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Desmids from Cambodia, with special reference to Phytoplankton of Lake Grands Lacs (Tonle Sap)

by

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During the winter period of 1969-1970 Kochi University made a scientific investigation for the Mekong Water System of Cambodia, and Dr. Masao OHNO, a member of the investigation party, collected many plankton samples in the Grands Lacs (Tonle Sap) and also collected freshwater algae from the ponds of Angkor Wat. These samples were sent to specialists in various areas of algae research. This writer received for study the phytoplankton of Lake Tonle Sap and some algae from the ponds of Angkor Wat. The results of this study are presented in this paper. The contribution does not include a study of diatoms and of the filamentous green algae in the ponds of Angkor Wat. I am much obliged to Dr. Masao OHNO and the members of the investigation party for giving me this rare opportunity to study these valuable and interesting materials.

Lake Tonle Sap is situated in the centre of Cambodia and is not connected directly to the flowing of the River Mekong. During the rainy season the lake area is enlarged several times more than its area during the dry season, and the lake water is yellowish-brown in colour because of mud sediments; therfore the transparency is low and shows only 33-88 cm. The tables show the place where algae collect in the Lake Tonle Sap and the ponds at Angkor Wat.

The chief members of the phytoplankton species in the Lake Tonle Sap are *Microcystis aeruginosa*, *M. flos-aquae*, *Anabaena circinalis*, *Dinobryon setularia*, *Ceratium hirundinella*, *Pediastrum clathratum*, *Cosmarium contractum* var. *minutum*, *Staurastrum limneticum* var. *burmense*, *St. paradoxum*, *St. subamericanum*, *St. tauphorum*, *St. tohopekaligense*. All of these species are found within the lake area, especially where *Anabaena*, *Pediastrum* and *Staurastrum* are marked. Although the following species are found in less abundance than those mentioned above, they are fully noteworthy. They are *Xanthidium sansibarense* forma *asymmetricum*, *St. freemanii* var. *nudiceps*, *St. leptopus* var. *variabile*, *St. protectum* var. *rangoonense*, and *St. wildemani*. The phytoplankton flora of the Lake Tonle Sap consists of many species and contains various kinds of algal-groups. The flora is particularly characteristic of the rich desmid-planktons; these desmid-planktons have been discovered in surrounding districts such as Sunda Islands, Burma, Ceylon. They even contain species found in E. Africa and Madagascar.

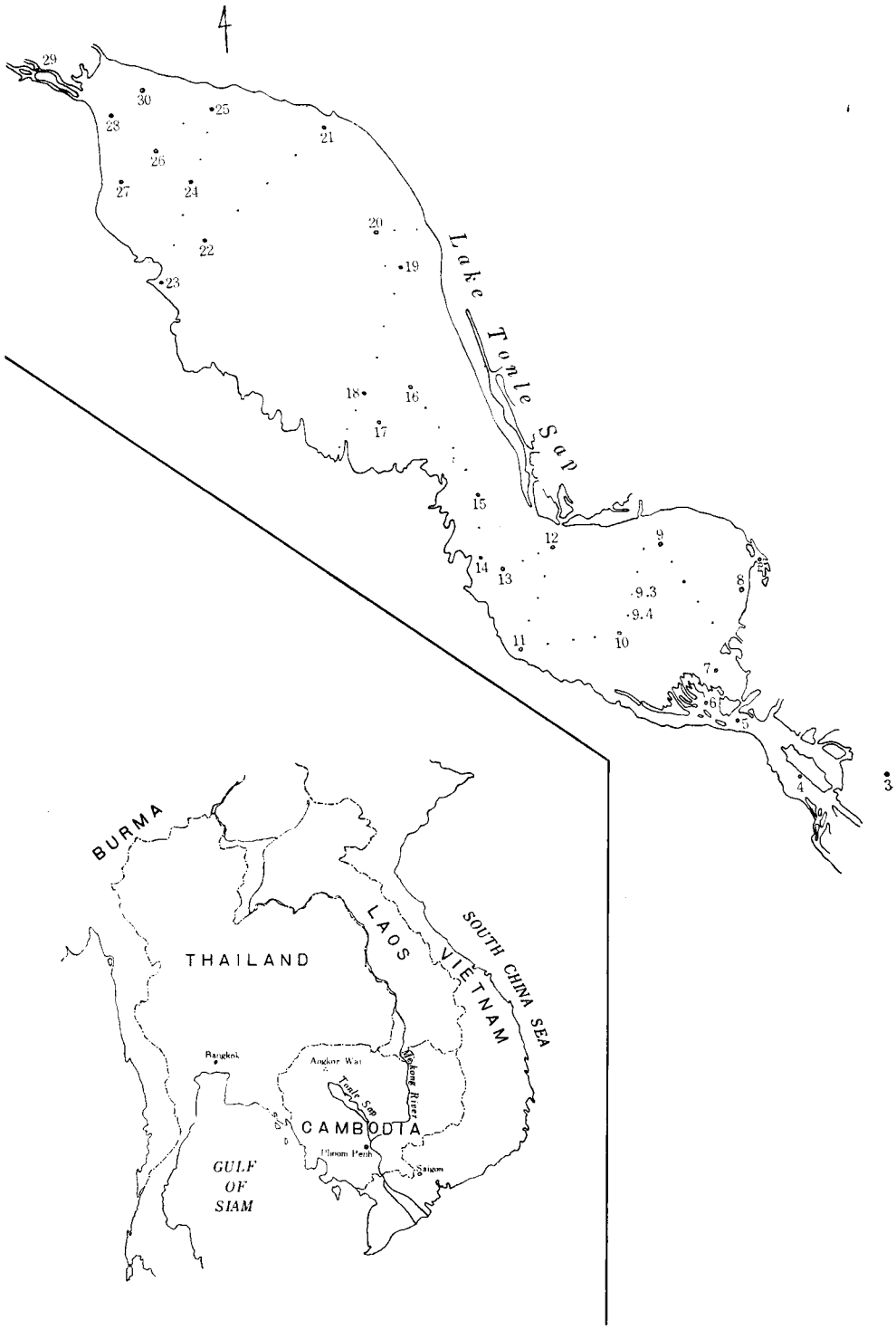
The freshwater algae in the ponds of Angkor Wat are rich in desmids, especially

those found in the collection obtained from the pond marked Anc. 4; however, the collections from others are in general poor in desmids.

Station	Locality	Date	Time	Depth (bottom) m	Sampling depth m	Air temperature °C	Water temperature °C	pH
C. P. 1	Peam Chhok	XII-27	17 : 30	—	0	—	—	6.5
3	Koh Tasok	XII-28	17 : 07	—	0	28.0	26.5	6.5(1) 6.6(2)
4	Vaal Phok (Prek Taphauk)	XII-29	11 : 00	4.5	0	26.5	26.7	7.3(1) 7.3(2)
5	Phat Sanday (Peam)	XII-29	9 : 45	4.0	0	25.8	26.0	7.2(1) 7.2(2)
6	Prek Tasom	XII-29	8 : 15	7	0	23.5	26.3	6.8(1) 6.75(2)
7		XII-30	9 : 00	3.8	0	24.8	26.5	7.5(1) 7.2(2)
8	Psaurt	XII-30	10 : 45	3.6	0	26.8	27.0	6.8(1) 6.8(2)
9	Balat	XII-30	12 : 15	4.15	0	26.9	28.1	7.3(1) 7.3(2)
9.3		XII-30	14 : 55	—	0	28.8	27.8	7.5(1) 7.4(2)
9.4		XII-30	15 : 10	—	0	29.3	28.1	7.4(1) 7.5(2)
10		XII-30	15 : 25	4.2	0	29.4	28.8	7.7(3)
11	Kg Luong	XII-31	8 : 15	3.7	0	23.5	25.8	7.2(2)
12	Peam Bang	XII-31	9 : 25	4.1	0	23.0	26.0	7.3(2) 7.2(3)
13	Reserve Tuol Veng	XII-31	11 : 06	4.35	0	26.3	26.5	7.4(2) 7.5(3)
14	Peam Stung	XII-31	14 : 30	3.6	0	29.0	28.5	7.4(2) 7.5(3)
15	Reserve Koh Kaek	XII-31	16 : 00	4.30	0	27.5	27.8	7.6(3)
16	Between Reserve Raing Til & Moat Khla	XII-31	17 : 25	4.0	0	27.8	27.5	7.4(2) 7.4(3)
17	Reserve Raing Til (South Centre)	XII-31	17 : 45	4.0	0	27.2	27.3	7.4(2) 7.5(3)
		(1970)						
18	Reserve Raing Til (North Centre)	I-1	9 : 10	4.30	0	23.5	25.5	7.4(2) 7.4(3)
19	7 Km East of Reserve Kg Khlaing	I-1	10 : 20	4.2	0	24.0	26.5	7.1(2) 7.2(3)
20	Centre of Reserve Kg Khlaing	I-1	11 : 15	4.5	0	25.5	26.2	7.4(2) 7.2(3)
21	Kg Phlok	I-2	16 : 45	3.9	0	28.2	27.3	6.8(2) 6.8(3)
22	Reserve Koh Thom (Centre north)	I-2	15 : 05	4.1	0	27.2	30.0	7.4(2) 7.4(3)
23		I-2	12 : 00	3.3	0	28.5	28.5	6.9(2) 6.8(3)

Station	Locality	Date	Time	Depth (bottom) m	Sampling depth m	Air temperature °C	Water temperature °C	pH
24	Between Phnom Krom & Kbal Tol	I-2	11 : 00	4.0	0	27.0	26.8	7.4(2) 7.3(3)
25	Phnom Krom	I-2	10 : 00	3.6	0	24.3	27.2	6.4(2)
26	Between Phnom Krom & Paok Kantel	I-5	11 : 00	3.8	0	28.0	26.2	6.9(2)
27	Peak Kantel	I-5	11 : 45	3.5	0	26.0	26.5	6.8(2)
28	Prak Toal	I-5	12 : 30	3.1	0	28.0	26.3	6.5(2)
29	Kg Prahoe (River)	I-5	15 : 40	4.0	0	27.0	26.8	6.6(2)
B. A. 1	Neng Amsorng (Mekong River)	I-6	16 : 55	2.8	0	30.5	28.3	7.6(3)
B. A. 2	Beng Ansorng Chhoung Kon Trey	I-6	17 : 25	2.8	0	29.0	28.0	7.6(3)
B. A. 3	Beng Ansorng Chhoung Toal	I-6	17 : 45	3.1	0	27.0	27.0	7.4(3)
P. C	Peam Chikung	I-7	10 : 50	4.8	0	28.0	27.3	6.6(2)
M.R.1.M	Koh Chrouk	I-7	16 : 30	6.0	0	26.5	25.5	8.0(3)
M.R.2.M	Chruoy Khmar	I-8	9 : 10	—	0	26.9	25.5	7.8(3)
M 5 R	Chok Touk	I-16	13 : 23			33	27.0	7.3

Limnological and Sedimentological Data of the Grands Lacs (Tonle Sap) and the Mekong River (Dec. 1969–Jan. 1970)


Lake Tonle Sap
BURMA
THAILAND
LAOS
VIETNAM
SOUTH CHINA SEA
CAMBODIA
GULF OF SIAM
Bangkok
Angkor Wat
Tonle Sap
Mekong River
Phnom Penh
Saigon

CONJUGATAE

Gonatozygaceae

Gonatozygon monotaenium De BARY in W. & G. S. WEST, Monogr. Brit. Desm. **1**, p. 30, pl. 1, f. 1-7, pl. 5, f. 5, 1904; HIRANO, Contr. Biol. Lab. Kyoto Univ. **1**, p. 22, pl. 1, f. 1, 1955.

Length of cells 123-145 μ, breadth 6.5-8 μ, and breadth of apices 7-8.8 μ.

Hab. 1, 13. Distr. India, Ceylon, Thailand, Java, Sumatra, Japan, Europe, Africa, and N. America.

Mesotaeniacae

Cylindrocystis Brebissonii MENEGH. in WEST, l. c. **1**, p. 58, pl. 4, f. 23-32, 1904; KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 207, pl. 6, f. 4-7, 1933.

Cells 54-77 μ long and 19-21 μ broad.

Hab. Anc. 3. Distr. Cosmopolitan.

Netrium digitus (EHRENB.) ITZIG. & ROTHE in WEST, l. c. **1**, p. 64, pl. 6, f. 14-16, 1904; KRIEGER, l. c. p. 214, pl. 7, f. 1, pl. 8, f. 1, 1933.

Hab. Anc. 4. Distr. Cosmopolitan.

Desmidiaceae

Closterium abruptum W. WEST in WEST, l. c. **1**, p. 158, pl. 20, f. 6-10, 1904; KRIEGER, l. c. p. 306, pl. 21, f. 9, pl. 22, f. 5-7, 1935.

Cells 134-152 μ long and 17-18 μ broad.

Hab. Anc. 4. Distr. India, Japan, Manchuria, Europe, N. America, and Brazil.

Closterium acerosum (SCHRANK) EHRENB. in WEST, l. c. **1**, p. 146, pl. 18, f. 2-5, 1904; KRIEGER, l. c. p. 314, pl. 24, f. 1, 1935.

Cells of the present specimens slightly curved, inner margin almost straight, outer margin slightly convex, gradually narrowed toward the apices which are truncated and with round angles; chloroplast with 10-11 pyrenoids at each half cell and 5 ridges visible across the cell. Cells 286-500 μ long and 31-39.5 μ broad.

Hab. 6, MR5. Distr. Cosmopolitan.

Closterium cornu EHRENB. var. ***javanicum*** GUTW. in Bull. Intern. Acad. Cracov. no. **9**, p. 582, pl. 36, f. 11, 1902; KRIEGER, l. c. p. 270, pl. 15, f. 11, 1935; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 10, pl. 2, f. 18, 1961.

Cells elongated, almost straight in the middle but slightly curved near the apex, about 30-31 times longer than broad, inner margin almost straight and not concave, apices obtusely rounded. Cells 157-165 μ long and 5-5.4 μ broad. The present specimens coincide with the description of var. *javanicum* except the former not having a concave inner margin.

Hab. 11. Distr. Java, Sumatra, Bali, and Thailand.

Closterium dianae EHRENB. in. WEST, l. c. **1**, p. 130, pl. 15, f. 1-6, 1904; KRIEGER, l. c. p. 294, pl. 19, f. 9-11, pl. 20, f. 1, 1935.

Cells 176-220 μ long and 17-20 μ broad.

Hab. 1, Anc. 4. Rare in plankton samples. Distr. Cosmopolitan.

Closterium Johnsonii W. & G. S. WEST in KRIEGER, l. c. p. 309, pl. 23, f. 3, 1935.

The cells of the present specimens elongated and slightly curved, about 17-30 times longer than broad, gradually attenuated toward the apices which are broad and truncately rounded, inner margin scarcely concave and not tumid in the middle; chloroplast with 3 ridges visible across the cell and contained about 10-12 pyrenoids in each semicell. Cells 340-513 μ long and 17.5-20 μ broad.

Hab. 11, 25. Distr. U. S. A.

Closterium juncidum RALFS var. ***elongatum*** ROY & BISS. in KRIEGER, l. c. p. 335, pl. 28, f. 4, 1935.

Cells 456-475 μ long and 11-11.5 μ broad.

Hab. Anc. 4. Distr. Java, Europe, and U. S. A.

Closterium Kutzingii BRÉB, in WEST, l. c. **1**, p. 186, pl. 25, f. 6-11, 1904; KRIEGER, l. c. p. 351, pl. 32, f. 8, 9, 1935.

Cells 500-524 μ long and 15.5-16 μ broad.

Hab. 11. Distr. Cosmopolitan.

Closterium lagoense NORDST. in KRIEGER, l. c. p. 371, pl. 37, f. 5, 6, 1935.

var. ***brevius*** HIRANO, var. nov.

Cellulae breviores et robustiores quam in forma typica, circiter 5-plo longiores quam latiores, gradatim attenuatae ad polos, non tumidae in medio, polis conicis et extremitatibus leviter rotundis, marginibus ventralibus paene rectis, marginibus dorsalibus valide convexis; membrana striata; cellulae 162-176μ longae et 36-37μ latae. Pl. 6. f. 1.

Hab. Anc. 4.

Closterium lanceolatum KÜTZ. in WEST, l. c. **1**, p. 149, pl. 17, f. 9, 10, 1904; KRIEGER, l. c. p. 319, pl. 24, f. 9, 10, 1935.

Cells large and robust, slightly curved, ventral margin slightly concave and dorsal margin convex, gradually attenuated toward the apices which are broad and rounded;

cell wall smooth. Cells 335-393μ long and 46-48μ broad.

Hab. Anc. 11. Distr. Cosmopolitan.

The present specimens similar to *Cl. spetsbergense* var. *laticeps* GRÖNBLAD reported from N. Europe but the breadth of cell is somewhat larger than that of the GRÖNBLAD's form.

Closterium libellula FOCKE var. ***intermedium*** (ROY & BISS.) G. S. WEST in KRIEGER, l. c. p. 255, pl. 12, f. 3-5. 1935.

Cells 75-78μ long and 17.5μ broad.

Hab. Anc. 3, Anc. 4. Distr. Cosmopolitan.

Closterium nematodes JOSHUA in KRIEGER, l. c. p. 370, pl. 37, f. 1, 2, 1935.

var. ***robustum*** HIRANO, var. nov.

Cellulae maiores et robustiores quam in forma typica, circiter 8-9 longiores quam latiores, marginibus ventralibus leviter concavis, marginibus dorsalibus valde convexis, gradatim attenuatae ad polos, polis rotundatis sed prope apicem dilatatis; membrana distincte striata cum sutura mediana; cellulis 350-357μ longis et 39.5-40μ latis. Pl. 6, f. 2.

Hab. Anc. 4.

Closterium parvulum NÄG. var. ***angustum*** W. & G. S. WEST in Monogr. **1**, p. 134, pl. 15, f. 13, 14, 1904; KRIEGER, l. c. p. 277, pl. 16, f. 20, 21, 1935.

Cells strongly curved, narrow, about 14 times longer than broad, median part not tumid, ends acute; chloroplast with 4 pyrenoids in each semicell and two ridges visible across the cell. Cells 92-96μ long and 6.5μ broad. Pl. 5, f. 1.

Hab. Kg Lu 2, Distr. Europe and S. America.

Closterium pusillum HANTZSCH var. ***monolithum*** WITTR. in KRIEGER, l. c. p. 281, pl. 14, f. 9, 1935.

Cells small, about 4 times longer than broad, ends broad and rounded, inner margin almost straight, outer margin convex; cell wall smooth. Cells 50-51μ long, 13μ broad. Pl. 5, f. 2.

Hab. Anc. 3. Distr. Europe and W. Africa.

The present specimens have a somewhat broader cell than those of the African form reported first by WEST as a var. *subrectum.*

Closterium Ralfsii BRÉB. var. ***gracilius*** (MASKELL) KRIEGER in Krypt. Fl. **13**, Abt. 1, p. 346, pl. 31, f. 6, 1935.

Cells about 10 times longer than broad, median part slightly tumid, inner margin almost straight or very slightly convex, gradually attenuated to the apices which are obliquely truncate. Cell wall delicately striated and with median suture. Length of cell 202μ and breadth 17.5μ. The present specimens resemble *Cl. strigosum* BRÉB. var. *elegans* (G. S. WEST) KRIEGER in the shape of cell but differ from it in the obliquely

truncated apex, while the apex of var. *elegans* is obtusely rounded.

Hab. Anc. 1. Distr. Burma, Australia, and Europe.

var. ***hybridum*** RABENH. in WEST, l. c. **1**, p. 183, pl. 24, f. 8-13, 1904; KRIEGER, l. c. p. 347, pl. 31, f. 4, 5, 1935.

