SYSTEMATIC
PART
Desmids are exclusively fresh water algae, they are usually unicellular, few of them remain in filamentous from cells consist of two parts; each part is commonly known as semicell. Each semicell may contain single or more than one chloroplast, which may be in different form like stellate, ribbon like digitate etc. Cell wall may be smooth or with true pores, various types of ornamentation including spines, ridges etc. Accordingly two groups of desmid have been recognized: – The Saccoderms and Placoderms. The former group is simpler and more primitive than the other.

Systematic arrangement of genera according to Brook (1981)
* Marked genera accommodated.

The saccoderm desmids –
Zygnematales
Mesotaeniaceae
1. Cylindrocystis
2. Mesotaenium
3. Spirotaenia
4. Netrium
5. Roya

The Placoderm desmids –
Desmidiales
Gonatozygaceae
1. Gonatozygon
2. Genicularia
Peniaceae
3. Penium
Closteriaceae
4. Closterium
Desmidiaceae
5. Euastrum
6 Cosmarium
7. Actinotaenium
8. Brachytheca*
9. Arthrodesmus
10. Bourrellyodesmus*
11. Xanthidium
12. Spinocosmarium
13. Staurastrum
14. Staurodesmus
15. Pleurotaenium
16. Haplotaenium*
17. Docidium
18. Streptonema
19. Hyalotheca
20. Spondylosium
21. Groenbladia
22. Teilingia
23. Onychonema
24. Sphaerozosma
25. Desmidium
26. Micrasterias
27. Triploceras
28. Triplastrum

**Zygmematales**: Saccoderm desmids

(Mesotaeniaceae)

Cell wall in one section, short cylindrical without pores; without median constriction each cell contains single chloroplast with one to two pyrenoids.

**Key to the genera described**

1. Cells slightly curved, with polar vacuole ... ... ... ... ... ... (V) Roya (p. 38)
1. Cells straight, without polar vacuole
   2. Cells larger, more than 5 times longer than broad ... ... ... (IV) Netrium (p. 35)
   2. Cells smaller, less than 5 times longer than broad
3. Chloroplast stellate with radiating lobes, pyrenoids usually one in each chloroplast .......... (I) *Cylindrocystis* (p. 29)

3. Chloroplast otherwise, with many pyrenoids

4. Chloroplast flattened or plate like, axial;
   cells elliptic ... ... ... ... ... ... ... ... ... ... (II) *Mesotaenium* (p. 32)

4. Chloroplast spiral or ribbon like, parietal;
   cells fusiform ... ... ... ... ... ... ... ... ... ... (III) *Spirotaenia* (p. 34)

I: *Cylindrocystis* Meneghini 1838

Cells cylindrical, straight or slightly curved, usually have a length two to three times the breadth with broadly rounded poles and may or may not have a slight constriction in the equatorial region; each semi cell contains a single stellate chloroplast with a spherical to rod shaped pyrenoid.

**Artificial key to the taxa described:**

1. Cells cylindrical lateral margins mostly parallel

2. Chloroplast with median constriction ........ ... (1) *C. brebissonii* var. *brebissonii*

2. Chloroplast without median constriction

3. Chloroplast stellate, cell wall smooth. ... ... (2) *C. brebissonii* var. *jenneri*

3. Chloroplast not stellate, cell wall with punctae

4. Cells larger 98 µm long, poles truncately rounded, punctae are arranged irregularly ... ... (4) *C. brebissonii* var. *turgida* f. *indica* f. nov.

4. Cells smaller 58 µm long, poles broadly rounded punctae are arranged in transverse rows ... ... ... ... (3) *C. brebissonii* var. *turgida*

1. Cells oblong, globose or fusiform, lateral margin not parallel

5. Cells oblong - ellipsoid, 3 times or more longer than broad ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... (8) *C. cyanosperma*

5. Cells elliptic or fusiform, less than 3 times longer than broad

6. Cells fusiform, narrowed from a wide mid region, poles sharply rounded ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... (9) *C. obesa*

6. Cells elliptic, slightly narrowed from mid region, poles broadly rounded

7. Cells more than 60 µm long, chloroplast not covering full length of the cell ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... (5) *C. crassa* var. *crassa*
7. Cells less than 60 μm long, chloroplast covering almost full length of the cell

8. Cells smaller, less than 16 μm long. (7) *C. crassa* var. *minor* var. nov.

8. Cells larger, greater than 16 μm long... (6) *C. crassa* var. *elliptica*

1. *C. brebissonii* Meneghini *var. brebissonii*

   Prescott *et al.* 1972, p. 20, pl. II, figs. 1-5; Dillard 1990, p. 65, pl. 24, fig. 4.

   [Plate I, Fig. 16]

   Cells more than 4 times longer than broad; cylindric, unconstricted, apices broadly rounded, chloroplast with radiating ridges, pyrenoid central.

   L. 68 μm, W. 14 μm.

   Field No. 190.

   Distribution: Karnataka (Bharati and Pai 1972, Hegde and Isaacs 1988), This is the new record of the species for West Bengal.

2. *C. brebissonii* var. *jenneri* (Ralfs) Reinsch & Kirchner

   Prescott *et al.* 1972, p. 21, pl. II, figs. 6-8; Dillard 1990, p. 66, pl. 24, fig. 5.

   [Plate I, Fig. 13, Plate XVI, Fig. 1]

   Cells 2-3 times longer than broad; cylindric, apices broadly rounded, wall smooth; chloroplast axial.

   L. 67-104 μm, W. 26-46 μm.

   Field No. 1054.

   Distribution: Probably this is the first record of the variety from India

3. *C. brebissonii* var. *turgida* Schmidle

   Prescott *et al.* 1972, p. 21, pl. II, figs. 17-18; Dillard 1990, p. 66, pl. 24, fig. 7.

   [Plate I, Fig. 10]

   Cells 1.5 times longer than broad; stoutly cylindrical, the poles rounded or somewhat truncate.

   L. 45-58 μm, W. 28-32 μm.

   Field No. 44, 364

   Distribution: Probably this is the first record of the variety from India


   [Plate I, Fig. 8]

   Cells 1.5 times longer than broad; barrel shaped, poles round or somewhat truncate width is much, pyrenoids 2 centrally located.
L. 98 μm, W. 57-58 μm.
Field No. 190
Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present specimen is much longer than the type, therefore treated as a new form

5. *C. crassa* de Bary var. *crassa*

Prescott *et al.* 1972, p. 22, pl. II, figs. 24, 26; Dillard 1990, p. 66, pl. 24, fig. 8.

[Plate I, Fig. 11]

Cells 1.5-2 times longer than broad; elliptic to oblong, the poles broadly rounded; chloroplast with a central pyrenoid and numerous plates.

L. 30-63μm, W. 16-30 μm.
The present specimen is shorter and broader than the type.
Field Nos. 44, 1118.
Distribution: Karnataka (Bharati and Pai 1972, Gurudeva *et al.* 1983), This is the new record of the species for West Bengal.

6. *C. crassa* var. *elliptica* West & West

Prescott *et al.* 1972, p. 22, pl. II, figs. 27-28; Dillard 1990, p. 66, pl. 24, fig. 9.

[Plate I, Fig. 9]

Cells broadly ovoid, short, sometimes also spherical, chloroplast crenulate.

L. 26-34 μm, W. 11-25 μm.
Field No. 1054.
Distribution: Probably this is the first record of the variety from India.

7. *C. crassa* var. *minor* var. nov.

[Plate I, Fig. 12]

Cells slightly longer than broad; elliptic or spherical, poles broadly rounded, chloroplast stellate with centrally located single pyrenoid.

L. 15 μm, W. 9 μm.
Field No. 190
Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the
algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is smaller than the type. Cells shape is also more or less elliptic and not ovoid.


Krieger 1937, p. 211, pl. 6, figs. 14, 15.

[Plate I, Fig. 14]

Cells 3 times longer than broad, cylindric, pole rounded or somewhat truncate, chloroplast axial.

L. 22 μm, W. 7 μm.

Field No. 1054.

Distribution: Probably this is the first record of the species from India.

9. *C. obesa* West & West

Prescott *et al.* 1972, p. 22, pl. II, fig. 30; Dillard 1990, p. 67, pl. 24, fig. 10.

[Plate I, Fig. 15]

Cells nearly 2 times longer than broad, fusiform, distinctly narrowed toward the poles; cell wall colourless; zygospore thick walled, blackish in colour.

L. 42 μm, W. 24 μm, Zygospore dia. 24 μm.

The present specimen is however smaller than the type. Zygospore has been observed in our sample. This is a new observation.

Field No. 606.

Distribution: Probably this is the first record of the species from India.

II : *Mesotaenium* Nägeli 1849

Cells solitary or embedded in large numbers within a common watery gelatinous matrix; cells oval, either cylindric to sub-cylindric and with broadly rounded poles; contains a single axial, laminate chloroplast with one to several pyrenoids.

**Artificial key to the taxa described:**

1. Cells less than 25 μm long

2. Cells 2 times longer than broad, nearly cylindric ....... (1) *M. chlamydosporum* var. *chlamydosporum*

2. Cells less than 2 times longer than broad,

   subcylindric ... ...... ...... ...... ...... ...... ...... ...... ...... ...... ...... (2) *M. chlamydosporum* var. *minus*
1. Cells greater than 25 μm long

3. Poles broadly rounded, lateral margin parallel ..... (3) *M. degreyii* var. *breve*

3. Poles abruptly rounded, lateral margin not parallel ..... (4) *M. macrococcum*

1. **M. chlamydosporum** de Bary var. *chlamydosporum*

Prescott *et al.* 1972, p. 8, pl. I, figs. 32, 33; Dillard 1990, p. 62, pl. 23, fig. 5.

[Plate I, Fig. 2, Plate XVI, Fig. 5]

Cells oblong-cylindric, more than 2 times longer than broad, the poles broadly rounded, chloroplast axial, narrow.

L. 24-75 μm, W. 10-34 μm.

Field No. 667.

Distribution: Probably this is the first record of the species from India.

2. **M. chlamydosporum** var. *minus* (Reinsch) West & West

Prescott *et al.* 1972, p. 9, pl. I, figs. 34-36; Dillard 1990, p. 63, pl. 23, fig. 6.

[Plate I, Fig. 1]

Cells cylindric with rounded poles, somewhat attenuated towards the pole, chloroplast axial.

L. 18-21 μm, W. 9-11 μm.

Field No. 818.

Distribution: Probably this is the first record of the variety from India.

3. **M. degreyii** Turner var. *breve* West

Prescott *et al.* 1972, p. 9, pl. I, figs. 1, 2; Dillard 1990, p. 63, pl. 23, fig. 8.

[Plate I, Fig. 4]

Cells elliptic, more than 1.5 times longer than broad, poles rounded.

L. 36 μm, W. 20 μm.

Field No. 1136.

Distribution: Probably this is the first record of the variety from India.

4. **M. macrococcum** (Kützing) Roy & Bissett

Prescott *et al.* 1972, p. 11, pl. I, figs. 27-30; Dillard 1990, p. 63, pl. 23, fig. 10.

[Plate I, Fig. 3]

Cells elliptic, longer than broad; poles rounded, chloroplast axial.

L. 26 μm, W. 15 μm.

Field No. 44.
Systematic part

Distribution: Maharashtra (Ashtekar and Kamat 1979), This is the new record of the species from West Bengal.

III: *Spirotaenia* Brébisson 1848

Cells cylindric, elliptic or slightly curved, rounded at poles or acute; spirally twisted; chloroplast extending full length of the cell, pyrenoids 2 to several, cell wall smooth and colourless, without punctae.

Artificial key to taxa described:

1. Cells larger, greater than 90 (100) μm long ..................... (2) *S. indica* sp. nov.
2. Cells smaller, less than 90 μm long
   2.1. Cells fusiform, narrowed towards the acutely rounded apices ........ (3) *S. minuta*
   2.2. Cells elliptic, apices rounded .......................................... (1) *S. bryophila*

1. *S. bryophila* (Bréb.) Lütkemüller

   Prescott *et al.* 1972, p. 15, pl. III, figs. 29-35; Krieger 1937, p. 184, pl. 1, fig. 10.

   [Plate I, Fig. 6]

   Cells minute, relatively fusiform, more than 3 times longer than broad, poles gradually tapered, rounded chloroplast in spiral band.

   L. 8 μm, W. 2 μm.

   Field No. 44.

   Distribution: Probably this is the first record of the species from India.

2. *S. indica* sp. nov.

   [Plate I, Fig. 7]

   Cells slender, fusiform with pointed poles, more than 15 times longer than broad, chloroplast two spiral, axial.

   L. 93 μm, W. 6 μm.

   Field No. 1136

   Holotype: No. PM 1136, Feb. 17, 2003, Bishnupur, Bankura, Brown & some creamish colour patch attached on submerged *Hydrilla verticillata* (pH 6, Temp. 23°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present specimen is close to *S. lemanensis* (Reverdin) Printz, but differs from it in i) length breadth ratio (20 times) ii) number of turns (6) iii) longer in dimension iv) narrower.

3. *S. minuta* Thuret

Prescott *et al.* 1972, p. 17, pl. IV, figs. 4-6; Krieger 1937, p. 186, pl. 2, fig. 8.

[Plate I, Fig. 5]

Cells minute, fusiform with acutely rounded apices; more than 5 times longer than broad, chloroplast parietal 2 turns.

L. 17-28 μm, W. 3-5 μm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

IV: *Netrium* (Nägeli) Itzigson & Rothe em. LütKemüller 1902

Cells broadly fusiform or sub-cylindric has a length at least two to three times longer than the broad; ends rounded to truncate; median constriction usually lacking; wall without pores (rarely with minute punctations) and without external markings; chloroplast axial with longitudinal ridges; each chloroplast with several pyrenoids.

Artificial key to taxa described:

1. Cells cylindric or spindle shaped with broadly rounded poles
   2. Cells spindle shaped, mid region slightly inflated .... (7) *N. indicum* sp. nov.
   2. Cells cylindric, not inflated in the mid region.
      3. Cells larger, 300 μm long. ....... (6) *N. elongatum*
      3. Cells smaller, less than 300 μm long. .......(1) *N. bengalicum* sp. nov.

1. Cells elliptic or broadly fusiform with truncate poles
   4. Chloroplast with median constriction and without longitudinal ridges.
      5. Cells elliptic. ....... (2) *N. digitus* var. *digitus*
      5. Cells rhomboidal........................................(4) *N. digitus* var. *rhomboideum*
   4. Chloroplast without median constriction and with prominent longitudinal ridges
      6. Each semicell with two chloroplast ....... (5) *N. digitus* var. *scottii* f. *minus*
      6. Each semicell with single chloroplast ....... (3) *N. digitus* var. *rectum.*
1. *N. bengalicum* sp. nov.  

[Plate II, Fig. 6]  
Cells fusiform or spindle shaped; 7 times longer than broad; chloroplast with undulate ridges; apex rounded.  
L. 105 μm, W. 15 μm.  
Field No. 1124  
Holotype: No. PM 1124, Jan. 20, 2003, Bishnupur, Bankura, Brown colour small algal patch attached on rotting *Hydrilla verticillata* (pH 6, Temp. 16°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.  
The present species differs from all the existing species of *Netrium* in typically spindle shaped vegetative cells and chloroplast with undulate longitudinal ridges. It apparently looks like *N. digitus* (Ehrenberg) Itzigson & Rothe f. elegans Kossinskaja but chloroplast mass in this species is undulate rather than digitate; cells are less broader and apex more narrow and round  

2. *N. digitus* (Ehrenberg) Itzigson et Rothe var. *digitus* West & West  
West & West 1904, p. 64, pl. 6, fig. 16; Prescott *et al.* 1972, p. 24, pl. IV, figs. 14-16, 21; Dillard 1990, p. 67, pl. 25, fig. 1.  
[Plate II, Fig. 1, Plate XVI, Figs. 2, 3]  
Cells oblong, elliptic gradually attenuated from the middle; poles rounded or somewhat truncate; chloroplast 2 in each semicell, with serrate margins.  
L. 118-388 μm, W. 23-66 μm.  
Field No. 1116.  
Distribution: Very common.  

Krieger 1935, p. 216, pl. 7, fig. 2; Prescott *et al.* 1972, p. 26, pl. IV, fig. 22.  
[Plate II, Fig. 2, Plate XVI, Fig. 4]  
Cells elliptic, gradually attenuated towards the poles, poles truncate; chloroplast single in each semicell.  
L. 162-294 μm, W. 32-34 μm.  
Specimen is much smaller than type.  
Field No. 1118.  
Distribution: Probably this is the first record of the variety from India.
4. *N. digitus var. rhomboideum* Grönblad

Grönblad 1920, p. 13, pl. 4, fig. 38; Prescott et al. 1972, p. 27, pl. IV, figs. 19, 20.

[Plate II, Fig. 3]

Cells rhomboidal tapering gradually from the mid region broad, mid region angular 4 times longer than broad; chloroplast axial, digitate.
L. 210 µm, W. 54 µm.
Field No. 1116.
Distribution: Kerala (Sindhu and Panikkar 1994), This is the new record of the variety for West Bengal.

5. *N. digitus var. scottii* Prescott f. minus Prescott, Croasdale & Vinyard

Prescott et al. 1972, p. 27, pl. V, fig. 8; Dillard 1990, p. 68, pl. 25, fig. 5.

[Plate II, Fig. 7]

Cells elliptic fusiform, middle portion is wider; poles rounded, chloroplast with distinct 3 notch, longitudinal ridged.
L. 128 µm, W. 24 µm.
Specimen is less wider than the type.
Field No. 1118.
Distribution: Probably this is the first record of the form from West Bengal.

6. *N. elongatum* Ohtani

Ohtani 1990, p. 34, figs. 29-31.

[Plate II, Fig. 4]

Cells cylindrical, poles rounded or somewhat truncate; chloroplast single, with deep median constriction, margin dentate, pyrenoids 8.
L. 300 µm, W. 60 µm.
Field No. 1116.
Distribution: Probably this is the first record of the species from India.

7. *N. indicum* sp. nov.

[Plate II, Fig. 5]

Cells typically spindle shaped with swollen mid region, gradually tapering towards the poles, poles rounded; chloroplast with longitudinal ridges.
L. 78 µm, W. 15 µm.
Field No. 352.
Holotype: No. PM 352, Oct. 17, 2001, Bishnupur, Bankura, Brown to blackish colour colonial patch associated with *Salvinia natans*. (pH 6.5, Temp. 32.5°C).
Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

It looks like *N. digitus* var. *rhomoideum* Grönblad but differs in shape of the cell, nature of apex and chloroplast margins. Moreover it is also smaller. It also looks like *N. minus* Prescott but differs in narrower mid region and length breadth ratio (i.e. 5 times) Cells in this new species are typically spindle shaped with swollen mid region and gradually tapered to rounded poles.

**V: Roya West & West em. Hodgetts 1920**

Cells cylindric or subcylindric, slightly curved or bowed, slightly attenuated towards the poles are truncate cell wall smooth colorless, without pores; chloroplast solitary, axial, pyrenoids several in a linear series.

Artificial key to taxa described:

1. Cells 200 μm long, chloroplast not deeply lobed ....... ..... ...... ...... ...(3) *R. obtusa* var. *indica* var. nov.

1. Cells less than 200 μm long, chloroplast lobed

2. Cells slightly curved, poles broadly rounded. .... .... (2) *R. obtusa* var. *obtusa*

2. Cells not curved, poles truncate .............. .......... .......(1) *R. anglica* f. *major*

**1. R. anglica West f. major N. Carter**


[Plate I, Fig. 18]

Cells cylindric; poles truncate, chloroplast deeply notched with 6-8 pyrenoids, presence of terminal vacuole.


The present specimen is broader than the type.

Field No. 1054.

Distribution: Probably this is the first record of the form from India.

**2. R. obtusa (Brébisson) West & West var. obtusa**

Prescott *et al.* 1972, p. 31, pl. VI, figs. 1-8.

[Plate I, Fig. 17]
Cells cylindric, very slightly curved, attenuated towards the apices, 7-9 times longer than broad, poles rounded; chloroplast extending the entire length, pyrenoid 5-8.


Field No. 190.

Distribution: Probably this is the first record of the variety from India.

3. *R. obtusa var. indica var. nov.*

[Plate I, Fig. 19]

Cells cylindric, slightly curved; poles rounded or subtruncately rounded, 9 times longer than broad pyrenoids many.

L. 189 μm, W. 21 μm.

Field No. 744.

Holotype: No. PM 744, Dec. 11, 2001, Khatra, Bankura, Green orange colour algal mass attached on aquatic stem (*Scirpus* sp.) (pH 6, Temp. 23°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is larger in size than the type and poles are subtruncately round.

**Desmidiales: Placoderm desmids**

*(Gonatozygaceae, Peniaceae, Closteriaceae, Desmidiaceae)*

Cell wall in two sections, the two portions adjoined in the mid region by a distinct isthmus and forming median constriction cells may forms filaments wall with true pores.

