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Desmids of Arctic Alaska

Minoru HIRANO

Introduction

Through the kindness of Prof. H. FUKUSHIMA of the Yokohama Municipal University, the writer had the rare opportunity to study the desmid samples of Alaska collected by Mr. K. MARUYAMA, a member of the Japanese Microbiological Expedition to the Alaskan Arctic in the summer of 1965, led by Dr. Y. KOBAYASI, National Science Museum, Tokyo. Knowledge about Alaskan fresh-water algae, especially desmids, was recently increased by the studies of WHELDEN, CROASDALE, GRÖNBLAD, PRESCOTT and others. However, phycological information on the adjacent districts, especially those covering the islands of Arctic Canada, extending from Continental America to Greenland, and the western parts of the Aleutian Islands, is not sufficient as yet.

The collections were made chiefly in the four areas within the Arctic circle, and these are summarized in the following list:

1. Cape Thompson area

Habitat no. 143: M, St.-2, 5 cm depth, 4.7 w.t. Aug. 15, 1965.

- .. no. 146: M, St.-4, 5 cm depth, Aug. 15.
- .. no. 148: M, St.-5, 5 cm depth, Aug. 15.
- .. no. 158: Sp, Sw-, n-St-7, 5 cm depth, Aug. 15.
- .. no. 160: M, St.-7, 5 cm depth, Aug. 15.
- .. no. 169: M, St.-10, 5 cm depth, Aug. 15.
- .. no. 172: Mu, Cr-1, 10 cm depth, Aug. 15.
- .. no. 173: Mu, Cr-1, 10 cm depth, Aug. 15.
- .. no. 536: GD, Sw-, n-Cr-1, 30 cm depth, Aug. 15.
- .. no. 538: Mu, Sw-, n-Cr-1, 30 cm depth, Aug. 15.

2. Barrow area

Habitat no. 2: Mu, Po-1, 5 cm depth, BV, Aug. 2, 1965.

- .. no. 6: FB, Po-4, 10 cm depth, 4.7 a.t., 8.4 w.t., 6.0 pH, PB-BB, Aug. 4.
- .. no. 14: Sp, Pn-3, 20 cm depth, 13.4 w.t., s-BV, Aug. 5.
- .. no. 15: GD, Pn-3, 20 cm depth, 13.4 w.t., s-BV, Aug. 5.
- .. no. 16: GD, Pn-3, 20 cm depth, 13.4 w.t., s-BV, Aug. 5.
- .. no. 22: Mu, Pn-4, 20 cm depth, s-BV, Aug. 5.

- Habitat no. 25: FB, Pn-8, 30 cm depth, 8.1 w.t., 5.4 pH, SBB, Aug. 5.
 .. no. 26: M, Pn-8, 30 cm depth, 8.1 w.t., 5.4 pH, SBB, Aug. 5.
 .. no. 28: M, Pn-8, 30 cm depth, 8.1 w.t., 5.4 pH, SBB, Aug. 5.
 .. no. 29: Mu, Pn-9, 20 cm depth, s-BB, Aug. 5.
 .. no. 30: Mu, Pn-9, 20 cm depth, s-BB, Aug. 5.
 .. no. 33: Mu, Sw-3, b-Pn-6, 10 cm depth, s-BV, Aug. 6.
 .. no. 36: GD, Sw-3, b-Pn-6, 10 cm depth, s-BV, Aug. 6.
 .. no. 38: Mu, Sw-4, n-Pn-7, 10 cm depth, 50 cm depth, s-BV, Aug. 6.
 .. no. 39: Mu, Sw-4, n-Pn-7, 10 cm depth, 50 cm depth, s-BV, Aug. 6.
 .. no. 40: Mu, Sw-4, n-Pn-7, 10 cm depth, 50 cm depth, s-BV, Aug. 6.
 .. no. 43: GD, St-1, n-Pn-7, 30 cm depth, 10.2 w.t., 5.8 pH, s-BV, Aug. 6.
 .. no. 44: Mu, St-1, n-Pn-7, 30 cm depth, 10.2 w.t., 5.8 pH, s-BV, Aug. 6.
 .. no. 45: GD, St-1, n-Pn-7, 30 cm depth, 10.2 w.t., 5.8 pH, s-BV, Aug. 6.
 .. no. 53: GD, Pn-10, 30 cm depth, 5.8 w.t., 5.4 pH, s-BB, Aug. 7
 .. no. 55: Mu, Sw-5, b-Pn-10, 10 cm depth, s-BB, Aug. 7.
 .. no. 56: Mu, Sw-5, b-Pn-10, 10 cm depth, s-BB, Aug. 7.
 .. no. 57: FB, Sw-5, b-Pn-10, 10 cm depth, s-BB, Aug. 7.
 .. no. 58: GD, Sw-5, b-Pn-10, 10 cm depth, s-BB, Aug. 7.
 .. no. 59: FB, Sw-6, n-PG, 10 cm depth, 8.8 w.t., s-BB, Aug. 7.
 .. no. 61: M, Sw-6, n-PG, 10 cm depth, 8.8 w.t., s-BB, Aug. 7.
 .. no. 64: M, Sw-8, n-PG, 10 cm depth, s-BB, Aug. 7.
 .. no. 65: M, Sw-8, n-PG, 10 cm depth, s-BB, Aug. 7.
 .. no. 72: M, Pn-11, 20 cm depth, 4.9 w.t., 5.6 pH, s-BB, Aug. 9.
 .. no. 74: Mu, Sw-9, b-Pn-11, 10 cm depth, 8.2 w.t., s-BB, Aug. 9.
 .. no. 76: M, Sw-9, b-Pn-11, 10 cm depth, 8.2 w.t., s-BB, Aug. 9.
 .. no. 93: Pl, Pn-14, 20 cm depth, 8.0 w.t., s-BB, Aug. 10.
 .. no. 94: M, Pn-14, 20 cm depth, 8.0 w.t., s-BB, Aug. 10.
 .. no. 513: M, Sw-7, n-PG, 10 cm depth, s-BB, Aug. 7.
 .. no. 523: G, Cr-1, 50 cm depth, 5.2 w.t., 5.8 pH, s-BV, Aug. 6.

3. Umiat area

- Habitat no. 104: M, Cr-1, 5 cm depth, 13.0 w.t., Aug. 11.
 .. no. 105: Mu, Cr-1, 5 cm depth, 13.0 w.t., Aug. 11.
 .. no. 106: Mu, Cr-1, 5 cm depth, 13.0 w.t., Aug. 11.
 .. no. 110: Pl, Pn-2, 30 cm depth, Aug. 12.
 .. no. 112: Sp, Pn-3, 50 cm depth, 12.1 w.t., Aug. 12.
 .. no. 115: Mu, Pn-3, 50 cm depth, 12.1 w.t., Aug. 12.
 .. no. 116: M, Pn-3, 50 cm depth, 12.1 w.t., Aug. 12.

- Habitat no. 117: FB, Pn-3, 50 cm depth, 12.1 w.t., Aug. 12.
 .. no. 118: P1, Pn-4, 30 cm depth, 10.4 w.t., 5.8 pH, Aug. 12.
 .. no. 119: Mu, Pn-4, 30 cm depth, 10.4 w.t., 5.8 pH, Aug. 12.
 .. no. 123: F, Pn-6, 150 cm depth, 12.2 w.t., Aug. 12.
 .. no. 530: G, L-, 30 cm depth, 15.8 a.t., 13.0 w.t., 5.8 pH, Aug. 13.

4. Lake Peters area

- Habitat no. 190: Mu, St-2, 5 cm depth, 8.8 w.t., Aug. 19.
 .. no. 193: Mu, St-3, 5 cm depth, Aug. 19.
 .. no. 199: G, St-6, 5 cm depth, 7.0 w.t., Aug. 19.
 .. no. 203: Mu, St-8, 5 cm depth, Aug. 19.
 .. no. 205: G, St-10, 5 cm depth, Aug. 19.
 .. no. 223: M, Sw, n-St-12, 10 cm depth, Aug. 20.
 .. no. 515: FB, L-4, 10 cm depth, Aug. 19.
 .. no. 516: Mu, L-1, 10 cm depth, 6.5 w.t., 5.8 pH, Aug. 19.

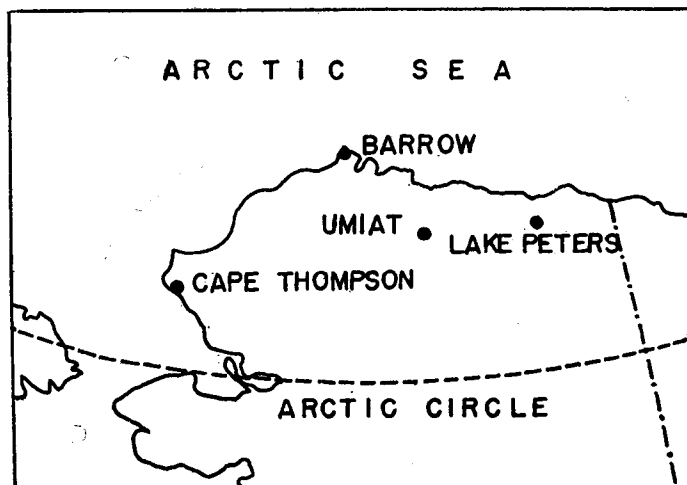


Fig. 1. Map of the Alaskan Arctic.

Abbreviation

- | | |
|--------------------|-------------------------|
| B-: Beside | Cr: Creek |
| BB: Barrow Base | F: Float |
| BV: Barrow village | FB: Float on the bottom |

G: Attached to the grass in the water	Pl: Plankton
GD: Attached to the grass deposit in the water	Pn: Pond
L: Lake	Po: Pool
M: Attached to the moss in the water	s-: South to
Mu: On the mud in the water	Sp; In the Sphagna
n-: Near	St: Stream
PB: Point Barrow	Sw: Swal

In the present paper more than two hundred species of desmids are identified, and about one half of them belong to the genus *Cosmarium*. This high percentage of *Cosmarium*-species in the arctic desmid-flora has already been pointed out by CROASDALE on the desmid-flora of Devon Island, with the scantiness of *Triploceras* and *Micrasterias*. The most frequent species found in the present collections are the following:

Closterium diana, *Cl. parvulum*, *Cl. striolatum*, *Pleurotaenium truncatum*, *Cosmarium costatum*, forma *minor*, *C. granatum*, *C. holmiense* var. *integrum*, *C. botrytis*, *C. cyclicum* var. *arcticum*, *C. subcrenatum*, *C. subcostatum*, *C. quadratum*, *C. turpinii* var. *eximium*, *C. ochthodes* var. *amoebum*, *C. tumidum*, *Euastrum bidentatum*, *E. binale* var. *gutwinski*, *E. obesum*, *E. elegans*, *Staurastrum borgeanum*.

However, all these species are not always the arctic species, and true arctic and noteworthy species are found rather rarely in the samples collected in some districts. Some of the species are particularly interesting in distribution and they have been previously known chiefly from the European side of the Arctic. These are the following:

Closterium elenkinii, *Cosmarium botrytis* var. *gemmiferum*, *C. anceps* and its forma *crispula* and f. *subparvula*, *C. incertum* var. *groenlandicum*, *C. hornavanense* var. *arcticum* and var. *dubovianum*, *C. hexalobum* var. *laticeps*, *C. hians*, *C. microsphinctum*, *C. subglobosum*, *C. subquasillus*, *C. subundulatum*, *C. tuddalense*, *C. subcostatum* var. *spetsbergense*, *C. woronichinii*, *C. speciosissimum*, *Staurastrum bieneanum* forma *spetsbergensis*, *St. insigne*, *St. petsamoense* and var. *minus*.

The writer expresses his hearty thanks to Dr. Y. KOBAYASHI of the National Science Museum, and to Dr. K. MARUYAMA of the Institute of Applied Microbiology, University of Tokyo. Gratitude is expressed also to the Arctic Institute of North America for the kind invitation to the present survey of botany.

Gonatozygaceae

Gonatozygon monotaenium DE BARY in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 30, pl. 1, f. 1-7; pl. 5, f. 5, 1904; CROASDALE, Farlowia, 4, p. 519, pl. 3, f. 1, 1955; FÖRSTER,

Ark. Bot., Ser. 2, 6(3), p. 124, pl. 1, f. 3, 4, 1965.

Cells 220–255 μ long, 13–13.4 μ broad, and apices 15–15.8 μ broad.

Hab. 30, 40, 523. Distr. Devon Island, Europe, and America.

Mesotaeniaceae

Cylindrocystis brebissonii MENEGH. in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 58, pl. 4, f. 23–32, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 207, pl. 6, f. 4–7, 1933; SKUJA, Nava Acta R. Soc. Scient. upsal., Ser. IV, 18(3), p. 177, pl. 29, f. 16–18, 1963.

Cells 44–64 μ long and 18.5–22 μ broad.

Hab. 29, 30, 61, 74, 94, 193, 205, 515, 516, 523. Distr. Greenland, Spitzbergen, Novaya Semlya, Franz Joseph Land, Devon Island, Europe, Asia, and N. America.

Cylindrocystis brebissonii var. *minor* W. & G. S. WEST, Monogr. Br. Desm., 1, p. 59, pl. 5, f. 11, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 209, pl. 6, f. 8, 9, 1933; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. IV, 18(3), p. 177, 1963.

Cells 41.7–42 μ long and 11–11.4 μ broad.

Hab. 203. Distr. Europe and Japan.

Spirotaenia condensata BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 38, pl. 2, f. 7–10, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 181, pl. 2, f. 1, 1933.

Cells 132–145 μ long and 22.7–24 μ broad.

Hab. 115. Distr. Alaska, Spitzbergen, Novaya Semlya, Europe, and Japan.

Spirotaenia obscura RALFS in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 44, pl. 3, f. 7–12, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 180, pl. 1, f. 5, 6, 1933.

Cells 118–120 μ long and 22.6–23 μ broad.

Hab. 223. Distr. Spitzbergen, Novaya Zemlya, Europe, U.S.A., and Japan.

Netrium digitus (EHRENB.) ITZIG. & ROTHE in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 64, pl. 6, f. 14–16, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 214, pl. 7, f. 1; pl. 8, f. 1, 1933.

Hab. 57, 61, 115. Distr. Gosmopolitan.

Netrium oblongum (DE BARY) LÜTKEM. in W. & G. S. WEST, Monogr. Br. Desm. 1, p. 66, pl. 8, f. 1–3, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 220, pl. 8, f. 6, 1933.

Hab. 61. Distr. Europe, N. & S. America, Japan, and India.

Desmidiaceae

Penium margaritaceum (EHRENB.) BRÉB. in WEST, Monogr. Br. Desm., 1, p. 83, pl. 8, f. 32–35, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 230, pl. 10, f. 2–4, 1935.

Cells 88–150 μ long and 24–28 μ broad.

Hab. 30, 106, 516. Distr. Alaska, Greenland, Spitzbergen, Europe, U.S.A., Devon Island, Japan, and Java.

Penium polymorphum PERTY in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 90, pl. 9, f. 9-11, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 229, pl. 11, f. 18-20, 1935; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. IV, 18(3), p. 179, pl. 30, f. 7, 8, 1963.

Cells 70-75 μ long and 22-26.4 μ broad.

Hab. 40, 44, 72, 104. Distr. Europe, U.S.A., Japan, and New Zealand.

Penium spirostriolatum BARKER in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 88, pl. 9, f. 1-8, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 227, pl. 9, f. 1-6, 1935.

Cells 136-140 μ long and 26-26.5 μ broad.

Hab. 61. Distr. Europe, U.S.A., Japan, Java, and Ceylon.

Closterium acerosum (SCHRANK) EHRENB. in KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 314, pl. 23, f. 11, 12; pl. 24, f. 1, 1935.

Closterium acerosum var. *nasutum* HIRANO, var. nov.

Cellulae minores quam in forma typica, circiter 8-9 longiores quam latiores, gradatim attenuatae ad verticem, apicibus rotundatis, marginibus internis paene rectis vel leviter concavis; membrana glabra. Long. 250-277 μ , lat. 27-31 μ .

The specimens are not recurved or conically attenuated near the apex. Cell outline rather resembles var. *elongatum* but is shorter. Pl. 2, fig. 3.

Hab. 45, 523.

Closterium acerosum var. *porosum* HIRANO, var. nov.

Membrana distincte punctata, sed ceteris in forma typica. Long. 370-414 μ , lat. 36-40.5 μ .

Cell wall with median girdle and distinctly punctated. MESSIKOMMER reported a similar form from Switzerland under the name of *Closterium pritchardianum* var. *micropunctata* (Arch. Hydrobiol., 47, p. 550, pl. 4, f. 5, 1953) but the present forms are smaller than his form. Pl. 1, fig. 10.

Hab. 106.

Closterium archerianum CLEVE in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 115, pl. 11, f. 8-10, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 368, pl. 36, f. 7, 8, 1935.

Hab. 56, 112, 115. Distr. Europe, Japan, India, and Java.

Closterium arcuarium HUGHES, Can. J. Bot., 30, p. 272, f. 23, 27, 57, 1952; CROASDALE, Farlowia, 4, p. 521, pl. 5, f. 18, 1955.

Cells 186-200 μ long and 17.6-18 μ broad. Pl. 1, fig. 8.

Hab. 22. Distr. Canada and Alaska.

Closterium calosporum WITTR. in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 138, pl. 16, f. 1-4, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 292, pl. 19, f. 1-3, 1935.

Cells 105-110 μ long and 8-8.8 μ broad.

Hab. 38. Distr. Novaya Zemlya, Europe, U.S.A., Ceylon, Thailand, and Africa.

Closterium cornu EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 157, pl. 20, f. 1-5, 1904; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., 83, p. 154, pl. 2, f. 13-15, 1964.

Cells 123-158 μ long and 6.6-10 μ broad.

Hab. 53, 61, 65, 190. Distr. Labrador. U.S.A., Novaya Zemlya, Europe, Japan, Thailand, Java, and Central Africa.

Closterium costatum CORDA in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 120, pl. 13, f. 1-3, 1904; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 358, pl. 34, f. 1-3, 1935; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., 83, p. 154, pl. 4, f. 13, 1964.

Cells 343-427 μ long and 40-57 μ broad.

Hab. 22, 36, 112. Distr. Canada, Greenland, Europe, Faeroes, U.S.A., and Japan.

Closterium costatum var. *subcostatum* (NORDST.) KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 360, pl. 34, f. 6, 1935.

Cells 310-318 μ long, 52-53 μ broad, and striae 4 in 10 μ . Pl. 2, fig. 4.

Hab. 61. Distr. U.S.A., Europe, India, and Brazil.

Closterium cynthia DE NOT. in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 113, pl. 11, f. 1-3, 1904; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., 83, p. 154, pl. 5, f. 4, 1964.

Cells 84-101 μ long and 13-15.4 μ broad.

Hab. 29, 58, 61, 74. Distr. N. America, Europe, Japan, India, Ceylon, Sumatra, E. Africa, New Zealand, and Brazil.

Closterium cynthia var. *jenneri* (RALFS) KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 366, pl. 36, f. 2, 1935.

Cells 79-120 μ long and 8.7-16 μ broad.

Hab. 14, 55, 57, 59. Distr. U.S.A., Greenland, Novaya Zemlya, Europe, Africa, Japan, Thailand, Java, and Brazil.

Closterium cynthia var. *latum* SCHMIDLE in KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 368, pl. 36, f. 3, 4, 1935.

Cells 75-81 μ long, 15.4-17.6 μ broad, and striae 7 in 10 μ .

Hab. 30, 40, 61. Distr. Europe, E. Africa, and Kerguelen.

Closterium diana EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., 1, p. 130, pl. 15,

f. 1-6, 1904; CROASDALE, *Farlowia* **4**, p. 522, pl. 5, f. 1-6, 1955.

Cells 120-295 μ long and 13-25 μ broad.

Hab. 14, 22, 35, 36, 40, 43, 44, 45, 58, 61, 64, 65, 74, 76, 93, 94, 104, 105, 190, 515, 538. Distr. Cosmopolitan.

Closterium diana var. *minus* (WILLE) SCHRÖDER in KRIEGER, *Kryptogamenflora*, **13**, Abt. 1, p. 296, pl. 19, f. 15, 1935.

Cells 116-119 μ long and 13 μ broad.

Hab. 40. Distr. Europe, Japan, and E. Africa.

Closterium didymotocum RALFS in KRIEGER, *Kryptogamenflora*, **13**, Abt. 1, p. 325, pl. 26, f. 1, 2, 1935.

Cells 427-493 μ long and 44-49.3 μ broad. Pl. 2, fig. 1.

Hab. 55. Distr. Europe, Greenland, Siberia, U.S.A., India, New Zealand, and Africa.

Closterium elenkinii KOSSINSKAYA in *Flora Plant. Crypt. URSS*, **5**, p. 229, pl. 19, f. 5-8, 1960; CROASDALE, *Trans. Am. microsc. Soc.*, **81**, p. 18, pl. 2, f. 22, 23, 1962.

Cells 300-360 μ long and 35-45 μ broad. The present specimens are larger in dimension than those of the Russian forms described by KOSSINSKAYA. Cells are prominently tumid in the middle of the cell, rapidly attenuating toward the apices, which are somewhat protruded. Cell walls are punctated but do not show any definite disposition. Pl. 1, fig. 6, 7.

Hab. 22, 55. Distr. Alaska and URSS.

Closterium gracile BRÉB. in W. & G. S. WEST, *Monogr. Br. Desm.*, **1**, p. 166, pl. 21, f. 8-12, 1904; KRIEGER, *Kryptogamenflora*, **13**, Abt. 1, p. 310, pl. 30, f. 7-9, 1935.

Cells 143-220 μ long and 7.5-11 μ broad.

Hab. 43, 104, 105, 530. Distr. U.S.A., Devon Island, Greenland, Siberia, Europe, SE. Asia, and S. America.

Closterium intermedium RALFS in WEST, *Monogr. Br. Desm.*, **1**, p. 125, pl. 14, f. 1-5, 1904; KRIEGER, *Kryptogamenflora*, **13**, Abt. 1, p. 335, pl. 28, f. 5, 6; pl. 29, f. 8, 1935; CROASDALE & GRÖNBLAD, *Trans. Am. microsc. Soc.*, **83**, p. 156, pl. 4, f. 1, 1964.

Cells 163-378 μ long, 18.5-23 μ broad, and striae 7 in 10 μ .

Hab. 29, 43, 64, 119. Distr. Alaska, Canada, U.S.A., Europe, Faeroes, Japan, Ceylon, Australia, and Brazil.

Closterium johnsonii W. & G. S. WEST in KRIEGER, *Kryptogamenflora*, **13**, Abt. 1, p. 309, pl. 23, f. 3, 1935.

Cells 264-268 μ long and 17.5 μ broad. The present specimens are smaller than those of KRIEGER's conception and the length of cells is about 15 times their breadth,

both sides are almost parallel and inner side is straight. The species resembles *Closterium macilentum* but is not so elongated.

Hab. 43. Distr. U.S.A. and Alaska.

Closterium juncidum RALFS var. *brevior* (RALFS) ROY in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 129, pl. 14, f. 15, 16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 334, pl. 28, f. 3, 1935; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 157, pl. 3, f. 19, 1964.

Cells 137–152 μ long and 9–9.5 μ broad.

Hab. 30. Distr. Alaska, Europe, and U.S.A.

Closterium kutzingii BRÉB. in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 351, pl. 32, f. 8, 9, 1935; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 157, pl. 4, f. 11, 12, 1964; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 126, pl. 1, f. 17–19, 1965.

Cells 416–638 μ long and 22–26.4 μ broad.

Hab. 36, 40, 45, 55, 61, 64, 65, 74, 106, 118. Distr. Cosmopolitan.

Closterium lanceolatum KÜTZ. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 149, pl. 17, f. 9, 10; pl. 18, f. 7, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 319, pl. 24, f. 9, 10, 1935.

Cells 216–232 μ long and 30–30.6 μ broad.

Hab. 53. Distr. Greenland, U.S.A., Europe, China, Japan, and Africa.

Closterium libellula FOCKE var. *intermedium* (ROY & BISS.) G. S. WEST in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 255, pl. 12, f. 3–5, 1935.

Hab. 45. Distr. Alaska, Europe, Japan, Ceylon, and Malaya.

Closterium littorale GAY in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 155, pl. 19, f. 14, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 298, pl. 20, f. 3–5, 1935.

Cells 154–160 μ long and 17.6–18 μ broad.

Hab. 30. Distr. U.S.A., Greenland, Europe, and Japan.

Closterium moniliferum (BORY) EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 142, pl. 16, f. 15, 16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 289, pl. 18, f. 6, 7, 1935; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 157, pl. 3, f. 1, 1964.

Cells 194–300 μ long and 35–53 μ broad.

Hab. 45, 94, 106. Distr. Alaska, Devon Island, U.S.A., Europe, Japan, Ceylon, and Africa.

Closterium navicula (BRÉB.) LÜTKEM. in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 257, pl. 12, f. 8–10, 1935.

Cells 75–79 μ long and 18.5–22 μ broad.

Hab. 105. Distr. U.S.A., Greenland, Europe, Japan, India, Ceylon, Malaya, and

Brazil.

Closterium parvulum NÄG. in W. & G. S. WEST, Monogr. Br. Desm., **1** p. 133, pl. 15, f. 9-12, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 275, pl. 16, f. 14-17, 1935.

Cells 88-121 μ long and 8.8-16 μ broad.

Hab. 14, 16, 57, 65, 72, 105, 106, 115, 117, 523, 536. Distr. Cosmopolitan.

Closterium pseudolunula BERGE in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 305, pl. 22, f. 3, 1935; SKUJA, Nova Acta R. Soc. Scient. Upsal., ser. IV, **18**(3), p. 183, 1963.

Cells 286-297 μ long and 36-38 μ broad. Pl. 1, fig. 9.

Hab. 106. Distr. U.S.A., Greenland, Spitzbergen, Europe, Sumatra, Africa, and Australia.

Closterium ralfsii BRÉB. var. *gracilius* (MASKELL) KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 346, pl. 31, f. 6, 1935; CROASDALE & GRÖNBLAD, Acta Soc. Fauna Flora Fenn., **83**, p. 158, pl. 4, f. 7, 1964.

Cells 211-370 μ long and 18.5-22 μ broad.

Hab. 22, 30, 43, 44, 45, 56. Distr. Canada, Europe, Burma, and New Zealand.

