Reprinted from the Journal of the Indian Botanical Society
Vol. XX, Nos. 1 & 2, 1941, pp. 73-103

DESMIDS FROM KODAIKANAL, SOUTH INDIA

By M. O. P. Iyengar, M.A., Ph.D. (Lond.), F.L.S.
and
Miss B. Vimala Bai, B.Sc. (Hons.), M.Sc. (Madras)

THE BANGALORE PRESS, MYSORE ROAD, BANGALORE CITY—1941

DESMIDS FROM KODAIKANAL, SOUTH INDIA*

BY M. O. P. IYENGAR, M.A., PH.D. (LOND.), F.L.S.

AND

MISS B. VIMALA BAI, B.SC. (HONS.), M.SC. (MADRAS)

Received for publication on September 3rd, 1940

THE number of papers dealing with systematic accounts of Desmids from various parts of India is rather few. Wallich's (1860) paper on the Desmidiaceæ from lower Bengal was the first systematic account of Desmids from India. In this paper he described nearly 140 species collected in the neighbourhood of Raneegunge—a place about 120 miles North-West of Calcutta. Hobson in 1863 published an account of two Desmids from Mahabuleshwar in the Bombay Presidency. Grunow in 1865 recorded 14 Desmids from the Island of Banka near Singapore. In 1873 Zeller recorded a few Desmids from Burma. Lagerheim (1888) recorded about 52 species from Bengal. Joshua (1885, 1886) recorded about 188 species and varieties from Rangoon. Turner (1893) gave an account of about 540 forms from North India based mainly on Wallich's extensive collections and notes. Borge (1899) recorded several forms from Bengal, Ceylon and Singapore. W. and G. S. West (1897) described a few desmids from Singapore. Schmidle in 1900 gave an account of 26 Desmids collected by Hansgirg in Bombay and the neighbourhood. In 1902, W. and G. S. West recorded about 246 species from Ceylon and Fritsch in 1907 recorded some Desmids from the same country. In 1907 W. and G. S. West gave a further account of 148 species, chiefly from Burma and a few from Bengal. In 1926 Carter recorded about 100 species from North-Western Himalayas, North-Western Frontier and Satpura Hills in the Central Provinces. About 121 species were recorded by P. Brühl and K. Biswas (1926) from the Loktak lake in the Manipur State.

All these records are from North India, Burma or Ceylon. Practically no work appears to have been done so far on the Desmidiaceæ of South India. The Desmids which form the subject of this paper were collected in 1921, 1923, 1933 and 1936 from Kodaikanal, a hill station in South India, with an elevation of about 7–8000 feet above the sea-level. The climate is sub-tropical and nearly temperate. Most of the forms described in this paper are planktonic and collected from the Kodaikanal lake and a few were collected from a swamp in Kodaikanal. The material was preserved in 4% formalin.

---

* From the University Botany Laboratory, Madras.

On the whole 35 forms are recorded in this paper, representing 13 genera. Of these 7 are new varieties and one a new form. Of the remaining 27 forms, 8 are new to India, Burma and Ceylon.

Systematic

Genus *Gonatozygon* De Bary 1856

1. *Gonatozygon Kinahani* (Arch.) Rabenh.

(Figs. 1, 2*a*, 2*b*)

Gonatozygon Kinahani Rabenhorst, *Flor. Europ. Alg.*, III, 1868, p. 156 ; Cooke, *Brit. Desmids*, 1887, p. 3, Pl. 1, Fig. 3 ; De Toni, *Syll. Alg.*, I, 1889, p. 802 ; W. and G. S. West, *Mon. Brit. Desmidiaceæ*, I, 1904, p. 35, Pl. 2, Figs. 1–3.

Gonatozygon leiodermum Turner, 1893, p. 24, Pl. 20, Fig. 5.

Cells mostly single, sometimes in chains of two or more cells ; 10–19 times longer than broad ; cylindrical ; apices truncate slightly dilated. Cell wall perfectly smooth ; pyrenoids 6–10 in each chloroplast.

Dimensions :

Length	..	..	..	124–259·5 μ
Breadth	..	..	..	10·9–14 μ

Hab.—Planktonic in Kodaikanal Lake.

The present form agrees with *Gonatozygon leiodermum* Turner (Turner, 1893) in general appearance and dimensions. Turner's Desmid was collected at Nilgiris, another hill station in South India, of the same elevation as Kodaikanal, *viz.*, 7–8,000 ft. above the sea-level. With regard to Turner's *G. leiodermum*, W. and G. S. West (1895, p. 65) state that it is " very probably an *Oedogonium*". But Turner's figure shows clearly that it is not an *Oedogonium* as suspected by West and West, since the cells are swollen at both the ends as is characteristic of *Gonatozygon* and not at one end only as in *Oedogonium*. There appears to be therefore no sufficient reason for considering the alga an *Oedogonium* and not a *Gonatozygon*.

Genus *Netrium* Nägeli 1849

2. *Netrium digitus* (Ehrbg.) Itzigs and Rothe.

(Figs. 5, 6)

Penium digitus Ralfs, *Brit. Desm.*, 1848, p. 150, Pl. 25, Fig. 3 ; Rabenhorst, *Flor. Europ. Alg.*, III, 1868, p. 118 ; Delponte, *Desm. Subalp.*, 1877, p. 86, Pl. 15, Figs. 50 and 51 ; West and West, *Freshw. Alg. Ceylon*, 1902, p. 134.

Penium digitus forma *rectum* Turner, *Freshw. Alg. E. India*, 1893, p. 18, Pl. 1, Fig. 27.

Netrium digitus West, W. and G. S., *Mon. Brit. Desm.*, I, 1904, p. 64, Pl. 6, Figs. 14–16 ; Smith, *Wisconsin phytoplankton*, pt. II, 1924, p. 6, Pl. 52, Fig. 5 ; Krieger, *Die Desmidiaceen der Deutsch Limn. Sunda Expedition*, 1932, p. 158, Pl. 3, Fig. 4.

Cells single, large, 3–4 times longer than broad, unconstricted, elliptic oblong, gradually attenuated towards the apices. Apex round, cell wall smooth. Chloroplast with eight longitudinal plates deeply notched at the free ends.

Dimensions :

Length	155–203 μ
Breadth at the middle	40–44 μ
Breadth at the apex	18–23·7 μ

Hab.—Kodaikanal lake.

Genus *Closterium* Nitzsch 1817

3. *Closterium libellula* Focke var. *pulneyensis* var. nov.

(Figs. 7, 8*a*, 8*b*)

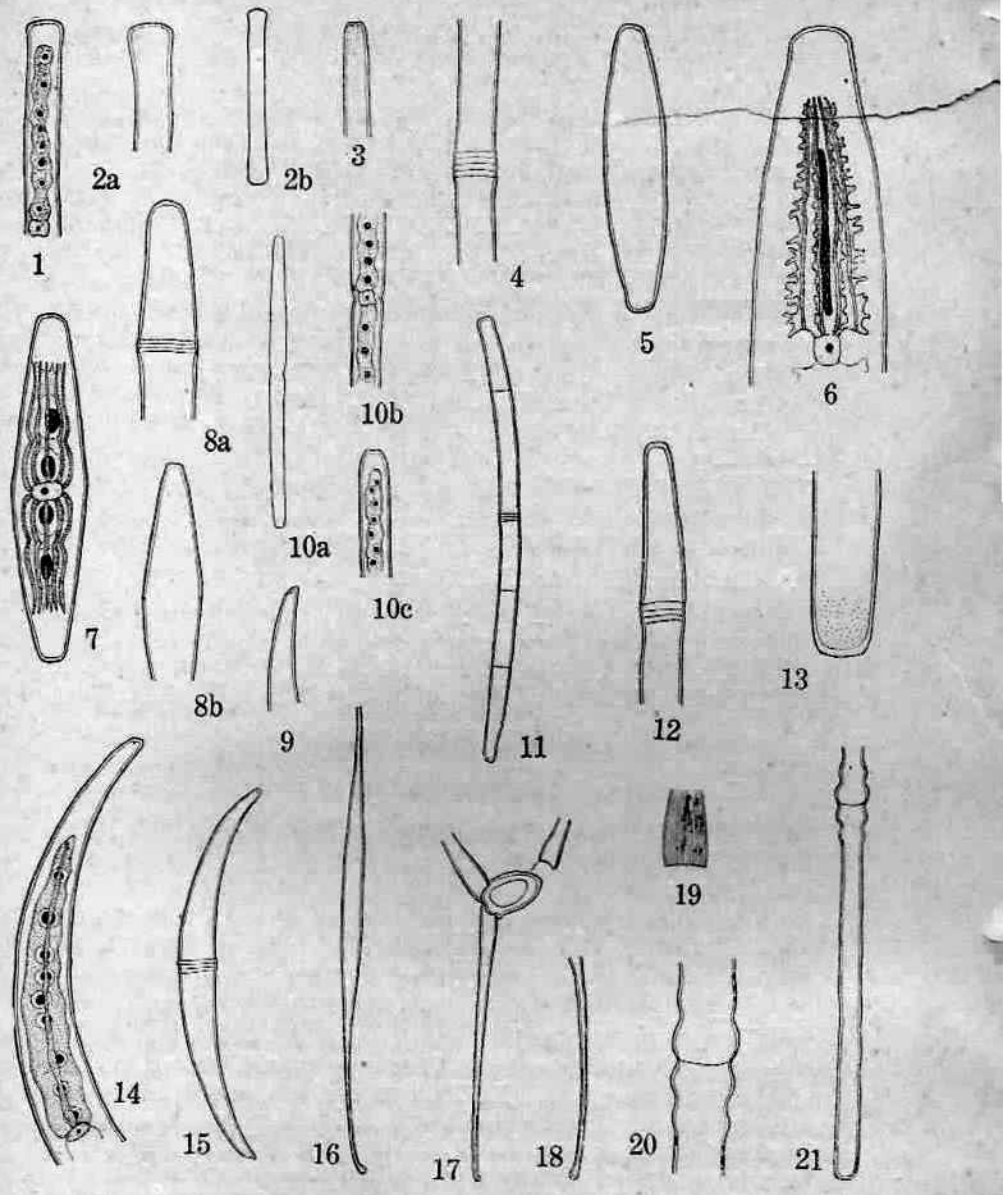
Cells single, size variable, generally large, 4–5 times longer than broad, not constricted, gradually attenuated from the middle towards the apices. Apex broadly rounded. Cell wall smooth, colourless or slightly brownish, with girdles very faintly visible at the isthmus. Each chloroplast slightly notched or constricted and not separated, with about 8 long plates. Pyrenoids two or three in each semicell.