**Key to the Genera Described**

1. Cells arranged in a filament

2. Cells adjoined by processes at their apices or rarely on their apical wall

   3. Cells adjoined by 3 prominent armlike processes ...... ...... ...... ...... ...... ...... *Desmidium baileyi* (P. 146)

3. Cells adjoined otherwise

   4. Cells adjoined by interlocking hooks ...... *Micrasterias foliacea* (P. 154)

4. Cells adjoined otherwise
5. Cells adjoined by 4 buttonlike tubercles on the apical wall ... ... ... ... ... ... ... ... (XXVII) *Teilingia* (P. 138)

5. Cells adjoined by other forms of processes

6. Cells adjoined by hornlike interlocking processes

7. Processes long ... ... ... ... (XXVIII) *Onychonema* (P. 140)

7. Processes short ... ... ... ... (XXIX) *Sphaerozosma* (P. 144)

6. Cells adjoined by 3 protrusion. (XXIII) *Streptonema* (P. 134)

2. Cells adjoined on their apical wall, processes lacking

8. Cells cylindric

9. Cells more than 5 times longer than broad, semicell slightly swollen

10. Cells longer, basal swelling evident ... ... ... ... ... ... ... ... (XX) *Pleurotaenium* (P. 117)

10. Cells shorter, without basal swelling ... ... ... ... ... ... ... ... (XI) *Haploporaenium* (P. 129)

9. Cells less than 5 times longer than broad

11. Middle portion slightly inflated. (XXVI) *Groenbladia* (P. 137)

11. Middle portion not inflated .......... (XXIV) *Hyalotheca* (P. 134)

8. Cells not cylindric but quadrate or lobed and triangular

12. Semicell transversely oval or reniform ... ... ... ... ... ... ... ... (XXV) *Spondylosium* (P. 135)

12. Semi cells of other shapes mostly quadrangular ... ... ... ... ... ... ... ... (XXX) *Desmidium* (P. 144)

1. Cells not arranged in filaments, solitary

13. Cells elongate cylindric, straight or slightly curved or crescent shaped

14. Cells with a median incision

15. Apex of semi cells lobed, the lobes bearing spine or long teeth.

16. Cells bearing whorls of spiny or toothed protuberances throughout their length ... ... ... ... ... ... (XXXII) *Triploceras* (P. 161)

16. Cells without whorls of spines or toothed protuberances throughout their length; spines on the extremities only ...... ...... (XXXIII) *Triplostrum* (P. 162)

15. Apex of semi cells not furnished with spines, lobes or teeth.
17. Semicell with longitudinal creases at the base ................................ (XXII) *Docidium* (P. 133)

17. Semicell without longitudinal creases at the base

18. Cells long cylindric, with conspicuous median incision ................ (XX) *Pleurotaenium* (P. 117)

18. Cells short cylindric, with slight median incision

19. Wall with spine or sharp granules with true pore .................. (VI) *Gonatozygon* (P. 42)

19. Wall with granules (not sharp); pores lacking

20. Poles truncate, chloroplast parietal spiral band ...................... (VII) *Genicularia* (P. 46)

20. Poles rounded, chloroplast axial with longitudinal ridges ............. (VIII) *Penium* (P. 47)

14. Cells without median incision, curved or strongly lunate .................. (IX) *Closterium* (P. 47)

13. Cells not cylindric or curved

21. Cells compressed

22. Cells strongly compressed, radiating lobes in one plane .............. (XXXI) *Micrasterias* (P. 149)

22. Cell compressed, radiating lobes in two to many planes

23. Radiating lobes in two plane ................................ (XIX) *Staurodesmus* (P. 116)

23. Radiating lobes in more than two plane ................................ (XVII) *Staurastrum* (P. 107)

21. Cells not compressed

24. Semi cells with prominent facial swelling

   with polar notch ........................................ (X) *Euastrum* (P. 64)

24. Cells without facial swelling

25. Semi cells with prominent spines at two or more angle

26. Semi cells with simple spine at either side

   of the apical margin

27. Spines are larger and horizontally placed ....................... (XVII) *Spinocosmarium* (P. 106)

27. Spines are smaller and downwardly curved ....................... (XIV) *Bourrellyodesmus* (P. 99)
26. Semi cells with different form and arrangement of spine
28. Semi cells furnished with 4,8 simple bifid
    or trifid spines ........... (XV) Xanthidium (P. 100)
28. Semi cells furnished with 2 or
    rarely 4 spine ..... (XVI) Arthrodesmus (P. 104)

25. Cells without spine
29. Median incision conspicuous .......... (XI) Cosmarium (P. 74)
29. Median incision shallow
30. Cells elliptic apex rounded ... (XII) Actinotaenium (P. 96)
30. Cells quadrate, apex flat or
    broadly rounded ..... (XIII) Brachytheca (P. 98)

VI: Gonatozygon de Bary 1856

Cells cylindrical with truncate poles, 10 or more times the diameter in length;
chloroplast spiral or twisted ribbon like, axial; pyrenoids in linear files (4-16); wall
with spines, sharp granules and true pores.

Artificial key to the taxa described

1. Wall without spines or granules.
   2. Wall punctate ...... (9) G. monotaenium f. punctatum.
   2. Wall smooth .......................................................... (5) G. kinahani
1. Wall with spines or granules
   3. Cells with long spine (6-9 μm)
      4. Cells less than 10 μm width
         5. Spines throughout the body ...... (3) G. aculeatum var. echinatum f.
            indica f. nov.
      5. Spine absent in the polar region. ...... (1) G. aculeatum var. aculeatum
   4. Cells greater than 10 μm width.
      6. Cells containing two chloroplast,
          poles retuse ...... (4) G. indicum sp. nov.
      6. Cells containing single chloroplast,
         poles not retuse ...... (2) G. aculeatum f. groenbladii
   3. Cells with short spines or granules
      7. Wall densely beset with small spines
8. Wall undulate ........................................ (11) *G. undulatum* sp. nov.
8. Wall straight ................................................... (10) *G. pilosum*
7. Wall densely granular.
9. Cells less than 100 µm long
  10. Chloroplast with median constriction,
      poles slightly inflated ........................................ (8) *G. monotaenium* var. *minutum*.
  10. Chloroplast without median constriction, poles.
      not inflated. ........................................ (6) *G. monotaenium* var. *monotaenium* forma
9. Cells greater than 100 µm long ................................ (7) *G. monotaenium* var. *gracile*.

1. *G. aculeatum* Hastings var. *aculeatum*
   [Plate III, Fig. 1]
   Cells cylindric, the apices truncate, slightly dilated, 14-15 times longer than broad; wall with sharp, erect spines; poles are spineless; chloroplast with many pyrenoids.
   L. 118-138 µm, W. 7-10 µm. Spine 6-9 µm.
   Field No. 44.
   Distribution: Allahabad (Pandey and Pandey 1980), This is the new record of the variety for West Bengal.

2. *G. aculeatum* f. *groenbladii* Ruzicka
   Bourrely 1984, p. 103, pl. 1, fig. 130.
   [Plate III, Fig. 9]
   Cells cylindric, apices truncate, 15 times longer than broad; walls densely beset with small sharp spines; poles are spineless; chloroplast spiral; pyrenoids 5-7.
   L. 167-185 µm, W. 10-11 µm, Spine 2-4 µm.
   Field No. 1122.
   Distribution: Probably this is the first record of the form from India.

   [Plate III, Fig. 6]
   Cells cylindric, slightly curved apical region, 9-12 times longer than broad; wall with densely beset longer spine, apex with spine.
   L. 66-111 µm, W. 8-9 µm, Spine 8-10µm.
   Field No. 749.
Holotype: No. PM. 749, Dec. 12, 2001, Ranibandh, Bankura, Blackish to brownish in colour assemblages lodged on *Utricularia stellaris* (pH 6, Temp. 22°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new form differs from the type in i) broader cells, ii) densely beset spines, iii) spines are longer (8-10 μm), iv) one end slightly curved.

4. *G. indicum* sp. nov.

[Plate III, Fig. 11]

Cells cylindric, poles truncate, length breadth ratio is lower; 7 times longer than broad; walls densely beset with spines, gradually tapering end; chloroplast 2; pyrenoids 4 in each semicell.

L. 106 μm, W. 15 μm, Apex 12 μm, Spine 2-3 μm.

Field No. 1122.

Holotype: No. PM 1122, Jan. 20, 2003, Bishnupur, Bankura, Gray colour algal mass attached on *Hydrilla verticillata* (pH 5, Temp. 24°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new species resembles *G. aculeatum* Hastings but differs in i) lower length breadth ratio (7) ii) short cells it differs from other known species of *Gonatozygon* in having gradually tapering ends which is shapely truncate.

5. *G. kinahani* (Archer) Rabenhorst

Krieger 1937, p. 35, pl. VII, figs. 1-4; Dillard 1990, p. 72, pl. 26, fig. 9.

[Plate III, Figs. 7, 8]

Cells cylindric, somewhat curved, pole truncate, 14-23 times longer than broad; wall smooth or granulate, chloroplast two pyrenoid 6-10.


Field No. 1123.

Distribution: Karnataka (Gurudeva et al. 1983), This is the new record of the species from West Bengal.

6. *G. monotaenium* de Bary var. *monotaenium* forma

[Plate III, Fig. 4]

Cells cylindric, apices dilated, slightly curved; wall wavy with fine granules, 12 times longer than broad.

L. 89 μm, W. 7 μm.
The present specimen is smaller than the type and the apices dilated with slightly curved end walls. Therefore, this taxa may be considered as a forma(?).

Field No. 44.

Distribution: Probably this is the first record of the form from India.

7. *G. monotaenium var. gacile* Krieger

Bourrelly Coute 1982, p. 234, pl. 4, fig. 7.

[Plate III, Fig. 12]

Cells cylindric, apices slightly dilated; 24 times longer than broad; wall densely granular.

L. 288 μm, W. 12 μm.

The present specimen is larger than the type (almost double).

Field No. 606.

Distribution: Probably this is the first record of the variety from India.

8. *G. monotaenium var. minutum* Cushman

Prescott et al. 1972, p. 36.

[Plate III, Fig. 3]

Cells smaller than typical, cylindric, apices dilated; wall with granules, 12 times longer than broad.

L. 75 μm, W. 6 μm.

Field No. 1140.

Distribution: Probably this is the first record of the variety from India.

9. *G. monotaenium f. punctatum* Croasdale

Croasdale 1965, p. 304, pl. 1, fig. 3; Prescott et al. 1972, p. 36, pl. VII, fig. 13.

[Plate III, Fig. 10]

Cells relatively stout, the walls punctate rather than granulate; chloroplast single an axial plate with 4 pyrenoids.

L. 52-71 μm, W. 4-7 μm.

Field No. 749, 1118.

Distribution: Probably this is the first record of the form from India.

10. *G. pilosum* Wolle

Wolle 1882, p. 27, pl. 13, fig. 16; Prescott et al. 1972, p. 36, pl. VII, figs. 14-17; Dillard 1990, p. 73, pl. 26, fig. 11.

[Plate III, Fig. 2, Plate XVI, Figs. 6, 7]
Cells cylindric, the apices truncate, 13 times longer than broad, wall densely beset with small straight spines; chloroplast two pyrenoids 4-6.

L. 72-187 μm, W. 6-18 μm.

The present specimen is smaller than the type.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

11. *G. undulatum* sp. nov.

[Plate III, Fig. 5]

Cell cylindric, apices dilated 6 times longer than broad, wall undulate, with finely beset granules and sharp spines.

L. 66 – 89 μm, W. 11-18 μm.

Field No. 40.

Holotype: No. PM 40, Nov. 19, 2000, Birshingha, Bankura, Blackish in colour, assemblages are free floating and some are attached on aquatic stems. (pH 6, Temp. 26.5°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (Burd), West Bengal, India.

The present specimen looks like *G. pilosum* Wolle but differs in i) undulate walls, ii) 6 times longer than broad, and iii) smaller in dimension.

VII: *Genicularia* de Bary 1858

The cells may be solitary or joined end to end to form short or relatively long filaments; cylindric with squarely truncate poles; chloroplast one or two spirally twisted ribbon, parietal wall densely and minutely granulate.

Artificial key to the taxa described

1. Cells filiform, curved poles slightly inflated .................................... (1) *G. elegans*

1. Cell broadened, not curved, poles truncate .................................... (2) *G. spirotaenia*

1. *G. elegans* West & West

West & West 1903, p. 536, pl. 14, figs. 1, 2; Prescott et al. 1972, p. 32, pl. VI, figs. 31-32; Dillard 1990, p. 70, pl. 26, fig. 1.

[Plate III, Fig. 14]

Cells cylindric, curved, poles truncate; walls bearing minute sharp granules, more than 40 times longer than broad; chloroplast 2, spiral.
Systematic part

L. 180 μm, W. 4-5 μm, Apex 5 μm.
Field No. 1169.
Distribution: Probably this is the first record of the species from India.

2. *G. spiropaenia de Bary*

Prescott et al. 1972, p. 33, pl. VI, figs. 26-30; Dillard 1990, p. 70, pl. 26, fig. 2.

[Plate III, Fig. 13]

Cells nearly cylindric, broadened at the truncate poles, 20 times longer than broad; wall minutely granular, Chloroplast 2, with numerous pyrenoids.
L. 123-205 μm, W. 6-15 μm.
Field No. 44, 1122.
Distribution: Probably this is the first record of the species from India.

VIII : *Penium de Brébisson 1844*

Cells cylindric, attenuated at the ends and truncate, median portion with slightly constricted or not; wall with simple pore or series of granules or stripe, chloroplast usually axial, one in each semicell, with several radiating longitudinal ridges with one or more axial pyrenoids.

1. *P. exiguum W. West*

Krieger 1939, p. 233, pl. 10, figs. 7-10; Dillard 1990, p. 79, pl. 27, fig. 2

[Plate III, Fig. 15]

Cell cylindric, attenuated at the ends and truncate; median portion slightly constricted, wall with pores, chloroplast axial.
L. 18 μm, W. 4 μm.
Field No. 190.
Distribution: Probably this is the first record of the species from India.

IX : *Closterium Nitzsch 1817*

Cells solitary, lunate, bow-shaped, or rarely straight, tapering from the mid-region to acute or truncate apices, cell wall smooth, striated, wall often yellowish or brown; chloroplast two, one in each semicell pyrenoids many, terminal vacuoles prominent.
Systematic part

Artificial key to the taxa described

1. Cells with a girdle band
   2. Cells bow-shaped or slightly lunate
      3. Cells with distinct apical notch ... (32) Cl. striolatum
      3. Cells with acute apex ... (35) Cl. turgidum
   2. Cells strongly curved, definitely lunate
      4. Cells relatively larger, more than 10 times longer than broad
         5. Wall costate ... (24) Cl. porrectum
         5. Wall striate ... (1) Cl. archerianum
      4. Cells relatively smaller, 6-7 times longer than broad
         6. Apex broadly rounded ...(7) Cl cynthia var. robustum
         6. Apex not broadly rounded ...(6) Cl. cynthia var. latum
   1. Cells without girdle band
      7. Cells straight or bow shaped
         8. Walls striated
            9. Apical extension long seta like
               10. Median portion inflated.
                   11. Mid region abruptly tapered to the long seta like apices, apices inwardly curved ... (31) Cl. setaceum var. vittatum
                   11. Mid region gradually tapered to the apices, apices almost straight ...(30) Cl. setaceum var. setaceum
               10. Median portion not inflated
                   12. Zygospore dumbbell shaped with distinct median constriction ... (15) Cl. kuetsingii var. linearis var. nov
                   12. Zygospore elliptical without median constriction .........................(16) Cl. kuetsingii var. vittatum
               9. Apical extension symmetrically tapered not seta like
                  13. Apex truncate ... (29) Cl. rostratum
                  13. Apex rounded
                     14. Wall with costae .................................(8) Cl. delpontei
                     14. Wall with striae .................................(18) Cl. lineatum
      8. Wall smooth or punctuate
         15. Cells shorter, 93-105 μm long
16. Cells straight, isthmus region compressed ........ .... (17) *Cl. lenzenwegerii* sp. nov.

16. Cell slightly curved, not compressed in the isthmus region ....................... (36) *Cl. tumidum*

15. Cells longer, more than 150 µm long

17. Cells 30-50 times longer than broad

18. Cells 3-7 µm in diameter, filiform ........ (13) *Cl. gracile*

18. Cells 17 µm in diameter, not filiform ....................... (34) *Cl. toxon var. indicum* var. nov.

17. Cells less than 30 times longer than broad

19. Cells straight

20. Apex truly truncate, wall smooth ............... (39) *Cl. yamagishi* sp. nov.

20. Apex acute, wall punctuate ................... (26) *Cl. pritchardianum*

19. Cells slightly curved or bow shaped

21. Mid region distinctly inflate ..................... (27) *Cl. pseudoralfsii*

21. Mid region not inflated ................... 25. *Cl. praelongum*

7. Cells strongly curved, lunate

22. Poles of cells swollen or with a subpolar thickening .............................. (20) *Cl. nematodes var. proboscideum*

22. Poles of cell not enlarged

23. Poles obliquely truncate

24. Cells larger, 250-445 µm long ............... (9) *Cl. dianae*

24. Cells short 110-150 µm long

25. Cells abruptly narrower to the apex

26. Cells 16 times longer than broad ..................... (3) *Cl. calosporum var. brasiliense*

26. Cells 13 times longer than broad .............. (2) *Cl. calosporum var. calosporum*

25. Cells gradually tapered to the apex

27. Cells with 13-17 µm in diameter .......................... (5) *Cl. calosporum var. maius*

27. Cells with 7-9 µm in
23. Poles symmetrically rounded

28. Much wider mid region, cells 4-5 times longer than broad ..................... (10) *Cl. ehrenbergii* var. *podolicum*

28. Less wide mid region, cells more than 5 times longer than broad.

29. Cell slightly curved

30. Cells relatively larger, 340-550 μm long .(19) *Cl. moniliferum*

30. Cells relatively shorter, 81-91 μm long

31. Poles bluntly rounded ..................... (28) *Cl. pulchellum*

31. Poles sharply pointed

32. Cells 81 μm long, containing

2 pyrenoids .............................. (11) *Cl. exile* var. *exile*

32. Cells 95 μm long, more than

2 pyrenoids .............................. (12) *Cl. exile* var. *indicum*

29. Cells strongly curved

33. Cells small 48-57 μm long,

3-4 μm in diameter ........................ (33) *Cl. subparvulum* sp. nov.

33. Cells larger, greater than 57 μm long

34. Cells symmetrically curved, the dorsal and ventral margins approximately equal, poles bluntly pointed.

35. Mid region slightly inflated, cells larger

120-135 μm long ..................... (38) *Cl. venus* var. *appollonionis*

35. Mid region not inflated, cells shorter,

99 μm long .............................. (37) *Cl. venus* var. *venus*

34. Cells sickle shaped, poles sharply or broadly rounded

36. Cells 8 times longer than broad, poles broadly rounded ........................ (14) *Cl. jenneri*

36. Cells more than 8 times longer than broad,
poles sharply rounded.

37. Cells less curved, 15 times longer than broad .......................... (23) *Cl. parvulum* var. *obtusum*

37. Cells strongly curved, less than 15 times longer than broad.
38. Cells larger, 232-277 μm long .............. (22) *Cl. parvulum* var. *maius*

38. Cells shorter, 116-177 μm long ........ (21) *Cl. parvulum* var. *parvulum*

1. *Cl. archerianum* Cleve, In: Lundell

Prescott *et al.* 1975, p. 34, pl. XXXIV figs. 6, 8, 9; Dillard 1990, p. 96, pl. 40, fig. 8.

[Plate III, Fig. 17]

Cells 11-13 times longer than broad, strongly curved, gradually attenuated to the apices; the poles narrow and obtusely rounded, wall brown in colour with 5 to 7 striae.

L. 212-220 μm, W. 14-19 μm, Apex 5 μm broad.

Field No. 44.

Distribution: Nagpur (Freitas and Kamat 1979), Gujrat (Patel and Asoka Kumar 1979), This is the new record of the species from West Bengal.

2. *Cl. calosporum* Wittrock var. *calosporum*

Wittrock 1869, p. 23, fig. 11; Prescott *et al.* 1975, p. 38, pl. XXXVI, figs. 8, 15; Dillard 1990, p. 97, pl. 41, fig. 9.

[Plate V, Fig. 12]

Cells 12 times longer than broad, strongly curved, gradually tapering to acutely rounded poles; wall smooth, colourless; chloroplast with 4-8 axial pyrenoids.

L. 77-120 μm, W. 7-9 μm, Apex 1-2 broad μm.

Field No. 40.

Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1966a, 1966b), Eastern Himalayas (Subba Raju and Suxena 1979), Gujrat (Kamat 1962, Patel and Asoka Kumar 1979), Madhya Pradesh (Agarkar and Agarkar 1973), Maharashtra (Kamat 1975), Uttar Pradesh (Pandey and Pandey 1980), Rajasthan (Kamat 1967), This is the new record of the species from West Bengal.

3. *Cl. calosporum* var. *brasiliense* Börgesen

Börgesen 1890, p. 934, pl. 2, fig. 5; Prescott *et al.* 1975, p. 39, pl. XXXVI, figs. 12-13; Krieger 1937, p. 294, pl. 19, fig. 8.

[Plate V, Fig. 13]
Cells 15-16 times longer than broad; chloroplast axial with 5-6 pyrenoids in each semicell; poles rounded gradually attenuated to the apices.

L. 111-122 μm, W. 5-7 μm.

Similar to Prescott et al. (1975). The specimen is also slender than the typical. Our specimen is rather smaller

Field No. 32.

Distribution: Probably this is the first record of the variety from India.

4. C. calosporum var. islamii var. nov.

[Plate V, Figs. 20, 21]

Cells 18 times longer than broad, slender slightly tapered to the apex, pole rounded; wall brown in colour; zygospore spherical with verrucate ornamentation.

L. 132 μm, W. 7 μm, Apex 3 μm, Zygospore dia. 27 μm with verrucae 3 μm broad.

Field No. 1123.

Holotype No. PM 1123, Jan. 20, 2003, Birshingha, Bankura, Whitish colour algal patch attached on the leaf surface of rotting Hydrilla (pH 6, Temp. 19°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present variety is close to Cl. calosporum Wittrock var. maius West et West. But differs from it in i) less broader vegetative cells ii) less curvature and iii) nature of zygospores i.e., with verrucate ornamentation. The variety is named in honour of Prof. A.K. M. Nurul Islam for his contributions to desmid taxonomy.