Closterium ralfsii var. *hybridum* RABENH. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 183, pl. 24, f. 8-13, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 347, pl. 31, f. 4, 5, 1935.

Cells 360-506 μ long and 33-43 μ broad.

Hab. 22, 45, 105, 106. Distr. Cosmopolitan.

Closterium striolatum EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 122, pl. 13, f. 7-16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 337, pl. 28, f. 8, 9; pl. 29, f. 9, 1935.

Cells 194-334 μ long and 22-55 μ broad.

Hab. 14, 16, 29, 30, 55, 56, 57, 58, 59, 61, 64, 65, 104, 105, 106, 513. Distr. Alaska, Greenland, Spitzbergen, Novaya Zemlya, Europe, and others.

Closterium striolatum var. *rectum* W. WEST, Monogr. Br. Desm., **1**, p. 124, pl. 13, f. 17, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 340, pl. 28, f. 13, 1935.

Cells 256-264 μ long and 38-39 μ broad. Pl. 1, fig. 5.

Hab. 16. Distr. Europe.

Closterium tumidum JOHNSON in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 156, pl. 19, f. 15-18, 1904; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 159, pl. 2, f. 10-12, 1964.

Cells 110-119 μ long and 11-12.3 μ broad.

Hab. 43, 45, 203. Distr. Alaska, Canada, U.S.A., Novaya Semlya, Europe, and others.

Closterium venus KÜTZ. var. *incurvum* (BRÉB.) KRIEGER in Kryptogamenflora, **13**, Abt. 1, p. 273, pl. 16, f. 6, 7, 1935.

Cells 53–95 μ long and 10–15.7 μ broad.

Hab. 26, 28, 39, 64, 121, 160, 169. Distr. Cosmopolitan.

Pleurotaenium ehrenbergii (BRÉB.) de BARY in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 205, pl. 29, f. 9–11; pl. 30, f. 1, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 410, pl. 42, f. 4–8, 1935.

Cells 317–396 μ long, 26.5–36 μ broad, and apices 17.6–26.5 μ broad.

Hab. 58, 116. Distr. Alaska, Siberia, Novaya Zemlya, Europe, and others. Cosmopolitan species.

Pleurotaenium trabecula (EHRENB.) NÄG. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 209, pl. 30, f. 11–13, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 395, pl. 40, f. 1–4, 1935.

Cells 466–502 μ long and 28.6–31.7 μ broad. Pl. 2, fig. 10.

Hab. 116, 536. Distr. Alaska, Greenland, Novaya Zemlya, Europe, Japan, India, and Thailand.

Pleurotaenium trabecula var. *crassum* WITTR. in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 399, Pl. 40, f. 6, 1935; CROASDALE, Farlowia, **4**, p. 528, pl. 10, f. 6, 1955.

Cells 273–352 μ long and 40–60 μ broad. Pl. 2, fig. 8, 9.

Hab. 115, 116. Distr. Alaska, Europe, Greenland, Novaya Zemlya, India, Central China, and Japan.

Pl. trabecula var. *elongatum* CEDERGREN in Kryptogamenflora, **13**, Abt. 1, p. 399, pl. 40, f. 5, 1935.

Cells 585–668 μ long, 31–33 μ broad. Pl. 2, fig. 11.

Hab. 117. Distr. Alaska and Europe.

Pleurotaenium truncatum (BRÉB.) NÄG. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 203, pl. 29, f. 3, 4, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 430, pl. 49, f. 2, 3, 1935.

Cells 308–458 μ long, 42–61.5 μ broad, and apices 20–26.5 μ broad. Pl. 2, fig. 5.

Hab. 30, 33, 56, 74, 104, 112. Distr. U.S.A., Europe, Alaska, Greenland, Novaya Zemlya, Spitzbergen, India, Japan, New Zealand, and S. America.

Pleurotaenium truncatum var. *crassum* BOLDT in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 204, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 432, pl. 49, f. 7, 1935; CROASDALE, Farlowia, **4**, p. 529, pl. 9, f. 9, 10, 1955.

Cells 300–370 μ long, 62–66 μ broad, and apices 26.4–27 μ broad. Pl. 2, fig. 6.

Hab. 74, 76. Distr. Alaska, Siberia, Novaya Zemlya, and Europe.

Tetmemorus laevis (KÜTZ.) RALFS in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 222, pl. 32, f. 11-16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 455, pl. 54, f. 9-12, 1937.

Cells 92.5-110 μ long and 28.6-33 μ broad.

Hab. 45 61, 65, 190. Distr. Alaska, U.S.A., Europe, Greenland, Novaya Zemlya, Australia, and New Zealand.

Cosmarium abbreviatum RACIB. var. *planctonicum* W. & G. S. WEST in Monogr. Br. Desm., **3**, p. 85, pl. 72, f. 13, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **16** (3), p. 209, pl. 35, f. 8, 1956; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 22, pl. 4, f. 55, 1962.

Cells 24-25 μ long, 24-25 μ broad, and isthmus 8 μ broad. Pl. 5, fig. 22.

Hab. 104. Distr. Alaska, Devon Island, and Europe.

Cosmarium amoeviforme HIRANO, sp. nov.

Cellulae modicae, cylindricae, circiter $1\frac{1}{2}$ longiores quam latiores, levissime constrietae ad medium, sinu late excavato; semicellulae subsemiellipticae vel semicirculares, apice convexo; membrana granulata, granulis magnis, in serie horizontalibus dispositis, granulis in serie infimae geminatis; in vertice visae circulares, marginibus granulatis, granulis in serie radialibus dispositis. Long. 48-50 μ , lat. 33-34 μ , isth. 30.7-31 μ lat. Pl. 8, fig. 7.

Hab. 94.

Similar forms to this species are already known from Burma, reported by JOSHUA under the name of *C. diadema* JOSHUA, but his species are larger than the present species and the vertical view of semicell is elliptic.

Cosmarium amoeviforme var. *angustatum* HIRANO, var. nov.

Cellulae angustiores quam in forma typica, apicibus semicellularum angusticonvexis; membrana granulata, granulis magnis in serie horizontalibus dispositis. Long. 50-52 μ , lat. 28.5-29 μ , isth. 27.3 μ lat. Pl. 8, fig. 6.

Hab. 104.

Cosmarium anceps LUND. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 47, pl. 69, f. 14-17, 1908; GRÖNBLAD, Nova Hedwigia, **4**, pl. 101, f. 2, 1962; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 203, pl. 33, f. 34; pl. 34, f. 1, 1963; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 132, pl. 5, f. 18, 1965.

Cells 34-40 μ long, 20-22 μ broad, and isthmus 8.7-15 μ broad. The specimens are similar to the British form reported by GRÖNBLAD but the cells are broader than his description. Pl. 5, fig. 17.

Hab. 15, 64, 148, 203, 223, 538. Distr. Alaska, Devon Island, Europe, Novaya Zemlya, Spitzbergen, Greenland, and Faeroes.

Cosmarium anceps forma *crispula* NORDST. in W. & G.S. WEST, Monogr. Br. Desm., **3**, p. 49, pl. 66, f. 17A, 1908; MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, **24**, p. 149, pl. 6, f. 8; pl. 7, f. 2, 1942.

Cells 35–36 μ long, 20–23 μ broad, and isthmus 11–14 μ broad. NORDSTEDT reported *Euastrum polare* (Öfv. K. Vet. Akad. Förh., 1872, no. 6, p. 37, pl. 7, f. 24) similar to this form but his species quite coincides with the present Alaskan form. The present form is distinguished from the typical form by having the undulated lateral margin. The present form resembles *C. pokornyianum* but the lower lateral margin is not divergent and retuse but rather convergent. Pl. 5, fig. 20–21.

Hab. 146. Distr. Europe and Novaya Zemlya.

C. anceps forma *subparvula* LARSEN, Meddr. Grönland, **33**(8), p. 326, pl. 7, f. 6, 1907; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 14, pl. 8, f. 19, 1956; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 133, pl. 5, f. 19, 22, 23; pl. 11, f. 1, 1965. — *Cosmarium parvulum* BRÉB. in WHELDEN, Bull. natn. Mus. Can., **97**, p. 84, pl. 5, f. 1, 1947. — *C. anceps* LUND. in SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 203, pl. 34, f. 2, 1963.

Cells 26.4–28.6 μ long, 15.4–17.6 μ broad, and isthmus 12.3–15.4 μ broad. Cells smaller than the typical form, sinus acuminate at the extremity but widely open outward. The present form differs from *C. parvulum* by having the basal inflation of lateral margin. Apex of semicell retuse, but some specimens from different places have a slightly convex apex. SKUJA explained all these forms obtained from North Europe unit as *C. anceps* itself. Sinus of typical form is somewhat deep and seems to be linear open, but other forms showing a sinus having a deep notch are reported from some parts of Europe and Canada. The present specimens coincide with the form reported by WHELDEN under another name. Pl. 5, fig. 8, 18, 19.

Hab. 146, 160, 223, 536. Distr. Alaska, Greenland, and Europe.

Cosmarium angulosum BRÉB. var. *concinnum* (RABENH.) W. & G.S. WEST in Monogr. Br. Desm., **3**, p. 94, pl. 72, f. 37, 38, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 16, pl. 11, f. 16, 1956.

Hab. 121. Distr. Alaska, Europe, Greenland, Japan, India, Africa, Australia, and S. America.

Cosmarium arctoum NORDST. in Öfv. K. Vet.-Akad. Förh., p. 28, pl. 7, f. 22, 1875; W. & G.S. WEST, Monogr. Br. Desm., **3**, p. 41, pl. 69, f. 2, 1908; GRÖNBLAD, Commentat. Biol., **5**(4), p. 3, f. 17–20, 1935; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 133, pl. 4, f. 19, 1965.

Cells 17.6–23 μ long, 13–17.5 μ broad, and isthmus 11.4–13 μ broad. Pl. 2, fig. 7.

Hab. 16, 43, 45, 55, 56, 76, 94, 104, 106, 190, 203. Distr. Spitzbergen, Greenland, Novaya Zemlya, Franz Joseph Land, and Europe.

Cosmarium biclavatum BORGE in Vid. Selsk. Skr. no. 11, p. 9, f. 7, 1911.

C. biclavatum var. *alaskanum* HIRANO, var. nov.

Cellulae minores quam in forma typica, leviter longiores quam latiores, modice constrictae ad medium, sinu excavato; semicellulae transverse ellipticae, marginibus lateralibus granulis quaternis ordinatis, apice truncato et glabro; membrana serie transalibus granulorum trans semicellulam, long. 22μ , lat. 18.5μ , lat. isth. 11μ , Pl. 6, fig. 6.

Hab. 45. The present variety is distinctly smaller than the typical form and the apex of semicell lacks granules. Also it differs from the typical form by the elliptic form of vertical view, instead of circular in the typical form.

Cosmarium binum NORDST. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 246, pl. 88, f. 10-14, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 16, pl. 16, f. 5, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 222, pl. 39, f. 7, 1963.

Cells $42-53\mu$ long, $35-40\mu$ broad, and isthmus $14-14.5\mu$ broad.

Hab. 30, 40, 56, 57, 72, 173. Distr. Alaska, U.S.A., Europe, Japan, Sumatra, Central Africa, Australia, and Brazil.

Cosmarium bioculatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 165, pl. 61, f. 3-7, 1908; BORGE, Ark. Bot., 23A(2), p. 35, pl. 2, f. 28, 1930; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 195, pl. 33, f. 6, 1963.

C. bioculatum var. *borgei* HIRANO, var. nov.

Semicellulae late oblongo-rectangulares, marginibus lateralibus leviter convexis et verticalibus, apice paullo convexo; cellulis in vertice visis rhomboido-oblongis, polis bene rotundatis, long. $25-26\mu$, lat. $26.4-27\mu$, lat. isth. $6.5-6.8\mu$. Pl. 4, fig. 5.

The present specimens are somewhat different from the typical form by having the closed sinus and different shape of semicell.

C. bioculatum var. *depressum* SCHAARSCHM. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 166, pl. 61, f. 8, 9, 1905; CROASDALE, Trans. Am. microsc. Soc., 84, p. 316, pl. 3, f. 1-3, 1965.

Cells $22-26.5\mu$ long, $24-26.5\mu$ broad, and isthmus $8.4-8.8\mu$ broad.

Hab. 65, 115, 513, 523. Distr. Alaska, Devon Island, Europe, and Japan.

Cosmarium biretum BRÉB. var. *minus* HANSG. in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 26, 1911.

Cells $44-45\mu$ long, $23-24\mu$ broad, and isthmus 11μ broad. Pl. 9, fig. 7.

Hab. 45. Distr. Europe.

Cosmarium blyttii WILLE in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 225, pl. 86, f. 1-4, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 18, pl. 14, f. 20, 1956.

Cells $15.4-16\mu$ long, $15.4-16\mu$ broad, and isthmus $4.4-5\mu$ broad.

Hab. 121. Distr. Alaska, U.S.A., Europe, Greenland, Central China, Japan, and Africa.

Cosmarium boeckii WILLE in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 234, pl. 86, f. 26-32, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 20, pl. 15, f. 14, 1956; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 134, pl. 7, f. 13, 1965.

Cells 35-44 μ long, 31-36.5 μ broad, and isthmus 10-11 μ broad. The semicells of the present specimens are trapeziform-semicircular, lateral margin crenate, upper crenae distinct but the middle and lower crenae indistinct, apex 4-crenate and middle two crenae small and reduced; semicells furnished with a distinct series of granules within each crena, diminishing towards the centre; disposition of granules above the isthmus is not of a cruciate form. Pl. 1, fig. 3.

Hab. 94, 121. Distr. Alaska, U.S.A., Europe, Iceland, and Bornholm.

Cosmarium boergesenii GRÖNBLAD, Acta Soc. Sci. fenn., nov. ser. B, 2(5), p. 36, pl. 2, f. 7, 1942; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., 83, p. 174, pl. 12, f. 22, 23, 1964.

Cells 26.5-44 μ long, 17.6-26.4 μ broad, and isthmus 4.4-6.6 μ broad. Lower lateral margin of semicells slightly divergent and retuse, upper lateral one is strongly convergent. Apex narrowly truncate or slightly convex. BORGE already reported a similar form from Africa and determined this form as *C. laeve*. The present Alaskan forms do not have retuse apex in semicell, so that I hesitate to agree with his determination. Pl. 4, fig. 10; Pl. 5, fig. 9.

Hab. 29, 56, 61, 74, 121. Distr. Alaska.

Cosmarium botrytis MENEGH. in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 1, pl. 96, f. 1, 2, 5-15, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 20, pl. 17, f. 3, 1956.

Cells 71-88 μ long, 57-70.5 μ broad, and isthmus 17.6-27 μ broad. Pl. 7, fig. 5.

Hab. 30, 36, 38, 45, 64, 72, 74, 115, 116, 117, 119, 121. Distr. Cosmopolitan.

Cosmarium botrytis var. *gemmiferum* (BRÉB.) NORDST. in W. & G. S. WEST, Monogr. Br. Desm., 4 p. 5, pl. 97, f. 4, 1911; INSAM & KRIEGER, Hedwigia, 76, p. 97, pl. 6, f. 11, 1936; MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, 24, p. 160, pl. 12, f. 1, 1942; CROASDALE, Trans. Am. microsc. Soc., 84, p. 316, pl. 6, f. 1, 1965.

Cells 71-84 μ long, 62-66 μ broad, and isthmus 22 μ broad. Pl. 9, fig. 2.

Hab. 40, 119, 538. Distr. Devon Island, Europe.

C. botrytis var. *mesoleium* NORDST. in BORGE, Ark. Bot., 28A(6), p. 31, pl. 3, f. 47, 1936; INSAM & KRIEGER, Hedwigia, 76, p. 97, pl. 6, f. 10, 1936.

Cells 57-66 μ long, 46-57 μ broad, and isthmus 17-17.6 μ broad. Apex of semicell straight and destitute of granules; cell wall furnished with scrobiculations in the middle of semicell. Pl. 6, fig. 13.

Hab. 106. Distr. Europe.

C. botrytis var. *tumidum* WOLLE in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 5, pl. 97, f. 2, 3, 1911; CROASDALE, Trans. Am. microsc. Soc., 75, p. 20, pl. 17, f. 7, 1956.

Cells 73–84 μ long, 64–66 μ broad, and isthmus 17.5–22 μ broad. Granules in the centre of semicell are somewhat elongate and larger than the others. FÖRSTER reported a similar form from Lapland by the name of *C. tetraophthalmum* var. *crassiverrucosum*, but his form has a somewhat longer cell than the present specimens. This variety is distinguished from the typical form by larger granules arranged in the centre of the semicell or above the isthmus. Also the present form should be compared with *C. ochthodes* reported by KRIEGER from Spitzbergen. Pl. 9, fig. 1.

Hab. 29, 56, 58, 61, 65, 72, 74, 76, 119, 123. Distr. Alaska, U.S.A., and Europe.

Cosmarium canadense IRENÉE-MARIE, Flora Desm. Reg. Mont., p. 164, pl. 32, f. 3, 4, 1939.

Cells 70–71 μ long, 63 μ broad, and isthmus 35 μ broad. Pl. 5, fig. 1.

Hab. 119. Distr. Canada.

Cosmarium connatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 25, pl. 67, f. 15–17, 1908.

Hab. 115, 116, 123. Distr. Alaska, U.S.A., Europe, Japan, South-east Asia, Central Africa, and Brazil.

Cosmarium conspersum RALFS, Br. Desm., p. 101, pl. 16, f. 4, 1848; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, 18(3), p. 211, pl. 37, f. 3, 1963.

Cells 97–101 μ long, 70–71 μ broad, and isthmus 26 μ broad.

Hab. 115, 116. Distr. Alaska, Devon Island, U.S.A., Greenland, Novaya Zemlya, Europe, Bornholm, Iceland, and S. America.

C. conspersum var. *latum* (BRÉB.) W. & G. S. WEST in Monogr. Br. Desm., 4, p. 15, pl. 99, f. 5, 6, 1911; INSAM & KRIEGER, Hedwigia, 76, p. 98, pl. 5, f. 18, 1936.

Cells 88–90 μ long, 72–73 μ broad, and isthmus 20 μ broad. Pl. 6, fig. 8.

Hab. 123. Distr. Alaska, U.S.A., Europe, Greenland, Faeroes, and Patagonia.

Cosmarium costatum NORDST., Öfv. K. Vet.-Akad. Förh., no. 6, p. 25, pl. 7, f. 17, 1875; W. & G. S. WEST, Monogr. Br. Desm., 3, p. 239, pl. 87, f. 13–16, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 221, pl. 39, f. 4, 5, 1964; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 135, pl. 7, f. 21, 22, 1965.

Cells 33–48.5 μ long, 31–37.5 μ broad, and isthmus 11–15.4 μ broad. Semicells truncate-semicircular or subtrapeziform, lateral margin distinctly crenate, apex slightly crenate, each crenation emarginate and furnished with a pair of minute granules; in some specimens (especially in a collection of no. 57) crenation is quite entire so that cell

wall is furnished with radial series of granules or similar crenations just within each crenation, with a distinct vertical series of granulated ridges on the central tumour, each ridge with a distinct rounded granule just below it, outer ridges somewhat arcuate. Pl. 7, fig. 2.

Hab. 14, 15, 29, 30, 39, 56, 57, 64, 76, 94, 104, 115, 143. Distr. Alaska, Spitzbergen, Greenland, Novaya Zemlya, Europe, U.S.A., and Franz Joseph Land.

C. costatum forma *minor* BOLDT, Bih. K. Svenska Vet. Akad. Handl., **13**, Afd. 3, no. 5, p. 21, 1887; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 240, 1908.

Cells 26.4–35 μ long, 22–31 μ broad, and isthmus 8.8–13 μ broad. Semicells with three lateral crenae on each side, vertical ridges with a distinct series of isolated granules just below each ridge. Pl. 7, fig. 4.

Hab. 15, 16, 30, 40, 45, 55, 56, 59, 64, 65, 72, 74, 76, 94, 104, 112, 121, 123. Distr. Greenland and Europe.

C. costatum var. *subhexalobum* BOLDT in GRÖNBLAD, Comment. Biol., **5**(6), p. 9, pl. 2, f. 42, 1936.

Cell 41.3 μ long, 40 μ broad, and isthmus 15.4 μ broad. Pl. 7, fig. 8.

Hab. 146. Distr. Greenland and Europe.

Cosmarium crenatum RALFS in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 35, pl. 98, f. 9–12, 1908; GRÖNBLAD, Comment. Biol., **5**(4), p. 3, f. 13, 14, 1935; WHELDEN, Bull. natn. Mus. Can., **97**, p. 76, 1947; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 26, pl. 4, f. 67–69, 1962; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 135, pl. 8, f. 1, 2, 1965.

Cells 38.7–40 μ long, 27.3–28 μ broad, and isthmus 16.7–17 μ broad. Lowermost crena in the lateral margin of semicells is retuse so that it seems to be two entire small crenae. Pl. 6, fig. 16.

Hab. 55, 148, 172. Distr. Alaska, U.S.A., Greenland, Spitzbergen, Siberia, Europe, Japan, Australia, and S. America.

C. crenatum var. *bicrenatum* NORDST., Öfv. K. Vet.-Akad. Förh., no. 6, p. 30, pl. 6, f. 10, 1872; INSAM & KRIEGER, Hedwigia, **76**, p. 98, pl. 4, f. 25, 1936; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 26, pl. 4, f. 70–72, 1962; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 219, pl. 37, f. 9, 1964.

Cells 26.4–27 μ long, 17.6–22 μ broad, and isthmus 8.8–10.6 μ broad. Pl. 6, fig. 17.

Hab. 64, 160, 223. Distr. Alaska, Spitzbergen, and Europe.

C. crenatum var. *boldtianum* (GUTW.) W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 37, pl. 98, f. 13, 14, 1908; WHELDEN, Bull. natn. Mus. Can., **97**, p. 76, 1947.

Cells 44–45 μ long, 31.7–32 μ broad, and isthmus 22 μ broad.

Hab. 148. Distr. Canada, Europe, and Sumatra.

Cosmarium cruciferum DE BARY, Conj., p. 72, pl. 7G, f. 3-6, 1858; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 241, 1935.—*Penium cruciferum* (DE BARY) WITTR. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 100, pl. 10, f. 18, 19, 1904.

Cells 22-24 μ long, 13-14 μ broad, and isthmus 13 μ broad.

Hab. 169, 190. Distr. U.S.A., Europe, New Zealand and East Africa.

Cosmarium cucumis CORDA in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 152, pl. 59, f. 18-20, 1905; WHELDEN, Bull. natn. Mus. Can., **97**, p. 229, 1947; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 189, pl. 32, f. 1, 1964.

Cells 86-92 μ long, 53-57 μ broad, and isthmus 30.7-31 μ broad. Pl. 4. fig. 14.

Hab. 45, 55. Distr. Alaska, Canada, Greenland, Spitzbergen, Novaya Zemlya, Europe, Siberia, and S. America.

Cosmarium cucurbita BRÉB. var. *attenuatum* G. S. WEST, Monogr. Br. Desm., **2**, p. 108, pl. 73, f. 34-36, 1908; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 135, pl. 3, f. 6, 1965.

Cells 31-37.4 μ long, 13-16.7 μ broad, and isthmus 12.8-16 μ broad. The length of cells of present specimens is 2.4 times their breadth, apex subtruncate. *Cosmarium adelochondrum* is similar to this variety but the cells are shorter than the present specimens.

Hab. 16, 55, 72, 169, 193, 203, 205, 223, 516. Distr. Devon Island, Europe, and W. Indies.

Cosmarium cucurbitinum (BISS.) LÜTKEM. forma *minor* (WEST) LÜTKEM. in GRÖNBLAD, Memo. Soc. Fauna. Flora. fenn., **10**, p. 267, pl. 4, f. 4, 5, 1934; HIRANO, Contr. Biol. Lab. Kyoto Univ., **1**, p. 80, pl. 16, f. 8, 1956.

Cells 44-55 μ long, 22-26.4 μ broad, and isthmus 20-25 μ broad. Pl. 3, fig. 7.

Hab. 22, 45, 65, 76, 148, 160, 173, 203, 223. Distr. Europe and Japan.

Cosmarium curtum (BRÉB.) RALFS in WEST & CARTER, Monogr. Br. Desm., **5**, p. 267, 1923; INSAM & KRIEGER, Hedwigia, **76**, p. 99, pl. 1, f. 25, 26, 1936.

Cells 51-53 μ long, 24-26.4 μ broad, and isthmus 22-25 μ broad. Semicells somewhat variable, some specimens are conical, but others are short subcylindrical with attenuated side and rounded apex. Pl. 4, fig. 15.

Hab. 15, 172, 173. Distr. Devon Island, Spitzbergen, Europe, and Japan.

C. curtum var. *obtusum* (W. & G. S. WEST) HIRANO. comb. nov.

Penium curtum BRÉB. var. *obtusum* W. & G. S. WEST in J. Bot., **38**, p. 289, pl. 412, f. 1, 2, 1900; Monogr. Br. Desm., **1**, p. 99, pl. 10, f. 26, 1904.

Cells 48.4-50 μ long, 24-26 μ broad, and isthmus 22-24 μ broad. Pl. 5, fig. 4.

Hab. 64, 172. Distr. Europe.

Cosmarium cyclicum LUND. var. *arcticum* NORDST., Öfv. K. Vetensk-Akad. Förh.,

no. 6, p. 31, pl. 6, f. 13, 1872; W. & G. S. WEST, Monogr. Br. Desm., 2, p. 146, pl. 58, f. 10, 1905; WHELDEN, Bull. natn. Mus. Can., 97, p. 77, pl. 5, f. 7, 1947; CROASDALE, Trans. Am. microsc. Soc., 81, p. 26, pl. 5, f. 73, 1962.

Cells 70.4–75 μ long, 74–75 μ broad, and isthmus 19–25 μ broad. Cells hexagono-circular, apex 4 crenate, crenae in some specimens slight but deep in others; granules on and within the margin of each crena are in pairs. Vertical view of semicell rhomboidal and centre of it smooth. Pl. 8, fig. 9.

Hab. 22, 55, 57, 58, 61, 76, 158, 203, 223. Distr. Alaska, Devon Island, Greenland, Spitzbergen, Novaya Zemlya, Europe, Faeroes, Bornholm, and Japan.