Dimensions :

Length	73–122·6 μ
Breadth at the middle	16·4–27 μ
Breadth at the apex	8·5–13·6 μ

Hab.—Kodaikanal Lake.

This at first sight appears to be a species of *Netrium*. But a treatment with concentrated KOH solution shows that the cell wall is made up of two pieces. A few girdle bands also are seen very faintly after this treatment. So this belongs to the Placodermæ. This form comes very near *Closterium libellula* var. *interruptum* (Krieger, 1935, p. 256, Pl. 12, Fig. 6) in general shape and measurements but the chloroplasts of the latter are completely divided into two in each semicell, while in the present form it is only deeply notched in the middle. This kind of a notched chloroplast is not seen in any of the varieties. The desmid appears therefore to be a new variety of *Cl. libellula*.



Figs. 1–21. Fig. 1. *Gonatozygon Kinahani*, chloroplast and nucleus (× 410). Fig. 2*a*. *Gonatozygon Kinahani*, end of the cell (× 410) Fig. 2*b*. *Gonatozygon Kinahani*, single cell (× 190). Fig. 3. *Pleurotænium minutum* var. *gracile*, part of cell showing punctæ (× 410). Fig. 4. *Closterium didymotocum* var. *annulatum* var. nov., girdle bands at the isthmus (× 410). Fig. 5. *Netrium digitus*, single cell (× 190). Fig. 6. *Netrium digitus*, chloroplast and the nucleus (× 410). Fig. 7. *Closterium*

4. *Closterium Kützingii* Breb.

(Figs. 16, 17, 18, 19)

Wolle, *Desm. U.S.*, 1884, p. 47, Pl. 8, Fig. 8; Cooke, *Brit. Desm.*, 1887, p. 134, Pl. 5, Fig. 3; De Toni, *Syll. Alg.*, 1889, p. 850; Turner, *Freshw. Alg. E. India*, 1893, p. 22, Pl. 1, Fig. 12; Nordst., *Index Desm.*, 1896, p. 152; W. and G. S. West, *Mon. Brit. Desm.*, I, 1904, p. 186, Pl. 25, Figs. 6–11; Bernard, *Protococcacées et Desm.*, 1908, p. 64, Figs. 52–54; Smith, *Wisconsin phytoplankton*, pt. II, 1924, p. 12, Pl. 53, Fig. 6.

Cells single, medium size; median part fusiform; outer and inner margins almost equally convex, attenuated towards each extremity into long processes; apices slightly incurved, round and often slightly swollen; cell wall colorless or straw coloured, striated, about 15 striæ visible across the cell. Pyrenoids 5–10 in each semi-cell.

Dimensions:

Length	.. ..	296–456·7 μ
Breadth at the middle	..	9–14 μ
Breadth at the apex	.. ..	2·5–3·6 μ

Hab.—Kodaikanal Lake.

This form is slightly smaller (narrower) especially in breadth than those described by W. and G. S. West and Smith, but agrees with Turner's form in all measurements. This form has 5–10 pyrenoids whereas in the type the number is 4–5 in each chloroplast.

5. *Closterium Dianæ* Ehrenberg

(Figs. 9, 14, 15)

Closterium acuminatum Rabenh., *Flor. Europ. Alg.*, III, 1868, p. 133; Wolle, *Desm. U.S.*, 1884, p. 44; De Toni, *Syll, Alg.*, 1889, p. 840.

Closterium Dianæ Ralfs., *Brit. Desm.*, 1848, p. 168, Pl. 28, Fig. 5; Rabenh., *Flor. Europ. Alg.*, III, 1868, p. 133; Cooke,

---

libellula var. *pulneyensis* var. nov., single cell with chloroplasts (× 410). Fig. 8*a*. *Closterium libellula* var. *pulneyensis*, girdle bands seen clearly after treatment with con. KOH (× 410). Fig. 8*b*. *Closterium libellula* var. *pulneyensis* (× 410). Fig. 9. *Closterium Dianeæ*, tip of the cell (× 410). Figs. 10 *a–c*. *Pleurotænium minutum* var. *gracile*. *a*, single cell (× 410); *b*, showing chloroplast and nucleus (× 410); *c*, showing chloroplast at the end of the cell (× 410). Fig. 11. *Closterium didymotocum* var. *annulatum* var. nov., single cell (× 190). Fig. 12. *Closterium didymotocum* var. *annulatum* var. nov., girdle bands in the middle of a semi-cell (× 410). Fig. 13. *Pleurotænium Trabecula*, tip of the cell with pores (× 410 Fig. 14. *Closterium Dianæ*, showing chloroplast and nucleus (× 410). Fig. 15. *Closterium Dianæ*, single cell with girdle bands (× 410). Fig. 16. *Closterium Kutzingii*, single cell (× 190). Fig. 17. *Closterium Kutzingii*, zygote with empty semi-cells (× 190). Fig. 18. *Closterium Kutzingii*, tip of the cell (× 410). Fig. 19. *Closterium Kutzingii*, striations on the cell-wall (× 410). Fig. 20. *Pleurotænium Trabecula*, portion at the isthmus (× 410). Fig. 21. *Pleurotaenium Trabecula*, part of the single cell (× 190).

Brit. Desm., 1887, p. 26, Pl. 23, Fig. 3; Nordst., *Index Desm.*, 1896, p. 104; W. and G. S. West, *Freshw. Alg. Ceylon*, 1902, p. 140; W. and G. S. West, *Mon. Brit. Desm.*, I, 1904, p. 130, Pl. 15, Figs. 1–6; Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 160, Pl. 4, Fig. 4.

Cells of medium size, 10–12 times longer than their diameter, fairly well curved, outer margin about 110–125° of arc, inner margin scarcely tumid gradually and gracefully attentuated towards the apices, dorsal margin at each apex obliquely truncate and slightly thickened. Cell wall smooth and of a reddish brown color. Chloroplasts obscurely ridged, 7–10 pyrenoids in a single row.

Dimensions:

Length or distance between the apices	159–246·5 μ
Breadth	16–23·7 μ
Breadth at the apex	5 μ

Hab.—Kodaikanal Lake.

This is slightly smaller than the European form and resembles *Cl. Dianæ* var. *arcuatum* in measurements. It differs from the type in having 7–10 pyrenoids while in the type only 5–6 pyrenoids are present. W. and G. S. West, however, have shown 7 pyrenoids in one of their figures (W. and G. S. West, *Mon. Brit. Desm.*, I, 1904, Pl. 15, Fig. 4).

6. *Closterium didymotocum* Corda

var. *annulatum* var. nov.

(Figs. 4, 11, 12)

Cells single, fairly big, 22–24 times longer than their diameter; outer margin about 25–35° of arc; inner margin very slighly concave, gradually and very slightly attenuated towards the apices. Apex broad and with rounded angles, truncate; cell wall smooth and brownish. Chloroplasts ridged, with 7–9 pyrenoids.

Dimensions:

Length	297–333 μ
Breadth	12–14 μ
Breadth at the apex	8 μ

Hab.—Kodaikanal Lake.

In the fully developed cell, the wall is brownish and girdle bands are also seen well. The dimensions of the cell are very much smaller than those of the type (W. and G. S. West, *Mon. Brit. Desm.*, I, 1904, Pl. 12, p. 116, Figs. 1–5) and several annular thickenings are formed. But the apex of the cell is not thickened or dark as in the type and in this respect the form comes near *Cl. didymotocum* var. *asperulum op. cit.*, Pl. 12, Figs. 11–13) but the cell wall differs from that of var. *asperulum*, in being smooth and colored. The minute asperulate type of cell wall as seen in the var. *asperulum* is also absent here.

Again this comes near *Cl. silesiacum* Gronblad (*Beitrag zur Kenntnis der Desmidiaceen Schlesiens*, 1926, p. 10, Pl. 1, Figs. 3–5) and agrees in measurements especially in breadth, but his figures do not show the peculiar annular markings on the cells. Hence it is best to keep it as a new variety of *Cl. didymotocum*, which may be named var. *annulatum*.

Genus *Pleurotœnium* Nägeli 1849

7. *Pleurotœnium Trabecula* (Ehrbg.) Nägeli

(Figs. 13, 20, 21)

Docidium Trabecula Wolle, *Desm. U.S.*, 1884, p. 48, Pl. 9, Figs. 2–4 and Pl. 11, Figs. 1–7; Turner, *Freshw. Alg. E. India*, 1893, p. 38.

Pl. Trabecula West, W. and G. S., *Mon. Brit. Desm.*, I, 1904, p. 209, Pl. 30, Figs. 11–13; Smith, *Wisconsin phytoplankton*, pt, II, 1924.

Cells big, semi-cells with one basal inflation and a slight second undulation above it gradually attnetuated towards the apex. Lateral margins almost straight, apices rounded, destitute of tubercles. Cell wall punctate.

Dimensions.

Length	464–551 μ
Breadth at the isthmus ..	20–25·6 μ
Breadth at the apex	14–20 μ
Isthmus	14–18 μ

Hab.—Planktonic in Kodaikanal Lake.

8*a*. *Pleurotœnium minutum* Delp. var. *gracile* Wille

(Figs. 3, 10*a*, 10*b*, 10*c*)

W. Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 167, Pl. 6, Fig. 7.

Pleurotœnium (?) *minutum* (Ralfs) Delp. var. *gracile* Wille, De Toni, *Syll. Alg.*, 1889, I, p. 905.

Penium minutum (Ralfs) Cleve var. *gracile* Wille, W. and G. S. West., *Mon. Brit. Desm.*, I, 1904, pp. 103–4, Pl. 10. Fig. 6.

Cells single, elongated with parallel walls and a very slight constriction in the middle, 16–20 times as long as broad; apex flat with a small depression in the middle, breadth uniform throughout except near the tip where it becomes slightly narrower; cell-wall very minutely punctate.

Dimensions:

Length	170–198·5 μ
Breadth	9–14·3 μ
Breadth at the apex	6·8 μ

Hab.—Planktonic in Kodaikanal Lake.

8*b*. *Pleurotœnium Kayei* Rabenh.

(Figs. 22, 31)

Docidium horridum Borge, *Austral. Susswasser-chlorophyceen*, 1896, p. 28, Pl. 4, Fig. 55.

Pleurotœnium Kayei Rabenh., *Flor. Europ. Alg.*, III, 1868, p. 144; Gutwinski, *De algis a Dre M. Raciborski anno 1899 in insula Java collectis*, 1902, p. 587, Pl. 37, Fig. 25; W. and G. S. West, *Freshw. Alg. Ceylon*, 1902, p. 141, Pl. 18, Figs. 33–34.