5. Cl. calosporum Wittrock var. maius West et West.

West & West 1896, p. 152, pl. 3, figs. 25, 26; Prescott et al. 1975, p. 39, pl. XXXVI, figs. 7,9; Krieger 1937, p. 293, pl. 19, figs. 4-7.

[Plate V, Fig. 19]

Cells 10 times longer than broad; larger than the typical, bow shaped, apex acute.

L. 150 μm, W. 15-17μm, Isth. 12 μm, Apex 2-4 μm broad.

Field No. 44.

Distribution: Andaman and Nikobar Island (Prasad et al. 1984, Prasad and Misra 1992), This is the new record of the variety from West Bengal.
6. *Closterium* De Notaris var. *latum* Schmidle

Schmidle 1898, p. 18, pl. 4, fig. 23; Krieger 1937, p. 368, pl. 36, figs. 3, 4; Prescott et al. 1975, p. 45, pl. XXXV, fig. 6.

[Plate III, Fig.19]

Cells 6 times longer than broad; slightly curved, pole rounded wall brownish and densely striate; chloroplast with 3-4 pyrenoids in each semicell.

L. 66 μm, W. 11-12.5 μm.

Present specimen is thinner than the type.

Field No. 44.

Distribution: Probably this is the first record of the variety from India.


Krieger 1937, p. 378, pl. 36, figs. 5, 6.

[Plate III, Fig. 18]

Cells 10 times longer than broad; slightly curved, apex rounded; wall brownish in colour with striations.

L. 72 μm, W. 10 μm, Apex 4 μm broad.

In this specimen fine striations have been distinctly noted. Prescott et al. (1975) considered this variety as *Closterium jenneri* Ralfs var. *robustum* G.S. West

Field No. 559.

Distribution: Uttar Pradesh (Habib and Pandey 1989), This is the new record of the variety from West Bengal.

8. *Closterium* delpontei (Klebs) Wolle

Krieger 1937, p. 348, pl. 31, figs. 7, 8; Prescott et al. 1975, p. 45, pl. XXXII, fig. 1.

[Plate IV, Figs. 7, 8]

Cells 18 times longer than the broad; slightly curved in the apical region, median region somewhat inflated, poles truncate with apical thickening of the wall; wall brownish with widely spaced costae.

L. 540 μm, W. 29-31 μm, Apex 9-10 μm broad.

Field No. 32.

Distribution: Gujrat (Patel and Asoka Kumar 1979), This is the new record of the species from West Bengal.


Ehrenberg. 1838, p. 92, pl. 5, fig. 17; Krieger 1937, p. 294, pl. 19, figs. 9-11; pl. 20, fig. 1; Prescott et al. 1975, p. 46, pl. XXIII, figs. 16, 16a, 17.

[Plate V, Fig. 4]
Cells 12-14 times longer than broad; strongly curved, gradually attenuated to the poles, poles truncate, wall colourless smooth walled, pyrenoid in series.

L. 260-308 μm, W. 18-23 μm, Apex 2-5 μm broad.

Field No. 44, 1123.

Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1966a), Gujrat (Patel and Asoka Kumar 1979), Himachal Pradesh (Kamat 1968b), Karnataka (Bharati and Bongale 1989), Madhya Pradesh (Agarkar 1969), Uttar Pradesh (Pandey and Pandey 1980a), Andaman and Nikobar Island (Prasad and Misra 1992), This is the new record of the species from West Bengal.

10. *Ct. ehrenbergii* Meneghini var. *podolicum* Gutwinski

Krieger 1937, p. 288, pl. 18, fig. 5; Prescott *et al.* 1975, p. 50, pl. XX, figs. 5-7.

[Plate V, Fig. 16]

Cells 4.5 times longer than the broad; tapering gradually and then abruptly apical region; apices slightly recurved, wall smooth colourless.

L. 444 μm, W. 77-100 μm, Apex 6 μm broad.

Field No. 664.

Distribution: Probably this is the first record of the variety from India.

11. *Cl. exile* West & West var. *exile*

West & West 1905, p. 15, pl. 1, fig. 10; Krieger 1937, p. 275, pl. 16, figs. 11, 12; Prescott *et al.* 1975, p. 51, pl. XIX, fig. 12.

[Plate V, Fig. 5]

Cells 11 times longer than the broad; slightly but symmetrically curved, ventral margin concave but straight in the mid region; poles rounded wall smooth & colourless.

L. 81 μm, W. 7 μm, Apex 3 μm broad.

Field No. 749.

Distribution: Probably this is the first record of the species from India.

12. *Cl. exile* var. *indicum* var. nov.

[Plate V, Fig. 14]

Cells 9 times longer than broad; slightly curved, uniformly attenuated to the poles, poles acute, pyrenoids more than two.

L. 95 μm, W. 10.3 μm, Apex 3 μm.

Field NO. 44.
Holotype: No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (Scirpus Sp.) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is large in every respect of *C. exile* West & West and number of pyrenoids are more than two (upto five).

13. **Cl. gracile** de Brébisson

Krieger 1937, p. 310, pl. 30, figs. 7-9; Prescott et al. 1975, p. 52, pl. XVI, figs. 2, 15, 16.

[Plate IV, Fig. 3]

Cells 44-51 times longer than the broad; slender, almost straight, margins parallel, gradually & gracefully curved towards the apical region; poles obtuse, wall smooth, brown in colour.

L. 132-310 μm, W. 2-7 μm, Apex 2 μm broad.

Field No. 32

Distribution: Gujrat (Patel and Asoka Kumar 1979), Karnataka (Bharati 1965), Madhya Pradesh (Agarkar 1969), This is the new record of the species from West Bengal.

14. **Cl. jenneri** Ralfs.

Ralfs 1848, p. 167, pl. 28, fig. 6; Krieger 1937, p. 366, pl. 36, fig. 2; Prescott et al. 1975, p. 55, pl. XXIII, figs. 4,10.

[Plate V, Fig. 8]

Cells 8 times longer than the broad; strongly curved, gradually attenuated to obtusely rounded poles; wall smooth & colourless.

L. 74-96 μm, W. 11-12 μm, Apex 3-4 μm broad.

Field No. 44.

Distribution: Karnataka (Gurudeva et al. 1983). This is the new record of the species from West Bengal.

15. **Cl. kuertzingii** de Brébisson var. *linearis* var. nov.

[Plate IV, Fig. 4, Plate XXII, Fig. 5]

Cells 55 times longer than broad; almost straight, gradually attenuated, apices slightly incurved, poles truncate; wall brownish, striated; zygospores dumbbell shaped, thick walled.

L. 170-677 μm, W. 4-12 μm, Apex 2-5 μm broad, zygospore: L. 17-76 μm, W. 10-34 μm.
Field No. 555.

Holotype: No. PM 555, Nov. 16, 2001, Radhanagar Bankura, Orange colour mass associated with some bluish green scum on *Utricularia* (pH 6, Temp. 28°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new variety differs from the type in (i) vegetative cells more linear, (ii) broader-tips (iii) dumbbell shaped zygospores.

16. *Cl. kuetzingii* de Brebisson var. *vittatum* Nordstedt.

Nordstedt 1888, p. 70, pl. 3, fig. 21; Krieger 1937, p. 353, pl. 32, fig. 11; Prescott *et al.* 1975, p. 58, pl. XXXI, figs. 8-14.

[Plate IV, Fig. 14]

Cells 31-47 times longer than the broad; almost straight, mid region fusiform, attenuated abruptly towards the apical region to form setaceous processes; apices; slightly incurved; wall yellowish brown in colour with striations, zygospore elliptic, thick walled.


Field No. 1123.

Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1970). Karnataka (Hegde and Bharati, 1983, Isaacs and Hegde 1986), Uttar Pradesh (Habib and Pandey 1989). This is the new record of the variety from West Bengal.

17. *Cl. lenzenwegerii* sp. nov.

[Plate IV, Fig. 12]

Cells 8 times longer than broad; straight, fusiform, gradually tapered to the poles; poles truncate; cell wall colourless & smooth.

L. 140-150 μm, W. 15-22 μm, Apex 3-5 μm broad.

Field No. 44.

Holotype: No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus* Sp.) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new species is similar to *Cl. subfusiforme* Messi-Kommer but differs in (i) smaller vegetative cells & (ii) distinctly compressed isthmus region.
18. *Cl. lineatum* Ehrenberg.

Krieger 1937, p. 349, pl. 32, figs. 1,2; Prescott *et al.* 1975, p. 63, pl. XXXII, figs. 7, 8, 12,18.

[Plate IV, Figs. 5, 6]

Cells 10-28 times longer than the broad; slender, moderately curved, gradually attenuated to the poles; poles truncate, wall brown with striations, presence of punctae between the striae; zygospore oval.

L. 288-560 µm, W. 10-32 µm, Apex 6-10 µm broad, zygospore dia. 27 µm.

Field No. 96, 1124.

Distribution: Tamil Nadu (Bharati and Pai 1972), Uttar Pradesh (Venkataraman 1957, Prasad and Mehrotra 1977b), Madhya Pradesh (Turner 1982), Gujrat (Patel and Asoka Kumar 1979), Madhya Pradesh (Kamat 1975, Freitas and Kamat 1979), Andaman and Nikobar Island (Prasad and Misra 1992). This is the new record of the species from West Bengal.


Ehrenberg 1838, p. 91, pl. 5, fig. 16; Krieger 1937, p. 289, pl. 18, figs. 6,7; Prescott *et al.* 1975, p. 70, pl. XXI, fig. 3.

[Plate V, Fig. 2, Plate XVI, Fig. 10]

Cells 6.5 times longer than broad; moderately curved; the outer wall strongly convex, the ventral wall somewhat inflated in the mid region; uniformly attenuated to the poles, poles rounded, wall smooth.

L. 338-550 µm, W. 48-81 µm, Apex 7-11 µm broad.

Field No. 677.

Distribution: Very common.

20. *Cl. nematodes* Joshua var. *proboscideum* Turner

Turner1892, p. 21, pl. 22, fig. 13f; Krieger 1937, p. 370, pl. 37, figs. 1,2; Prescott *et al.* 1975, p. 72, pl. XXXIV, figs. 11, 12,14.

[Plate V, Fig. 7, Plate XVI, Fig. 8 ]

Cells 8 times longer than broad; strongly curved, midregion inflated, thickened both internally and externally; poles rounded & conelike; wall with costae.

L. 210 µm, W. 25 µm, Apex 6 µm broad.

Field No. 32.

Distribution: Probably this is the first record of the variety from India.

21. *Cl. parvulum* Nägeli, var. *parvulum*

Krieger 1937, p. 275, pl. 16, figs. 14-17; Prescott *et al.* 1975, p. 73, pl. XXIV, figs. 18-20.

[Plate V, Fig. 1]
Cells 7-15 times longer than the broad; strongly curved, midregion straight gradually attenuated to the apical region; the poles sharply rounded; cell wall colourless to brown; pyrenoids in axial row.

L. 116-204 μm, W. 13-18 μm, Apex 3-4 μm broad.

Field No. 749, 1123

Distribution: Very common.

22. Cl. parvulum var. maius West

Krieger 1937, p. 277, pl. 16, fig. 18; Prescott et al. 1975, p. 74, pl. XXIV, fig. 1.

[Plate V, Fig. 3]

Cells 10-12 times longer than the broad; gradually attenuated to the poles, mid region slightly inflated, poles sharply rounded; cell wall colourless

L. 232-275 μm, W. 17-26 μm, Apex 3-5 μm broad.

Field No. 32, 44.

Distribution: Probably this is the first record of the variety from India.

23. Cl. parvulum var. obtusum Croasdale

Croasdale & Grönblad 1964, p. 157, pl. 2, figs. 25-27; Prescott et al. 1975, p. 74, pl. XXIV, fig. 3

[Plate V, Fig. 18]

Cells 15 times longer than broad; less curved than the typical, gradually attenuated; poles bluntly rounded; pyrenoids in axial row; wall colourless.

L. 136 μm, W. 9 μm.

Field No. 364.

Distribution: Probably this is the first record of the variety from India.

24. Cl. porrectum Nordstedt

Krieger 1937, p. 369, pl. 36, fig. 9; Prescott et al. 1975, p. 76 pl. XXXV, fig. 15

[Plate III, Fig. 16]

Cells 10 times longer than broad; strongly curved midregion; inflated pole broadly rounded, wall brownish with striae.

L. 185-236 μm, W. 18-23 μm, Apex 4 μm broad.

Field No. 32.

Distribution: Madhya Pradesh (Agarkar 1971), Karnataka (Gurudeva 1983), This is the new record of the species from West Bengal.

25. Cl. praelongum Brébisson.

Brébisson 1856, p. 152, pl. 2, fig. 14; Krieger 1937, p. 323, pl. 25, fig. 7,8; Prescott et al. 1975, p. 76, pl XXVIII , figs. 3, 3a.
Cells 24 times longer than the broad; slender, moderately curved, gradually attenuated to the pole; poles, truncate; wall colourless.

L. 1095 μm, W. 44 μm, Apex 14 μm broad.

Field No. 677.

Distribution: Kerala (Sindhu and Panikkar 1994), This is the new record of the species from West Bengal.

26. *Cl. pritchardianum* Archer

Archer 1862, p. 250, pl. 12, figs. 25-27; Krieger 1937, p. 321, pl. 25, figs. 1-4; Prescott et al. 1975, p. 77, pl. XXV, figs. 7, 14

Cells 14 times longer than broad; slender, straight, gradually attenuated to the poles, poles truncate; cell wall colourless; pyrenoid many in axial row.

L. 670 μm, W. 40-48 μm, Apex 16 μm broad.

Field No. 677.

Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1966a, 1966b), Madhya Pradesh (Agarkar 1971), Andaman and Nikobar Island (Prasad and Misra 1992), This is the new record of the species from West Bengal.

27. *Cl. pseudoralfsii* sp. nov.

Cells 10 times longer than the broad, slightly curved, midregion inflated, gradually attenuated to the poles; poles obliquely truncate; cell wall brownish in colour with striations.

L. 288 μm, W. 28 μm, Apex 5 μm.

Field No. 539.

Holotype: No. PM 539, Nov. 15, 2001, Onda, Bankura, Deep orange colour mass attached on *Jussiaea repens* (pH 6, Temp. 28°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new species is close in morphology to *Cl. ralfsii* de Brébisson but differs from it in (i) having smaller size, (ii) distinctly truncate apex, (iii) ventral margin elevated at the isthmus region rather than simply convex which makes the cell a distinctive appearance.
28. *Cl. pulchellum* West & West

West & West 1897, p. 158, pl. 8, fig. 8; Krieger 1937, p. 278, pl. 16, fig. 10; Prescott et al. 1975, p. 80, pl. XXV, fig. 3.

![Plate V, Fig. 6]

Cells 8.5 times longer than the broad; slightly curved ventral margin, concave, not inflated in the mid region; poles narrowly rounded; wall smooth.

L. 87 µm, W. 10 µm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

29. *Cl. rostratum* Ehrenberg

Krieger 1937, p. 354, pl. 33, figs. 1-3; Prescott et al. 1975, p. 83, pl. XXXI, figs. 3.12.

![Plate IV, Fig. 11]

Cells 12 times longer than broad; slender, slightly curved, fusiform in the mid region, tapering rather abruptly to form an rostrate extension; poles obliquely truncate, wall brownish.

L. 555 µm, W. 44 µm, Apex 9 µm broad.

Field No. 36.

Distribution: Kashmir (Suxena and Venkateswarlu 1968), Madhya Pradesh (Agarkar 1969). This is the new record of the species from West Bengal.

30. *Cl. setaceum* Ehrenberg var. *setaceum*

Krieger 1937, p. 356, pl. 33, figs. 8-10; Prescott et al. 1975, p. 84, pl. XXXI, figs. 1.11.

![Plate IV, Fig. 1, Plate XVI, Fig. 9]

Cells 23 to 35 times longer than broad; almost straight, fusiform in the mid region, abruptly narrower to the apical region; poles truncate, wall brownish, with fine striae.

L. 365-467 µm, W. 11-18 µm, Apex 1-3 µm broad.

Field No. 744.

Distribution: Karnataka (Gurudeva et al. 1983). This is the new record of the variety from West Bengal.

31. *Cl. setaceum* var. *vittatum* Grönblad

Grönblad 1945, p. 10, pl. 1, fig. 15; Prescott et al. 1975, p. 85, pl. LVII, fig. 8.

![Plate IV, Fig. 2]

Cells 18 times longer than broad; distinctly swollen in the mid region, tapering abruptly to long straight setae; setae inwardly curved.
L. 257 μm, W. 15 μm.

Field No. 749.

Distribution: Probably this is the first record of the variety from India.

32. *Cl. striolatum* Ehrenberg

Krieger 1937, p. 337, pl. 28, figs. 8,9, pl. 29, fig. 9; Prescott et al. 1975, p. 87. pl. XXVII, figs. 1, 3,10, pl. XXVIII, fig. 4.

[Plate III, Fig. 21]

Cells 13 times longer than broad; slightly curved, mid region slightly inflated, gradually attenuated towards the poles with distinct apical notch; deep brown in colour.

L. 496 μm, W. 34-37 μm, Apex 8-9 μm broad.

Field No. 32.

Distribution: Gujarat (Patel and Asoka Kumar 1979). This is the new record of the species from West Bengal.

33. *Cl. subparvulum* sp. nov.

[Plate V, Fig. 15]

Cells 16 times longer than the broad; much smaller, strongly curved slender, gradually tapered to the pole; pole sharply ended.

L. 48-57 μm, W. 3-4 μm.

Field No. 44.

Holotype: No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus* Sp.) (pH 5.5, Temp. 26°C). Kept in the algal herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new species looks likes *Cl. parvulum* Nägeli var. *taylorii* Jackson but differs from it in much smaller dimension. Moreover cells are much slender with much sharp curvature.

In external appearance it also looks like *Cl. acutum* (Lyngb.) de Brébisson var. *variabile* (Lemm.) Krieger but differ in smaller size and acute curvature.

34. *Cl. toxon* West var. *indicum* var. nov.

[Plate IV, Figs. 9, 10]

Cells 32 times longer than broad; straight in the mid region, apical region inwardly curved; poles broadly truncate; wall smooth.

L. 555 μm, W. 17 μm.
Field No. 740.
Holotype: No. PM 740, Dec. 11, 2001, Khatra, Bankura, Green colour filamentous algal mass attached on submerged *Ipomoea* stem (pH 5.5, Temp. 22.5°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
This new variety differs from the type in its much longer & slender vegetative cells.

35. *Cl. tumidum* Johnson

Johnson 1895, p. 291, pl. 232, fig. 4; Krieger 1937, p. 267, pl. 14, figs. 10,11; Prescott et al. 1975, p. 92, pl. XVII, figs. 2,11.

[Plate IV, Fig. 13, Plate XXII, Fig. 1]

Cells 7.5 times longer than broad; stout, slightly curved; poles not uniformly attenuated; wall colourless. Zygospore globose.
L. 93-182 μm, W. 12-16 μm, Apex 2-3 μm broad.
Field No. 760.
Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1968a), Gujrat (Patel and Asoka Kumar 1979), Kerala (Patel 1982), Madhya Pradesh (Agarkar 1971), Punjab (M Singh 1966b), Uttar Pradesh (Lakshminarayana 1963, Pandey and Pandey 1980b), Karnataka (Gurudeva et al 1983), This is the new record of the species from West Bengal.

36. *Cl. turgidum* Ehrenberg

Ehrenberg 1838, p. 95, pl. 6, fig. 8; Krieger 1937, p. 330, pl. 27, figs. 1,2; Prescott et al. 1975, p. 93, pl. XXV, fig. 10.

[Plate III, Fig. 20]

Cells 13 times longer than broad; more or less straight, gradually attenuated to the apical region; poles obliquely truncate, middle portion thickened; wall brown in colour.
L. 332 μm, W. 25 μm, Apex 6 μm broad.
Field No. 756.
Distribution: Gujrat (Patel and Asoka Kumar 1979), Kerala (Sindhu and Panikkar 1994), This is the new record of the species from West Bengal.

37. *Cl. venus* Kützing var. *venus*

Kützing 1845, p. 130; Krieger 1937, p. 272, pl. 16, figs. 1-5; Prescott et al. 1975, p. 96. pl. XXIV, figs. 5, 12.2

[Plate V, Fig. 9]
Cells 12 times longer than broad; strongly curved, ventral side always concave, gradually attenuated to the pole; poles acutely rounded; wall colourless.
L. 99-135 µm, W. 6-13 µm, Apex 1-3 µm broad.
Field No. 739.
Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1966a), Gujarat (Kamat 1962, Patel and Asoka Kumar 1979), Karnataka (Bongale 1989), Madhya Pradesh (Agarkar 1969, Agarkar and Agarkar 1973), Maharashtra (Kamat 1963a), Manipur (Bruehl and Biswas 1926), Uttar Pradesh (Kamat 1973, Prasad and Mehrotra 1977b, Pandey and Pandey 1980a), Andaman and Nikobar Island (Prasad and Misra 1992), This is the new record of the species from West Bengal.

38. *Cl. venus* var. *apollonionis* Croasdale.

Croasdale 1965, p. 310, pl. 1, figs. 18-20; Prescott et al. 1975, p. 96, pl. XXIV, fig. 4

[Plate V, Fig. 17]

Cells 8 times longer than the broad; strongly curved, median region slightly inflated, gradually tapered to the poles, pole acutely rounded.
L. 120-135 µm, W. 16-18 µm, Apex 3-4 µm broad.
Field No. 44.
Distribution: Uttar Pradesh (Habib and Pandey 1989). This is the new record of the variety from West Bengal.

39. *Cl. yamagishii* sp. nov.