Cosmarium cymatonotophorum WEST, Monogr. Br. Desm., 3, p. 40, pl. 68, f. 37–39, 1908; INSAM & KRIEGER, Hedwigia, 76, p. 99, pl. 4, f. 13, 1936.

Cell 10 μ long, 8.8 μ broad, and isthmus 4.4 μ broad. Pl. 4, fig. 8.

Hab. 56. Distr. Europe.

Cosmarium debaryi ARCH. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 61, pl. 70, f. 14–16; pl. 93, f. 2, 1908; IRENÉE-MARIE, Bull. natn. Mus. Can., 82, p. 132, f. 4, 1955; CROASDALE, Trans. Am. microsc. Soc., 84, p. 318, pl. 4, f. 6, 7, 1965.

Cells 105–108 μ long, 48–49 μ broad, and isthmus 35–36 μ broad.

Hab. 56. Distr. Alaska, U.S.A., Devon Island, Novaya Zemlya, Spitzbergen, Europe, Bornholm, and Brazil.

C. debaryi var. *novae-semiliae* WILLE, Öfv. K. Vet.-Akad. Förh., no. 5, p. 48, pl. 13, f. 47, 1879; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 136, pl. 4, f. 2, 1965.

Cells 102–107 μ long, 49.3–55 μ broad, and isthmus 31.7–36 μ broad. Pl. 3, fig. 16.

Hab. 76. Distr. Novaya Zemlya and N. Europe.

Cosmarium decedens (REINSCH) RACIB. var. *borgei* KRIEGER, Ber. dt. bot. Ges., 56, p. 61, pl. 1, f. 18, 1938.

Cells 39–40 μ long, 22–22.5 μ broad, and isthmus 13 μ broad. The present forms coincide with the forms known from Spitzbergen by having slight undulations on the lateral margin. Pl. 4, fig. 1.

Hab. 64. Distr. Spitzbergen.

Cosmarium depressum (NÄG.) LUND. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 176, pl. 62, f. 2–5, 1905; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, 18(3), p. 196, pl. 33, f. 1, 1963.

Cells 37.4–55 μ long, 35–53 μ broad, and isthmus 13–14 μ broad.

Hab. 56, 61, 74, 76, 93, 115, 117, 119, 123. Distr. Alaska, U.S.A., Greenland, Europe, India, Ceylon, Burma, Japan, and Australia.

C. depressum var. *planctonicum* REV. in SKUJA Nova Acta R. Soc. Scient. upsal. ser.

4, 18(3), p. 196, pl. 33, f. 2, 3, 1964.

Cells 28–29 μ long, 29.5–30 μ broad, and isthmus 6.6–7 μ broad. Pl. 6, fig. 7.

Hab. 110. Distr. N. Europe.

Cosmarium difficile LÜTKEM. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 96, pl. 73, f. 1–3, 1908; GRÖNBLAD, Nova Hedwigia, 4, pl. 101, f. 3, 1962; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 208, pl. 35, f. 29; pl. 36, f. 7, 8, 1963.

Cells 35–42 μ long, 22–28.6 μ broad, and isthmus 8–10.6 μ broad. BORGE reported a similar form as *C. meneghinii* from Sweden, but his form is smaller. Lower lateral margins of *C. meneghinii* are vertical and the apex of semicell is retuse. The determination to his form is questionable. The transverse series of punctations are sometimes indistinct. Pl. 3, fig. 2.

Hab. 65, 115. Distr. U.S.A. and Europe.

C. difficile var. *sublaeve* LÜTKEM. in CROASDALE, Trans. Am. microsc. Soc., 75, p. 28, pl. 11, f. 11, 18, 1956.

Cell 35 μ long, 23 μ broad, and isthmus 8.7 μ broad. Pl. 4, fig. 3.

Hab. 123. Distr. Alaska and Canada.

Cosmarium diplosporum (LUND.) LÜTKEM. var. *americanum* (W. & G. S. WEST) HIRANO, comb. nov.

Cylindrocystis americana W. & G. S. WEST, J. Linn. Soc., Bot., 33, p. 281, pl. 18, f. 5, 6, 1898.

Cells 77–81.4 μ long, 35–39.6 μ broad. The present specimens correspond to the intermediate size between the typical form and var. *maius* W. WEST. Pl. 3, fig. 15.

Hab. 117, 123. Distr. U.S.A.

Cosmarium formosulum HOFF. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 240, pl. 88, f. 1–3, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 32, pl. 16, f. 1, 1956.

Cells 45–57 μ long, 39–48 μ broad, and isthmus 13–17.5 μ broad. Semicells subtrapeziform, basal part somewhat dilated upward, therefore lowermost lateral margin slightly divergent and then convex convergent, lateral margin 7-crenate, apex rather narrow and slightly 4-crenate. Pl. 9, fig. 6.

Hab. 44, 94. Distr. Alaska, Canada, Iceland, Faeroes, Bornholm, and Europe.

Cosmarium furcatospermum W. & G. S. WEST, Monogr. Br. Desm., 3, p. 206, pl. 81, f. 10–11; pl. 84, f. 8–10, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 34, pl. 14, f. 14, 15, 1956.

Cells 22–24 μ long, 21–22 μ broad, and isthmus 8 μ broad.

Hab. 16. Distr. Alaska, Europe, Canada, and Japan.

Cosmarium globosum BULNH. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 29, pl.

68, f. 1, 2, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 190, pl. 29, f. 19, 1964.

Cells 31–32 μ long, 21–21.5 μ broad, and isthmus 19.7–20 μ broad.

Hab. 15, 169. Distr. Europe, Novaya Zemlya, Spitzbergen, U.S.A., Greenland, Japan, E. Africa, and S. America.

Cosmarium granatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 186, pl. 63, f. 1–3, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 34, pl. 6, f. 11, 12, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, 18(3), p. 198, pl. 33, f. 16–18, 20, 1964.

Cells 40–48 μ long, 25.5–31 μ broad, and isthmus 7.5–8.8 μ broad. Pl. 5, fig. 6.

Hab. 30, 43, 55, 56, 57, 58, 59, 64, 76, 106, 115, 119, 123, 538. Distr. Canada, U.S.A., Greenland, Spitzbergen, Iceland, Faeroes, Siberia, Europe, Novaya Zemlya, Japan, India, Ceylon, and S. America.

C. granatum var. *concauum* LAGERH. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 188, 1905.

Cell 37.4 μ long, 26.4 μ broad, and isthmus 6.6 μ broad. Semicells of *C. granatum* variable in form, and the majority of specimens coincide with the typical form of species. In some specimens upper lateral margin of semicell is retuse and this corresponds to var. *concauum* LAGERH. WEST did not give a special name to such a variation. Such a form apparently resembles *C. hammeri*, but is distinguished from the latter by the smaller size. Apex always convex and narrow in general, but in some specimens not so narrow as those of the typical form. Pl. 5, fig. 14.

Hab. 121. Distr. Ecuador.

C. granatum var. *elongatum* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 189, pl. 63, f. 10, 1905; MESSIKOMMER, Vjschr. naturf. Ges. Zürich, 80, p. 46, pl. 2, f. 20, 1935; CROASDALE, Trans. Am. microsc. Soc., 75, p. 36, pl. 6, f. 14, 15, 1956.

Cells 56–62 μ long, 29–30 μ broad, and isthmus 15–16.5 μ broad. Pl. 5, fig. 3.

Hab. 160. Distr. Alaska, Greenland, Spitzbergen, Europe, and Afghanistan.

C. granatum var. *subgranatum* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 188, pl. 63, f. 5–8, 1905; CROASDALE, Trans. Am. microsc. Soc., 75, p. 36, pl. 6, f. 14, 15, 1956.

Cells 31–33 μ long, 24–25.5 μ broad, and isthmus 8–8.8 μ broad. The undulation of upper part of lateral margin seems to be variable, biundulate in normal type, but sometimes shows a tendency to triundulate in some individuals, lowermost part of lateral margin is vertical and retuse, and in these respects the present forms coincide with the explanation by CROASDALE. In European forms the lowermost lateral margin is slightly divergent. The apex of the present forms is slightly broader than the European description. Pl. 5, fig. 5.

Hab. 117, 119, 123. Distr. Alaska, U.S.A., Europe, Japan, New Zealand, and S. America.

Cosmarium hammeri REINSCH var. *homalodermum* (NORDST.) W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 182, pl. 62, f. 22, 1905; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 36, pl. 6, f. 8, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 198, pl. 33, f. 12, 1964.

Cells 57-70 μ long, 48.5-61.6 μ broad, and isthmus 15.4-17.6 μ broad. Pl. 3, fig. 9.

Hab. 16, 22, 169, 193, 223, 513, 538. Distr. Alaska, Europe, Greenland, Spitzbergen, Novaya Zemlya, Faeroes, Japan, and India.

Cosmarium hexalobum NORDST. var. *laticeps* GRÖNBLAD, Acta Soc. Scient. fenn., n.s. B, **2**(5), p. 37, pl. 2, f. 47, 1942.

Cells 59-60 μ long, 41.5-42 μ broad, and isthmus 15-15.7 μ broad. The present forms resemble *C. subhieronymusii* which WHELDEN reported from Arctic Canada. Pl. 8, fig. 3.

Hab. 169. Distr. Europe.

Cosmarium hians BERGE, Bot. Notiser, p. 13, pl. 1, f. 6, 1913.

Cells 22 μ long, 20 μ broad, and isthmus 11 μ broad. SKUJA reported *C. wittrockii* var. *quasidepressum* from Lapland, Sweden resembling this species in form and in its size of cell, but semicells are broader than the typical form and the apex broad and straight, sinus almost rectangularly open. The number of horizontal series of granules on the face of semicell is much more than five series of his form of *C. wittrockii*. Pl. 8, fig. 2.

Hab. 123. Distr. Europe.

Cosmarium holmiense LUND. var. *integrum* LUND. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 2, pl. 65, f. 3-5, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 38, pl. 7, f. 12, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 201, pl. 35, f. 21, 1964.

Cells 50.6-64 μ long, 31-39.6 μ broad, and isthmus 17.6-20.7 μ broad. Pl. 5, fig. 7.

Hab. 64, 72, 143, 146, 148, 160, 172, 173, 190, 223, 523. Distr. Alaska, Canada, Devon Island, Europe, Spitzbergen, Novaya Zemlya, Faeroes, and U.S.A.

Cosmarium hornavanense GUTW. in DEFLANDRE, Bull. Soc. bot. Fr., **75**, f. 4 in p. 1009, 1928; INSAM & KRIEGER, Hedwigia, **76**, p. 101, pl. 6, f. 1, 1936; RUZICKA, Prirodov. Sb. ostrav. Kraje, **17**, p. 44, pl. 3, f. 24, 25, 1956; MESSIKOMMER, Nova Hedwigia, **4**, p. 162, f. 6, 1962.

Cells 71-100 μ long, 57-77 μ broad, and isthmus 17.6-26.4 μ broad. Pl. 9, fig. 10.

Hab. 45, 57, 72, 94, 106, 116, 123, 172, 513. Distr. Europe.

C. hornavanense forma *arcticum* CROASDALE in Trans. Am. microsc. Soc., **84**, p. 320,

pl. 6, f. 3, 4, 1965.

Cells 88–94.6 μ long, 66–72.6 μ broad, and isthmus 22 μ broad. The specimens resemble the form of var. *dubovianum* reported by FÖRSTER from Swedish Lapland. Pl. 9, fig. 5.

Hab. 55, 74, 536. Distr. Devon Island.

C. hornavanense var. *dubovianum* (LÜTKEM.) RUZ. in FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 140, pl. 6, f. 13, 14, 1965; MESSIKOMMER, Schweiz. Z. Hydrol. 27, p. 152, f. 11, 1965. — *C. dubovianum* LÜTKEM. in Verh. zool.-bot. Ges. Wien, p. 487, pl. 2, f. 14–16, 1910.

Cells 57–88 μ long, 53–64 μ broad, and isthmus 15.4–22 μ broad. Cells with a transverse series of granules just above the isthmus and with a smooth space in the middle of semicell. Pl. 1, fig. 4.

Hab. 30, 523, 536. Distr. Alaska and Europe.

Cosmarium humile (GAY) NORDST. var. *striatum* (BOLDT) SCHMIDLE, Öst. bot. Z., no. 7, p. 389, 1895; W. & G. S. WEST, Monogr. Br. Desm., 3, p. 223, pl. 85, f. 21, 22, 1908.

Cells 15.4–23.3 μ long, 15.4–23.3 μ broad, and isthmus 5.3–8.8 μ broad. Lower lateral margin of semicell slightly divergent and retuse, apical angles obliquely truncate and emarginate, apex minutely 4-undulate. Cell wall furnished with two series of minute granules within the margin and 3 elongate granules horizontally disposed above the isthmus. Pl. 4, fig. 7.

Hab. 56, 116, 117. Distr. Alaska, U.S.A., Siberia, Europe, Faeroes, Japan, Malaya, and Patagonia.

Cosmarium impressulum ELFV. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 86, pl. 72, f. 14–18, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 194, pl. 32, f. 17–19, 1964.

Cells 24–31.7 μ long, 17.6–24 μ broad, and isthmus 5.7–8 μ broad. The whole margin of semicell with 7 undulations and three on each side, sometimes undulation is not distinct and the outline of semicell resembles *C. granatum* var. *subgranatum* which has a narrow apex. Pl. 4, fig. 12.

Hab. 116, 117. Distr. U.S.A., Siberia, Greenland, Europe, Japan, India, New Zealand, Australia, and S. America.

Cosmarium incertum SCHMIDLE var. *groenlandicum* (BOLDT) GUTW. in CROASDALE, Trans. Am. microsc. Soc., 75, p. 40, pl. 11, f. 15, 1956; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 141, pl. 5, f. 27, 1965.

Cells 35–39.6 μ long, 22 μ broad, and isthmus 6.6–7.5 μ broad. Pl. 4, fig. 22.

Hab. 116, 117, 123. Distr. Alaska, Europe, and Greenland.

Cosmarium isthmochondrum NORDST. var. *decussiferum* (BORGE) CROASDALE in Trans.

Am. microsc. Soc., **75**, p. 40, pl. 14, f. 7-10, 1956.—*C. decussiferum* BERGE, Ark. Bot., **6**, p. 33, pl. 2, f. 18, 1906.

Cells 37-39 μ long, 27-28 μ broad, and isthmus 15-16 μ broad. Pl. 6, fig. 2.

Hab. 172. Distr. Alaska and Europe.

Cosmarium kjellmanii WILLE var. *grande* WILLE, Öfv. K. Vet.-Akad. Förh., no. 5, p. 43, pl. 12, f. 33, 1879; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 221, pl. 85, f. 15, 1908.

Cells 46-48.4 μ long, 43-44 μ broad, and isthmus 14.7-15.4 μ broad. Semicells truncate-semicircular, lateral margin convex and converging upward, furnished with 8-9 granules, apex truncate and 6-undulate, apical angle somewhat emarginate or with a single granule; cell wall with a prominent series of granules above the isthmus which are vertically disposed. Pl. 6, fig. 10.

Hab. 116. Distr. Greenland, Novaya Zemlya, and Siberia.

Cosmarium latifrons LUND. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 33, pl. 94, f. 6, 1911.

Cells 39.5-41.8 μ long, 41.5-44 μ broad, and isthmus 13-15.4 μ broad. Pl. 8, fig. 1.

Hab. 36, 76, 94, 112. Distr. Europe and Siberia.

Cosmarium margaritatum (LUND.) ROY & BISS. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 18, pl. 99, f. 8, 10, 1911; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18** (3), p. 211, pl. 37, f. 4-6, 1964.

Cells 70.4-88 μ long, 57-75 μ broad, and isthmus 17.6-26.4 μ broad.

Hab. 30, 55, 64, 115, 116, 117, 123. Distr. Alaska, Canada, U.S.A., Greenland, Europe, Japan, Ceylon, Malaya, and Africa.

C. margaritatum forma *minor* (BOLDT) W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 19, pl. 99, f. 9, 1911; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 41, pl. 16, f. 11, 1956.

Cells 53-54 μ long, 44-45 μ broad, and isthmus 13-13.5 μ broad.

Hab. 112. Distr. Alaska, Europe, Japan, Greenland, and Africa.

C. margaritatum var. *rotundatum* HIRANO, var. nov.

Cellulae submagnae, leviter longiores quam latiores, profunde constrictae ad medium, sinu sublineari aperto et rotundato ad apicem; semicellulae aliquantum elliptico-subrectangulares, angulis basalibus et apicalibus late rotundatis, marginibus lateralibus convexis aliquando marginibus lateralibus inferioribus divergentibus, marginibus lateralibus aliquando convexo-convergentibus ad apicem; membrana distincte granulata, granulis in serie obliqua dispositis, inter granulos distincte punctata. Cellulae 101-106 μ longae, 79-88 μ latae, 32-35 μ lat. isth. Pl. 7, fig. 1.

Hab. 28, 65, 538.

Cosmarium margaritifera MENEGH. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p.

199, pl. 83, f. 4-11, 1908; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 182, pl. 14, f. 8-11, 1964.

Cells 47-53 μ long, 37.4-48.5 μ broad, and isthmus 14-15.4 μ broad.

Hab. 16, 26, 45, 55, 115, 117, 123. Distr. Alaska, Canada, U.S.A., Siberia, Greenland, Iceland, Europe, Japan, and Brazil.

Cosmarium microsphinctum NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 156, pl. 60, f. 5-8, 1905; KRIEGER, Ber. dt. bot. Ges., **56**, p. 62, pl. 1, f. 27, 1938; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 42, pl. 4, f. 4, 1956; SKUYA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 192, pl. 31, f. 10-12, 1964.

Cells 41-48 μ long, 30-35 μ broad, and isthmus 14-20.7 μ broad. Pl. 3, fig. 10.

Hab. 56, 59, 72, 146, 158, 160, 169, 172, 173, 223. Distr. Alaska, U.S.A., Spitzbergen, Greenland, Novaya Zemlya, Franz Joseph Land, Europe, Iceland, and Japan.

Cosmarium nasutum NORDST., Öfv. K. Vet.-Akad. Förh., no. 6, p. 33, pl. 7, f. 17, 18, 1872; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 259, pl. 90, f. 9, 10, 1908.

Cells 48.4-52.8 μ long, 37-39.6 μ broad, and isthmus 12.3-16 μ broad.

Hab. 76, 94. Distr. Alaska, Canada, U.S.A., Europe, Greenland, Spitzbergen, and Japan.

Cosmarium ochthodes NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 10, pl. 98, f. 1-3, 1911.

Cells 115-118 μ long, 80-82 μ broad, and isthmus 23-24 μ broad.

Hab. 55. Distr. Alaska, U.S.A., Europe, Greenland, Spitzbergen, Novaya Zemlya, and Japan.

C. ochthodes var. *amoebum* WEST in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 11, pl. 98, f. 4-6, 1911; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 43, pl. 17, f. 13, 14, 1956.

Cells 97-106 μ long, 69.5-72.6 μ broad, and isthmus 24-26.4 μ broad. Semicells rather semicircular, not truncate-pyramidate, broader than those of the typical form.

Hab. 14, 16, 22, 28, 30, 33, 40, 45, 55, 59, 65, 72, 76, 104, 105, 112, 119. Distr. Alaska, Spitzbergen, and Europe.

Cosmarium pachydermum LUND. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 139, pl. 57, f. 7, 1905.

C. pachydermum var. *alaskense* HIRANO, var. nov.

Semicellulae late depresso-ovatae, sinu leviter angusto-lineari ad apicem sed interdum in extrorsum leviter acutangulo. Cellulae 105-106 μ longae, 83-84 μ latae, 48 μ lat. isth. Pl. 4, fig. 21.

Hab. 115. The present specimens coincide well with the Alaskan form reported by CROASDALE. This variety differs from the typical form by having a more depressed

semicell.

Cosmarium phaseolus BRÉB. var. *achondrum* BOLDT, Öfv. K. Vet.-Akad. Förh., no. 2, p. 103, pl. 5, f. 7, 1885; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 45, pl. 4, f. 9, 10, 1956.

Cells 35–37 μ long, 33–34 μ broad, and isthmus 10.5–11 μ broad. Pl. 4, fig. 20.

Hab. 116. Distr. Alaska and Siberia.

C. phaseolus var. *elevatum* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 159, pl. 60, f. 16, 17, 1905; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 195, pl. 33, f. 4, 5, 1964; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 322, pl. 2, f. 15, 16, 1965.

Cells 28.5–39 μ long, 31–35 μ broad, and isthmus 8.8–13 μ broad. Semicells low truncate-pyramidate; cell wall punctate-scrobiculate, sinus narrowly linear but in some specimens acutely open, papilla of central part of semicell is distinctly visible. Pl. 3, fig. 3; Pl. 4, fig. 18.

Hab. 29, 30, 55, 56, 58, 59, 61, 119. Distr. Alaska, Canada, Devon Island, Europe, Spitzbergen, Iceland, Faeroes, and Japan.

Cosmarium pokornyianum (GRUN.) W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 190, pl. 63, f. 11–15, 1905; KRIEGER, Ber. dt. bot. Ges., **56**, p. 62, pl. 1, f. 26, 1938; SKUYA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 199, pl. 33, f. 26–28, 1964.

Cells 33–41 μ long, 20–26 μ broad, and isthmus 9–15 μ broad. There are two different forms in the present collections: lower lateral margin of semicell is divergent in some specimens, and almost vertical in others. The present Alaskan forms coincide with the figure given by KRIEGER from Spitzbergen. Pl. 3, fig. 1.

Hab. 64, 72, 173. Distr. Alaska, Devon Island, U.S.A., Europe, Greenland, Spitzbergen, Novaya Zemlya, and Japan.

Cosmarium portianum ARCH. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 165, pl. 80, f. 4–7, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 46, pl. 12, f. 6, 7, 1956.

Cells 38–40 μ long, 28–32 μ broad, and isthmus 11–13 μ broad.

Hab. 117, 123. Distr. Alaska, Canada, U.S.A., Europe, Spitzbergen, Novaya Zemlya, Siberia, and Japan. Probably cosmopolitan.

Cosmarium praemorsum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 196, pl. 84, f. 1–5, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 217, pl. 38, f. 1, 2, 1964; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 183, pl. 14, f. 7, 1964.

Cells 44–51 μ long, 42–44 μ broad, and isthmus 13–16 μ broad. There are two different forms among the collections from various places: semicells in some specimens truncate-subsemicircular and trapeziform in others, apex truncate or slightly convex,

granules distinct and rounded. The species is similar to *C. punctulatum*, but is distinguished from it by the smaller size, the nature of granules, and by the sparse arrangement of granules on the face of semicell. Pl. 9, fig. 4.

Hab. 38, 55, 64, 76, 536, 538. Distr. Canada, Europe, and E. Africa.

Cosmarium protractum (NÄG.) DE BARY in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 181, pl. 94, f. 4, 5, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 46, pl. 12, f. 8, 1956.

Cells 42-44 μ long, 40-42 μ broad, and isthmus 10.5-12.5 μ broad.

Hab. 74, 115, 116, 117. Distr. Alaska, U.S.A., and Europe.

Cosmarium protumidum NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 34, pl. 7, f. 18, 1872; KRIEGER, Ber. dt. bot. Ges., 56, p. 62, pl. 1, f. 21-23, 1938; GRÖNBLAD, Acta Soc. Sci. fenn., n. ser. B, 2(5), p. 39, pl. 3, f. 4, 1942.

Cells 40-42 μ long, 31-35 μ broad, and isthmus 11-13 μ broad. Pl. 6, fig. 4, 9.

Hab. 64, 169. Distr. Alaska, Spitzbergen, and Europe.

Cosmarium pseudonitidulum NORDST. var. *validum* W. & G. S. WEST, Monogr. Br. Desm., 2, p. 196, pl. 63, f. 27-30, 1905; CROASDALE, Trans. Am. microsc. Soc., 84, p. 323, pl. 4, f. 2, 3, 1965.

Cells 62-63 μ long, 40-46 μ broad, and isthmus 13-17 μ broad. The specimens resemble those from Devon Island reported by CROASDALE. Pl. 4, fig. 16.

Hab. 76, 115. Distr. Canada, Devon Island, Europe, Japan, India, Malaya and W. Africa.

Cosmarium pseudoprotuberans KIRCHN. forma *minus* KOSSINSKAYA in CROASDALE, Trans. Am. microsc. Soc., 75, p. 47, pl. 10, f. 5, 1956; *l. c.*, 84, p. 323, pl. 3, f. 23-25, 1965.

Cells 20-26 μ long, 19-22 μ broad, and isthmus 6-9 μ broad. Semicells slightly reniform-hexagonal, lower lateral margin slightly longer than upper one, sinus sublinearly open. The specimens coincide well with the forms reported previously by CROASDALE. Pl. 5, fig. 10-13, 16.

Hab. 26, 29, 36, 39, 43, 44, 61, 65, 94. Distr. Devon Island, Alaska, and Siberia.

C. pseudoprotuberans var. *alpinum* RACIB. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 83, pl. 91, f. 10, 1908; BERGE, Ark. Bot., 28A(6), p. 36, pl. 1, f. 23, 1936.

Cells 15-17.6 μ long, 12-13 μ broad, and isthmus 3.5-4 μ broad. Semicells with convex apex and broadly rounded apical angles, lateral margin convex and divergent, sinus closed. The specimens somewhat smaller than the dimension of European forms given by BERGE from North Europe. Pl. 5, fig. 15.

Hab. 44. Distr. Europe.

C. pseudoprotuberans var. *angustius* NORDST., Bih. K. Svenska. Vet.-Akad. Handl., 22(8), p. 58, pl. 6, f. 15, 16, 1888; CROASDALE, Trans. Am. microsc. Soc., 75, p. 47, pl. 10, f. 6, 1956.

Cells 30–31 μ long, 24 μ broad, and isthmus 7.8–8 μ broad. The present specimens are somewhat smaller than those of the original description, but coincide with them in other respects. Lower lateral margin of the Alaskan forms is convex, while straight or sometimes retuse on the form reported from New Zealand. Apex very narrow and scarcely flattened. The plants on the present specimens are similar to *C. scopulorum* in outline of semicell, but larger. INSAM & KRIEGER described var. *borgei* from Tirol as a new variety of *C. pseudoprotuberans*. His form closely resembles the present Alaskan form but is larger in size. These three forms might belong to the same species. Pl. 4, fig. 6,

Hab. 116. Distr. Alaska.