Cells big, 4–5 times longer than their breadth (with spines), semi-cells with spinose margins caused by always four rings of prominent double-headed spines, gradually tapering from the base to the apex; apex slightly dilated, truncate furnished with a peripheral ring of about 10 spine-like projections. Cell-wall smooth or sparsely punctate, punctæ not quite distinct.

Dimensions:

Length	217–275·5 μ
Breadth at isthmus with spines ..	54·9–58·5 μ
Breadth at isthmus without spines	40–47·5 μ
Breadth at the apex with spines ..	43·9–51 μ
Breadth at the apex without spines	29–32·9 μ
Isthmus	21·9–25 μ

Hab.—In a swamp at Kodaikanal.

Gutwinski (1902) has shown 5 and 6 whorls of spines in his figures while Borge (1896) gives only four rings of spines. The number of spines seems to be variable.

9. *Pleurotœnium tessellatum* (Joshua) Lagerh.

var. *bulbosum* Krieger

(Figs. 23, 24)

Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 168, Pl. 6, Fig. 11.

Cells single, large, well constricted with sides slightly attenuated towards the apices; basal inflation slight; apex truncate with short spine-like projections. Cell-wall with about 7–10 transverse rings of irregular quadrangular projecting areas, areas being small at the base and elongated at the apex.

Dimensions:

Length	217·5–304·5 μ
Breadth at the base	34–44·9 μ
Breadth at the apex	25–31 μ
Isthmus	21–25·6 μ

Hab.—In a swamp at Kodaikanal.

This form shows a close resemblance to *Pleurotœnium trochiscum* var. *tuberculatum* (Smith, *Wisconsin phytoplankton*, pt. II, 1924, p. 17,—

Pl. 55, Fig. 33) but as pointed out by Krieger (1932), *Pl. trochiscum* is more cylindrical, whereas the present form is somewhat narrowed towards the apex. The spines at the apex in the present form are again more robust than in *Pl. trochiscum* var. *tuberculatum*. But the difference between these two species appears to be very very small.

Genus *Euastrum* Ehrenbg. 1832

10. *Euastrum sinuosum* Lenorm.

(Fig. 25)

Ralfs, *Brit. Desm.*, 1848, p. 85; Cooke, *Brit. Desm.*, 1887, p. 71, Pl. 34, Fig. 3; Nordst., *Index Desm.*, 1896, p. 235; W. and G. S. West, *Freshw. Alg. Ceylon*, 1902, p. 148; W. and G. S. West, *Mon. Brit. Desm.*, II, 1905, p. 20, Pl. 36, Fig. 1.

Cells deeply constricted, sinus narrowly linear with a dilated extremity; semi-cells three lobed; polar lobe prominent and outstanding; angles rounded; apex with a narrow median incision; lateral lobes bilobulate, lobules separated by a widely open sinus, rounded lobules, upper not projecting so far as the lower, the margin of the lower lobule slightly crenate; semi-cells with three prominent protuberances across the base, and two across the centre. Cell wall punctate. A small but prominent scrobiculation in each of the protuberance.

Dimensions:

Length	73–86 μ
Breadth at the centre ..	40–47·5 μ
Breadth at the apex	16–23 μ
Isthmus	10·9–12·8 μ

Hab.—In a swamp at Kodaikanal.

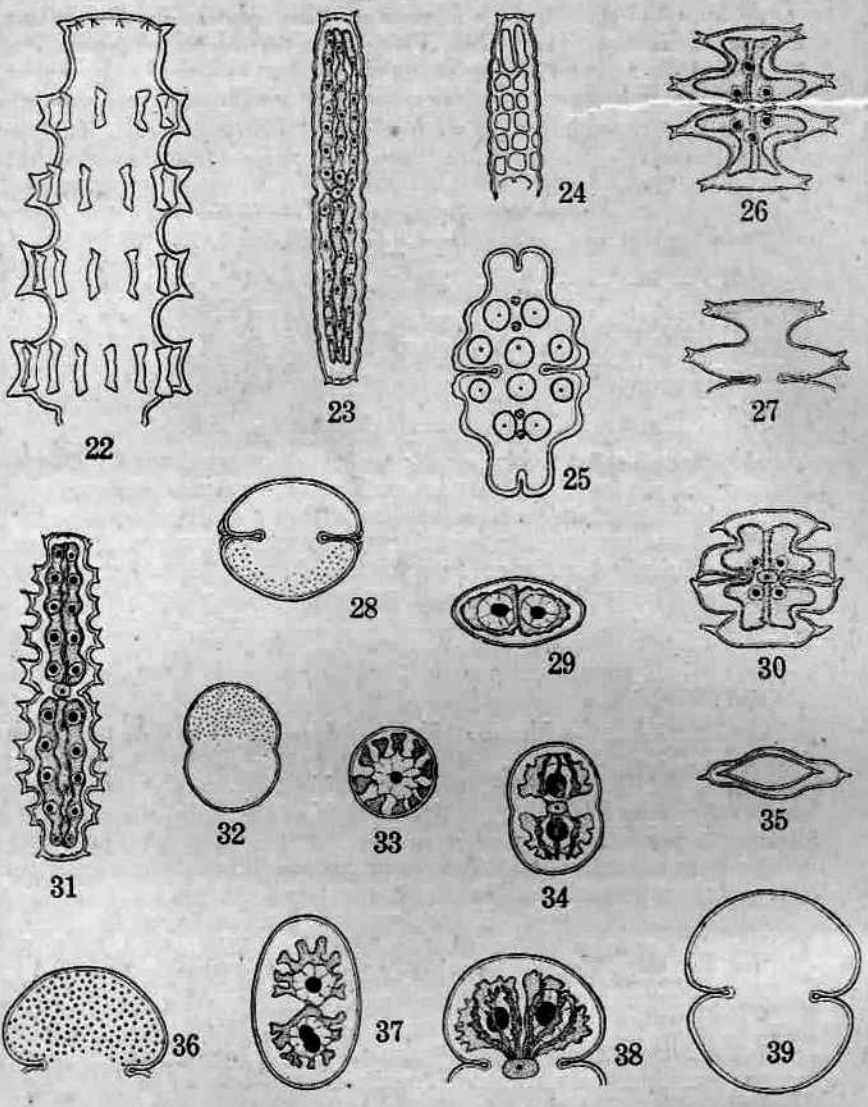
The crenate margin of the lower lobule and the presence of a small prominent scrobiculation in the centre of the protuberances are not seen in the type. In the presence of scrobiculations this resembles *E. sinuosum* var. *ceylanicum* West and West (W. and G. S. West, *Freshw. Alg. Ceylon*, 1902, p. 148, Pl. 19, Fig. 6). But, as only one or two specimens of the present form were found in the material, and since the side views of these individuals could not be obtained, it was decided to leave it for the present under the type itself until more material is available.

Genus *Micrasterias* Agardh 1827

11. *Micrasterias pinnatifida* (Kutz.) Ralfs.

(Figs. 26, 27)

Ralfs, *Brit. Desm.*, 1848, p. 77, Pl. 10, Fig. 3; Wolle, *Desm. U.S.*, 1884, p. 116, Pl. 37, Figs. 7–8; Cooke, *Brit. Desm.*, 1887, p. 54, Pl. 20, Fig. 3; Turner, *Freshw. Alg. E. India*, 1893, p. 88, Pl. 5, Fig. 3; W. and G. S. West, *Mon. Brit. Desm.*, II, 1905,



Figs. 22–39. Fig. 22. *Pleurotænium Kayei*, single semi-cell showing spines (× 410). Fig. 23. *Pleurotænium tessellatum* var. *bulbosum*, single cell with chloroplasts (× 190). Fig. 24. *Pleurotænium tessellatum* var. *bulbosum*, semi-cell with quadrangular areas (× 190). Fig. 25. *Euastrum sinuosum*, single cell (× 410). Fig. 26. *Micrasterias pinnatifida*, single cell with chloroplasts (× 410). Fig. 27. *Micrasterias pinnatifida*, portion of the cell with pores (× 410). Fig. 28. *Cosmarium obsoletum*, single cell with pores and basal mamillæ with pore canals at the base of semi-cells (× 410). Fig. 29. *Cosmarium obsoletum*, vertical view with chloroplasts (× 410). Fig. 30. *Micrasterias incisa* var. *Wallichiana*, single cell with chloroplasts (× 410). Fig. 31. *Pleurotænium Kayei*, single cell with

p. 80, Pl. 41, Figs. 7–11; Smith, *Wisconsin phytoplankton*, pt. II, 1924, p. 41, Pl. 59, Figs. 1–2; Brühl and Biswas, *Alg. of Loktak Lake*, 1926, p. 279, Pl. 6, Fig. 51.

Cells small, slightly broader than long, deeply constricted, sinus open, isthmus very narrow. Semi-cells 3 lobed polar lobe, flattened or slightly convex, widely spreading extremities narrower than those of lateral lobes, ends bifid, lateral lobes horizontally disposed, semifusiform in shape with bifid ends. Incisions between lateral lobes and polar lobe very broad, Cell wall minutely punctate.

Dimensions:

Length	47–51·3 μ
Breadth	49–54·7 μ
Breadth of the polar lobe ..	38–46 μ
Isthmus	8–10 μ

Hab.—Planktonic in Kodaikanal Lake.

The Kodaikanal form seems to be slightly smaller than the type.

12. *Micrasterias incisa* (Breb.) Ralfs.

var. *Wallichiana* Turner

(Figs. 30, 35)

Turner, *Freshw. Alg. E. India*, 1893, p. 89, Pl. 6, Fig. 52; Brühl and Biswas, *Alg. of the Loktak Lake*, 1926, p. 280, Pl. 6, Figs. 7 and 9.

Cells small, little broader than long, deeply constricted, sinus narrow and opening out; isthmus narrow; semicells three lobed, polar lobe entire, broadly trapezoidal, outer margins converging towards the apex, ending in small spines at the end; lateral lobes horizontal, trapezoidal, ending in short spines towards the sinus; incision between the polar lobe and lateral lobes broad; vertical view oblong elliptic. Cell wall minutely punctate.

Dimensions:

Length	38–41 μ
Breadth	45–51 μ
Isthmus	7–11 μ
Polar lobe	34–40 μ
Thickness	11 μ

Hab.—Planktonic in Kodaikanal Lake.

---

chloroplasts (× 190). Fig. 32. *Cosmarium globosum*, single cell with pores (× 410). Fig. 33. *Cosmarium globosum*, vertical view with chloroplasts (× 410). Fig. 34. *Cosmarium globosum*, single cell with chloroplasts (× 410). Fig. 35. *Micrasterias incisa* var. *Wallichiana*, vertical view (× 410). Fig. 36. *Cosmarium pachydermum* var. *indicum* var. nov. semi-cell with big pores (× 410). Fig. 37. *Cosmarium pachydermum* var. *indicum* var. nov., vertical view with chloroplasts (× 410). Fig. 38. *Cosmarium pachydermum* var. *indicum* var. nov., semi-cell showing chloroplasts (× 410). Fig. 39. *Cosmarium pachydermum* var. *indicum* var. nov., single cell (× 410).