[Plate IV, Figs. 15, 16]

Cells 19 times longer than the broad; straight, much larger, gradually attenuated to the poles, poles truncate, chloroplast with several ridges, wall colourless.
L. 715 µm, W. 37 µm, Apex 6-7 µm.
Field No. 32.
Holotype : No. PM 32, Oct. 28, 2000, Birshingha, Bankura, Green filaments & some small algal patch attached on the aquatic grass stem (*Scirpus* sp.) (pH 6, Temp. 25°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new species is close in morphology to *Cl. subfusiforme* Messi-Kommer but differs from it in (i) much larger vegetative cells (almost 3 times its dimension). (ii) reticulate nature of chloroplast & higher length; breadth ratio (it is over 16 times longer than broad in comparison to 9-13 times in *Cl. fusiforme*). The
species has been named in honour of Takkaki Yamaghishi for his contributions to fresh water algal taxonomy.

**X: Euastrum Ehrenberg ex Ralfs 1848**

The cells are compressed with a deeply constricted isthmus and with incision at the apex of each semicell; semi cells usually truncate; cell wall smooth, punctate or granulate; semicell with an axial chloroplast; pyrenoid many.

**Artificial key to the taxa described**

1. Apical margin of the polar lobes with a narrow median, vertical incision

2. Apical angles or margin of the cell with spine or long sharp granules

3. Wall with granules or coarse punctae.

4. Margins of the semicell undulate ... ... ... ... ... ... ... ... (17) *E. sinuosum*

4. Margins not undulate

5. Semicell broadly rounded in basal angles and then abruptly tapered to the apex ... ... ... (1) *E. ansatum var. ansatum*

5. Semicell with narrowly rounded basal angles and polar lobes slender ..................(2) *E. ansatum var. longum*

3. Wall with spines

6. Margin of the semi cells with stout long spines

7. Sinus closed ... ... ... ... ... ... (9) *E. flammecum var. flammecum*

7. Sinus open ... ... ... ... ... ... (10) *E. flammecum var. kalimontanum*

6. Margin of the semi cells with small spines

8. Apical incision deep, U-shaped

9. Lateral lobes of each semicell 2-3 times incised

10. Polar lobe elongated,

   sinus open ... ... ... ... ... ... (15) *E. rostratum var. boiculatum*

10. Polar lobe not elongated, sinus closed ... ... ... (16) *E. serratum*

9. Lateral lobe of each semicell without incision ... ... ... ... ... ... ... ... (22) *E. subdistortum*

8. Apical incision less deep

11. Cells more than 30 μm

   long ... ... ... ... ... ... ... ... ... ... (5) *E. denticulatum var. angusticeps*
11. Cells less than 30 \( \mu \)m long ........................................ (14) *E. pseudocorraloides*

2. Apical angles or cell margins without spines or granules

12. Basal lobe inflated & abruptly narrower
to the apex ........................................ (4) *E. cuneatum* var. *subansatum*

12. Basal lobes not inflated

13. Vertical incision deep ..................................... (8) *E. fissum* var. *indicum* var. nov.

13. Vertical incision less deep

14. Each semicell with two distinct mucilage pore ........................................ (23) *E. subserratum* sp. nov.

14. Semi cells lacking mucilage pore ............................................... (3) *E. birsinghensis* sp. nov.

1. Apical margin of the polar lobes without a narrow vertical incision

15. Cell wall without spines or granules

16. Apex flat, sinus

outwardly open ........................................ (12) *E. pectinatum* var. *nizamum* var. nov.

16. Apex convex, sinus closed ........................................ (11) *E. luetkemuelleri*

15. Cell wall with spines & granules

17. Basal lobes bilobed on the margin

18. Lateral lobes divergent ........................................ (7) *E. divergens*

18. Lateral lobes horizontal

19. Margin with finger like projections

20. Cells more than 60 \( \mu \)m long ................................. (19) *E. pinulosum* f. *burmensc*

20. Cells less than 60 \( \mu \)m long ................................ (20) *E. pinulosum* forma

19. Margin with typical spines

21. Each semicell with 6 emarginate verrucae ........................................ (21) *E. pinulosum* var. *vasii*

21. Semi cells without emarginated verrucae ........................................ (18) *E. pinulosum* var. *pinulosum*

17. Basal lobes not bilobed on the margin

22. Cells as long as broad or longer

23. Lateral lobes upwardly directed, each semicell with central ring of circular granules ........................................ (24) *E. subsellatum*

23. Lateral lobes horizontally directed, no such central granular ring ........................................ (13) *E. platycerum*

22. Cells broader than long ........................................ (6) *E. diplostauron*
1. *E. ansatum* Ehrenberg var. *ansatum*

Prescott *et al.*. 1977, p. 15, pl. LVIII, figs. 6, 6a; Dillard 1993, p. 21, pl. 7, figs. 9, 7f, 8.

[Plate VI, Fig. 2]

Cells narrowly oval, more than 2 times longer than broad; flat apex with rounded angles; median notch short and closed, the sinus deep and narrow; wall coarsely punctate.


Field No. 364.

Distribution: Common.

2. *E. ansatum* var. *longum* Grönblad

Grönblad 1945, p. 12 pl. 3, fig. 38; Prescott *et al.*. 1977, p. 18, pl. LIX, figs. 14, 14b. (f).

[Plate VI, Fig. 3, Plate XVI, Fig. 11]

Cells very slender; base of the semi cells slightly swollen then tapering to the polar lobe. apex rounded, median notch short, nearly closed; the sinus deep & narrow; wall punctate.

L. 102-202 μm, W. 39-86 μm, Isth. 12-28 μm

Field No. 1122.

Distribution: Probably this is the first record of the variety from India.

3. *E. birsinghensis* sp. nov.

[Plate VI, Fig. 13]

Cells sub rectangular, nearly 2 times longer than broad; flat, gullet like incision between apical and lateral lobes; sinus deep and closed; no spines on the body.

L. 42 μm, W. 24-27 μm, Isth. 7 μm.

Field No. 44.

Holotype : No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (Scirpus. Sp.) (pH 5.5, Temp. 26°C).

Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new species looks like *E. abruptum* Nordstedt and *E. pictum* Börgesen but differs in i) gullet like incision between apical and lateral lobes ii) absence of spines on the body and iii) spines on lateral lobes not prominent.


Kossinskaja 1936, p. 416, pl. 1, fig. 5; Prescott *et al.*. 1977, p. 39, pl. LVIII, fig. 2.

[Plate VI, Fig. 15]
Cells trapezoid in outline, about 2 times longer than broad; semi cells cuneate, basal lobe broadly rounded then retuse to a polar lobe, apex truncate; apical notch short, sinus deep closed; cell margin undulate, wall smooth.

L. 74 μm, W. 40 μm, Isth. 11 μm.

Field No. 44.

Distribution: Probably this is the first record of the variety from India.


Grönblad 1921, p. 13, pl. 3, figs. 10, 11; Prescott et al. 1977, p. 40, pl. LXXV, figs. 3, 4

[Plate VI, Fig. 11]

Semi cells sub-rectangular, narrower to the polar lobe; basal angles broadly rounded with 3 sharp granules on the margin; apex flat, and the angles extended into short spines; sinus deep, closed.

L. 32 μm, W. 19-21 μm, Isth. 7μm.

Field No. 44.

Distribution: Probably this is the first record of the variety from India.

6. *E. dipllostauron* Skuja

Skuja 1949, p. 112, pl. 24, fig. 1; Ling & Tyler 1986, p. 27, pl. 18, fig. 28. 

[Plate VI, Fig. 24, Plate XVII, Fig. 12]

Semi cells triangular, lateral lobe of each semicell possessing short sharp spines; apex concave, consisting of short spines; sinus deep and open, centre of each semicell with a distinct circle.

L. csp. 24-60 μm, ssp. 20-55μm, W. csp. 30-88 μm, ssp. 25-82 μm, Isth. 7-20 μm.

The present specimen is smaller than the type.

Field No. 190.

Distribution: Probably this is the first record of the species from India.

7. *E. divergens* Joshua

Joshua 1886, p. 640, pl. 26, figs. 8, 9; Ling & Tyler 1986, p. 27, pl. 18, fig. 27.

[Plate VI, Fig. 22]

Cells rectangular to quadrate, as long as broad; pole truncate, lateral lobe has bifurcate notch, each with sharp spines, sinus deep and open, central portion of each semicell showing circular granule.

L. 48 μm, W. 45 μm, Isth. 12 μm.
Field No. 1114.

Distribution: Probably this is the first record of the species from India.

8. *E. fissum* West & West var. *indicum* var. nov.

[Plate VI, Fig. 16]

Cells rectangular, nearly 2 times longer than broad; basal portion of each semicell is swollen, apex rounded with deep notch, sinus deep & closed; wall smooth.

L. 33 μm, W. 19 μm, Isth. 4 μm.

Field No. 190.

Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new variety differs from the type in lacking any tubercle on the body only lateral margins have insignificant subapical tubercles. In this respect it looks like *E. fissum* var. *americanum* Cushman but differs from it in much smaller size, absence of any tubercle on body and nature of lateral margin.

9. *E. flammeum* Josh. var. *flammeum*

Joshua 1886, p. 640, pl. 26, figs. 8, 9; Scott & Prescott 1961, p. 27, pl. 11, fig. 10.

[Plate VI, Fig. 4]

Cells rectangular, 2 times longer than broad; apex flat, with deep apical notch; sinus deep and open, apical and lateral margins with sharp, short spine; each semicell with some circular granules, one at centre and remaining four to the periphery.

L. 42-45 μm, W. 27 μm, Isth. 6-7 μm.

Field No. 1123

Distribution: Probably this is the first record of the species from India.


Scott & Prescott 1961, p. 27, pl. 11, fig. 11.

[Plate VI, Figs. 5, 6]

Cells similar to the typical except sinus is widely open; presence of circular granules in each semicell each, semicell with sharp distinct spine.

L. 45 μm, W. 16 μm, Isth. 9 μm.
Field No. 192.
Distribution: Probably this is the first record of the variety from India.

11. *E. luetkemuelleri* Ducellier

Ducellier 1918a, p. 134, fig. 123a; Prescott *et al.* 1977, p. 81, pl. LXXII, figs. 2, 2a; Dillard 1993, p. 52, pl. 9, fig. 19.

[Plate VI, Fig. 17]

 Cells truncate, oval in outline, more than 1.5 times longer than broad; apex of the polar lobe bluntly pointed, apical margin with slightly notch; sinus narrow & closed; wall smooth.

L. 21 μm, W. 12 μm, Isth. 5 μm.

Field No. 895.
Distribution: Madhya Pradesh (Agarkar 1971), This is the new record of the species from West Bengal.

12. *E. pectinatum* Brébiisson ex Ralfs var. *nizamum* var. nov.

[Plate VI, Fig. 14]

Cells sub-rectangular; apex flat, truncate; basal portion in each semicell slightly swollen; sinus deep, closed; cell wall smooth lacking punctae.

L. 36 μm, W. 24 μm, Isth. 8 μm.

Field No. 744.

Holotype: No. PM 744, Dec. 11, 2001, Khatra, Bankura, Green orange colour algal mass attached on aquatic stem (*Scirpus* sp.) (pH 6, Temp. 23°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new variety looks like *E. pectinatum* var. *lagenale* Boldt but differs from it in (i) much smaller size (ii) absence of any punctae on the wall & (iii) flat apex.

This variety has been named in honour of Late Prof. Jafar Nizam Indian phycologist of international repute.

13. *E. platycerum* Reinsch

Reinsch 1875, p. 85, pl. 12, fig. 6; Prescott *et al.* 1977, p. 95, pl. LXXXI, figs. 6, 6a; Dillard 1993, p. 58, pl. 9, fig. 9.

[Plate VI, Fig. 23]

Cells 1 to 1.5 times longer than broad; base of the semicell, broadly rounded & horizontally extended; lateral margins with shoulder like incision; polar lobe
angles rounded and spiny, apical margin flat; sinus narrow and closed; wall with a scattering of granules.


Field No. 190.

Distribution: Karnataka (Gurudeva et al. 1983, Hegde & Isaacs 1988), This is the new record of the species from West Bengal.


Fritsch 1918, p. 549, fig. 25; Prescott et al. 1977, p. 98, pl. XXIV, fig. 25.

[Plate VI, Fig. 10]

Cells rhomboid to nearly sphaeroidal in outline; semicell, subquadrate, basal lobe rounded, polar lobe mucronate, apical margin flat, with a short V-shaped median incision; sinus narrow and closed; small spines on the wall.

L. 18-22 μm, W. 14-15 μm, Isth. 3-4 μm.

The present specimen is smaller than the type.

Field No. 895.

Distribution: Probably this is the first record of the species from India.


Scott & Prescott 1961, p. 37, pl. 11, figs. 8,9.

[Plate VI, Fig. 7]

Cells rectangular, 1.5 times longer than broad; basal lobe inflated, polar lobe flat with U shaped median incision; sinus deep, slightly open; wall with spines.

L. 60 μm, W. 39 μm, Isth. 10 μm.

Field No. 744.

Distribution: Probably this is the first record of the variety from India.

16. *E. serratum* Joshua

Scott & Prescott 1961, p. 39, pl. 11, figs. 6,7.

[Plate VI, Fig. 8]

Cells elliptical, more than 1.5 times longer than broad; lateral lobe inflated margins dentate, polar lobe with V-shaped apical notch; sinus deep, closed; wall with small spines restricted to the margins.

L. 51 μm, W. 30 μm, Isth. 8 μm.

Field No. 1123.

Distribution: Karnataka (Hegde & Bharati 1983), This is the new record of the species from West Bengal.
17. *E. sinuosum* Lenormand.

*Prescott et al. 1977, p. 103, pl. LX, fig. 13*

[Plate VI, Fig. 1]

Cells rectangular 1.5 times longer than broad; lateral lobes flat rounded, polar lobe with short incision, apex rounded truncate; sinus deep and closed, cell wall smooth.

L. 60 µm, W. 37 µm, lsth. 15 µm.

Field No. 190.

Distribution: Tamil Nadu (Bharati & Pai 1972), Karnataka (Hegde & Bharati 1983), This is the new record of the species from West Bengal.

18. *E. spinulosum* Delponte var. *spinulosum*

*Scott & Prescott 1961, p. 41, pl. 10, fig. 3; Prescott et al. 1977, p. 107, pl. LXXXI, fig. 10.*

[Plate VI, Fig. 20]

Cell nearly circular, semicell broadly oval, basal angles broadly rounded; lateral lobe with a short, crown-like polar lobe, angles rounded; semi cells centre with broad central circular granules sinus deep and closed.

L. 45-48 µm, W. 39-44 µm, lsth. 12-13 µm.

Field No. 44.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Gujarat (Kamat 1962), Maharashtra (Kamat 1963a, Ashtekar and Kamat 1979), Madhya Pradesh (Agarkar et al 1979), Uttar Pradesh (Pandey and Pandey 1980a), Karnataka (Bongale and Bharati 1980a, Hegde and Bharati 1983), This is the new record of the species from West Bengal.


[Plate VI, Fig. 18]

Cells circular in outline; width greater than length, the basal lobes truncate; rounded polar lobes narrow and closed; the apical margins retuse, the lateral margins strongly convex in the mid region, sinus deep and closed.

L. csp 51 µm, ssp 48 µm, W. csp 53 µm, ssp 48 µm lsth. 19 µm.

Field No. 44.

Holotype: No. PM 44, Nov, 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus* Sp.) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present specimen posses finger like projections rather than typical spines, therefore this taxa is treated as a new form.

20. *E. spinulosum f. burmense* West & West.

West & West 1907, p. 197, pl. 14, fig. 10; Krieger 1937, p. 636, pl. 93, figs. 11,12.

[Plate VI, Fig. 21, Plate XVII, Fig. 1]

Semicell broadly oval; basal angles broadly rounded, polar lobe short and crown-like; the margins of all lobes with short, sharp spine-like granules, semi cells with a broad central, circular pattern of granules; poles rounded and bearing spine like granules.

L. 63-112 μm, W. 52-99 μm, Isth. 12-26 μm.

Field No. 1122.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), West Bengal (Turner 1892), Manipur (Bruehl and Biswas 1926), Uttar Pradesh (Prasad and Mehrotra 1977b, Pandey and Pandey 1980).

21. *E. spinulosum var. vasii* Scott & Prescott

Scott & Prescott 1961, p. 41, pl. 70, fig. 6.

[Plate VI, Fig. 19]

Cells as long as broad; circular in outline, each semicell with 6 large emarginated verrucae, one each on the lower and upper lateral lobes and two on the polar lobe, each semicell with central granular ring; sinus deep and closed.

L. csp. 67 μm, ssp. 60 μm, W. csp. 66 μm, ssp. 60 μm, Isth. 21 μm.

Field No. 44.

Distribution: Tamil Nadu (Bharati & Pai 1972), This is the new record of the variety from West Bengal.

22. *E. subdistortum* sp. nov.

[Plate VI, Fig. 9]

Cells elongated about twice as long as broad; basal lobe slightly inflated, polar lobe narrower with deep median incision, polar & lateral lobes with spines; sinus deep & closed.

L. 39 μm, W. 21 μm, Isth. 7.5 μm.

Field No. 190.

Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the
algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This new species looks like *E. distortum* Scott & Prescott but differs in (i) about twice as long as broad (ii) presence of spine on the wall (iii) presence of the broad spines each on each side a lateral lobes. (iv) presence of apical slit ending in a broad basal region.

23. *E. subserratum* sp. nov.  

[Plate VI, Fig. 12]

Cells rectangular 1.5 times longer than broad; lateral and polar lobes extends horizontally, each lobe with deep incision, polar lobe with ‘U’ shaped apical incision; each semicell with 2 mucilage pore; sinus deep and closed.  
L. 66 μm, W. 39 μm, lsth. 6 μm.  
Field No. 190.  
Holotype No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.  
In general appearance this species looks like *E. serratum* Josh. but differs from it in (i) larger size (ii) undulate more or less trilobed epical lobes, (iii) absence of verrucae or projections on the semi cells except two small mucilage pores (iv) more or less rectangular outline, polar lobes horizontal extended, almost to lateral lobes.


Scott & Prescott et al. 1961, p. 44, pl. 11, figs. 1, 2.  

[Plate VI, Fig. 25, Plate XVII, Fig. 2; Plate XXIII, Fig. 4]

Cells semicell quadrate as long as broad; lateral lobes upwardly directed, polar lobe slightly inflated at the end; all angles of the lateral & polar lobes with sharp spines; each semicell with central granular circle encircling 4 larger granules; sinus deep and open.  
L. csp 40-109 μm, ssp 36-99 μm, W. csp 39-104 μm, ssp 36-91 μm, lsth. 11-23 μm.  
In present specimen spines are larger and divergent. The specimen is close in morphology to the diagrams and dimensions provided by Islam (1970) for the species from adjoining Bangladesh.
Field No. 1140.
Distribution: Tamil Nadu (Bharati & Pai 1972), This is the new record of the species from West Bengal.

**XI: Cosmarium Corda ex Ralfs 1848**

Cell compressed slightly greater than the breadth and a deep constriction; cell wall smooth or ornamented; chloroplast few and large, axile or parietal; pyrenoids large and conspicuous.

**Artificial key to the taxa described**

1. Cell wall smooth

2. Cells 22-81 µm long

3. Poles truncate

4. Basal region of the semi cells inflated

   5. Semi cells trilobed ................. (54) *C. trilobulatum*

   5. Semi cells with more than three lobes ................. (31) *C. pokornyanum var. groenbladii*

4. Basal region of the semi cells not inflated

6. Margins undulate ................. (3) *C. angulatum f. major*

6. Margins not undulate ................. (46) *C. sexangulare var. minus*

3. Poles rounded or flat or slightly retuse

7. Cells polygonal ................. (32) *C. polygonum*

7. Cells elliptic, reniform or elliptic oblong

8. Cells reniform

9. Vegetative cell polygonal zygosporocyte, smooth walled ........ (26) *C. ocellatum var. incrassatum.*

9. Vegetative cell spherical zygosporocyte with sharp spines ................. (29) *C. phaseolus var. phaseolus*

8. Cells elliptic or oblong- elliptic

10. Margins undulate

11. Cells wider, 1.2 times longer than broad ................. (57) *C. undulatum var. wollei*

11. Cells less wider, 1.6-1.7 times longer than broad
12. Semi cells subsemicircular, apex
   not retuse .......... (56) C. undulatum var. minutum
12. Semi cells pyramidal,
   apex retuse .......... (50) C. subimpressulum

10. Margins not undulate
13. Median constriction deep
14. Cells truncate, pyramidal
   with flat apex .......... (42) C. rectosporum
14. Cells quadrate, with nearly
   rounded apex .......... (4) C. angulosum
13. Median constriction shallow
15. Cells larger, 65-73 μm long ..... (9) C. connatum
15. Cells smaller, 24-30 μm long
16. Apex retuse .......... (14) C. goniodes
16. Apex broadly rounded .......... (53) C. tinctum

2. Cells 7.5-21 μm long
17. Cells upto 15 μm long
18. Margins with crenulations... (17) C. humile var. danicum
18. Margins without crenulations
19. Cell apex retuse .......... (38) C. quadratulum var. aplanatum
19. Cell apex flat or truncately rounded
20. Cells upto 10 μm long
21. Semi cells angular-oval,
   5 sided .......... (1) C. abbreviatum var. minus
21. Semi cells subrectangular or oval
22. Cells oval .... (23) C. minimum var. subrotundatum
22. Cells sub-rectangular... (35) C. pseudoprotuberans
   var. alpinum
20. Cells more than 10 μm
   long ... (6) C. asphaerosporum var. strigosum

17. Cells more than 15 μm long
23. Midregion of the semi cells with
   small tubercular thickenings... (43) C. regnellii var. chondrophorum
23. Midregion of the semi cells without any thickening ... ... ... (52) *C. tetragonum* var. *lundellii* f. *minus*.