C. pseudoprotuberans var. *pygmaeum* GUTW. in MESSIKOMMER, Beitr. geobot. Landes-aufn. Schweiz, 24, p. 147, pl. 5, f. 7, 1942.

Cells 13–14 μ long, 11–12 μ broad, and isthmus 3–5 μ broad. Semicells of the present specimens are obtuse, and the lateral margins are divergent. Apex of semicell somewhat variable, the specimens obtained from no. 115 are convex, and the apex of no. 117 is flattened, sinus of these specimens are perfectly closed. PRINTZ reported var. *trapezoidricum* from Norway and his figure shows the truncate apex. His specimens are slightly larger than those of the Alaskan form but resemble the form reported from Davos by MESSIKOMMER. RYBNICEK reported and figured a similar form from Czechoslovakia, but he did not give a special name to his specimens. WHELDEN reported *C. coarctatum* from arctic Canada, and the figure of his specimens coincides with the present Alaskan specimens. Pl. 4, fig. 9.

Hab. 115, 117. Distr. Europe.

Cosmarium punctulatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 206, pl. 84, f. 13, 14; pl. 52, f. 22, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 217, pl. 36, f. 21, 1964.

Cells 33–35 μ long, 30–31 μ broad, and isthmus 8.7–9 μ broad.

Hab. 119, 123, 513, 530. Distr. Cosmopolitan.

C. punctulatum var. *subpunctulatum* (NORDST.) BÖRGES. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 209, pl. 84, f. 15–20; pl. 85, f. 1–3, 1908.

Cells 30–37.4 μ long, 26.4–37 μ broad, and isthmus 8–12 μ broad. Pl. 6, fig. 14.

Hab. 36, 74, 104, 116, 117. Distr. Alaska, Europe, Siberia, Faeroes, New Zealand and Brazil.

Cosmarium pycnochondrum NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 23, pl. 6,

f. 14, 1875; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 244, pl. 88, f. 7, 1908.

Cells 60.7–62 μ long, 50–61.6 μ broad, and isthmus 16–17.5 μ broad.

Hab. 74, 169, 193, 203, 223. Distr. Europe, Spitzbergen, and Greenland.

Cosmarium quadratulum (GAY) DE TONI in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 121, pl. 72, f. 33; pl. 93, f. 4, 1908; INSAM & KRIEGER, Hedwigia, **76**, p. 106, pl. 3, f. 13, 1936; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 208, pl. 35, f. 24, 25, 1964.

Cells 18–20 μ long, 16–17 μ broad, and isthmus 3.5–4 μ broad. Apex of semicell convex and retuse in the middle, lower margin slightly divergent and retuse. Pl. 4, fig. 4.

Hab. 116. Distr. Europe and Australia.

Cosmarium quadratum RALFS, Br. Desm., p. 92, pl. 15, f. 1a, b, 1848; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 57, pl. 70, f. 6–8, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 204, pl. 35, f. 8, 1964.

Cells 44–88 μ long, 35–44 μ broad, and isthmus 20–27 μ broad. Pl. 3, fig. 6, 12.

Hab. 16, 36, 43, 45, 55, 58, 59, 64, 94, 104, 117, 119, 121, 203. Distr. Alaska, U.S.A., Europe, Spitzbergen, Greenland, Novaya Zemlya, Siberia and Japan.

C. quadratum var. *divergens* HIRANO, var. nov.

Semicellulae angusto-subquadratae, marginibus lateralibus inferioribus leviter divergentibus et paene rectis vel paulo retusis, angulis apicalibus late rotundatis, apicibus semicellularum late rectis. Cellulis leviter brevioribus quam in forma typica, 57 μ long. 35 μ lat. 17 μ lat. isth. Pl. 5, fig. 2.

Hab. 72.

Cosmarium quadrifarium LUND. var. *octastichum* NORDST. in IRENÉE-MARIE, Naturaliste can., **75**, p. 163, pl. 2, f. 13, 1948; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 224, pl. 40, f. 6, 1964; CROASDALE, Trans. Am. microsc. Soc., **83**, p. 185, pl. 13, f. 22, 1964.

Cells 48.4–66 μ long, 44–48.5 μ broad, and isthmus 17–24 μ broad.

Hab. 29, 40, 56, 57, 58, 59, 65, 72. Distr. Canada, Devon Island, and Europe.

Cosmarium quadrum LUND., Nova Acta R. Soc. Scient. upsal., ser. 3, **8**, p. 25, pl. 2, f. 11, 1871; W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 20, pl. 100, f. 3–6, 1911; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 323, pl. 4, f. 4, 5, 1965.

Cells 57–60 μ long, 49.5–51 μ broad, and isthmus 16.3–17 μ broad.

Hab. 538. Distr. Canada, Devon Island, U.S.A., Europe, Japan, India, Ceylon, and Sumatra.

C. quadrum var. *minus* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 21, 1911.

Cells 46–48.5 μ long, 39–44 μ broad, and isthmus 16–17 μ broad.

Hab. 123. Distr. Europe and Greenland.

Cosmarium reniforme (RALFS) ARCH. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 157, pl. 79, f. 1, 2; pl. 82, f. 15, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 51, pl. 13, f. 3, 1956.

Cells 66–68 μ long, 57–58 μ broad, and isthmus 17–18 μ broad.

Hab. 59, 74, 93. Distr. Alaska, Devon Island, U.S.A., Europe, Greenland, Spitzbergen, Faeroes, Japan, and S. America.

Cosmarium sexnotatum GUTW. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 227, pl. 86, f. 7, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 51, pl. 14, f. 22, 1956; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 148, pl. 6, f. 5–8, 1965.

Cells 25–26.5 μ long, 21–22 μ broad, and isthmus 7–7.5 μ broad. Lateral margin of semicell slightly 6 crenate, apex 4 crenate; cell wall furnished with two concentric and radial series of granules within the margin and a transverse series of three elongated large granules in the centre of semicell. Pl. 6, fig. 12.

Hab. 58. Distr. Alaska and Europe.

Cosmarium simplicius (W. & G. S. WEST) GRÖNBLAD, Comment. Biol., **10**(5), p. 9, pl. 1, f. 18–20, 1948; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 52, pl. 16, f. 16, 1956; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 148, pl. 6, f. 2–4, 1965.—*C. elegantissimum* LUND. var. *simplicius* W. & G. S. WEST in J. Linn. Soc., Bot. **33**, p. 308, pl. 17, f. 7, 1898.

Cells 48.4–57 μ long, 24–26.5 μ broad, and isthmus 21–24 μ broad. Pl. 5, fig. 23.

Hab. 55, 76, 123. Distr. Alaska, U.S.A. and Europe.

Cosmarium speciosissimum SCHMIDLE, Öst. bot. Z., p. 24, pl. 15, f. 30, 31, 1895; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 254, pl. 89, f. 14, 15, 1908; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 30, pl. 5, f. 78, 79, 1962.

Cells 46–48 μ long, 37.5–38 μ broad, and isthmus 21–22 μ broad. Pl. 5, fig. 24.

Hab. 64, 94. Distr. Alaska and Europe.

C. speciosissimum var. *arcticum* HIRANO, var. nov.

Cellulae minores et breviores quam in forma typica; semicellulae semicirculares (non semiellipticae), marginibus crenulatis, apice convexo et 4-crenulato, crenae non profundiores quam in forma typica; membrana cum serie concentrice crenulis intra marginem crenarum. Cellulae 35–36 μ longae, 28.6–29 μ latae, 13 μ lat. isth. Pl. 7, fig. 3.

Hab. 58.

Cosmarium speciosum LUND., Nova Acta R. Soc. Scient. upsal., ser. 3, **8**, p. 34, pl. 3, f. 5, 1871; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 247, pl. 89, f. 1–3, 1908; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 324, pl. 5, f. 13, 1965.

Cells 51.5–70 μ long, 35–44 μ broad, and isthmus 15.4–23.4 μ broad. The present specimens coincide with the form reported from Devon Island by CROASDALE by having the radial series of crenae within the marginal crenae. The granulation on the apex and lateral crenae is not seen, and cell wall of semicell has concentric series of crenae instead of bigranulation within the margin. Pl. 1, fig. 1.

Hab. 40, 64, 106, 160, 169, 172, 173, 193, 203. Distr. Alaska, Devon Island, U.S.A., Greenland, Spitzbergen, Novaya Zemlya, Faeroes, Europe, New Zealand, and S. America.

C. speciosum var. *rostaffinskii* (GUTW.) W. & G. S. WEST forma *americana* W. & G. S. WEST, Monogr. Br. Desm., 3, p. 251, 1908; IRENÉE-MARIE, Naturaliste can., 78, p. 115, pl. 2, f. 22, 1951.—*C. rostaffinskii* GUTW. var. *americanum* W. & G. S. WEST, J. Linn. Soc., Bot., 33, p. 304, pl. 17, f. 13, 1898.

Cells 44–46 μ long, 30–30.5 μ broad, and isthmus 16.7–19 μ broad. Semicells of present specimens are subrectangular-subpyramidate or truncate-elliptic, sinus somewhat shallow in the specimens collected in the place of no. 15, lateral margin convex and 4-crenate sometimes with 5 crenations, centre of semicell smooth without any decoration of granules or ridges. Pl. 1, fig. 2.

Hab. 40, 160. Distr. U.S.A. and Canada.

C. speciosum var. *simplex* NORDST. in GRÖNBLAD, Memo. Soc. Fauna Flora fenn., 10, p. 269, f. 4: 15, 16, 1934; INSAM & KRIEGER, Hedwigia, 76, p. 108, pl. 4, f. 28, 1936; CROASDALE, Trans. Am. Microsc. Soc., 75, p. 52, pl. 16, f. 8, 1956.

Cells 46–70 μ long, 35–48.4 μ broad, and isthmus 13–24 μ broad. Semicells semielliptic, apex convex-crenulate, lateral margin crenulate, crenae become smaller from upper to downward and lowermost crena indistinct, central part of semicell smooth. The present specimens are slightly larger than var. *intermedium* reported from Tirol by INSAM & KRIEGER. The specimens obtained from no. 203 coincide with the form reported from N. Russia by GRÖNBLAD. Pl. 9, fig. 9.

Hab. 146, 148, 173, 193, 223, 516. Distr. Alaska and Europe.

Cosmarium subarctoum (LAGERH.) RACIB. in W. & G. S. WEST, Monogr. Br. Desm., 3, p. 31, pl. 68, f. 6–8, 1908; SKUJA, Nova Acta R. Soc. Scient. ups., ser. 4, 18(3), p. 190, pl. 36, f. 1, 2, 1964.

Cells 19–20 μ long, 14.5–15 μ broad, and isthmus 8.7–9 μ broad. Pl. 4, fig. 13.

Hab. 117, 123. Distr. Europe, Greenland, and Argentine.

Cosmarium subcostatum NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 37, pl. 12, f. 13, 1875; W. & G. S. WEST, Monogr. Br. Desm., 3, p. 236, pl. 87, f. 3–5, 1908; CROASDALE, Trans. Am. microsc. Soc., 75, p. 53, pl. 15, f. 18, 19, 1956.

Cells 30–44 μ long, 25.5–37 μ broad, and isthmus 8.7–11 μ broad. Lateral margin of

semicell crenate, upper two crenae distinct and lower two indistinct and show two entire crenae. Lateral margin of typical form consists of 4 larger crenae and two entire crenae, but the size of cell rather belongs to the typical form and to forma *minor* in view of the number of crenae, apical crenation consists of 4 (two central crenae are small and shallow, and both outside crenae larger and more distinct than the central ones). The disposition of the granules on the central tumour of semicell shows a tendency to become concentric and the central granules among series of granules larger than the surrounding ones. Pl. 6, fig. 1.

Hab. 15, 22, 38, 40, 43, 64, 93, 94, 119, 146, 172, 193, 203, 530. Distr. Alaska, Europe, Greenland, Faeroes, and Ceylon.

C. subcostatum forma *minor* W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 238, pl. 87, f. 6-9, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 53, pl. 15, f. 20, 1956.

Cells 24.6-27 μ long, 22-23.5 μ broad, and isthmus 6-7 μ broad.

Hab. 76, 121. Distr. Alaska, U.S.A., Europe, and Africa.

C. subcostatum var. *beckii* (GUTW.) W. & G. S. WEST in Monogr. Br. Desm., **3**, p. 238, pl. 87, f. 10-12, 1908.

Cells 41-44 μ long, 36-37.4 μ broad, and isthmus 8-10 μ broad. Pl. 6, fig. 3.

Hab. 121. Distr. Europe.

C. subcostatum var. *spetsbergense* BORGE, Vidensk. Skr. math.-nat. Kl., no. 11, p. 18, f. 13, 1911; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 31, pl. 4, f. 65, 1962; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 149, pl. 8, f. 4-6, 1965.

Cells 26-27 μ long, 22-22.5 μ broad, and isthmus 6-6.5 μ broad. Pl. 6, fig. 11.

Hab. 58. Distr. Alaska, Europe, and Spitzbergen.

Cosmarium subcrenatum HANTZ. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 228, pl. 86, f. 10-14, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 53, pl. 15, f. 12, 1956; *l.c.* **84**, p. 326, pl. 5, f. 7-10, 1965.

Cells 25.5-35 μ long, 24-26.5 μ broad, and isthmus 6.5-10 μ broad. Pl. 9, fig. 3.

Hab. 14, 15, 16, 25, 26, 28, 29, 30, 36, 38, 44, 45, 53, 55, 56, 61, 65, 74, 106, 112, 115, 116, 117, 123, 146, 148, 158, 193, 523, 536, 538. Distr. Alaska, Canada, Devon Island, Europe and Japan.

Cosmarium subcucumis SCHMIDLE in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 155, pl. 60, f. 1-3, 1905.

Cells 53-66 μ long, 33-40 μ broad, and isthmus 15.4-22 μ broad. Pl. 3, fig. 11, 13.

Hab. 55, 65, 74, 76, 112. Distr. Alaska, Canada and Europe.

Cosmarium subglobosum NORDST. in INSAM & KRIEGER, Hedwigia, **76**, p. 109, pl. 1, f. 8, 1936.

Cells 46–48 μ long, 24–28 μ broad, and isthmus 22 μ broad. Pl. 3, fig. 8.

Hab. 30, 74, 172. Distr. Europe.

Cosmarium subochthodes SCHMIDLE var. *scrobiculatum* (MESSIK.) CROASDALE, TRANS. Am. microsc. Soc., **75**, p. 54, pl. 17, f. 12, 1956.

Cell 95 μ long, 70 μ broad, and isthmus 17.5 μ broad. Cell wall granulate-scrobiculate, granules slightly flattened and the scrobiculations disposed on the top of each granule. Pl. 6, fig. 15.

Hab. 58. Distr. Alaska.

Cosmarium subquasillus BOLDT in Bih. K. Svenska Vet.-Akad. Handl., **13**, Afd. 3, no. 5, p. 25, pl. 1, f. 25, 1887.

Cells 67–70 μ long, 61.5–68 μ broad, and isthmus 17 μ broad. Semicells truncate-semicircular or subtrapeziform, lateral margin crenate, crenae 7 including apical and basal angles, apex shallow crenate, crenae 4 including both apical angles, all the crenae bigranulate; cell wall furnished with 3 or 4 concentric series of binate granules within each lateral and apical crena, granulate series increases and becomes irregular in number near the sinus, central tumour furnished with concentric series of granules which are somewhat larger than the marginal ones. There is a smooth space between the marginal series of granules and central granulate tumour. MESSIKOMMER reported a form similar to the present species from Switzerland known as *C. quasillus* var. *calvum* KAISER. I have not yet seen KAISER's original figure, but it seems to be a reduced form of *C. subquasillus*, judging from MESSIKOMMER's figure, namely, lateral crenae are indistinctly bigranulate, and the produced apical part of semicell seems to suggest that KAISER's variety does not belong to *C. quasillus* but to *C. subquasillus*. Recently CROASDALE reported *C. quasillus* forma *debonense* from Devon Island, but I feel it belongs to *C. subquasillus* which was reported first from Greenland. Pl. 9, fig. 11.

Hab. 536, 538. Distr. Greenland.

Cosmarium subspeciosum NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 22, pl. 6, f. 13, 1875; BÖRGESSEN, Meddr. Grönland, **43**, p. 83, f. 4, 1910; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 252, pl. 89, f. 11, 1908.

Cells 61–70 μ long, 48–56 μ broad, and isthmus 20–22 μ broad. Pl. 5, fig. 25.

Hab. 15, 65, 172, 205, 223. Distr. U.S.A., Europe, Spitzbergen, Greenland, Novaya Zemlya, Ceylon, Africa, Madagascar, and Brazil.

C. subspeciosum var. *transiens* MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, **24**, p. 155, pl. 9, f. 4–8, 1942.

Cells 39–53 μ long, 31–37 μ broad, and isthmus 11–16 μ broad. Pl. 9, fig. 8.

Hab. 22, 72, 148, 169, 203. Distr. Europe.

Cosmarium subtumidum NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 192, pl. 63, f. 18-20, 1905.

Cell 35μ long, 35μ broad, and isthmus 12μ broad.

Hab. 115. Distr. Alaska, Devon Island, Europe, Greenland, Japan, Australia, Central Africa, and Brazil.

C. subtumidum var. *groenbladii* CROASDALE in Trans. Am. microsc. Soc., **83**, p. 187, pl. 11, f. 26, 27, 1964.

Cells $48-48.6\mu$ long, $38.3-38.7\mu$ broad, and isthmus 22μ broad. The specimens coincide with the form reported from Labrador by CROASDALE. The outline of semi-cell is variable and two semicells of the same individual are sometimes different from each other. The dimensions of the present specimens are slightly larger than those given by the previous author. Pl. 4, fig. 17.

Hab. 116. Distr. Canada.

C. subtumidum var. *klebsii* (GUTW.) W. & G. S. WEST in Monogr. Br. Desm., **2**, p. 193, pl. 63, f. 21, 22, 23, 1905.

Cells $34-36\mu$ long, $29.5-30\mu$ broad, and isthmus 8μ broad.

Hab. 121. Distr. Alaska and Europe.

C. subtumidum var. *rotundum* HIRANO, Acta phytotax. geobot., **14**, p. 70, f. 2, 1951; Contr. Biol. Lab. Kyoto Univ., **4**, p. 133, pl. 22, f. 8, 1957.

Cells $31-33\mu$ long, $22-23\mu$ broad, and isthmus $7.5-8\mu$ broad. Pl. 4, fig. 11.

Hab. 116, 117. Distr. Japan.

Cosmarium subundulatum WILLE in CROASDALE, Trans. Am. microsc. Soc., **75**, p. 55, pl. 3, f. 12, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 195, pl. 32, f. 22-24, 1964.

Cells $53-66\mu$ long, $44-45\mu$ broad, and isthmus $15.5-17\mu$ broad. Pl. 4, fig. 19.

Hab. 30, 33, 55, 56, 58, 59, 76, 94, 121, 123. Distr. Alaska, Canada and Europe.

Cosmarium supraspeciosum WOLLE, Desm. U.S. p. 88, pl. 50, f. 5, 6, 1884.

Cells $79-91\mu$ long, $66-68\mu$ broad, and isthmus 22μ broad. Margin crenulate-granulate; cells furnished with radial and concentric series of pairs of granules on and within each crena, and another series of granules on the median part of semicell, granules are disposed in 6 vertical series and are slightly arcuate. Pl. 5, fig. 26.

Hab. 94, 538. Distr. U.S.A.

Cosmarium taticum RACIB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 45, pl. 69, f. 10, 1908; GRÖNBLAD, Acta Soc. Sci. fenn., n. ser. B, **2**(5), p. 39, pl. 3, f. 12, 1942.

Cells $26.5-28\mu$ long, $17.6-18\mu$ broad, and isthmus $9-9.5\mu$ broad. The specimens coincide well with the form reported by GRÖNBLAD, and are rather smaller than the

dimensions of British forms described by WEST.

Hab. 169. Distr. Alaska and Europe.

C. tatricum forma *minor* MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, **24**, p. 149, pl. 6, f. 7, 1942.

Cell 23μ long, 15.4μ broad, and isthmus 7.5μ broad. The present specimens coincide well with the forms reported from Davos. The sinus is closed and moderately deep. KRIEGER reported a similar form from Spitzbergen by the name of *E. sublobatum* var. *kriegeri*, but the sinus of *E. sublobatum* is deep, yet not as deep as in the *C. tatricum*. Pl. 6, fig. 5.

Hab. 160. Distr. Europe.

Cosmarium tetragonum NÄG. var. *heterocrenatum* W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 19, pl. 66, f. 22, 1908; GRÖNBLAD, Acta Soc. Sci. fenn., B, **2**(5), p. 39, pl. 3, f. 21, 1942.

Cells $36-38.7\mu$ long, $26.4-28.6\mu$ broad, and isthmus $15-17\mu$ broad. Apex of semicells in the present specimens is 4 crenated, lateral margins 4 or 5 crenated, three superior crenae including apical angles on each side are larger than those of the inferior ones. Sinus somewhat linearly open and coincides with the North European forms. According to the description and figure by WEST of the British forms, sinus narrowly linear and has deeper constrictions than those of the figure given by GRÖNBLAD; however, there is another form belonging to the present form, having somewhat larger size and much crenated lateral margin (7 crenae including apical and basal angles) in the collection from the same place. Lateral crenae becoming gradually smaller toward the base in the present forms. INSAM & KRIEGER reported the similar form from Tirol under the separate name (*C. notabile* var. *transiens* INSAM & KRIEGER) but their forms differ from the present form in the nature of sinus. Pl. 2, fig. 2.

Hab. 148, 169. Distr. Europe (Britain)

Cosmarium tetraophthalmum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 270, pl. 95, f. 4-7, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 57, pl. 17, f. 1, 1956.

Cells $106-126\mu$ long, $75-88\mu$ broad, and isthmus $28.7-35\mu$ broad.

Hab. 22, 56, 64, 76, 115, 121. Distr. Cosmopolitan.

Cosmarium tuddalense STRÖM, Nyt Mag. Naturvid., **57**, p. 171, pl. 4, f. 8, 1920.

Cell 141μ long, 101μ broad, and isthmus 31μ broad. Pl. 7, fig. 6, 7.

Hab. 115. Distr. Europe.

Cosmarium tumidum LUND. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 160, pl. 60, f. 18, 1905; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 188, pl. 10, f. 16-18, 1964; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 152, pl. 3, f. 22, 23, 1965.

Cells 37.4–44 μ long, 26.5–35 μ broad, and isthmus 6.5–10 μ broad. Outline of semi-cell variable, subsemicircular-elliptic to reniform, sinus closed; cells in vertical view elliptic-rhomboid, with a broad inflation on each side. INSAM & KRIEGER reported *C. pseudoprotuberans* var. *borgei* from Tirol. Its semicell is reniform and coincide with some of the specimens collected from nos. 29 and 58. NORDSTEDT reported *C. pseudoprotuberans* var. *angustius* from New Zealand resembling var. *borgei*, although var. *angustius* is the first name of these forms. Pl. 3, fig. 4, 5.

Hab. 29, 30, 43, 50, 55, 57, 58, 59, 74, 119, 123. Distr. U.S.A., Alaska, Greenland and Europe.

Cosmarium turpinii BRÉB. var. *eximium* W. & G. S. WEST, Monogr. Br. Desm., 3, p. 192, pl. 83, f. 3, 1908; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 152, pl. 7, f. 4, 1965.

Cells 57–70 μ long, 51–64 μ broad, and isthmus 14–17 μ broad. Pl. 8, fig. 5.

Hab. 26, 28, 29, 30, 53, 55, 59, 61, 65, 74, 93, 105, 121. Distr. Alaska, Devon Island, and Europe.

Cosmarium undulatum CORDA var. *alaskanum* CROASDALE forma *reductum* CROASDALE, Trans. Am. microsc. Soc., 75, p. 59, pl. 3, f. 9, 1956.

Cells 35–39.6 μ long, 27–28.6 μ broad, and isthmus 8.7–9 μ broad. The Alaskan form is similar to *C. subimpressulum*, while the number of undulations on each lateral margin is one more than those of his species. Pl. 4, fig. 2.

Hab. 117, 123. Distr. Alaska.

C. undulatum var. *crenulatum* (NÄG.) WITTR. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 150, pl. 59, f. 11, 12, 1905.

Cells 22–25.5 μ long, 17.6–24.5 μ broad, and isthmus 6.5–8.6 μ broad. In general the present specimens are slightly smaller than the European description, but coincide with the outline of cell. CROASDALE reported a small form belonging to this variety as forma *minus* from Alaska, and the present forms coincide well with the Alaskan form in size and in outline. The specimens collected at no. 515 represent the intermediate size between the size given by WEST and the dimensions by CROASDALE.

Hab. 57, 106, 117, 121, 536, 538. Distr. Europe, Spitzbergen, Bornholm, Japan, India and Brazil.

C. undulatum var. *crenulatum* forma *minus* CROASDALE, Trans. Am. microsc. Soc., 75, p. 59, pl. 3, f. 10, 1956.

Cells 20.7–24 μ long, 16.7–19 μ broad, and isthmus 5.7–6.6 μ broad. BORGE already reported var. *reinschii* ISTRV. from Arctic. BORGE's forms are distinguished from the present form by the small ratio of the length of cell to its breadth.

Hab. 56, 115, 118. Distr. Alaska.

Cosmarium vexatum WEST var. *lacustre* MESSIKOMMER, Vjschr. naturf. Ges. Zürich, **80**, p. 51, pl. 5, f. 62, 1935.—var. *concauum* SCHMIDLE in Ber. dt. bot. Ges., **11**, p. 550, pl. 28, f. 21, 1895; INSAM & KRIEGER, Hedwigia, **76**, p. 111, pl. 6, f. 5, 1936.

Cells 55–57 μ long, 46–53 μ broad, and isthmus 13–16 μ broad. Pl. 8, fig. 8.

Hab. 94, 123. Distr. Europe.

Cosmarium wollei (W. & G. S. WEST) GRÖNBLAD, Acta Soc. Fauna Flora fenn., **66** (1), p. 25, pl. 1, f. 8, 9, 1947; IRENÉE-MARIE, Hydrobiol., **4**, p. 138, pl. 12, f. 10, 1952.

Cells 46.5–48.4 μ long, 31–31.4 μ broad, and isthmus 26.4–28.6 μ broad. Pl. 3, fig. 14.

Hab. 148, 172, 173. Distr. Canada.