Cells large and slightly curved, slightly tumid in the middle, gradually attenuated toward the apices which are obliquely truncate and rounded; cell wall yellowish and finely striated. Cells 735-742μ long and 40μ broad.

Hab. Anc. 4. Distr. Cosmopolitan.

Closterium setaceum EHRENB. in WEST, l. c. **1**, p. 190, pl. 26, f. 9-13, 1904; KRIEGER, l. c. p. 356, pl. 33, f. 8-10, 1935.

Cells 460-484μ long and 17-18μ broad.

Hab. 25. Distr. Cosmopolitan.

Closterium striolatum EHRENB. var. ***Borgei*** (BORGE) KRIEGER in l. c. p. 339, pl. 28, f. 11, 1935.

Cells moderately curved, not tumid in the middle, inner margin scarcely concave and outer margin strongly convex, apex obliquely truncate. Cells 184-190μ long and 22-24 μ broad.

Hab. Anc. 1, Anc. 2. Distr. Europe, U. S. A., and Brazil.

Closterium toxon W. WEST in Monogr. **1**, p. 160, pl. 20, f. 13, 14, 1904; KRIEGER, l. c. p. 310, pl. 23, f. 4, 5, 1935.

Cells not tumid in the middle, and not parallel in the middle, inner margin almost straight, outer margin slightly convex, slightly curved, ends fairly broad and rounded, cells about 19 times longer than broad. Cells 210-225μ long and 11-11.4μ broad.

Hab. 1. Distr. Singapore, Japan, Europe, and U. S. A.

Closterium tumidum JOHNSON var. ***nylandicum*** GRÖNBLAD in KRIEGER, l. c. p. 268, pl. 14, f. 12-16, 1935.

Cells slightly curved, almost straight in inner margin but slightly convex in the outer margin, gradually attenuated towards the ends which are obtuse and rounded, chloroplasts with 4 pyrenoids in half cell and with 3 ridges visible across the cell. Cells 95-98μ long and 8.5-9μ broad.

Hab. 1. Distr. Europe, Spitzbergen, N. America, and Brazil.

Closterium venus KÜTZ. in WEST, l. c. p. 137, pl. 15, f. 15-20, 1904; KRIEGER, l. c. p. 272, pl. 16, f. 1-5, 1935.

Cells 6 times longer than broad, strongly curved, not tumid in the middle, ends acute. Cells 50-52μ long and 8μ broad.

Hab. 1, Kg Lu 2. Distr. Cosmopolitan.

Pleurotaenium burmense (JOSHUA) KRIEGER in Krypt. Fl. **13**, Abt. 1, p. 416, pl. 45, f. 4, 1937.

Cells 984-1162μ long, 56-57μ broad, and apices 46-47μ broad.

Hab. Anc. 4. Distr. Burma and Australia.

Pleurotaenium Ehrenbergii (BRÉB.) De BARY var. ***crenulatum*** (EHRENB.) KRIEGER in l. c. p. 413, pl. 43, f. 6, 1937.

Cells slightly broader than those of the typical form, lateral margin slightly convex, without inflation above the basal inflation, gradually attenuated towards the apices. Cells 560-572μ long, 43-44μ broad, and apices 30.5-31μ broad.

Hab. Anc. 4. Distr. Japan, Australia, and S. America.

Pleurotaenium elatum (TURNER) BORGE in KRIEGER, Arch. Hydrobiol. Suppl. **11**, p. 166, pl. 7, f. 6, 1932; Krypt. Fl. **13**, Abt. 1, p. 425, pl. 46, f. 3, 1937.

var. ***undulatum*** HIRANO, var. nov.

Cellulae submagnae, cylindricae, circiter 12 duplo longiores quam latiores; semicellulae non attenuatae ad apicem, cum inflatione prominenti basali et saepe subundulis multis parvis supra basim, apicibus truncatis cum annulis tuberculis, 518-544μ longae et 44-48μ latae.

Hab. Anc. 4. Pl. 1, f. 5, 6.

The typical form was described from India by TURNER under the name of *Docidium elatum*. He also reported *Docidium robustum* at the time although both species resemble each other except in the dimension of cell. The present specimens coincide well with the Japanese form reported as *Pl. elatum*. The similar form was reported from Sunda-Islands by KRIEGER, but the lateral undulation of his form is few in number and each undulation is larger than that of the present specimens. So that I propose that the present form be separated from the typical one as a new variety.

Pleurotaenium eugeneum (TURNER) W. & G. S. WEST in l. c. **1**, p. 202, 1904; KRIEGER, l. c. p. 417, pl. 44, f. 4, 5, 1935.

Cells fairly large, about 13-14 times longer than broad, semicells gradually attenuated towards the apices which are truncate and furnished with a crown of flat tubercles, with a distinct basal inflation, lateral margin straight and not undulate in my present specimens. Cells 675-692μ long and 50-52μ broad, and apices 37.6-38μ broad. Pl. 1, f. 4.

Hab. Anc. 4. Distr. India, Ceylon, Singapore, China, Africa, U.S.A., and Columbia.

Pleurotaenium excelsum (TURNER) GUTW. in KRIEGER, l. c. p. 416, pl. 43, f. 8, 9, 1937; SCOTT & PRESCOTT, Rec. Amer. Austral. Exped. **3**, p. 26, f. 2:3, 1958.

Cells 465-484μ long, 21-22μ broad, and apices 15-15.5μ broad.

Hab. Anc. 4. Distr. India, Singapore, Thailand, Java, Japan, N. Australia, and N. America.

Pleurotaenium indicum (GRUN.) LUND. in KRIEGER, l. c. p. 403, pl. 41, f. 8, 1937; HIRANO, Contr. Biol. Lab. Kyoto Univ. **2**, p. 64, pl. 11, f. 1, 1956.

Cells in moderate size, elongate, about 20-24 times longer than broad, semicells with a prominent basal inflation and slightly attenuated towards the apices, lateral margin with 4-5 undulations above the basal inflation but upper half of semicell with straight margin. Cells 702-835μ long, 35μ broad, and apices 22μ broad. Pl. 1, f. 1.

Hab. Anc. 4. Distr. India, Ceylon, Java, Japan, Burma, Australia, Madagascar, U. S. A., Hawaii, and Brazil.

Pleurotaenium maculatum (TURNER) KRIEGER in l. c. p. 426, pl. 46, f. 4, 1937.

Cells fairly large, robust, about 10-11 times longer than broad, not attenuated towards the apices which are more or less dilated and with a crown of flattened tubercles, tubercles arranged dense; semicells with a basal inflation, lateral margins almost straight and parallel, 600-620μ long, 57-57.5μ broad, and apices 50-51μ broad.

Hab. 29. Distr. India and Burma.

The present specimens are slightly smaller than those described by TURNER and KRIEGER.

Pleurotaenium nodosum (BAIL.) LUND. var. ***Gutwinskii*** KRIEGER in l. c. p. 437, pl. 47, f. 2, 1937; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 17, pl. 5, f. 6, 1961.

Hab. Anc. 4. Distr. Ceylon, Java, Australia, Borneo, and S. America.

Pleurotaenium ovatum NORDST. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 434, pl. 50, f. 1, 1937; HIRANO, Contr. Biol. Lab. Kyoto Unive. **2**, p. 71, pl. 14, f. 5, 1956.

Cells 430-458μ long, 83.5-85μ broad, isthmus 44-45μ broad, and apices 30.5-31μ broad.

Hab. Anc. 4. Distr. India, Java, Australia, Japan, Africa, and S. America.

Pleurotaenium Trabecula (EHRENB.) NÄG. in WEST, l. c. **1**, p. 209, pl. 30, f. 11-13, 1904; KRIEGER, l. c. p. 395, pl. 40, f. 1-4, 1937; SCOTT & PRESCOTT, Rec. Amer.-Austral. Exped. **3**, p. 27, f. 2:4, 1958.

Cells 308-383μ long, 35-42μ broad, and apices 20.5-22μ broad.

Hab. Anc. 4. Distr. Cosmopolitan.

var. ***maximum*** (REINSCH) ROLL in KRIEGER, Arch. Hydrobiol. Suppl. **11**, p. 169, pl. 7, f. 7, 1932; l. c. p. 400, pl. 40, f. 8, 1937.

Cells 584-590μ long, 68-69μ broad, and apices 48.5-49μ broad. Pl. 1, f. 2.

Hab. Anc. 4. Distr. Burma, Java, Sumatra, Japan, Europe, N. & S. America.

var. ***rectum*** (DELP.) W. & G. S. WEST in l. c. **1**, p. 212, pl. 30, f. 9, 10, 1904; KRIEGER, l. c. p. 402, pl. 41, f. 2, 1937; SCOTT & PRESCOTT, Rec. Amer.-Austral. Exped. **3**, p. 27, f. 2:5, 1958.

Cells 360-372 μ long, 17.5-18 μ broad, and apices 12 μ broad.

Hab. Kg Lu 1. Distr. India, China, Japan, Europe, Australia N. Amer., and Brazil.

Pleurotaenium truncatum (BRÉB.) NÄG. in WEST, l. c. **1**, p. 203, pl. 29, f. 3, 4, 1904; KRIEGER, l. c. p. 430, pl. 49, f. 2, 3, 1937.

Cells 534-542 μ long, 53-53.5 μ broad, and apices 28.5 μ broad. The basal inflation of the present specimens is well developed with a slight constriction just above the basal inflation, lateral margin slightly convex. Pl. 1 f. 3.

Hab. Anc. 4. Distr. Probably cosmopolitan.

Pleurotaenium verrucosum (BAIL.) LUND. in KRIEGER, l. c. p. 438, pl. 51, f. 3, 1937; SCOTT & PRESCOTT, Rec. Amer.-Austral. Exped. **3**, p. 27, f. 2 : 14, 1958.

Cells 378-380 μ long, 35-36 μ broad, and apices 22.5-23 μ broad.

Hab. Anc. 4. Distr. India, Burma, Java, Africa, U. S. A., Brazil, and Cuba.

Triploceras gracile BAIL. in KRIEGER, l. c. p. 442, pl. 52, f. 1-7, 1937.

Cells 165-330 μ long, 26.5 μ broad, and isthmus 13 μ broad.

Hab. 8, 25. Distr. India, Burma, Ceylon, Sumatra, Japan, Australia, N. America, and Brazil.

Cosmarium bengalense (GRUN.) TURNER in K. Sv. Vet. Akad. Handl. **25**, p. 56, pl. 8, f. 33, pl. 9, f. 33, 1893; SKUJA, Nov. Act. Regn. Soc. Sci. Ups. ser. IV, **14 : 5**, p. 118, pl. 25, f. 12, 1949.

Cells 71-73 μ long, 43-44 μ broad, and isthmus 15-15.5 μ broad.

Hab. Anc. 4. Distr. India, Burma, Thailand, Java, and Japan.

Cosmarium Blyttii WILLE var. ***novae-silvae*** W. & G. S. WEST in Monogr. Brit. Desm. **3**, p. 227, pl. 86, f. 5, 6, 1908; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 55, pl. 31, f. 16, 1961.

Semicells trapeziform-semicircular, upper lateral crenae emarginate, and larger than those of the lower entire crenae, apical angles become emarginate crena and larger than the two central ones; cell wall with two series of small granules within each crena; central area of semicell smooth and furnished with a group of granules which are composed of one prominent large and 3 small granules disposed in arc below a large granule. Cells 17-20 μ long, 15-17.5 μ broad, and isthmus 4.5-5 μ broad. Pl. 2, f. 6.

Hab. Anc. 4. Distr. Java and Europe.

Cosmarium Braunii REINSCH var. ***pseudoregnellii*** MESSIKOMMER in Viertelj. naturf. Ges. Zürich **80**, p. 45, pl. 4, f. 41, 42, 1935.

Cells 20-21 μ long, 17.6-18 μ broad, and isthmus 4.5 μ broad. The present specimens

should be compared with *C. Regnellii* but differ from that species by having a broad apex and without a distinctly produced lateral angles. The apex of semicell almost straight or slightly retuse in the middle and semicells subrectangular and apical and basal angles are rounded, lateral margin convex and crenulate, middle crena somewhat produced, sinus deep and closed.

Hab. Anc. 4. Distr. Europe.

Cosmarium cambodiense HIRANO, sp. nov.

Cellulae mediocres, leviter longiores quam latiores sine spinis, profunde constrictae ad medium, sinu angusto-lineari extremo leviter dilatato; semicellulae depresso-semicirculares vel rotundo-trapeziformes, angulis apicalibus late rotundatis, apice leviter convexo vel recto, angulis basalibus late rotundatis; membrana spinulata, spinis numerosis robustis modice longis in serie radiantibus ordinatis sed prope centrum irregularibus; cellulae in vertice virsae oblongae sine inflatione mediana. Cellula sine spinis 57 μ long., 53 μ lata, isthmus 16.5 μ lat. Pl. 6, f. 5.

Hab. Anc. 4.

Cosmarium capax JOSHUA var. ***minus*** (SCHMIDLE) HIRANO in Nature and Life SE Asia **5**, p. 45, pl. 8, f. 2, 1967.

Cells 88-92.5 μ long, 51-57 μ broad, and isthmus 47-53 μ broad.

Hab. Anc. 4. Distr. Thailand, Malaya, Sumatra, China, Australia, Iapan, E. Africa and Ireland.

Cosmarium contractum KIRCHN. in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 170, pl. 61, f. 23-25, 34, 1905.

Semicells almost exactly elliptic, sinus deep and acuminate but not rounded at the extremity. Cells 31-42 μ long, 24-28.5 μ broad, and isthmus 5.6-9 μ broad. Pl. 3, f. 10.

Hab. 15, 16, 17, 21, 25, 29. Distr. Cosmopolitan.

forma ***Jacobsenii*** (ROY) W. & G. S. WEST in Monogr. Brit. Desm. **2**, p. 171, pl. 61, f. 26, 1905.

Cells 31-44 μ long, 22-31 μ broad, and isthmus 4.5-8 μ broad.

Hab. 9, Anc. 4. Distr. Japan, central Africa, and Europe.

var. ***ellipsoideum*** (ELEV.) W. & G. S. WEST in Monogr. Brit. Desm. **2**, p. 172, pl. 61, f. 28, 35, 1905; KRIEGER, Arch. Hydrobiol. Suppl. **11**, p. 173, pl. 9, f. 2, 1932.

Cells 37-41 μ long, 31-32 μ broad, and isthmus 9 μ broad. Pl. 3, f. 5.

Hab. 10. Distr. Burma, Thailand, Sumatra, Celebes, Japan, Siberia, Europe, N. America, and Africa.

var. ***minutum*** (DELP.) W. & G. S. WEST in Monogr. Brit. Desm. **2**, p. 173, 1905; HIRANO, Contr. Biol. Lab. Kyoto Univ. **4**, p. 99, pl. 20, f. 6, 1956; GERLOFF, Gatt.

Cosm. **1**, p. 75, pl. 17, f. 8, 1962.

Cells not exactly oblong-elliptic but somewhat pyramidate-semicircular or reniform-elliptic, sinus narrow but open linearly, extremity obtuse; vertical view of semicell slightly rhomboid-elliptic. In tropical Asian regions the present form has been identified with various names, namely, *C. ellipsoideum* f. *minor*, or var. *minus*. SKUJA reported *C. bioculatum* from Europe (Nov. Act. Regn. Soc. Sci. Ups. 18:3, p. 195, pl. 33, f. 7, 1964) but it seems to be the same with the present form. Cells 18–21 μ long, 13–15 μ broad, and isthmus 4.5 μ broad.

Hab. 3, 4, 5, 10, 12, 13, 16, 17, 19, 20, 21. Distr. Thailand, Japan, Europe, U.S.A., and Brazil.

Cosmarium controversum W. WEST in Monogr. Brit. Desm. **4**, p. 9, pl. 97, f. 7, 8, 1911; SKUJA, Act. Reg. Soc. Sci. Ups. ser. V, **18:3**, p. 210, pl. 37, f. 2, 1964.

Cells 105–106 μ long, 77–77.5 μ broad, and isthmus 35 μ broad. The present species similar to *C. magnificum* but different in the nature of the granules. The granules of *C. controversum* are rounded but the granules of *C. magnificum* have an emarginate wart-like appearance. Pl. 2, f. 3.

Hab. MRl. Distr. Europe.

Cosmarium decoratum W. & G. S. WEST in Trans. Linn. Soc. Bot. **5**, p. 61, pl. 7, f. 21, 1895; KRIEGER, Arch. Hydrobiol. Suppl. **11**, p. 175, pl. 17, f. 15, 1932; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 57, pl. 25, f. 1, 1961.

Cells 70–72 μ long, 61.5–62 μ broad, and isthmus 24 μ broad. Pl. 4, f. 8.

Hab. Anc. 4. Distr. Sumatra, Java, Borneo, Japan, Madagascar, and W. Africa.

Cosmarium depressum (NÄG.) LUND. in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 176, pl. 62, f. 2–5, 1905; HIRANO, Contr. Biol. Lab. Kyoto Univ. **2**, p. 102, pl. 19, f. 30, 1956.

Cells 42–45 μ long, 45–48 μ broad, and isthmus 12–13 μ broad.

Hab. 19. Distr. Cosmopolitan.

Cosmarium geminatum LUND. in Nov. Act. Reg. Soc. Ups. ser. 3, **8**, p. 31, pl. 6, f. 8, 1871; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 177, pl. 81, f. 15, 1908; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. 4, **14:5**, p. 123, pl. 31, f. 8–10, 1949.

Cells 24–25 μ long, 22–22.5 μ broad, and isthmus 6–6.5 μ broad.

Hab. Kg Lu 1, Anc. 4. Distr. Burma, Thailand, Japan, Europe, and Brazil.

Cosmarium globosum BULNH. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 29, pl. 68, f. 1, 2, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **2**, p. 82, pl. 16, f. 15, 16, 1956; FÖRSTER, Ergebn. Forsch-Unters. Nepal. Himal. **3**, p. 41, pl. 1, f. 33, 1965.

Cells 26.5–31 μ long, 17.5–21 μ broad, and isthmus 16.7–19.5 μ broad.

Hab. Anc. 1, Anc. 4. Distr. Cosmopolitan.

Cosmarium glyptodermum W. & G. S. WEST var. ***tuberculatum*** SCOTT & PRESCOTT in Record Amer.-Austral. Sci. Exped. Arnhem Land **3**, p. 46, Fig. 13, f. 14, 1958.

Cells large, moderately constricted, sinus widely open and obtuse-rounded at the extremity; semicells subglobose-cylindrical, apex rounded broadly; cell wall granulate, granules uniformly disposed in around the margin and concentric series within near the margin, granules large and flat, between the granules furnished with distinct scrobiculations, which are disposed in hexagonal manner around each granule. Vertical view of cell circular. Cells 97-99 μ long, 61.5-62 μ broad, and isthmus 48.5-49 μ broad. Pl. 2, f. 1.

Hab. Anc. 4. Distr. Australia.

The present specimens differ from *C. striolatum* by being small in size and typical form *C. glyptodermum* described from Madagascar by W. & G. S. WEST.

Cosmarium granatum BRÉB. in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 186, pl. 63, f. 1-3, 1905.

Cells 32-35 μ long, 23.5-25.5 μ broad, and isthmus 7-7.5 μ broad.

Hab. Anc. 4. Distr. Cosmopolitan.

var. ***pyramidale*** SCHMIDLE in GRÖNBLAD, SCOTT & CROASDALE, Act. Bot. Fenn. **66**, p. 18, pl. 4, f. 76, 77, 1964.

Cells slightly broader than those of the typical form and the lateral margin distinctly concave. Cells 36-37.5 μ long, 25-26.5 μ broad, and isthmus 8 μ broad. Pl. 3, f. 6.

Hab. Anc. 4. Distr. Africa.

Cosmarium hammeri REINSCH var. ***protuberans*** W. & G. S. WEST in Monogr. Brit. Desm. **2**, p. 183, pl. 62, f. 24, 25, 1905; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**:**5**, p. 124, pl. 29, f. 7-9, 1949.