The measurements of the desmid agree with those given by Turner except that it is slightly shorter in length. The length given by Turner is 48–53 μ whereas here it is only 38–41 μ.

Genus *Cosmarium* Corda 1834

13. *Cosmarium moniliforme* (Turp.) Ralfs. forma *punctata* Lagerh.

(Figs. 40, 41, 42, 43)

W. and G. S. West, *Mon. Brit. Desm.*, III, 1908, p. 22, Pl. 87, Fig. 4.

Cells single, deeply constricted, sinus widely open, usually acute; semi-cells circular or subcircular; side views of semi-cells almost circular, verticle view circular. Cell wall punctate. One axile chloroplast in each semi-cell with a central pyrenoid and six radiating plates.

Dimensions:

Length	..	..	40–47 μ
Breadth	..	..	21–27 μ
Isthmus	..	..	5–7·6 μ

Hab.—Planktonic in Kodaikanal Lake.

14. *Cosmarium moniliforme* (Turp.) Ralfs forma *panduriformis* Heimerl

(Figs. 46, 47, 48)

Dysphinctum inferum Turner, *Freshw. Alg. E. India*, 1893, p. 40, pl. 1, Fig. 21.

C. moniliforme forma *panduriformis* W. and G. S. West, *Mon. Brit. Desm.*, III, 1908. p. 22, Pl. 67, Figs. 8–9.

Cells single, very small, slightly constricted; isthmus broad with an obtusely rounded sinus; semi-cells subcircular, vertical view circular, cell wall smooth. Chloroplasts axile, one in each semi-cell with a central pyrenoid and about 6 to 7 radiating vertical plates.

Dimensions:

Length	..	..	17–19·6 μ
Breadth	..	..	11–12·8 μ
Isthmus	..	..	8–10 μ

Hab.—Planktonic in Kodaikanal Lake.

This comes near *C. pseudarctum* (W. and G. S. West, *Mon. Brit. Desm.*, III, 1908, p. 32, Pl. 68, Figs. 12–14) in general shape and size but the four radiating cruciately disposed lobes of the chloroplast are not seen in the present form. This also shows some resemblance to *C. connatum* (W. and G. S. West, *Mon. Brit. Desm.*, III, 1908,

p. 25, Pl. 76, Figs. 15–17) in shape but the present form is much smaller and has a smooth wall.

15. *Cosmarium obsoletum* (Hanztsch) Reinsch

(Figs. 28, 29)

Cosmarium palustre Turner, *Freshw. Alg. E. India*, 1893, p. 60, Pl. 8, Figs. 65 and 64 ; Pl. 9, Fig. 29.

C. obsoletum subsp. *palustre*. Brühl and Biswas, *Alg. of the Loktak Lake*, 1926, p. 285, Pl. 9, Figs. 91–92.

C. obsoletum Nordst., *Index Desm.*, 1896, p. 186, W. and G. S. West, *Freshw. Alg. Ceylon*, 1903, p. 164 ; W. and G. S. West, *Mon. Brit. Desm.*, II, 1905, p. 133, Pl. 56, Figs. 1–3.

Cells single, medium size, a little broader than long, deeply constricted, sinus narrowly linear with a dilated apex; semi-cells semielliptic; basal angles submamillate with a small pore or canal; apex convex or slightly flat. Vertical view elliptic slightly attenuated towards poles. Cell wall punctate. Chloroplasts axile, each with two pyrenoids.

Dimensions :

Length	..	..	36–40 μ
Breadth	..	..	42–45·7 μ
Isthmus	..	..	18–25 μ
Thickness	..	..	23·9 μ

Hab.—Planktonic in Kodaikanal Lake.

This agrees in dimensions with the smaller European form but shows a mamillate thickening through which the canal referred to in the large tropical forms is also seen (W. and G. S. West, *Mon. Br. Desm.*, 1905, II, p. 134, Pl. 56, Fig. 4). But the place where this form occurs is not typically tropical but subtropical and nearly temperate.

16. *Cosmarium globosum* Bulnh.

(Figs. 32, 33, 34)

Rabenh. *Flor. Europ. Alg.*, III, 1868, p. 178 ; Cooke, *Brit. Desm.*, 1887, p. 121, Pl. 43, Fig. 6; Nordst., *Index Desm.*, 1896, p. 130 ; W. and G. S. West, *Mon. Brit. Desm.*, III, 1908, p. 29, Pl. 68, Figs. 1–2.

Cells small, slightly constricted, sinus rapidly widening from an acute apex; semi-cells subcircular; vertical view circular. Chloroplasts axile, with a central pyrenoid and a number (6–8) of vertically disposed lobes.

Dimensions :

Length	..	..	27–31 μ
Breadth	..	..	20–22 μ
Isthmus	..	..	18–20 μ

Hab.—Planktonic in Kodaikanal Lake.

p. 25, Pl. 76, Figs. 15–17) in shape but the present form is much smaller and has a smooth wall.

15. *Cosmarium obsoletum* (Hanztsch) Reinsch

(Figs. 28, 29)

Cosmarium palustre Turner, *Freshw. Alg. E. India*, 1893, p. 60, Pl. 8, Figs. 65 and 64 ; Pl. 9, Fig. 29.

C. obsoletum subsp. *palustre*. Brühl and Biswas, *Alg. of the Loktak Lake*, 1926, p. 285, Pl. 9, Figs. 91–92.

C. obsoletum Nordst., *Index Desm.*, 1896, p. 186, W. and G. S. West, *Freshw. Alg. Ceylon*, 1903, p. 164 ; W. and G. S. West, *Mon. Brit. Desm.*, II, 1905, p. 133, Pl. 56, Figs. 1–3.

Cells single, medium size, a little broader than long, deeply constricted, sinus narrowly linear with a dilated apex; semi-cells semielliptic; basal angles submamillate with a small pore or canal; apex convex or slightly flat. Vertical view elliptic slightly attenuated towards poles. Cell wall punctate. Chloroplasts axile, each with two pyrenoids.

Dimensions :

Length	..	..	36–40 μ
Breadth	..	..	42–45·7 μ
Isthmus	..	..	18–25 μ
Thickness	..	..	23·9 μ

Hab.—Planktonic in Kodaikanal Lake.

This agrees in dimensions with the smaller European form but shows a mamillate thickening through which the canal referred to in the large tropical forms is also seen (W. and G. S. West, *Mon. Br. Desm.*, 1905, II, p. 134, Pl. 56, Fig. 4). But the place where this form occurs is not typically tropical but subtropical and nearly temperate.

16. *Cosmarium globosum* Bulnh.

(Figs. 32, 33, 34)

Rabenh. *Flor. Europ. Alg.*, III, 1868, p. 178 ; Cooke, *Brit. Desm.*, 1887, p. 121, Pl. 43, Fig. 6; Nordst., *Index Desm.*, 1896, p. 130 ; W. and G. S. West, *Mon. Brit. Desm.*, III, 1908, p. 29, Pl. 68, Figs. 1–2.

Cells small, slightly constricted, sinus rapidly widening from an acute apex; semi-cells subcircular; vertical view circular. Chloroplasts axile, with a central pyrenoid and a number (6–8) of vertically disposed lobes.

Dimensions :

Length	..	..	27–31 μ
Breadth	..	..	20–22 μ
Isthmus	..	..	18–20 μ

Hab.—Planktonic in Kodaikanal Lake.

17. *Cosmarium pachydermum* Lund.
var. *indicum* var. nov.

(Figs. 36, 37, 38, 39)

Cells single, large, about $1\frac{1}{4}$ times longer than broad, rather deeply constricted, sinus narrowly linear with a dilated apex; semi-cells widely semielliptic, apices broad, sometimes truncate; side view of the semi-cells subcircular, vertical view elliptic; cell wall punctate with big punctæ. Chloroplasts ridged with two pyrenoids in each semi-cell. In vertical view they are stellate with several vertical ridges.

Dimensions:

Length	62–69·5 μ
Breadth	49–58·5 μ
Isthmus	25–29μ
Thickness	34–37 μ

Hab.—Planktonic in Kodaikanal Lake.

This form closely resembles *Cosmarium pachydermum* (W. and G. S. West, *Mon. Br. Desm.*, II, 1905, p. 139, Pl. 57, Fig. 7) in general shape, but is a much smaller form with thinner walls. It comes very near *C. pachydermum* var. *æthiopicum* but differs in size, in the shape of semi-cells and also in the absence of minor punctæ between scrobiculations.

Genus *Xanthidium* Ehrenberg 1837

18. *Xanthidium sexmamillatum* W. and G. S. West
var *pulneyensis* var. nov.

(Figs. 53, 57)

Cells fairly big, little longer than broad, without spines, deeply constricted, sinus broadly open; semi-cells transversely elliptic; lateral margin with 3 mamillæ on each side, one apical, one sub-apical, and one median. Six strong spines on the apices of these six mamillæ on each semi-cell. Apical and sub-apical spines curved upwards, the median being almost horizontal. A fourth distinctly marked mamillæ with a short spine on both the lower sides of the semi-cell. Apex mostly straight. Vertical view nearly rhomboidal, sides thickened slightly more yellowish, three asymmetrically disposed spines at each pole. Cell wall punctate; pyrenoids 2 in each semi-cell.

Dimensions:

Length without spines	49–52 μ
Length with spines	75–78 μ
Breadth without spines ..	40–45 μ
Breadth with spines	68–84 μ
Isthmus	10–12 μ
Thickness	30 μ

Hab.—In a swamp at Kodaikanal.

This form comes very near *X. sexmamillatum* W. and G. S. West (*Freshw. Alg. from Burma*, 1907, p. 211, Pl. 15 Figs. 11, 12) especially in the six spines situated on the apices of six mamillate projections, but differs from it in the presence of two more small, well marked, mamillæ on both the lower sides of the semi-cell, with the beginnings of a very short spine on each. The vertical view of the present form differs from that of *X. sexmamillatum* in being more rhomboidal and in the spines being disposed asymmetrically. In this respect (vertical view) it resembles *X. pseudobengalicum* Gronblad (New Desmids from Finland and North Russia, 1921, p. 50, Pl. 4, Figs. 32, 33) but there are no mamillate projections in *X. pseudobengalicum*.

Genus *Arthrodesmus* Ehrenberg 1838

19. *Arthrodesmus subulatus* Kutz.

