yang & Yuan, 2012; copyright ©2012 Elsevier Masson SAS, all rights reserved).

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. 566,*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).

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. 567,*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. 567,*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. 567,*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. 567,*4a–b*. **V. schischlovi*, Verkhnemonok Formation, Botoman, Bol'shoy Karakol River, West

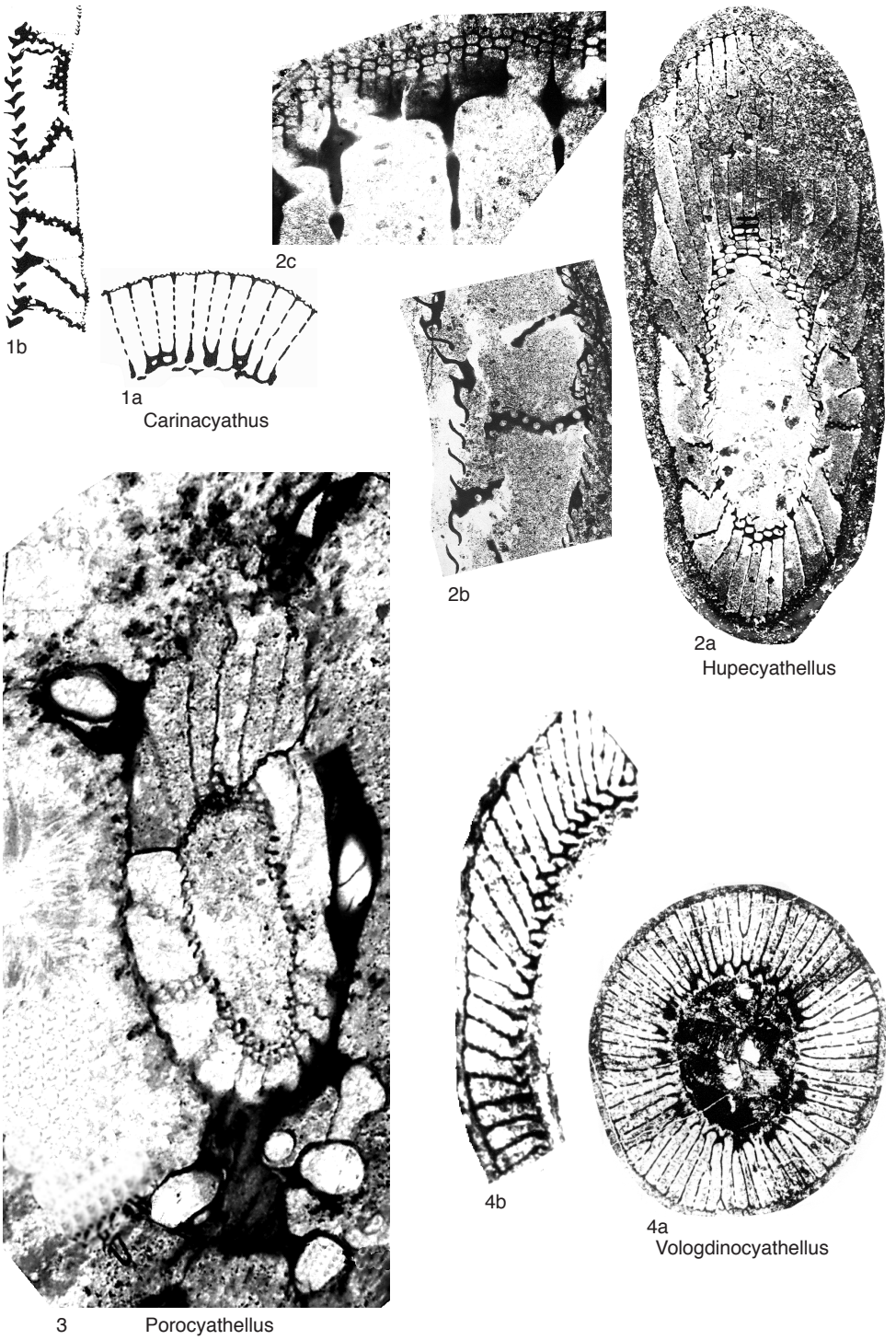


FIG. 567. Carinacyathidae (p. 984–987).

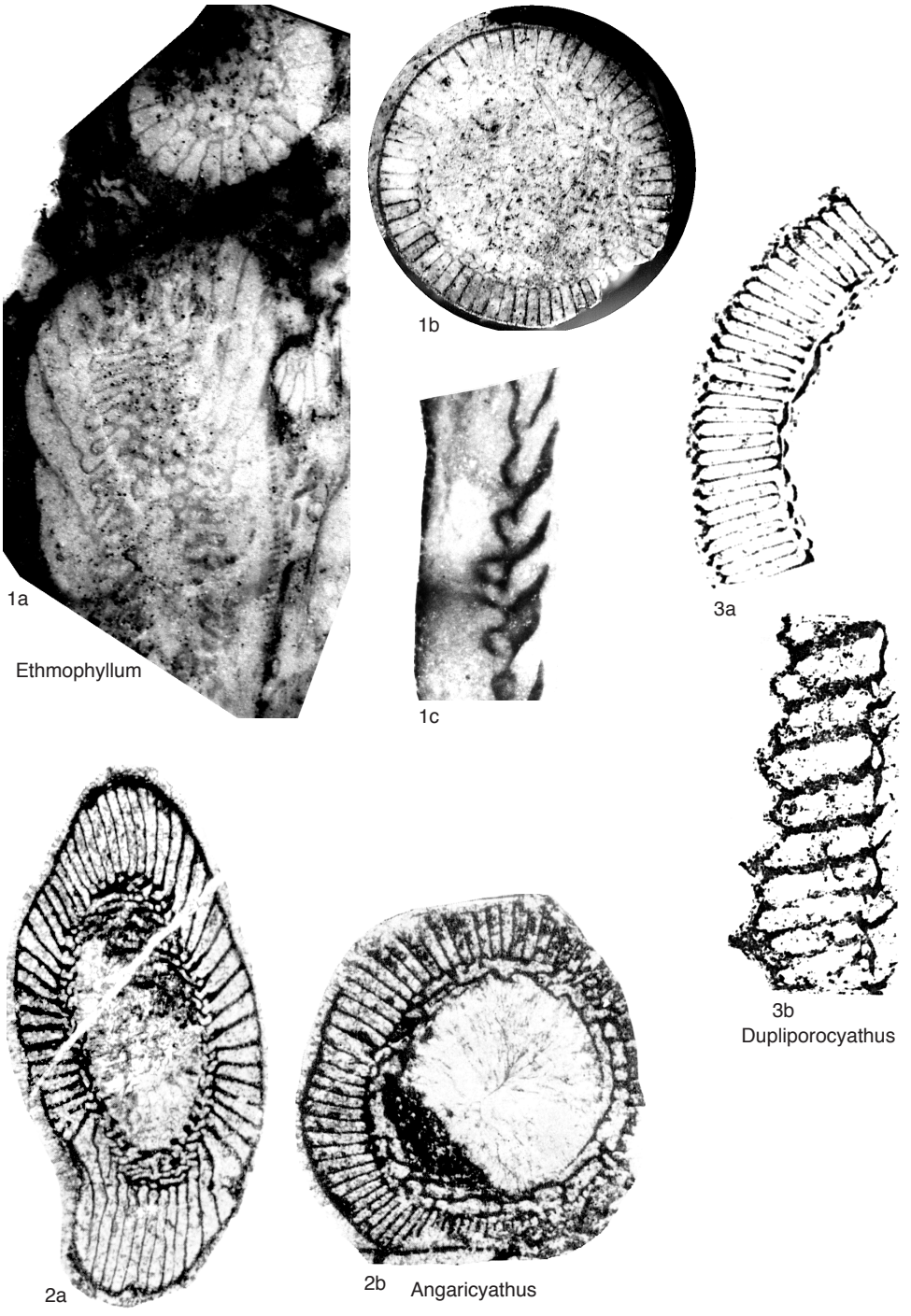


FIG. 568. Ethmophyllidae (p. 987).

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. 568,*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. 568,*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 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. 569,*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. 569,*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. 568,*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; reproduced from Debrenne & others, 2002. ©Kluwer Academic/Plenum Publishers, New York, p. 1593, Figure 31H–I with kind permission of Springer Science and Business Media).

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*

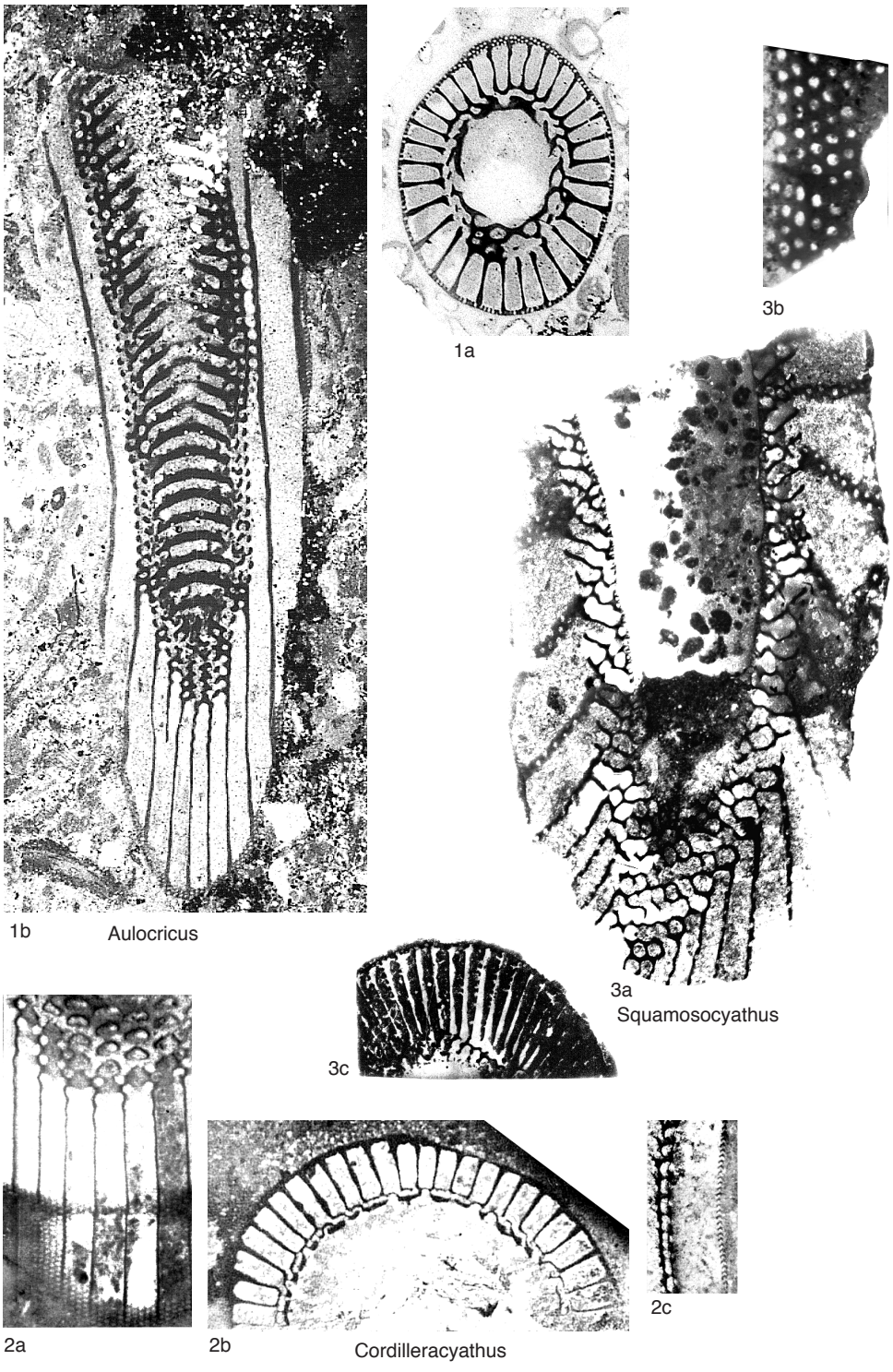


FIG. 569. Ethmophyllidae (p. 987–990).

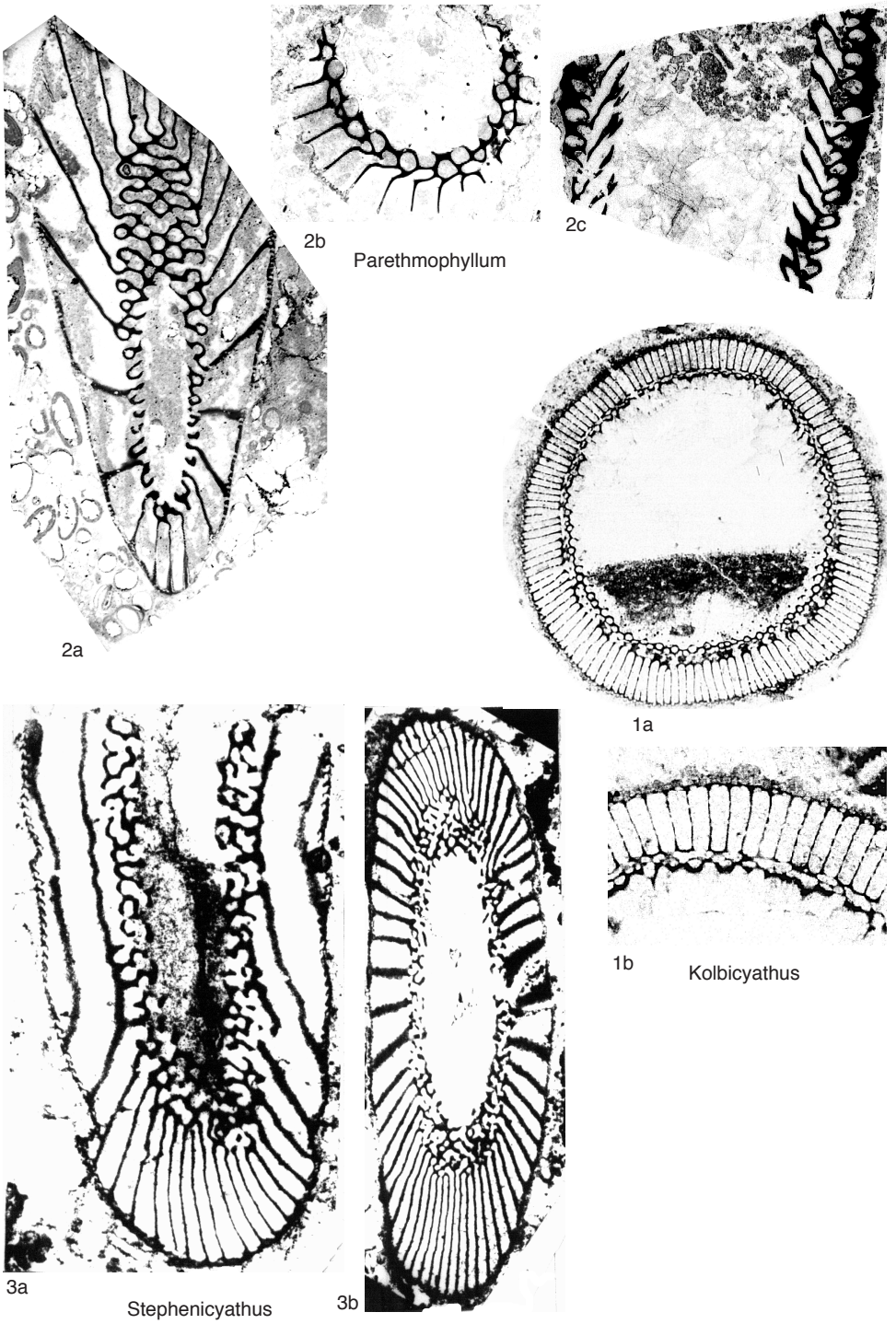


FIG. 570. Ethmophyllidae (p. 987–990).

Cambrian (Bot.1): Altay Sayan, Mongolia.——Fig. 570,*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. 570,*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. 569,*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. 570,*3a–b*. **S. rowlandi*, Sekwi Formation, Botoman, Mackenzie Mountains, Northwest Territories, Canada; *a,* 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. 571,*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).