Cells 20-25 μ long, 16-19 μ broad, and isthmus 5.3-6.5 μ broad. SCOTT & PRESCOTT reported var. *africanum* FRITSCH of this species from North Australia and the present specimens similar to their forms but smaller in size.

Hab. Anc. 3, Anc. 4. Distr. Burma, Thailand, Celebes, Japan, Europe, and U.S.A.

Cosmarium impressulum ELFV. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 86, pl. 72, f. 14-18, 1908; MISSIKOMMER, Viertelj. naturf. Ges. Zürich **80**, p. 47, pl. 4, f. 34, 35, 1935.

Cells 24-27 μ long, 17-18 μ broad, and isthmus 4.5 μ broad.

Hab. Anc. 4. Distr. Cosmopolitan.

Cosmarium lapponicum BORGE in Bot. Notis. p. 19, pl. 1, f. 14, 1913; SKUJA,

Nov. Act. Reg. Soc. Sci. Ups. Ser. IV, **18**:**3**, p. 196, pl. 34, f. 7, 1964.

Cells with undulate lateral margins and rather flat apex; semicells somewhat elliptic-reniform. Cells 22-23 μ long, 16-19.5 μ broad, and isthmus 8.7-9 μ broad.

Hab. Anc. 3. Distr. N. Europe.

Cosmarium lomnicense LÜTKEM. in SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, 14:5, p. 126, pl. 30, f. 23, 1949; HIRANO, Nature Life SE Asia **5**, p. 49, pl. 8, f. 8, 1967.

Cells moderate size, deeply constricted in the middle, sinus narrowly linear but outer portion acutely open; semicells depressed oval, furnished with concentric series of granules around and within the margin, central part of semicell smooth but a group of scrobiculations disposed in star-like manner. Cells 39-40 μ long, 31-33 μ broad, and isthmus 11.5-13 μ broad. Pl. 2, f. 4.

Hab. Anc. 4. Distr. Burma, Thailand, Europe, and Africa.

Cosmarium Lundellii DELP. var. ***circulare*** (REINSCH) KRIEGER in Arch. Hydrobiol. Suppl. **11**, p. 178, pl. 9, f. 21, 1932; HIRANO, Contr. Biol. Lab. Kyoto Univ. **4**, p. 120, pl. 22, f. 10, 1957.

Cells 44-48 μ long, 38-44 μ broad, and isthmus 15-15.5 μ broad. Pl. 3, f. 1.

Hab. Anc. 4, Anc. 6. Distr. Java, Sumatra, Malaya, Japan, and Afghanistan.

var. ***sinense*** GERLOFF in Gatt. Cosm. **1**, p. 5, Pl. 22, f. 3, 1962.

Cells elliptic in outline, deeply constricted in the middle, sinus narrowly linear at the extremity but acutely open in outer portion; semicells trapeziform-semicircular, lower lateral margin shortly divergent and then convergent and convex at the majority of lateral margin continuing to the convex apex; cell wall roughly punctate. Cells 41-42 μ long, 39-39.5 μ broad, and isthmus 18.5 μ broad. Pl. 3, f. 2.

Hab. Anc. 6. Distr. China.

The present specimens resemble *C. regulare* SCHMIDLE in size and in the form of semicell but differ from it by having an open sinus at the outer portion and convex apex.

Cosmarium maculatiforme SCHMIDLE var. ***maior*** GUTW. in SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**:**5**, p. 126, pl. 27, f. 18, 1949; HIRANO, Nature Life SE Asia **5**, p. 49, pl. 11, f. 3, 1967.

Cells 132-198 μ long, 68-97 μ broad, and isthmus 40-44 μ broad. Pl. 3, f. 15.

Hab. Anc. 4. Distr. Burma, Thailand, and Java.

Cosmarium moniliforme (TURP.) RALFS in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 20, pl. 67, f. 1-3, 1908; GRÖNBLAD, SCOTT & CROASDALE, Act. Bot. Fenn. **66**, p. 21, pl. 3, f. 47, 1964.

Cells 62-65 μ long, 41-43 μ broad, and isthmus 13-14 μ broad.

Hab. 24. Distr. Cosmopolitan.

Cosmarium norimbergense REINSCH in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 52, pl. 69, f. 25-27, 1908; HIRANO, Contr. Biol. Lab. Kyoto Univ. **4**, p. 142, pl. 24, f. 10, 1957.

Cells 13-14 μ long, 10.5-11 μ broad, and isthmus 3.5-4 μ broad.

Hab. Anc. 4. Distr. Thailand, Ceylon, Japan, central Africa, Afghanistan, Europe, and New Zealand.

Cosmarium obsoletum (HANTZSCH) REINSCH in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 133, pl. 56, f. 1-3, 1905.

Cells 60-63 μ long, 72-74 μ broad, and isthmus 25-26 μ broad.

Hab. Anc. 4. Distr. Cosmopolitan.

var. ***sitvense*** GUTW. in Bull. Intern. Acad. Sci. Cracov. no. **9**, p. 594, pl. 38, f. 39, 1902; W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 134, pl. 56, f. 4, 1905.

Cells 67-68 μ long, 74-75 μ broad, and isthmus 37-38 μ broad.

Hab. Anc. 4, Anc. 8. Distr. Burma, Thailand, Malaya, Java, Sumatra, China, and Japan.

Cosmarium phaseolus BRÉB. var. ***minutum*** (BISWAS) GERLOFF in Gatt. Cosm. **1**, p. 55, pl. 14, f. 6, 1962.

Cells minute, deeply constricted, sinus closed; semicells trapeziform, basal angle rounded, side convex and convergent, apex truncate and slightly convex or straight; vertical view somewhat rhomboidal, with a protuberance in the middle on each side; side view of semicell circular with prominent protuberance on each side. Cells 13-13.5 μ long, 13-13.5 μ broad, and isthmus 3.5 μ broad. Pl. 3, f. 14.

Hab. Anc. 4. Distr. India.

Cosmarium pseudopyramidatum LUND. in Nov. Act. Soc. Ups. ser. III, **8**, p. 41, pl. 2, f. 18, 1871; W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 201, pl. 64, f. 9-12, 1905.

Cells 51-55 μ long, 33-35 μ broad, and isthmus 11-13 μ broad.

Hab. Anc. 4. Distr. Cosmopolitan.

Cosmarium punctulatum BRÉB. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 206, pl. 84, f. 13, 14, 1908.

Cells 35-36 μ long, 30-31 μ broad, and isthmus 10-11 μ broad.

Hab. Anc. 4. Distr. Cosmopolitan.

Cosmarium Quadrum LUND. var. ***minus*** NORDST. in W. & G. S. WEST,

Monogr. Brit. Desm. **4**, p. 21, 1911.

Cells 50-51 μ long, 52.5-53 μ broad, and isthmus 17-17.5 μ broad.

Hab. Anc. 4. Distr. Manchuria, Europe, Greenland, and U. S. A.

Cosmarium Regnellii WILLE forma ***minima*** EICHL. & GUTW. in GRÖNBLAD, Act. Soc. Faun. Flor. Fenn. **49**, p. 40, pl. 7, f. 49, 50, 1921; MESSIKOMMER, Viertelj. naturf. Ges. Zürich **80**, p. 49, pl. 4, f. 43, 44, 1935.

Cells 12-15.4 μ long, 11-13 μ broad, and isthmus 3-4.5 μ broad.

Hab. Kg Lu 2, Anc. 8. Distr. Nepal, Japan, Europe, and U. S. A.

Cosmarium regnesi REINSCH var. ***montanum*** SCHMIDLE in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 39, pl. 68, f. 29-31, 1908; CROASSDALE, Trans. Amer. Micr. Soc. **83**, p. 186, pl. 13, f. 6, 1964.

Cells 13-14 μ long, 13-13.5 μ broad, and isthmus 4.5-5 μ broad. Pl. 10, f. 4.

Hab. Anc. 4. Distr. Madagascar, Europe, U. S. A., and Patagonia.

Cosmarium regulare WILLE in Bih. K. Sv. Vet. Akad. Handl. **8**, p. 16, pl. 1, f. 34, 1884; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 89, pl. 72, f. 25-28, 1908; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. IV, **14**:**5**, p. 139, pl. 29, f. 4, 1949.

Semicells depressed semicircular, apex slightly flattened; cell wall punctated. Cells 40-44 μ long, 34-39 μ broad, and isthmus 11-12 μ broad. Pl. 3, f. 9.

Hab. 12, Anc. 5. Distr. India, Burma, Ceylon, China, Japan, Europe, Africa, N. & S. America.

Cosmarium scabratulum W. & G. S. WEST in Trans. Linn. Soc. Bot. **5**, p. 64, pl. 6, f. 27, 1895.

Cells in moderate size, deeply constricted in the middle, sinus open and acute angled but not obtuse at the extremity; semicells oblongo-hexagonal, lateral angles well rounded, lower lateral margin slightly convex, upper lateral margin straight or slightly convex, apex flattened; cell wall granulate, granules small and radially arranged within the margin but irregular and indistinct at the centre of the semicell. Cells 38-40 μ long, 37-39 μ broad, and isthmus 18-19 μ broad. Pl. 3, f. 13.

Hab. Anc. 4. Distr. Madagascar.

Cosmarium stigmosum (NORDST.) KRIEGER in Arch. Hydrobiol. Suppl. **11**, p. 186, pl. 10, f. 19, 1932; GRÖNBLAD, SCOTT, CROASDALE, Act. Bot. Fenn. **66**, p. 25, pl. 10, f. 231, 1964; GERLOFF, Gatt. Cosm. **2**, p. 169, pl. 35, f. 1, 1965.

Cells 43-44 μ long, 42.5-43 μ broad, and isthmus 20 μ broad. Pl. 4, f. 4.

Hab. Lg. Lu. 4. Distr. Java, Sumatra, Africa, and New Zealand.

Cosmarium subauriculatum W. & G. S. WEST in Trans. Linn. Soc. Bot. **5**, p. 55, pl. 6, f. 31, 1895; GRÖNBLAD, SCOTT, CROASDALE, Act. Bot. Fenn. **66**, p. 25, pl.

3, f. 54, 55, 1964.

Cells 44-45 μ long, 45-47 μ broad, and isthmus 24 μ broad. The present specimens coincide well with the original figure and description by WEST from Madagascar. BERNARD reported *C. auriculatum* var. *bogoriense* from Java but his figure coincides well with the present specimens and also with the form from Madagascar by WEST. According to the WEST, BERNARD's form is *C. subauriculatum*. KRIEGER adopted BERNARD's name to his form which was found in Sunda Islands and the figure of his form is similar to the present specimens. PRESCOTT & SCOTT reported *C. auriculatum* from Indonesia and the form and size of cells are similar to the present specimens but their forms are somewhat different from the present specimens by having 4 papillae at each lateral angle. Pl. 3, f. 7.

Hab. Anc. 8. Distr. Madagascar, Africa, and Java.

Cosmarium subpyramidatum (W. & G. S. WEST) LÜTKEM. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 213, 1933; HIRANO, Nature Life SE. Asia **5**, p. 53, pl. 10, f. 3, 1967; GERLOFF, Gatt. Cosm. **3-4**, p. 355, pl. 59, f. 11, 1969.

Cells small, slightly constricted in the middle, sinus in shallow depression; semicells rotundo-pyramidate, lateral margin slightly convex, apex narrow and convex. Cells 25-26.5 μ long, 15-15.5 μ broad, and isthmus 14.5 μ broad. Pl. 2, f. 5.

Hab. Anc. 4. Distr. Thailand, E. Africa, and Europe.

Cosmarium sulcatum NORDST. in W. & G. S. WEST, Trans. Linn. Soc. Bot. **5**, p. 57, pl. 9, f. 28, 29, 1895.

Cells transversely angular-reniform, lateral margin with three undulations, lower one divergent, middle one convergent and the uppermost one more convergent and gradually continuing to the apex, apex slightly convex, sinus narrowly linear and deeply constricted; vertical view of cell narrow rhomboid-elliptic, with a slight inflation on both sides, inflation somewhat tricrenulate. Cells 26-28 μ long, 24-28 μ broad, and isthmus 5-6.5 μ broad. Pl. 3, f. 3.

Hab. Anc. 4. Distr. Madagascar.

The present specimens are smaller than those of the forms reported from Madagascar.

Cosmarium sumatranum KRIEGER var. ***nepalense*** FÖRSTER in Ergebn. Forsch.-Unters. Nepal Himal. **3**, p. 49, pl. 3, f. 34, 1965.

Semicells trapeziform, basal angles rounded, lateral margin convex, apex truncate and straight; cell wall uniformly granulate, granules disposed in radial and concentric series; vertical view of cell rhomboid-oblong or elliptic rhomboid, slightly tumid on both sides. Cells 22-23 μ long, 19.5-20 μ broad, and isthmus 7 μ broad. Pl. 3, f. 8.

Hab. 16, 17, 22, Kg Lu 3. Distr. Nepal.

The present specimens are similar to *C. orthostichum* but smaller in size and larger

than those of the var. *pumila* of the typical species and also slightly different from both forms in granular arrangement of the cell wall.

Cosmarium trachypleurum LUND. var. ***minus*** RACIB. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 173, pl. 81, f. 4, 5, 1908.

Cells 32-33.5 μ long, 26-26.5 μ braod, and isthmus 6.5-7 μ broad. Pl. 9, f. 1.

Hab. 15. Distr. Europe.

Cosmarium trilobulatum REINSCH var. ***Printzii*** MESSIKOMMER in HIRANO, Contr. Biol. Lab. Kyoto Univ. **4**, p. 130, pl. 20, f. 18, 1957.

Cells 17.5-18 μ long, 11 μ broad, and isthmus 3 μ broad.

Hab. Anc. 4. Distr. Japan and Europe.

Cosmarium tumidum LUND. in Nov. Act. Reg. Soc. Ups. ser. 3, 8, p. 45, pl. 3, f. 16, 1871; MESSIKOMMER, Viertelj. naturf. Ges. Zürich **88**, pl. 9, f. 4, 1943; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 72, pl. 27, f. 16, 1961.

Cells subcircular or rotundo-reniform, deeply constricted in the middle, sinus narrowly linear, apex of semicell narrow and flattened; cell well punctate and distinctly scrobiculate in the centre. Cells 30-31 μ long, 22-23 μ broad, and isthmus 4.5-5 μ broad. Pl. 3. f. 4,

Hab. Anc. 4. Distr. Sumatra and Europe.

Cosmarium turgidum BRÉB. in W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 115, pl. 75, f. 1-3, 1908; KRIEGER, Arch. Hydrobiol. Suppl. **11**, p. 189, pl. 8, f. 10, 1932; GERLOFF, Gatt. Cosm. **3-4**, p. 364, pl. 62, f. 6a, 1969.

Cells 198-205 μ long, 75-77 μ broad, and isthmus 64-65 μ broad.

Hab. Anc. 4. Distr. Cosmopolitan.

Cosmarium variolatum LUND. var. ***rotundatum*** (KRIEGER) MESSIKOMMER in Hedw. **78**, p. 173, pl. 3, f. 34, 1938; GERLOFF, Gatt. Cosm. **2**, p. 119, pl. 24, f. 16, 1965.

Cells 35-40 μ long, 26-27 μ broad, and isthmus 8.7-9.5 μ broad. Pl. 2, f. 2.

Hab. Anc. 1. Distr. Sumatra, China, Europe, Africa, and Brazil.

Cosmarium Wittrockii LUND. in Nov. Act. Reg. Soc. Ups. ser. **3**, 8, p. 31, pl. 3, f. 14, 1871; W. & G. S. WEST, Monogr. Brit. Desm. **3**, p. 179, pl. 78, f. 19, 1908.

Cells with a deep constriction and acute angles. Semicells transversely elliptic with broad lateral angles. Cell wall granulate, granules disposed in somewhat irregular longitudinal and transverse series (about 8 series in longitudinal). Cells 20-22 μ long, 16-17 μ broad, and isthmus 7.5-8 μ broad. Pl. 3, f. 11.

Hab. Anc. 4. Distr. Thailand, Nepal, Japan, Siberia, Europe, and Novaya Semlja.

The present species resemble *C. Portianum* but small in size. It is said in general that *C. Portianum* exhibits smaller size in the tropics than that in the temperate

regions but the present forms are far smaller than those of the previous description. Also it should be compared with *C. Portianum* var. *orthostichum* SCHMIDLE reported by W. & G. S. WEST from Africa (Journ. Bot. **35**, p. 121, pl. 368, f. 9, 1898).

Arthrodesmus convergens EHRENB. in W. & G. S. WEST, Monogr. Brit. Desm. **4**, p. 106, pl. 116, f. 4-13, 1911.

The sinus of the present specimens varies in its opening; in some specimens sinus narrowly linear but others acutely open. The spines of the lateral angles in some specimens are short in one angle and is missing in other angle in the same individual. Some specimens resemble *A. mucronatus* f. *depauperatus* but differ from it in the position of lateral angles and of the attaching place of the spines. Cells 35-46 μ long, 37.5-51 μ broad (without spine), and isthmus 11-13 μ broad. Pl. 4, f. 1, pl. 7, f. 2, 4.

Hab. 3, 7, 13, 16, 19, 20, 21. Distr. Cosmopolitan.

Arthrodesmus curvatus TURNER in W. & G. S. WEST, Monogr. Brit. Desm. **4**, p. 109, pl. 116, f. 14, 1911.

Cells 40-48 μ long, 44-53 μ broad (without spine), and isthmus 11-12 μ broad. Pl. 2, f. 7, pl. 7, f. 3.

Hab. 16, 25, Kg Lu 1. Distr. India and Japan.

var. ***kalimantanum*** SCOTT & PRESCOTT in Hydrobiol. **17**, p. 75, pl. 34, f. 1, 1961.

Cells 101-102 μ long, 103-104 μ broad (without spine), and isthmus 26-26.5 μ broad. The sinus of this variety is narrowly linear, and the lateral spines long and incurved. The present specimens coincide well with the forms reported by SCOTT & PRESCOTT from Indonesia in respect of the form of semicell and of the attaching place of spine but the spines are not straight and usually incurved. *A. convergens* varies very much in form and in sinus appearance, and the present specimens somewhat resemble one of the forms of *A. convergens* which possess an extremely closed sinus. Pl. 4, f. 2.

Hab. 29. Distr. Borneo.

Arthrodesmus subulatus KÜTZ. in W. & G. S. WEST, Monogr. Brit. Desm. **4**, p. 109, pl. 116, f. 14, 1911.

Cells 44-45 μ long, 44-48 μ broad (without spine), and isthmus 11-11.5 μ broad. The spines of the present specimens have a incurved tendency in the direction of the spine. The curvatures of the lateral margin are variable in some degree among the individuals. Pl. 7, f. 1.

Hab. 19, 25. Distr. India, Japan, Europe, Africa, Madagascar, N. & S. America.

Xanthidium acanthophorum NORDST. in SCOTT & PRESCOTT, Record Amer.-Austral. Arnhem Land **3**, p. 55, F. 11, f. 1, 1958.

Cells 38-40 μ long (without spine), 35-39 μ broad (without spine), and isthmus 12-13 μ broad. Pl. 8, f. 4.

Hab. Anc. 4, St. 16. Distr. Japan, Java, Ceylon, and Europe.

Xanthidium antilopaeum (BRÉB.) KÜTZ. var. ***laeve*** SCHMIDLE in HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 221, pl. 30, f. 1, 1957.

Cells 74-79 μ long (without spine), 68-70 μ broad (without spine), and isthmus 20-22 μ broad.

Hab. 25. Distr. Japan, Siberia, and Europe.

var. ***laeve*** forma ***longispinum*** SCOTT & PRESCOTT in Hydrobiol. **17**, p. 79, pl. 38, f. 2, 1961.