1. Cell wall granular, punctate or scrobiculate

24. Margins entire

25. Cells larger, more than 100 µm long (112-150 µm)

26. Cells gradually tapered from mid region to the apex

27. Sinus open ... ... ... ... ... ... ... ... (28) *C. pakistanicum*

27. Sinus closed ... (36) *C. pseudopyramidatum* var. *maximum*

26. Cell nearly parallel from the mid region to the apex

28. Median incision deep

29. Cells oblong-elliptic,

   upto 120 µm long ... (10) *C. cucumis* var. *magnum*

29. Cells elliptic, 120-150 µm long

   ... .......(21) *C. maculatiforme* var. *indicum* var. *nov.*

28. Median incision shallow ... ... ... ... ... ... (18) *C. javanicum*

25. Cells smaller, 24-67 µm long

30. Cells broader or as long as broad

31. Basal angles with prominent rounded mammillae ... ... ... ... ... ... (37) *C. pseudotaxichondrum* var. *rotundatum* f. *punctatum* f. *nov.*

31. Basal angles without mammillae

32. Apex rounded or broadly rounded

33. Cells as long as broad ........... (49) *C. subcirculare*

33. Cells broader than long ............ (12) *C. depressum* f. *minutum*

32. Apex truncates

34. Semicell reniform.... (30) *C. phaseolus* var. *elevatum*

34. Semi cells pyramidal

35. Sinus outwardly open, 30-34 µm

   long ... ... ... ... ... ... ... (13) *C. dorsitruncatum*

35. Sinus closed, 55-67 µm

   long ... ... ... ... ... ... ... (24) *C. obsoletum*
30. Cells longer than broad

36. Cells 33-35 μm long

37. Semi cells retuse from basal angle to apex, apex truncate ... ... ... ... ... (34) C. pseudogranatum

37. Semicell not retuse, apex flat ... ... ... ... ... (15) C. hammeri var. schmidlei

36. Cells 52-72 μm long

38. Basal angles bearing a small blunt spine ... ... ... ... ... ... ... ... (47) C. smolanicum

38. Basal angles without such spine

39. Sinus closed ... ... ... ... ... ... (41) C. raciborskii

39. Sinus open

40. Cells semi-circular ............... (8) C. canadense

40. Cells rhombic elliptic

41. Cells as long as broad .... (19) C. lundellii var. corruptum

41. Cells 1.3 times longer than broad ... ... ... (20) C. lundellii var. ellipticum

24. Margins of the semi cells undulate, with crenations or rarely spinate

42. Margin of the semicell with sharp spiny projection

43. Spines only in basal angle ... ... ... ... ... ... ... ... ... ... ... (7) C. auriculatum

43. Spines throughout the cell

44. Cells 41 μm long, projections larger ... ... ... ... ... (5) C. armatum

44. Cells 22 μm long, projection smaller ... ... ... ... ... ... ... ... ... ... ... (45) C. sarmanianum sp. nov.

42. Margins with granules, crenulation or simply undulate

45. Margins with granules

46. Median constriction shallow ... ... (22) C. mansangense var. africanum

46. Median constriction deep

47. Cells as long as broad ... ... ... ... ... ... (44) C. regnesi

47. Cells longer than broad

48. Sinus widely open ... ... ... ... ... ... ... ... ... ... (2) C. amoenum

48. Sinus closed ... ... ... ... ... (40) C. quinarium f. irregularis
Systematic part

45. Margins with crenulations or undulations

49. Cells quadrate or sub-rectangular ... ... (39) C. quadrum var. sublatum

49. Cells of other shapes, not sub-rectangular

50. Cells broader than long

51. Semicell with intra-marginal granules,
   sinus outwardly open or closed

52. Basal angles with downwardly directed
   (mucros) ... ... ... (51) C. taxichondrum var. mauritianum

52. Basal angles without mucros ... ... ... ... (11) C. cuneatum

51. Semi cells without intra-marginal spines, sinus
   widely open ... ... (27) C. orthopunctulatum var. indicum var. nov.

50. Cells longer than broad

53. Cells more than 1.5 times longer than broad ... ... ... ... (33) C. pseudodecoratum sp. nov.

53. Cells less than 1.5 times longer than broad

54. Cells 18-31.5 μm long

55. Basal angles broadly rounded, apex flat ...(55) C. umbilicatum

55. Basal angles not broadly rounded, apex slightly
dilated ...(58) C. venustum var. excavatum f. indium f. nov.

54. Cells 42-67 μm long

56. Midregion of the semi cells with 5 elongated
   wart like protrusion ... (48) C. speciosissimum var. arcticum

56. Midregion of the semi cells without such protrusion

57. Margins of the semi cells strongly
   crenate ... ... ... ... (16) C. hornavense f. arcticum

57. Margins undulate ... ... ... ... ... (25) C. obtusatum.

1. C. abbreviatum Raciborski var. minus (West & West) Krieger et. Gerloff

Krieger and Gerloff 1969, p. 242, pl. 42, fig. 18; Prescott et al. 1981, p. 60, pl. CCXI, fig. 7.

[Plate VII, Fig. 22]

Cells as wide as long, median constriction deep; sinus narrow, closed, lateral
margins slightly angular; pole truncately rounded; wall smooth.
L. 9 μm, W. 9 μm, Isth. 3 μm.
Field No. 1054.

Distribution: Probably this is the first record of the variety from India.

2. **C. amoenum Bréb.**

Skuja 1949, p. 117, pl. 27, fig. 4; Dillard 1991, p. 43, pl. 39, fig. 10.

[Plate VII, Fig. 35]

Cells length is greater than width, median constriction shallow; sinus widely open with U-shaped notch; semi cells elliptic, poles rounded; cell wall with distinct wart like projections arranged in 6-7 sub-circular rings.

L. 66 μm, W. 40 μm, Isth. 21 μm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

3. **C. angulatum (Perty) Rabenhorst f. major (Grunow) Turner**

Turner 1892 (as *C. bengalense* Turner), p. 56, pl. VIII, fig. 35, pl. IX, fig. 25; Prescott et al. 1981, p. 69, pl. CCIV, figs. 8, 11, pl. CCV, fig. 12.

[Plate VIII, Fig. 2, Plate XVII, Fig. 3]

Cells length is about double of width, median constriction deep; sinus closed, linear; semi cells rectangular; poles truncate; cell wall smooth wall margin undulate.

L. 81-159 μm, W. 45-81 μm, Isth. 16-29 μm.

The present specimen is larger than the type.

Field No. 1028.

Distribution: Probably this is the first record of the form from India.

4. **C. angulosum Brébisson**

Prescott et al. 1981, p. 70, pl. CCXI, figs. 1-4; Dillard 1991, p. 45, pl. 21, fig. 1.

[Plate VII, Fig. 24]

Cells length is slightly greater than width; median constriction deep, sinus open, semicell subquadrate, apex truncately rounded chloroplast 1 in each semicell, wall smooth.

L. 19-24 μm, W. 14-20 μm, Isth. 3-6 μm.

Field No. 96.

Distribution: Probably this is the first record of the species from India.

5. **C. armatum Joshua**

Prescott et al. 1981, p. 74, pl. CCLXIII, fig. 1

[Plate VII, Fig. 38]
Cells length is greater than width; median constriction, deep sinus narrow; semi cells trapezoidal, margin undulate and tipped with sharp spines, sub-polar region showing 4 large granule and in central position a ring of circular granules; wall with granule and spine.

L. csp. 41 μm, ssp. 37 μm, W. csp. 28 μm, ssp. 25 μm, Isth. 8 μm.

Field No. 1124

Distribution: Probably this is the first record of the species from India.

6. C. asphaerosporum var. strigosum Nordstedt

Prescott et al. 1981, p. 76, pl. CLXXIII, figs. 5-8; Dillard 1991, p. 47, pl. 8, fig. 2.

[Plate VII, Fig. 19]

Cells length slightly greater than width; deep median constriction, sinus widely open; semi cells rectangular, poles truncate; wall smooth.

L. 11-13 μm, W. 6-7 μm, Isth. 4 μm.

Field No. 44.

Distribution: Probably this is the first record of the variety from India.

7. C. auriculatum Reinsch

Turner 1892, p. 50, pl. VII, fig. 35; Prescott et al. 1981, p. 76, pl. CCXXIII, fig. 4.

[Plate VIII, Fig. 10]

Cells slightly wider than length; median constriction relatively shallow, sinus widely open; semi cells transversely elliptic, lateral margins furnished with 3 blunt spines; apex broadly convex, wall with fine punctae.

L. 42-45 μm, W. 49-54 μm, Isth. 17-20 μm.

Field No. 895.

Distribution: Uttar Pradesh (Prasad and Mehrotra 1977, Habib and Pandey 1989), Karnataka (Bongale 1989), This is the new record of the species from West Bengal.

8. C. canadense Irénée - Marie

Prescott et al. 1981, p. 95, pl. CLXI, figs. 1-3; Dillard 1991, p. 45, pl. 20, fig. 2.

[Plate VII, Fig. 31]

Cells slightly longer than broad; relatively deep median incision; sinus sharp angled open; semi cells semicircular, apex broadly convex; wall with larger punctae.

L. 52-69 μm, W. 42-48 μm, Isth. 24 μm.

Field No. 1116, 1122.
Distribution: Probably this is the first record of the species from India.

9. *C. connatum* (Bréb.) Ralfs

Prescott et al. 1981, p. 102, pl. CCII, figs. 8,9,12,13; Dillard 1991, p. 57, pl. 16, fig. 7.

[Plate VII, Fig. 9]

Cells length is greater than width; median constriction shallow, sinus widely open; semi cells subelliptic, apex slightly flattened; poles rounded; wall smooth.


Field No. 44.

Distribution: Very common.

10. *C. cucumis* Corda ex Ralfs var. *magnum* Raciborski


[Plate VIII, Fig. 3, Plate XXIII, Fig. 3]

Cells about 2 times longer than broad; median constriction deep; sinus closed, linear; semi cells semi-elliptic, apices truncately rounded; wall with dense punctae.

L. 120-128 μm, W. 63-75 μm, Isth. 33-57 μm.

Field No. 1122.

Distribution: Probably this is the first record of the variety from India.

11. *C. cuneatum* Joshua

Prescott et al. 1981, p. 115, pl. CCXLVIII, fig. 2; Dillard 1991, p. 62, pl. 5, fig. 3.

[Plate VII, Fig. 41]

Cells about as broad as long, median constriction deep; sinus with dilated apex; semicell semi-circular, extreme margins with 16-17 circular granules, another row of granules also present in the midregion, 4 central granules in each semicell.

L. 36-42 μm, W. 41-46 μm, Isth. 11-12 μm.

Field No. 1122.

Distribution: Karnataka (Hegde and Bharati 1983, Gurudeva et al. 1983). This is the new record of the species from West Bengal.

12. *C. depressum* (Näg.) Lundell f. *minutum* Heimerl

Krieger et Gerloff 1962, p. 25, pl. 8, fig. 8; Prescott et al. 1981, p. 124, pl. CLXXIX, figs. 4,5.

[Plate VII, Fig. 16]

Cells broader than long, median constriction deep; sinus linear, outwardly open; semi cells elliptic, apex truncate; wall finely punctate.
L. 20-24 μm, W. 26-30 μm, Isth. 5-7 μm.

Field No. 190.

Distribution: Probably this is the first record of the form from India.

13. *C. dorsitruncatum* (Nordst.) G.S. West

Krieger et Gerloff 1962, p. 26, pl. 8, fig. 12.

[Plate VIII, Fig. 12]

Cells width is greater than length, median constriction shallow sinus outwardly open; semi cells elliptic, apex truncate; each semicell with 2 pyrenoid wall punctate.

L. 30-34 μm, W. 44 μm, Isth. 23 μm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

14. *C. gonioides* West et West


[Plate VII, Fig. 18]

Cells about twice as long as broad, median constriction shallow, sinus open; semi cells oval, apices slightly compressed; wall smooth.

L. 24 μm, W. 13 μm, Isth. 7-8 μm.

The present specimen is larger than the type

Field No. 44.

Distribution: Probably this is the first record of the species from India.

15. *C. hammeri* Reinsch var. *schmidlei* Grönblad et Scott


[Plate VII, Fig. 29]

Cells slightly longer than broad, median constriction deep, sinus nearly closed; semi cells trapeziform apex flattened, truncate; wall with distinct scrobiculations.

L. 33 μm, W. 30 μm, Isth. 9 μm.

In this specimen scrobiculations are present, not observed in the type.

Field No. 895.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Andhra Pradesh (Suxena and Venkateswarlu 1966b, 1968b), Madhya Pradesh (Agarkar et al 1979), Uttar Pradesh (Pandey and Pandey 1980), This is the new record of the variety from West Bengal.
16. *C. hornavense* Gutwinski f. *arcticum* Croasdale

Prescott *et al.* 1981, p.156, pl. CCLXVIII, fig.1.

[Plate VII, Fig. 36]

Cells slightly longer than broad; median constriction deep, sinus linear; semi cells semi-circular, apices rounded, strongly crenate margin, each semicell with central ornamentation of granules.

L. 62-67 μm, W. 51-54 μm, Isth. 16-22 μm.

The scrobiculations are large in this specimen.

Field No. 44.

Distribution: Probably this is the first record of the form from India.

17. *C. humile* (Gay) Nordstedt var. *danicum* (Börges.) Schmidle

Prescott *et al.* 1981, p. 157, pl. CCLXXI, fig. 3.

[Plate VII, Fig. 23]

Cells slightly longer than broad; median constriction deep, sinus narrowly, linear; semi cells traperiform, apices rounded and margin slightly retuse lateral with crenation; wall smooth.

L. 15 μm, W. 12 μm, Isth. 5 μm.

Field No. 1054.

Distribution: Probably this is the first record of the variety from India.

18. *C. javanicum* Nordstedt

Turner 1892, (as *C. maculatum*), p. 49, pl. 7, fig. 31; Prescott *et al.* 1981, p. 165, pl. CXCl. fig. 8.

[Plate VIII, Fig. 9]

Cells 2 times longer than broad; median constriction, shallow, sinus linear, closed; semi cells elliptic, poles rounded, wall scrobiculate-punctate, chloroplast in parallel bands.

L. 123-138 μm, W. 63 μm, Isth. 40-56 μm.

Field No. 1116.

Distribution: Assam (Bordoloi 1983), Uttar Pradesh (Habib and Pandey 1989), Madhya Pradesh (Agarkar 1969, Agarkar and Agarkar 1990), This is the new record of the species from West Bengal.

19. *C. lundellii* Delponte var. *corruptum* (Turn.) West et West.


[Plate VIII, Fig. 13]
Cell slightly longer than broad; median constriction deep, sinus open; semi cells elliptic; wall with pore; zygospore with sharp long spines.
L. 72 μm, W. 68 μm, lsth. 30 μm.
Field No. 344.
Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Northern India (Turner 1892), Manipur (Bruehl and Biswas 1926), Maharashtra (Kamat 1975), Madhya Pradesh (Patel and Satyanarayan 1976), Western Himalayas (Suxena 1979a), Uttar Pradesh (Pandey and Pandey 1980b), This is the new record of the variety from West Bengal.

20. *C. lundellii* var. *ellipticum* West et West
Prescott *et al.* 1981, p. 179, pl. CLX, fig. 7; Dillard 1991, p. 83, pl. 4, fig. 1.

[Plate VII, Fig. 32]
Cells longer than broad, median constriction shallow, sinus open; semi cells elliptic, apex rounded; wall with distinct larger punctae.
L. 55 μm, W. 40 μm, lsth. 22 μm.
Field No. 44.
Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Maharashtra (Gonzalves and Joshi 1956, Kamat 1975), Karnataka (Bharati 1965b, 1966), Andhra Pradesh (Suxena and Venkateswarlu 1966a), Uttar Pradesh (Prasad and Mehrotra 1977b, Pandey and Pandey 1980a), Kerala (Patel *et al* 1977), This is the new record of the variety from West Bengal.

21. *C. maculatiforme* Schmidle var. *indicum* var. nov.

[Plate VIII, Fig. 5]
Cells 2 times longer than broad; median constriction deep, sinus closed; semi cells elliptic, apex rounded; wall with large pores.
L. 150 μm, W. 75 μm, lsth. 30 μm.
Field No. 1116.
Holotype: No. PM 1116, Dec. 31, 2002, Bishnupur, Bankura, Brown colour mass attached on rotting submerged *Hydrilla verticillata* and *Ceratophyllum demersum* (pH 6, Temp. 19°C) Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
Present variety differs from the typical in having i) elongated semi cells (ii) larger pores (iii) chloroplast with broader ribs.
22. *C. mansangense* West et West var. *africanum* Fritsch et Rich  
Skuja 1949, p. 128, pl. XXVII, figs. 5-7.  

[Plate VIII, Fig. 1]  
Cells about 2 times longer than broad; median constriction shallow, sinus with V-shaped notch; semi cells elliptic, apex rounded, margin undulate; wall with distinct scrobiculations.  
L. 52-63 μm, W. 26-28 μm, lsth. 23 μm.  
The present specimen tallies with the form described by Skuja (1949).  
Field No. 36.  
Distribution: Probably this is the first record of the variety from India.

23. *C. minimum* var. *subrotundatum* West et West  
West & West 1895, p. 59, pl. 8, fig. 11; Prescott *et al.* 1981, p. 189 pl. CCVI, fig. 8.  

[Plate VII, Fig. 20]  
Cells about as broad as long; median constriction shallow, sinus with V-shaped notch; semi cells elliptic to oval, apex truncate; wall smooth.  
L. 7-11 μm, W. 6-10 μm, lsth. 3-4 μm.  
Field No. 44.  
Distribution: Probably this is the first record of the variety from India.

24. *C. obsoletum* (Hantzsch) Reinsch  
Prescott *et al.* 1981, p. 203, pl. CLVI, figs. 1,2,5; Dillard 1991, p. 92, pl. 3, fig. 2.  

[Plate VIII, Fig. 15]  
Cells longer than broad; median constriction deep, sinus linear; semi cells semicircular, apex rounded, margin striated; wall with distinct pores.  
L. 55-67 μm, W. 74-85 μm, lsth. 26-34 μm.  
Present specimen is larger than the type.  
Field No. 1123.  
Distribution: Very common.

25. *C. obtusatum* Schmidle  
Prescott *et al.* 1981, p. 204, pl. CCXXXIV, fig. 5; Dillard 1991, p. 92, pl. 15, fig. 2.  

[Plate VIII, Fig. 8]  
Cells 1.5 times longer than broad; median constriction deep, sinus linear; semi cells truncate, pyramidal, margin undulate, apex truncately rounded; wall coarsely punctate.  
L. 42 μm, W. 36 μm, lsth. 12 μm.
Field No. 1116.

Distribution: Very common.

26. *C. ocellatum* Eichler et Gutwinski var. *incrassatum* West et West

Prescott *et al.* 1981, p. 206, pl. CLXIII, figs. 8-11; Dillard 1991, p. 93, pl. 5, fig. 2.

[Plate VII, Fig. 5]

Cells as broad as long, sinus linear; semi cells elliptic, mid region of the semi cells thickened, apex rounded; wall smooth; zygospore more or less rectangular in shape.

L. 27 μm, W. 27 μm, Isth. 12 μm, Th. 15 μm, Zygospore dia. 39 μm.

Field No. 1123.

Distribution: Probably this is the first record of the variety from India.

27. *C. orthopunctulatum* Schmidle var. *indicum* var. nov.

[Plate VII, Figs. 33, 34]

Cells width is greater than long, median constriction deep, sinus widely open; semi cells elliptic, margin with prominent undulations, thick, apex rounded; vertical view showing three distinct granular rows.

L. 37 μm, W. 41-45 μm, Isth. 9 μm, Th. 15 μm.

Field No. 1124.

Holotype: No. PM 1124, Jan. 20, 2003, Bishnupur, Bankura, Brown colour small algal patch attached on rotting *Hydilla verticillata* (pH 6, Temp. 16°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is differ from the type due to present of (i) cell wall thick (ii) wall undulation distinct (iii) three row of larger granules in the apex (as seen in end view).

28. *C. pakistanicum* Islam

Islam 1970, p. 926, pl. 14, fig. 2, pl. 23, figs. 1-10.

[Plate VIII, Fig. 7, Plate XVII, Fig. 4]

Cells about 2 times longer than broad; median constriction deep sinus with V-shaped notch semi cells elliptic apex rounded wall with distinct punctae.

L. 112-122 μm, W. 59-63 μm, Isth. 42-45.

Apparently the specimen looks like *C. javanicum* Nordstedt but differs its i) sinus is shallow not linear (ii) sinus open on the other hand the sinus is deep
with respect to Actinotaenium turgidum (Brèb) Teiling ex Růžička et Pouzar such forms are intermediate between Actinotaenium and Cosmarium.

Field No. 40.

Distribution: Probably this is the first record of the species from India.

29. *C. phaseolus* Brébisson in Ralfs var. *phaseolus*

Turner 1892, p. 73, pl. XXXII, fig. 5; Prescott et al. 1981, p. 222, pl. CLXXI, figs. 1-3.

[Plate VII, Fig. 7]

Cells length is greater than width; semi cells kidney shaped or reniform, margin thick walled, apex rounded; wall smooth, zygospore with sharp long spines throughout the body.

L. 33 μm, W. 25 μm, Isth. 12 μm, Zygospore dia. 34 μm.

Field No. 190.

Distribution: Uttar Pradesh (Prasad and Mehrotra 1977, Habib and Pandey 1989). This is the new record of the variety from West Bengal.

30. *C. phaseolus* var. *elevatum* Nordstedt

Prescott et al. 1981, p. 223, pl. CLXXI, figs. 6,7; Lenzenweger 1999, p. 54, pl. 14, fig. 4.

[Plate VII, Fig. 10]

Cells about as long as broad, median constriction deep, sinus slightly dilated; semi cells elliptic, lateral margin inwardly invaginate and form reniform appearance, poles truncate; wall with punctae.