Cosmarium woronichinii KOSSINSKAYA, Acta Trudy bot. Inst. Acad. Nauk. SSSR., ser. 2, **3**, p. 431, pl. 3, f. 11, 1936; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 31, pl. 5, f. 86, 1962.

Cells 80–97 μ long, 62–66 μ broad, and isthmus 24–39 μ broad. Pl. 8, fig. 4.

Hab. 29, 30, 55, 57. Distr. Siberia and Alaska.

Arthrodesmus convergens EHRENB. var. *xanthioides* GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 53, pl. 4, f. 34, 35, 1920.

Cells 74–75 μ long, 79–80 μ broad without spine, and isthmus 19–20 μ broad.

Hab. 116. Distr. Europe.

Arthrodesmus extensus (ANDERS.) HIRANO, Contr. Biol. Lab. Kyoto Univ., **5**, p. 210, pl. 29, f. 16, 1957.

Cells 22–28.6 μ long, 21–24 μ broad without spine, and isthmus 5.7–9 μ broad.

Hab. 56, 59, 65, 123. Distr. New Foundland, Europe and Japan.

Arthrodesmus incus (BRÉB.) HASS. var. *borgeseni* MESSIKOMMER in Beitr. geobot. Landesaufn. Schweiz, **24**, p. 160, pl. 11, f. 3, 1942.

Cells without spine 27.3–33 μ long, 28.6–33.4 μ broad without spine, and isthmus 12.5–13 μ broad. The present specimens are slightly larger than the forms known from central Europe, spines horizontal. HIRN reported the same form from Finland under the name of *A. incus*. Pl. 10, fig. 13.

Hab. 43, 93. Distr. Europe.

Arthrodesmus incus var. *vulgaris* EICHL. & RACIB. forma *recta* EICHL. & RACIB. in FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 152, pl. 9, f. 23, 1965.

Cells without spine 46–46.5 μ long, 46–46.5 μ broad without spine, and isthmus 15–15.4 μ broad. Pl. 10, fig. 14.

Hab. 121. Distr. Europe.

Arthrodesmus ralfsii W. WEST in J. Linn. Soc., Bot., **29**, p. 168, 1892; SMITH, Wis.

Bull., 57, p.129, pl.85, f.9-12, 1924. — *A. incus* (BRÉB.) HASS. var. *ralfsii* W. & G.S. WEST forma *latiuscula* W. & G.S. WEST, Monogr. Br. Desm., 4, p.96, pl.114, f.5, 1911.

Cells 22-23 μ long, 19.5-21 μ broad without spine, and isthmus 7 μ broad. Pl. 5, fig. 27.
Hab. 61, Distr. U.S.A. and Europe.

A. ralfsii var. *brebissonii* (RACIB.) SMITH in Wis. Bull., 57, p.130, pl.85, f.13-17, 1924.
Cells 39-40 μ long, 35 μ broad without spine, and isthmus 10 μ broad. Pl.10, fig.12.
Hab. 56. Distr. U.S.A.

A. ralfsii var. *subhexagonum* (WEST) HIRANO, comb. nov.

A. incus (BRÉB.) HASS. var. *ralfsii* W. & G.S. WEST forma *subhexagona* WEST, Monogr. Br. Desm., 4, p.96, pl.114, f.6, 1911.

Cells 26-28.6 μ long, 28-30.6 μ broad without spine, and isthmus 5-7 μ broad. Pl. 10, fig. 15.

Hab. 115. Distr. Europe.

Arthrodesmus triangularis LAGERH. in W. & G.S. WEST, Monogr. Br. Desm., 4, p.97, pl.114, f.11-13, 1911.

A. triangularis var. *alaskanum* HIRANO, var. nov.

Cellulae latiores quam in forma typica, isthmo elongato, sinu excavato, apice recto vel leviter convexo. Cellula 21 μ longa, 22 μ lata sine spinis, 9.7 μ lat. isth. Pl. 10, fig. 11.

Hab. 26.

Xanthidium antilopaeum (BRÉB.) KÜTZ. in W. & G.S. WEST, Monogr. Br. Desm., 4, p.63, pl.108, f.7-18, 1911; GRÖNBLAD, Acta Soc. Fauna Flora fenn., 49, p.44, pl.4, f.1-7, 1921; CROASDALE, Trans. Am. microsc. Soc., 76, p.120, pl.1, f.1, 1957.

Cells without spine 57-84 μ long, 61.5-80 μ broad, and isthmus 19-24 μ broad.

Hab. 40, 58, 112, 115, 116, 123. Distr. Alaska, Canada, Devon Island, U.S.A., Europe, Faeroes, Bornholm, Siberia, Japan and S. America.

X. antilopaeum var. *crameri* GRÖNBLAD, Acta Soc. Fauna Flora fenn., 49(7), p.47, pl.4, f.28, 29, 1921.

Cells without spine 59-60 μ long, 51-62 μ broad, and isthmus 17-17.5 μ broad. The present specimens are distinguished from the original form described by GRÖNBLAD from Finland by having the depressed semicell and linearly open sinus, but coincide with the latter in the disposition of central scrobiculations, which gradually become smaller in size from middle to both ends. Pl. 10, fig. 16.

Hab. 117, 123. Distr. Canada and N. Europe.

X. antilopaeum var. *laeve* SCHMIDLE in W. & G.S. WEST, Monogr. Br. Desm., 4, p.68, pl.109, f.3, 1911; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p.230, pl.42,

f. 2, 1964.

Cells without spine 79–84 μ long, 70–75 μ broad, and isthmus 22–26.5 μ broad. The present specimens are larger than the typical form and the sinus is open. Semicells are without a series of central scrobiculations.

Hab. 36. Distr. Europe.

X. antilopaeum var. *laeve* SCHMIDLE forma *incrassata* GRÖNBLAD, Acta Soc. Fauna Flora fenn., 49(7), p. 46, pl. 4, f. 19, 20, 1921.

Cells without spine 79–84 μ long, 74.7–75 μ broad, and isthmus 22 μ broad.

Hab. 115. Distr. N. Europe.

Xanthidium cristatum BRÉB. var. *leiodermum* (ROY & BISS.) TURNER in W. & G.S. WEST, Monogr. Br. Desm., 4, p. 72, pl. 110, f. 11, 1911; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., 83, p. 190, pl. 16, f. 9–13, 1964.

Cells without spine 60–63.7 μ long, 47–50.6 μ broad, and isthmus 13.5–15.4 μ broad.

Hab. 123. Distr. Canada, U.S.A., Europe, Japan and India.

Xanthidium fasciculatum EHRENB. var. *ornatum* NORDST. in Öfv. K. Vet.-Akad. Förh., no. 2, p. 12, pl. 7, f. 10, 1885.

Cells without spine 53–62 μ long, 50.6–53 μ broad, and isthmus 17.6–26.4 μ broad. Central granules situated in the middle of semicell are slightly larger than those of the figures given by NORDSTEDT from Greenland, and their disposition is variable. Paired spines are long in some specimens and short in others. Pl. 11, fig. 7.

Hab. 36, 76, 104. Distr. Greenland.

Euastrum bidentatum NÄG. in W. & G.S. WEST, Monogr. Br. Desm., 2, p. 39, pl. 37, f. 16–19, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 601, pl. 85, f. 1, 2, 1937; CROASDALE, Trans. Am. microsc. Soc., 83, p. 162, pl. 7, f. 1, 2, 1964.

Cells 48–70 μ long, 33–39.6 μ broad, and isthmus 8.8–13 μ broad.

Hab. 14, 16, 22, 29, 40, 55, 56, 57, 58, 59, 61, 64, 65, 74, 76, 94, 104, 106, 115, 116, 117, 119, 123, 223, 513, 515. Distr. Alaska, Canada, Devon Island, U.S.A., Europe, Iceland, Bornholm, Japan and Brazil.

Euastrum binale (Turp.) EHRENB. var. *gutwinskii* SCHMIDLE in W. & G.S. WEST, Monogr. Br. Desm., 2, p. 53, pl. 38, f. 31, 32, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 551, pl. 75, f. 13–15, 1937; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., 83, p. 164, pl. 7, f. 13–15, 1964.

Cells 22–25.5 μ long, 16.7–22 μ broad, and isthmus 4.4–6.6 μ broad.

Hab. 14, 16, 29, 40, 55, 56, 58, 59, 61, 65, 74, 76, 94. Distr. Alaska, Canada, Europe and Japan.

Euastrum boldtii SCHMIDLE in KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 563, pl. 77,

f. 5-7, 1937.

Cells 31-37.4 μ long, 15.5-26.4 μ broad, and isthmus 6.5-8.7 μ broad. There are two different forms in the collections: some specimens bear distinct acute granules on the margin of lateral lobes and others are wanting. The apex of polar lobe is convex and retuse in the middle, but in some specimens it is undulate. The size of cells is larger than the dimensions given by KRIEGER. The distinction between the typical form and its variety is not so distinct on the present specimens. Pl. 11, fig. 1, 2.

Hab. 29, 55, 57, 58, 59, 61. Distr. New Foundland, Europe, and Greenland.

Euastrum dubium NÄG. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 43, pl. 38, f. 5-8, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 571, pl. 79, f. 1-5, 1937.

Cells 25.5-27 μ long, 17.6-18.7 μ broad, and isthmus 5 μ broad.

Hab. 119, 536. Distr. Canada, U.S.A., Europe, Greenland, Spitzbergen, Siberia, Japan, Mongolia and Africa.

E. dubium var. *ornatum* WOLOSZ. in KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 572, pl. 79, f. 10, 1937.

Cells 26.4-48.5 μ long, 24-35 μ broad, and isthmus 6.5-9 μ broad.

Hab. 30, 104. Distr. Europe.

Euastrum elegans (BRÉB.) KÜTZ. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 48, pl. 38, f. 16, 17, 21, 1905; GRÖNBLAD, Acta Soc. Fauna Flora fenn., 47, p. 31, pl. 6, f. 34, 1920; KRIEGER, Kryptogamenflora 13, Abt. 1, p. 591, pl. 81, f. 14-18, 1937.

Cells 33-39.6 μ long, 22-26.4 μ broad, and isthmus 4.5-6.5 μ broad. Pl. 10, fig. 4.

Hab. 14, 16, 29, 30, 36, 40, 55, 56, 58, 59, 61, 64, 65, 74, 76, 94, 115, 117, 121, 123. Distr. Alaska, Canada, U.S.A., Europe, Spitzbergen, Greenland, Novaya Zemlya, Bornholm, Siberia and Japan.

Euastrum obesum JOSHUA in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 29, pl. 36, f. 16, 17, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 495, pl. 59, f. 9, 10, 1937; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., 83, p. 168, pl. 6, f. 14, 1964.

Cells 84-97 μ long, 44-48.5 μ broad, and isthmus 13-19.5 μ broad. Pl. 10, fig. 8.

Hab. 29, 30, 55, 56, 57, 58, 59, 61, 64, 65, 74, 76, 94, 104, 116, 119. Distr. Canada, U.S.A., Europe, India, Ceylon, Sumatra, Burma and Africa.

Euastrum oblongum (GREV.) RALFS in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 12, pl. 34, f. 7-9; pl. 35, f. 2, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 526, pl. 70, f. 3-6, 1937; CROASDALE, Farlowia, 4, p. 532, pl. 11, f. 1, 1955.

Cells 150-158.5 μ long, 66-73.5 μ broad, and isthmus 22-24 μ broad.

Hab. 56, 57. Distr. Canada, U.S.A., Europe, Greenland, Faeroes, Bornholm, Japan and Brazil.

Euastrum pectinatum BRÉB. var. *brachylobum* WITTR. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 62, pl. 39, f. 16, 1905; GRÖNBLAD, Acta Soc. Sci. fenn., n.ser. B, 2(5), p. 36, pl. 1, f. 24, 1942; CROASDALE, Farlowia, 4, p. 532, pl. 11, f. 8, 1955.

Cells 75-79 μ long, 53-53.4 μ broad, and isthmus 13-17.5 μ broad. Pl. 10, fig. 7.

Hab. 56, 61. Distr. Canada, New Foundland, Greenland, and Europe.

Euastrum subalpinum MESSIKOMMER in Vjschr. naturf. Ges. Zürich, 80, p. 120, pl. 1, f. 5, 1935; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 569, pl. 77, f. 35-37, 1937.

Cells 26-30 μ long, 17-20 μ broad, and isthmus 6.5-8 μ broad. The present specimens are larger than the dimension given by KRIEGER but coincide well with the outline of cell. Polar lobe somewhat elongate and slightly dilated upward, and sometimes slightly longer than the basal part of semicell. CROASDALE reported var. *crassum* of this species from Labrador, but the present specimens do not coincide with it. Pl. 10, fig. 2, 3.

Hab. 104, 223. Distr. Canada and Europe.

Euastrum turneri W. WEST, Monogr. Br. Desm., 2, p. 37, pl. 37, f. 9, 10, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 589, pl. 82, f. 20, 21, 1937.

Cells 30-42 μ long, 22-31 μ broad, and isthmus 6.5-7.5 μ broad.

Hab. 30, 40, 104, 123. Distr. Canada, U.S.A., Europe, Japan, Manchuria, Australia and S. America.

Euastrum verrucosum EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 64, pl. 40, f. 1, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 643, pl. 94, f. 1-3, 1937.

Cells 97-99 μ long, 75-78 μ broad, and isthmus 22-22.5 μ broad.

Hab. 40, 56, 59, 65, 74, 119. Distr. U.S.A., Canada, Greenland, Europe, Faeroes, Bornholm, Siberia, Japan, Australia, S. America and Africa.

E. verrucosum var. *alatum* WOLLE in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 67, pl. 40, f. 6, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 1, p. 645, pl. 94, f. 4, 1937.

Cells 120-132 μ long, 103-110 μ broad, and isthmus 24-26.5 μ broad. The present forms coincide well with the description and figure given by KRIEGER. Cell wall furnished with a concentric series of granules just above the isthmus and the inner granules are distinctly larger than the peripheral ones. Lateral lobes of the semicell seems to be somewhat produced.

Hab. 117. Distr. Canada, U.S.A., and Europe.

Micrasterias americana (EHRENB.) RALFS in W. & G. S. WEST, Monogr. Br. Desm., 2, p. 117, pl. 53, f. 4, 5, 1905; KRIEGER, Kryptogamenflora, 13, Abt. 2, p. 45, pl. 108, f. 5-8, 1939.

Cells 132-154 μ long, 114-128 μ broad, and isthmus 26.5-32 μ broad.

Hab. 536, 538. Distr. U.S.A. and Europe.

Micrasterias angulosa HANTZSCH in GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 33, pl. 6, f. 4, 5, 1920.—*M. denticulata* BRÉB. var. *angulosa* (HANTZSCH) W. & G. S. WEST in Monogr. Br. Desm., **2**, p. 107, pl. 50, f. 3, 4, 1905.

Cells 258–264 μ long, 175–190 μ broad, and isthmus 32–35 μ broad.

Hab. 61. Distr. Europe, Greenland, Bornholm, Japan, and New Zealand.

Micrasterias brachyptera LUND. in Nova Acta R. Soc. Scient. upsal. ser. 3, **8**, p. 12, pl. 1, f. 4, 1871; KRIEGER, Kryptogamenflora, **13**, Abt. 2, p. 83, pl. 125, f. 3–6, 1939.

Cells 220–223 μ long, 150–154 μ broad, and isthmus 22–22.5 μ broad.

Hab. 115. Distr. Europe.

Micrasterias denticulosa BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 105, pl. 50, f. 1, 4, 1905; GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 35, 1920; KRIEGER, Kryptogamenflora, **13**, Abt. 2, p. 105, pl. 137, f. 3–6, 1939.

Cells 246–260 μ long, 185–205 μ broad, and isthmus 26.5–35 μ broad.

Hab. 64, 76, 104. Distr. U.S.A., Europe, Greenland, Faeroes, Japan, India, Sumatra, Australia, New Zealand, and Brazil.

Micrasterias sol (EHRENB.) KÜTZ. var. *ornata* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 97, pl. 46, f. 3, 4, 1905; KRIEGER, Kryptogamenflora, **13**, Abt. 2, p. 96, pl. 131, f. 3–5, 1939.

Cells 134–141 μ long, 114–119 μ broad, and isthmus 18–20 μ broad.

Hab. 119. Distr. U.S.A., Europe and Brazil.

Staurastrum aculeatum (EHRENB.) MENEGH. var. *ornatum* NORDST. in KRIEGER, Ber. dt. bot. Ges., **56**, p. 64, pl. 2, f. 5, 6, 1938; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 136, pl. 7, f. 110, 1957; *l.c.* **84**, p. 329, pl. 8, f. 13, 1965.

Cells 34–35 μ long, 37.4–38 μ broad, and isthmus 13 μ broad. Pl. 11, fig. 11.

Hab. 16, 65. Distr. Alaska, Devon Island and Spitzbergen.

S. aculeatum var. *ornatum* forma *simplex* BOLDT in CROASDALE, Trans. Am. microsc. Soc., **84**, p. 329, pl. 8, f. 14–16, 1965.

Cells 34–35 μ long, 33–35 μ broad, and isthmus 9–9.5 μ broad. Pl. 12, fig. 6.

Hab. 56. Distr. Devon Island.

Staurastrum alternans BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 170, pl. 126, f. 8, 9, 1911; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 152, pl. 8, f. 15, 1965.

Cells 30–40.5 μ long, 30–44 μ broad, and isthmus 9–15 μ broad. Semicells subelliptic, lateral angles slightly produced and truncated, sinus widely open but acuminate at the extremity; lateral margin retuse in the vertical view of semicell; cell wall granulate, granules disposed in concentric series of about 5–6 around the angle.

Hab. 118, 536, 538. Distr. Cosmopolitan.

S. alternans var. *basichondrum* SCHMIDLE in CROASDALE, Trans. Am. microsc. Soc., **81**, p. 36, pl. 7, f. 125, 1962.

Cells 31–37.4 μ long, 31–39.5 μ broad, and isthmus 10–12 μ broad. Pl. 13, fig. 7.

Hab. 15, 16, 22, 40, 43, 59, 118, 193, 513. Distr. Alaska and Europe.

Staurastrum apiculatum BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 6, pl. 129, f. 6–8, 1923.

Cells 21–23 μ long, 21–23 μ broad, and isthmus 6 μ broad.

Hab. 121. Distr. U.S.A., Europe, Greenland, Japan, Burma, Thailand and Australia.

Staurastrum avicula BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 40, pl. 133, f. 8–10, 1923; GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 57, pl. 3, f. 36–38, 1920.

Cells 33–34 μ long, 31–37 μ broad, and isthmus 6.6–7 μ broad.

Hab. 57. Distr. Alaska, Devon, Island, U.S.A., Europe, Greenland, Faeroes, Japan, and Brazil.

Staurastrum bieneanum RABENH. forma *spetsbergensis* NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 33, pl. 8, f. 35, 1875; W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 137, pl. 120, f. 7, 1911; KRIEGER, Ber. dt. bot. Ges., **56**, p. 64, pl. 2, f. 3, 4, 1938.

Cells 30–31 μ long, 30–31 μ broad, and isthmus 8.7–9 μ broad. The cell form corresponds well to the form reported from Spitzbergen, but the cells are slightly smaller than his form. Similar form was reported from central Europe by MISSIKOMMER under the name of var. *ellipticum*. Semicells of the present specimens are almost elliptic, but the ventral margin more convex than the dorsal one, and the lateral angles are acutely rounded. Pl. 11, fig. 13.

Hab. 59. Distr. Alaska, Spitzbergen, Greenland, Faeroes, and Siberia.

St. bieneanum var. *ellipticum* WILLE in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 137, pl. 120, f. 8, 1911; GROASDALE, Trans. Am. microsc. Soc., **76**, p. 142, pl. 4, f. 58, 1957.

Cells 33–35 μ long, 31–33 μ broad, and isthmus 8–9 μ broad. Pl. 11, fig. 8.

Hab. 61. Distr. Alaska, Europe, Spitzbergen, Greenland, Samoa and Australia.

Staurastrum boldtianum GRÖNBLAD, Acta Soc. Sci. fenn., n.ser. B, **2**(5), p. 40, pl. 4, f. 4, 1942; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 153, pl. 9, f. 15–17, 1965.

Cells 26–28.6 μ long, 26.5–29 μ broad, and isthmus 11 μ broad. Pl. 10, fig. 1.

Hab. 22. Distr. Europe.

Staurastrum borgeanum SCHMIDLE in THOMASSON, Bot. Notiser, **110**, p. 260, f. 5, 1957; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 36, pl. 8, f. 135–141, 1962; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 153, pl. 9, f. 1, 2, 1965.

Cells 40–44 μ long, 48.4–55 μ broad including process, and isthmus 13–15 μ broad. Body of semicells elliptic-subfusiform or depressed cup-shaped, apex convex and furnished with a serie of emarginate verrucae, below the apex are also disposed the vertical series of similar verrucae but these series often less distinct than the apical series of verrucae, processes horizontal or incurved, tipped with 4 short spines, with a transverse serie of granules just above the isthmus; semicell in vertical view trigonal, sides slightly concave with 4 verrucae at the middle but median two are prominent, within the margin with an arched serie of verrucae on each side, central part of semicell smooth, angles produced into short attenuated and denticulated processes which are provided with 4 series of denticulations from base to top. Pl. 12, fig. 7, 8; Pl. 13, fig. 8.

Hab. 30, 40, 45, 57, 58, 61, 65, 74, 94, 104, 123, 516, 523. Distr. Alaska, Canada, and Europe.

Staurastrum brebissonii ARCH. in WEST & CARTER, Monogr. Br. Desm., 5, p. 61, pl. 137, f. 4, 5, 1923; KRIEGER, Ber. dt. bot. Ges., 56, p. 64, pl. 2, f. 1, 2, 1938.

Cells 35–37 μ long, 37.5–39 μ broad, and isthmus 13 μ broad. The present specimens are distinguished from *St. pilosum* by bearing the long spines at the angles. Pl. 12, fig. 5.

Hab. 58. Distr. Alaska. Devon Island, U.S.A., Europe, Novaya Zemlya. Spitzbergen, Greenland, Patagonia and Antarctic.

Staurastrum brevispinum BRÉB. var. *boldtii* LAGERH. in SKUYA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 248, pl. 49, f. 10, 1964.

Cells 52–53 μ long, 41–42 μ broad, and isthmus 15–15.6 μ broad. Pl. 10, fig. 10.

Hab. 118. Distr. Europe.

St. brevispinum var. *retusum* BORGE, Bih. K. Svenska. Vet.-Akad. Handl., 19, Afd. 3, p. 36, pl. 3, f. 42, 1894.

Cells 46–46.5 μ long, 37.4–38 μ broad, and isthmus 13 μ broad. Pl. 10, fig. 5.

Hab. 119. Distr. Europe.

Staurastrum capitulum BRÉB. var. *spetsbergense* (NORDST.) COOCKE in WEST & CARTER, Monogr. Br. Desm., 5, p. 126, pl. 118, f. 8, 1923; KRIEGER, Ber. dt. bot. Ges., 56, p. 64, pl. 2, f. 9, 10, 1938; CROASDALE, Trans. Am. microsc. Soc., 81, p. 38, pl. 6, f. 119, 1962; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 153, pl. 9, f. 13, 14; pl. 12, f. 12, 1965.

Cells 50–53 μ long, 33–34.4 μ broad, and isthmus 19–20 μ broad. Pl. 11, fig. 6.

Hab. 94. Distr. Alaska, N. Europe, Spitzbergen, Novaya Zemlya and Brazil.

Staurastrum cristatum (NÄG.) ARCH. in WEST & CARTER, Monogr. Br. Desm., 5, p. 47, pl. 139, f. 5, 1923; WHELLEN, Bull. natn. Mus. Can., 97, p. 100, pl. 7, f. 7, 1947; CROASDALE, Trans. Am. microsc. Soc., 81, p. 38, pl. 7, f. 129, 1962.

Cells without spine 41–48 μ long, 39.5–48 μ broad, and isthmus 20–22 μ broad.

Hab. 55, 74, 115, 121. Distr. Alaska, Greenland, Spitzbergen, Europe, Bornholm, Faeroes, Siberia, Japan and India.

Staurastrum cyrtocerum BRÉB. in WEST & CARTER, Monogr. Br. Desm., 5, p. 135, pl. 149, f. 9; pl. 150, f. 4, 1923; CROASDALE, Trans. Am. microsc. Soc., 76, p. 143, pl. 6, f. 102, 103, 1957; *l.c.* 84, p. 330, pl. 8, f. 11, 12, 1965.

Cells 33–37.5 μ long, 35–39.6 μ broad, and isthmus 8.7–13 μ broad.

Hab. 40, 56, 57, 94, 121. Distr. Alaska, Devon Island, U.S.A., Europe, Spitzbergen, Bornholm, Japan, Australia and S. America.

Staurastrum dejectum BRÉB. in WEST & CARTER, Monogr. Br. Desm., 5, p. 7, pl. 129, f. 9–12, 1923; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 249, pl. 49, f. 11, 1964.

Cells without spine 31–37.5 μ long, 31–39.5 μ broad, and isthmus 7.5–11 μ broad.

Hab. 29, 61, 115, 530. Distr. Canada, U.S.A., Europe, Greenland, Iceland, Faeroes, Siberia, Japan, Mongolia, China, and E. Africa.

St. dejectum var. *inflatum* W. & G. S. WEST in WEST & CARTER, Monogr. Br. Desm., 5, p. 10, pl. 130, f. 3–5, 1923; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 249, pl. 50, f. 4, 1964.

Cells without spine 46–48.5 μ long, 46–48.5 μ broad, and isthmus 12–13 μ broad.

Hab. 121. Distr. Europe.

Staurastrum dilatatum EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 172, pl. 126, f. 10–15 μ , 1911; CROASDALE, Trans. Am. microsc. Soc., 76, p. 143, pl. 4, f. 71, 1957; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 154, pl. 8, f. 16, 1965.

Cells 26.5–28 μ long, 26.5–28 μ broad, and isthmus 8.7–9.5 μ broad.

Hab. 29. Distr. Alaska, Devon Island, Europe, Greenland, U.S.A., Japan, Africa, Madagascar, New Zealand and S. America.

Staurastrum ellipticum WEST, Monogr. Br. Desm., 4, p. 138, pl. 119, f. 7, 1911.

Cells 42–44 μ long, 32–33 μ broad, and isthmus 13 μ broad.

Hab. 203. Distr. Europe, Greenland and Paraguay.