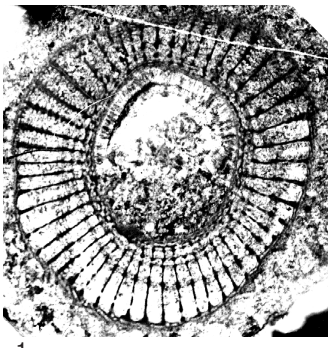
Family BOTOMOCYATHIDAE Zhuravleva, 1955

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

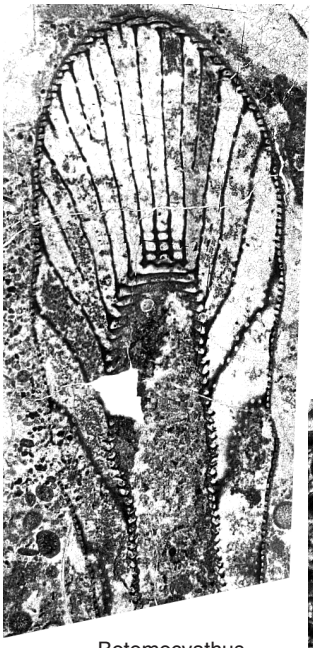
Inner wall with annuli. *lower Cambrian (Atd.4–Bot.3).*

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. 571,*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).

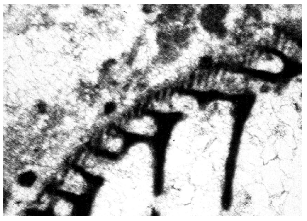
Clathrithalamus Debrenne & Kruse, 1986, p. 256 [**C. mawsoni*; OD; holotype, Debrenne & Kruse, 1986, fig. 21A–C, GNS MG511, Lower Hutt]. Inner wall with one pore row per intersept and upright, V-shaped annuli; septa aporose to sparsely porous; pectinate tabulae may be present. *lower Cambrian (Bot.3):* Antarctica.——Fig. 571,*3a–c*. **C. mawsoni*, Shackleton Limestone, Botoman, Holyoake Range, Nimrod



1 Piamaecyathellus



2a Botomocyathus



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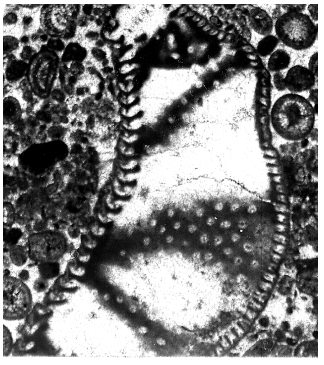

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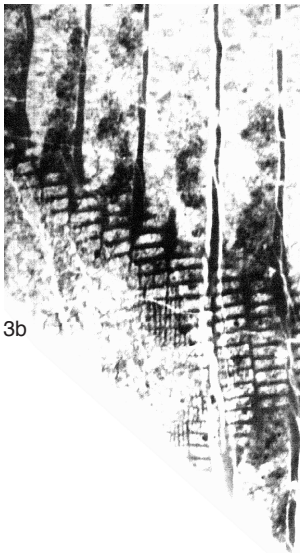
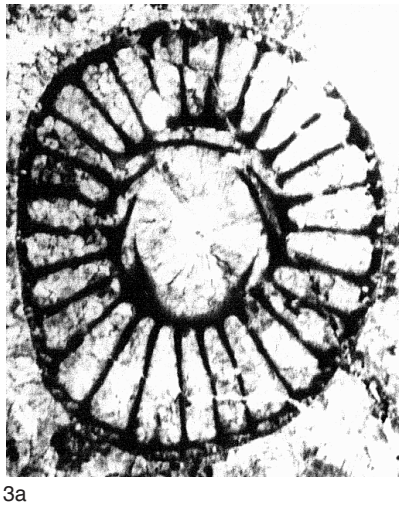
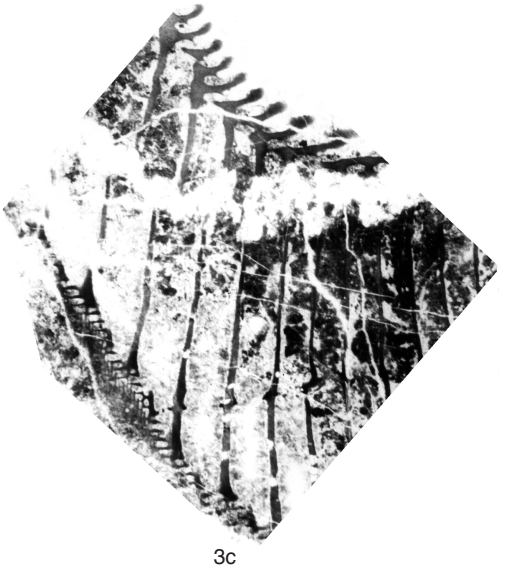


3b



3a



3c Clathrithalamus

FIG. 571. Piamaecyathellidae and Botomocyathidae (p. 990–992).

FIG. 572. Olgaecyathidae (p. 992).

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. 572. **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).*

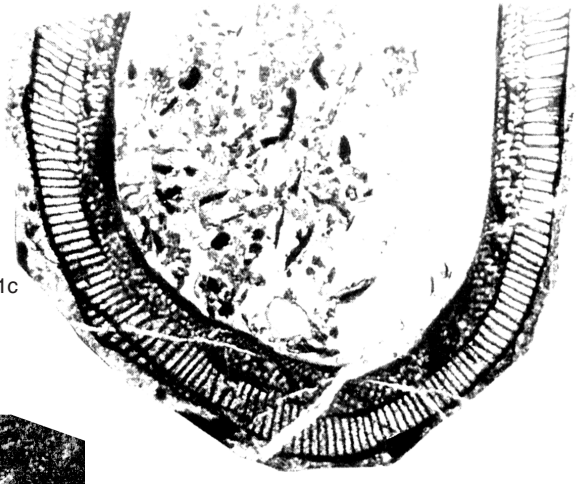
Tercyathus VOLOGDIN in SIMON, 1939, p. 40 (VOLOGDIN, 1932, p. 55, *nom. nud.*, without designated type species) [**T. duplex* VOLOGDIN, 1932, p. 56; OD; lectotype, VOLOGDIN, 1932, pl. 13,*2;* SD BORODINA, 1974, p. 154, TsNIGRm 71a-g/2957, St. Petersburg] [=*Piamaecyathus* ZHURAVLEVA, 1960a, p. 45 (type, *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. 573,*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, 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. 573,*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).

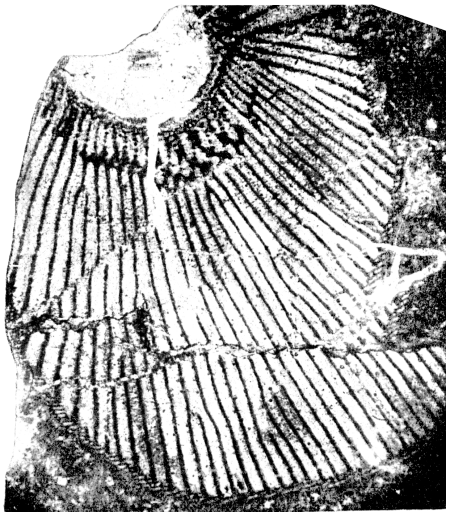
Clathricyathus VOLOGDIN in SIMON, 1939, p. 25 (VOLOGDIN, 1932, p. 50, *nom. nud.*, without designated type species) [**C. firmus* VOLOGDIN, 1932, p. 50; OD; lectotype, VOLOGDIN, 1932, pl. 10,*12;* SD BORODINA, 1974, p. 150, TsNIGRm 65, 65a-v/2957, St. Petersburg] [=*Clathrocyathus* VOLOGDIN, 1937b, p. 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;

1a Tercyathus

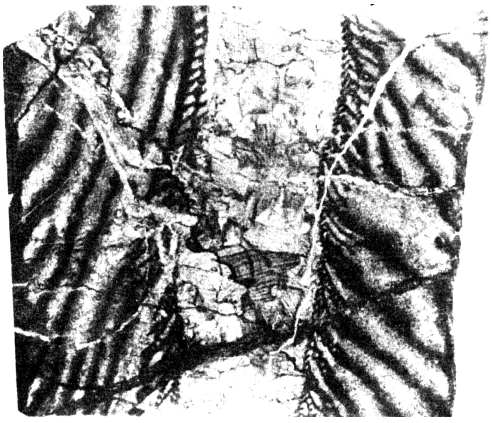
1b



1c



2a Clathricyathellus



2b

FIG. 573. Tercyathidae (p. 992).

FIG. 574. Tercyathidae (p. 992–994).

pectinate tabulae may be present. *lower Cambrian (Bot.3):* Altay Sayan.——FIG. 574,*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. 574,*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).*

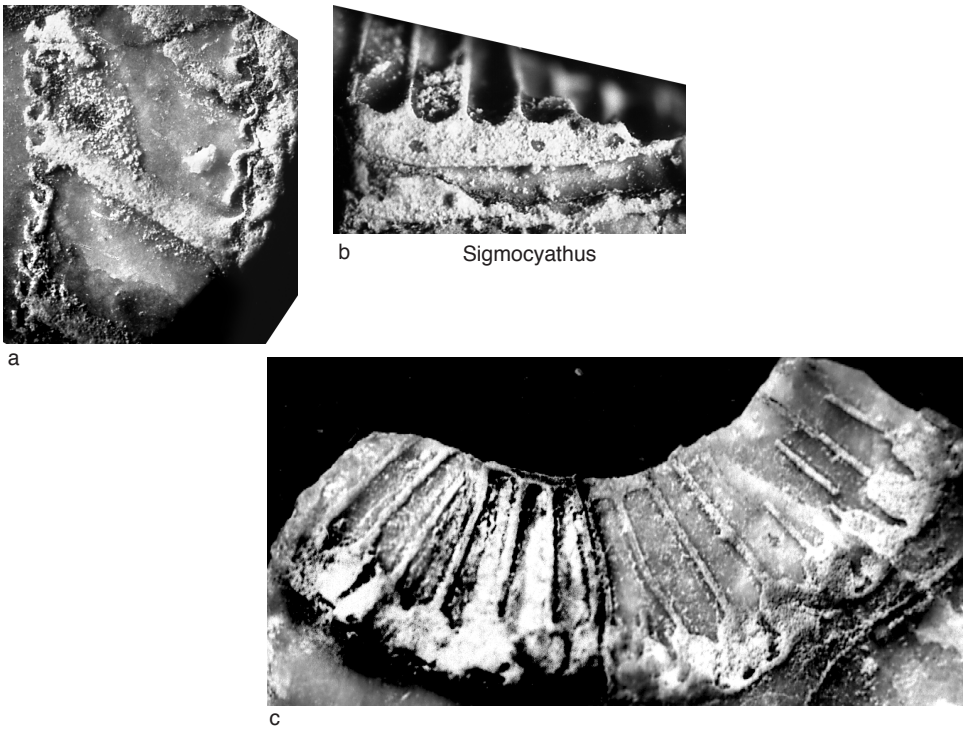


FIG. 575. Sigmocyathidae (p. 995).

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 per intersept and upwardly projecting, S-shaped annuli; septa aporose to sparsely porous. *lower Cambrian (Bot.3):* Australia, ?Antarctica.——FIG. 575*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. 576*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. 577*a–c*. **W. nexus*, Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia, holotype, AM F.83298; *a,* transverse section, AM FT.8268, ×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).

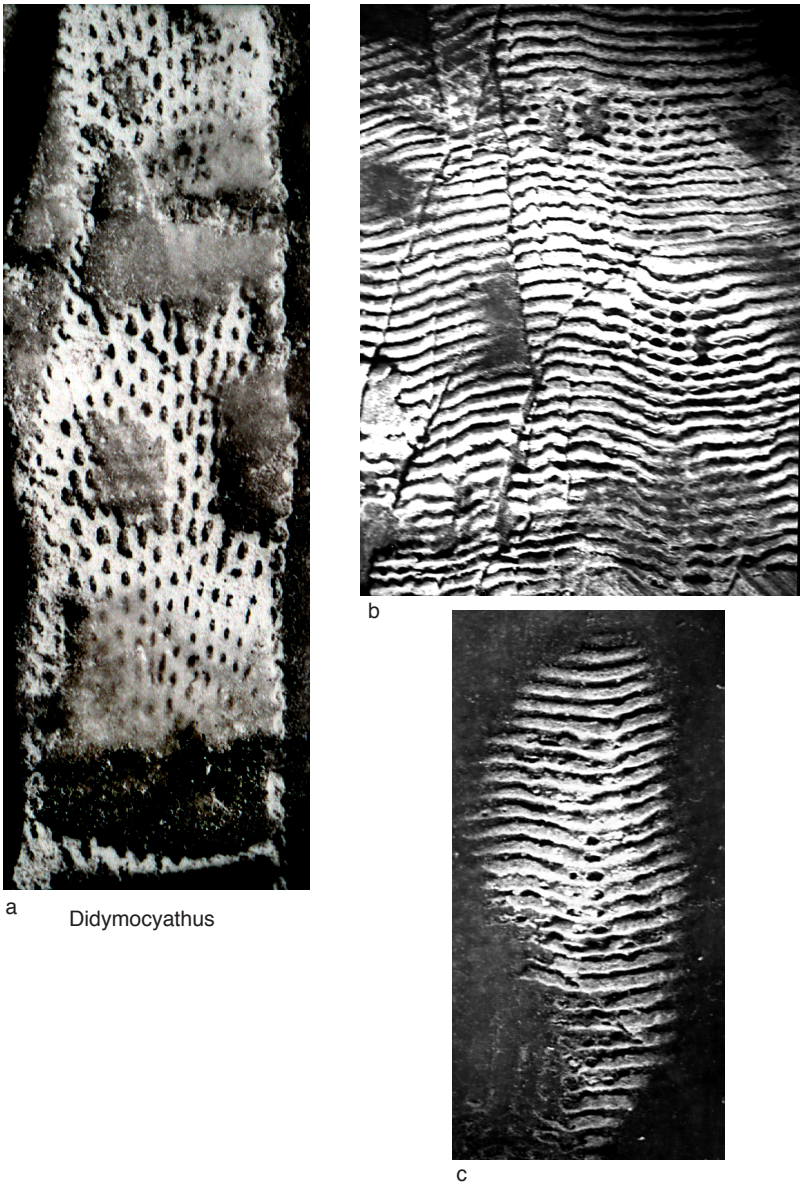


FIG. 576. Sigmocyathidae (p. 995).

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).*

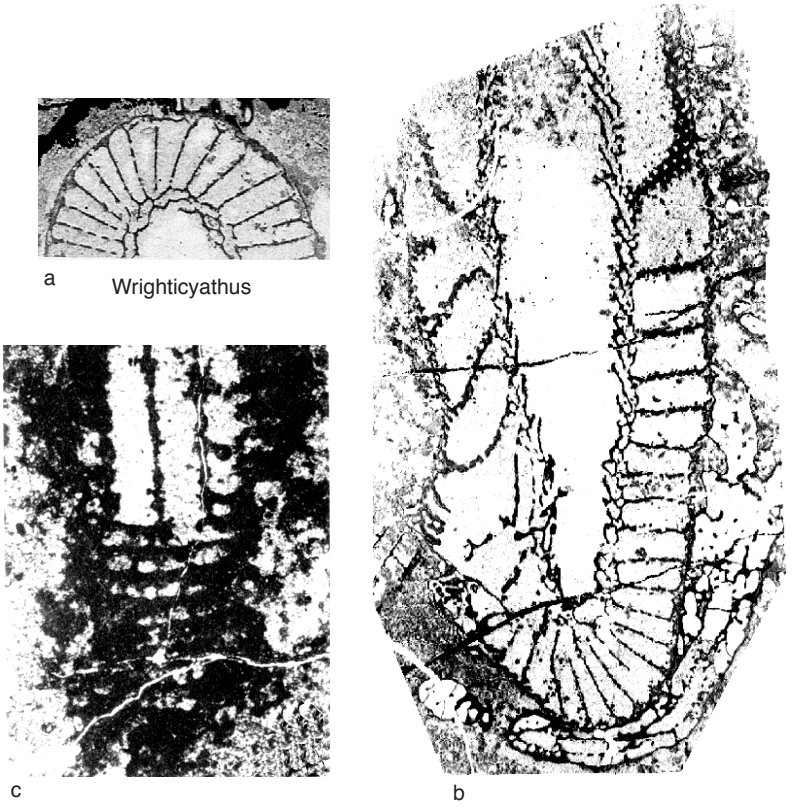


FIG. 577. Wrighticyathidae (p. 995).