L. 40 μm, W. 41 μm, Isth. 18 μm.

Field No. 1128.

Distribution: Probably this is the first record of the variety from India.

31. *C. pokornyanum* (Grun.) West et West var. *groenbladii* Förster


[Plate VII, Fig. 2]

Cells very slightly longer than broad; median constriction moderately deep. semi cells subtrilobed, basal portion slightly dilated, apex truncate, retuse; wall smooth.

L. 24 μm, W. 16 μm, Isth. 6 μm.

Field No. 44.

Distribution: Probably this is the first record of the variety from India.
32. *C. polygonum* (Näg) Archer


[Plate VII, Fig. 4]

Cells longer than broad; median constriction deep, the sinus short, semi cells hexagonal, apex slightly reteuse, basal angle rounded; wall smooth; zygospore globose.

L. 24-32 µm, W. 15-16 µm, Isth. 6 µm, Zygospore dia. 21 µm -31 µm.

Field No. 1140.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Maharashtra (Kamat 1975), Andhra Pradesh (Suxena and Venkateswarlu 1966a), Madhya Pradesh (Agarkar 1971), This is the new record of the species from West Bengal.

33. *C. pseudodecoratum* sp. nov.

[Plate VIII, Fig. 6]

Cells longer than broad; median constriction moderate, sinus dilated semicell obtusely rounded, apex rounded, margins with crenulation wall with distinct granules no scrobiculation.

L. 117 µm, W. 69 µm, Isth. 33 µm.

Field No. 1029.

Holotype : No. PM 1029, March 9, 2002, Bishnupur, Bankura, Yellowish to creamish colour assemblages lodged on *Hydrilla verticillata* (pH 5.5, Temp. 33°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is similar to *C. decoratum* West et West but differs in following aspects (i) larger cell with obtusely rounded pole (ii) more prominent granules (iii) absence of any scrobiculations.

34. *C. pseudogranatum* Nordstedt


[Plate VII, Fig. 27]

Cells 1.3 times longer than broad, median constriction deep, the sinus closed; semi cells cuneate, basal portion slightly swollen, apex truncate; wall punctate.

L. 35 µm, W. 22 µm, Isth. 6 µm.

Field No. 96.

Distribution: Probably this is the first record of the species from India.
35. *C. pseudoprotuberans* Kirchner var. *alpinum* Raciborski

Prescott et al. 1981, p. 241, pl. CCXVII, fig. 3.

[Plate VII, Fig. 25]

Cells about as long as broad, moderate median constriction, sinus nearly closed; semi cells subrectangular, apex truncately rounded; wall smooth.

L. 10 \( \mu m \), W. 9 \( \mu m \), Isth. 4-5 \( \mu m \).

Field No. 1010.

Distribution: Probably this is the first record of the variety from India.


[Plate VIII, Fig. 11]

Cells about 2 times longer than broad, median constriction shallow, sinus closed; semicell pyramidal, apex rounded, margin striated; wall smooth.

L. 115-135 \( \mu m \), W. 63-67 \( \mu m \), Isth. 46 \( \mu m \).

Field No. 40.

Distribution: Probably this is the first record of the variety from India.


[Plate VII, Fig. 6, Plate XVII, Fig. 5]

Cells as long as broad, median constriction deep, the sinus slightly dilated; semi cells truncate pyramidal, lower angles acute and slightly convex, apex broadly truncate; wall with definite punctae.

L. 32-57 \( \mu m \), W. 33-75 \( \mu m \), Isth. 11 \( \mu m \).

Field No. 190.

Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30\(^{\circ}\)C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This form differs from the typical in having distinct punctation on the wall.

38. *C. quadratulum* (Gay) De Toni var. *aplanatum* Insam et Krieger

Prescott et al. 1981, p. 259, pl. CCVIII, fig. 3.

[Plate VII, Fig. 21]
Cells slightly longer than broad, median constriction deep, sinus closed; semi cells semi-rectangular, basal angle broadly rounded, lateral margins retuse; wall smooth.

L. 14 µm, W. 11 µm, Isth. 4 µm.

Field No. 44.

Distribution: Probably this is the first record of the variety from India.


[Plate VIII, Fig. 14, Plate XXIII, Fig. 1]

Cells slightly longer than broad, median constriction deep, sinus linear; semi cells rectangular, apex slightly retuse; cell wall with densely and regularly arranged granules; In between granules there were number of pores present. zygospore globose.

L. 42-50 µm, W. 36-45 µm, Isth. 10-12 µm, zygospore dia. 45 µm.

The present specimens differs from the typical in its smaller size.

Field No. 36.

Distribution: Probably this is the first record of the variety from India.

40. *C. quinarium* Lundell f. *irregularis* Nordstedt

Prescott *et al.* 1981, p. 267, pl. CCXXXVII, fig. 9.

[Plate VII, Fig. 44]

Cells longer than broad, median constriction deep, the sinus linear with slightly dilated extremity; semi cells broadly pyramidal truncate, margin with acute granules, apex truncate; wall with warts, central portion of each semicell with circular granular ring (7 in number).

L. 46 µm, W. 36 µm, Isth. 14 µm.

Field No. 744.

Distribution: Maharashtra (Ashtekar and Kamat 1979), This is the new record of the form from West Bengal.

41. *C. raciborskii* (Racib.) Lagerheim

Prescott *et al.* 1981, p. 267, pl. CCLVII, figs. 11-12; Dillard 1991, p. 118, pl. 30, fig. 6.

[Plate VII, Fig. 30]

Cells about as long as broad, moderate median constriction, sinus narrow; semi cells elliptic, apex rounded; wall punctate.

L. 48-52 µm, W. 42-49 µm, Isth. 15-19 µm.
Field No. 44.
Distribution: Probably this is the first record of the species from India.

42. *C. rectosporum* Turner.

Turner 1892, p. 69, pl. 10, fig. 16; Prescott et al. 1981, p. 271, pl. CLXXXIX, figs. 8-10.

[Plate VII, Fig. 26]

Cells longer than broad; median constriction deep, sinus narrow, closed; semi cells truncate, pyramidal, margin entire, apex truncate; wall smooth.
L. 26-37 μm, W. 18-26 μm, Isth. 7-12 μm.

Field No. 44

Distribution: Probably this is the first record of the species from India.

43. *C. regnellii* Wille var. *chondrophorum* Skuja

Skuja 1949, p. 139, pl. 29, fig. 5; Prescott et al. 1981, p. 273, pl. CCXIX, figs. 9,13.

[Plate VII, Fig. 14]

Cells small, longer than broad; median constriction distinct, sinus linear; semi cells trapezoid, hexagonal, apex with slightly mid region of each semicell with small granular thickening.
L. 18 μm, W. 12 μm, Isth. 4 μm.

Field No. 44

Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1968b). This is the new record of the variety from West Bengal.

44. *C. regnesi* Reinsch


[Plate VII, Fig. 43]

Cells about as long as broad, median constriction deep, sinus open; semi cells oblong-rectangular, margins with 6 minute marginal teeth, apex widely retuse.
L. csp 15 μm ssp 10 μm W. 15 μm, Isth. 4 μm.

Although in external morphology it is close to the type but its size approaches to *C. regnesi* Reinsch var. *productum*. West et West.

Field No. 190.

Distribution: Karnataka (Gurudeva et al 1983). This is the new record of the species from West Bengal.
45. *C. sarmanianum* sp. nov.

[Plate VII, Fig. 28]

Cells longer than broad; median constriction deep, sinus linear closed, apex rounded.

L. 22 μm, W. 19 μm, Isth. 5 μm.

Field No. 758.

Holotype: No. PM 758, Dec. 12, 2001, Bishnupur, Bankura, Some green & brownish colour assemblages lodged on submerged *Utricularia* (pH 5.5, Temp. 23°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The specimens apparently looks like *C. subcrenatum* Hantzsch var. *sublaeve* Taylor, but differs in having (i) smaller size, margin with sharp spines except to the apical region, (ii) central portion of each semicell having a distinct circular granular (7 tubercules) ring. In some respects it looks like *Xanthidium raneeegungeense* Turner and *X. eximium* Turner but nature and disposition of spines are distinctly different. Moreover the sinus in this species is narrow, at the same time large punctae are present on the wall.

This species has been named in honour of Prof. P. Sarma, a veteran phycologist of international repute.


Prescott et al. 1981, p. 284, pl. CCXX, figs. 9-10; Dillard 1991, p. 124, pl. 20, fig. 10.

[Plate VII, Fig. 3]

Cells 1.5 times longer than broad, median constriction deep, sinus linear closed; semicell elliptic, apex truncate; cell wall thickened, wall smooth.

L. 23-30 μm, W. 12-18 μm, Isth. 6-8 μm.

Field No. 44.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Karnataka (Bharati 1966), Andhra Pradesh (Suxena and Venkateswarlu 1966a), Kashmir (Suxena and Venkateswarlu 1968c), Madhya Pradesh (Agarkar and Agarkar 1977), Uttar Pradesh (Pandey and Pandey 1980), This is the new record of the variety from West Bengal.

47. *C. smolandicum* Lundell

Prescott et al. 1981, p. 287, pl. CLVII, figs. 6-7; Dillard 1991, p. 125, pl. 3, fig. 4.

[Plate VIII, Fig. 4]
Cells as broad as long, median constriction deep; sinus slightly dilated; semi cells semi circular, basal angles bearing small papilla, apex broadly rounded; wall with distinct punctae are larger in our specimen.

L. 66 µm, W. 65 µm, Isth. 33 µm.

The present specimen is smaller than the type.

Field No. 739.

Distribution: Probably this is the first record of the species from India.

48. C. speciosissimum Schmidle var. arcticum Hirano.

Hirano 1968, p. 30, pl. 7, fig. 3; Prescott et al. 1981, p. 288, pl. CCXXXVIII, fig. 5.

[Plate VII, Fig. 37]

Cells about 1.5 times longer than broad; median constriction deep, sinus linear, outwardly open; semi cells circular margin with crenations, central position of each semicell having 6 elongated granular structure, axile with distinct granules in regular circular fashion.


Field No. 744.

Distribution: Probably this is the first record of the variety from India.

49. C. subcirculare Turner.

Turner 1892, p. 52, pl. VIII, fig. 3.

[Plate VII, Fig. 15]

Cells about as long as broad, moderate median constriction semi cells sub reniform, apex broadly rounded; wall densely punctate.

L. 34-48 µm, W. 36-45 µm, Isth. 15-24 µm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

50. C. subimpressulum Börge


[Plate VII, Fig. 13]

Cells 1.5 times longer than broad; median constriction deep, sinus linear closed; semi cells pyramidal chloroplast one in each semicell, apex truncate wall with strong undulation, smooth.

L. 25-30 µm, W. 15-19 µm, Isth. 6-7 µm.

Field No. 536.
Distribution: Bihar (Sinha and Mishra 1967), Kashmir (Suxena and Venkateswarlu 1968c), Karnataka (Hegde 1986), Maharashtra (Ashtekar and Kamat 1979), Uttar Pradesh (Pandey and Pandey 1980), This is the new record of the species from West Bengal.


[Plate VII, Fig. 42]

Cells breadth is slightly greater than length; median constriction deep, sinus narrow and slightly dilated at the apex; semi cells semicircular, apex broadly rounded, margin undulate, apical region with 3 distinct granules; wall smooth.

L. 29 µm, W. 30 µm, Isth. 7 µm.

Field No. 536.

Distribution: Probably this is the first record of the variety from India.

52. *C. tetragonum* (Näg) Archer var. *lundellii* Cooke f. *minus* Croasdale


[Plate VII, Fig. 17]

Cells about as long as broad; median constriction deep, semi cells sub-rectangular, presence of 4 distinct crest on all sides of semi cells, apex truncate, margin undulate; wall smooth.

L. 18 µm, W. 14-16 µm, Isth. 4-6 µm.

The present specimen is smaller than the type.

Field No. 44.

Distribution: Probably this is the first record of the form from India.

53. *C. tinctum* Ralfs.


[Plate VII, Fig. 11]

Although intact vegetative cells have not found but the reproductive characters and nature of semi cells associated with it clearly indicate that the specimen belongs to *C. tinctum* (measurement of the cell slightly greater than the typical); semi cells elliptical, smooth walled zygospores more or less rectangular.

L. 30 µm, W. 15 µm, Zygospore dia. 30 µm.

Field No. 1123.

Distribution: Probably this is the first record of the species from India.
54. *C. trilobulatum* Reinsch

Prescott *et al.* 1981, p. 331, pl. CLXXXIII, figs. 11-13, pl. CCXXI, fig. 8; Lenzenweger 1999, p. 86, pl. 52, fig. 5.

![Plate VII, Fig. 1]

Cells 1.5 times longer than broad; median constriction deep, sinus closed; semi cells 3-lobed, basal lobe slightly inflated, apex truncate; wall smooth.

L. 27 μm, W. 18 μm, Isth. 6 μm, Th. 16 μm.
Field No. 1010.

Distribution: Madhya Pradesh (Agarkar 1969), Uttar Pradesh (Pandey and Pandey 1980). This is the new record of the species from West Bengal.

55. *C. umbilicatum* LütKemüller


![Plate VII, Fig. 39]

Cells slightly longer than broad, median constriction deep, sinus linear closed; semi cells sub-reniform, apex flat; broad; truncate; margin undulate; wall with distinct pore

L. 24-31 μm, W. 16-21 μm, Isth. 4-6 μm.

The specimen is slightly larger than the type.
Field No. 190.

Distribution: Probably this is the first record of the species from India.

56. *C. undulatum* Corda ex Ralfs var. *minutum* Wittrock

Krieger & Gerloff 1962, p. 41, pl. 11, fig. 11; Prescott *et al.* 1981, p. 341, pl. CLXVII, figs. 7-9.

![Plate VII, Fig. 12]

Cells 1.7 times longer than broad, median constriction deep, sinus linear closed; semi cells elliptic, margin undulate, apex truncate; wall smooth.

L. 26 μm, W. 15 μm, Isth. 6 μm.
Field No. 96.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Maharashtra (Frijetas and Kamat 1979, Ashtekar and Kamat 1979), Kashmir (Suxena and Venkateswarlu 1968), Uttar Pradesh (Pandey and Pandey 1980). This is the new record of the variety from West Bengal.

57. *C. undulatum* var. *wolle* West


![Plate VII, Fig. 8]
Cells slightly longer than broad; median constriction deep, sinus linear semi cells semicircular, margin undulate, apex broadly rounded; wall smooth.
L. 48 μm, W. 39 μm, Isth. 14 μm.
Field No. 895.
Distribution: Probably this is the first record of the variety from India.


[Plate VII, Fig. 40]
Cells longer than broad; median constriction deep, sinus linear closed, semi cells truncate pyramidal, margin with undulations sometimes it forms a polygonal appearance, apex retuse, presence of large ocellus on each semicell, with a central pyrenoid; wall punctate.
L. 18-21 μm, W. 14-16 μm, Isth. 6-9 μm.
Field No. 44.
Holotype : No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus*. Sp.) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
Present specimens differ from the typical in (i) large ocellus (ii) shorter size (iii) presence of punctae on wall.

XII : *Actinotaenium* (Nägeli) Teiling 1954.
Cells solitary, mostly elongate with a very faint median constriction, poles rounded; wall smooth with irregularly arranged dense pores; chloroplast mostly axial or stellate with central pyrenoid.

Artificial key to the taxa described
1. Cells larger, more than 100 μm long
   2. Cells with distinct median constriction ... ... ... (2) *A. clevei* var. *crassum*
   2. Cells without median constriction or
      with negligible constriction ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... (1) *A. capax*

1. Cells smaller, less than 100 μm long
   3. Apex truncately rounded ... ... ... ... ... ... ... ... ... (4) *A. cucurbitinum* f. *minutum*
3. Apex strongly rounded
4. Chloroplast lobe stelloid with one central pyrenoid ...(5) *A. diplosporum* var. *americanum* f. *minus*
4. Chloroplast a number of parietal bands each containing 4 to 5 pyrenoids ... ... ... ... ... ... ... ... ...(3) *A. costatum*

1. *A. capax* (Josh.) Teiling

Teiling 1954, p. 396, fig. 29; Prescott *et al.* 1981, p. 5, pl. CLVI, fig. 5.

[Plate IX, Fig. 2, Plate XVII, Fig. 8, Plate XXIII, Fig. 2]

Cells ovate, more than 1.5 times longer than broad, apices rounded; chloroplast with 7-8 bands cell wall punctate.

L. 93-137 µm, W. 66-93 µm.

Field No. 38.

Distribution: Probably this is the first record of the species from India.

2. *A. clevei* (Lund.) Teiling var. *crassum* (West & West) Teiling

Teiling 1954, p. 393, fig. 11; Prescott *et al.* 1981, p. 6, pl. CXLIX, figs. 4,5.

[Plate IX, Fig. 1]

Cells broader, about 2 times longer than broad with distinct median constriction, apex broadly rounded; wall punctate.

L. 105 µm, W. 57 µm.

The present specimen is slightly broader than the type.

Field No. 739.

Distribution: Probably this is the first record of the variety from India.

3. *A. costatum* (Wolle) Bourrelly

Bourrelly 1966, p. 102, pl. 18, figs. 1, 2; Prescott *et al.* 1981, p. 8, pl. CXLIX, figs. 10-11; Dillard 1991, p. 14, pl. 1, fig. 5.

[Plate IX, Fig. 3]

Cells about 1.8 times longer than broad with slight median constriction, poles rounded; chloroplast axial with radiating lamellae.

L. 65-72 µm, W. 40-46 µm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

Teiling 1954, p. 399, fig. 36; Prescott et al. 1981, p. 11, pl. CLI, figs. 1-3; Dillard 1991, p. 15, pl. 2, fig. 2.

[Plate IX, Fig. 4]

Cells about 3 times longer than wide, sinus with shallow notch, apices rounded; chloroplast 2, with central pyrenoids.

L. 26 μm, W. 9 μm.

Field No. 1010.

Distribution: Probably this is the first record of the form from India.


Teiling 1954, p. 413, figs. 76, 79; Prescott et al. 1981, p. 17, pl. CLV, figs. 10-13; Dillard 1991, p. 16, pl. 1, fig. 10.

[Plate IX, Fig. 5]

Cells elliptical, poles rounded, 1.5 times longer than broad chloroplast stelloid with one central pyrenoid.

L. 26-38 μm, W. 17-22 μm.

Field No. 44.

Distribution: Probably this is the first record of the form from India.

**XIII : Brachytheca Gontcharov et. M. Watanabe 1999**

Cells solitary, cylindrical without median constriction, semicell sub-quadrate, cell wall with circular row of pores, poles rounded; chloroplast stellate, one in each semicell.

*Brachytheca indica* sp. nov.

[Plate IX, Fig. 8, Plate XVII, Figs. 6, 7]

Cells solitary, elliptic or suglobose, without median constriction, semicell with longitudinal groove. Apex broadly rounded to flat chloroplast one in each semicell possessing several irregular ridges wall with transversely arranged row of granules.

L. 69-81 μm, W. 58-61 μm.

Field No. 1122.
Holotype: No. PM 1122, Jan. 20, 2003, Bishnupur, Bankura, Gray colour algal mass attached on *Hydrilla verticillata* (pH 5, Temp. 24°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is differs from the others due to following characters (i) cells with larger size (ii) cells elliptic or subglobose (iii) apex not depressed rather flat or broadly rounded species i.e. *B. sulcata* Gontcharov et. M. Watanabe and *B. inopinata* Fumanti et Alfinito.

**XIV: Bourrelyodesmus Compère 1976**

Cells solitary, deeply constricted at the middle, isthmus narrow, the sinus linear; semi cells elliptical with single spine on each side, and in the centre of the semicell with several conspicuous granules which alternate with triangular scrobiculations; chloroplast one per semicell, cell margin smooth.

**Artificial key to the taxa described**

1. Cells longer than broad; each semicell with
   two downwardly curved spines. ............ (1) *B. heimii* var. *indicus* var. nov.

1. Cells broader than long; each semicell with
   two short horizontal spines ................. (2) *B. excrescens*.

1. *B. heimii* (Bourrelly) var. *indicus* var. nov.

[Plate IX, Fig. 6, Plate XVII, Fig. 11]

Cells slightly longer than broad; deeply constricted at the middle, sinus widely open; semi cells sub-elliptic, lateral angles with a short, stout, slightly downwardly curved spines, centre of each semicell with distinct triangular scrobiculations, chloroplast one in each semi cell; wall with distinct pores.

L. 78-112 μm, W. 69-86 μm, Isth. 14-15 μm, Spines 7-9 μm, Th. 41 μm.

Field No. 190.

Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the
algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This variety differs from type in following aspects (i) different ornamentation, (ii) densely arranged larger pores.

2. *B. excrescens* (Scott & Grönlad) Bicudo & Compère

Bicudo & Compère 1978, p. 412, figs. 1-5.

[Plate IX, Fig. 7]

Cells without spines, slightly wider than long, deeply constricted at the middle sinus widely open; semi cells angles furnished with a simple short, spines; cell wall colourless, smooth, except a large emarginated tubercle in the midregion.

L. 33 µm, W. 39 µm, Isth. 11 µm, Th. 21 µm.

The present specimen is larger than the type.

Field No. 895.

Distribution: Probably this is the first record of the species from India.

**XV : *Xanthidium* Ehrenberg 1835**

Cells are slightly longer than broad and are compressed, oval or elliptical in vertical views; semi cells with a deep median constriction, lateral margins have stout paired spines and mid region is thickened; each semicell contain two laminate axile chloroplasts with single pyrenoid.

**Artificial key to the taxa described**

1. Semi cells with 6-8 µm long spines

2. Cell wall with granules

   3. Spines straight directed horizontally

      or upwardly ... ... ...