Staurastrum forficulatum LUND. var. *verrucosum* GRÖNBLAD in Acta Soc. Fauna Flora fenn., 47, p. 64, pl. 3, f. 47, 50, 51, 1920; HIRANO, Contr. biol. Lab. Kyoto Univ., 9, p. 333, pl. 42, f. 1, 1959.

Cells with process 48–52 μ long, 38–40 μ broad, and isthmus 14–15 μ broad.

Hab. 104. Distr. Europe and Japan.

Staurastrum furcigerum BRÉB. in WEST & CARTER, Monogr. Br. Desm., 5, p. 188,

pl. 156, f. 7, 8, 1923; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 154, pl. 8, f. 29, 1965.

Cells with process 84–88 μ long, 75–79 μ broad, and isthmus 19–21 μ broad.

Hab. 30, 57, 115. Distr. Alaska, Canada, U.S.A., Europe, Greenland, Siberia, Japan, Mongolia and Patagonia.

Staurastrum granulosum (EHRENB.) RALFS var. *acutum* (BRÉB.) W. & G.S. WEST, Monogr. Br. Desm., **4**, p. 190, pl. 128, f. 14, 1911.

Cells 31–33 μ long, 28–31 μ broad, and isthmus 9–9.5 μ broad. Pl. 11, fig. 9.

Hab. 56. Distr. Europe.

Staurastrum gronbladii SKUJA in CROASDALE, Trans. Am. microsc. Soc., **76**, p. 144, pl. 4, f. 63, 64, 1957.

Cells 27.5–28 μ long, 25–25.7 μ broad, and isthmus 10.5–11 μ broad. The present specimens resemble *St. orbiculare* var. *quadratum*, but differ from it by the form of sinus and less deep constriction. Pl. 11, fig. 12.

Hab. 538. Distr. Alaska and Europe.

Staurastrum insigne LUND. in Nova Acta R. Soc. Scient. upsal., ser. 3, **8**, p. 58, pl. 3, f. 25, 1871; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 39, pl. 7, f. 123, 1962; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 154, pl. 8, f. 11; pl. 12, f. 14, 15, 1965.

Cells 27–29 μ long, 22–22.6 μ broad, and isthmus 11.5 μ broad. Pl. 10, fig. 6.

Hab. 58. Distr. Europe.

Staurastrum johnsonii W. & G.S. WEST, Trans. Linn. Soc. Bot., **5**, p. 266, pl. 17, f. 16, 1896; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 145, pl. 9, f. 126, 127, 1957.

Cells 58–61.6 μ long, 94–96.8 μ broad including process, and isthmus 14–16 μ broad.

Hab. 115. Distr. Alaska and U.S.A.

Staurastrum lapponicum (SCHMIDLE) GRÖNBLAD in CROASDALE, Trans. Am. microsc. Soc., **83**, p. 204, pl. 18, f. 7, 8, 1964; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 255, pl. 51, f. 10, 1964.

Cells 35–44 μ long, 35–44 μ broad, and isthmus 10–13 μ broad.

Hab. 26, 40, 56, 61, 65, 115, 117, 119, 121. Distr. Europe and Japan.

Staurastrum lunatum RALFS in WEST & CARTER, Monogr. Br. Desm., **5**, p. 29, pl. 133, f. 17–19, 1923.

Cells 31–35 μ long, 31–32.6 μ broad, and isthmus 11–13 μ broad. Pl. 11, fig. 10.

Hab. 93, 119, 123. Distr. Alaska, Europe, Faeroes, Greenland, Siberia and Japan.

St. lunatum var. *planctonicum* W. & G.S. WEST in WEST & CARTER, Monogr. Br. Desm., **5**, p. 30, pl. 133, f. 20–22, 1923; SKUYA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 253, pl. 51, f. 3, 4, 1964.

Cells 44–53 μ long, 48.5–53 μ broad, and isthmus 14.5–19 μ broad. Pl. 12, fig. 2.

Hab. 65. Distr. Canada and Europe.

Staurastrum margaritaceum (EHRENB.) MENEGH. in WEST & CARTER, Monogr. Br. Desm., 5, p. 131, pl. 150, f. 5–9, 1923; CROASDALE, Trans. Am. microsc. Soc., 76, p. 145, pl. 6, f. 101, 1957.

Cell 22 μ long, 22 μ broad, and isthmus 8.7 μ broad.

Hab. 16, 58, 115. Distr. Alaska, U.S.A., Europe, Greenland, Spitzbergen, Japan, India, Thailand, Celebes and Brazil.

Staurastrum megacanthum LUND. in GRÖNBLAD, Acta Soc. Fauna Flora fenn., 47, p. 69, pl. 1, f. 41, 1920; WEST & CARTER, Monogr. Br. Desm., 5, p. 20, pl. 131, f. 7, 8, 1923.

Cells without spine 54–57 μ long, 56.5–59 μ broad, and isthmus 12–13 μ broad.

Hab. 61. Distr. U.S.A., Canada, Europe, Iceland, Japan, India, and Patagonia.

Staurastrum monticulosum BRÉB. in WEST & CARTER, Monogr. Br. Desm., 5, p. 183, pl. 154, f. 8, 1923.

St. monticulosum var. *alaskanum* HIRANO, var. nov.

Semicellulae subfusiformes, marginibus lateralibus et apicibus convexis, angulis lateralibus cum spinis singulis longis robustis; in vertice visae lateribus retusis; processibus apicalibus prominentibus productis; in basi visae lateribus cum spinis brevibus variabilibus, long. sine proc. 37.4 μ , cum proc. 44 μ ; lat. cum proc. 39.6 μ , cum spin. 47.4 μ ; lat. isth. 10 μ . Pl. 12, fig. 4.

Hab. 119.

The present variety differs from the typical form by having a single long and stout spine at each lateral angle as seen in the front view, and the sides in the vertical view are retuse in the middle. Apical processes are developed better than those of the typical form. There are short spines or denticulations on or within each lateral side as observed in basal view, but these spines are considerably varied among the specimens. The present form apparently resembles *St furcatum* var. *subsenarium*, but the lateral spines are single on each angle and do not pair vertically as seen in the latter species, and is distinguished from the latter by having a straight side in vertical view. LÜTKEMÜLLER reported *St. lunatum* forma *luxurians* from Bohemia and the present form is similar to that form, but he does not show the vertical view of forma *luxurians* in his paper.

Staurastrum mucronatum RALFS var. *subtriangulare* W. & G. S. WEST in WEST & CARTER, Monogr. Br. Desm., 5, p. 12, pl. 130, f. 13, 14, 1923; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 251, pl. 50, f. 10, 1964; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 156, pl. 9, f. 21, 1965.

Cells 35–37 μ long, 35–37 μ broad, and isthmus 8.7–9 μ broad. Apex of semicell convex and spines slightly short, sinus more open and obtuse at the extremity. Pl. 10, fig. 9.

Hab. 16, 56, 119. Distr. Europe, Burma and Japan.

Staurastrum muticum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 133, pl. 118, f. 16–20, 1911; FÖRSTER, Ark. Bot., ser. 2, 6(3), p. 156, pl. 8, f. 12, 1965.

Cells 26.5–29 μ long, 26.5–29 μ broad, and isthmus 8.7–10 μ broad.

Hab. 119. Distr. Devon Island, U.S.A., Europe, Faeroes, Spitzbergen, Siberia, Japan, Mongolia, Java, Central Africa and Brazil.

Staurastrum orbiculare RALFS var. *depressum* ROY & BISS. in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 158, pl. 124, f. 17–19, 1911.

Cells 23–25 μ long, 22–24 μ broad, and isthmus 6.5–7 μ broad.

Hab. 55. Distr. Alaska, Europe, Japan, China, Thailand, Australia, New Zealand and Madagascar.

St. orbiculare var. *ralfsii* W. & G. S. WEST in Monogr. Br. Desm., 4, p. 156, pl. 124, f. 12, 13, 15, 16, 1911.

Cells 34–35 μ long, 33–33.5 μ broad, and isthmus 9–10 μ broad.

Hab. 29, 56. Distr. Alaska, Europe, Spitzbergen, Greenland, Bornholm, Novaya Zemlya, India and Australia.

Staurastrum oxyacanthum ARCH. in WEST & CARTER, Monogr. Br. Desm., 5, p. 169, pl. 143, f. 18, 19, 1923.

St. oxyacanthum var. *croasdaleae* HIRANO, var. nov.

Semicellulae cyathiformes, marginibus ventralibus tumidis, apice convexo, angulis apicalibus productis in processus longos denticulatos leviter convergentes et attenuatos apicibus acute 4-spinatis; in vertice visae tetragonae, lateribus leviter concavis cum spinis longis duobus juxta infra marginem, angulis productis in processus longos 4 denticulatos leviter attenuatos, spice processuum 4 spinato, 39–40 μ long., 52–53 μ lat., 11 μ lat. isth. Pl. 12, fig. 1.

Hab. 115.

St. oxyacanthum var. *sibiricum* BOLDT in Öfv. K. Vet.-Akad. Förh., no. 2, p. 119, pl. 6, f. 40, 41, 1885; BORGE, Ark. Bot., 6(1), p. 48, pl. 3, f. 40, 1906.

Cells 34–35 μ long, 33–35 μ broad, and isthmus 10 μ broad. Pl. 13, fig. 4.

Hab. 56. Distr. Europe and Siberia.

Staurastrum pachyrhynchum NORDST. in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 151, pl. 121, f. 8, 9, 1911.

Cells 42–44 μ long, 40–43 μ broad, and isthmus 13–14 μ broad. Pl. 11, fig. 5.

Hab. 55. Distr. U.S.A., Europe, Greenland, Spitzbergen, Novaya Zemlya, Siberia and Japan.

St. pachyrhynchum forma *kossinskayae* CROASDALE in Trans. Am. microsc. Soc., **81**, p. 39, pl. 7, f. 122, 1962.

Cells 45–46 μ long, 47–48.5 μ broad, and isthmus 13 μ broad. Pl. 11, fig. 4.

Hab. 55. Distr. Alaska.

Staurastrum pendulum NYGAARD var. *pinguiforme* CROASDALE in Trans. Am. microsc. Soc., **77**, p. 31, f. 2, 1958.

Cells 35 μ long, 48–48.5 μ broad with process, and isthmus 13 μ broad. Semicells cup-shaped, sinus shallow but acuminate, apex slightly convex, angles produced into long, slender, horizontal, attenuated processes which terminate with 3 minute spines; in vertical view of semicell 3-angular, side slightly concave, angles produced into slender attenuated processes, with a delicate series of emarginate verrucae within each margin. Pl. 12, fig. 10.

Hab. 22, 29, 55, 55, 116. Distr. Alaska.

Staurastrum petsamoense (BOLDT) JÄRNEFELT in THOMASSON, Bot. Notiser., **110**, p. 254, f. 2, 1957; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 262, pl. 53, f. 1–3, 1964.

Cells 48–49 μ long, 78–80 μ broad with process, and isthmus 15–15.5 μ broad. The present specimens have slightly longer processes and also the number of denticulations is larger than those of North European forms. Each side of semicell in the vertical view is concave and slightly undulated and with a series of verrucae within each margin. Pl. 13, fig. 1–3, 6.

Hab. 29, 57, 115. Distr. North Europe.

St. petsamoense var. *minus* THOMASSON in Bot. Notiser., **110**, p. 254, f. 3, 1957.

Cells 39–40 μ long, 48.5–53 μ broad with process, and isthmus 13–15 μ broad. In the specimens obtained from the place of no. 538, the processes are short, robust, horizontal, and 5 denticulated; semicells without a transverse series of denticulations above the isthmus; side of cell in the vertical view almost straight and the undulation is not distinct, sometimes with a series of 4 verrucae within the margin. Pl. 12, fig. 9; Pl. 13, fig. 9.

Hab. 45, 123, 530, 538. Distr. North Europe.

Staurastrum pilosum (NÄG.) ARCH. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 63, pl. 138, f. 1–3, 1923; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 156, pl. 8, f. 23, 1965.

Cells 40–57 μ long, 41.7–61.5 μ broad, and isthmus 13–14 μ broad.

Hab. 57, 65, 72, 74, 76, 104, 536. Distr. Europe, Greenland, Spitzbergen, Faeroes, Iceland and Siberia.

Staurastrum polymorphum BRÉB. in WEST & CARTER, Monogr. Br. Desm., 5, p. 125, pl. 142, f. 24; pl. 143, f. 1-3, 1923; CROASDALE, Trans. Am. microsc. Soc., 76, p. 147, pl. 6, f. 99, 100, 1957; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 260, pl. 52, f. 11, 1964.

Cells 26.5-27 μ long, 24.5-31 μ broad with process, and isthmus 7-8.8 μ broad.

Hab. 15, 29, 61, 74, 123, 203. Distr. U.S.A., Alaska, Canada, Europe, Spitzbergen, Greenland, Novaya Zemlya, Faeroes, Siberia and Japan.

Staurastrum polytrichum (PERTY) RABENH. in WEST & CARTER, Monogr. Br. Desm., 5, p. 53, pl. 136, f. 8-10, 1923; CROASDALE, Trans. Am. microsc. Soc., 81, p. 39, pl. 7, f. 130, 1962.

Cells without spine 59.5-88 μ long, 57-70 μ broad, and isthmus 22-24 μ broad.

Hab. 74, 119, 203. Distr. U.S.A., Canada, Alaska, Europe, India and S. America.

Staurastrum punctulatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 179, pl. 127, f. 8-11, 13, 14, 1911; CROASDALE, Trans. Am. microsc. Soc., 76, p. 148, pl. 4, f. 74, 1957; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 254, pl. 51, f. 2, 1964.

Cells 40.5-48.4 μ long, 40.5-44 μ broad, and isthmus 13-14.5 μ broad. The present specimens coincide well with the Alaskan forms reported by CROASDALE. The apex of semicell is less convex than that of the British form figured by WEST, and sinus is acuminate at the extremity. The specimens in which the collection was made in a place of no. 173 coincide with figure 73 given by CROASDALE, and its cell form apparently resembles var. *kjellmani* of this species, and the side of cell in the vertical view is straight or faintly convex and never shows retuseness. Angles of semicell are broadly rounded and do not coincide with the acute angles of typical form, so that the present specimens will be related rather to the following var. *kjellmani*.

Hab. 169, 536, 538. Distr. Alaska, Canada, U.S.A., Europe, Spitzbergen, Greenland, Iceland, Bornholm, Japan, India, Java, Australia and S. America.

St. punctulatum var. *kjellmani* WILLE in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 182, pl. 127, f. 13, 17-19, 21, 22, 1911; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, 18(3), p. 254, 1964; CROASDALE, Trans. Am. microsc. Soc., 84, p. 332, pl. 7, f. 21, 22, 1965.

Cells 44-53 μ long, 39.6-44 μ broad, and isthmus 13-22 μ broad. The specimens collected from no. 22 bear hexagonal semicell, its apex is straight, and the series of granules are distinct. This form is similar to *St. hexagonale* FRITSCH described from Africa, but is distinguished by larger size of cell. The specimens collected from the place of no. 203 are quadrangular in form and the side in vertical view is slightly retuse, while those collected from no. 173 are triangular.

Hab. 22, 30, 72, 172, 173, 203, 223, 513. Distr. Devon Island, Europe, Novaya Zemlya, Spitzbergen, Greenland, Faeroes and Japan.

St. punctulatum var. *muricatiforme* SCHMIDLE in W. & G. S. WEST, Monogr. Br. Desm., 4, p. 186, 1911.—*St. muricatiforme* SCHMIDLE in Öst. bot. Z., p. 162, pl. 16, f. 14, 15, 1896.

Cells 44μ long, 39.6μ broad, and isthmus 13μ broad. Semicells are more depressed than those of the typical form, and the sinus is more acute and slightly open. Angles of semicell are broadly rounded. The sides of semicell in vertical view are retuse. Pl. 11, fig. 3.

Hab. 28. Distr. Europe.

Staurastrum sebaldi REINSCH var. *impar* CROASDALE in Trans. Am. microsc. Soc., 77, p. 32, f. 3, 1958.

Cells with process $58-61\mu$ long, $70-74.5\mu$ broad, and isthmus $12-13\mu$ broad. The specimens coincide well with the form reported from Kodiak, Alaska. Semicells tetragonal, angles produced into about 7 denticulated slightly attenuated stout process, base of processes with a pair of fairly long spines, in vertical view of semicell sides with a serie of three verrucae within each margin.

Hab. 119. Distr. Alaska.

Staurastrum senarium (EHRENB.) RALFS var. *nigrae-silvae* SCHMIDLE, Ber. dt. bot. Ges., 11, p. 553, pl. 28, f. 19, 1893.

Cells with process $44-48\mu$ long, $40-53\mu$ broad, and isthmus $13-15\mu$ broad. Pl. 13, fig. 5.

Hab. 29, 56. Distr. Europe.

Staurastrum sibiricum BERGE in Bih. K. Svenska Vetensk-Akad. Handl., 17, Afd. 3, no. 2, p. 9, f. 4, 1891.

Cell 22μ long, 21μ broad, and isthmus 8.7μ broad. Semicells obversely semicircular, lateral margin slightly convex, apex almost straight or slightly retuse and angles obtuse, sinus subrectangular but acuminate at the extremity. GRÖNBLAD reported *C. capitulum* var. *gronlandicum* BÖRGES. but the present specimens differ from the latter by the slightly larger size. Pl. 12, fig. 3.

Hab. 123. Distr. Siberia.

Staurastrum subavicula W. & G. S. WEST in WEST & CARTER, Monogr. Br. Desm., 5, p. 181, pl. 155, f. 10, 1923; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., 83, p. 205, pl. 21, f. 5, 6, 1964.

Cells without spine $37-39.6\mu$ long, $37-39\mu$ broad, and isthmus $10-11\mu$ broad.

Hab. 16. Distr. Canada, Europe and Australia.

Staurastrum teliferum RALFS in WEST & CARTER, Monogr. Br. Desm., 5, p. 58, pl.

136, f. 2-6, 1923.

Cells 42-44 μ long, 42-44 μ broad, and isthmus 11 μ broad.

Hab. 56. Distr. U.S.A., Canada, Europe, Iceland, Faeroes, Greenland, Siberia, Japan, Burma and Brazil.

Staurastrum varians RACIB. in CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 206, pl. 18, f. 9, 10, 1964.

Cell 35 μ long, 39.5 μ broad, and isthmus 16 μ broad.

Hab. 22. Distr. Canada and Devon Island.

Staurastrum vestitum RALFS in WEST & CARTER, Monogr. Br. Desm., **5**, p. 158, pl. 151, f. 9-11; pl. 152, f. 5, 6, 1923; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 150, pl. 8, f. 118, 119, 1957.

Cells 40-41 μ long, 84-87 μ broad with process, and isthmus 8 μ broad.

Hab. 29. Distr. Alaska, U.S.A., Canada, Europe, Bornholm, Japan, Australia and Brazil.

Hyalotheca dissiliens (SM.) BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 229, pl. 161, f. 16-27, 1923; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 152, pl. 10, f. 140, 141, 1957.

Cells 15.4-19.8 μ long, 26.4-35 μ broad, and isthmus 23-24 μ broad.

Hab. 64, 121, 536. Distr. Cosmopolitan.

Hyalotheca mucosa (MERT.) EHRENB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 235, pl. 162, f. 1-4, 1923; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 277, pl. 58, f. 12, 1964.

Cells 16.3-22 μ long, 15.4-22 μ broad.

Hab. 118, 121, 123. Distr. Alaska, Canada, U.S.A., Europe, Japan, India, Australia, Africa and Brazil.

Desmidium aptogonum BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 242, pl. 164, f. 1-3, 1923; CROASDALE, Trans. Am. Microsc. Soc., **76**, p. 152, pl. 10, f. 145, 146, 1957; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 278, pl. 59, f. 5, 1964.

Cells 20-22 μ long, 32-35 μ broad, and isthmus 25-25.3 μ broad.

Hab. 121. Distr. Alaska, U.S.A., Europe, Japan, India, Ceylon, Burma, Australia and Madagascar.

Desmidium baileyi (RALFS) NORDST. in CROASDALE, Trans. Am. microsc. Soc., **76**, p. 153, pl. 10, f. 149, 150, 1957.

Cells 23-26.5 μ long, 22-25 μ broad.

Hab. 116, 121. Distr. Alaska, Europe and Japan.

Desmidium swartzii AG. in WEST & CARTER, Monogr. Br. Desm., 5, p. 246, pl. 163, f. 5-8, 1923.

Cells 19-20 μ long, 43-44 μ broad, and isthmus 38 μ broad.

Hab. 117. Distr. Cosmopolitan.

Plate 1

1. *Cosmarium speciosum* LUND. p. 30
2. *C. speciosum* var. *rostaffinskii* (GUTW.) W. & G. S. WEST
 forma americana W. & G. S. WEST p. 31
3. *C. boeckii* WILLE p. 15
4. *C. hornavanense* GUTW. var. *dubovianum* (LÜTKEM.) RUZ. p. 23
5. *Closterium striolatum* EHRENB. var. *rectum* W. WEST p. 10
- 6-7. *Cl. elenkinii* KOSSINSKAJA p. 8
8. *Cl. arcuarium* HUGHES p. 6
9. *Cl. pseudolunula* BERGE p. 10
10. *Cl. acerosum* (SCHRANK) EHRENB. var. *porosum* HIRANO, sp. nov. p. 6
 1-4 : × ca. 650; 9 : × 350; 5-8, 10 : × ca. 500

Plate 1

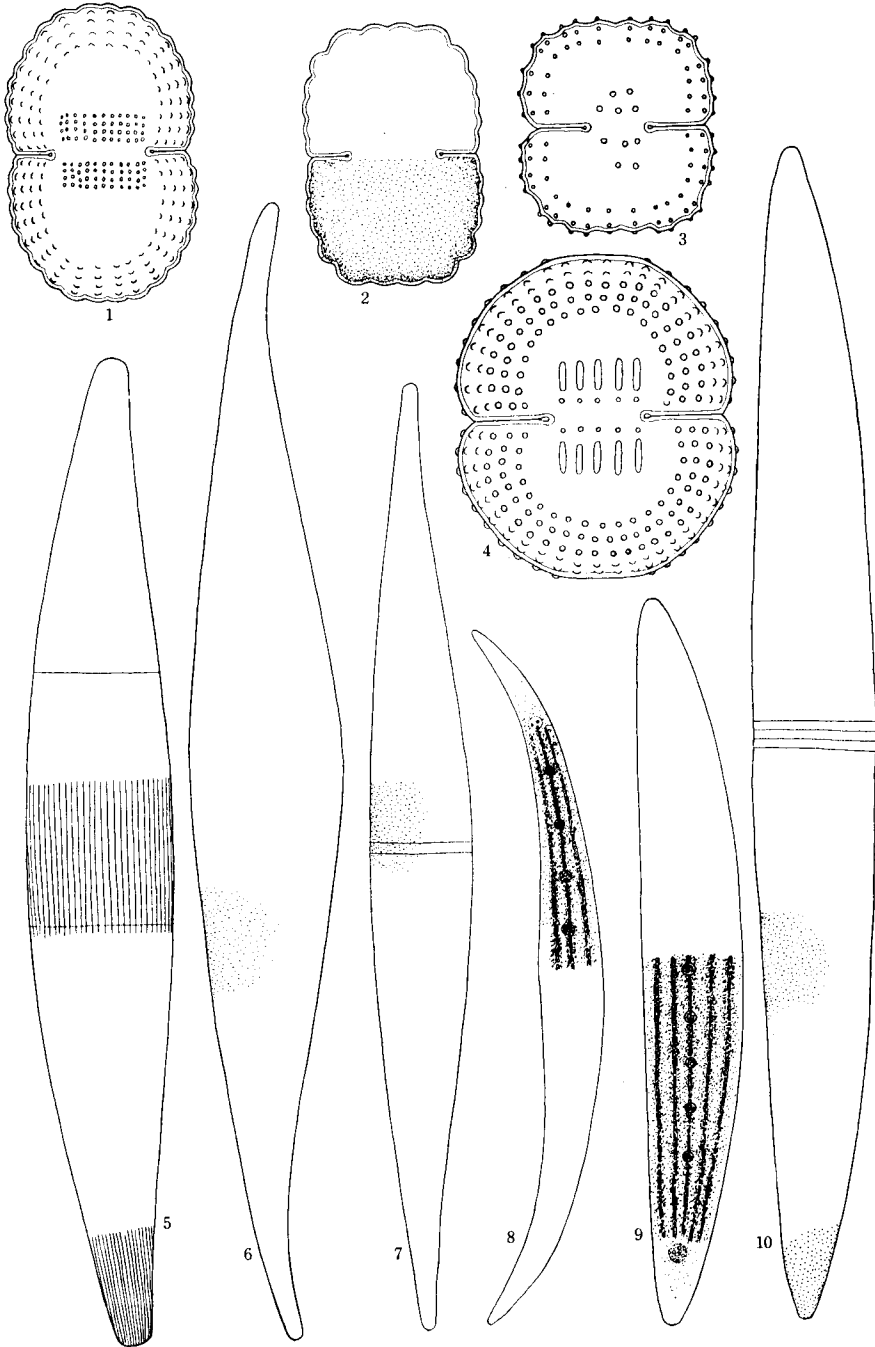


Plate 2

1. *Closterium didymotocum* RALFS p. 8
2. *Cosmarium tetragonum* NÄG. var. *heterocrenatum* W. & G. S. WEST p. 35
3. *Closterium acerosum* (SCHRANK) EHRENB. var. *nasutum* HIRANO, var. nov. p. 6
4. *Cl. costatum* CORDA var. *subcostatum* (NORDST.) KRIEGER p. 7
5. *Pleurotaenium truncatum* (BRÉB.) NÄG. p. 11
6. *Pl. truncatum* var. *crassum* BOLDT p. 11
7. *Cosmarium arctoum* NORDST. p. 13
- 8-9. *Pleurotaenium trabecula* (EHRENB.) NÄG. var. *crassum* WITTR. p. 11
10. *Pl. trabecula* (EHRENB.) NÄG. p. 11
11. *Pl. trabecula* var. *elongatum* CEDERGREN p. 11