Family ASTEROCYATHIDAE Vologdin, 1956

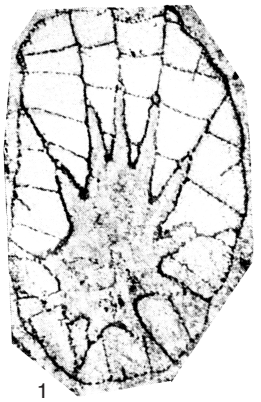
[Asterocyathidae VOLOGDIN, 1956, p. 879] [=Erismacoscinidae DEBRENNE, 1964, p. 166; =Syringocoscinidae VOLOGDIN & YAZMIR, 1967, p. 1375]

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. 578,*1. *A. salairicus*, Gavrilovskoe Formation, Atdabanian, Belaya Gorka, Gorskino, Salair, Russia, unlocated syntype, oblique transverse section, ×5 (Vologdin, 1940b).

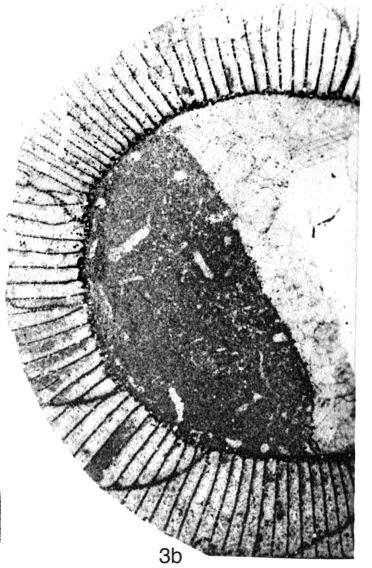
Antoniococsinus ZHURAVLEV in DEBRENNE, ZHURAVLEV, & ROZANOV, 1988, p. 98 [**Coscinocyathus vsevolodi* KORSHUNOV in ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, p. 51; OD; holotype, ZHURAVLEVA, KORSHUNOV, & ROZANOV, 1969, pl. 20,*2,4;* KORSHUNOV, 1972, pl. 15,*5;* pl. 16,*5*), TsSGM 323/84, Novosibirsk]. Inner 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, South China, Morocco, Iberia, Sardinia.——FIG. 578,*2a–b*. **A. vsevolodi* (KORSHUNOV), Oy-Muran reef massif, Botoman, Oy-Muran, Lena River, Sakha (Yakutia), Russia, holotype, TsSGM 323/84; *a,* transverse section, ×4 (Debrenne, Zhuravlev, & Kruse, 2012b); *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 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, ?Falkland



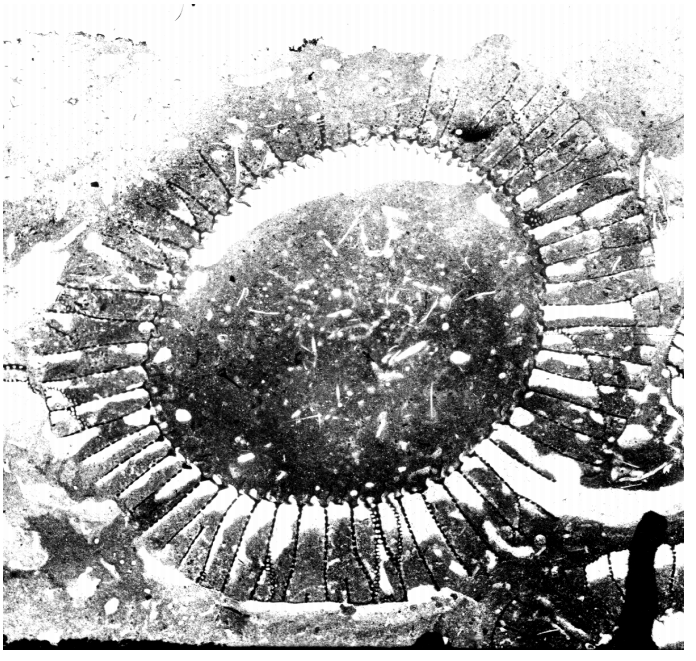
1
Asterocyathus

3a



3b
Erismacoscinus

2b
Antoniocoscinus



2a

FIG. 578. Asterocyathidae (p. 997–999).

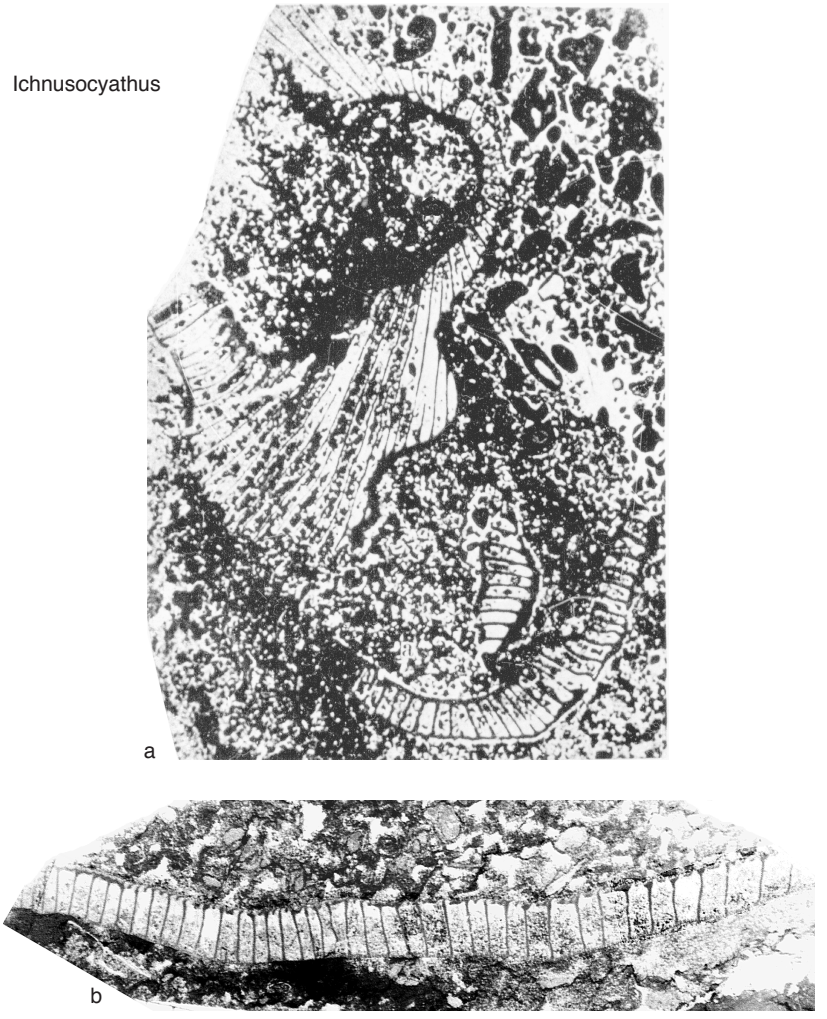


FIG. 579. Asterocyathidae (p. 999).

Islands (allochthonous), Tarim, South China, Morocco, Iberia, France, Sardinia, Germany.——FIG. 578,*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. 579*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.

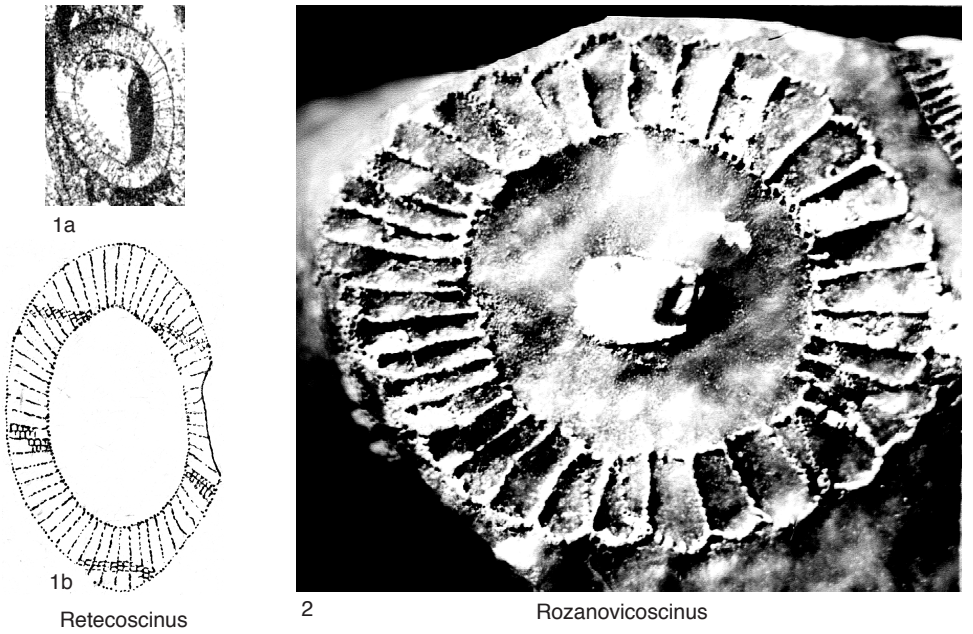


FIG. 580. Asterocyathidae (p. 999–1000).

580,*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. 580,*2. *R. fonini*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, holotype, USNM PU86614, transverse view, ×5 (Debrenne, 1970a).

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. 581,*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 (Debrenne, Zhuravlev, & Kruse, 2012b).

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 bracts; septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* South China.——FIG. 581,*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. 581,*3. *Y. futchinensis*, Xiannudong Formation,

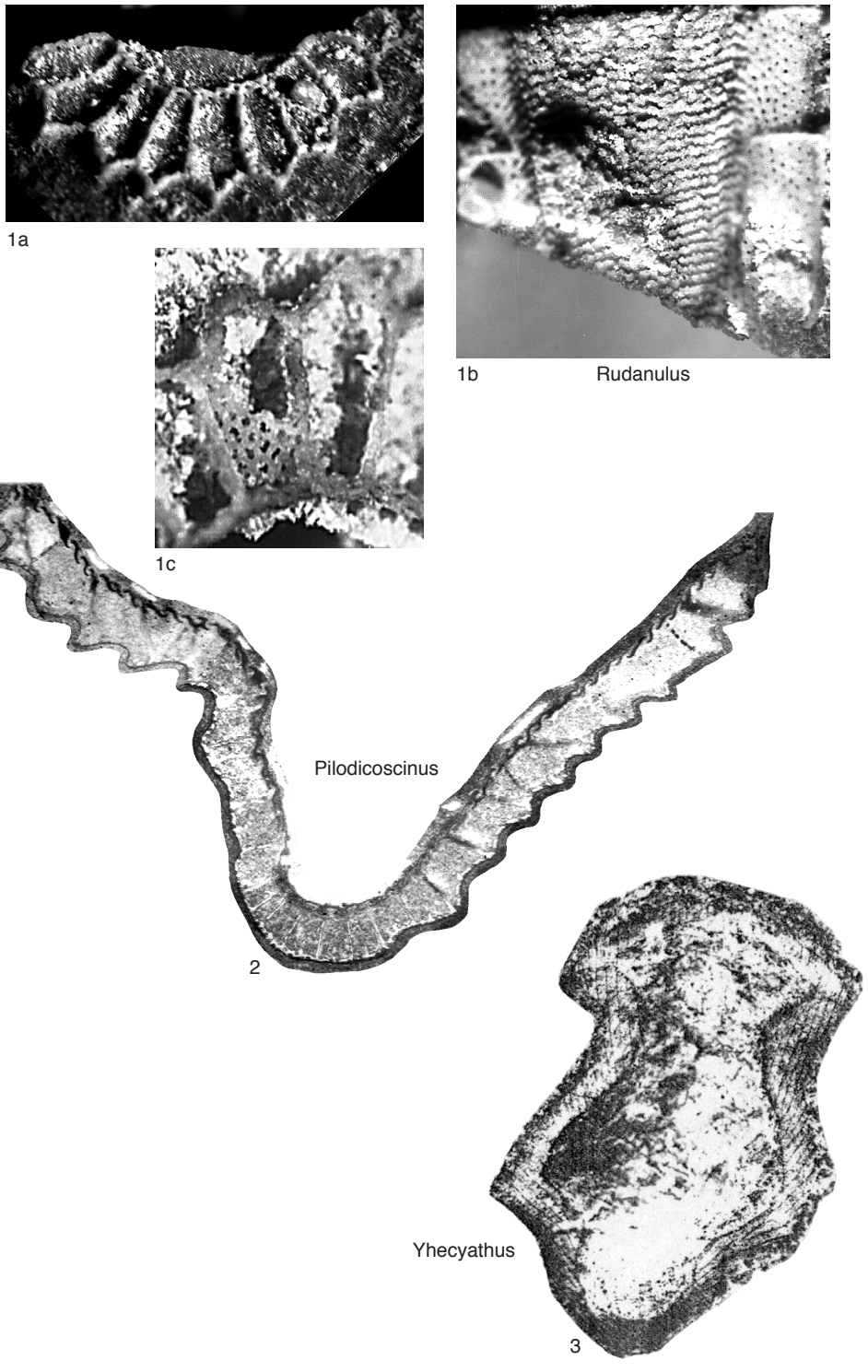


FIG. 581. Rudanulidae (p. 1000–1003).

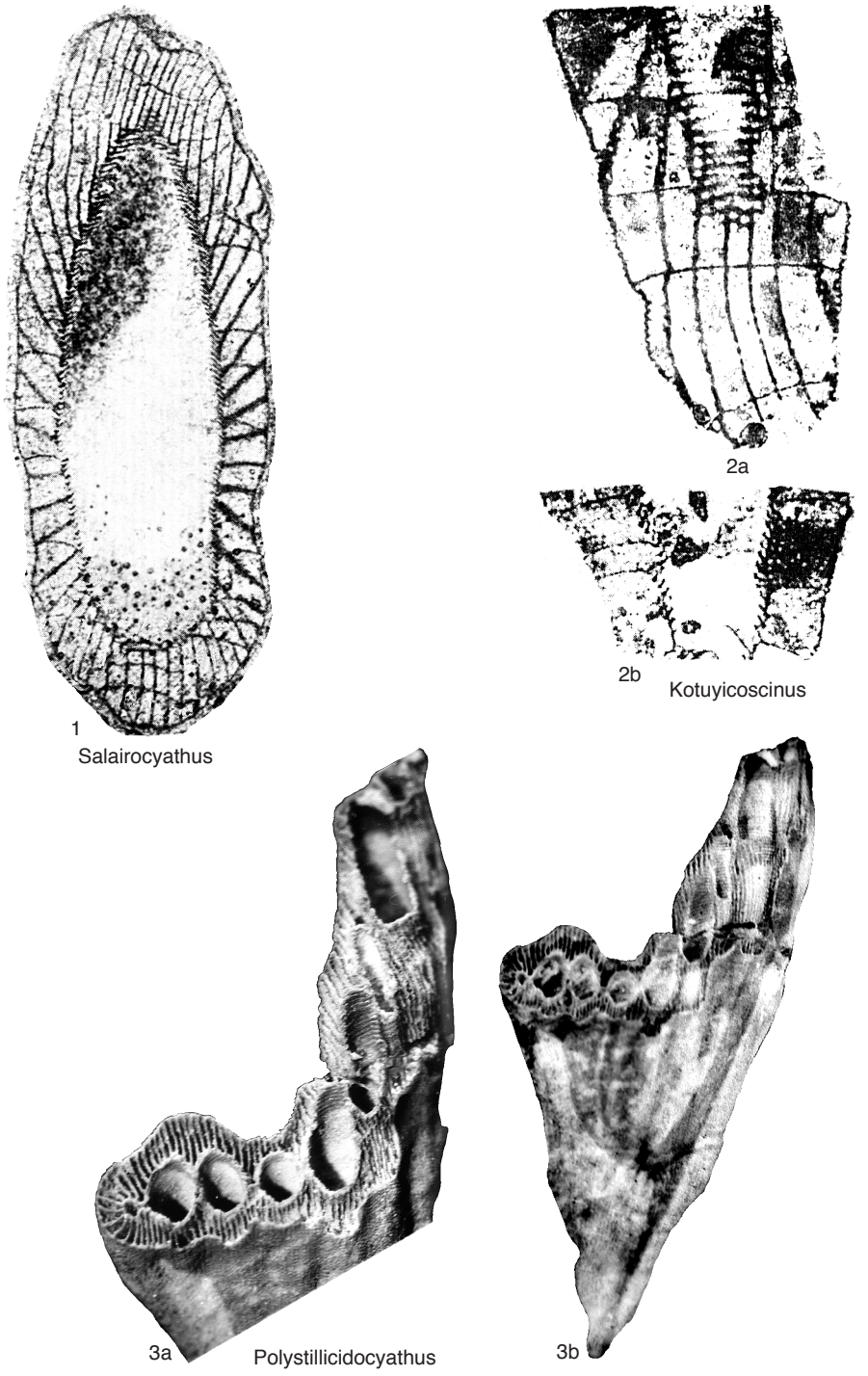


FIG. 582. Salairocyathidae (p. 1003).