      (2) *X. antilopaeum* var. *antilopaeum* f. *javanium*

   3. Spines curved, upwardly directed ... ... ... ... ... ... ...

      (3) *X. bengalicum*

2. Cell wall smooth

4. Cells as long as broad ... ... ... ... ... ... ...

   (5) *X. hastiferum* f. *angulata*

4. Cells broader than long ... ... ...

   (6) *X. hastiferum* var. *javanicum* f. *planum*

1. Semi cells with more than 8 µm long spines,

5. Spines 6-12 µm long
6. Semi cells with scrobiculations and central circular granular ring... ... ... ... ... ... ... ... ... ... ... (1) *X. aculeatum*

6. Semi cells with no such ring; only scrobiculations on wall... ... ... ... ... ... ... ... ... ... ... (7) *X. raneegungense*

5. Spines up to 7 μm long

7. Spines with bulbous base, not stout... ... ... ... ... ... ... ... ... ... ... (8) *X. turneri* sp. nov.

7. Spines without bulbous base, stout ............ (4) *X. freemanii* var. *minor* var. nov.

1. *X. aculeatum* Ehrenberg

Prescott *et al.* 1982, p. 45, pl. 311, fig. 1; Dillard 1991, p. 171, pl. 52, fig. 3.

[Plate IX, Fig. 12, Plate XVIII, Fig. 4]

Cell as broad as long excluding spines; semi cells elliptic, reniform, apex subtruncate and often slightly elevated; spines stout, irregular in disposition, cell wall with larger & densely arranged pores.

L. csp. 57-63 μm, ssp. 39-41 μm, W. csp. 51-54 μm, ssp. 33-36 μm, Isth. 12 μm.

The present specimen is smaller and pores are larger and less densely arranged.

Field No. 1124.

Distribution: Probably this is the first record of the species from India.

2. *X. antilopaeum* (Brév.) Kützing *f. javanicum* Nordstedt.

Prescott *et al.* 1982, p. 47, pl. 314, fig. 2; Dillard 1991, p. 173, pl. 49, fig. 1.

[Plate IX, Fig. 9]

Cells as broad as long excluding spines; semi cells subelliptical having 4 spines on each lateral margins, 2 spines inserted at the upper angles, sinus open; cell wall with scrobiculations.

L. csp. 66 μm, ssp. 45 μm, W. csp. 75 μm, ssp. 42 μm, Isth. – 10 μm.

The present specimen is smaller than the type.

Field No. 190.

Distribution: Probably this is the first record of the form from India.


Turner 1892, p. 100, pl. 12, fig. 32; Prescott *et al.* 1982, p. 59, pl. 317, fig. 7.

[Plate IX, Fig. 11]
Cells as broad as long; semi cells subelliptic, hexagonal, the base convex, median constriction deep, sinus linear, single, stout long and slightly curved spines from all angles of each semi cell; cell wall punctate.

L. csp. 72 μm, ssp. 43-45 μm, W. csp. 68-69 μm, ssp. 45-46 μm, Isth. 10 μm.

Field No. 1146.

Distribution: Probably this is the first record of the species from India.

4. *X. freemanii* West & West. var. minor. var. nov.

[Plate IX, Fig. 15]

Cells slightly wider than long, semi cells compressed, isthmus region wider & sinus open; irregularly dispose small stout spines throughout the surface.

L. csp. 62 μm, ssp. 54 μm, W. csp. 69 μm, ssp. 60 μm, Isth. 26 μm.

Field No. 364.

Holotype: No. PM 364, Oct. 17, 2001, Bishnupur, Bankura, Green filament with some algal mass attached on the aquatic stem of *Jussiaea repens*. (pH 6, Temp. 33°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is differs from the typical due to following feature (i) cells smaller in size (ii) semicell compressed (iii) isthmus region wider and open.

5. *X. hastiferum* Turner f. angulata

Turner 1892, p. 100, pl. XII, fig. 16.

[Plate IX, Fig. 10, Plate XVII, Fig. 9]

Cells as broad as long excluding spines; semi-cells sub elliptic hexagonal, lateral angles bearing a long horizontally directed spine, 8 spines in each semi-cell; isthmus region deeply constricted cell wall smooth.

L. csp. 75-79 μm, ssp. 48-54 μm, W. csp. 89-94 μm, ssp. 48-54 μm, Isth. 9 μm.

The present specimen is smaller than the type.

Field No. 1054.

Distribution: Probably this is the first record of the form from India.


Turner 1892, p. 100, pl. 12, figs. 23, 6, pl. 13; Prescott *et al*. 1982, p.71, pl. 326, fig. 6; Scott & Prescott 1961, p. 81, pl. 40, fig. 5.

[Plate IX, Fig. 16]
Cell broader than long; semi cells elliptic, deeply constricted in the isthmus region, single large stout spines from each angle of the semicell; sinus open; cell wall smooth.

L. csp. 72 µm, ssp. 42 µm, W. csp. 85 µm, ssp. 52 µm, Isth. 12 µm.

Field No. 895.

Distribution: Karnataka (Hegde and Bharati 1983), West Bengal (Turner 1892).

7. *X. raneegungense* Turner

Turner 1892, p. 102, pl. XIII, fig. 11.

[Plate IX, Fig. 14]

Cells slightly longer than wide; semi cells elliptic, apex rounded, numerous stout spines covering the cell surface, base of the spine is wider, spines are irregularly disposed.

L. csp. 52-63 µm, ssp. 33-42 µm, W. csp. 48-60 µm, ssp. 31-39 µm, Isth. 9-11 µm.

Field No. 190.

Distribution: Karnataka (Gurudeva et al. 1983), West Bengal (Turner 1892).

8. *X. turneri* sp. nov.

[Plate IX, Fig 13, Plate XVII, Fig. 10]

Cells larger than broad, with broadly rounded poles; semi-cells sub-elliptical, slightly longer than wide, deeply constricted in the isthmus region, sinus almost closed, spines in two horizontal bonds covering the semi-cell except the isthmus region, spine morphology unique in having broad base and suddenly tapering ends; cell wall smooth.

L. csp. 81-111 µm, ssp. 77-96 µm, W. csp. 80-87 µm, ssp. 64-81 µm, Isth. 19-21 µm.

Field No. 190.

Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C) Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

It is close in morphology to *X. torquatum* Turner but differs in i) large size ii) spines in two horizontal bands. Covering the semicell except to the isthmus and nearby region. iii) sinus almost closed iv) spines with broad base and suddenly tapering ends v) spines are longer.
Systematic part

XVI: *Arthrodesmus* Ehrenberg 1838

Cells are generally triangular, sometimes subquadrate or elliptic, the median constriction of the cell is fairly deep, sinus open; cell wall is smooth, of a uniform thickness throughout, and with single straight or strongly curved spines at the angles.

**Artificial key to the taxa described**

1. Semi cells with 2 spines
   2. Cells with distinct mucilage strand,
      wall with crenulations ... ... .......... (6) *A. subulatus* var. *crenulatus* var. nov.
   2. Cells without any mucilage strand, wall not crenulate
   3. Spines more than 15 \(\mu m\) long, horizontally or upwardly directed
      4. Apex rounded, spines straight,
         horizontally directed ... ... ... ... ... (5) *A. subulatus* var. *subaqualis*
      4. Apex flat, slightly concave, spines
         upwardly directed .................................................. (4) *A. quiriferus*
   3. Spines less than 15 \(\mu m\) long, downwardly curved
      5. Wall with pore, median constriction deep ............... (1) *A. convergens*
      5. Wall smooth, median constriction less deep ............... (2) *A. maximus*
   1. Semi cells with more than 2 spines ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... .. (3) *A. octocornis*

1. *A. convergens* Ehrenberg

Ehrenberg ex Ralfs 1848, p. 118, pl. 20, fig. 3d; Prescott and Vinyard 1982, p. 10, pl. 304. figs. 2-4, 6, 9(f). 12(f).

[Plate IX, Fig. 20]

Cells sub-elliptic, median constriction deep, sinus widely open, apex relatively broad and convex; cell wall punctate.

L. 36-39 \(\mu m\), W. csp. 69-71 \(\mu m\), ssp. 39-42 \(\mu m\), Isth. 9-11 \(\mu m\), Spine 15-17 \(\mu m\).

Field No. 190.

Distribution: Very common.

2. *A. maximus* Borge

Borge 1925, p. 37, pl. 4, fig. 18; Prescott and Vinyard 1982, p. 23, pl. 305, figs. 1-5,7: Dillard 1991, p. 162, pl. 45, fig. 5.

[Plate IX, Fig. 19, Plate XVIII, Fig. 2]
Cells sub-elliptic, median constriction deep, sinus widely open, slightly rounded extremity; spines downwardly curved.

L. 48-52 μm, W. csp. 77-84 μm, ssp. 48-52 μm, lsth. 14-16 μm.

The present specimen is smaller than the type.

Field No. 364.

Distribution: Probably this is the first record of the species from India.

3. *A. octocornis* Ehrenberg

Prescott and Vinyard 1982, p. 26, pl. 295, fig. 10; Dillard 1991, p. 163, pl. 42, fig. 8.

[Plate IX, Fig. 17]

Cells elliptic, median constriction deep, sinus wide, poles concave, with fairly long spines; wall smooth.

L. csp. 40 μm, ssp. 18 μm, W. csp. 35 μm, ssp. 13 μm, lsth. 4 μm, Th. 7 μm.

Field No. 190.

Distribution: Probably this is the first record of the species from India.

4. *A. quiriferus* West et West

West & West 1903, p. 542, pl. 17, fgs. 9-10; Prescott and Vinyard 1982, p. 29, pl. 297, fgs. 4-6.

[Plate IX, Fig. 18, Plate XVIII, Fig. 1]

Cells sub-elliptic, median constriction fairly deep, sinus widely open, apex broadly concave; spines divergent stout; cell wall smooth.

L. csp. 60-100 μm, ssp. 28-62 μm, W. csp. 77-162 μm, ssp. 30-67 μm lsth. 6-12 μm, Th. 10-17 μm.

Field No. 1116.

Distribution: Probably this is the first record of the species from India.

5. *A. subulatus* Kützing var. *crenulatus* var. nov.

[Plate IX, Fig. 21]

Cells sub-elliptic, median constriction deep, margin crenulate, poles straight, spines shorter, divergent

L. 30 μm, W. csp. 66 μm, ssp. 36 μm, lsth. 11 μm, Th. 18 μm.

Field No. 1124.

Holotype: No. PM 1124 Jan. 20, 2003, Bishnupur, Bankura, Brown colour small algal patch attached on rotting *Hydrilla verticillata* (pH 6, Temp. 16°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present specimen differs from the typical by i) cell wall margin crenulate ii) presence of dense mucilage strands iii) lateral spine thinner and smaller.

6. *A. subulatus* Kützing var. *subaqualis* West et West

West & West 1912, p. 110, pl. 117, figs. 2, 3; Prescott and Vinyard 1982, p. 32, pl. 308, figs. 2, 10; Dillard 1991, p. 166, pl. 45, fig. 2.

*Plate IX, Fig. 22*

Cells narrowly elliptical distinct median constriction, poles rounded, spines shorter, divergent; cell wall smooth.

L. 30 μm, W. csp. 69 μm, ssp. 31 μm, Isth. 9 μm, Th. 16 μm.

Field No. 364.

Distribution: Probably this is the first record of the variety from India.

**XVII : Spinocosmarium Prescott et Scott 1942**

Cells compressed, semi cells elliptic, semi-circular with simple or bifurcated spines, the median constriction is consistently deep, semi cells with a large granule

*S. indium* sp. nov.

*Plate IX, Fig. 27*

Cells slightly wider than long, semi cells gracefully reniform, median constriction deep, apex with two bifurcate spines, lateral margins extended into stout bifurcate arms; cell wall smooth.

L. csp. 51 μm, ssp. 32 μm, W. csp. 60 μm, ssp. 42 μm, Isth. 10 μm.

Field No. 393.

Holotype : No. PM 393, Oct. 17, 2001, Bishnupur, Bankura, Brownish colour alga, mass attached on aquatic stem of *Ipomoea* (pH 6.5, Temp. 33°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is close in morphology to *S. laconiense* (West et West) Prescott et Scott but differs in i) semicell gracefully semiformal ii) apex with two bifurcate stout spine.

Like *S. loconiense* lateral margins in this species are extended into stout armed bifurcate process (like fish tail).

This new species exhibits intermediate characters between *Spinocosmarium laconiense* and *S. quadrident* (Wood) Prescott et Scott.
XVIII: *Staurastrum* Meyen 1829

Cells are radially symmetrical and usually triangular in end view; semicell various in shape elliptical triangular to quadrangular; cell wall smooth or ornamented; semi cell contains single axial chloroplast with a deeply incised lobe; several pyrenoids in each lobe.

**Artificial key to the taxa described**

1. Cells without arms and elongated processes from the face of the semicell
   2. Cell wall smooth, without spines or granules
      3. Cells as long as broad, apex rounded ...(3) *St. clepsydra* var. *minimum*
      3. Cells longer than broad, apex concave ...(17) *St. subclepsydra* sp. nov.

2. Cell wall not smooth with spine and granules
   4. Semi cells broadly oval or elliptical
      5. Sinus deep, widely open ...(21) *St. trachytiithophorum*
      5. Sinus broad, not open widely ...(11) *St. muticum*

4. Semi cells of other shapes
   6. Lateral angles bearing a pair of stout spines
      7. Basal margin bearing bifurcate processes ...(4) *St. contectum*
      7. No processes on the basal margin ...(2) *St. bifidum*

6. Lateral angles without spines
   8. Semi cells subfusiform, basal margins
      slightly convex ...(10) *St. margaritaceum*
   8. Semi cells quadrangular, margins
      deeply retuse ...(5) *St. disputatum* var. *extensum*

1. Cells with stout or much extended long arms and processes from the face of the semicell
   9. Cell with arms and processes that are smooth margined
      10. Lateral processes long, irregularly disposed ...(20) *St. tohopekaligense* var. *insigne*
      10. Lateral processes short, symmetrically disposed
      11. Each semicell bearing 12 processes ...(12) *St. quadricornutum*
      11. Each semicell bearing 6 processes ...(22) *St. turneri* sp. nov.

9. Cells with arms and processes which are granulate or spiny
   12. Semi cells bearing more than 8 stout processes
13. Cell wall smooth
14. Cells larger, lateral arms with
   gullet like incision ... ... ... (16) *St. sexangulare* var. *asperum*
14. Cells shorter, lateral arms
   without incision ... ... ... (15) *St. sexangulare* var. *sexangulare*
13. Wall with granules or spines
15. Apex rounded, convex, arms with sharp spines ... ... (6) *St. elegans*
15. Apex concave, arms with small spine ... ... ... (1) *St. arctiscon*
12. Semi cells bearing less than 8 processes
16. Cells longer or as long as broad
17. Cells smaller 24-30 µm long, without median granules
   18. Lateral arms with distinct spiny margin
      sinus slightly open ... ... ... (19) *St. tetracerum* var. *validum*
   18. Lateral arms undulate or with very short spines,
      sinus closed ... ... ... (18) *St. tetracerum* var. *tetracerum*
17. Cells larger, 52-56 µm long, with central
   transverse row of granules ... ... ... ... (13) *St. rectangularae*
16. Cells broader
19. Lateral processes 3-6 times longer than the central width
20. Lateral processes 6 times longer than the central
    width, poles without granules ... ... ... (7) *St. leptocladum*
20. Lateral processes 3 times longer than the central
    width, poles with transverse row
    of granules ... ... ... ... ... ... (8) *St. longibrachiatum*
19. Lateral arms 1-2 times longer than the central width
21. Spines of the lateral arms are larger and
    irregularly disposed ... ... ... (14) *St. saltans* var. *polycharax*
21. Spines of the lateral arms are shorter and
    evenly disposed ... (9) *St. luetkemuehleri* var. *urniforme*

1. *St. arctiscon* (Ehrenb.) Lundell
Lundell, 1871, p. 70, pl. 4, fig. 8; Prescott et al. 1982, p. 129, pl. 410, fig. 6.
[Plate X, Fig. 10]
Cells more than 1.5 times longer than broad; median constriction distinct, the
sinus open; semi cells broadly elliptic with 2 superimposed whorls of processes,
upper whorl upwardly divergent & lower whorl nearly horizontal each with 3
long, sharp teeth and transverse whorls of denticulations; apical processes
convex, apex truncate, body smooth.
L. csp. 110-120 µm, ssp. 54-62 µm, W. csp. 110-120 µm, ssp. 44-52 µm, Isth.
21-24 µm.
The present specimen is smaller than the type.
Field No. 1010.
Distribution: Tamil Nadu (Bharti and Pal 1972), This is the new record of the
species from West Bengal.

2. *St. bifidum* (Ehrenb.) Brébisson in Ralfs

Prescott *et al.* 1982, p. 142, pl. 363, fig. 13; Lenzenweger 1997, p. 75, pl. 29, fig. 10.

[Plate X, Fig. 5]

Cells slightly wider than long, median constriction slight, sinus widely open;
semi cells sub-elliptic, triangular apex broadly rounded, each apical angle
bearing a pair of sharp spines; wall smooth.
L. 32-38 µm, W. csp. 45-48 µm, ssp. 32-36 µm, Isth. 13-15 µm,
Margin of the present specimen is wavy.
Field No. 1124.
Distribution: Karnataka (Hegde and Bharati 1983, Gurudeva *et al.* 1983), This is
the new record of the species from West Bengal.

3. *St. clepsydra* Nordsted var. *minimum* var. *nov.*

[Plate X, Fig. 6]

Cells about as broad as long, median constriction deep, sinus with U- shaped
notch, lateral margins convex at the base, apex rounded, apical margin truncate
and straight; wall smooth.
L. 18 µm, W. 18 µm, Isth. 7 µm.
Field No. 190.
Holotype : No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish
colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the
algae herbarium of the Department of Botany, The University of Burdwan
(BURD), West Bengal, India.
4. *St. contextum* Turner

Turner. 1892, p. 111, pl. 15, fig. 20; Prescott et al. 1982, p. 165, pl. 363, fig. 5.

[Plate X, Fig. 4]

Cells triangular; median constriction shallow, semi cells bow-shaped- lateral margins bear bifurcate long sharp spines; wall smooth.
L. 30 μm, W. 33 μm, Isth. 12 μm.
The present specimen is smaller than the type.
Field No. 190.
Distribution: Probably this is the first record of the species from India.

5. *St. disputatum* West et West var. *extensum* (Borge) West et West

West et West 1912, p. 177, pl. 126, fig. 17; Prescott et al. 1982, p. 190, pl. 340, figs. 3,4.

[Plate X, Fig. 8]

Cells slightly longer than broad; median constriction deep, sinus widely open, semi cells cuneiform, quadrangular in vertical view, lateral lobes somewhat longer than the typical, with 4 to 5 series of granules encircling each lobe.
L. 27 μm, W. 18 μm, Isth. 7 μm.
Field No. 536
Distribution: Gujarat (Patel and Asoka Kumar 1980), This is the new record of the variety from West Bengal.

6. *St. elegans* Borge

Borge, 1896, p. 15, pl. 2, fig. 21; Ling & Tyler 1986, p. 40, pl. 35, figs. 1-7, pl. 36, figs. 1,2.

[Plate X, Fig. 13]

Cells slightly longer than the broad; median constriction deep, sinus open, semi cells broadly elliptic, each semicell 14 diverging process, few of them horizontally directed and few are upwardly directed, process tipped with 3-4 stout spines and transverse row of denticulation; body of the wall smooth.
L. cpr. 99 μm, spr. 63 μm, W. cpr. 94 μm, spr. 48 μm, Isth. 25 μm, Th. 36 μm.
Field No. 190.
Distribution: Probably this is the first record of the species from India.

7. *St. leptocladium* Nordstedt.

Prescott et al. 1982, p. 234, pl. 406, figs. 2-3; Ling & Tyler 1986, p. 42, pl. 31, fig. 21

[Plate X, Fig. 22]

Cells about one-half as broad as long without processes; median constriction posses a V-shaped notch, semi cells subcompanionate, lateral margins concave
and then diverging into long, slender and tapering processes which are directed slightly upward, processes tipped with 2 stout teeth, apical margin convex and slightly elevated, poles with a pair of intramarginal spines.

L. csp. 40-48 µm, ssp. 36-42 µm, W. csp. 75-96 µm, ssp. 22-23 µm, Isth. 7-8 µm.

Field No. 1124.

Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1970), This is the new record of the species from West Bengal.

8. *St. longibrachiatum* (Borge) Gutwinski

Gutwinski, 1902, p. 605, pl. 14, figs. 2a-2f; Prescott *et al.* 1982, p. 240, pl. 415, fig. 6; Ling & Tyler 1986, p. 42, pl. 31, figs. 24-28.

![Plate X, Fig. 19](image)

Cells width is greater than length; median constriction moderately deep, the sinus a broad notch; semi cells bowl-shaped, apical angles extended into long, slender horizontally directed processes, bispinate at the tips, apical margins truncate with series of teeth on the ventral margin of the process.

L. 36 µm, W. 66 µm, Isth. 9 µm, Th. 15 µm.

Field No. 190.

Distribution: Probably this is the first record of the species from India.

9. *St. lutkemuelleri* Donat et Ruttner. var. *urniforme* (Lundb.) Teiling.

Prescott *et al.* 1982, p. 243, pl. 419, fig. 1.

![Plate X, Figs. 16, 17](image)

Cells longer than broad, median constriction shallow, the sinus U-shaped notch semi cells cyathiform in vertical view triangular, the basal part inflated, margins convex with a marginal granule, apical angles with upwardly directed processes and tipped with 3 teeth, apical margins inflated with 2 emarginate verrucae.

L. 55 µm, W. 36 µm, 62-65 µm with processes, Isth. 12 µm, Th. 20-24 µm.

The present specimen is larger, close to the type.