(Figs. 44, 49, 50)

A. convergens var. *subulatus* (Kutz.) Rabenh. *Flor. Europ. Alg.*, III, 1868, p. 227.

A. subulatus Kutz., *Species. Alg.*, 1849, p. 176; Wolle, *Desm. U.S.*, 1884, p. 96, Pl. 24, Figs. 11, 12; De Toni, *Syll. Alg.*, 1889, p. 1059; Turner, *Freshw. Alg. E. India*, 1893, p. 133; W. and G. S. West, *Mon. Brit. Desm.*, IV, 1912, p. 109, Pl. 116, Fig. 14; Smith, *Wisconsin phytoplankton*, pt. II, 1924, p. 127, Pl. 85, Figs. 1–3.

Cells single, a little longer than broad (without spines), deeply constricted, sinus widely open, angles of the semi-cells, each furnished with a long stout straight spine. Vertical view elliptic with a long spine at each pole. Cell wall finely punctate. Chloroplasts axile, one in each semi-cell with a central pyrenoid and two deeply forked processes radiating one towards each pole.

Dimensions:

Length	23·5–26·8 μ
Breadth without spines ..	17–23 μ
Breadth with spines	45–55 μ
Isthmus	3·6–5·4 μ
Thickness	12–14 μ

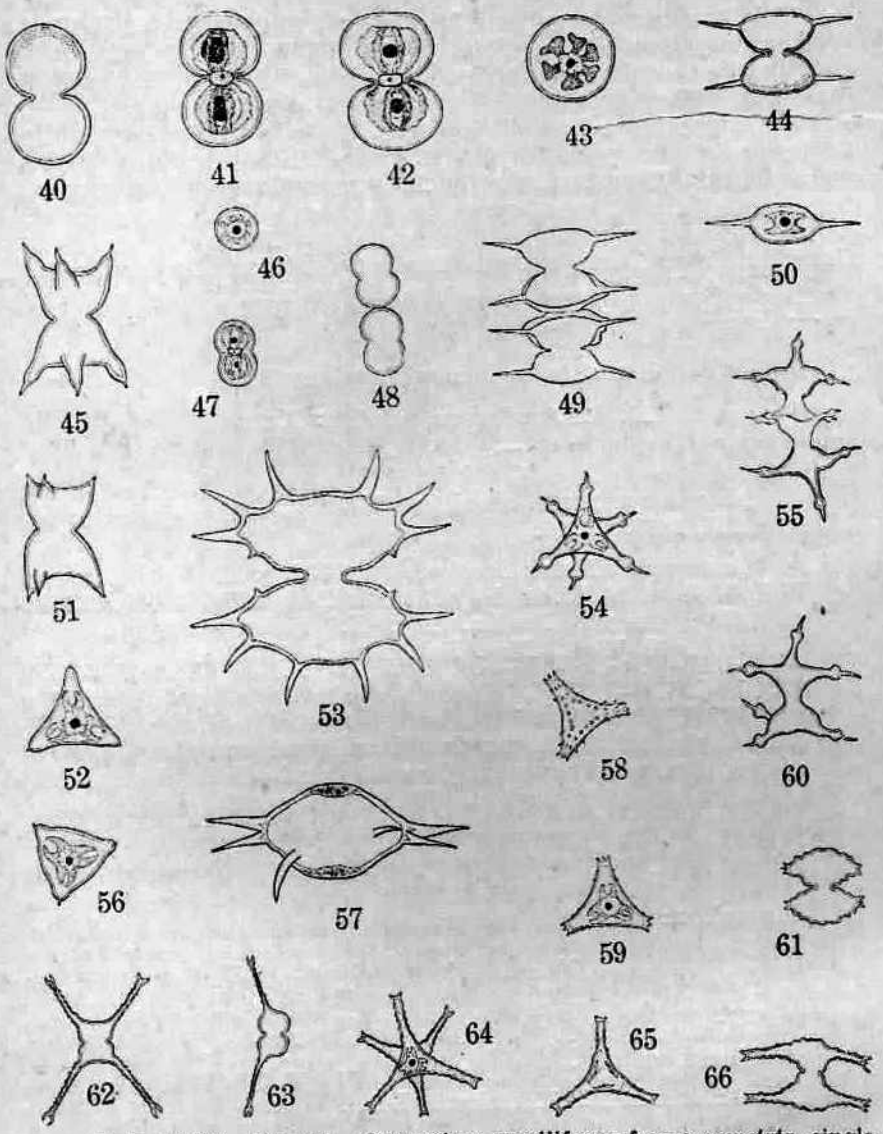
Hab.—Planktonic in Kodaikanal Lake.

Genus *Staurastrum* Meyen 1829

20. *Staurastrum corniculatum* Lund. var. *spinigerum* West

(Figs. 45, 51, 52, 56)

W. and G. S. West, *Mon. Brit. Desm.*, IV, 1912, p. 164, pl. 125, Figs. 19–22.



Figs. 40–66. Fig. 40. *Cosmarium moniliforme* forma *punctata*, single cell with pores (× 410). Fig. 41. *Cosmarium moniliforme* forma *punctata*, semi-cells circular and chloroplasts (× 410). Fig. 42. *Cosmarium moniliforme* forma *punctata*, semi-cells with flattened apices and chloroplasts. (× 410). Fig. 43. *Cosmarium moniliforme* forma *punctata*, vertical view with chloroplasts (× 410). Fig. 44. *Arthrodesmus subulatus*, single cell with pores (× 410). Fig. 45. *Staurastrum corniculatum* var. *spinigerum* West, single cell (× 410). Fig. 46. *Cosmarium moniliforme* forma *panduriformis*, vertical view with chloroplasts (× 410). Fig. 47. *Cosmarium moniliforme* forma *panduriformis*, single cell with chloroplasts (× 410). Fig. 48. *Cosmarium moniliforme* forma *panduriformis*, two daughter cells.

Cells small, longer than broad, slightly constricted; semi-cells subcuneate, gradually widened from a broad base; sides very slightly convex, apex straight, angles of semi-cells produced and each furnished with a minute spine. Vertical view triangular with straight sides and 3 small spines at the 3 angles. Chloroplasts two, one in each semi-cell, axile, with a central big pyrenoid and 3 deeply forked processes radiating one into each angle.

Dimensions:

Length	..	..	.. 25–29 μ
Breadth	..	..	.. 17–21·9 μ
Isthmus	..	..	.. 10 μ
Spine	..	..	.. 1·7–2 μ

Hab.—Planktonic in Kodaikanal Lake.

This form exhibits variation in having the processes at the angles sometimes tumid (Fig. 45) and sometimes straight (Fig. 51).

21. *Staurastrum Tohopikaligense* Wolle.

(Figs. 79, 86)

St. nonanum Turner, *Freshw. Alg. E. India*, 1893, p. 119, Pl. 15, Fig. 15.

St. Tohopekaligense De Toni, *Syll. Alg.*, 1889, p. 1162; W. and G. S. West, *Freshw. Alg. Ceylon*, 1902, p. 180; W. and G. S. West and N. Carter, *Mon. Brit. Desm.*, V, 1923, p. 178, Pl. 155, Figs. 12–14; Smith, *Wisconsin phytoplankton*, pt. II, 1924, p. 121, Pl. 82, Figs. 8–11.

Cells of medium size, deeply constricted, sinus narrow at first, later widely opening; semi-cells broadly oval; lateral angles produced to form long slender processes; upper part of semi-cells with

---

after division (× 410). Fig. 49. *Arthrodesmus subulatus*, daughter cells after division showing the outer piece (× 410). Fig. 50. *Arthrodesmus, subulatus*, vertical view showing chloroplasts (× 410). Fig. 51. *Staurastrum corniculatum* var. *spinigerum*, single cell (× 410). Fig. 52. *Staurastrum corniculatum* var. *spinigerum*, vertical view with chloroplasts (× 410). Fig. 53. *Xanthidium sexmamillatum* var. *pulneyensis* var. nov., single cell (× 410). Fig. 54. *Staurastrum unicorne* var. *gracile* var. nov., vertical view showing chloroplasts (× 410). Fig. 55. *Staurastrum unicorne* var. *gracile* var. nov., cells in division (× 410). Fig. 56. *Staurastrum corniculatum* var. *spinigerum*, vertical view with chloroplasts (× 410). Fig. 57. *Xanthidium sexmamillatum* var. *pulneyensis* var. nov., vertical view (× 410). Fig. 58. *Staurastrum hexacerum*, vertical view showing spines (× 410). Fig. 59. *Staurastrum hexacerum* vertical view showing chloroplasts (× 410). Fig. 60. *Staurastrum unicorne* var. *gracile* var. nov., single cell (× 410). Fig. 61. *Staurastrum hexacerum*, single cell (× 410). Fig. 62. *Staurastrum columbetoides*, single cell (× 410). Fig. 63. *Staurastrum columbetoides*, side view of the cell (× 410). Fig. 64. *Staurastrum gracile*, vertical view with chloroplasts (× 410). Fig. 65. *Staurastrum gracile*, vertical view with ridges at the top (× 410). Fig. 66. *Staurastrum gracile*, single cell (×410).

six sub-apical processess, altogether about 9 in each semi-cell. All processes hollow, ending in two long divergent spines. Vertical view triangular with sides straight, bending only at the angles, produced into long processes, with another pair at each lateral side. Cell wall punctate. Chloroplast axile, with a big central pyrenoid and 6–9 radiating processes, some extending into the processes also.

Dimensions:

Length without spines	32–44·4 μ
Length with spines	72–80 μ
Breadth without processes ..	27–32·2 μ
Breadth with processes ..	58–65 μ
Isthmus	10–14 μ

Hab.—Planktonic in Kodaikanal Lake.

The type species has two or three spines at the end of each process. But here the number of spines is always two. This form appears to be same as *St. nonanum* Turner.

22. *Staurastrum unicorne* Turner

var. *gracile* var. nov.

(Figs. 54, 55, 60)

Cells single, small, deeply constricted; semi-cells cuneate or triangular the sides being more convex; angles of the semi-cells produced into smooth processes with capitate ends and short fine spines; the processes before the capitate ends narrow and elongated. Vertical view always trigonal, the lateral sides being mostly flat or occasionally concave. Chloroplasts two, axile, one in each semi-cell with a central axis enclosing a big pyrenoid and three massive deeply forked processes radiating one into each angle.

Dimensions:

Length	21–25·5 μ
Breadth with processes ..	38–43·9 μ
Isthmus	5–7 μ

Hab.—Planktonic in Kodaikanal Lake.