Cells 79-80 μ long (without spine), 66-67 μ broad (without spine), and isthmus 13-14 μ broad. Pl. 7, f. 5, 6.

Hab. 29. Distr. Sumatra.

forma ***minus*** SCOTT & PRESCOTT in Hydrobiol. **17**, p. 80, pl. 38, f. 3, 1961.

Cells 47-48 μ long (without spine), 44-45 μ broad (without spine), and isthmus 13 μ broad. Pl. 8, f. 2.

Hab. 8. Distr. Sumatra.

Xanthidium hastiferum TURNER var. ***javanicum*** (NORDST.) TURNER in HIRANO, Contr. Biol. Lab. Kyoto Univ. **5**, p. 219, pl. 30, f. 19, 1957.

Cells 41-42 μ long (without spine), 40-42 μ broad (without spine), and isthmus 13-14.5 μ broad. Pl. 8, f. 8.

Hab. Kg Lu 1. Distr. India, Burma, Java, and Japan.

Xanthidium sansibarense HIER. forma ***asymmetricum*** SCOTT & PRESCOTT in Hydrobiol. **17**, p. 84, pl. 37, f. 6, 7, 1961.

Cells 57-64 μ long (without spine), 51-57 μ broad (without spine), and isthmus 13-15.5 μ broad.

I have found some variations in the form of semicell and the spine development. Some specimens have an almost straight lower lateral margin and in other specimens the lower lateral margin shows convex side. The spines of each lateral and apical angles are not always developed, sometimes lacking in one or two angles in the same individual but the basal swelling of the spines is always existent. Pl. 4, f, 5, 6, pl. 8, f. 5.

Hab. 13, 15, 16, 19, 20, 22, 24, 25. Distr. Borneo and Sumatra.

Xanthidium sexmamillatum W. & G. S. WEST var. ***pulneyense*** IYENGAR & BAI in SCOTT & PRESCOTT, Hydrobiol. **17**, p. 84, pl. 39, f. 2, 1961.

Cells 43-48 μ long (without spine), 48-50 μ broad (without spine), and isthmus 11 μ broad. Pl. 8, f. 1.

Hab. 16, 20, 21. Distr. Sumatra.

Xanthidium spinosum (JOSHUA) W. & G. S. WEST in SCOTT & PRESCOTT,

Hydrobiol. **17**, p. 84, pl. 37, f. 2, 3, 1961.

Cells 50-53 μ long (without spine), 48 μ broad (without spine), and isthmus 26-28 μ broad. Semicells somewhat elliptic with six pairs of short spines on each side of the lateral margin and the pairs of spines disposed equidistantly. Sinus open acutely not possessing the part of the closing. Pl. 8, f. 3.

Hab. Anc. 4. Distr. Sumatra.

Euastrum ansatum EHRENB. var. ***pyxidatum*** DELP. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 489, pl. 58, f. 7, 1935.

Cells 90-92 μ long, 52-54 μ broad, and isthmus 15-16 μ broad. Pl. 5, f. 11.

Hab. Anc. 4. Distr. India, Sumatra, Europe, Greenland, and U. S. A.

Euastrum ceylanicum (W. & G. S. WEST) KRIEGER in Krypt. Fl. **13**, Abt. 1, p. 627, pl. 90, f. 16, 17, 1937.

Cells 97-103 μ long, 84-88 μ broad, and isthmus 26-26.5 μ broad.

Hab. 29, Anc. 4. Distr. Ceylon, Sumatra, and Japan.

Euastrum denticulatum (KIRCHN.) GAY var. ***quadrifarium*** KRIEGER in Krypt. Fl. **13**, Abt. 1, p. 585, pl. 80, f. 20, 21, 1937; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 25, pl. 13, f. 10, 1961.

Cells 20-21 μ long, 15.5-16 μ broad, and isthmus 4.5 μ broad. Pl. 4, f. 7.

Hab. Anc. 4. Distr. Sumatra and Bali.

Euastrum didelta RALFS var. ***bengalicum*** LAGERH. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 519, pl. 67, f. 4-6, 1937.

Cells 106-110 μ long, 59-62 μ broad, and isthmus 13-15 μ broad. Pl. 5, f. 12.

Hab. Anc. 4. Distr. India, Ceylon, Java, Singapore, and Australia.

Euastrum divergens JOSHUA var. ***ornatum*** (BORGE) SCHMIDLE in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 643, pl. 92, f. 20, 21, 1937; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 26, pl. 10, f. 7, 1961.

Cells 50-51 μ long, 42-43 μ broad, and isthmus 11 μ broad. Lower lateral lobe short and horizontal, upper lateral lobe long and divergent, furnished with series of denticulations, polar lobe rectangular and relatively short than the lateral lobe. Pl. 5, f. 9.

Hab. Anc. 4. Distr. Borneo and Australia.

Euastrum flammeum JOSHUA in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 608, pl. 86, f. 12-14, 1937.

Cells 44-46 μ long, 27-28.5 μ broad, and isthmus 7.5 μ broad. Pl. 5, f. 5.

Hab. Anc. 4. Distr. Burma and Japan.

Euastrum serratum JOSHUA in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 623, pl. 88,

f. 24-26, 1937.

Cells 48-50 μ long, 28.5-31 μ broad, and isthmus 6.5-7 μ broad. Pl. 5, f. 4.

Hab. Anc. 4. Distr. India, Burma, and Ceylon.

Euastrum sinuosum LENORM var. ***germanicum*** (RACIB.) LÜTKEM. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 502, pl. 63, f. 1, 1937.

Cells 61.5-63 μ long, 35-36 μ broad, and isthmus 9-10 μ broad. Pl. 5, f. 10.

Hab. Anc. 4. Distr. Japan, Australia, and Europe.

var. ***scrobiculatum*** NORDST. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 503, pl. 63, f. 2, 3, 1937.

Cells 57-60 μ long, 35-37 μ broad, and isthmus 11-12 μ broad.

Hab. Anc. 4. Distr. Sumatra and Europe.

Euastrum spinulosum NORDST. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 633, pl. 93, f. 1-3, 1937; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 40, pl. 10, f. 3, 1961.

Cells 47-50 μ long, 41-43 μ broad, and isthmus 11-12 μ broad. Pl. 5, f. 6.

Hab. Anc. 4. Distr. India, Ceylon, Burma, Java, Sumatra, Africa, Madagascar, Japan, and Europe.

Euastrum substellatum NORDST. in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 629, pl. 90, f. 21-24, 1937; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 44, pl. 11, f. 1, 2, 1961.

Cells 44-46 μ long, 42-44 μ broad, and isthmus 9-10 μ broad. Pl. 5, f. 3, 8.

Hab. Anc. 4. Distr. India, Burma, Java, and Japan.

Micrasterias alata WALL. in KRIEGER, Arch. Hydrobiol. Suppl. **11**, p. 217, pl. 24, f. 5, 1932; Krypt. Fl. **13**, Abt. 2, p. 61, pl. 114, f. 1-4, 1939.

Cells 176-185 μ long, 163-176 μ broad, and isthmus 15.5-19 μ broad.

Hab. 8, 19. Distr. India, Java, Japan, and Cuba.

Micrasterias apiculata (EHRENB.) MENEGH. in W. & G. S. WEST, Monogr. Brit. Desm. **2**, p. 97, pl. 47, f. 1-2, 1905; KRIEGER, Krypt. Fl. **13**, Abt. 2, p. 78, pl. 122, f. 3, 4, 1939.

Cells 190-195 μ long, 165-170 μ broad, and isthmus 35-37 μ broad.

Hab. Anc. 4. Distr. India, Burma, Thailand, Japan, Siberia, Europe, and U. S. A.

Micrasterias foliacea BAIL. in KRIEGER, Krypt. Fl. **13**, Abt. 2, p. 76, pl. 120, f. 8, 9, pl. 121, f. 1-5, 1939; HIRANO, Contr. Biol. Lab. Kyoto Univ. **7**, p. 279, pl. 37, f. 2, 1959.

Cells 55-57 μ long, 86-88 μ broad, and isthmus 12.5-13 μ broad.

Hab. 29. Distr. Burma, Ceylon, Java, Borneo, Malaya, Thailand, Philippines, China, Japan, Australia, Africa, and N. America.

Micrasterias mahabuleshwarensis HOBSON in SMITH, Wisc. Bull. **57**, p. 143, pl. 16, f. 1, 1924; KRIEGER, Krypt. Fl. **13**, Abt. 2, p. 49, pl. 109, f. 7-10, 1939.

Cells 148-152 μ long, 120-132 μ broad, and isthmus 17-22 μ broad.

Hab. 8, Anc. 4. Distr. India, Ceylon, Burma, Thailand, Java, Japan, Australia, Africa, U. S. A., and S. America.

var. ***asymmetricum*** HIRANO in Act. Phytotax. Geobot. **14**, p. 69, 1951; Contr. Biol. Lab. Kyoto Univ. **7**, p. 282, pl. 36, f. 1, 1959.

Cells 136-140 μ long, 95-104 μ broad, and isthmus 16.5-18 μ broad. Cells slightly smaller than those of the Japanese form.

Hab. 29. Distr. Japan.

Micrasterias radians TURNER in K. Sv. Vet. Akad. Handl. **25**, p. 92, pl. 5, f. 6a, 1893; KRIEGER, Krypt. Fl. **13**, Abt. 2, p. 67, pl. 115, f. 8, pl. 116, f. 1, 1939.

Cells 123-125 μ long, 105-108 μ broad, and isthmus 13-14 μ broad.

Hab. Anc. 4. Distr. India, Burma, Japan, and S. Africa.

Staurastrum acanthocephalum SKUJA in Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**:**5**, p. 151, pl. 34, f. 25, 1949; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 85, pl. 52, f. 5, 6, 1961.

Cells without process 17.5-22 μ long, with proc. 28.5-40 μ long, 39.5-58 μ broad (with process), and isthmus 4.5-6.5 μ broad. Pl. 12, f. 9.

Hab. 1, 3, Anc. 11, Kg Lu 1. Distr. Burma, Borneo, and Singapore.

The present specimens are somewhat longer than those of the original description by SKUJA and curve upward; spines of the process are distinctly reduced.

Staurastrum aculeatum (EHRENB.) MENEGH. var. ***ornatum*** NORDST. in DICK, Bot. Arch. **3**, p. 226, pl. 3, f. 5, 1923; KRIEGER, Ber. dtsch. Bot. Ges. **56**, p. 64, pl. 2, f. 5, 6, 1938; HIRANO, Contr. Biol. Lab. Kyoto Univ. **21**, p. 42, pl. 11, f. 11, 1968.

Cells 42-44 μ long, 43-45 μ broad, and isthmus 10-11 μ broad. Pl. 9, f. 2.

Hab. Anc. 4. Distr. Europe, Alaska, Spitzbergen, and Japan.

Staurastrum Bieneanum RABENH. in W. & G. S. WEST, Monogr. Brit. Desm. **4**, p. 135, pl. 120, f. 4-6, 1911; HIRANO, Contr. Biol. Lab. Kyoto Univ. **7**, p. 288, pl. 38, f. 5, 1959.

Cells 37-45 μ long, 35-44 μ broad, and isthmus 9-11 μ broad. The dimension of the present specimens is slightly larger than that of the European species given by WEST. Lateral angles acutely rounded, apex of semicell slightly convex. The present specimens seem to be *St. grande* var. *parvum* WEST but smaller in size than those of that species. Also the present specimens resemble *St. subpygmaeum* var. *subangulatum* W. & G. S. WEST but the lateral angles do not produce as are found in that species. The sinus is acuminate at the extremity but the outer part of the sinus shows the

fairly wide variation in opening from the acute angle to the rectangular one. Pl. 10, f. 6.

Hab. 7, 12, 13, 16, 19, 20, 21, 24. Distr. Japan, New Zealand, Madagascar, Europe, Siberia, N. America, and Novaya Semlya.

Staurastrum bifidum (EHRENB.) BRÉB. var. ***tortum*** TURNER in K. Sv. Vet. Akad. Handl. **25**, p. 108, pl. 15, f. 8, 1893. JOSHUA, Journ. Linn. Soc. Bot. **21**, p. 640, pl. 24, f. 8, 9, 1886.

Cells 37.5-40 μ long, 40-41 μ broad (without spine), 61-62 μ broad (with spine), and isthmus 11-16 μ broad. The present specimens coincide with the TURNER's figure and JOSHUA's one. JOSHUA first recorded this variety from Burma but he did not give a special variety name, althongh he considered this form as a different one from the typical.

Staurastrum contectum TURNER in K. Sv. Vet. Akad. Handl. **25**, p. 111, pl. 15, f. 20, 1893.——var. *inevolutum* TURNER, l. c. p. 111, pl. 22, f. 11, 1893; W. & G. S. WEST, Trans. Linn. Soc. Bot. **5**, p. 257, pl. 16, f. 19, 1896.

Cells 36-38 μ long, 40-42 μ broad (without spine), and isthmus 7 μ broad. Pl. 5. f. 7.

Hab. 21. Distr. India, U. S. A., and Japan.

Staurastrum columbetoides W. & G. S. WEST in Trans. Linn. Soc. Bot. **6**, p. 186, pl. 22, f. 8, 9, 1902, HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 351, pl. 44, f. 1, 1959.

Cells 16-17.5 μ long (without process), 80-84 μ long (with process), 13-13.5 μ broad (without process), 37-40 μ broad (with process), isthmus 4.5-5 μ broad. Pl. 10, f. 2.

Hab. 21. Distr. Ceylon and Japan.

Staurastrum corniculatum LUND. var. ***pelagicum*** TEILING in Bot. Notis. p. 82, f. 33, 1946.

Cells 44-45 μ long, 35-36 μ broad, and isthmus 15 μ broad. Pl. 6, f. 6.

Hab. 21. Distr. Europe.

The present species resemble *St. connatum* but the size is larger than that of *St. connatum* and also the apical spine of the present specimens is short.

Staurastrum cyathodes JOSHUA in Journ. Linn. Soc. Bot. **21**, p. 642, pl. 23, f. 22, 23, 1886.

Cells without process 30-31 μ long, with process 63-65 μ long, 21-22 μ broad (without process), 45-46 μ broad (with process), and isthmus 3 μ broad. The present specimens coincide well with *St. pseudopelagicum* W. & G. S. WEST reported by WEST & CARTER in their Monogr. V, p. 107, pl. 145, f. 11, 12, 1923, although JOSHUA already reported a similar form from Burma. JOSHUA's figure is not accurate in detail but present forms of Cambodia are similar to his figure in many respects and perhaps

the form from Cambodia will be the same species with the form from Burma. The apical angles are slightly produced and have a tendency to become process. This process is furnished with 3 series of granules.

Hab. 21. Distr. Burma.

Staurastrum Dickiei RALFS in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 3, pl. 129, f. 14, 1923; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 303, pl. 39, f. 12, 1959.

Cells 37.5-41 μ long, 35 μ broad (without spine), and isthmus 11 μ broad.

Hab. 13, 19. Distr. Cosmopolitan.

Staurastrum ensiferum TURNER in K. Sv. Vet. Akad. Handl. **25**, p. 109, pl. 14, f. 22, 1893; W. & G. S. WEST, Trans. Linn. Soc. Bot. **6**, p. 176, 1902; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 313, pl. 40, f. 19, 1959.

Cells 31-32 μ long (without spine), 39-40 μ broad (without spine), and isthmus 13 μ broad. Pl. 6, f. 7.

Hab. Kg Lu 1. Distr. India, Ceylon, and Japan.

Staurastrum excavatum G. S. WEST in Trans. Linn. Soc. Bot. **5**, p. 78, pl. 8, f. 42, 1895; Journ. Linn. Soc. Bot. **39**, p. 71, pl. 6, f. 19-20, 1909; SCOTT & PRESCOTT, Record Amer.-Austral. Exped. Arnhem Land **3**, p. 60, F. 15, f. 1, 1958.

Cells 15.5-17.6 μ long (without process), 40-53 μ long (with process), 13 μ broad (without process), 57-61 μ broad (with process), and isthmus 4.5-7.5 μ broad. Semicells subrectangular, basal angles somewhat acute, apex distinctly excavated. The present specimens coincide well with the description and figure given by GRÖNBLAD under the name of *St. teracerum* var. *subexcavatum* GRÖNBLAD. But the distinct excavation of apex shown in the present specimens is so characteristic that GRÖNBLAD's name for his variety cannot be used for the present specimens. This species was first reported by WEST from Madagascar and later found again in Australia. The processes of the forms reported from these districts by WEST are gradually attenuated to the apex, while the processes of the present specimens are attenuated to the apex in the same way but have a tendency to dilate at the extremity of the process. Pl. 10, f. 1.

Hab. 11, 25. Distr. Madagascar and Australia.

Staurastrum freemanii W. & G. S. WEST var. ***nudiceps*** SCOTT & PRESCOTT in Hydrobiol. **17**, p. 92, pl. 43, f. 3, 1961.

Cells 31-42 μ long (without process), 44-84 μ long (with process), 35-46 μ broad (without process), 53-84 μ broad (with process), and isthmus 9-12 μ broad. Pl. 11, f. 3, 6, 7.

Hab. 12, 15, 16, 20, 21, 25. Distr. Borneo and Sumatra.

Staurastrum gracile RALFS var. ***elegantum*** SCOTT & PRESCOTT in Hydrobiol. **17**, p. 94, pl. 57, f. 10, 1961.

Cells 35 μ long (without process), 37.5 μ long (with proc.), 19.5-20 μ broad (without proc.), 70-71 μ broad (with process), and isthmus 9 μ broad. WEST reported the var. *elegantulum* from Ceylon and his form is smaller than that of the present specimens. The processes of the var. *elegantum* are almost horizontal. The basal part of semicell is campanulate and this point coincides well with the present form. The present form resembles also *St. pingue* reported by TEILING in respect of the form of semicell, deep constriction of median part of cell, closed sinus, campanulate basal part of semicell, and rounded basal angles of semicell. The direction of processes on the present specimens, however, is horizontal or slightly divergent and is not distinctly divergent upward as shown by the *St. pingue*. Pl. 10, f. 3.

Hab. AB3. Distr. Sumatra.

Staurastrum javanicum (NORDST.) TURNER var. ***apiculiferum*** (TURNER) KRIEGER in Arch. Hydrobiol. Suppl. **11**, p. 201, pl. 20, f. 3, 1932; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 97, pl. 44, f. 6, 1961.

Cells 52-55 μ long, 29-35 μ broad (without proc.), 88-108 μ broad (with proc.), and isthmus 13-13.5 μ broad. Pl. 12, f. 6, 7.

Hab. 10, 25, TB. Distr. Java and Sumatra.

Staurastrum leptocladum NORDST. in W. & G. S. WEST, Journ. Linn. Soc. Bot. **33**, p. 317, 1898; SMITH, Wisc. Bull. **57**, p. 102, pl. 78, f. 1-7, 1924; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 377, pl. 50, f. 6, 1959.

Cells 38-48.4 μ long, 20-39 μ broad (without proc.) 100-110 μ broad (with proc.), and isthmus 6-8.5 μ broad. Pl. 10, f. 7.

Hab. 16, 17, 19, 21. Distr. Burma, Japan, Central Africa, and U. S. A.

Staurastrum leptodermum LUND. var. ***Ikapoae*** (SCHMIDLE) W. & G. S. WEST in Ann. Roy. Bot. Gard. Calcatta **6**, p. 213, pl. 16, f. 8, 1907.

Cells 40-41 μ long, 34-35 μ broad, and isthmus 13-14 μ broad. Pl. 6, f. 8.

Hab. 16. Distr. Burma.

Staurastrum leptopus KRIEGER var. ***variabile*** SKUJA in Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14**:**5**, p. 159, pl. 34, f. 12, 23, 1949.