1, 3-6, 8-11: \times ca. 500; 2, 7: \times ca. 800

Plate 2

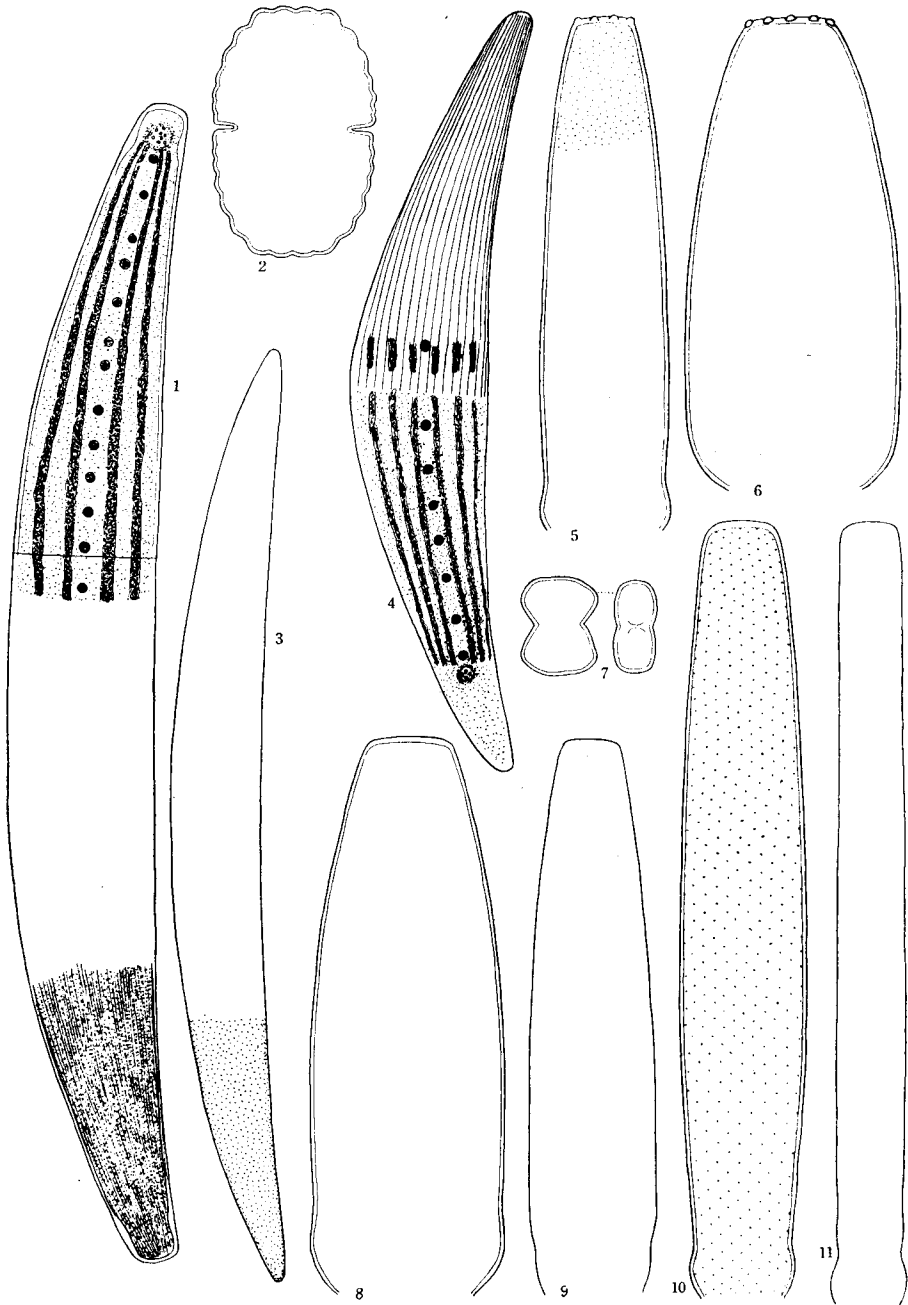


Plate 3

1. *Cosmarium pokornyanum* (GRUN.) W. & G. S. WEST p. 26
2. *C. difficile* LÜTKEM. p. 20
3. *C. phaseolus* BRÉB. var. *elevatum* NORDST. p. 26
- 4-5. *C. tumidum* LUND. p. 35
6. *C. quadratum* RALFS p. 29
7. *C. cucurbitinum* (BISS.) LÜTKEM. forma *minor* (WEST) LÜTKEM. p. 18
8. *C. subglobosum* NORDST. p. 32
9. *C. hammeri* REINSCH var. *homalodermum* (NORDST.) W. & G. S. WEST p. 22
10. *C. microsphinctum* NORDST. p. 25
11. *C. subcucumis* SCHMIDLE p. 32
12. *C. quadratum* RALFS p. 29
13. *C. subcucumis* SCHMIDLE p. 32
14. *C. wollei* (W. & G. S. WEST) GRÖNBLAD p. 37
15. *C. diplosporium* (LUND.) LÜTKEM. var. *americanum* (W. & G. S. WEST)
HIRANO, comb. nov. p. 20
16. *C. debaryi* ARCH. var. *novae-semlicae* WILLE p. 19

1-16 : × ca. 650

Plate 3

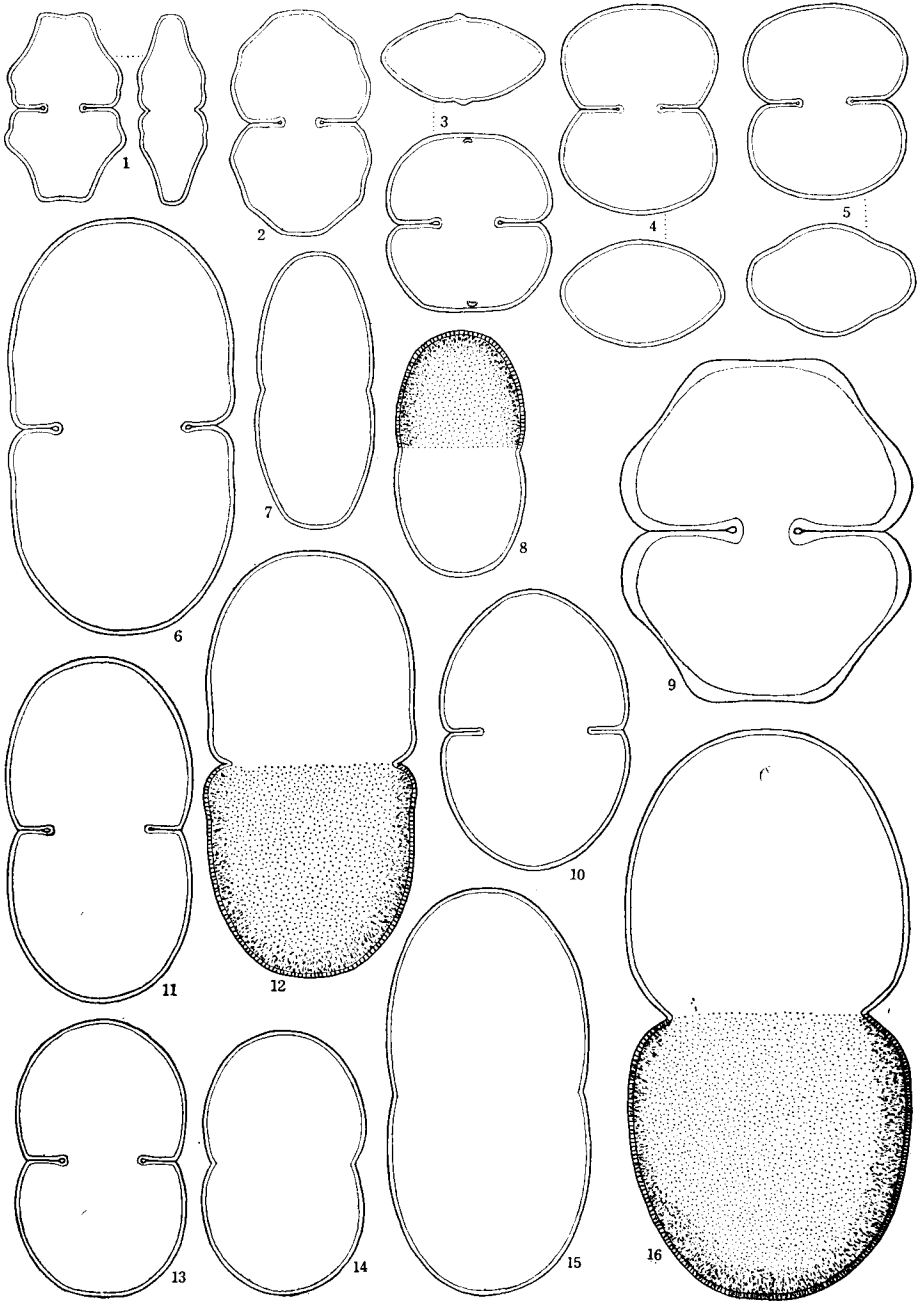


Plate 4

1. *Cosmarium decedens* (REINSCH) RACIB. var. *borgei* KRIEGER p. 19
2. *C. undulatum* CORDA var. *alaskanum* CROASDALE forma *reductum* CROASDALE p. 36
3. *C. difficile* LÜTKEM. var. *sublaeve* LÜTKEM. p. 20
4. *C. quadratum* (GAY) DE TONI p. 29
5. *C. bioculatum* BRÉB. var. *borgei* HIRANO, var. nov. p. 14
6. *C. pseudoprotuberans* KIRCHN. var. *angustius* NORDST. p. 28
7. *C. humile* (GAY) NORDST. var. *striatum* (BOLDT) SCHMIDLE p. 23
8. *C. cymatonotophorum* WEST p. 19
9. *C. pseudoprotuberans* KIRCHN. var. *pygmaeum* GUTW. p. 28
10. *C. borgesinii* GRÖNBLAD p. 15
11. *C. subtumidum* NORDST. var. *rotundum* HIRANO p. 34
12. *C. impressulum* ELFV. p. 23
13. *C. subarctoum* (LAGERH.) RACIB. p. 31
14. *C. cucumis* CORDA p. 18
15. *C. curtum* (BRÉB.) RALFS p. 18
16. *C. pseudonitidulum* NORDST. var. *validum* W. & G. S. WEST p. 27
17. *C. subtumidum* NORDST. var. *gronbladii* CROASDALE p. 34
18. *C. phaseolus* BRÉB. var. *elevatum* NORDST. p. 26
19. *C. subundulatum* WILLE p. 34
20. *C. phaseolus* BRÉB. var. *achondrum* BOLDT p. 26
21. *C. pachydermum* LUND. var. *alaskense* HIRANO, var. nov. p. 25
22. *C. incertum* SCHMIDLE var. *gronlandicum* (BOLDT) GUTW. p. 23

1-22 : × ca. 650

Plate 4

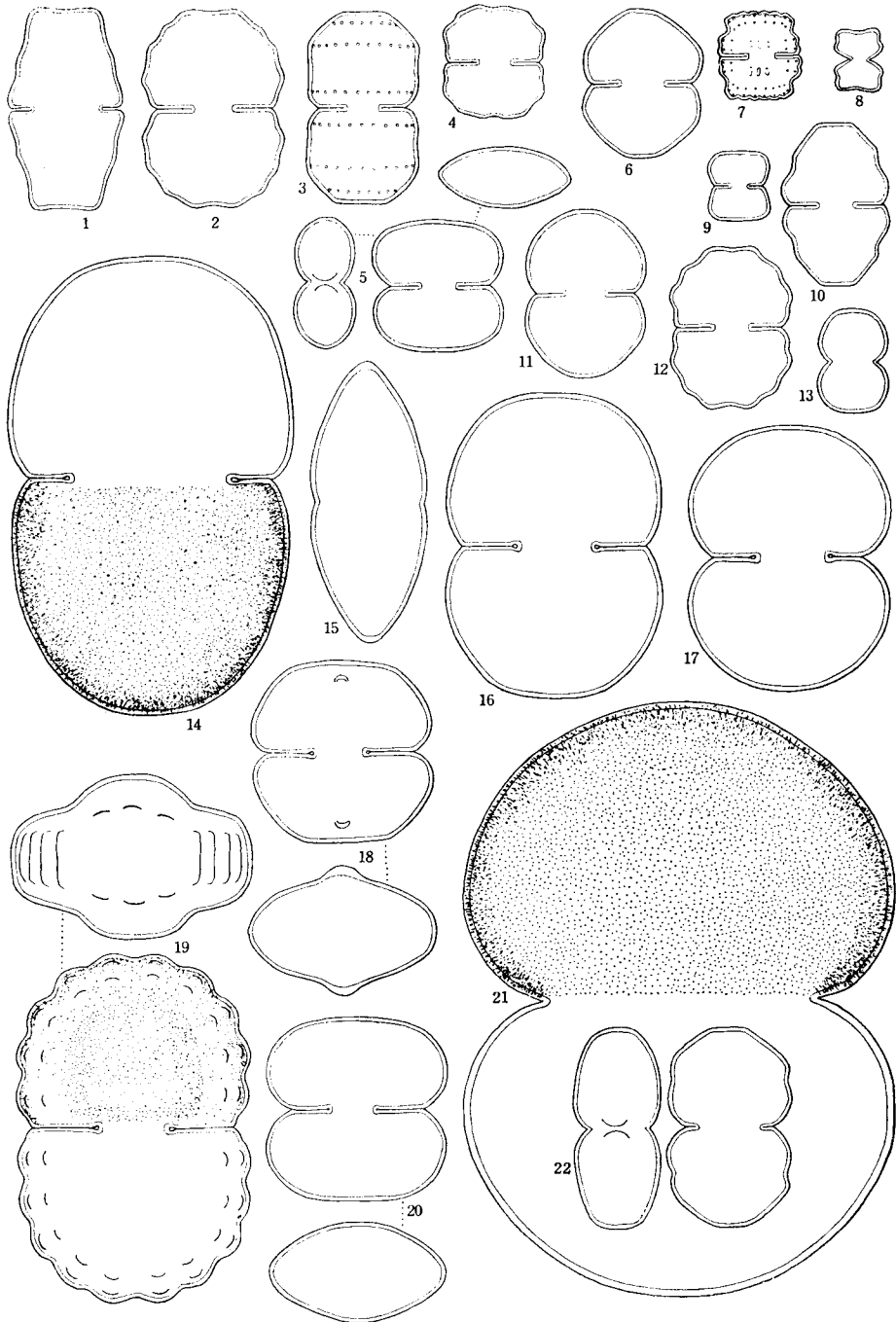


Plate 5

1. *Cosmarium canadense* IRENÉE-MARIE p. 16
2. *C. quadratum* RALFS var. *divergens* HIRANO, var. nov. p. 29
3. *C. granatum* BRÉB. var. *elongatum* NORDST. p. 21
4. *C. curtum* (BRÉB.) RALFS var. *obtusum* (W. & G. S. WEST) HIRANO, comb. nov. p. 18
5. *C. granatum* BRÉB. var. *subgranatum* NORDST. p. 21
6. *C. granatum* BRÉB. p. 21
7. *C. holmiense* LUND. var. *integrum* LUND. p. 22
8. *C. anceps* LUND. forma *subparvula* LARSEN p. 13
9. *C. borgeseni* GRÖNBLAD p. 15
- 10-13. *C. pseudoprotuberans* KIRCHN. forma *minus* KOSSINSKAJA p. 27
14. *C. granatum* BRÉB. var. *concauum* LAGERH. p. 21
15. *C. pseudoprotuberans* KIRCHN. var. *alpinum* RACIB. p. 27
16. *C. pseudoprotuberans* forma *minus* KOSSINSKAJA p. 27
17. *C. anceps* LUND. p. 12
- 18-19. *C. anceps* forma *subparvula* LARSEN p. 13
- 20-21. *C. anceps* forma *crispula* NORDST. p. 13
22. *C. abbreviatum* RACIB. var. *planctonicum* W. & G. S. WEST p. 12
23. *C. simplicius* (W. & G. S. WEST) GRÖNBLAD p. 30
24. *C. speciosissimum* SCHMIDLE p. 30
25. *C. subspeciosum* NORDST. p. 33
26. *C. supraspeciosum* WOLLE p. 34
27. *Arthrodesmus ralfsii* W. WEST p. 37

1-27 : × ca. 650

Plate 5

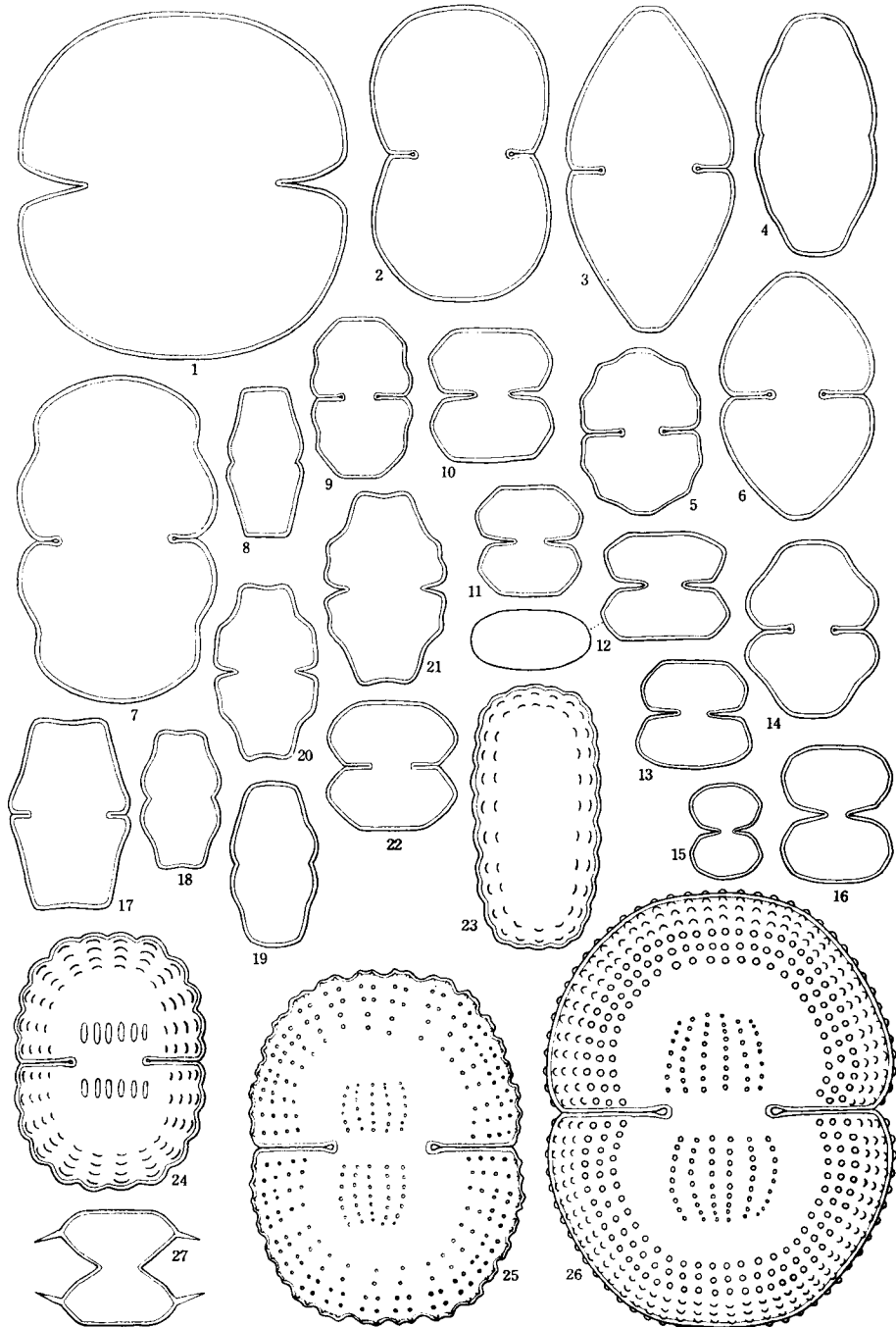


Plate 6

1. *Cosmarium subcostatum* NORDST. p. 31
2. *C. isthmochondrum* NORDST. var. *decussiferum* (BORGE) CROASDALE p. 23
3. *C. subcostatum* NORDST. var. *beckii* (GUTW.) W. & G. S. WEST p. 32
4. *C. protumidum* NORDST. p. 27
5. *C. tatricum* RACIB. forma *minor* MESSIK. p. 35
6. *C. biclavatum* BORGE var. *alaskanum* HIRANO, var. nov. p. 14
7. *C. depressum* (NÄG.) LUND. var. *planctonicum* REV. p. 19
8. *C. conspersum* RALFS var. *latum* (BRÉB.) W. & G. S. WEST p. 16
9. *C. protumidum* NORDST. p. 27
10. *C. kjellmani* WILLE var. *grande* WILLE p. 24
11. *C. subcostatum* NORDST. var. *spetsbergense* BORGE p. 32
12. *C. sexnotatum* GUTW. p. 30
13. *C. botrytis* MENEGH. var. *mesoleium* NORDST. p. 15
14. *C. punctulatum* BRÉB. var. *subpunctulatum* (NORDST.) BÖRGES. p. 28
15. *C. subochthodes* SCHMIDLE var. *scrobiculatum* (MESSIK.) CROAS. p. 33
16. *C. crenatum* RALFS p. 17
17. *C. crenatum* var. *bicrenatum* NORDST. p. 17

1-17 : × ca. 650

Plate 6

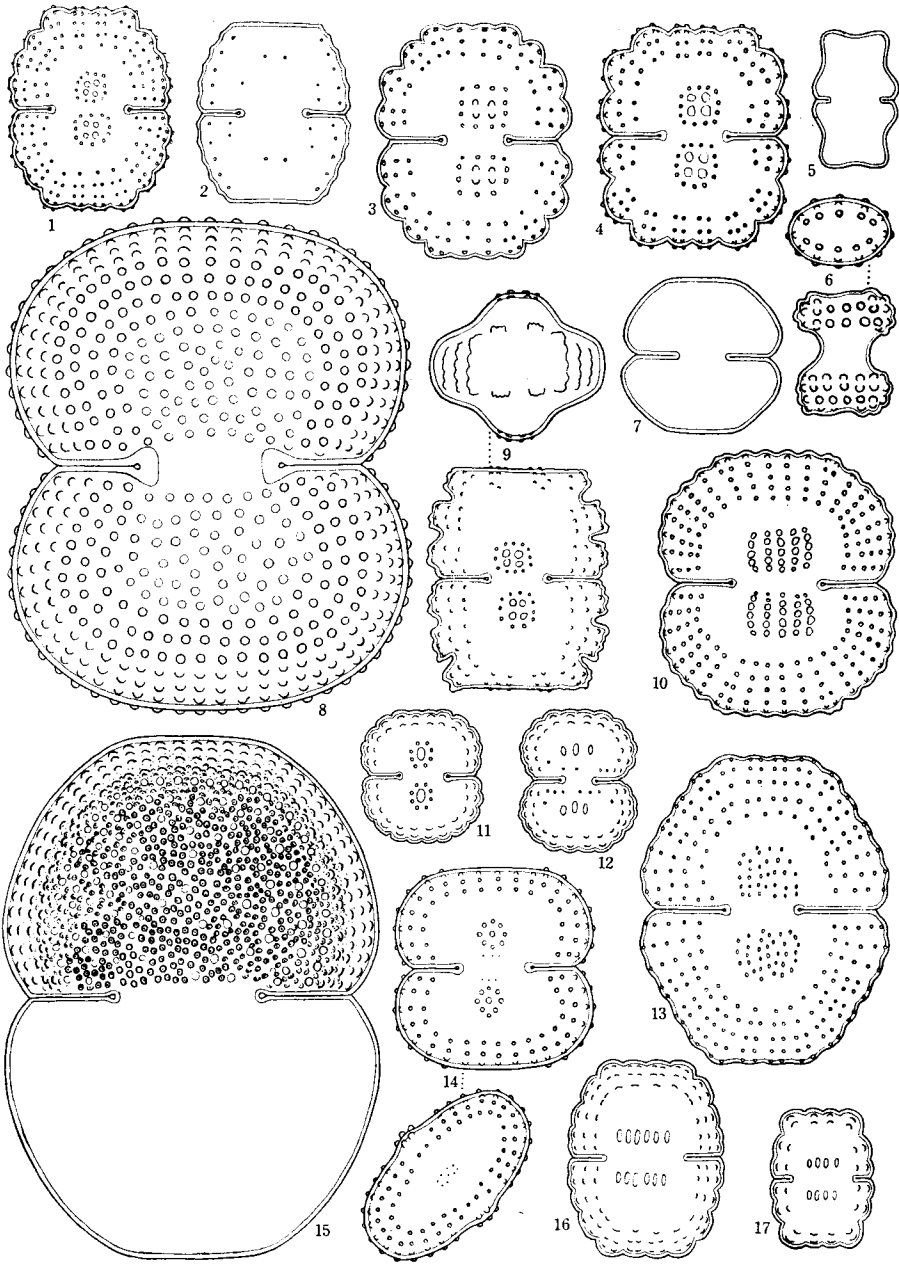


Plate 7

1. *Cosmarium margaritatum* (LUND.) ROY & BISS. var. *rotundatum* HIRANO,
var. nov. p. 24
2. *C. costatum* NORDST. p. 16
3. *C. speciosissimum* SCHMIDLE var. *arcticum* HIRANO, var. nov. p. 30
4. *C. costatum* NORDST. forma *minor* BOLDT p. 17
5. *C. botrytis* MENEGH. p. 15
- 6-7. *C. tuddalense* STRÖM p. 35
8. *C. costatum* NORDST. var. *subhexalobum* BOLDT p. 17