Botoman, Fuchin, Shaanxi, China, 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. 582,*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. 582,*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. 582,*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).

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. 583,*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. 583,*2a–b*. **C. repandus*, Ajax Limestone, Atdabanian, Mount Scott Range, South Australia, 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. 583,*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]

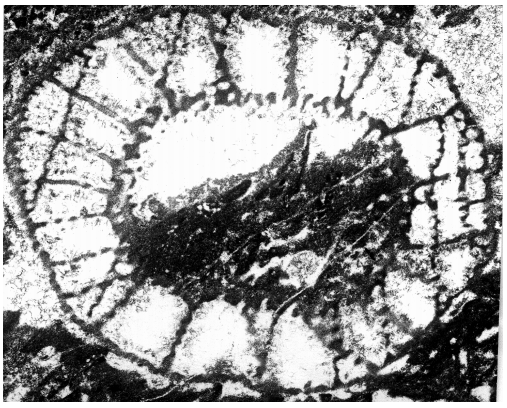
Outer wall with independent microporous sheath. *lower Cambrian (Atd.1–Bot.3).*

Family AGYREKOCYATHIDAE Konyushkov, 1967

[Agyrekocyathidae KONYUSHKOV, 1967, p. 110]

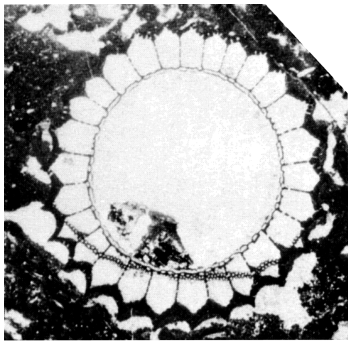
Inner wall with simple pores. *lower Cambrian (Atd.1–Bot.1).*

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



1 Crassicoscinus

2a



2b Crucicyathus

3 Dentatocoscinus

FIG. 583. Crassicoscinidae (p. 1003).

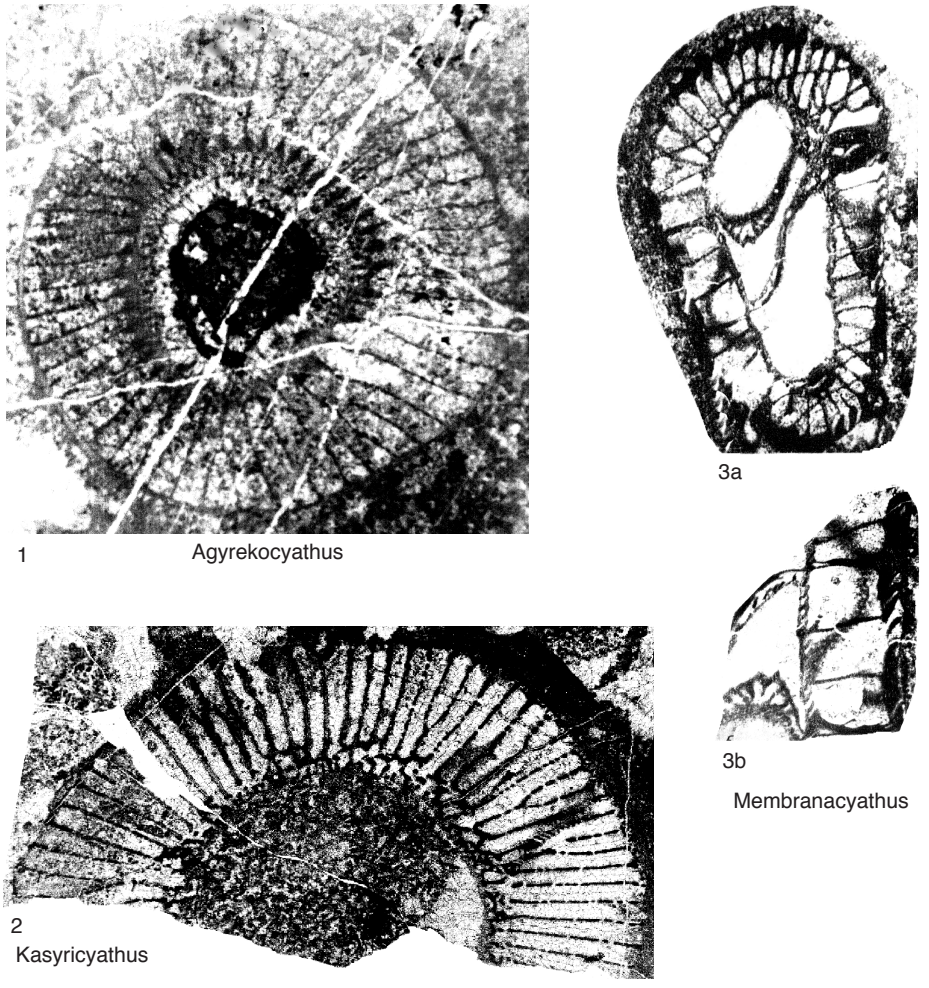


FIG. 584. Agyrekocyathidae, Kasyricyathidae, and Membranacyathidae (p. 1003–1007).

& 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. 584,*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]

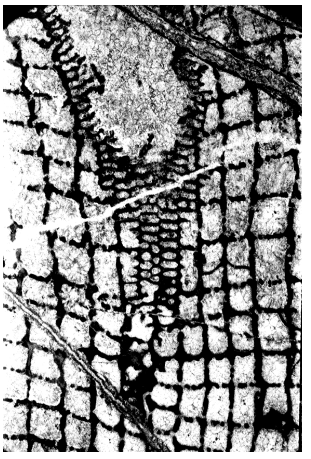
Inner wall with bracts or scales. *lower Cambrian (Bot.3).*

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. 585*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

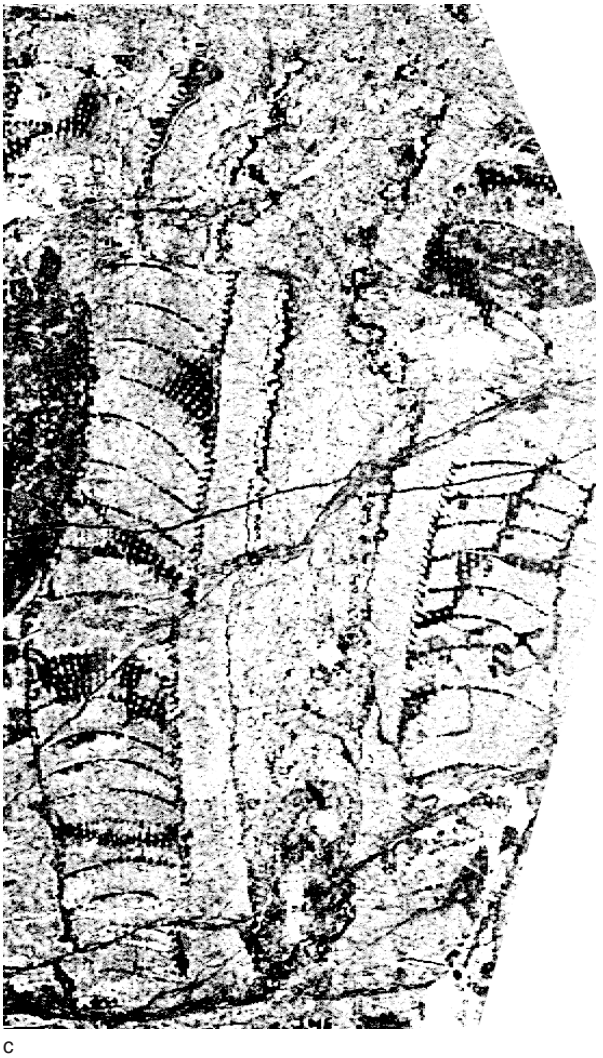
[Kasyricyathidae ZHURAVLEVA in MUSATOV & others, 1961, p. 29]

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



a Xestecyathus

b



c

FIG. 585. Xestecyathidae (p. 1005).

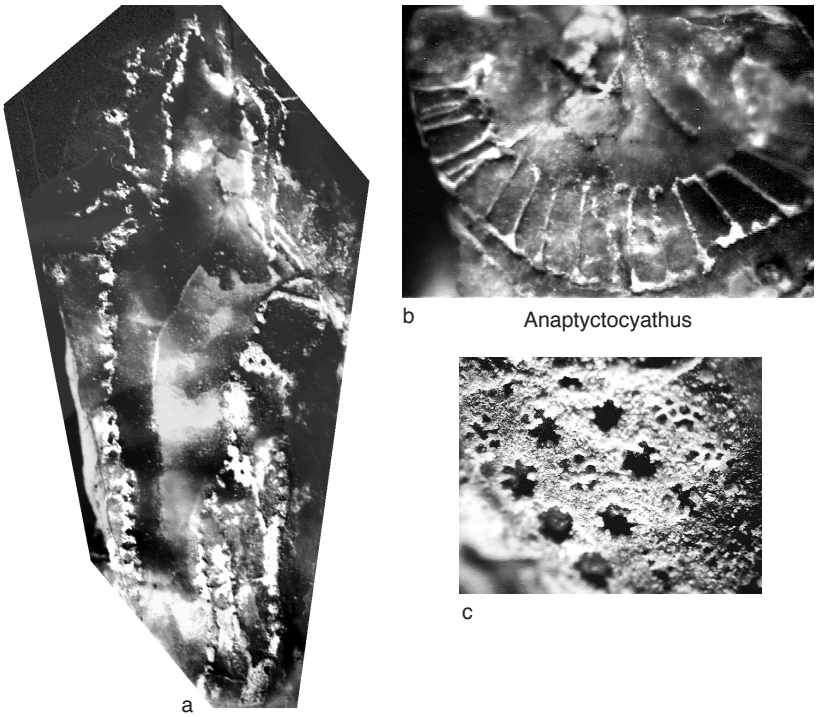


FIG. 586. Anaptyctocyathidae (p. 1008).

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. 584,*2. *K. schirokovae*, Balakhtinson Formation, Botoman, Kazyr River, East Sayan, 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. 584,*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).*

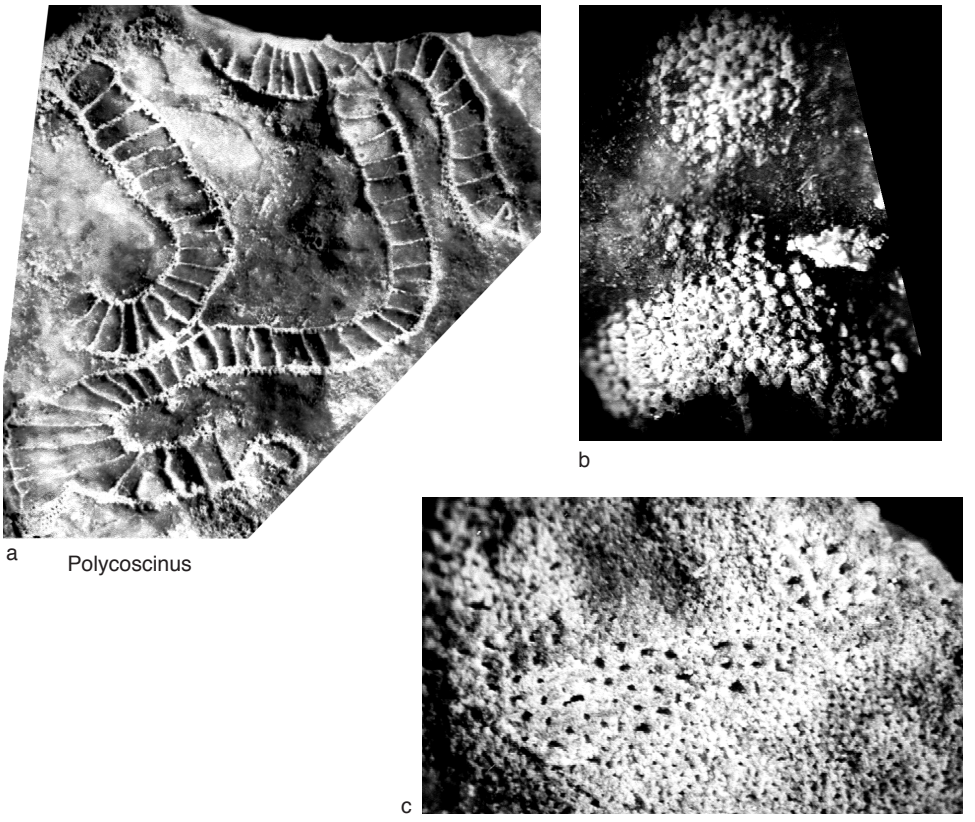


FIG. 587. Polycoscinidae (p. 1008–1009).

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. 586*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, Falkland Islands (allochthonous).——FIG. 587*a–c*. **P. contortus*, Ajax Limestone, Atdabanian, Paint Mine, South Australia,

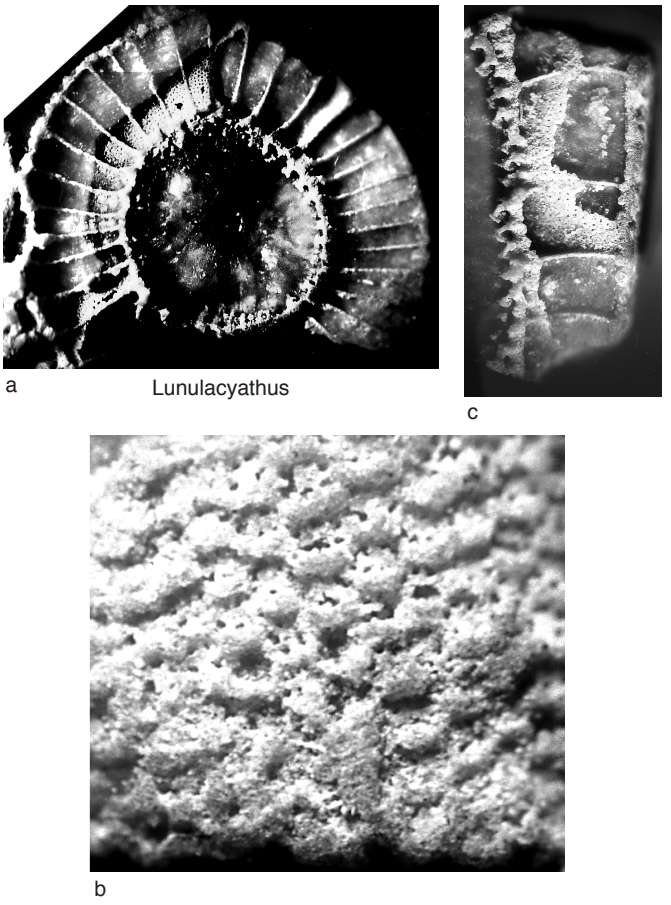


FIG. 588. Polycoscinidae (p. 1009).

Australia, holotype, USNM PU87217, specimen 222; *a,* transverse view of modular skeleton, ×3; *b,* detail 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. 588*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 (Debrenne, Zhuravlev, & Kruse, 2012b).