Cells 27-48 μ long (without proc.), 48-110 μ long (with proc), 15.5-31 μ broad (without proc.), 81-163 μ broad (with proc.), and isthmus 11-16 μ broad. Process of the present specimens long and slender, smooth or slightly undulate with large and sharp spines at the extremity. Pl. 12, f. 4, 5, pl. 13, f. 3.

Hab. 3, 6, 7, 12, 16, 19, 20, 25. Distr. Burma.

Staurastrum limneticum SCHMIDLE var. ***burmense*** W. & G. S. WEST in Ann. Roy. Bot. Gard. Calcatta **6**, p. 222, pl. 16, f. 13, 1907; GRÖNBLAD, Act. Soc. Sci. Fenn. n. s. B, II:**6**, p. 27, pl. 11, f. 225, 1945; SCOTT & PRESCOTT, Hydrobiol. **17**, p.

97, pl. 42, f. 2, 3, 1961.

Cells 31-34 μ long (without proc.), 53-57 μ long (with proc.), 75-88 μ broad (with proc.), and isthmus 8-9 μ broad. In the form reported by WEST form Burma, apex of semicell deficient in a cycle of granules, process somewhat variable in its length and in the number of undulation: one semicell with 3 nodulated processes and another semicell with 4 nodulated processes at the same individual. The present specimens have in many cases 4 nodulated processes but in some specimens the processes have 3 nodulated ones. Pl. 12, f. 8, pl. 13, f. 1.

Hab. 3, 4, 7, 9, 10, 12, 14, 15, 16, 19, 20, 24. Distr. Burma, Borneo, and Sumatra.

Staurastrum megacanthum LUND. in WEST & CARTER, Monogr, Brit. Desm. **5**, p. 20, pl. 131, f. 7, 8, 1923.

Cells 31-35 μ long, 30-31 μ brond, and isthmus 6.5-7 μ broad. Semicells triangular, apex straight or slightly convex, median constriction of cell deep, sinus subrectangular but slightly acuminate at the extremity, angles with a fairly long spine which is horizontal or divergent. The present specimens resemble *St. dejectum* f. *major* W. & G. S. WEST reported by WEST from English lakes as a plankton but smaller in size.

Hab. 25, Anc. 4. Distr. India, Java, Europe, N. America, and Patagonia.

Staurastrum mucronatum RALFS var. ***subtriangulare*** W. & G. S. WEST & CARTER in Monogr. Brit. Desm. **5**, p. 12, pl. 130, f. 13, 14, 1911.

Cells 30-32 μ long, 28.5-31 μ broad, and isthmus 7.5-8 μ broad. Sinus almost rectangular but slightly acuminate at the extremity, apex of semicell almost straight or slightly convex, angles provided with short spine which is slightly divergent. Pl. 10, f. 5.

Hab. 16, Anc. 10. Distr. Burma, Europe.

Staurastrum muticum BRÉB. in WEST, Monogr. Brit. Desm. **4**, p. 133, pl. 118, f. 16-20, 1911.

Cells 31-40 μ long, 30-35 μ broad, and isthmus 9-10 μ broad.

Hab. 9, 12, 16, 20, 21, 25. Distr. Cosmopolitan.

Staurastrum orbiculare RALFS var. ***extensum*** NORDST. in W. & G. S. WEST, Monogr. Brit. Desm. 4, p. 158, pl. 125, f. 1, 2, 1911.

Cells 40-44 μ long, 31-35 μ broad, and isthmus 12-13 μ broad.

Hab. 13, 15, 16, 18. Distr. Europe.

var. ***Messikommeri*** HIRANO in Contr. Biol. Lab. Kyoto Univ. **9**, p. 291, pl. 37, f. 19, 1959.

Cells 17-18 μ long, 17-18 μ broad, and isthmus 5.3 μ broad.

Hab. Anc. 4. Distr. Japan and Europe.

Staurastrum pachyrhynchum NORDST. in W. & G. S. WEST, Monogr. Brit.

Desm. **4**, p. 151, pl. 121, f. 8, 9, 1911.

Cells 38-40 μ long, 35-36 μ broad, and ishmus 8.8-9 μ broad.

Hab. 25. Distr. Burma, Japan, Europe, Spitzbergen, Greenland, and N. America.

Staurastrum paradoxum MEYEN in SMITH, Wisc. Bull. **57**, p. 85, pl. 72, f. 15-22, pl. 73, f. 1-2, 1924; WEST & CARTER, Monogr. Brit. Desm. **5**, p. 101, pl. 145, f. 1-5, 1923.

Cells 25-36.5 μ long (without proc.), 44-62 μ long (with proc.), 44-62 μ broad (with proc.), and isthmus 6.5-8.5 μ broad.

Hab. 4, 6, 7, 9, 12, 14, 16, 17, 18, 23, 24, 26. Distr. Japan, Australia, Europe, and N. & S. America.

Staurastrum pinnatum TURNER var. ***subpinnatum*** (SCHMIDLE) W. & G. S. WEST in Trans. Linn. Soc. Bot. **6**, p. 182, pl. 21, f. 33, 1902.——*St. subpinnatum* SCHMIDLE in Flora **82**, p. 311, pl. 9, f. 20, 1896.

Cells 24-25 μ long, 31-32 μ broad (with proc.), and isthmus 7.5 μ broad. The present specimens are smaller than those of the form reported by WEST from Ceylon and the processes are shorter than those of the Ceylon's form and have 3 nodulations along the side while 4 nodulations in the Ceylon's form. The basal part of semicell is destitute of the ring of granules. In other respects the present specimens coincide with the form known from Ceylon. The typical form of this species has been reported from India but the description is not accurate in detail. The present specimens coincide with the Ceylon's form in that the processes of the upper whorl are smooth and destitute of nodulation. Pl. 12, f. 1, 2.

In var. *hydra* reported from Sunda Islands by KRIEGER the processes have one nodulation and the shape of basal part of semicell in the front view differs from that of the present form, var. *hydra* apparently being a different variety from the present specimens of Cambodia.

STRÖM reported *St. pinnatum* from North Australia (Nyt. Mag. Naturvid. **59**, p. 6, pl. 1, f. 20, 1921). This report has the figure of the vertical view of *St. pinnatum* but not the figure of front view. The present specimens coincide with the figure given by STRÖM only in the vertical view of semicell of *St. pinnatum*. According to STRÖM the form obtained from N. Australia coincides well with the Ceylon's form by WEST. This form corresponds with the var. *subpinnatum* by WEST. As pointed out by WEST the typical form of *St. pinnatum* is not described unfortunately. There is therefore some confusion among the forms of the *pinnatum* reported from various districts. The typical form and var. *subpinnatum* probably belong to the same category and if this opinion is permitted the distributional area of this species covers the lands around the Indian Ocean: from East Africa to SE Asia eastward and further up to Japan and N. Australia in the southern part.

Hab. Anc. 4. Distr. Ceylon and Australia.

Staurastrum planctonicum TEILING in Bot. Notis. p. 77, f. 30, 32, 1946; SKUJA, Symb. Bot. Ups. **9**:**3**, p. 173, pl. 19, f. 9, 1948.

Cells 37-40 μ long (without proc.) 53-57 μ long (with proc), 70-72 μ broad (with proc), and isthmus 7.5-8 μ broad. Semicells of the present specimens are cup-shaped with slightly inflated base, sinus acuminate and the processes are long and furnished with about 10 nodulations from base to apex, and 4 sharp spines at the extremity. Vertical view of semicell 3-radiate, side almort straight and with a pair of geminate granules just within the side. The present specimens coincide with the forms reported by SMITH from Wisconsin lakes in the shape of semicell in front view but lack the series of intramarginal granules in his form. The forms obtained form Tonle Sap are similar to *St. cingulum* (W. & W.) Smith but the semicell in the front view lacks a transverse series of granules disposed just above the isthmus. In vertical view of semicell of *St. cingulum* reported from Wisconsin lakes there is no pair of granules within the margin. From these points above mentioned the present specimens do not belong to either *St. gracile* or *St. cingulum*. Pl. 13, f. 4.

Hab. 4, 21, 22. Distr. Europe.

Staurastrum polymorphum BRÉB. in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 125, pl. 142, f. 24, pl. 143, f. 1-3, 1923; MESSIKOMMER, Schw. Ztschr. Hydrol. **16**, pl. 4, f. 13, 1954.

Cells 17.5-20 μ long, 27-30 μ broad (with proc.), and isthmus 3.5-4 μ broad. The basal part of semicell rectangular, basal angles rectangularly rounded, sinus acuminate at the extremity. TURNER reported *St. ambiguum* from India and the apex of semicell in this species is elevated and in this character the present specimens differ from his species. The vertical view of the present specimens shows 3-angular, side slightly concave, processes 4 nodulated and the series of granules are not prominent. Pl. 4, f. 3.

Hab. Anc. 4. Distr. Cosmopolitan.

Staurastrum protectum W. & G. S. WEST var. ***rangoonense*** (SKUJA) SCOTT & PRESCOTT in Hydrobiol. **17**, p. 103, pl. 44, f. 1, 2, 1961.

Cells 28.5-35 μ long (without proc.), 48.5-66 μ long (with proc.), 37.5-42 μ broad (without proc.), 55-62 μ broad (with proc.), and isthmus 9-10.5 μ broad. Pl. 9, f. 3.

Hab. 3, 6, 9, 14, 16, 17, 19, 20, 21. Distr. Burma and Borneo.

Staurastrum punctulatum BRÉB. in W. & G. S. WEST, Monogr. Brit. Desm. **4**, p. 179, pl. 127, f. 8-11, 13, 14, 1911.

Cells 38-40 μ long, 32-33 μ broad, and isthmus 8-9 μ broad.

Hab. 25. Distr. Cosmopolitan.

Staurastrum saltans JOSHUA var. ***sumatranum*** SCOTT & PRESCOTT in Hydrobiol. **17**, p. 106, pl. 51, f. 3, 4, 1961.

Cells 39-40 μ long, 91-93 μ broad (with proc.), and isthmus 8.5-9 μ broad. Pl. 11, f. 5.

Hab. Anc. 4. Distr. Sumatra.

Staurastrum Sebaldi REINSCH var. ***ornatum*** NORDST. in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 167, pl. 148, f. 7, 1923; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **18**:**3**, p. 270, pl. 55, f. 3, 1964; FÖRSTER, Hydrobiol. **23**, p. 427, pl. 31, f. 9-11, 1964; LIND & CROASDALE, Journ. Phycol. **2**, p. 111, f. 1-14, 1966.

Cells 48-51 μ long, 62-88 μ broad (with proc.), and isthmus 13-17 μ broad. Pl. 6, f. 3, 4.

Hab. Kg Lu 1. Distr. Sumatra, Australia, New Zealand, Africa, Europe, and Brazil.

Staurastrum sexangulare (BULNH.) LUND. in Nov. Act. Reg. Soc. Ups. ser. III, 8, p. 71, pl. 4, f. 9, 1871; GRÖNBLAD, Act. Soc. Faun. Flor. Fenn. **47**, p. 77, pl. 3, f. 118, 1920; WEST & CARTER, Monogr. Brit. Desm. **5**, p. 194, pl. 157, f. 2, 3, 1923.

Cells 65-67 μ long (with proc.), 63-64 μ broad (with proc.), and isthmus 12 μ broad.

Hab. 8, 19, 21. Distr. Malaya, Japan, and Europe.

var. ***asperum*** PLAYFAIR in KRIEGER, Arch. Hydrobiol. Suppl. **11**, p. 206, pl. 17, f. 2, 1932; SCOTT & PRESCOTT, Hydrobiol. **17**, p. 107, pl. 45, f. 1-3, 1961.

Cells 57-58 μ long (without proc.), 97-99 μ long (with proc.), 76-97 μ broad (with proc.), and isthmus 17 μ broad.

The processes of the present specimens are shorter and robust than those of the forms reported by SCOTT and KRIEGER and not nodulated. In the vertical view of semicells Cambodian forms are 6-angular while in the form of Java the semicells are 7-angular. TURNER reported a similar form named var. *crassum* from India but it differs from the present specimens by less nodulation of process. Pl. 9, f. 6.

Hab. Anc. 4. Distr. Java and Australia.

var. ***bidentatum*** GUTW. in SCOTT & PRESCOTT, Record Amer.-Austral. Sci. Exped. Arnhem Land **3**, p. 65, Fig. 19, f. 5-9, Fig. 21, f. 14, 1958.

Cells 88-101 μ long (without proc.), 95-97 μ long (with proc.), 88-101 μ broad (with proc.), and isthmus 21-22 μ broad. Pl. 10. f. 9.

Hab. 15, 24, 25. Distr. Australia.

var. ***crassum*** TURNER in GRÖNBLAD, Act. Soc. Faun. Flor. Fenn. **47**, p. 77, pl. 3, f. 119-120, 1920.

Cells 90-92 μ long (with proc.), 96-98 μ broad (with proc.), and isthmus 21-22 μ broad. Pl. 9, f. 5.

Hab. Anc. 4. Distr. India, Japan, and Europe.

var. ***subglabrum*** W. & G. S. WEST in Trans. Linn. Soc. Bot. **6**, p. 181, pl. 21,

f. 35, 1902; OKADA Bot. Mag. **50**, p. 259, pl. 3, f. 14, 1936.

Cells 56-60 μ long (with proc.), 62-65 μ broad (with proc.), and isthmus 9-10 μ broad.

Hab. 16, 20, 24, 25. Distr. Ceylon and Japan.

Staurastrum subamericanum GRÖNBLAD in Act. Soc. Sci. Fenn. n. ser. B, II : **6**, p. 30, pl. 13, f. 277, 1945.

Cells 30-39 μ long (without proc.), 57-80 μ long (with proc.), 17.5-26.5 μ broad (without proc.), 98-105 μ broad (with proc.), and isthmus 7-8.6 μ broad. The apex of semicell is slightly convex and undulated, processes long and not attenuated to the apex and curved upward, the extremity of process is provided with sharp and large spines. The present species resemble *St. chaetoceros* but differ from it by not having a curved process and the more elected process. Pl. 9, f. 4.

Hab. 3, 4, 6, 9, 10, 12, 15, 16, 21, 27, Anc. 11, BA1, BA3. Distr. Europe.

Staurastrum tauphorum W. & G. S. WEST in Trans. Linn. Soc. Bot. **6**, p. 191, pl. 22, f. 23-25, 1902; SKUJA, Nov. Act. Reg. Soc. Sci. Ups. ser. IV, **14** : **5**, p. 161, pl. 35, f. 18, 19, 1949.

Cells 49-56 μ long (without proc.), 73-96 μ long (with proc.), 24-26.5 μ broad (without proc.), 84-105 μ broad (with proc), and isthmus 8.6-9.5 μ broad. The present specimens coincide well with the original description and figure reported from Ceylon by WEST. WEST described forma *burmense* from Burma as being different from the typical form by having long processes, but SCOTT & PRESCOTT have an opinion that the typical form of Ceylon and forma *burmense* are identical. Pl. 11, f. 1, 2.

Hab. 3, 6, 10, 12, 13, 14, 17, 18, 19, 20, Hab. Burma and Ceylon.

Staurastum teliferum RALFS in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 58, pl. 136, f. 2-6. 1923.

Cells 41-42 μ long. 37.5-38 μ broad. and isthmus 13 μ broad.

Hab. 16, 21. Distr. Burma, Japan, Siberia. Europe. N. America, and Brazil.

Staurastrum tohopekaligense WOLLE in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 178, pl. 155, f. 12, 1923; HIRANO, Contr. Biol. Lab. Kyoto Univ. **9**, p. 378, pl. 51, f. 1, 2, 1959.

Cells 35-40 μ long (without proc.), 74.6-79 μ long (with proc.), 26.5-28.5 μ broad (without proc.), 70-79 μ broad (with proc.), and isthmus 15-17 μ broad.

Hab. 3, 5, 6, 7, 9, 10, 12, 13, 14, 15, 16, 18, 19, 20, 21, 25, Anc. 4. Distr. India, central Africa, Japan, and Europe.

Staurastrum unguiferum TURNER in K. Sv. Vet. Akad. Hand. **25**, p. 130, pl. 15, f. 18, 1893; GRÖNBLAD, Act. Soc. Faun. Flor. Fenn. **66** : **1**, p. 25, pl. 1, f. 22, 1947.

Cells 47-48.5 μ long, 38-39.5 μ broad, and isthmus 17 μ broad. The present speci-

mens are not always coincide with the form reported from India by TURNER. Sinus acuminate at the extremity and apical angles not mamillated. For this nature GRÖNBLAD considered such a form as a forma however it is doubtful whether the forms reported from India have mamillate apical angles or not until I may observe directly the Indian specimens. Because TURNER's figures on other species are in general inaccurate. The apical angle on *St. unguiferum* figured by TURNER gives both impressions mamillate and non-mamillate appearance.

Hab. 25. Distr. India.

var. ***inerme*** (TURNER) W. & G. S. WEST in Ann. Roy. Bot. Gard. Calcatta **6**, p. 213, pl. 16, f. 11, 1907.

Cells 45-46 μ long, 34.5-35 μ broad, and isthmus 11 μ broad. The semicells of the present specimens are broader than those of the original form described by WEST from Burma. Lateral angles of semicell slightly produced upward so that the base of process namely lateral margin seem to be retuse and for this nature the present specimens resemble *St. leptodermum* but lack spine. The apex of semicell seem to be hollow for the projection of processes. Pl. 11, f. 4.

Hab. 21. Distr. India and Burma.

Staurastrum Wildemani GUTW. in SCOTT & PRESCOTT, Hydrobiol. **17**, p. 119, pl. 49, f. 1, 1961.

Cells 46-57 μ long, 51-57 μ broad (without spine), 81.5-88 μ broad (with spine), and isthmus 17-19 μ broad. Semicells transversely subelliptic, apex convex. The forms known from Java and other Sunda Islands have flattened or very faintly convex apex of semicell so that semicells seem to be subtriangular. Lateral spines of the present specimens are somewhat closely disposed each other while in the form of Sunda Islands spines fairly widely disposed and opened outward each other. The present species are similar to *St. longispinum* but the size of cell of the *St. Wildemani* is prominently larger than those of the *St. longispinum* and is about twice as large as that species. Pl. 6, f. 9.

Hab. 3, 12, 16, 19, 20, 24, 25. Distr. Borneo, Java, and Sumatra.

var. ***unispiniferum*** SCOTT & PRESCOTT in Reiwardtia **3**, p. 356, f. 19, 20, 1956; FÖRSTER, Hydrobiol. **23**, p. 431, pl. 33, f. 17, 1964.

Cells 46-51 μ long, 48.5-53 μ broad (without spine), and isthmus 17-20 μ broad. Pl. 10, f. 8.

Hab. 16, 19, 20. Distr. Sumatra.

Staurastrum xanthium KRIEGER in SCOTT & PRESCOTT, Hydrobiol. **17**, p. 119, pl. 58, f. 10, 1961.

Cells 27-28 μ long (without spine), 44-45 μ long (with spine), 32-36 μ broad (without spine), 45-50 μ broad (with spine), and isthmus 10-11 μ broad. Pl. 13, f. 2.

Hab. 21. Distr. Java and Borneo.

Staurastrum zonatum BÖRGES. var. ***majus*** SCOTT & PRESCOTT in Hydrobiol. **17**, p. 119, pl. 46, f. 8, pl. 48, f. 7, 8, 1961.

Cells 30-35 μ long (without proc.), 37.5-48 μ long (with proc.), 20-22 μ broad (without proc.), 53-70 μ broad (with proc.), and isthmus 9-16 μ broad. There is a small emarginate verruca on both sides of the base of processes in the vertical view of semicell on the original description of Indonesian specimens but this verruca does not seen in Cambodian specimens. The present specimens similar to *St. limneticum* reported from Lake Victoria by GRÖNBLAD, SCOTT and CROASDALE in the vertical view of semicell: namely semicell in vertical view 6-angular and with six processes but differ from their forms by the processes are much graceful and much nodulated than the form reported from Lake Victoria. In vertical view of semicell there is no granular ornamentation within the body. Also the forms from Lake Victoria seem to be differing from the forms reported from E. Africa by SCHMIDLE judging from their description and figure. *St. limneticum* and its variety reported by CROASDALE and others must be belong to the other separate species. Pl. 12, f. 3.

