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

by

Minoru Hirano

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; therefore 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. taehorum, 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.

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(After 1970)
Desmids from Cambodia

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

**Gonatozygaceae**


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


**Mesotaeniaceae**

*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 μm long and 19-21 μm 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.


**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 μm long and 17-18 μm 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 μm long and 31-39.5 μm broad.


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.


**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.


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 truncatedly 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 extremitatis leviter rotundis, marginibus ventralibus paene rectis, marginibus dorsalibus valide convexis; membrana striata; cellulae 162-176 μ longae et 36-37 μ 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.


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


Cells 75-78μ long and 17.5μ broad.


*Closterium nematodes* Joshua in Krieger, l. c. p. 370, pl. 37, f. 1, 2, 1935.

var. *robustum* Hiranò, 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 350–357 μ longis et 39.5–40 μ latis. Pl. 6, f. 2.

Hab. Anc. 4.

*Closterium parvulum* Nag. 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.


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*.


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 *Closterium 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.


**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.


**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.


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 22-24μ broad.


**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.


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

Pleurotaenium Ehrenbergii (Bréb.) De Bary var. crenulatum (Ehrenb.)
Krieger in 1. 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.

var. undulatum Hirano, var. nov.
Cellulae submagnae, cylindraceae, circiter 12 duplo longiores quam latiores; semicellulae non attenuatae ad apicem, cum inflatione prominenti basali et saepe subundulatis 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.

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.

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.

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 702-835\(\mu\) long, 35\(\mu\) broad, and apices 22\(\mu\) 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, 600-620\(\mu\) long, 57-57.5\(\mu\) broad, and apices 50-51\(\mu\) broad.

Hab. 29. Distr. India and Burma.

The present specimens are slightly smaller than those described by Turner and Krieger.


Cells 430-458\(\mu\) long, 83.5-85\(\mu\) broad, isthmus 44-45\(\mu\) broad, and apices 30.5-31\(\mu\) broad.


Cells 308-383\(\mu\) long, 35-42\(\mu\) broad, and apices 20.5-22\(\mu\) broad.


Cells 504-590\(\mu\) long, 68-69\(\mu\) broad, and apices 48.5-49\(\mu\) broad. Pl. 1, f. 2.


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.

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

**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.

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.

Semicells trapeziform-semicircular, upper lateral crenae emarginate, and larger than those of the lower entire crenae, apical angles become emarginate crenae 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.

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, latera margin convex and crenulate, middle crena somewhat produced, sinus deep and closed.

**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 radiantis 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, Japan, E. Africa and Ireland.


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.


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.


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.

Desmids from Cambodia

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

Cells not exactly oblong-elliptic but somewhat pyramidal-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.


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

Hab. MRI. Distr. Europe.


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.


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


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.


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

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 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.

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


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.


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.


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


Cosmarium lapponicum Borge in Bot. Notis. p. 19, pl. 1, f. 14, 1913; Skuja,
Desmids from Cambodia


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.


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.


**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.


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


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.


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.


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


Cells 62-65 $\mu$ long, 41-43 $\mu$ broad, and isthmus 13-14 $\mu$ broad.

Cells 13-14 $\mu$ long, 10.5-11 $\mu$ broad, and isthmus 3.5-4 $\mu$ broad.

Cells 60-63 $\mu$ long, 72-74 $\mu$ broad, and isthmus 25-26 $\mu$ broad.

Cells 67-68 $\mu$ long, 74-75 $\mu$ broad, and isthmus 37-38 $\mu$ broad.

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 $\mu$ long, 13-13.5 $\mu$ broad, and isthmus 3.5 $\mu$ broad. Pl. 3, f. 14.
Hab. Anc. 4. Distr. India.

Cells 51-55 $\mu$ long, 33-35 $\mu$ broad, and isthmus 11-13 $\mu$ broad.

**Cosmarium punctulatum** Breb. in W. & G. S. West, Monogr. Brit. Desm. 3, p. 206, pl. 84, f. 13, 14, 1908.
Cells 35-36 $\mu$ long, 30-31 $\mu$ broad, and isthmus 10-11 $\mu$ broad.

**Cosmarium Quadrum** Lund. var. *minus* Nordst. in W. & G. S. West,
Desmids from Cambodia

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,

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

Cosmarium regnesi Reinsch var. montanum Schmidle in W. & G. S. West,

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

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;

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.

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


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

Cosmarium subauriculatum W. & G. S. West in Trans. Linn. Soc. Bot. 5,
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.


Cells small, slightly constricted in the middle, sinus in shallow depression; semicells roundo-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.


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.

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


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.
Desmids from Cambodia

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


Cells 32–33.5 \( \mu \) long, 26–26.5 \( \mu \) broad, and isthmus 6.5–7 \( \mu \) broad. Pl. 9, f. 1.

Hab. 15. Distr. Europe.


Cells 17.5–18 \( \mu \) long, 11 \( \mu \) broad, and isthmus 3 \( \mu \) broad.


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 \( \mu \) long, 22–23 \( \mu \) broad, and isthmus 4.5–5 \( \mu \) broad. Pl. 3, f. 4.

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


Cells 198–205 \( \mu \) long, 75–77 \( \mu \) broad, and isthmus 64–65 \( \mu \) broad.


Cells 35–40 \( \mu \) long, 26–27 \( \mu \) broad, and isthmus 8.7–9.5 \( \mu \) broad. Pl. 2, f. 2.