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][=*Bractocyathus* KRUSE, 1978, p. 41 (type, *B. labiosus;* OD)]. Inner wall with several rows of horizontal to upwardly projecting, straight canals per intersept, bearing spines projecting radially across orifice

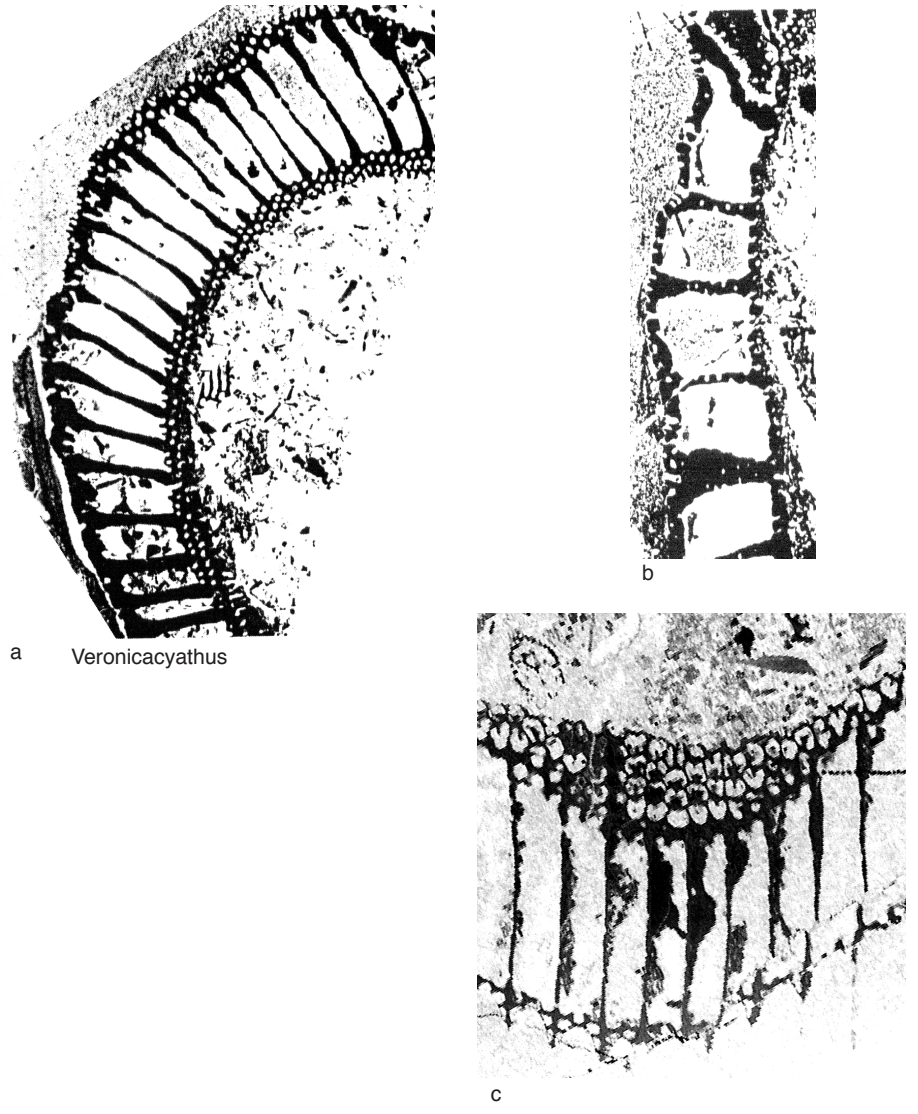


FIG. 589. Veronicacyathidae (p. 1009–1010).

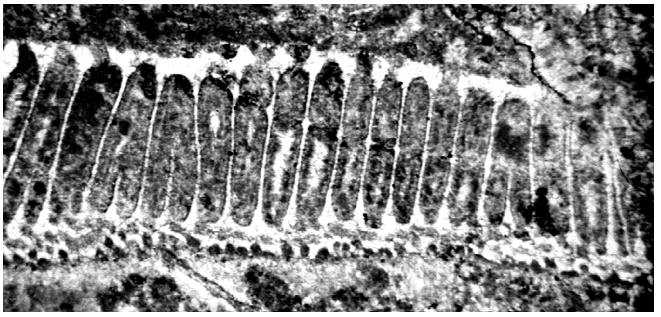
to form screen; septa aporose to sparsely porous; tabulae with normal pores. *lower Cambrian (Atd.4–Bot.3):* Australia, Antarctica.——FIG. 589*a–b*. **V. tatei* (ETHERIDGE), Parara Limestone, Botoman, Pavy Gully, Ardrossan, South Australia, Australia, lectotype, SAM T1245; *a,* transverse section, ×3; *b,* longitudinal section (outer wall to left), ×3 (Debrenne, Zhuravlev, & Gravestock, 1993).——FIG. 589*c, V. labiosus* (KRUSE), Cymbric Vale Formation, Botoman, Mt. Wright, New South Wales, Australia; topotype, AM FT.10077, detail of inner wall, tangential section, ×6 (Kruse, 1982).

Family ZONACOSCINIDAE Debrenne, 1971

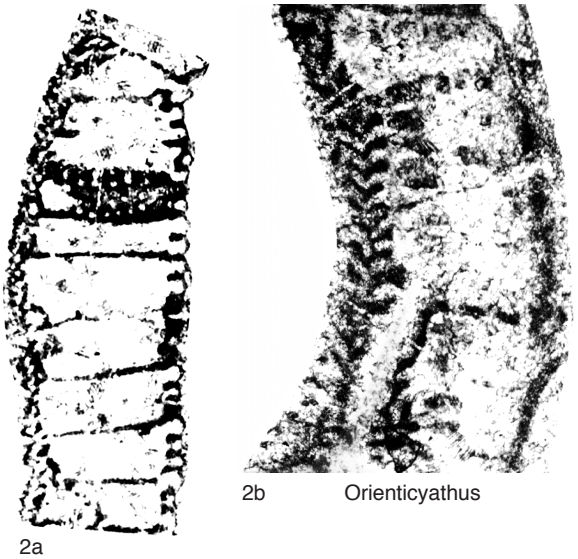
[Zonacoscinidae DEBRENNE, 1971, p. 194]

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



1 Zonacoscinus



2a 2b Orienticyathus

FIG. 590. Zonacoscinidae (p. 1010–1011).

several rows of horizontal to upwardly projecting, straight canals per intersept, canals branching toward central cavity; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.1):* Sardinia.——FIG. 590,*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/K8/3-3, 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. 590,*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).*

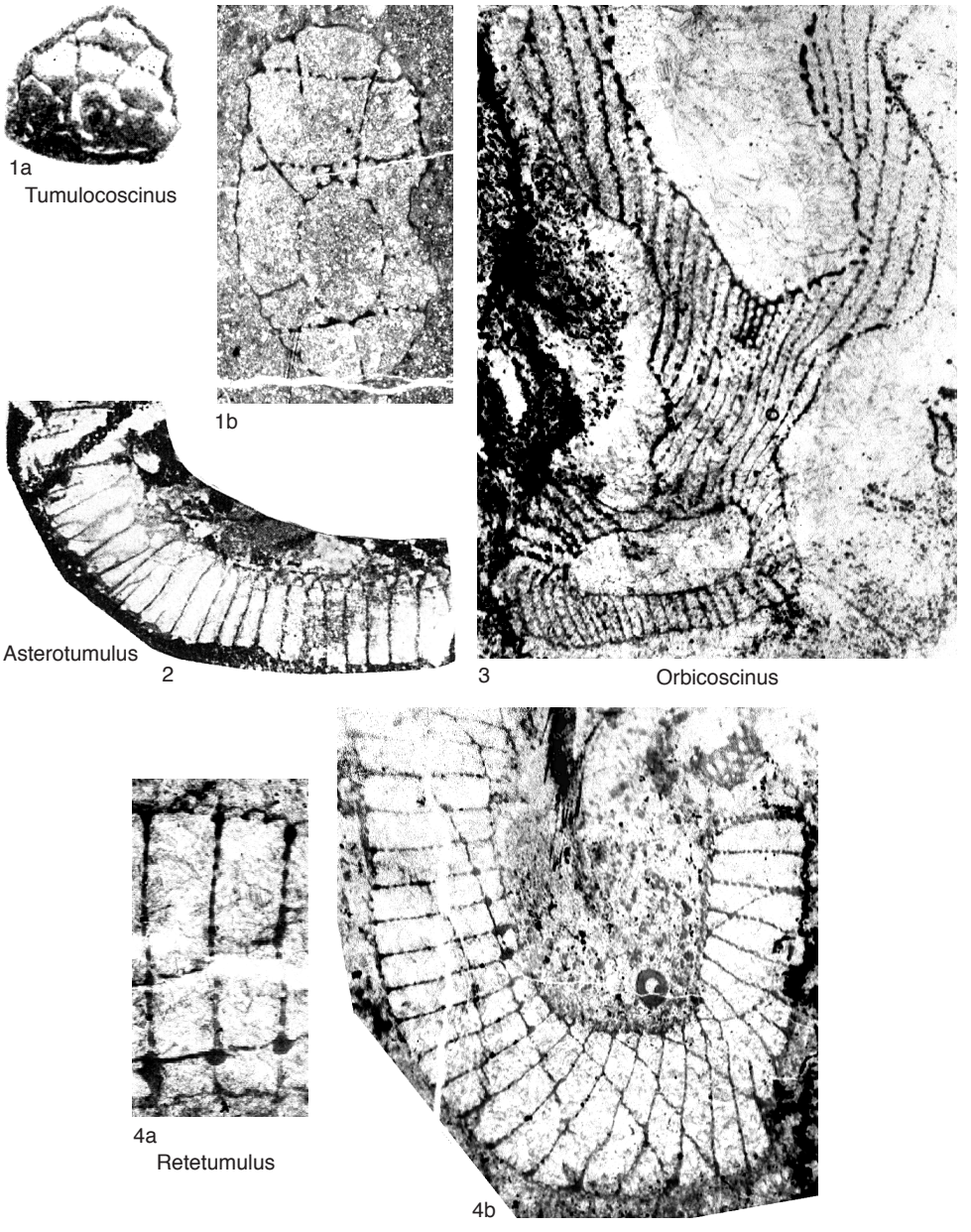


FIG. 591. Tumulocoscinidae (p. 1012–1013).

Family TUMULOCOSCINIDAE Zhuravleva, 1960

[*nom. transl.* DEBRENNE, 1970a, p. 25, *ex* Tumulocosininae 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. 591,*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. 591,*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. 591,*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. 591,*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 several rows of horizontal to upwardly projecting, S-shaped canals per intersept; canals may be fused to form pseudoannuli; septa completely porous; tabulae with normal pores. *lower Cambrian (Bot.3):* Australia.——Fig. 592,*1a–b*. **E. papillipora* (R. Bedford & W. R. Bedford), Ajax Limestone, Botoman, Ajax Mine, South Australia, 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. 592,*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, *nom. nov. pro Coscinoptycha* Taylor, 1910, p. 141, *non* Meyrick, 1881, p. 700, insect [**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]. 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):*

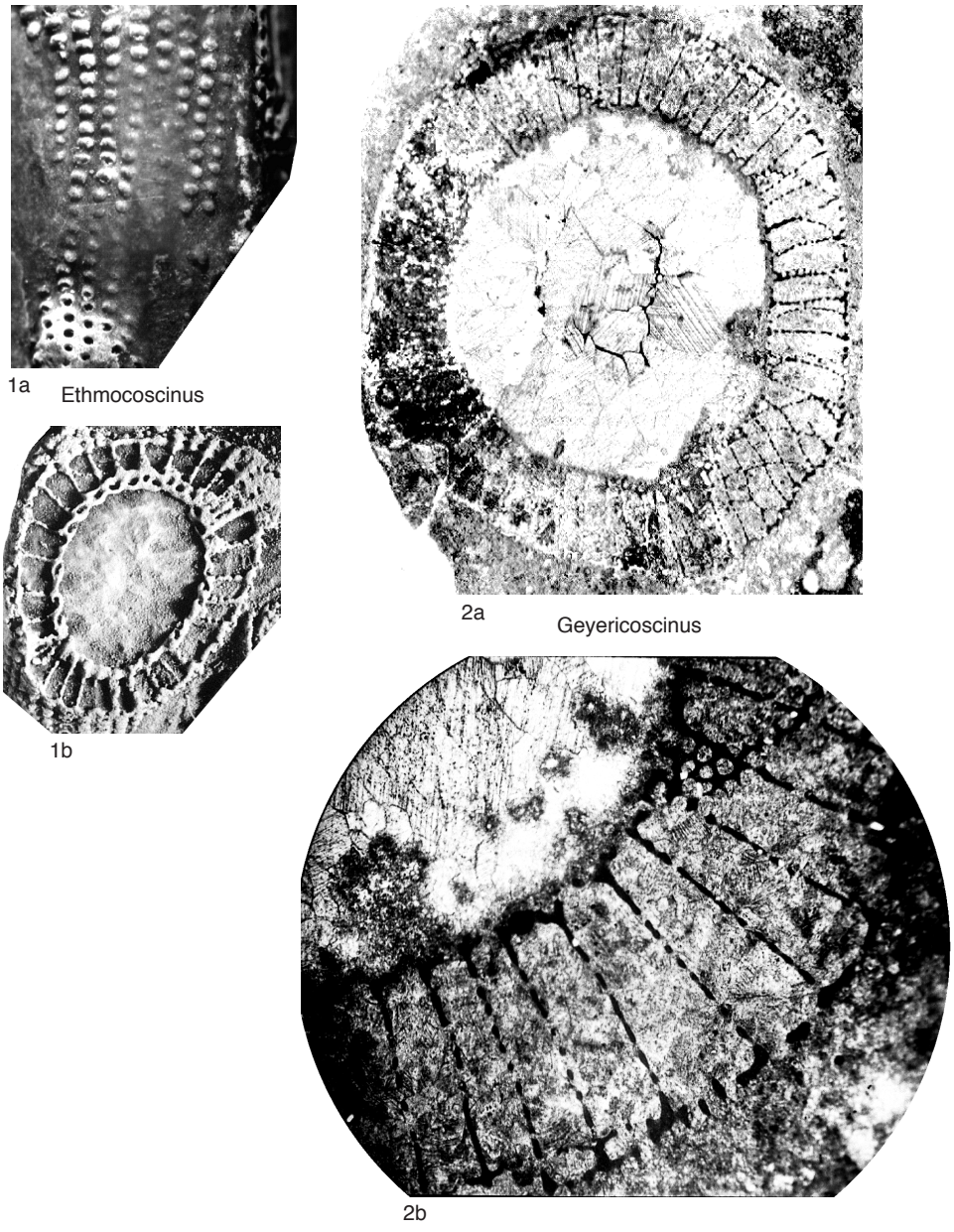


FIG. 592. Ethmocoscinidae and Geyericoscinidae (p. 1013).

Australia, Antarctica.——FIG. 593*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).*

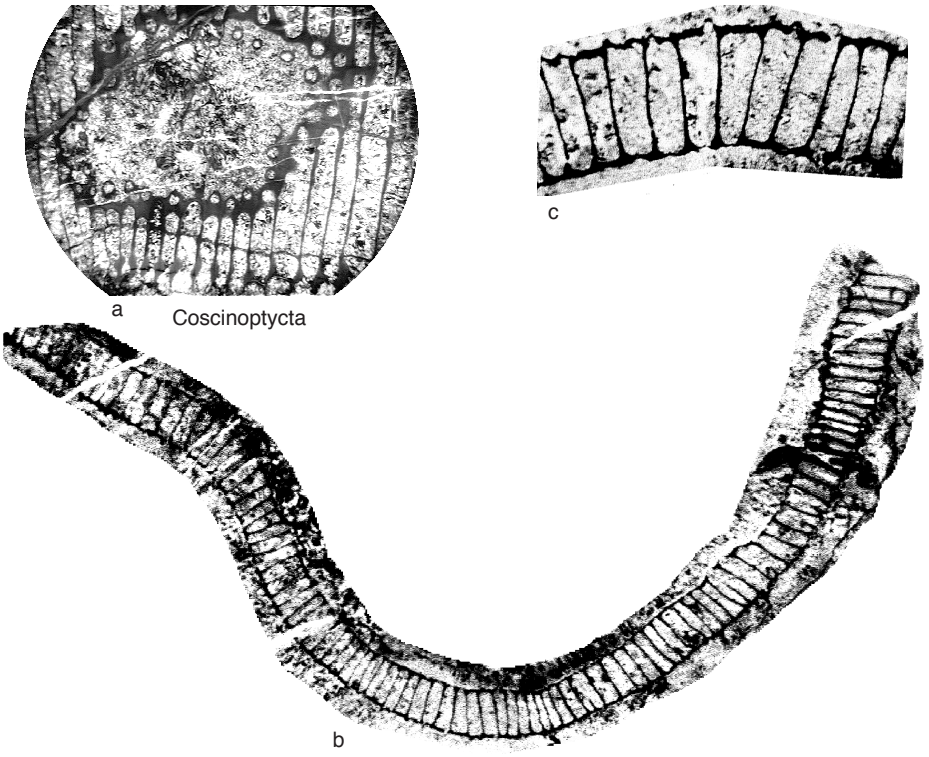


FIG. 593. Coscinoptyctidae (p. 1013–1014).