Hab. 1, 6, 14, 21, 25, BA3. Distr. Borneo and Sumatra.

var. ***productum*** W. & G. S. WEST in Ann. Roy. Bot. Gard. Calcatta **6**, p. 222, pl. 16, f. 14, 1907.

Cells 30-31 μ long (without proc.), 32-33 μ long (with proc.), 21-22 μ broad (without proc.), 45-46 μ broad (with proc.), and isthmus 12 μ broad. The present specimens are larger than those of the *St. asteroideum* reported from N. America. The basal part of semicell furnished with a transverse row of granules just above the isthmus. The processes are slightly divergent and its length is almost equal to the breadth of the body of semicell. Pl. 13, f. 5.

Hab. 16. Distr. Burma.

Sphaerozosma granulatus ROY & BISSET in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 213, pl. 160, f. 6, 7, 1923.

Cells 11-13 μ long, 13-13.5 μ broad, and isthmus 4.5 μ broad.

Hab. 3, 7, 9, 14, 15, 16. Distr. Cosmopolitan.

Onychonema filiforme (EHRENB.) ROY & BISSET in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 216, pl. 160, f. 13, 14, 1923.

Cells 10-11 μ long, 10.5-11.5 μ broad, and isthmus 3.5 μ broad.

Hab. Anc. 4. Distr. India, Celebes, Australia, New Zealand, Europe, and Japan.

Onychonema laeve NORDST. in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 217, pl. 160, f. 15, 16, 1923.

Cells 16 μ long, 21-22 μ broad (without spine), and isthmus 5.5 μ broad.

Hab. Anc. 4. Distr. India, Ceylon, Burma, Java, Australia, Japan, Europe, N. America, and Brazil.

Desmidium Baileyi (RALFS) NORDST. in HIRANO, Contr. Biol. Lab. Kyoto Univ. **11**, p. 397, pl. 53, f. 4, 1960.

Cells 21-22 μ long, 17.5-18 μ broad.

Hab. 4, 7, 9, 10, 16, 20, 21, 24, 25. Distr. Ceylon, Japan, Europe, Africa, and N. America.

Desmidium Swartzii AG. in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 246, pl. 163, f. 5-8, 1923.

Cells 14-15 μ long, 38-40 μ broad, and isthmus 32-34 μ broad.

Hab. Anc. 4. Distr. Cosmpolitan.

Gymnozyga moniliformis EHRENB. in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 255, pl. 165, f. 8, 9, 1923.

Cells 34-35 μ long, 17-17.5 μ broad, and isthmus 15 μ broad.

Hab. 29. Distr. Cosmopolitan.

Plate 1

1. *Pleurotaenium indicum* (GRUN.) LUND.
2. *Pl. Trabecula* (EHRENB.) NÄG. var. *maximum* (REINSCH) ROLL
3. *Pl. truncatum* (BRÉB.) NÄG.
4. *Pl. eugeneum* (TURNER) W. & G. S. WEST

5, 6. *Pl. elatum* (TURNER) BORGE var. *undulatum* var. nov.

7. *Pl. ovatum* NORDST.
8. *Pl. burmense* (JOSHUA) KRIEGER var. *longissimum* SCOTT & PRESCOTT

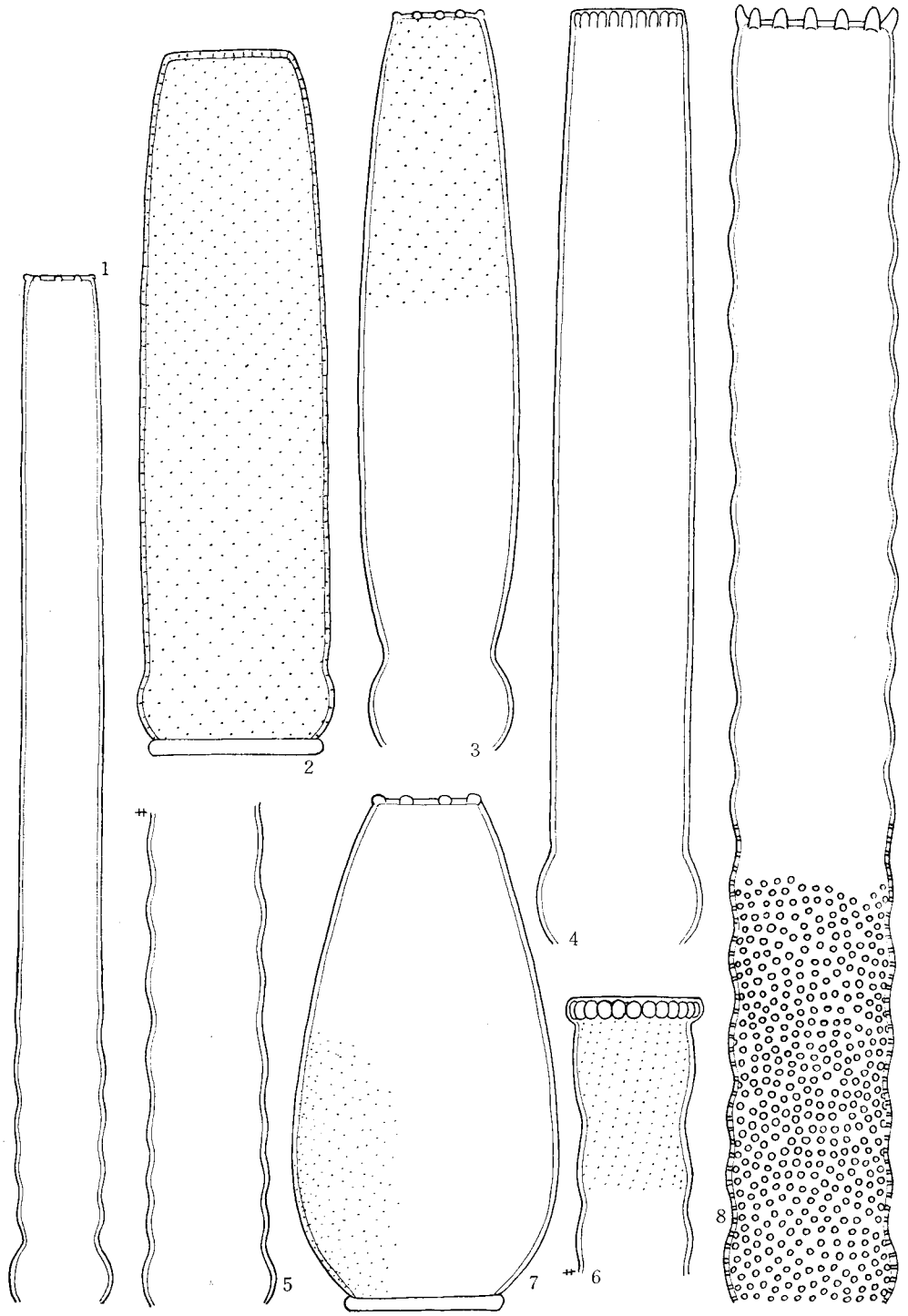

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Plate 2

1. *Cosmarium glyptodermum* W. & G. S. WEST var. *tuberculatum* SCOTT & PRESCOTT
2. *C. variolatum* LUND. var. *rotundatum* MESSIKOMMER
3. *C. controversum* W. WEST
4. *C. lomnicense* LÜTKEM.
5. *C. subpyramidatum* (W. & G. S. WEST) LÜTKEM.
6. *C. Blyttii* WILLE var. *novae-silvae* W. & G. S. WEST
7. *Arthrodesmus curvatus* TURNER

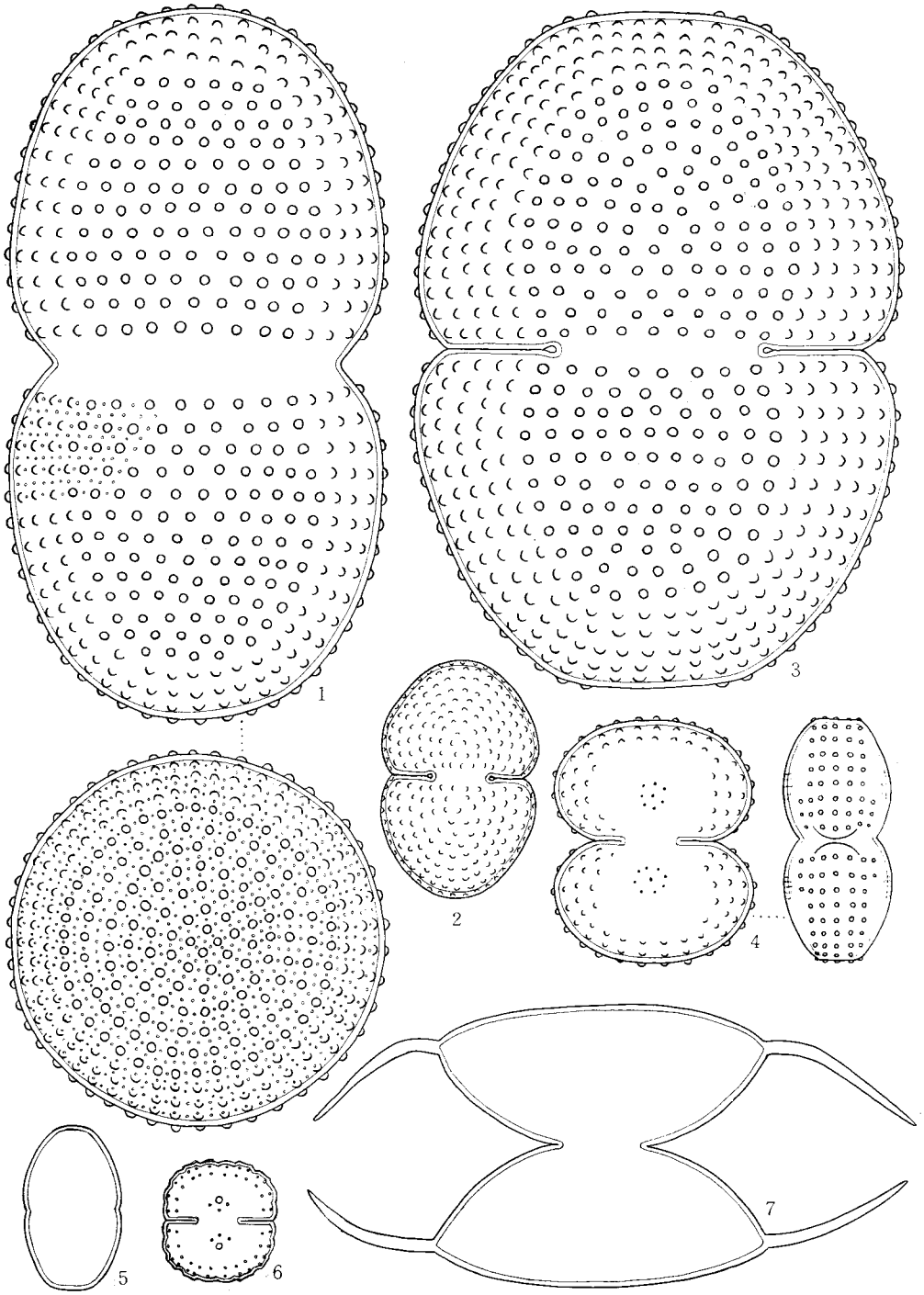
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Plate 3

1. *C. Lundellii* DELP. var. *circulare* (REINCH) KRIEGER
2. *C.* " " var. *sinense* GERLOFF
3. *C. sulcatum* NORDST.
4. *C. tumidum* LUND.
5. *C. contractum* KIRCHN. var. *ellipsoideum* (ELFV.) W. & G. S. WEST
6. *C. granatum* BRÉB. var. *pyramidale* SCHMIDLE
7. *C. subauriculatum* W. & G. S. WEST
8. *C. sumatranum* KRIEGER var. *nepalense* FÖRSTER
9. *C. regulare* WILLE
10. *C. contractum* KIRCHN.
11. *C. Wittrockii* LUND.
12. *C. lapponicum* BORGE
13. *C. scabratum* W. & G. S. WEST
14. *C. phaseolus* BRÉB. var. *minutum* (BISWAS) GERLOFF
15. *C. maculatiforme* SCHMIDLE var. *maior* GUTW.

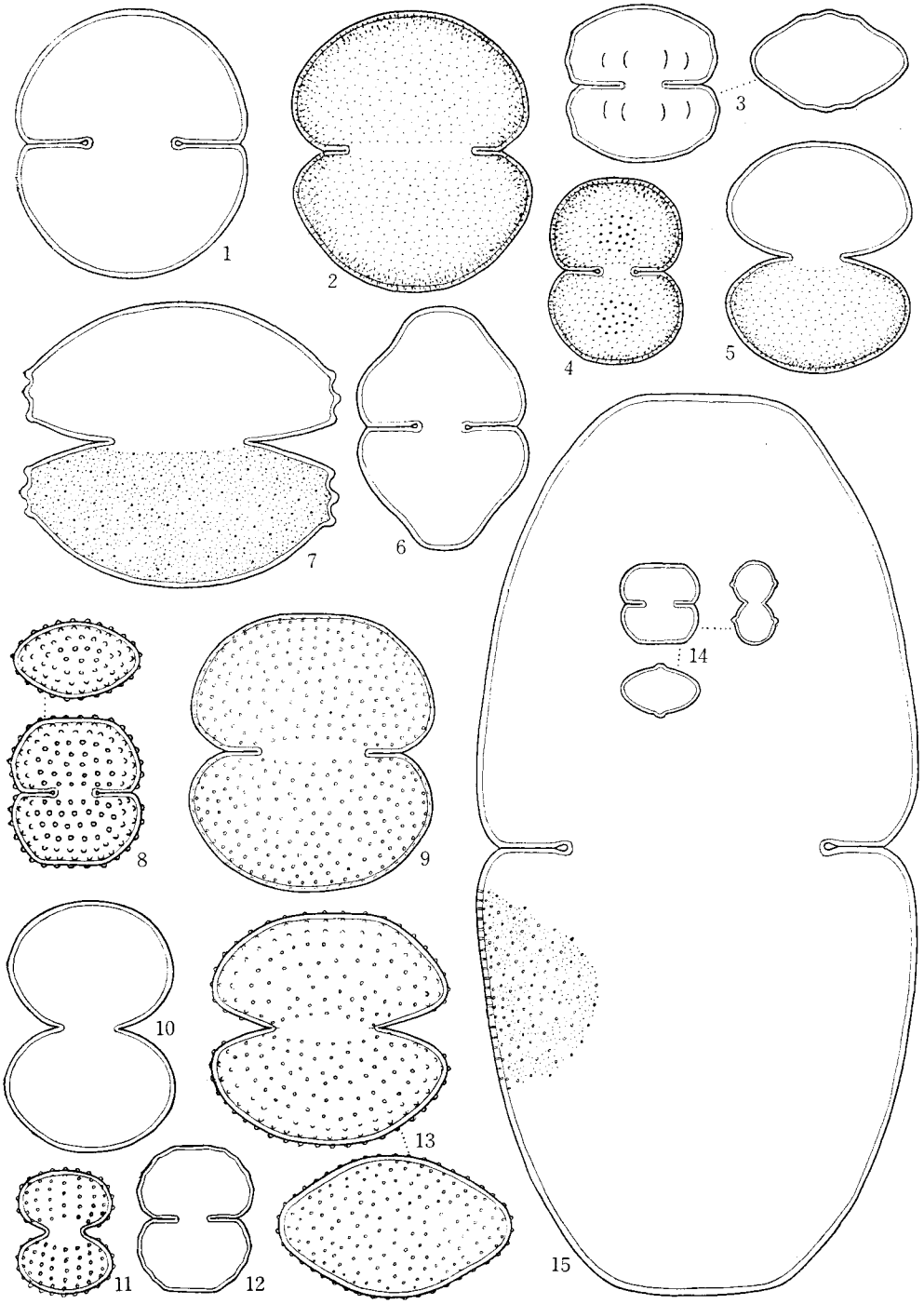
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Plate 4

1. *Arthrodesmus convergens* EHRENB.
2. *A. curvatus* TURNER var. *kalimantanum* SCOTT & PRESCOTT
3. *Staurastrum polymorphum* BRÉB.
4. *Cosmarium stigmosum* (NORDST.) KRIEGER

5, 6. *Xanthidium sansibarense* HIER. forma *asymmetricum* SCOTT & PRESCOTT

7. *Euastrum denticulatum* (KIRCHN.) GAY var. *quadrifarium* KRIEGER
8. *Cosmarium decoratum* W. & G. S. WEST

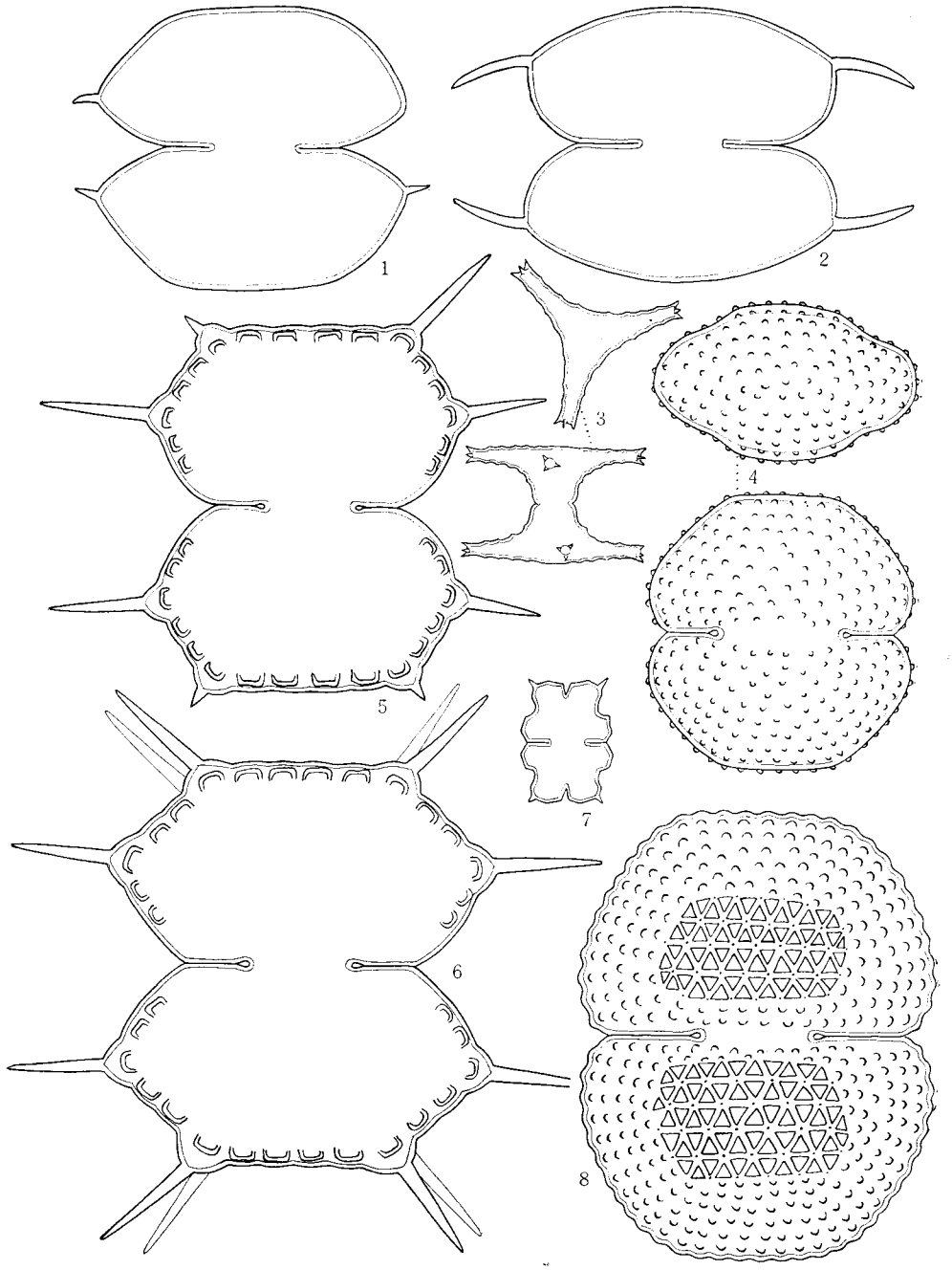
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Plate 5

1. *Closterium parvulum* NÄG. var. *angustum* W. & G. S. WEST
2. *Cl. pusillum* HANTZSCH var. *monolithum* WITTR.
3. *Euastrum substellatum* NORDST.
4. *E. serratum* JOSHUA
5. *E. flammeum* JOSHUA
6. *E. spinulosum* DELP.
7. *Staurastrum contectum* TURNER
8. *Euastrum substellatum* NORDST.
9. *E. divergens* JOSHUA var. *ornatum* (BORGE) SCHMIDLE
10. *E. sinuosum* LENORM var. *germanicum* (RACIB.) LÜTKEM.
11. *E. ansatum* EHRENB. var. *pyxidatum* DELP.
12. *E. didelta* RALFS var. *bengalicum* LAGERH.