This Desmid resembles *Staurastrum scolopacinum* (Turner, *Freshw. Alg. E. India*, 1893, p. 107, Pl. 17, Fig. 10) in general appearance, but is more constricted below the swellings. In this latter point it comes near *Staurastrum unicorne* (Turner, *Freshw. Alg. East India*, 1893, p. 107, Pl. 15, Fig. 16). But the dorsal surface of the present form is more flat and the arms are much more elongated and narrowed than in *St. unicorne*. It differs from it again in having the sides either flat or concave in vertical view and also in having the tips much more tumid.

23. *Staurastrum contectum* Turner
var. *inevolutum* Turner.

(Figs. 67, 71)

W. and G. S. West, *Some North American Desmideæ. Trans. Linn. Soc.*, Series II, B. 1896, p. 257, Pl. 16, Fig. 18.

Cells small, single, broader than long, deeply constricted, sinus acute; semi-cells trapezoidal; bifid and curved spine on each side near the apex, apex broad and flat with two spines at each angle. Vertical view triangular, sides slightly concave. Cell wall minutely punctate; chloroplasts two, one in each semi-cell, axile with a central axis enclosing a single big pyrenoid, three deeply forked processes radiating one into each arm.

Dimensions:

Length	21–29 μ
Breadth with spines	32–40 μ
Isthmus	5–7 μ

Hab.—Planktonic in Kodaikanal Lake.

24. *Staurastrum longibrachiatum* (Borge) Gutwin.
var. *intermedium* var. nov.

(Figs. 77, 80, 81)

Cells single, medium size, fairly constricted, sinus widely open, semi-cells truncate gradually attenuated towards the apex with four big verrucæ at the apex, two big in the centre and two small on either side. Angles of the semi-cells produced into long hollow slender processes with sharply dentate upper and lower margins, ends of the processes bifurcated, a short verruca at the base of the process on each side of the semi-cells. Vertical view elliptic, poles continued into long processes with slightly undulate margins, and about four verrucæ in the top view. Cell wall punctate. Chloroplasts axile with a central big pyrenoid, and four radiating forked processes.

Dimensions:

Length	31–36·6 μ
Breadth with processes ..	65–95 μ
Breadth without processes ..	12–16 μ
Isthmus	4–7 μ
Thickness	12–14 μ

Hab.—Planktonic in Kodaikanal Lake.

This form resembles *St. longibrachiatum* (Borge) Gutwin. (Borge, *Austral. Susswass. Chl.*, 1896, p. 15, Pl. 2, Fig. 22; Gutwinski, *De Algis a Dre M. Raciborski anno* 1899 *in Insula Java coll.*, 1902, p. 605, Pl. 40, Fig. 62) in general appearance and in the number of verrucæ at the apex. Borge has shown only four at the apex. But the sides of the semi-cells have more verrucæ in his as well

as in Gutwinski's figures. In possessing only one at the side of the semi-cell this comes near to *Staurastrum longibrachiatum* var. *pseudanchora* (Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 202, Pl. 16, Fig. 3) but Krieger's figure shows more verrucæ at the apex. Hence the present form is best kept as a new variety.

25. *Staurastrum retusum* Turner var. *punctulatum* Eichl. and Gutwin.

(Figs. 82, 84)

W. and G. S. West, *Freshw. Alg. Ceylon*, 1902, p. 178; *Freshw. Alg. of Burma*, 1907, p. 216, Pl. 15, Figs. 30–32.

Cells single, small, deeply constricted, semi-cells pyramidate or trapeziform, angles slightly rounded, lateral margins convex, vertical view triangular, rounded angles and concave sides. Cell wall punctate. Chloroplast axile with a central big pyrenoid and three deeply forked processes radiating one into each arm.

Dimensions:

Length	..	..	21–23·7 μ
Breadth	..	..	21–23·7 μ
Isthmus	..	..	5–6·8 μ

Hab.—Planktonic in Kodaikanal Lake.

26. *Staurastrum gladiosum* Turner

(Figs. 68, 69, 72, 73)

De Toni, *Syll. Alg.*, 1889, p. 1172: Turner, *Freshw. Alg. E. India*, 1893, p. 112, Pl. 17, Fig. 2; W. and G. S. West and N. Carter, *Mon. Brit. Desm.*, V, 1923, p. 57, Pl. 137, Figs. 1–2; Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 199, Pl. 15, Fig. 14.

Cells of medium size, about as long as broad or slightly longer than broad, sinus acute and not very widely open; semi-cells elliptic reniform; cell wall uniformly covered with stout spines, more or less arranged in circles and scattered further away. Vertical view triangular, sides slightly concave, angles broadly rounded, about 6–8 spines on each side. Chloroplast axile, one in each semi-cell, with a central big pyrenoid and three deeply forked lobes radiating one into each angle.

Dimensions:

Length with spines	..	..	31–34·7 μ
Length without spines	..	..	25–31 μ
Breadth with spines	..	..	27–32 μ
Breadth without spines		..	23·7–25·6 μ
Isthmus	..	..	5–7 μ

Hab.—Planktonic in Kodaikanal Lake.

This form seems to be slightly smaller than the type.

27. *Staurastrum furcatum* (Ehr.) Breb.

(Figs. 75, 76)

Xanthidium furcatum Ralfs, *Brit. Desm.*, 1848, p. 213.

Staurastrum spinosum Ralfs, *Brit. Desm.*, 1848, p. 143, Pl. 22, Fig. 28; De Bary, *Conjugaten*, 1858, p. 44.

Staurastrum furcatum Rabenh., *Flor. Europ. Alg.*, III, 1868, p. 218; Nordst., *Norges Desm.*, 1873, p. 33; Wolle, *Desm. U.S.*, 1884, p. 150, Pl. 40, Figs. 40–41; Cooke, *Brit. Desm.*, 1887, p. 146; De Toni, *Syll. Alg.*, 1889, p. 1153; W. and G. S. West and N. Carter, *Mon. Brit. Desm.*, V, 1923, p. 173, Pl. 155, Figs. 1–4; Smith, *Wiscon. phytopl.*, pt. II, 1924, p. 118, Pl. 83, Figs. 1–3; Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 199, Pl. 17, Fig. 11.

Cells small, slightly longer than broad, deeply constricted, sinus acute, each semi-cell with 9 bifid processes, cell wall smooth. Vertical view triangular, angles continued into short processes ending in a spine, sides with a pair of bifid processes on each lateral margin. Chloroplast axile, one in each semi-cell, with a central pyrenoid and 3 forked processes radiating one into each angle.

Dimensions:

Length with spines ..	.. 18–29 μ
Length without spines ..	.. 15–19·5 μ
Breadth with spines ..	.. 17–25·6 μ
Breadth without spines	.. 11·9–17 μ
Isthmus	.. 5–6·8 μ

Hab.—Planktonic in Kodaikanal Lake.

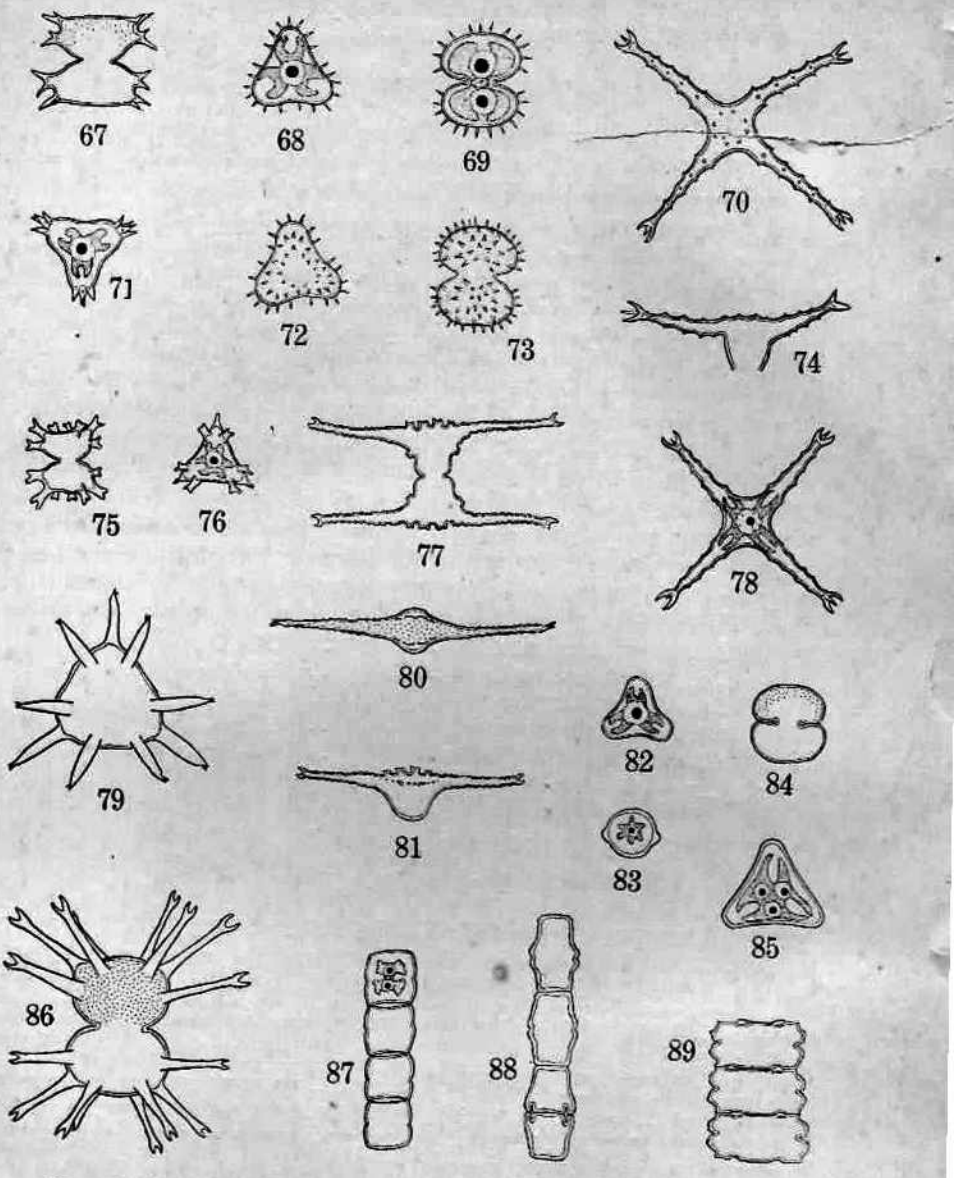
28. *Staurastrum hexacerum* (Ehr.) Wittr.