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. 594,*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. 594,*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]

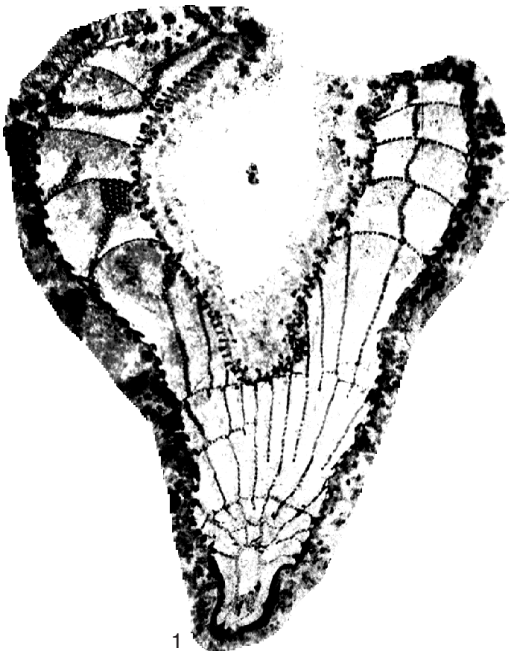
Outer wall with bracts or scales. *lower Cambrian (Bot.1–Bot.3).*

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,



1 Jebileticoscinus

2 Irhoudicoscinus

FIG. 594. Jebileticoscinidae (p. 1015).

denticulate, curved 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. 595*a–c*. **S. sylvia* (R. BEDFORD & J. BEDFORD), Ajax Limestone, Botoman, Ajax Mine, South Australia, 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. 596,*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. 596,*2*. **S. oosthuizeni*, Dwyka Subgroup, Botoman (allochthonous in Permian), Zwartskraal, South Africa, holotype, SAM(C) K44945, oblique longitudinal section, ×10 (Debrenne, 1975).

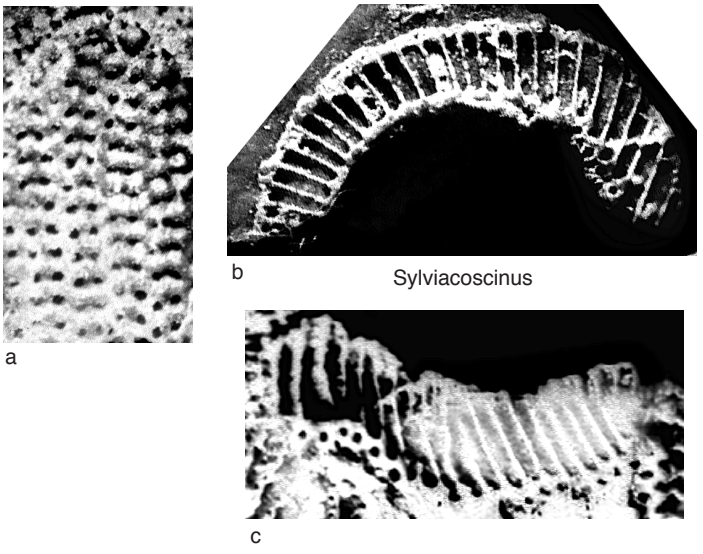


FIG. 595. Sylviacoscinidae (p. 1015–1016).

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.597,*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]

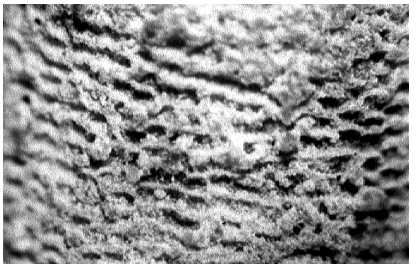
Inner wall with annuli. *lower Cambrian (Bot.1).*

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. 597,*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 & others, 1968, pl. 9,*3*, TsSGM

1a Sigmocoscinus

1b



1c

1d

2 Statanulocyathus

FIG. 596. Sigmocoscinidae (p. 1016).

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. 597,*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. 598,*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. 598,*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. 598,*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]

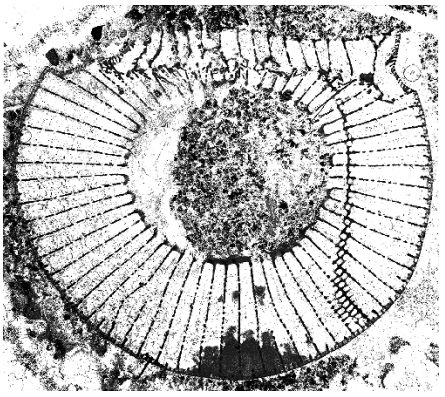
Inner wall with bracts or scales. *lower Cambrian (Bot.3).*

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. 599*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).

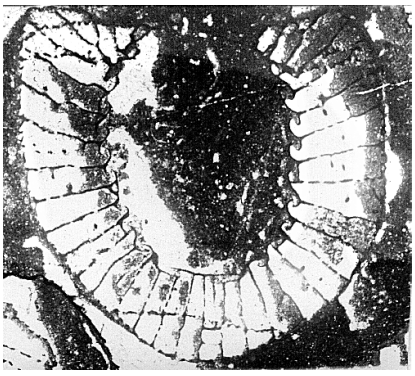
Order PUTAPACYATHIDA Vologdin, 1961

[Putapacyathida Vologdin, 1961, p. 177]

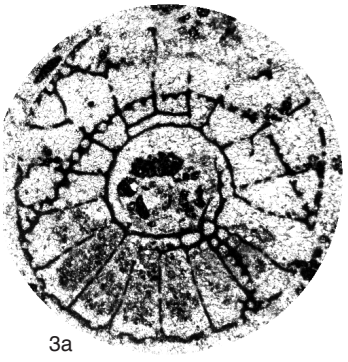
Intervallum with plate tabulae; redimiculi may be present on intervallum side of either or both walls. *lower Cambrian (Bot.1–Bot.3).*



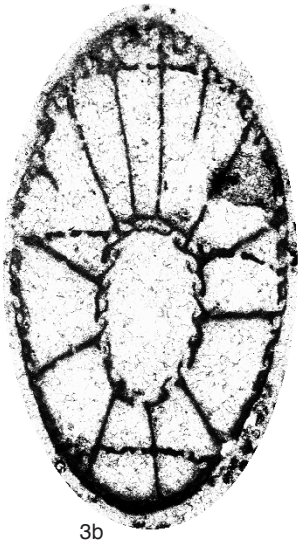
1 Rozanovicyathus



2 Muchattocyathus



3a Schumnyicyathus



3b

FIG. 597. Rozanovicyathidae and Tatijanaecyathidae (p. 1017–1019).

Superfamily ALPHACYATHOIDEA R. Bedford & J. Bedford, 1939

[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)]

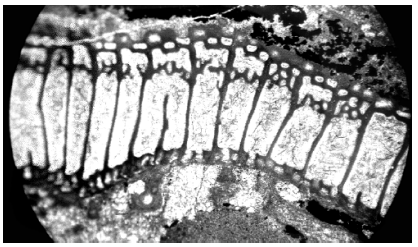
Outer wall with simple pores. *lower Cambrian (Bot.1–Bot.3).*

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, 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. 600,*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,

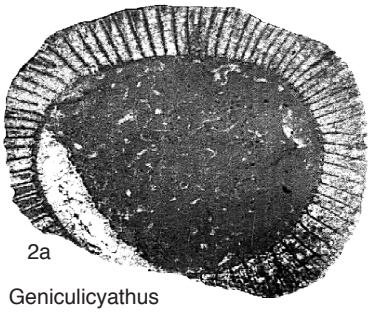


1a Porocoscinus

1b

3a

Tubicoscinus



2a

Geniculicyathus

2b

3b

FIG. 598. Porocoscinidae (p. 1019).

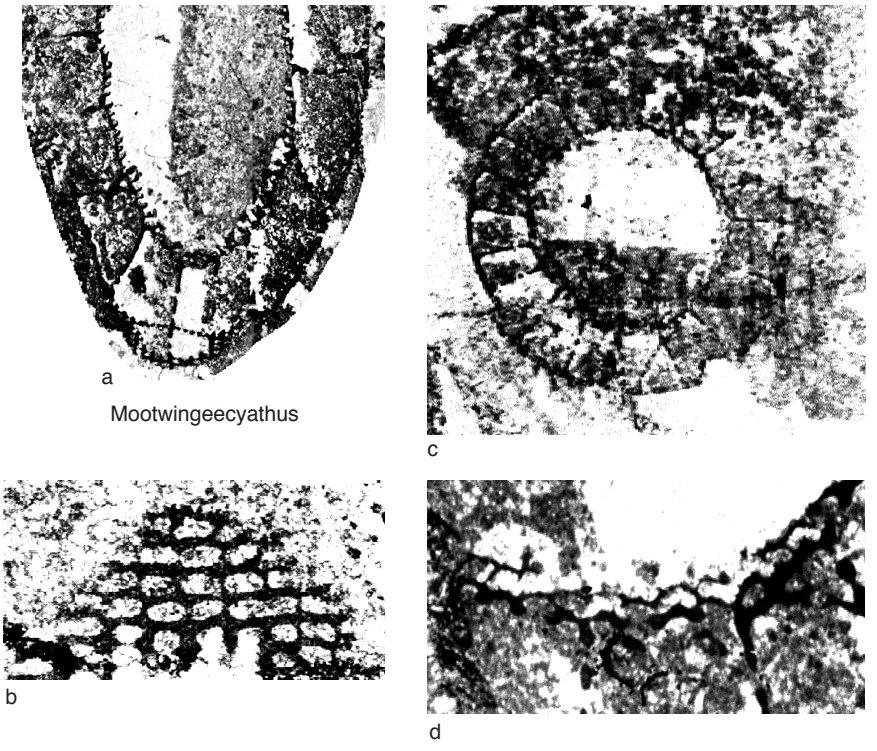


FIG. 599. Mootwingeecyathidae (p. 1019).

Zhuravlev, & Kruse, 2002); *c,* paralectotype, NHM S4822, longitudinal view, ×12 (Debrenne, Zhuravlev, & Kruse, 2012b).

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. 600,*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).

Superfamily PUTAPACYATHOIDEA R. Bedford & J. Bedford, 1936

[*nom. transl.* DEBRENNE, 1970a, p. 24, *ex* Putapacyathidae R. BEDFORD & J. BEDFORD, 1936, p. 24; *nom. correct*. DEBRENNE, ZHURAVLEV, & KRUSE, 2002, p. 1638 (*pro* Putapacyathacea)]

Outer wall with attached microporous sheath. *Lower Cambrian (Bot.3).*

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

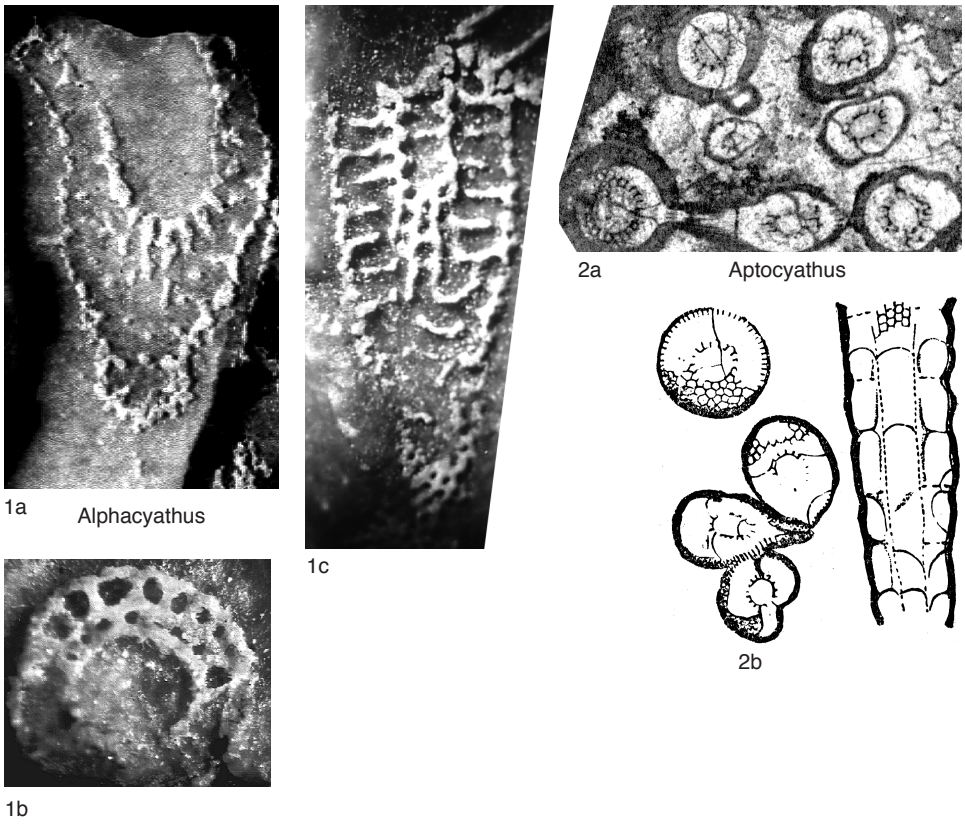


FIG. 600. Alphacyathidae (p. 1020–1022).

pores per intertabulum, bearing downwardly projecting cupped bracts; tabulae with normal pores; sporadic septa may be present. *lower Cambrian (Bot.3):* Australia.——FIG. 601*a–c. *P. regularis*, Ajax Limestone, Botoman, Ajax Mine, South Australia, Australia, 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]

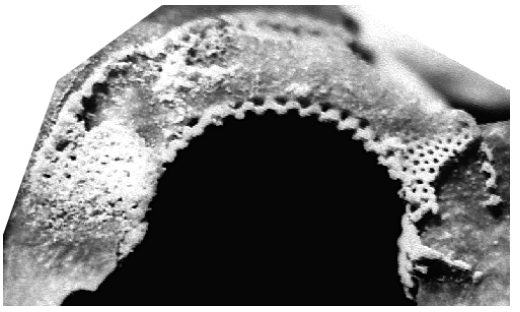
Outer wall with canals. *lower Cambrian (Atd.4).*

Family HUPECYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1990

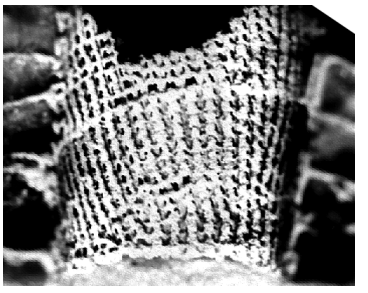
[Hupecyathidae DEBRENNE, ROZANOV, & ZHURAVLEV, 1990, p. 121]

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. 602*a–b. *H. sphinctoides*, Amouslek Formation, Atdabanian, Ouijane, holotype, MNHN M80258, specimen Ki135; *a,* transverse section, ×6; *b,* detail of longitudinal



a



c

Putapacyathus

b

FIG. 601. Putapacyathidae (p. 1022–1023).

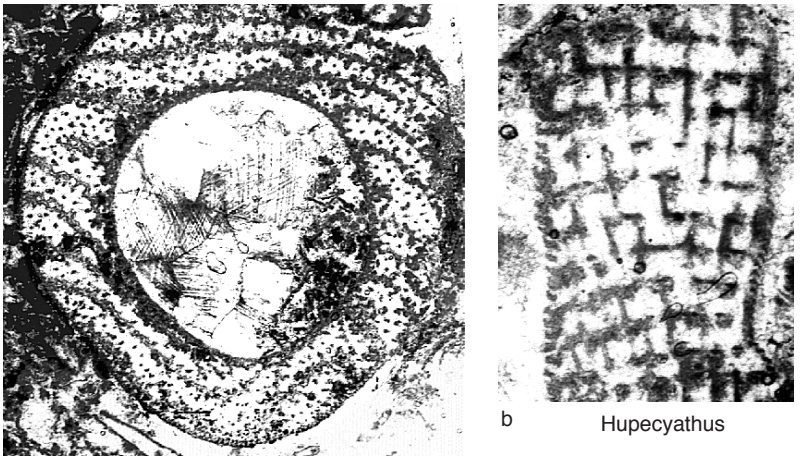


FIG. 602. Hupecyathidae (p. 1023–1025).

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).*

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. 603*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).*

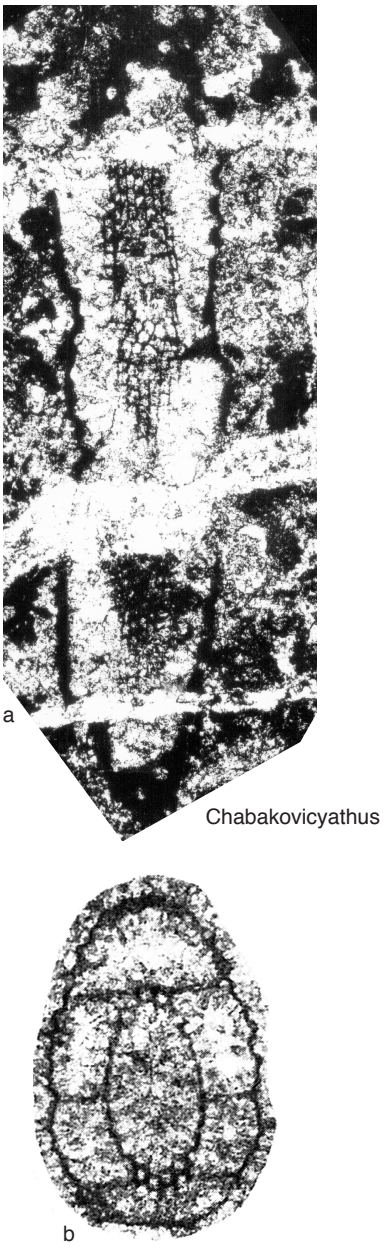


FIG. 603. Chabakovicyathidae (p. 1025).