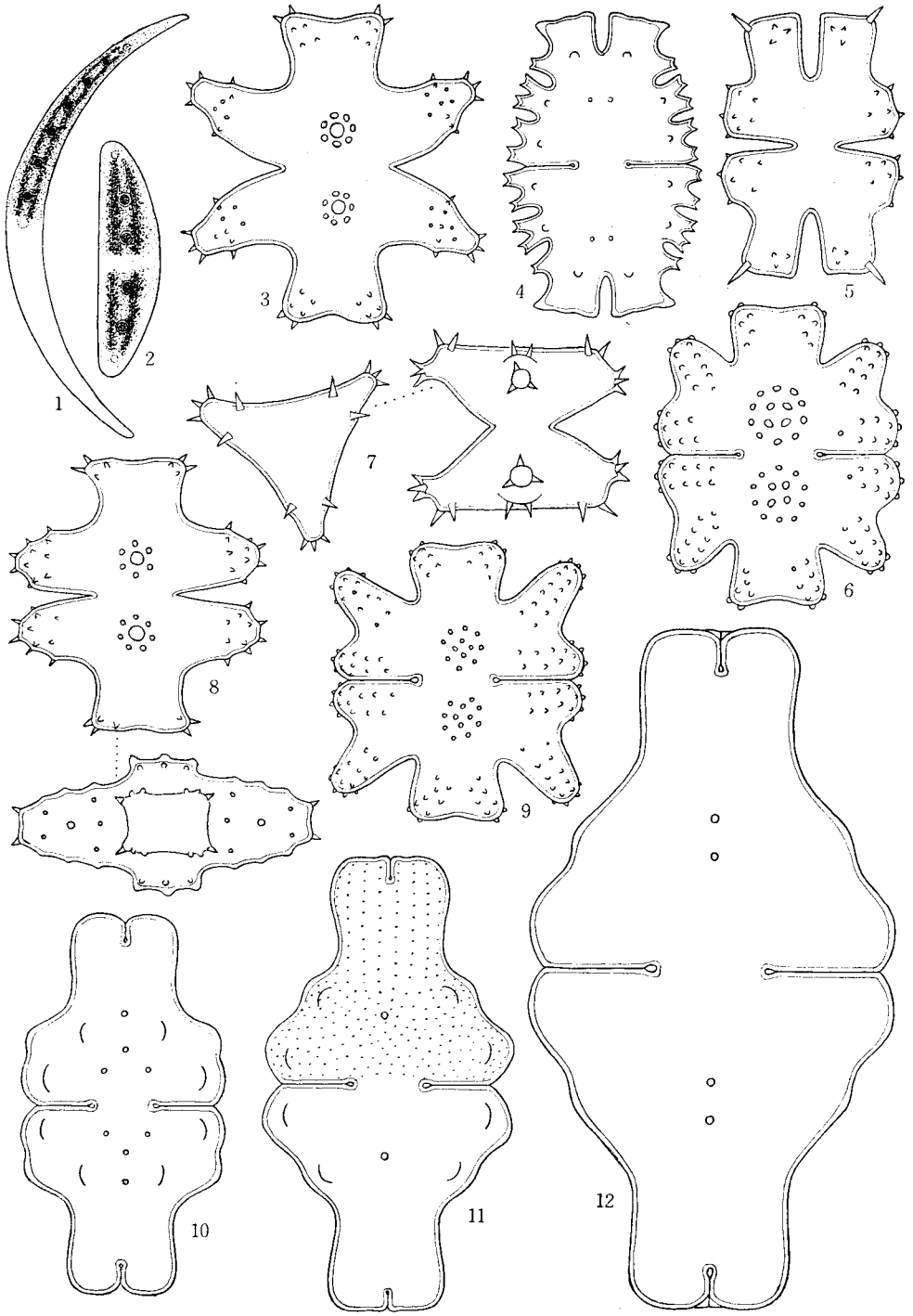
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Plate 6

1. *Closterium lagoense* NORDST. var. *brevius* var. nov.
2. *Cl. nematodes* JOSHUA var. *robustum* var. nov.
3, 4. *Staurastrum Sebaldi* REINSCH var. *ornatum* NORDST.
5. *Cosmarium cambodiense* sp. nov.
6. *Staurastrum corniculatum* LUND. var. *pelagicum* TEILING
7. *St. ensiferum* TURNER
8. *St. leptodermum* LUND. var. *Ikapoae* (SCHMIDLE) W. & G. S. WEST
9. *St. Wildemani* GUTW.

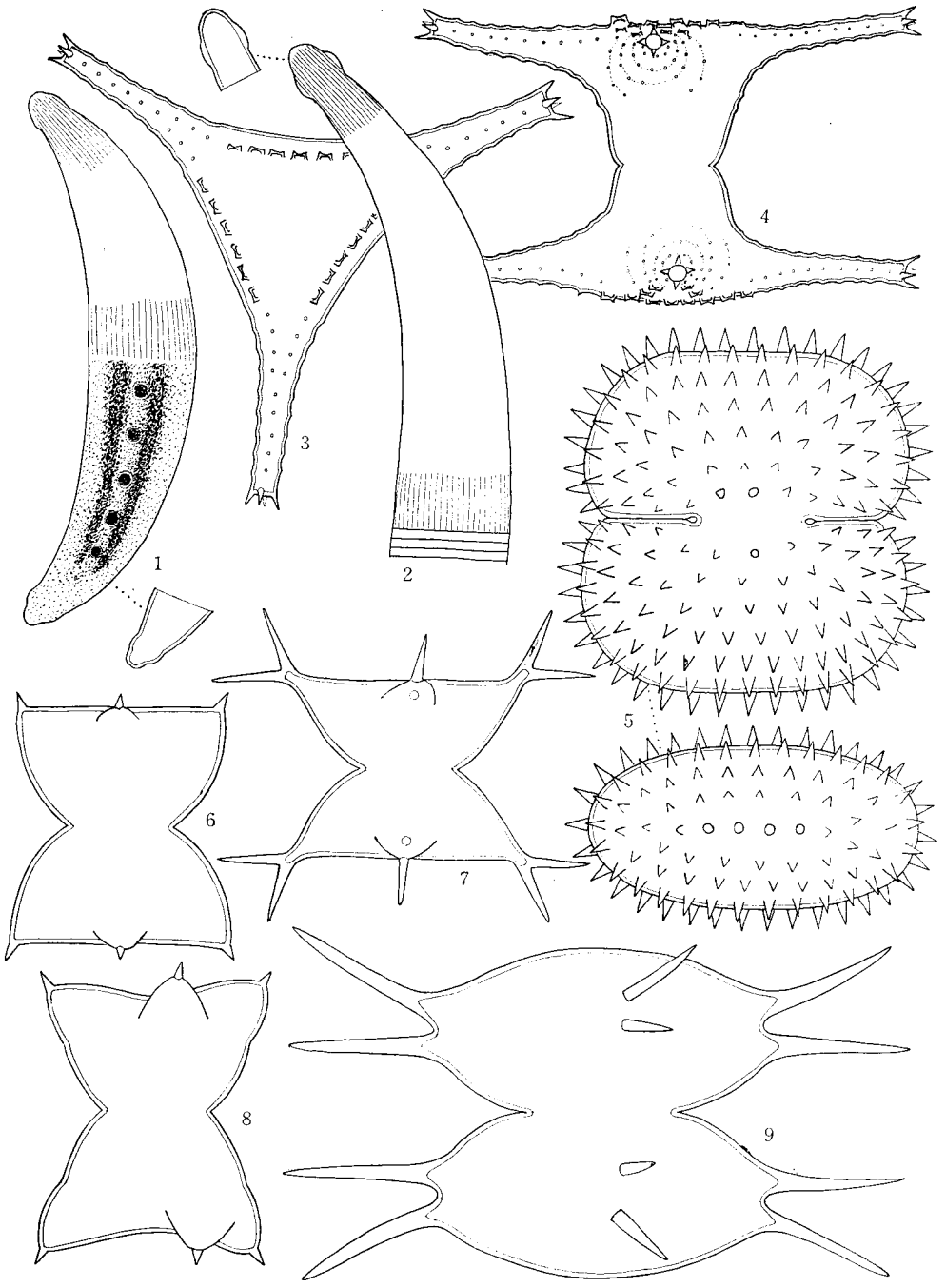
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Plate 7

1. *Arthrodesmus subulatus* KÜTZ.
2. *A. convergens* EHRENB.
3. *A. curvatus* TURNER
4. *A. convergens* EHRENB.

5, 6. *Xanthidium antilopaeum* (BRÉB.) KÜTZ. var. *laeve* SCHMIDLE forma *longispinum* SCOTT & PRESCOTT

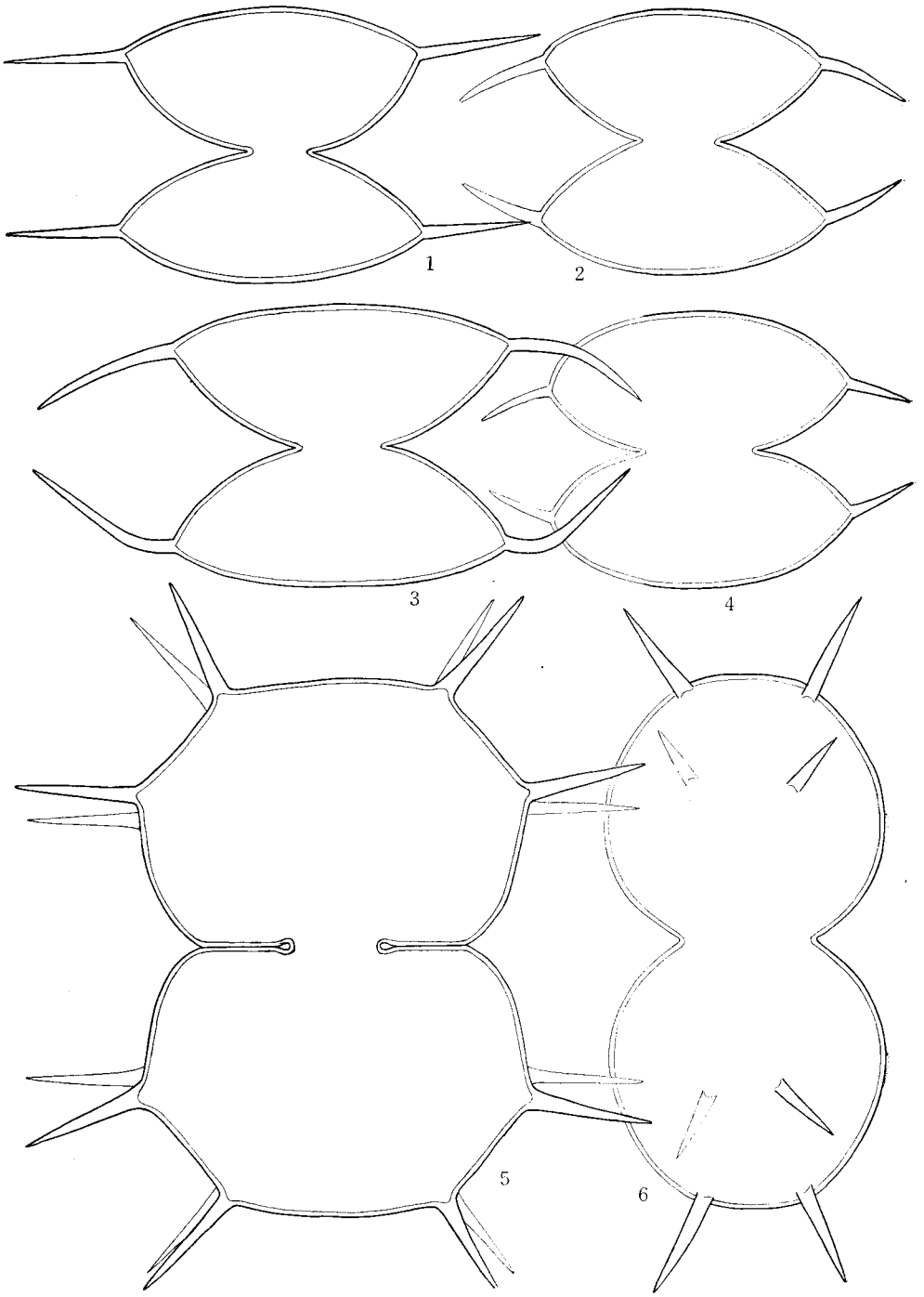
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Plate 8

1. *Xanthidium sexmamillatum* W. & G. S. WEST var. *pulneyense* IYENGAR
2. *X. antilopaeum* (BRÉB.) KÜTZ. var. *laeve* SCHMIDLE forma *minus* SCOTT & PRESCOTT
3. *X. spinosum* (JOSHUA) W. & G. S. WEST
4. *X. acanthophorum* NORDST.
5. *X. sansibarense* HIER. forma *asymmetricum* SCOTT & PRESCOTT
6. *X. hastiferum* TURNER var. *javanicum* (NORDST.) TURNER

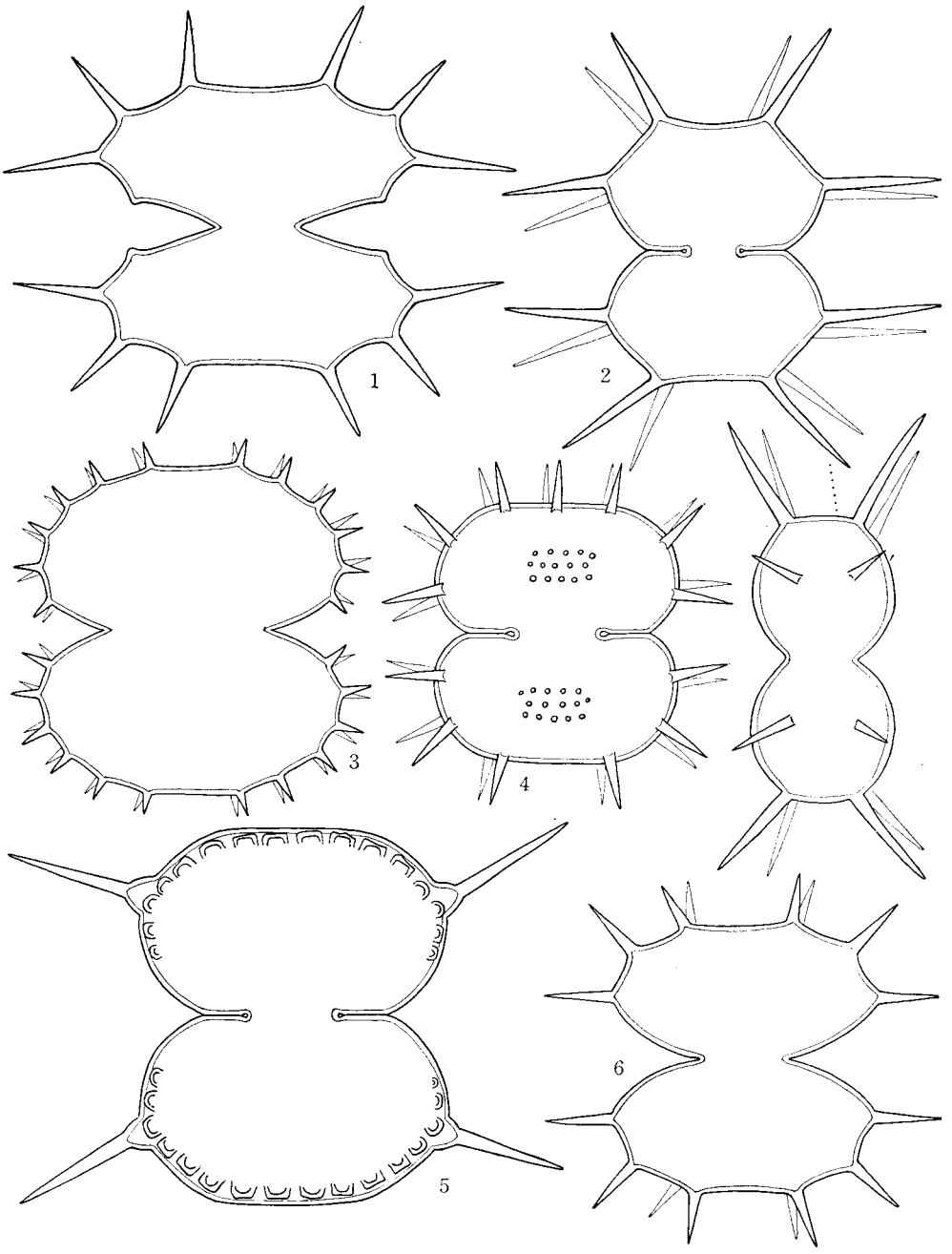
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Plate 9

1. *Cosmarium trachypleurum* LUND. var. *minus* RACIB.
2. *Staurastrum aculeatum* (EHRENB.) MENEGH. var. *ornatum* NORDST.
3. *St. protectum* W. & G. S. WEST var. *rangoonense* (SKUJA) SCOTT & PRESCOTT
4. *St. subamericanum* GRÖNBLAD
5. *St. sexangulare* (BULNH.) LUND. var. *crassum* TURNER
6. *St.* 〃 〃 〃 var. *asperum* PLAYFAIR