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


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 \( \mu \) long, 16–17 \( \mu \) broad, and isthmus 7.5–8.5 \( \mu \) broad. Pl. 3, f. 11.


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).


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.


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.


Cells 101–102 μ long, 103–104 μ broad (without spine), and isthmus 26–26.5 μ broad. 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.


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 an 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.


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.
Desmids from Cambodia


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


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.


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


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. 81, 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.


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


**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.


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.


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.


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. _bengaticum_ Lagerh. in Krieger, Krypt. Fl. 13, Abt. 1, p. 519, pl. 67, f. 4-6, 1937.


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


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.


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


_Euastrum serratum_ Joshua in Krieger, Krypt. Fl. 13, Abt. 1, p. 623, pl. 88,
Desmids from Cambodia

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.

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.

Cells 57–60 μ long, 35–37 μ broad, and isthmus 11–12 μ broad.
Hab. Anc. 4. Distr. Sumatra and Europe.

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.

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.

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.

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.

Cells 55–57 μ long, 86–88 μ broad, and isthmus 12.5–13 μ broad.
Cells 148-152 μ long, 120-132 μ broad, and isthmus 17-22 μ broad.

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.

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.

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.

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

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. *grandes* 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.


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, although he considered this form as a different one from the typical.


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


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.

**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.

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.


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. pseudopeleagicum* 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.


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


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.


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.


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

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.


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.


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.


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


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.

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 broad, 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. subtriangularare 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.


**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.


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


**Staurastrum pachyrhynchum** Nordst. in W. & G. S. West, Monogr. Brit.
Desmids from Cambodia

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

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


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. *hydras* 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. *hydras* 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.

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 acuminated 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 almost straight and with a pair of germinative 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 from 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.


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 acuminated 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.


**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.


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

Hab. Anc. 4. Distr. Sumatra.


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.


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.


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.


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,

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 7.6-8.6 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.


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.

Staurastrum 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.


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.


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 Grönb 
blad 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 inaccu 
rate. The apical angle on St. unguiferum figured by Turner gives both impressions— 
mamillate and non-mamillate appearance.

Hab. 25. Distr. India.

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.


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.


var. unispiniferum Scott & Prescott in Reiwartia 3, p. 356, f. 19, 20, 1956; 

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


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.

*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 Grönlad, 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. Distr. Borneo and Sumatra.


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.


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


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.


Cells 16 μ long, 21–22 μ broad (without spine), and isthmus 5.5 μ broad.
Desmids from Cambodia

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

Cells 21-22 µ long, 17.5-18 µ broad.

**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.

Cells 34-35 µ long, 17-17.5 µ broad, and isthmus 15 µ broad.
Plate 1

1. *Pleurotaenium indicum* (GRU.) LUND.
2. *Pl. Trabecula* (EHRENB.) NÄG. var. *maximum* (REINSC) 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
Plate 2

1. *Cosmarium glyptodermum* W. & G. S. West var. *tuberculatum* Scott & Prescott
2. *C. variolatum* Lund. var. *rotundatum* Messikomer
3. *C. controversum* W. West
5. *C. subpyramidatum* (W. & G. S. West) Lútkem.
6. *C. Blyttii* Wille var. *novae-silvae* W. & G. S. West
7. *Arthodesmus curvatus* Turner
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 Kirch. var. ellipsoideum (Elfv.) W. & G. S. West
6. C. granatum Bréb. var. pyramidalé SchmIdle
7. C. subauriculatum W. & G. S. West
8. C. sumatranum Krieger var. nepalense Förster
9. C. regulare Wille
10. C. contractum Kirch.
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.
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. *quadrisarium* Krieger
8. *Cosmarium decoratum* W. & G. S. West
Plate 5

1. *Closterium parvulum* Näg. var. angustum W. & G. S. West
2. *Cl. pusillum* Hantzsch var. monolithum Wittr.
4. *E. serratum* Joshua
5. *E. flammeum* Joshua
7. *Staurastrum contectum* Turner
9. *E. divergens* Joshua var. ornatum (Borge) Schmidle
10. *E. sinuosum* Lenorm var. germanicum (Racib.) Lütkem.
11. *E. ansatum* Ehrenb. var. pyxidatum Delp.
Plate 6

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

1. *Arthrodesmus subulatus* Kütz.
2. *A. convergens* Ehrenb.
3. *A. curvatus* Turner
5, 6. *Xanthidium antilopaeum* (Bréb.) Kütz. var. *laeve* Schmidle forma *longispinum* Scott & Prescott
Plate 8

1. *Xanthidium sexmamillatum* W. & G. S. West var. *pulneyense* Iyengar
2. *X. antilopaeum* (Bréb.) Kütz. var. *laeve* Schombie forma *minus* Scott & Prescott
3. *X. spinosum* (Joshua) W. & G. S. West
4. *X. acanthophorum* Nordst.
5. *X. sansibarense* Hier. forma *asymmetricum* Scott & Prescott
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. n n n var. asperum* PLAYFAIR
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.
Plate 11

1, 2. *Staurastrum tauhorum* 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
Plate 12

1, 2. *Staurastrum pinnatum* var. *subpinnatum* (Schmidle) W. & G. S. West
3. *St. zonatum* Börjes. 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
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* Börjes var. *productum* W. & G. S. West