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. 604,*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).

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. 604,*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. 604,*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. 605,*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.

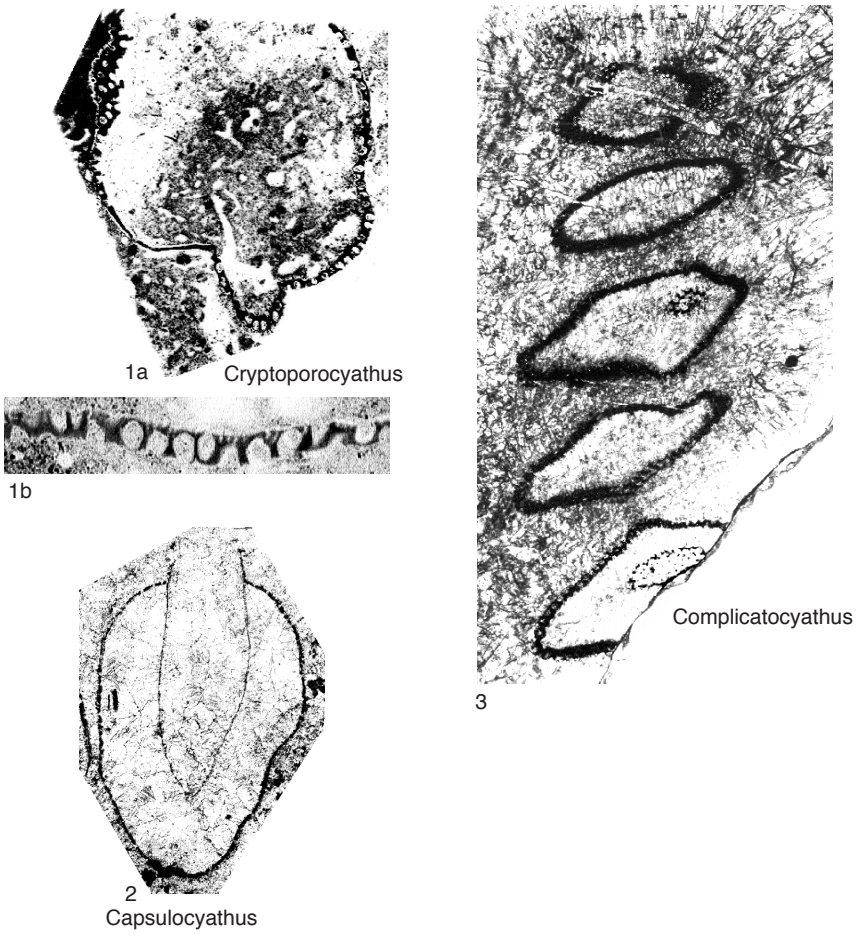


FIG. 604. Cryptoporocyathidae (p. 1026).

lower Cambrian (Bot.1): Far East.——FIG. 605,*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. 605,*3. *P. americana*, Valmy Formation, Botoman, Galena Canyon, Nevada, United States, holotype, USNM 434924, specimen GA5.18F, longitudinal section, ×20 (Debrenne & Wood, 1990; ©Cambridge University Press).

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*

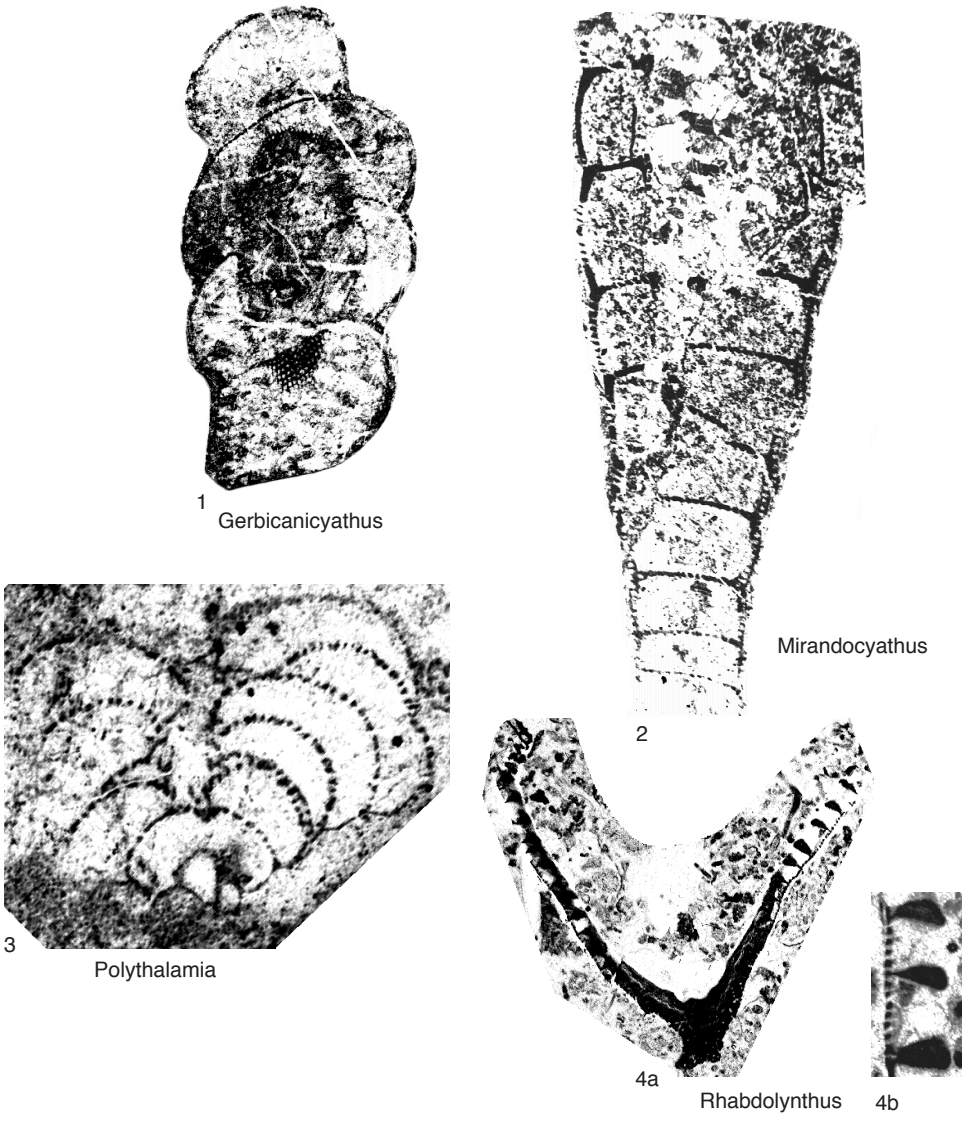


FIG. 605. Cryptoporocyathidae and Uralocyathellidae (p. 1026–1028).

(Bot.1): Siberian Platform, Altay Sayan.——FIG. 605,*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 & 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. 606,*1.* **T. bullatus* (ZHURAVLEVA), Balakhtinson Formation, Botoman, Kazyr River, East Sayan, Altay Sayan, Russia, holotype,

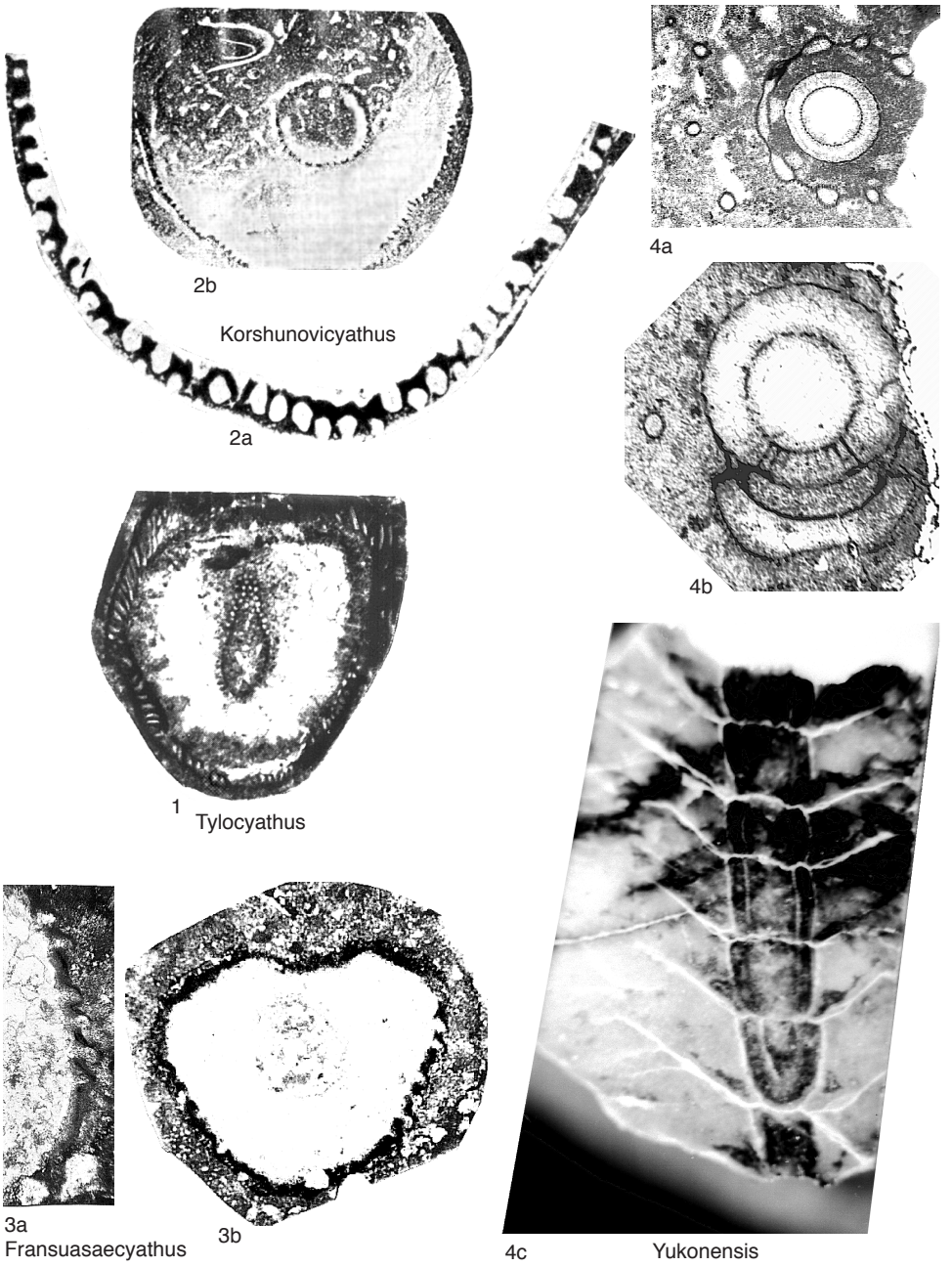


FIG. 606. Tylocyathidae and Fransuasaecyathidae (p. 1028–1030).

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. 606,*2a–b*. **K. melnikovi* (KORSHUNOV & ZHURAVLEVA); *a,* Tyuser Formation, Atdabanian,

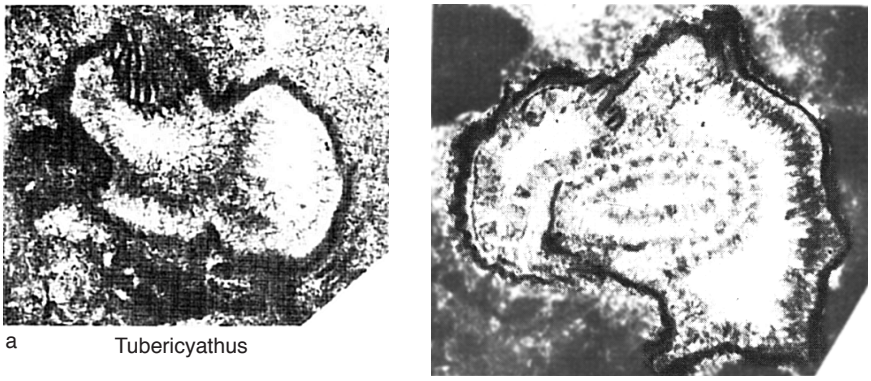


FIG. 607. Tubericyathidae (p. 1030).

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), 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. 606,*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. 606,*4a–c*. **Y. yukonensis* (HANDFIELD); *a–b,* Adams Argillite, Botoman, Tatonduk River, Alaska, United States; *a,* transverse section, locality USGS 5156-CO (A1), collection not located, ×6 (Debrenne, Zhuravlev, & Kruse, 2002); *b,* transverse section, locality USGS 5156-CO (A4), collection not located, ×10 (Nitecki & Debrenne, 1979); *c,* Sekwi Formation, Botoman, Mackenzie Mountains, Yukon Territory, Canada, holotype, GSC 21059, longitudinal section, ×4.5 (Debrenne, Zhuravlev, & Kruse, 2012b).

Family TUBERICYATHIDAE Debrenne, Rozanov, & Zhuravlev, 1989

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

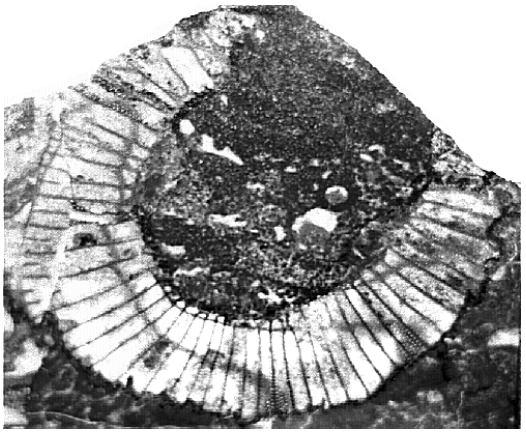
Outer wall with bracts or scales. *lower Cambrian (Bot.1).*

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. 607*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).

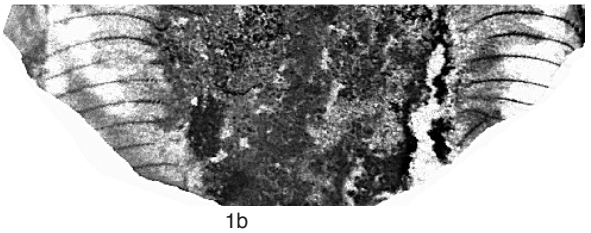
Suborder COSCINOCYATHINA Zhuravleva, 1955

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

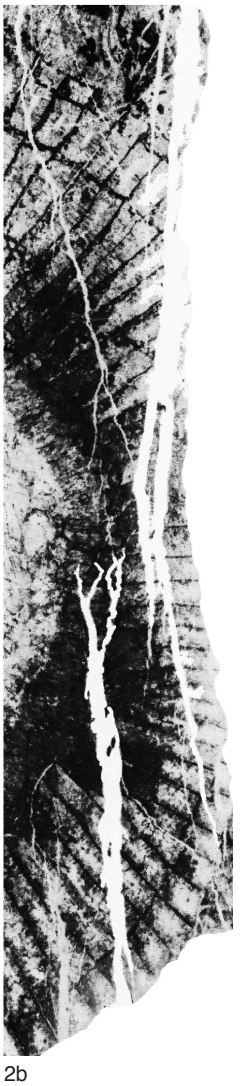
Cup multichambered; intervallum with septa. *lower Cambrian (Atd.1–Bot.3).*



1a Coscinocyathus

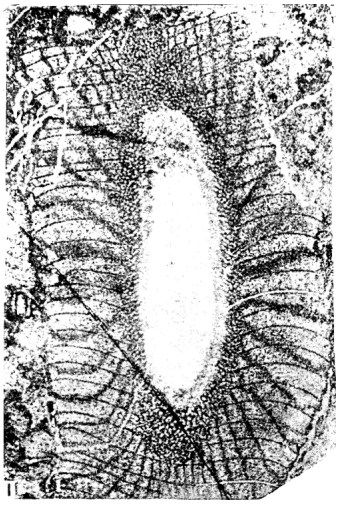


1b



2b Mawsonicoscinus

2a



3 Coscinocyathellus

FIG. 608. Coscinocyathidae, Mawsonicoscinidae, and Coscinocyathellidae (p. 1032).

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. 608,*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, ?Falkland Islands (allochthonous).——Fig. 608,*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. 608,*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. 609*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. 610*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 in ZHURAVLEVA, KRASNOPEEVA, & CHERNYSHEVA, 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. 611*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. 609. Tomocyathidae (p. 1032).