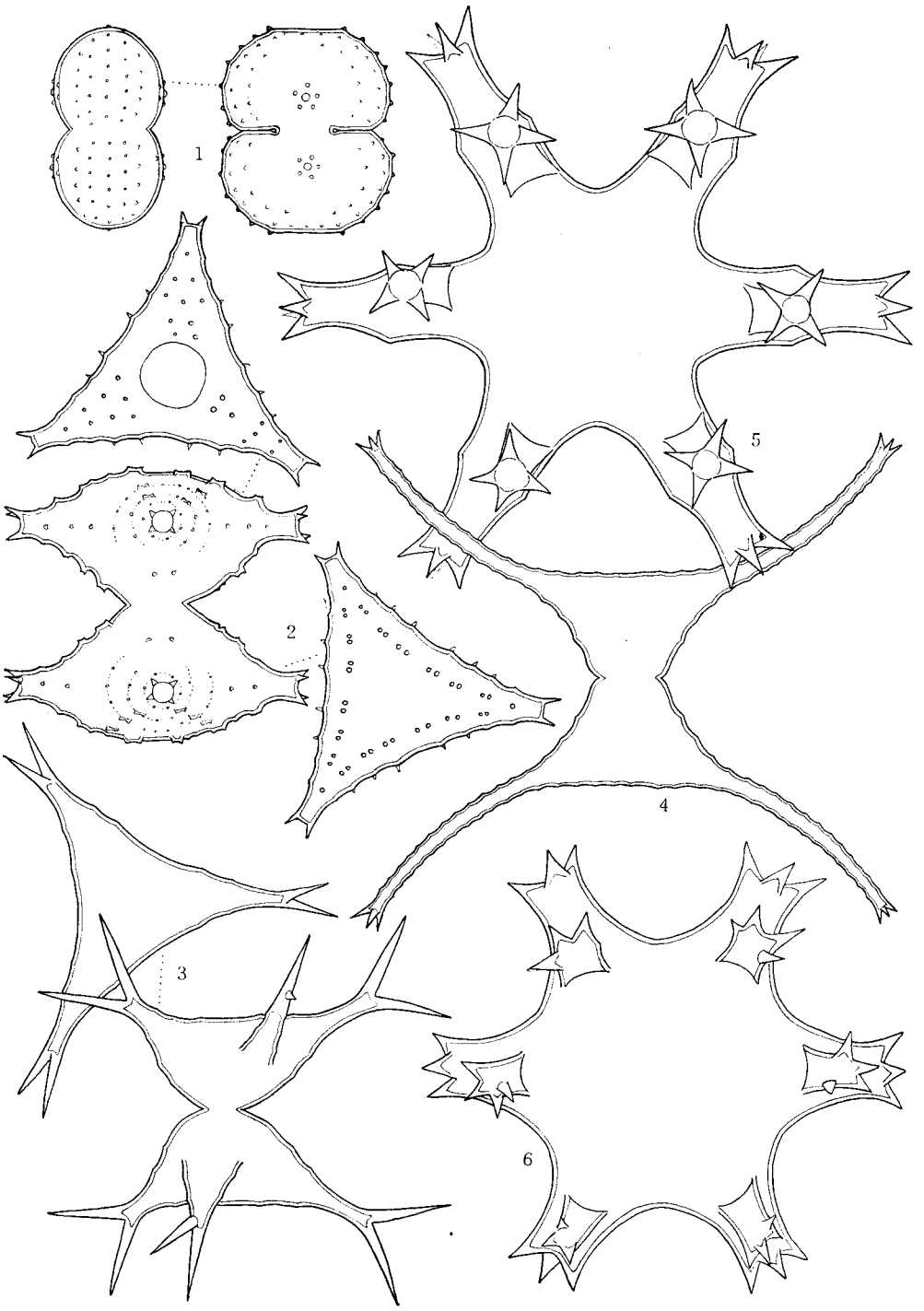
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Plate 10

1. *Staurastrum excavatum* G. S. WEST
2. *St. columbetoides* W. & G. S. WEST
3. *St. gracile* RALFS var. *elegantum* SCOTT & PRESCOTT
4. *Cosmarium regnesi* REINSCH var. *montanum* SCHMIDLE
5. *Staurastrum mucronatum* RALFS var. *subtriangulare* W. & G. S. WEST
6. *St. bieneanum* RABENH.
7. *St. leptocladum* NORDST.
8. *St. Wildemani* GUTW. var. *unispiniferum* SCOTT & PRESCOTT
9. *St. sexangulare* (BULNH.) LUND. var. *bidentatum* GUTW.

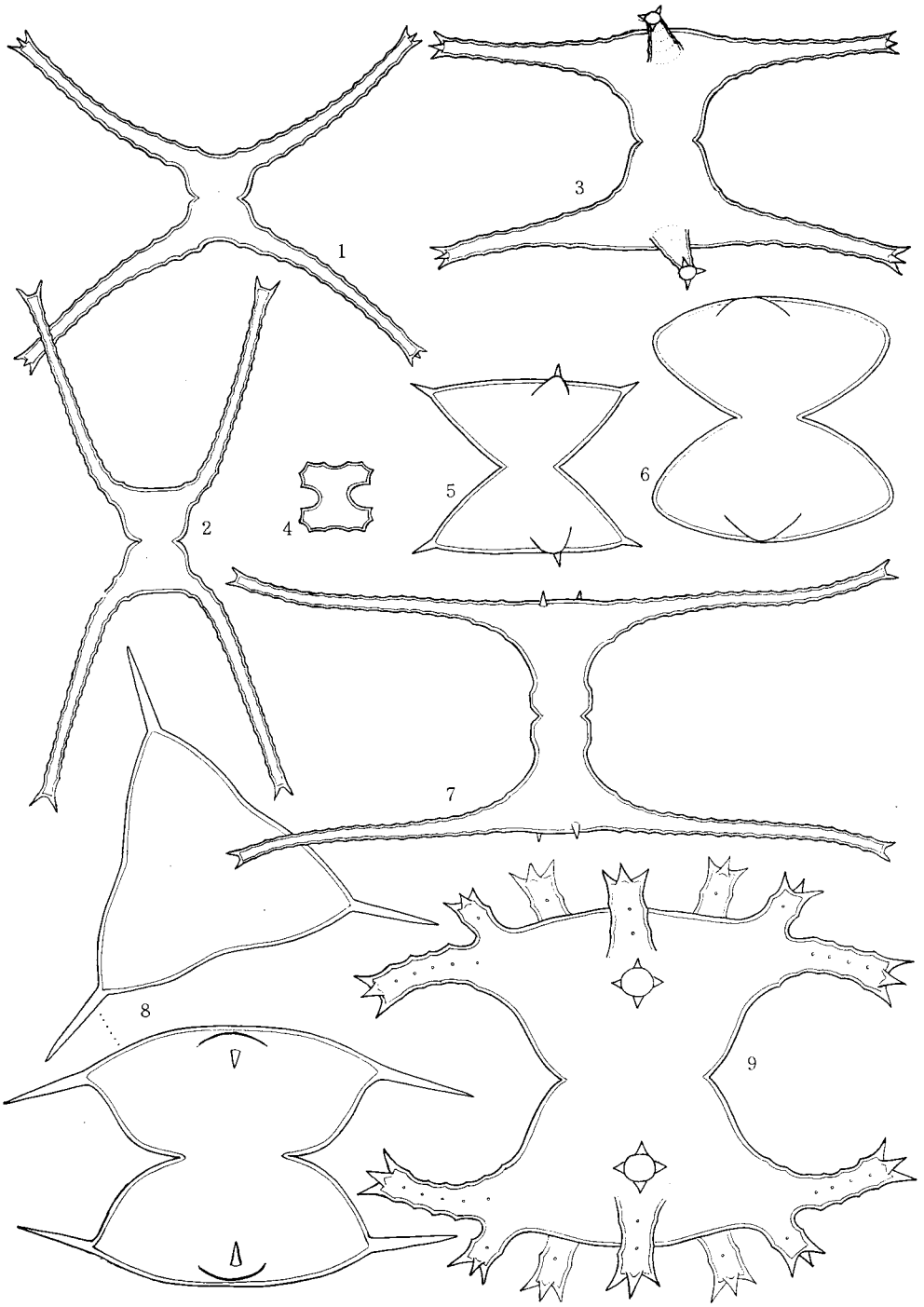
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Plate 11

1, 2. *Staurastrum tauphorum* W. & G. S. WEST
3. *St. freemani* W. & G. S. WEST var. *nudiceps* SCOTT & PRESCOTT
4. *St. unguiferum* TURNER var. *inerme* (TURNER) W. & G. S. WEST
5. *St. saltans* REINSCH var. *sumatranum* SCOTT & PRESCOTT
6, 7. *St. freemani* W. & G. S. WEST var. *nudiceps* SCOTT & PRESCOTT

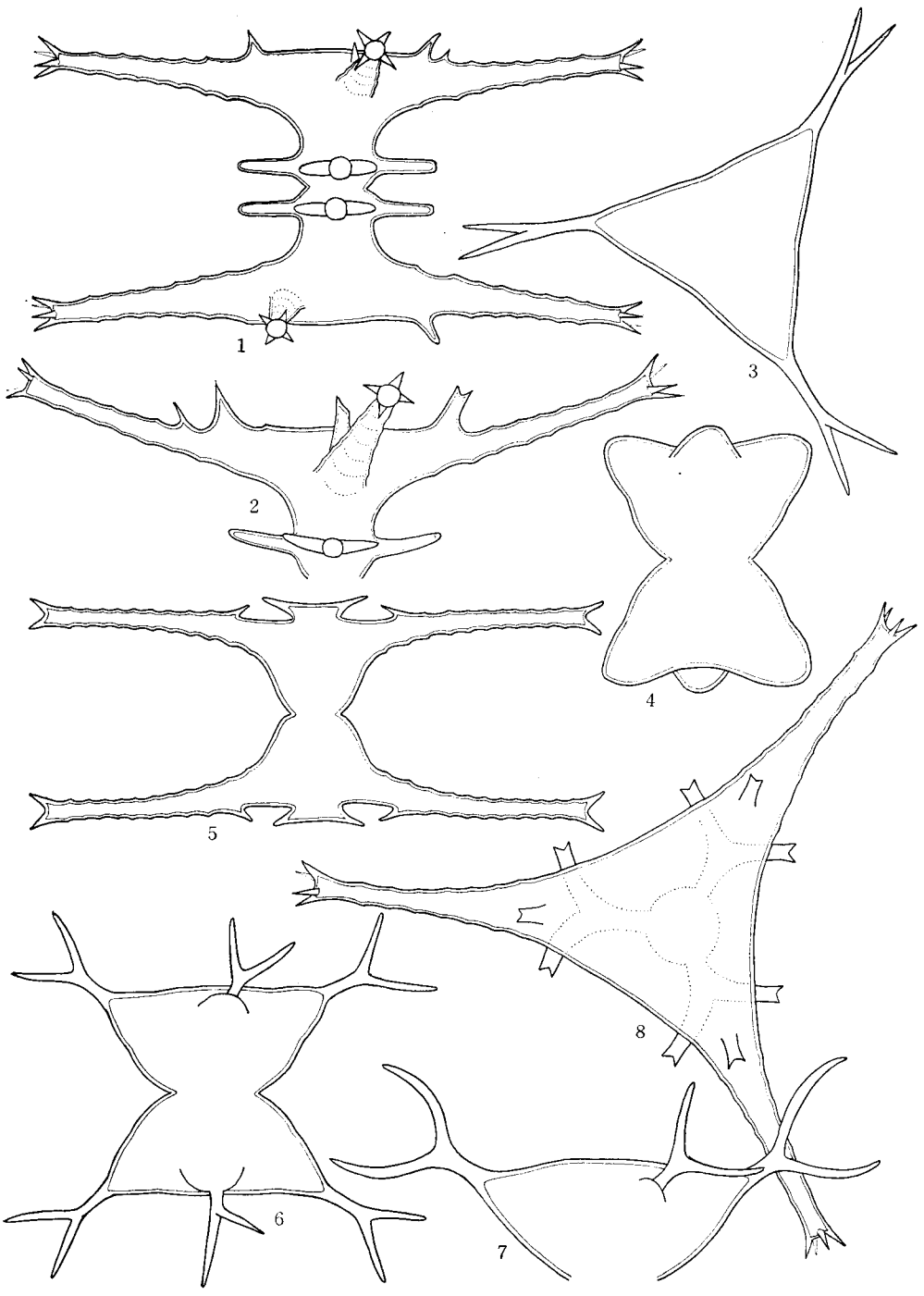
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Plate 12

1, 2. *Staurastrum pinnatum* var. *subpinnatum* (SCHMIDLE) W. & G. S. WEST
3. *St. zonatum* BÖRGES. var. *majus* SCOTT & PRESCOTT
4, 5. *St. leptopus* KRIEGER var. *variabile* SKUJA
6, 7. *St. javanicum* (NORDST.) TURNER var. *apiculiferum* (TURNER) KRIEGER
8. *St. limneticum* SCHMIDLE var. *burmense* W. & G. S. WEST
9. *St. acanthocephalum* SKUJA

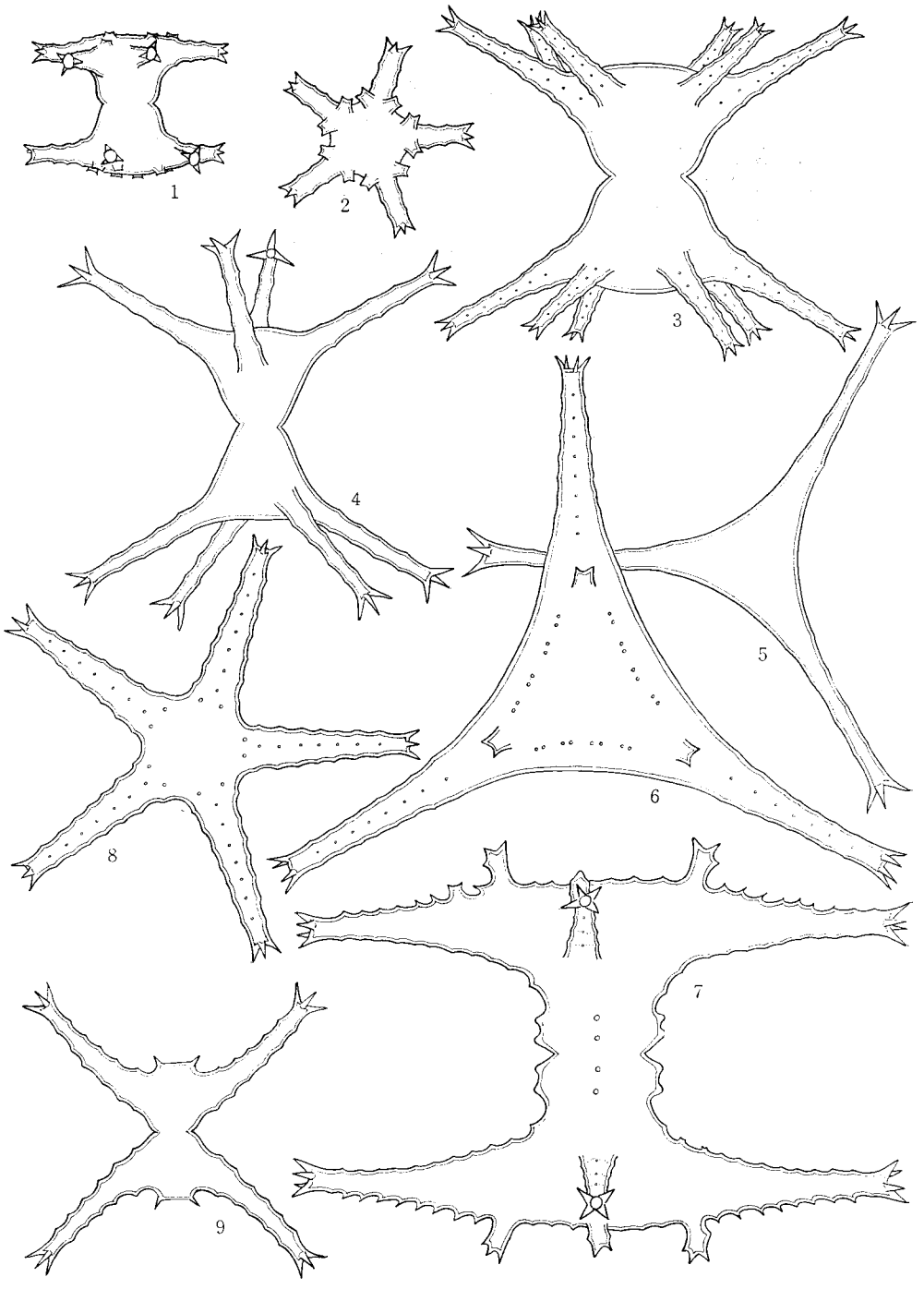
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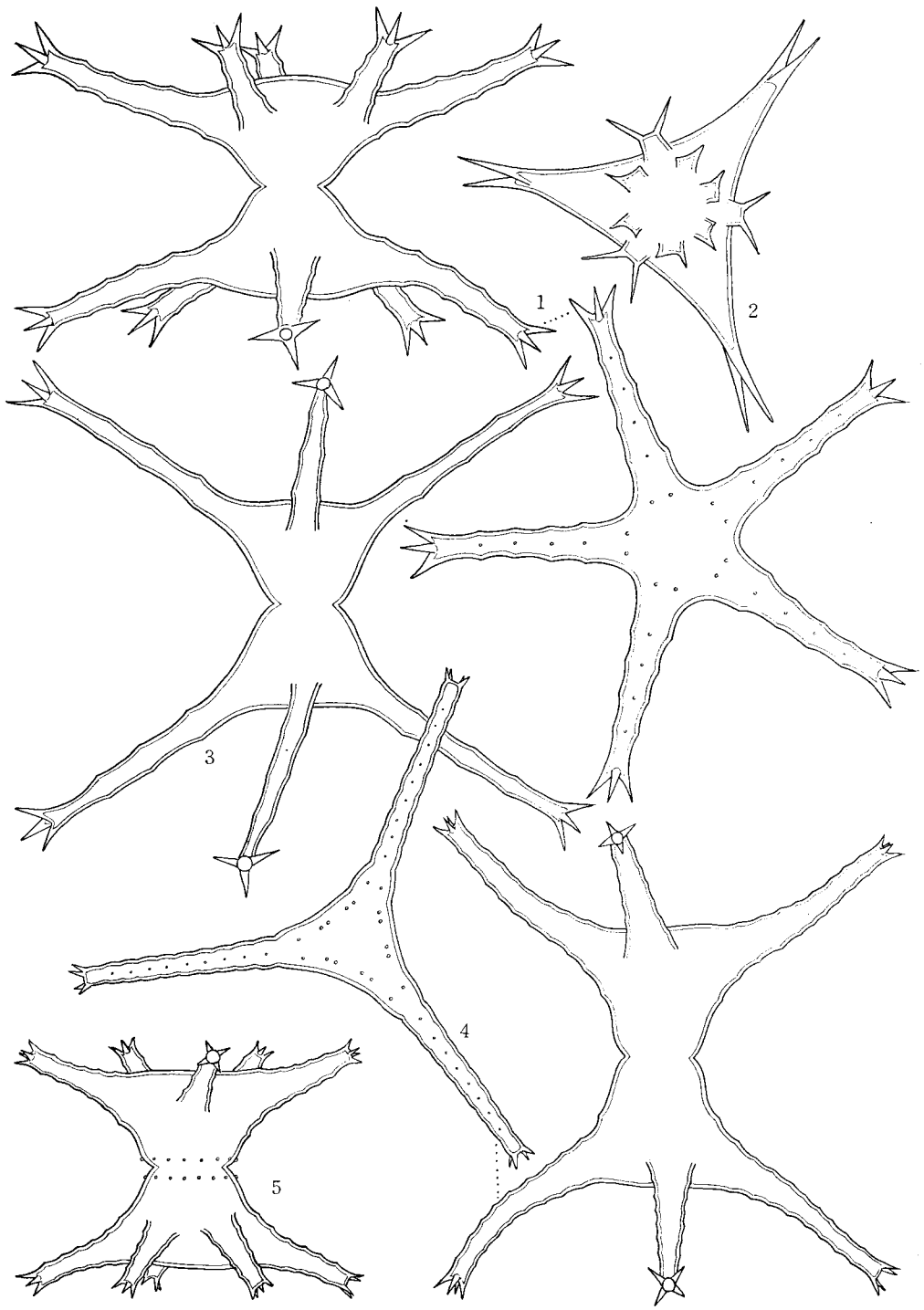
Plate 13

1. *Staurastrum limneticum* SCHMIDLE var. *burmense* W. & G. S. WEST
2. *St. xanthium* KRIEGER
3. *St. leptopus* KRIEGER var. *variabile* SKUJA
4. *St. planctonicum* TEILING
5. *St. zonatum* BÖRGES var. *productum* W. & G. S. WEST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