1-8: × ca. 650

Plate 7

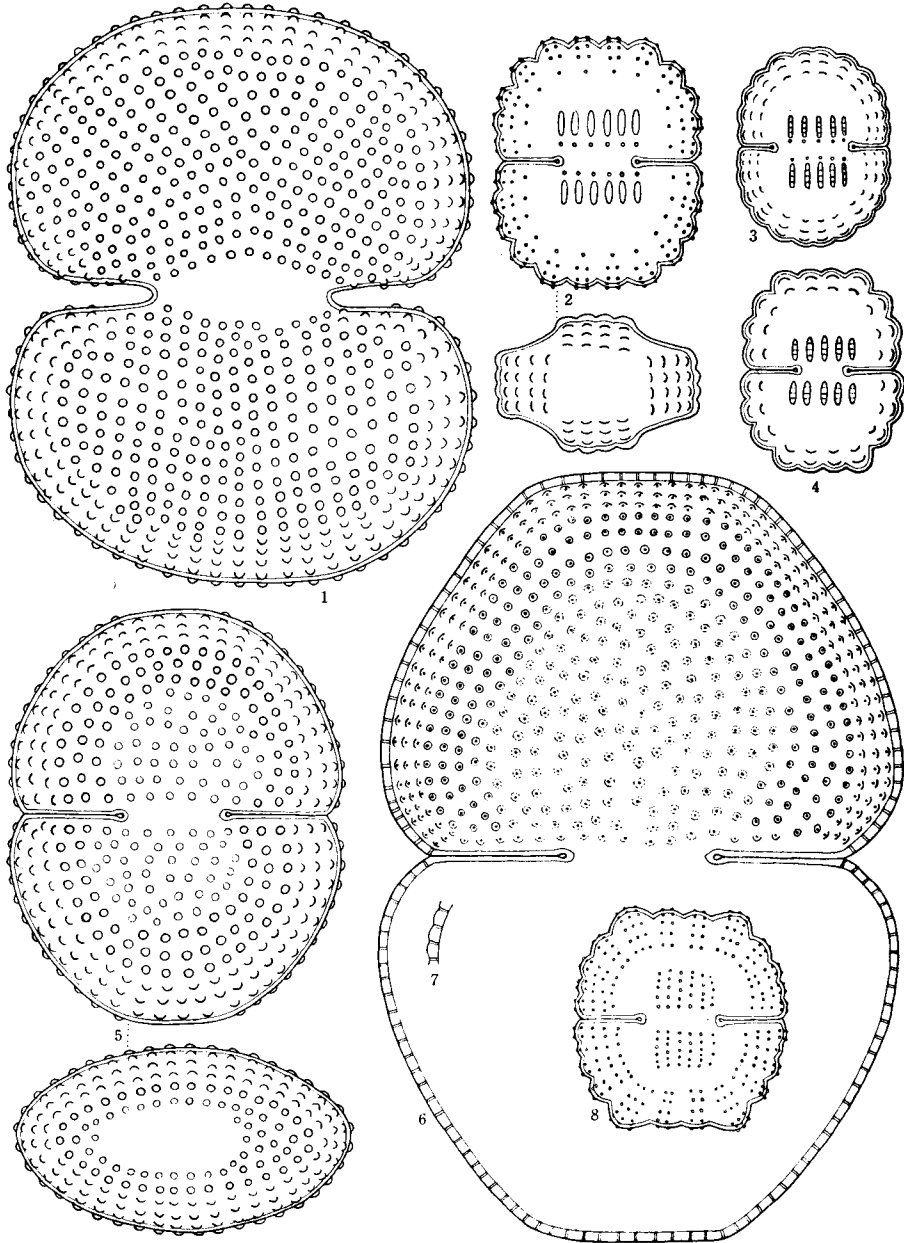


Plate 8

1. *Cosmarium latifrons* LUND. p. 24
2. *C. hians* BERGE p. 22
3. *C. hexalobum* NORDST. var. *laticeps* GRÖNBLAD p. 22
4. *C. woronichinii* KOSSINSKAJA p. 37
5. *C. turpinii* BRÉB. var. *eximium* W. & G. S. WEST p. 36
6. *C. amoeviforme* HIRANO var. *angustatum* HIRANO, var. nov. p. 12
7. *C. amoeviforme* HIRANO, sp. nov. p. 12
8. *C. vexatum* WEST var. *lacustre* MESSIK. p. 37
9. *C. cyclicum* LUND. var. *arcticum* NORDST. p. 18

1-9: × ca. 650

Plate 8

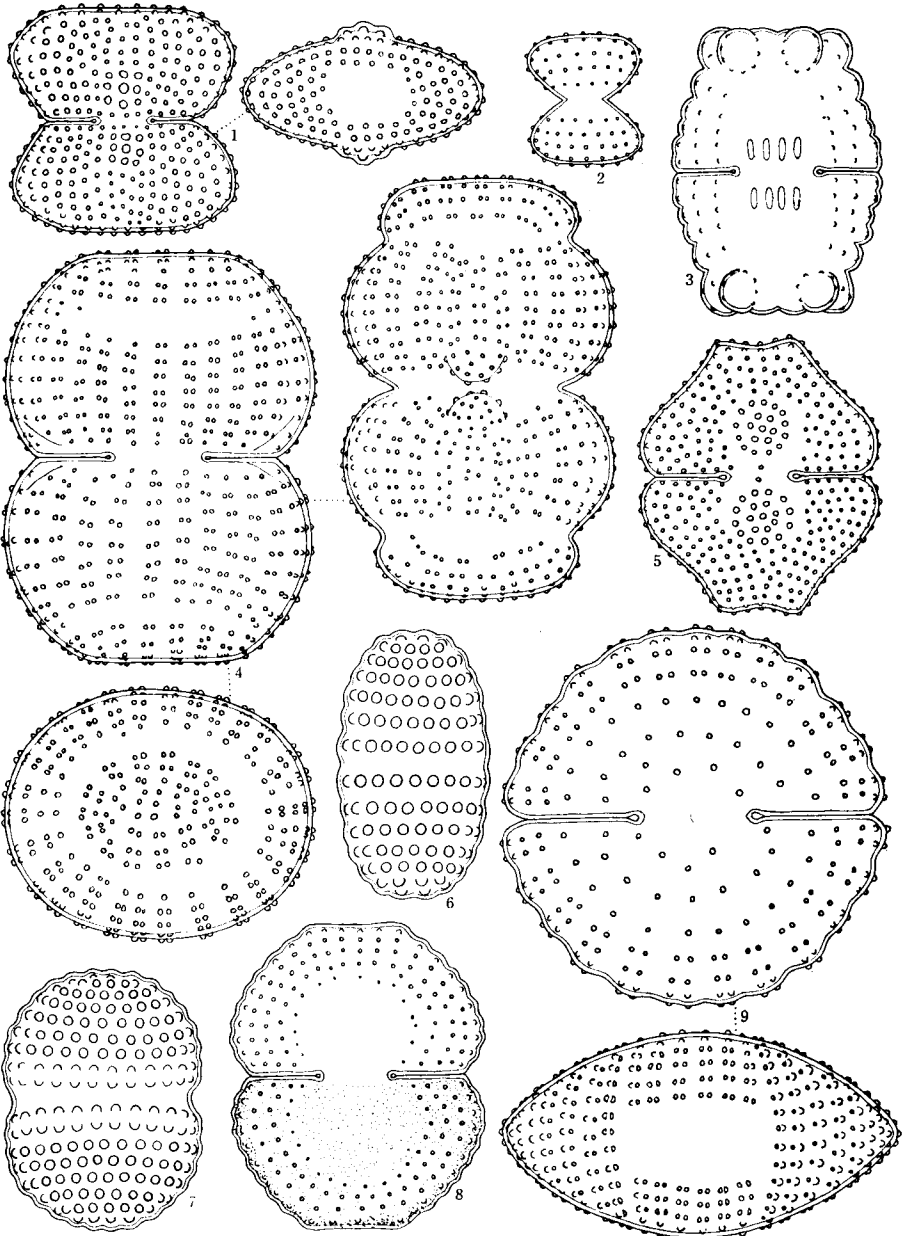


Plate 9

1. *Cosmarium botrytis* MENEGH. var. *tumidum* WOLLE p. 16
2. *C. botrytis* var. *gemmiferum* (BRÉB.) NORDST. p. 15
3. *C. subcrenatum* HANTZ. p. 32
4. *C. praemorsum* BRÉB. p. 26
5. *C. hornavanense* GUTW. forma *arcticum* CROASDALE p. 22
6. *C. formosulum* HOFF. p. 20
7. *C. biretum* BRÉB. var. *minus* HANSG. p. 14
8. *C. subspeciosum* NORDST. var. *transiens* MESSIK. p. 33
9. *C. speciosum* LUND. var. *simplex* NORDST. p. 31
10. *C. hornavanense* GUTW. p. 22
11. *C. subquasillus* BOLDT p. 33

1-11 : × ca. 650

Plate 9

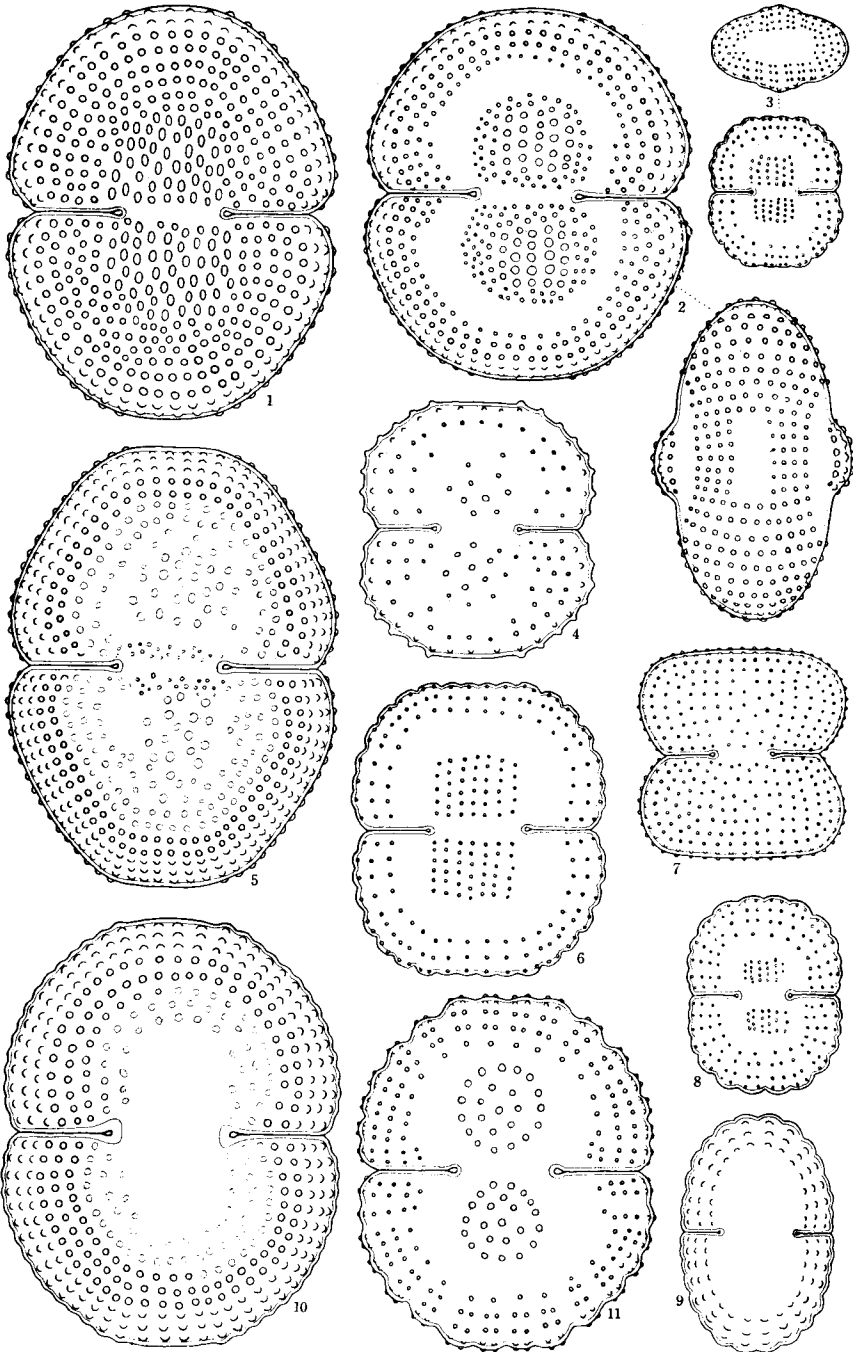


Plate 10

1. *Staurastrum boldtianum* GRÖNBLAD p. 43
- 2-3. *Euastrum subalpinum* MESSIK. p. 41
4. *E. elegans* (BRÉB.) KÜTZ. p. 40
5. *Staurastrum brevispinum* BRÉB. var. *retusum* BORGE p. 44
6. *St. insigne* LUND. p. 46
7. *Euastrum pectinatum* BRÉB. var. *brachylobum* WITTR. p. 41
8. *E. obesum* JOSHUA p. 40
9. *Staurastrum mucronatum* RALFS var. *subtriangulare* W. & G. S. WEST p. 47
10. *St. brevispinum* var. *boldtii* LAGERH. p. 44
11. *Arthrodesmus triangularis* LAGERH. var. *alaskanum* HIRANO, var. nov. p. 38
12. *A. ralfsii* W. WEST var. *brebissonii* (RACIB.) SMITH p. 38
13. *A. incus* (BRÉB.) HASS. var. *borgesenii* MESSIK. p. 37
14. *A. incus* var. *vulgaris* EICHL. & RACIB. forma *recta* EICHL. & RACIB. p. 37
15. *A. ralfsii* W. WEST var. *subhexagonum* (WEST) HIRANO, comb. nov. p. 38
16. *Xanthidium antilopaeum* (BRÉB.) KÜTZ. var. *crameri* GRÖNBLAD p. 38

1-16 : × ca. 700

Plate 10

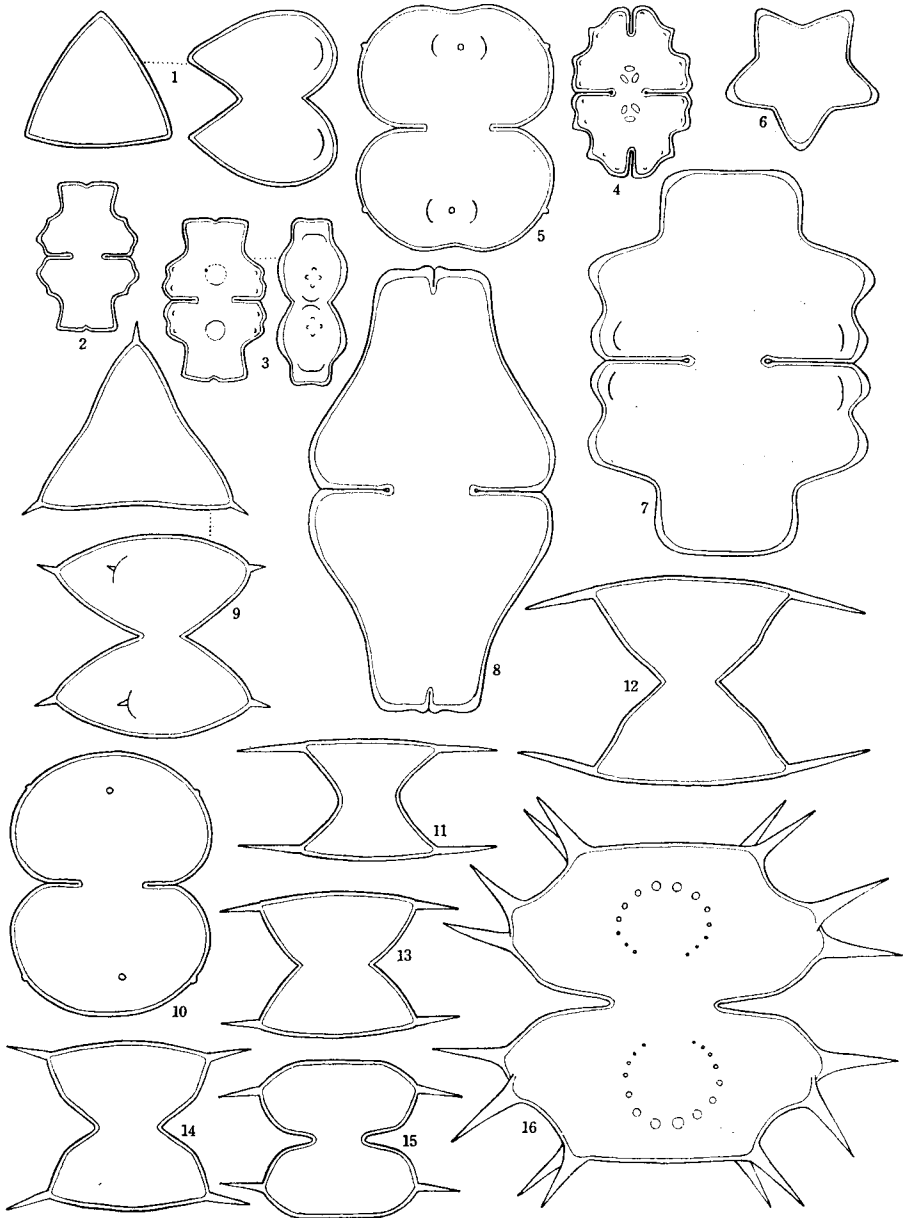


Plate 11

- 1-2. *Euastrum boldtii* SCHMIDLE p. 39
3. *Staurastrum punctulatum* BRÉB. var. *muricatiforme* SCHMIDLE p. 51
4. *St. pachyrhynchum* NORDST. forma *kossinskajae* CROASDALE p. 49
5. *St. pachyrhynchum* NORDST. p. 48
6. *St. capitulum* BRÉB. var. *spetsbergense* (NORDST.) COOKE p. 44
7. *Xanthidium fasciculatum* EHRENB. var. *ornatum* NORDST. p. 39
8. *Staurastrum bieneanum* RABENH. var. *ellipticum* WILLE p. 43
9. *St. granulosum* (EHRENB.) RALFS var. *acutum* (BRÉB.) W & G.S. WEST p. 46
10. *St. lunatum* RALFS p. 46
11. *St. aculeatum* (EHRENB.) MENEGH. var. *ornatum* NORDST. p. 42
12. *St. gronbladii* SKUJA p. 46
13. *St. bieneanum* RABENH. forma *spetsbergensis* NORDST. p. 43

1-13: × ca. 800

Plate 11

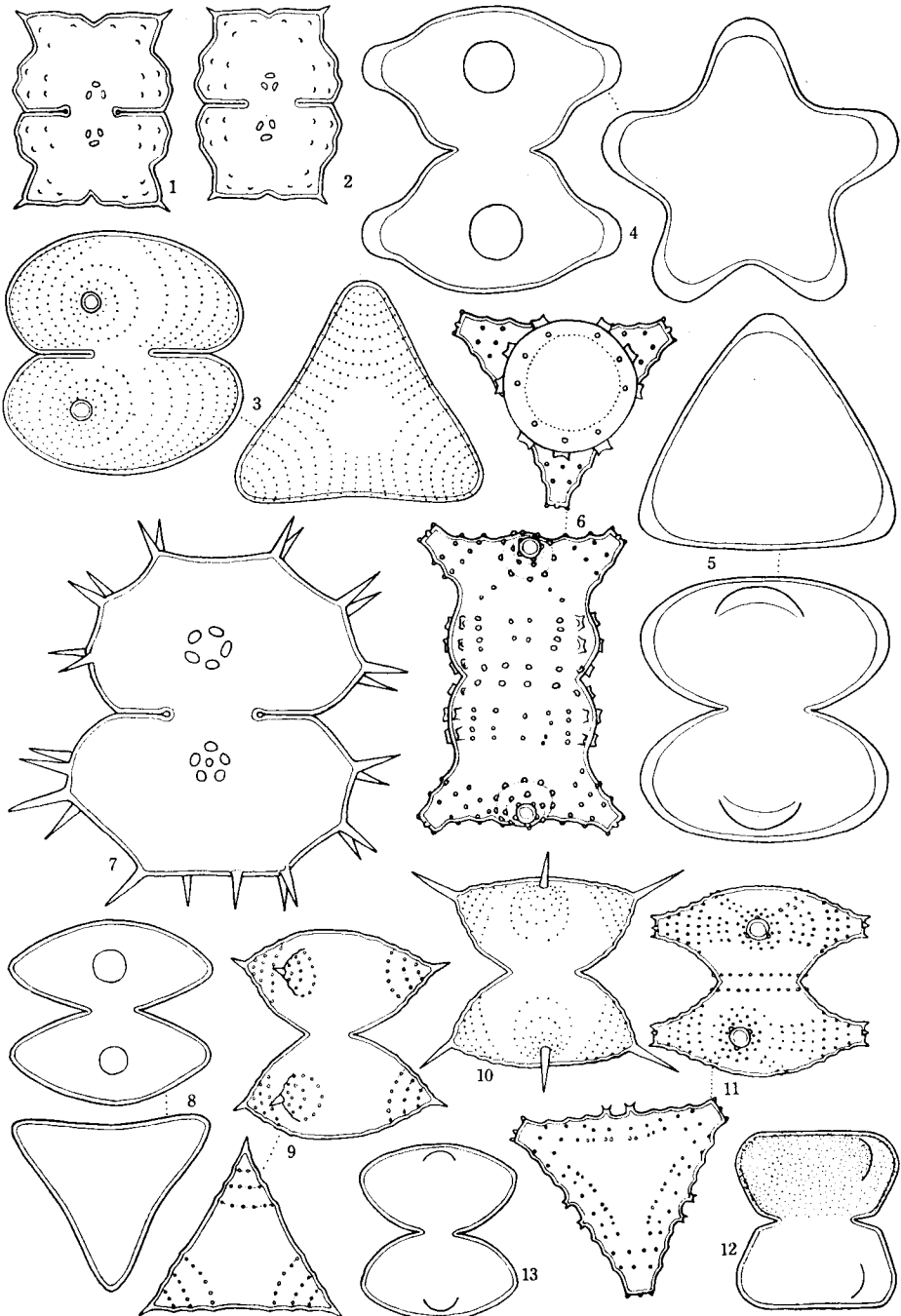


Plate 12

1. *Staurastrum oxyacanthum* ARCH. var. *croasdaleae* HIRANO, var. nov. p. 48
2. *St. lunatum* RALFS var. *planctonicum* W. & G. S. WEST p. 46
3. *St. sibiricum* BORGE p. 51
4. *St. monticulosum* BRÉB. var. *alaskanum* HIRANO, var. nov. p. 47
5. *St. brebissonii* ARCH. p. 44
6. *St. aculeatum* (EHRENB.) MENEGH. var. *ornatum* NORDST. forma *simplex* BOLDT p. 42
- 7-8. *St. borgeanum* SCHMIDLE p. 43
9. *St. petsamoense* (BOLDT) JÄRNEFELT var. *minus* THOMASSON p. 49
10. *St. pendulum* NYGAARD var. *pinguiforme* CROASDALE p. 49

1-12 : × ca. 800

Plate 12

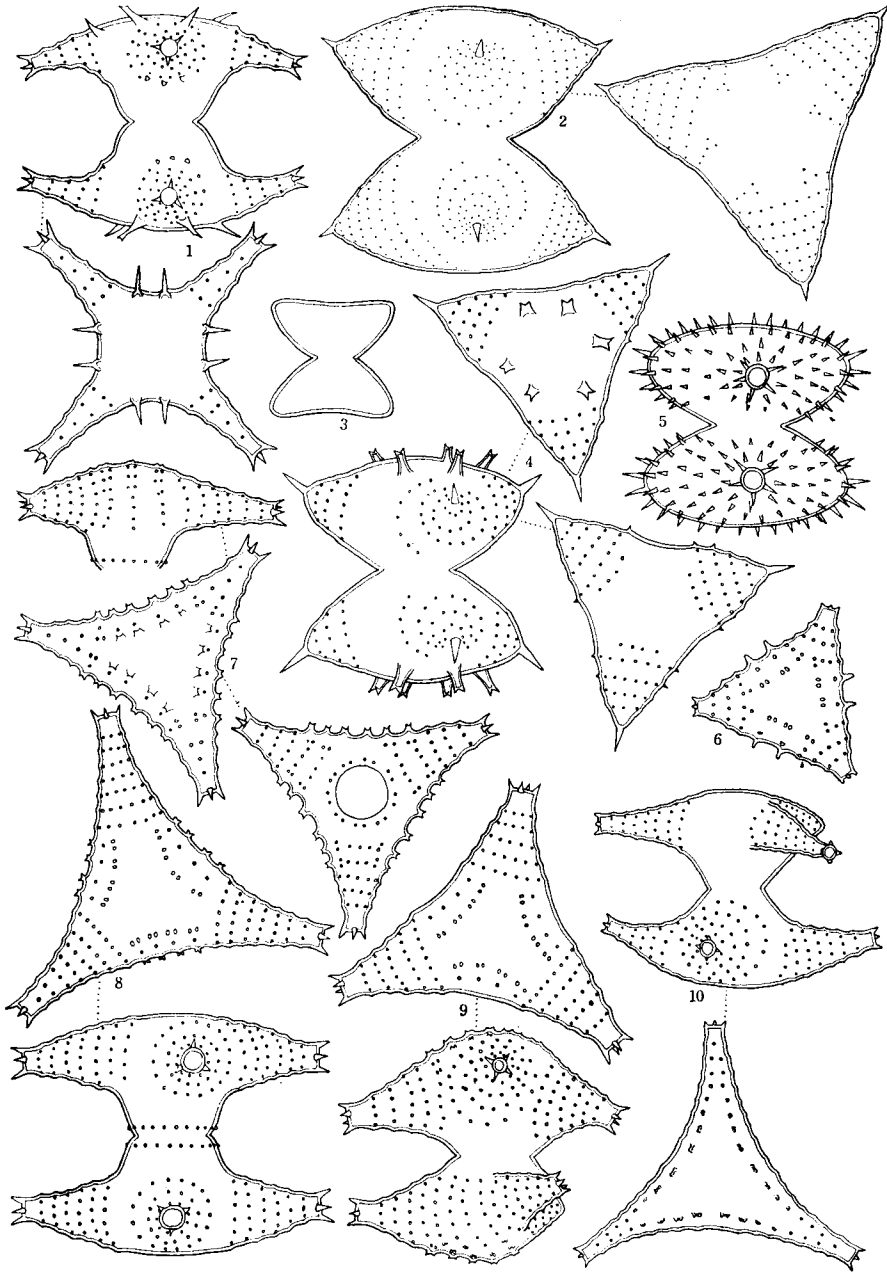


Plate 13

- 1-3. *Staurastrum petsamoense* (BOLDT) JÄRNEFELT p. 49
4. *St. oxyacanthum* ARCH. var. *sibiricum* BOLDT p. 48
5. *St. senarium* (EHRENB.) RALFS var. *nigrae-silvae* SCHMIDLE p. 51
6. *St. petsamoense* (BOLDT) JÄRNEFELT p. 49
7. *St. alternans* BRÉB. var. *basichondrum* SCHMIDLE p. 43
8. *St. borgeanum* SCHMIDLE p. 43
9. *St. petsamoense* (BOLDT) JÄRNEFELT var. *minus* THOMASSON p. 49

1-9 : × ca. 700

Plate 13