(Figs. 58, 59, 61)

Staurastrum tricorne Ralfs, *Brit. Desm.*, 1848, p. 134, Pl. 22, Fig. 11, and Pl. 34, Fig. 8*a*; Delponte, *Desm. subalp.*, 1877, p. 145, Pl. 11, Figs. 48–50; Wolle, *Desm. U.S.*, 1884, p. 126, Pl. 41, Figs. 36–38; Cooke, *Brit. Desm.*, 1887, p. 167, Pl. 53, Fig. 2.

Staurastrum hexacerum Turner, *Freshw. Alg. E. India*, 1893, p. 125; W. and G. S. West, *Freshw. Alg. Burma*, 1907, p. 218; W. and G. S. West and N. Carter, *Mon. Brit. Desm*, 1923, V, p. 138, Pl. 142, Figs. 11–14.

Cells small, slightly broader than long, deeply constricted, sinus open; semi-cells sub-triangular, both margins being convex and tapering towards the angles, forming very short processes ending in about 3–4 spines. Cell wall rough with tiny granules arranged in concentric series. Vertical view triangular; lateral margins concave; chloroplast axile with a big central pyrenoid and three deeply forked processes radiating one into each angle.



Figs. 67–89. Fig. 67. *Staurastrum contectum* var. *inevolutum*, single cell showing punctæ (× 410). Fig. 68. *Staurastrum gladiosum*, vertical view with chloroplasts (× 410). Fig. 69. *Staurastrum gladiosum*, single cell with chloroplasts (× 410). Fig. 70. *Staurastrum arachne* var. *pulneyensis* var. nov., vertical view showing spines (× 410). Fig. 71. *Staurastrum contectum* var. *inevolutum*, vertical view showing chloroplasts (× 410). Fig. 72. *Staurastrum gladiosum*, vertical view showing spines

Dimensions :

Length	21·9–23·7 μ
Breadth with processes	21·9–26·4 μ
Breadth without processes ..	14·6–18 μ
Isthmus	3·6–5·4 μ

Hab.—Kodaikanal Lake.

This form exhibits a certain amount of variation in shape and in the granules. Sometimes the granules appear as very short spinous projections and sometimes they appear only as marginal denticulations.

29. *Staurastrum columbetoides* West and West

(Figs. 62, 63)

W. and G. S. West, *Freshw. Alg. Ceylon*, 1902, p. 186, Pl. 22, Figs. 8–9.

Cells single, small, about 1½ times longer than broad without processes, deeply constricted, sinus narrow and linear; semi-cells truncate pyramidate, sides slightly convex, angles produced into thin delicate, long processes with denticulated margins and bifurcate ends.

Dimensions :

Length with processes	38–47·5 μ
Length without processes ..	12·8–16·4 μ
Breadth with processes ..	27–38 μ
Breadth without processes ..	10–14·6 μ
Isthmus	7–5 μ

Hab.—Planktonic in Kodaikanal Lake.

(× 410). Fig. 73. *Staurastrum gladiosum*, single cell with spines (× 410). Fig. 74. *Staurastrum-arachne* var. *pulneyensis* var. nov., semi-cell (× 410). Fig. 75. *Staurastrum furcatum*, single cell (× 410). Fig. 76. *Staurastrum furcatum*, vertical view with chloroplasts (× 410). Fig. 77. *Staurastrum longibrachiatum* var. *intermedium* var. nov., single cell (× 410). Fig. 78. *Staurastrum arachne* var. *pulneyensis* var. nov., vertical view showing chloroplasts (× 410). Fig. 79. *Staurastrum Tohopekaligense*, vertical view (× 410). Fig. 80. *Staurastrum longibrachiatum* var. *intermedium* var. nov., vertical view (× 410). Fig. 81. *Staurastrum longibrachiatum* var. *intermedium* var. nov., semi-cell showing the verrucæ (× 410). Fig. 82. *Staurastrum retusum* var. *punctulatum*, vertical view with chloroplasts (× 410). Fig. 83. *Gymnozyga moniliformis*, vertical view with chloroplasts (× 410). Fig. 84. *Staurastrum retusum* var. *punctulatum*, single cell with pores (× 410). Fig. 85. *Desmidium Swartzii*, vertical view with chloroplasts (× 410). Fig. 86. *Staurastrum Tohopekaligense*, single cell showing pores (× 410). Fig. 87. *Hyalotheca dissiliens* (× 410). Fig. 88. *Gymnozyga moniliformis*, filament with one cell in division showing the replicate folds (× 410). Fig. 89. *Desmidium Swartzii* (× 410).

30. *Staurastrum arachne* Ralfs
var. *pulneyensis* var. nov.

(Figs. 70, 74, 78)

Cells single, small, fairly constricted; semi-cells cup-shaped with the apices bearing small spines; angles produced into long processes, each process being tipped with about 3 spines and rough with about 5–6 concentric series of denticulations. Vertical view four-sided with concave sides and a circle of eight granules in the centre. Chloroplast axile with four lobes, deeply forked, radiating one into each process.

Dimensions:

Length	25·6–27 μ
Breadth with processes	68–70 μ
Breadth without processes ..	17–18·7 μ
Isthmus	8·5–9·4 μ

Hab.—Kodaikanal Lake.

The circle of 8 spines seen in the vertical view appears as spines at the apex in side view. In possessing this ring of spines, the Desmid comes very near *St. arachne* var. *arachnoides* (W. and G. S. West and N. Carter, *Mon. Brit. Desm.*, V, 1923, p. 132, Pl. 150, Fig. 3). But it differs from var. *arachnoides* in possessing only 8 spines and being only 4 radiate while var. *arachnoides* has 9–10 verrucæ and is 4–5 radiate. Again 5–6 concentric rows of denticulations in the processes makes the present form quite different from var. *arachnoides* which has the rows much closer and also a large number of rows, about 9–11 or more.

31. *Staurastrum gracile* Ralfs

forma (Figs. 64, 65, 66)

Cells variable, usually small about 1½ times broader than long including the processes, constriction slight as a notch; semi-cells cup-shaped broadening slightly towards the apex which is very slightly convex. Angles produced into long processes tipped with 3 or 4 minute spines and provided with several concentric series of denticulations; processes horizontal or slightly curved. Vertical view always triangular, with the sides straight or slightly concave and the angles produced to form long processes, elongated ridges seen inside the lateral sides running somewhat parallel to it; each ridge appearing slightly constricted in the middle. Chloroplast axile with a central big pyrenoid and three deeply forked processes radiating one into each arm.

Dimensions:

Length	21–24·6 μ
Breadth with processes	29–39·6 μ
Breadth without processes ..	10–13·6 μ
Isthmus	5–5·9 μ

Hab.—Kodaikanal Lake.

This comes very near *St. gracile* var. *ornatum* (Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 200, Pl. 18, Fig. 13) in general outline and in the possession of the ridges in the vertical view. But in var. *ornatum* the ridges are well marked into 6 double-headed distinct verrucæ whereas the present form has only long ridges. In addition var. *ornatum* has a small granule at the isthmus on each side of the semi-cell, which is absent here. *St. gracile* forma (Krieger, *op. cit.*, p. 200, Pl. 18, Fig. 12) also resembles this form but the *forma* has more arched arms in the side view and in the vertical view no ridges are present. So the present form appears to be different from the other varieties in possessing the elongated ridges which are double and very slightly divided in the middle. *St. gracile* var. *coronulatum* (W. and G. S. West and N. Carter, *Mon. Brit. Desm.*, V, 1923, p. 100, Pl. 144, Fig. 10) also resembles this but this has not got the ridges but only distinct emarginate processes.

Genus *Hyalotheca* Ehrenberg 1840

32. *Hyalotheca dissiliens* (Sm.) *De Breb.*

(Fig. 87)

Ralfs, *Brit. Desm.*, 1848, p. 51, Pl. 1, Fig. 1; Delponte, *Desm. subalp.*, 1877, p. 47; Turner, *Freshw. Alg. E. India*, 1893, p. 151; W. and G. S. West, *Freshw. Alg. of Ceylon*, 1902, p. 195; W. and G. S. West and N. Carter, *Mon. Brit. Desm.*, Vol. V, 1923, p. 230, Pl. 161, Figs. 16–27; Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 221, Pl. 26, Fig. 11.

Filamentous, cells small, faintly constricted, constriction being a slight concavity in the middle of the lateral margins. Chloroplast axile, with a central pyrenoid and a number of radiating ridges.

Dimensions:

Length	..	..	.. 13–17 μ
Breadth	..	..	.. 16–18 μ

Hab.—Kodaikanal Lake.

Genus *Desmidium* Agardh 1824.

33. *Desmidium Swartzii* Ag.

(Figs. 85, 89)

Ralfs, *Brit. Desm.*, 1848, p. 61, Pl. 4; W. and G. S. West and N. Carter, *Mon. Brit. Desm.*, V, 1923, p. 246, Pl. 163, Figs. 5–8; Smith, *Wisconsin phytoplankton*, pt. II, 1924, p. 144, Pl. 88, Figs. 1–2; Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 221, Pl. 26, Fig. 8.

Filaments spirally twisted, breadth of cells about twice the length, moderately constricted; apex of semi-cell broadly truncate,

with a short connecting process at each angle of the cell. Spaces between the cells faintly visible. Vertical view triangular with concave sides, angles broadly rounded. Chloroplasts massive, axile with broad projections running to the angles of the cells, projections incised about half the distance from the apex; pyrenoid one in each lobe, opposite to the sides.

Dimensions:

Length	13–15·6 μ
Breadth at centre	31–34 μ
Breadth at apex	27–29·9 μ
Isthmus	23–25·6 μ

Hab.—Kodaikanal Lake.

This form appears to be slightly narrower than West's form, but agrees with the measurements given by Krieger.

Genus *Gymnozyga* Ehrenberg, 1841

34. *Gymnozyga moniliformis* Ehrenberg

(Figs. 83, 88)

Turner, *Freshw. Alg. E. India*, 1893, p. 151, W. and G. S. West and N. Carter, *Mon. Brit. Desm.*, Vol. V, 1923, p. 255, Pl. 165, Figs. 8–9; Smith, *Wisconsin phytoplankton*, pt. II, 1924, p. 146, Pl. 87, Fig. 11; Brühl and Biswas, *Alg. of Loktak Lake*, 1926, p. 314, Pl. 15, Fig. 157; Krieger, *Die Desmidiaceen der Deutsch. Limn. Sunda Expedition*, 1932, p. 221, Pl. 26, Fig. 10.

Filaments with barrel-shaped cells; semi-cells with a small basal inflation and an extremely median constriction, lateral margins straight; apex broad and truncate. Vertical view circular with two opposite mamillæ. Chloroplasts axile, with a central big pyrenoid and about 6 radiating plates.

Dimensions:

Length	29 μ
Breadth at centre	17 μ
Breadth at the apex	11·9 μ

Hab.—Kodaikanal Lake.