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).*

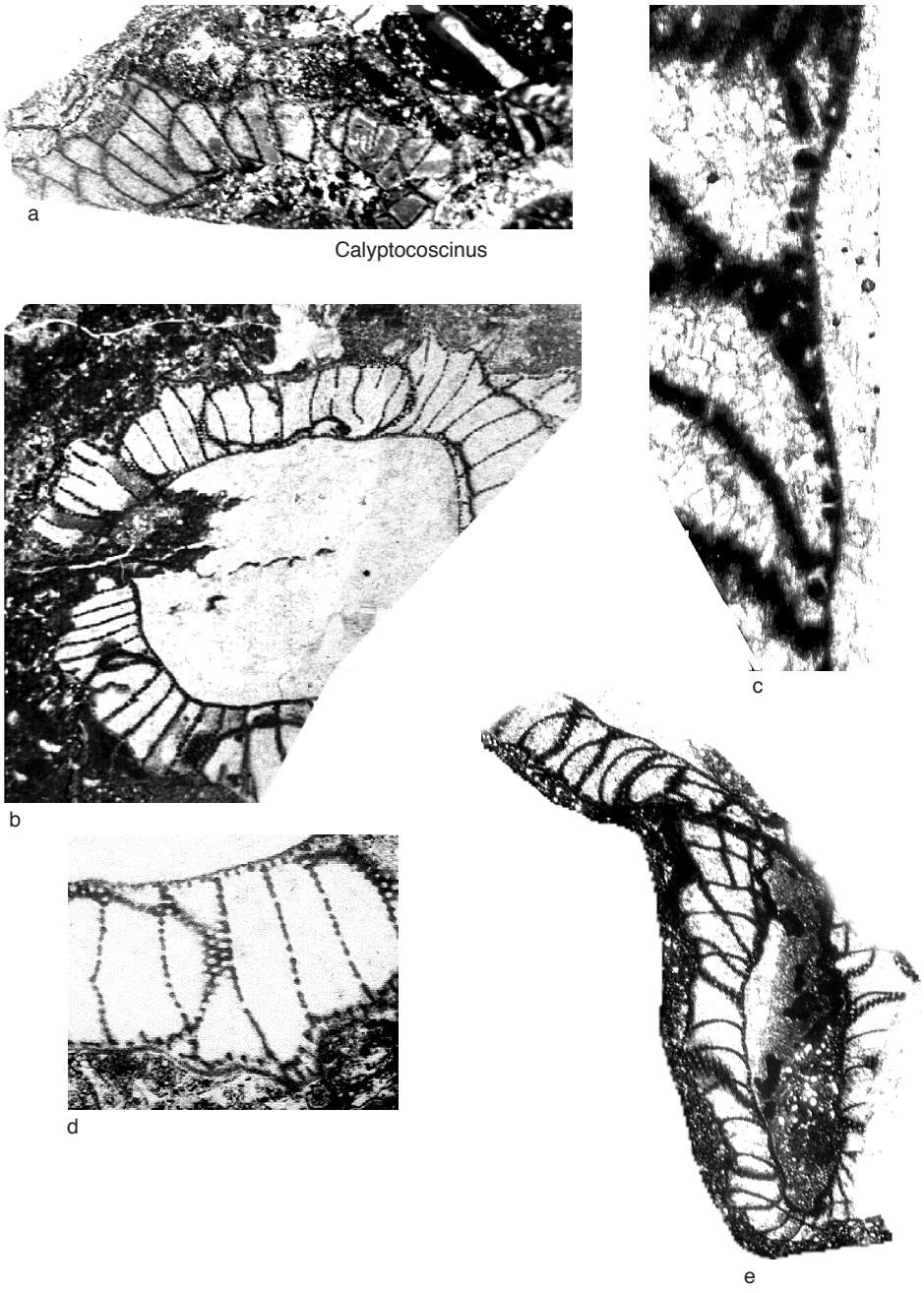


FIG. 610. Calyptocoscinidae (p. 1033).

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. 612,*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. 612,*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, 1935b, p. 90] [=Anthomorphida Okulitch, 1935b, p. 90, *nom. correct*. Okulitch, 1955a, p. 18, *pro* order Anthomorphina Okulitch, 1935b, p. 90; =Syringocnemidida Okulitch, 1935b, p. 90, *nom. correct*. Debrenne, 1964, p. 117, *pro* order Syringocnemina Okulitch, 1935b, 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]

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. 611. Alataucyathidae (p. 1033).

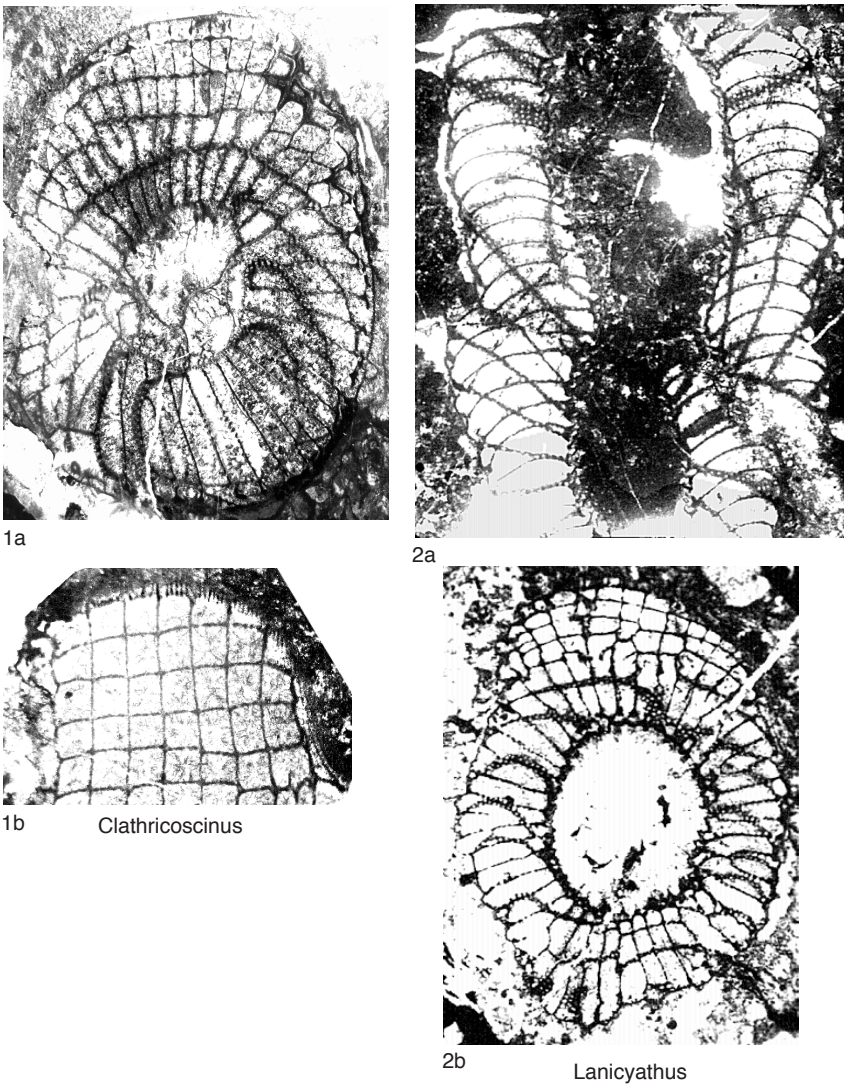


FIG. 612. Clathricoscinidae and Lanicyathidae (p. 1034–1035).

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. 613,*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. 613,*2a–b*. **A. webersi*, Minaret Formation, Springer Peak, Heritage Range, Ellsworth Mountains, Antarctica; *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. 613,*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. 614,*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. 614,*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.3):* Siberian Platform, Altay Sayan, Tuva, Mongolia, Transbaikalia, Far East, Urals, Australia, Morocco, Iberia, Germany.——Fig. 614,*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).

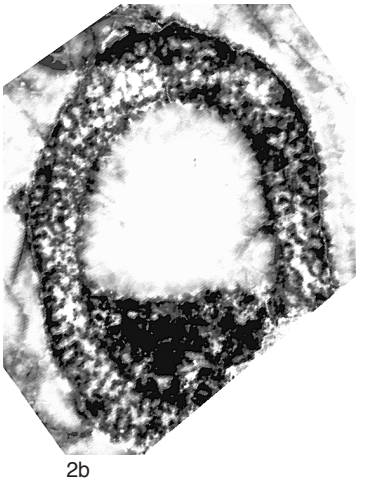
Okulitchicyathus Zhuravleva, 1960b, p. 281 [**Ajacicyathus discoformis* Zhuravleva in Zhuravleva & Zelenov, 1955, p. 68; OD; holotype, Zhuravleva & Zelenov, 1955, pl. 1,*1*, PIN 100(1), Moscow, not located] [=*Lermontovaecyathus* Korshunov, 1972, p. 59 (type, *L. isiti*, OD; =*Ajacicyathus discoformis* Zhuravleva in Zhuravleva & Zelenov, 1955, p. 68, for discussion, see Debrenne & Zhuravlev, 1992b, p. 128); =*Alconeracyathus*

1a Loculicyathus

1b

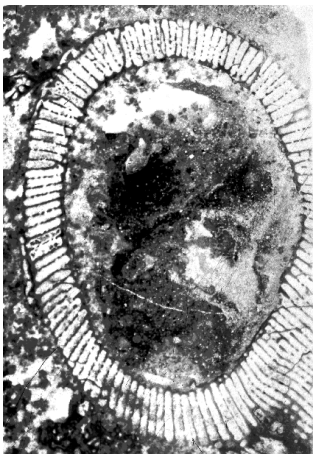
3 Ardrossacyathus

2a

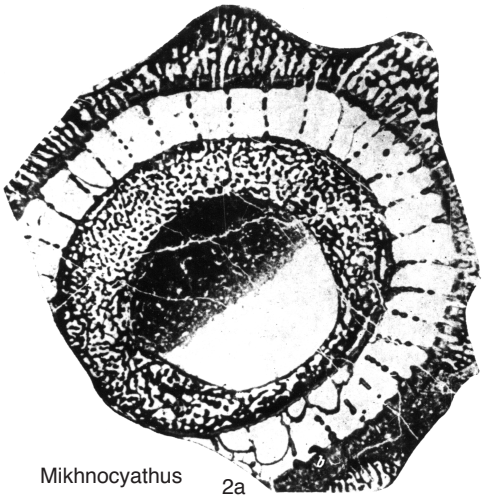


2b
Antarcticocyathus

FIG. 613. Loculicyathidae (p. 1037).

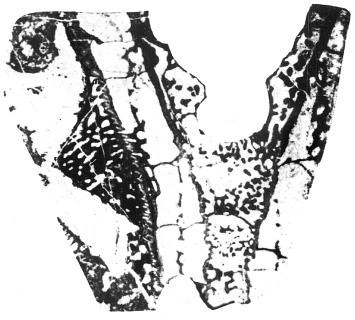


1a Cambrocyathellus

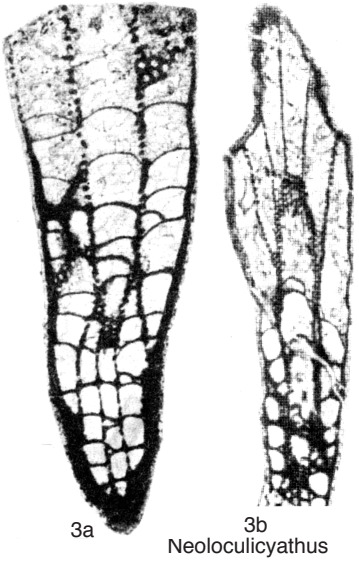


Mikhnocyathus 2a

1b



2b

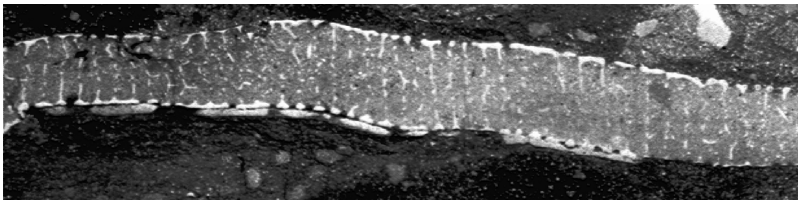


3a 3b
Neoloculicyathus

FIG. 614. Loculicyathidae (p. 1037).

1a

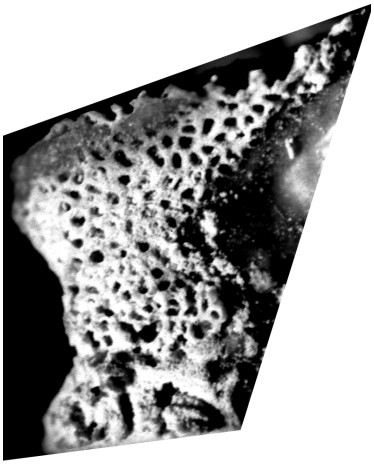
Okulitchicyathus



1b

2a

Paranacyathus



2b

FIG. 615. Loculicyathidae (p. 1037–1041).

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. 615,*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, 1936, p. 17; OD; holotype, R. BEDFORD

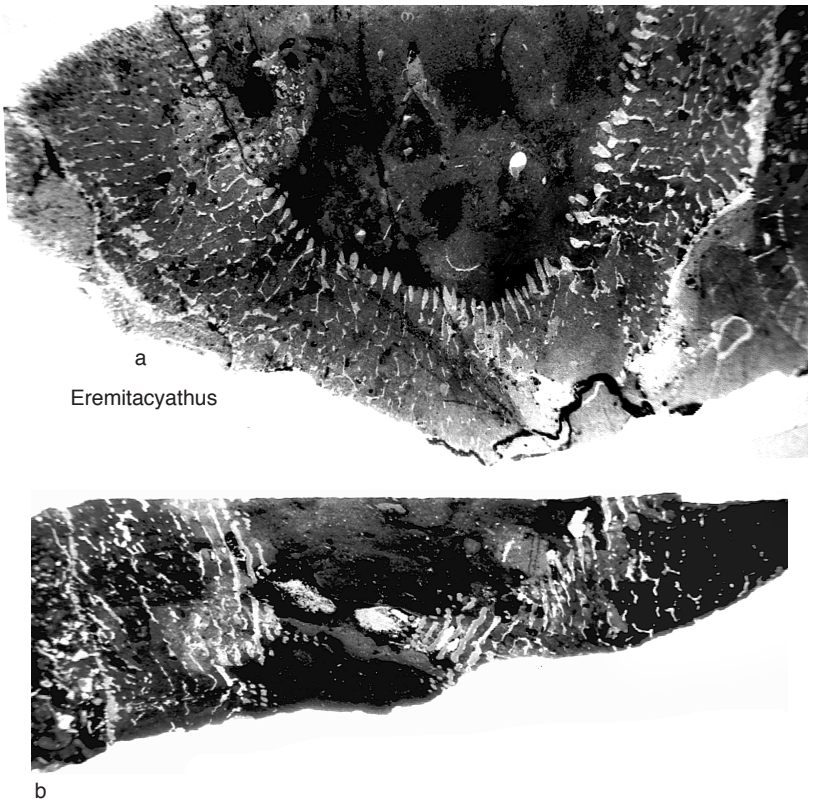


FIG. 616. Eremitacyathidae (p. 1041).

& 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. 615,*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. 616*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).*

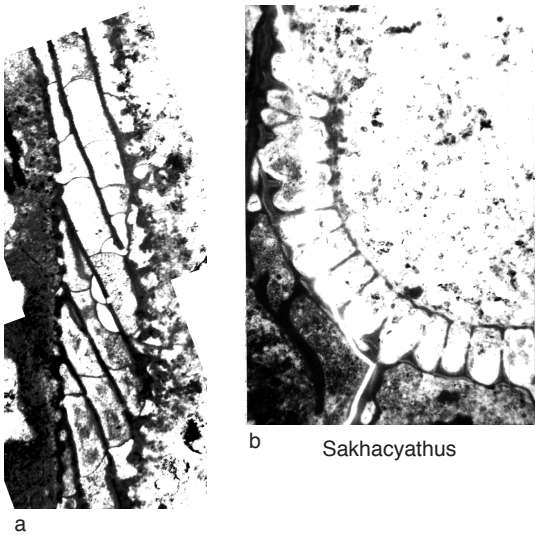


FIG. 617. Sakhacyathidae (p. 1042).

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. 617*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; ©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. 618,*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):* Altay Sayan.——FIG. 618,*2a–b*. **T. validus*, Uba Formation, Atdabanian,