LITERATURE CITED

Bernard, Ch. (1908) .. *Protococcacées et Desmidiées*, Batavia.

———— (1909) .. *Algues unicellulaires d' eau douce*, Buitenzorg.

Borge, O. (1896) .. "Australische Susswasserchlorophyceen," *Bih. K. Sv. Vet. Akad. Handl*, **22**, Afd. III, No. 9.

———— (1899) .. "Über tropische und subtropische Süsswasser-Chlorophyceen," *Ibid*,, **24**, Afd. III, No. 12.

Brühl, P., and Biswas, K. (1926) — " Algæ of the Loktak Lake," *Mem. Asiat. Soc.*, Bengal, **8**, 257–316.

Carter, N. (1926) .. " Freshwater algæ from India," *Records of the Botanical Survey of India*, **9**, No. 4, 263–302.

——— (1935) .. " Alpine Desmids from British Columbia," *Journ. Linn. Soc. Lond. Bot.*, **1**, 151–71.

Cooke, M. C. (1887) .. *British Desmids*, London.

Crow, W. B. (1923) .. " Freshwater plankton from Ceylon," *Journ. of Botany*, **61**.

De Bary, A. (1858) .. *Untersuchungen über die Familie der Conjugaten*, Leipzig.

Delponte, G. B. (1876–78) .. " Specimen Desmidiacearum subalpinarum," *Mem. d. R. Acad. d. Scienze di Torino*, Ser. 2.

De Toni (1889) .. *Sylloge Algarum*, Vol. I.

Fritsch, F. E. (1907) .. " A general consideration of the subaerial and freshwater algal flora of Ceylon," *Proc. Roy. Soc. London*, **79**.

———, and Rich, F. (1924) " Contributions to our knowledge of the freshwater algæ of Africa, 4. Freshwater and Subaerial algæ from Natal," *Trans. Roy. Soc. S. Africa*, **11**, 297–398.

——— (1935) .. " Contributions to our knowledge of the freshwater algæ of Africa, 11. Algæ from a pan in Southern Rhodesia," *ibid.*, **13**, 107–60.

Grönblad, R. (1921) .. " New Desmids from Finland and Northern Russia with critical remarks on some known species," *Acta Soc. pro Fauna et Flora Fennica*, **49**, No. 7.

——— (1926) .. " Beitrag zur Kenntnis der Desmidiaceen Schlesiens," *Soc. Scient. Fennica. Comment. Biolog.*, II, 5.

Grunow, A. (1865) .. " Süsswasser-Diatomaceen und Desmidiaceen von der Insel Banka," in Rabenhorst's *Beitr. zur Kenntniss und Verbreitung der Algen*, Hft. II.

Gutwinski, R. (1902) .. " De algis a D:e M. Raciborski anno 1899 in insula Java collectis," *Bull. d. l'Acad. d. Sc. d. Cracovie.*

Hobson, J. (1863) .. " Notes on Indian Desmidieæ," *Quarterly Journ. Micr. Sci.*, **3**, 168–70.

Joshua, W. (1885) .. " On some New and Rare Desmidieæ," *Jour. Bot.*, **23**, 33–35.

——— (1886) .. " Burmese Desmidieæ, with descriptions of new species occurring in the neighbourhood of Rangoon," *Journ. Linn. Soc. Lond. Bot.*, **21**.

Krieger, W. (1932) .. " Die Desmidiaceen der Deutschen Limnologischen Sunda-Expedition," *Arch. f. Hydrobiologie, suppl.*, Bd. **11**, 129–230.

——— (1933–35) .. " Die Desmidiaceen Europas mit Berücksichtigung der aussereuropaischen Arten," *Rabenh. Kryptogamenfl.*, Bd. **13**, Abt. 1, Lieferung 1 and 2.

Kützing, F. T. (1849) .. *Species Algarum*, Lipsiæ.

Lagerheim, G. (1888) .. "Über Desmidiaceen aus Bengalen," *K. Sv. Vet. Akad. Handl.*, Bd. **18**.

Nordstedt, O. (1873) .. "Bidrag till Kännedomen om Sydligare Norges Desmidieer," *Acta Univ. Lund.*

——— (1896) .. *Index Desmidiacearum, Lund.*

——— (1908) .. *Index Desmidiacearum, Supplementum, Lund.*

Rabenhorst, L. (1868) .. *Flora Europæa Algarum*, Section III, Lipsiæ.

Ralfs, J. (1848) .. *The British Desmidieæ*, London.

Schmidle, W. (1900) .. "Uber einige von Prof. Hansgirg in Ostindien gesammelte Süsswasseralgen," *Hedwigia*, **39**, 100–90.

Smith, G. M. (1924) .. "Phytoplankton of the Inland lakes of Wisconsin, Part 2, Desmidiaceæ," *Bull. Wisc. Geol. and Nat. Hist. Survey*, **57**.

Turner, W. B. (1893) .. "Freshwater algæ of East India," *K. Sv. Vet. Akad. Handl.*, **25**.

Wallich, G. C. (1860) .. "Desmidiaceæ of Lower Bengal," *Ann. Mag. Nat. Hist.*, Ser. 3, **5**.

West, W., and G. S. (1895) "Some Recently Published Desmidieæ," *Journ. Bot.*, **33**, 65–70.

——— (1896) .. "On some North American Desmidieæ," *Trans. Linn. Soc. Bot.*, Ser. 2, **5**.

——— (1897) .. "Desmids from Singapore," *Journ. Linn. Soc. Bot.*, **33**.

——— (1902) .. "A Contribution to the Freshwater Algæ of Ceylon," *ibid.*, Ser. 2, **5**.

——— (1904–12) .. *A Monograph of British Desmidiaceæ*, Vols. I—IV, London.

——— (1907) .. "Freshwater Algæ from Burma, including a few from Bengal and Madras," *Ann. Roy. Bot. Garden*, **6**.

——— and Carter, N. (1923) *A Monograph of the British Desmidiaceæ*, Vol. V, London.

Wolle, Fr. (1884) .. *Desmids of the United States*, Bethlehem.

Zeller, G. (1873) .. "Algæ collected by Mr. S. Kurz in Arracan and British Burma," *Journ. Asiat. Soc.*, Bengal, **42**.

Statement showing the distribution of the forms recorded in this paper

Names of the forms	Place of collection in S. India	Previous places of collection in India	Author
Gonatozygon Kinahani (Arch.) Rabenh. ..	Kodaikanal	Assam, Burma, Bengal	Carter, W. and G. S. West, Turner
Netrium digitus (Ehrb.) Itzigs and Rothe ..	do.	Ceylon, Burma, Hyderabad	Fritsch, W. and G. S. West, Carter, Turner
Closterium libellula Focke var. *pulneyensis* var. nov.	do.	..	..
Closterium Kutzingii Breb.	do.	Ceylon, Burma, Bengal	Crow, W. and G. S. West, Turner
Closterium Dianæ Ehrenb.	do.	Burma, Ceylon, Bombay	Joshua, W. and G. S. West, Schmidle
Closterium didymotocum Corda var. *annulatum* var. nov.	do.	..	..
Pleurotænium Trabecula (Ehrenbg.) Nägeli ..	do.	Ceylon, Burma, Bengal	Fritsch, W. and G. S. West, Turner
Pleurotænium minutum Delp. var. *gracile* Wille ..	do.	Ceylon	W. and G. S. West
Pleurotaenium Kayei Rabenh.	do.	Assam, Burma, Bengal	Carter, Joshua, Lagerheim
Pleurotænium tessellatum Joshua var. *bulbosum* Krieger.	do.	..	..
Euastrum sinuosum Lenorm	do.	Burma, Bengal	Carter, Joshua, Turner
Micrasterias pinnatifida (Kutz.) Ralfs.	do.	Ceylon, Loktak Lake, Bengal, Chittagong, Burma	W. and G. S. West, Brühl and B was, Carter, Joshua, Turner

Statement showing the distribution of the forms recorded in this paper—(Contd.)

Names of the forms	Place of collection in S. India	Previous places of collection in India	Author
Micrasterias incisa (Breb.) Ralfs. var. *Wallichiana* Turner	Kodaikanal	Loktak Lake, Bengal, Assam, Burma	Brühl and Biswas, Carter, Joshua, Turner
Cosmarium moniliforme (Turp.) Ralfs. forma *punctata* Lagerh.	do.	..	..
Cosmarium moniliforme (Turp.) Ralfs. forma *panduriformis* Heimerl	do.	..	..
Cosmarium obsoletum (Hanztsch) Reinsch. ..	do.	Bengal, Ceylon, Burma	Lagerheim, Crow, W. and G. S. West, Joshua, Turner
Cosmarium globosum Bulnh.	do.	Ceylon, Burma	W. and G. S. West, Joshua
Cosmarium pachydermum Lund. var. *indicum* var. nov.	do.	..	..
Xanthidium sexmamillatum West and West var. *pulneyensis* var. nov.	do.	..	..
Arthrodesmus subulatus Kutz.	do.	Ceylon, Burma, Bengal	Crow, Joshua, Turner
Staurastrum corniculatum Lund. var. *spinigerum* West	do.	..	..
Staurastrum Tohopekaligense Wolle	do.	..	..
Staurastrum unicorne Turner var. *gracile* var. nov.	do.	..	..

Staurastrum contectum (Turner) var. *inevolutum* Turner	do.	Bengal ..	Turner ..
Staurastrum longibrachiatum (Borge.) Gutw. var. *intermedium* var. nov.	do.	..	..
Staurastrum retusum Turn. var. *punctulatum* Eichl. and Gutw.	do.	Ceylon, Burma	W. and G. S. West
Staurastrum gladiosum Turner	do.	..	..
Staurastrum furcatum (Ehr.) Breb.	do.	..	..
Staurastrum hexacerum (Ehr.) Wittr.	do.	Burma, Bengal	W. and G. S. West. Turner
Staurastrum columbetoides West and West ..	do.	Ceylon	W. and G. S. West
Staurastrum arachne Ralfs. var. *pulneyensis* var. nov.	do.	..	..
Staurastrum gracile Breb. forma	do.	..	..
Hyalotheca dissiliens (Sm.) Breb.	do.	Ceylon, Loktak Lake, Bengal, Burma	Fritsch, W. and G. S. West, Brühl and Biswas, Wallich, West and West, Turner
Desmidium Swartzii Ag.	do.	Loktak Lake, Bengal	Brühl and Biswas, Wallich, Turner
Gymnozyga moniliformis Ehrenb.	do.	Ceylon, Loktak Lake, Bengal, Burma	Fritsch, W. and G. S. West, Brühl and Biswas, Wallich, W. and G. S. West, Turner