Field No. 40.

Distribution: Probably this is the first record of the variety from India.

10. *St. margaritaceum* (Ehrenb.) Ralf.

Ralfs 1848, p. 134, pl. 21, fig. 9; Prescott *et al.* 1982, p. 248, pl. 390, figs. 1, 3, pl. 391, figs 1-2; Lenzenweger 1997, P. 103, pl. 31, figs. 1-5.

![Plate X, Fig. 7](image)
Cells slightly longer than broad, median constriction shallow, the sinus open; semi cells subfusiform, basal margins slightly convex, lateral projection mostly horizontally directed, apical margin convex, semicell with series of granules on the body.
L. csp. 25 \(\mu m\), ssp. 21 \(\mu m\), W. csp. 18 \(\mu m\), ssp. 15 \(\mu m\), Isth. 8 \(\mu m\).
Field No. 44.
Distribution: Probably this is the first record of the species from India.

11. *St. muticum* (Bréb.) Ralfs.
Ralfs 1848, p. 125, pl. 21, fig. 4, pl. 24, fig. 13; Prescott et al. 1982, p. 257, pl. 331, figs. 1, 2, 4, 5.

[Plate X, Fig. 2]
Cells triangular in vertical view, about as broad as long, median constriction deep, sinus open; semi cells subreniform, apical margin convex; wall smooth.
L. 36 \(\mu m\), W. 32 \(\mu m\), Isth. 12 \(\mu m\).
Field No. 749.
Distribution: Probably this is the first record of the species from India.

Turner, 1892, p. 110, pl. 14, fig. 2; Prescott et al. 1982, p. 296, pl. 386, fig. 3.

[Plate X, Fig. 11]
Cells slightly broader than long, median constriction deep, sinus open; semi cells subrectangular, lateral margin extending into bidentate processes, apical margin truncate and convex; wall smooth.
L. csp. 33 \(\mu m\), ssp. 27 \(\mu m\), W. csp. 36 \(\mu m\), ssp. 26 \(\mu m\), Isth. 11 \(\mu m\).
Field No. 190, 1122.
Distribution: Andhra Pradesh (Suxena and Venkateswarlu 1970), This is the new record of the species from West Bengal.

13. *St. rectangulare* Borge.
Borge 1896, p. 16, pl. 4, fig. 65; Prescott et al. 1982, p. 299, pl. 414, figs. 1, 4.

[Plate X, Fig. 18]
Cells about as broad as long; slight median constriction, semi cells subrectangular, sinus V-shaped notch, basal margins convex and slightly inflated, apical processes nearly vertical with 3 stout teeth, apical margin truncate; cell wall with 1 transverse row of granules above the isthmus.
L. 52-56 \(\mu m\), W. 16-19 \(\mu m\), Isth. 12 \(\mu m\).
Field No. 190.

Distribution: Probably this is the first record of the species from India.


Ling & Tyler 1986, p. 45, pl. 31, figs. 1-14.

[Plate X, Fig. 23, Plate XVIII, Fig. 6]

Cells about as long as broad; median constriction deep, sinus with V-shaped notch; semi cells subglobose, lateral margins extended with stout spinate processes, apical margin slightly concave with upwardly directed pair of spines; wall smooth.

L. csp. 46 μm, ssp. 40 μm, W. csp. 47-60 μm, ssp. 21-23 μm, Isth. 11 μm.

Field No. 529.

Distribution: Probably this is the first record of the variety from India.

15. *St. sexangulare* (Bulnh.) Lundell var. *sexangulare*

Prescott et al. 1982, p. 310, pl. 423, fig. 3; Ling & Tyler 1986, p. 45, pl. 34, figs. 7-10.

[Plate X, Fig. 15, Plate XXIV, Fig. 1]

Cells as broad as long, median constriction shallow, sinus broad U-shaped notch; semicell subelliptic, basal margin concave, lateral margins bear horizontally directed bifurcate processes, upper plane of the semi cells with short arms, all the processes terminated into sharp spines; wall smooth.

L. csp. 51 μm, ssp. 39 μm, W. csp. 51 μm, ssp. 28 μm, Isth. 12-14 μm.

Field No. 190.

Distribution: Probably this is the first record of the species from India.

16. *St. sexangulare* var. *asperum* Playfair

Scott & Prescott et al. 1961, p. 107, pl. 45, figs. 1-3; Ling & Tyler 1986, p. 46, pl. 37, figs. 3-5.

[Plate X, Fig. 14]

Cells larger, median constriction distinct arms are irregularly disposed and each arm with gullet like crenulation that terminates into 3-4 sharp, long stout spines.

L. csp. 105 μm, ssp. 63 μm, W. csp. 100 μm, ssp. 45 μm, Isth. 18-19 μm.

Field No. 1054.

Distribution: Probably this is the first record of the variety from India.

17. *St. subclepsydra* sp. nov.

[Plate X, Fig. 1]

Cells about as broad as long, median constriction deep, sinus with V-shaped notch, basal lobe convex, apex concave, pole rounded; cell wall smooth.
Systematic part

L. 24 μm, W. 22 μm, Isth. 7 μm.

Field No. 190.

Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is differs from the *St. clepsydra* Nordstedt following character i) apex more or less concave ii) sinus widely open iii) gradually rounded lateral margin ending in rounded poles.

18. *St. tetracerum* (Kütz.) Ralfs. var. *tetracerum*

Prescott *et al.* 1982, p. 331, pl. 402, figs. 5, 7-9; Lenzenweger 1997. p. 137. pl. 34, fig. 15.

[Plate X, Fig. 21]

Cells as broad as long including the processes, median constriction deep, sinus with V-shaped notch, apical angles with two upwardly directed processes terminates into small teeth; wall smooth.

L. csp. 24 μm, ssp. 14 μm, W. csp. 24 μm, ssp. 12 μm, Isth. 9 μm.

Field No. 190.

Distribution: Probably this is the first record of the species from India.

19. *St. tetracerum* var. *validum* West et West

Prescott *et al.* 1982, p. 332, pl. 402, fig. 10.

[Plate X, Fig. 20]

The present specimen differs from the typical in having larger in size and stouter processes, processes with marginal undulations.

L. csp. 30 μm, ssp. 12 μm, W. csp. 24 μm, ssp. 12 μm, Isth. 4-5 μm.

The present specimen is smaller than the type.

Field No. 190.

Distribution: Probably this is the first record of the variety from India.

20. *St. tohopekaligense* Wolle var. *insigne* West & West


[Plate X, Fig. 9]

Cells as broad as long including processes, median constriction distinct, sinus open. Eight to ten processes in each semicell, each process terminates with bifurcate spine, wall smooth.
L. csp. 82-86 μm, ssp. 43-48 μm, W. csp. 86-88 μm, ssp. 31-32 μm, Isth. 18-19 μm.
Field No. 1054.
Distribution: Probably this is the first record of the variety from India.

21. *St. trachytithophorum* West et West.

West et West 1897, p. 493, pl. 6, fig. 22; Prescott *et al.* 1982, p. 335, pl. 337, figs. 4, 5, pl. 338. fig. 14.

[Plate X, Fig. 3]

Cells triangular in vertical view length is slightly greater than width; median constriction deep, sinus open, basal margin convex, apical angles slightly upward, apical margin broadly rounded; wall smooth.
L. 30 μm, W. 24 μm, Isth. 9 μm,
Field No. 1054.
Distribution: Probably this is the first record of the species from India.

22. *St. turneri* sp. nov.

[Plate X, Fig. 12]

Cells about as long as broad; median constriction deep, sinus with V-shaped notch and open lateral angles extended to slender processes, apical angles also extended into upwardly directed processes; each semicell with 12 processes in two whorls; processes sometimes tipped into mono or bispinate endings; wall smooth.
L. csp. 27 μm, ssp. 22 μm, W. csp. 27 μm, ssp. 16 μm. Isth. 9 μm.
Field No. 348.
Holotype: No. PM 348, Oct. 10, 2001, Bishnupur, Bankura, Some blackish filamentous algae associated with some brown coloured mass on some rotting stem. (pH 6, Temp. 32.5°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present specimen differs from existing specimens in having arms in two tiers.

23-25. *Stauastrum* sp. : [Only zygospores available, species could not be determined due to lack of vegetative cells]

[plate X, figs. 23-25]
XIX: Staurodesmus Teiling 1948

Cells mostly triangular, each angle bearing a single spine bending upward or downwardly or sometimes expending at right angles, cells with distinct median constriction, wall smooth or having pores.

Artificial key to the taxa described

1. Lateral lobes upwardly or horizontally exerted
   2. Spines upwardly divergent .......................................... (2) Std. dejectus
   2. spines straight ....................................................... (1) Std. cuspidatus

1. Lateral lobes downwardly exerted
   3. Cells larger in dimension wall with granules .... (4) Std. dickiei var. maximus
   3. Cells smaller dimension, wall smooth .................. (3) Std. dickiei

1. Std. cuspidatus (Bréb. ex Ralfs) Teiling
   Lenzenweger 1997, p. 24, pl. 22, figs. 15-17, 24-27.
   [Plate IX, Fig. 24]

   Cells about as long as broad; median constriction broad invagination, the sinus a mere notch, semi cells triangular, basal margins slightly convex, apical angles bear a slender, slightly downwardly projected spine, apical margin convex and elevated; wall smooth.
   L. csp. 21 μm, ssp. 18 μm, W. csp. 24 μm, ssp. 15 μm, Isth. 5 μm.
   Field No. 190.

   Distribution: Probably this is the first record of the species from India.

2. Std. dejectus (Bréb. ex Ralfs) Teiling
   Lenzenweger 1997, p. 25, pl. 22, figs. 5,6.
   [Plate IX, Fig. 26]

   Cells longer than broad; median constriction deep, sinus widely open, semi cells triangular, lateral margins convex, apical angles with upwardly directed spines; wall smooth.
   L. csp. 21-39 μm ssp. 13-19 μm, W. 21-29 μm, Isth. 4-5 μm.
   Field No. 190, 895, 1010.

   Distribution: Probably this is the first record of the species from India.
3. *Std. dickiei* (Ralfs) Lither

Ling & Tyler 1986, p. 51, pl. 27, figs. 15-18; John *et al.* 2003, p. 579, pl. 141B.

[Plate IX, Fig. 23]  

Cells elliptic, triangular in top view, arms ending in a downwardly curved spine, considered to be a small form of *Staurastrum dickiei* (Ralfs) var. *maximum* W. West.  

L. 22-27 μm, W. csp. 26-32 μm, ssp. 23-30 μm, Isth. 7-8 μm.  

Field No. 1054.  

Distribution: Probably this is the first record of the species from India.

4. *Std. dickiei* var. *maximus* (W. West) Thomason

Ling & Tyler 1986, p. 52, pl. 26, fig. 2.

[Plate IX, Fig. 25]  

Cells elliptic, poles rounded, spines are shorter, downwardly curved; wall punctate.  

L. 74 μm, W. csp. 74μm, ssp. 66 μm, Isth. 18 μm.  

The present specimen is slightly larger than the type.  

Field No. 364.  

Distribution: Probably this is the first record of the variety from India.

XX : *Pleurotaenium* Nägeli 1849

Cells straight, longer than broad, poles truncate, smooth or with circle of granules; well defined median constriction; chloroplast several, parietal, straight to undulate, band shaped extending the length of the semicell; with several pyrenoids.

**Artificial key to the taxa described**

1. Cell wall corrugated or with whorls of rectangular areas  
   2. Apex smooth ....................................................... (27) *Pl. trochiscum*  
   2. Apex with 6 visible tubercles ................................ (23) *Pl. sub verrucosum*  

1. Cell wall without corrugation or whorls of small rectangular areas  
   3. Apex without crown of rounded or acute tubercles  
      4. Wall hirsute ............................................... (29) *Pl. wolleanum* var. *bankurii* var. nov.  
      4. Wall not hirsute  
      5. Cell wall with wart like large granules throughout the body .................................. (13) *Pl. granuliferum*
5. Wall without wart like granules
6. Cells more than 500 μm long
   7. 0-3 swellings above basal inflation
      8. Wall punctuate ... ... .... (25) Pl. trabecula var. trabecula
      8. Wall smooth
      9. Single basal inflation beyond
         the constriction .......(3) Pl. baculoides var. brevius
      9. More than 2 basal inflations beyond
         the constriction ....(2) Pl. baculoides var. baculoides
   7. More than 3 swellings above basal inflation.
   10. Only lower half of the semicell undulate.(15) Pl. indicum
   10. Semi cells undulate from base to apex.(19) Pl. repandum
6. Cells less than 500 μm long
   11 Cells straight, with single
      basal swelling ...... ...... ...... ...(26) Pl. trabecula var. rectum
   11. Cells distinctly curved, semicell undulate
      from base to apex ...... ...... ...... ...(18) Pl. ramanathanii sp. nov.
3. Apex with crown of rounded or acute tubercles
   12. Cells ovate, side of the semi cells
      markedly swollen ...... ...... ...... ...... ...... ...... ...... ...(17) Pl. ovatum
   12. Cells elongate, plane, undulate
   13. Apical tubercles few, usually less than 8 in front view
      14. Semi cells with 4 large undulation or
         circle of nodules ...... ...... ...... ...... ...... ...... ...... ...... ...... ...... ...(16) Pl. nodosum
      14. Semi cells without large circle of nodules,
         simply undulate or plane
   15. Cells more than 400 μm long
   16. Cell wall with punctae
      ...... ...... (10) Pl. ehrenbergii var. elongatum f. elongatum
   16. Cell wall smooth
      17. Semi cells undulate from base
         to apex ...... ...... ...... (11) Pl. ehrenbergii var. undulatum
      17. Semi cells undulate upto the lower half
18. Single basal swelling evident
   ... ... ... ... (9) Pl. ehrenbergii var. attenuatum
18. More than 2 swelling ...
   ... ... ... ... ... (8) Pl. ehrenbergii var. ehrenbergii

15. Cells less than 400 μm long
19. Cells joined end to end to form filament ... (28) Pl. turnerii sp. nov.
19. Cells occur singly
20. Cells gradually narrower to the apex
   21. Cells 16 times longer than broad,
       semi cells curved ... ... ... ... ... (6) Pl. curvatum sp. nov.
21. Cells less than 16 times longer than broad,
       semi cells more or less straight
22. Wall with pore ... ... ... ... ... (20) Pl. sarmae sp. nov.
22. Wall smooth ... ... ... ... ... (24) Pl. subquantillum
20. Cells not tapered to the apex
   23. Wall undulate throughout
       the cell. ... ... ... ... ... ... ... ... ... ... ... (14) Pl. hypocymatium
23. Wall with basal swelling ... ... ...
   ... ... ... ... ... (5) Pl. coronatum var. benghalense var. nov.

13. Apical tubercles many
24. Apex bulbous swollen
   25. Cells solitary, ... ... ... ... ... ... ... ... ... ... (4) Pl. caldense
25. Cells in very short filaments
   26. Cells 14 times longer than broad,
       wall smooth ... ... ... ... ... (22) Pl. subcoronulatum var. africanum
26. Cells 23 times longer than broad, wall
       punctuate ... ... ... ... ... (21) Pl. subcoronulatum f. elongatum
24. Apex not bulbous swollen
   27. Apex broadened at very top.
   28. Cells 9.5 times longer than broad ... ... ... ... ... (1) Pl. alternans
28. Cells 17 times longer than broad ... ... ... ... ... ... (7) Pl. cylindricum
27. Apex not broadened at the top ... ... ... ... ... (12) Pl. excelsum var. borgei
1. *Pl. alternans*. Nordstedt

Bando, 1988, p.51, figs. 30, 50.

[Plate XII, Fig. 3]

Cells stout, near about 10 times longer than broad; semi cells with a prominent basal inflation; margin wavy, apex truncate bulbous-swollen; wall punctate.

L: 585 μm, W: 60 μm, Isth. 45 μm.

Field No. 1116.

Distribution: Probably this is the first record of the species from India.


[Plate XI, Fig. 7]

Cells slender, basal inflation evident, with 3 swellings above it, apex truncate; wall smooth.


Field No. 44.

Distribution: Kerala (Sindhu and Panikkar 1994), Uttar Pradesh (Habib and Pandey 1989). This is the new record of the variety from West Bengal.

3. *Pl. baculoides* var. *brevius* (Skuja) Krieger 1937

Krieger 1937, p. 404, pl. 41, fig. 5f; Prescott et al. 1975, p. 109, pl. 39, fig. 19

[Plate XI, Fig. 6]

Cells straight; semi cells with single basal inflation and slightly tapered to the rounded truncate apex.

L: 585 μm, W: 15-26 μm, Isth. 22 μm, Apex 12-22 μm.

Field No. 32.

Distribution: Probably this is the first record of the variety from India.


Krieger 1937, p. 425, pl. 46, fig. 2; Prescott et al. 1975, p. 110, pl. 50, figs. 2, 3.

[Plate XI, Figs. 22, 23]

Cells straight semi cell with single basal inflation margin not undulate, apex truncate.

L: 170 μm, W: 26-28 μm, Apex 14-21 μm, Zygospore dia. 65 μm.

Field No. 36.
Distribution: Kerala (Sindhu and Panikkar 1994), This is the new record of the variety from West Bengal.

5. *Pl. coronatum* (Bréb.) Rabenhorst var. *benghalense* var. nov.

[Plate XII, Fig. 5]

Cells 12 times longer than broad; slightly tapered to the truncate apex only, semi cells with single basal inflation, margin wavy, wall with distinctly scrobiculate.

L. 233 μm, W. 18 μm, lsth. 14 μm.

Field No. 190.

Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C).

Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is differs from all the existing varieties of *P. coronatum* (Bréb.) Rabenhorst smaller vegetative cells ii) distinct larger scrobiculations.

6. *Pl. curvatum* sp. nov.

[Plate XI, Fig. 20]

Cells curved; semi cells gradually tapered to the truncate apex, with 2 undulations, chloroplast axial and single margins not straight, wall smooth.

L. 370 μm, W. 21-23 μm, lsth. 20-21μm.

Field No. 44.

Holotype: No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus* Sp.) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is close to *Pl. excelsum* (Turner) Gutw. But differs from it in i) the curved semi cells ii) wall smooth iii) chloroplast axial & single iv) apical tubercles closely placed & eight in number.

7. *Pl. cylindricum* (Turner) Schmidle

Schmidle 1898, p. 28, pl 2, fig. 11; Prescott et al. 1975, p. 113, pl. XLVII, fig. 15

[Plate XII, Fig. 6]

Cells slender; semi cells with evident basal inflation and slightly broadened at the apex which shows 12-16 tubercles.
8. *Pl. ehrenbergii* (Bréb.) De Bary var. *ehrenbergii*

Prescott *et al.* 1975, p. 114, pl. XLV, figs. 1-5.

[Plate XI, Fig. 17, Plate XVIII, Fig. 8]

Cells elongate, 20 times longer than broad; semi cells with conspicuous basal inflation and with more than two swellings beyond, apex truncate; chloroplast in longitudinal parietal bands with many pyrenoids.

L. 286-421 μm, W. 21-23 μm, Isth. 19-21 μm.

Field No. 44.

Distribution: Very common.

9. *Pl. ehrenbergii* var. *attenuatum* Krieger

Krieger 1937, p. 413, pl. 43, fig. 6; Prescott *et al.* 1975, p. 116, pl. XLV, figs. 10,11.

[Plate XI, Fig. 21]

Cells cylindric; semi cells tapering strongly to the apex, basal inflation evident, apex truncate, 7 tubercles visible; zygospores globose, smooth walled.

L. 400 μm, W. 20-22 μm, Apex 15 μm, Zygospore dia. 43 μm.

The present specimen is narrower than the type.

Field No. 744.

Distribution: Probably this is the first record of the variety from India.

10. *Pl. ehrenbergii* var. *elongatum* west. f. *elongatum*

Prescott *et al.* 1975, p. 117, pl. XLVI, figs. 1-3.

[Plate XI, Fig. 13]

Cells 25 times longer than broad; semi cells straight evenly tapered, with a small basal swelling, 2-3 smaller swelling beyond it, apex truncate.

L. 504 μm, W. 19 μm, Apex 15-17 μm.

Field No. 44.

Distribution: Probably this is the first record of the form from India.

11. *Pl. ehrenbergii* var. *undulatum* Schaarschmidt

Schaarschmidt 1883, p. 278, pl. 1, fig. 21; Prescott *et al.* 1975, p. 117, pl. XLVI, figs. 5,6,18; Ling & Tylcr 1986, p. 35, pl. 14, figs. 7-8.
Cells 20 times longer than broad; margins of semi cells gently and symmetrically undulate beyond the basal inflation, apex truncate.
L. 599 μm, W. 29-44 μm, Isth. -26μm.
Field No. 32.
Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Uttar Pradesh (Pandey and Pandey 1980b), West Bengal (Turner 1892 as Docidium crispulum and D. solebrosum).

12. Pl. excelsum (Turner) Gutw. var. borgei (W. West et G.S. West) Bando
Bando 1988, p. 38, pl. 1, figs. 18, 42.

Cells elongate, more than 20 times longer than broad; semi cells with large basal inflation, generally with 1 top 3 smaller swellings above it, apex rounded truncate; cell wall minutely punctate.
L. 481 μm, W. 17-19 μm, Apex 13 μm, Isth. 15-16 μm.
Field No. 44.
Distribution: Probably this is the first record of the variety from India.

13. Pl. granuliferum (Joshua) Hirano
Bando 1988, p. 45, figs. 24-47.

Cells more than 11 times longer than their diameter; semi cells with a prominent basal inflation, apex truncate, near the apex rather abruptly tapered; cell wall with pored granules.
L. 740 μm, W. 60 μm, Apex 33 μm, Basal inflation 72 μm.
Field No. 32.
Distribution: Probably this is the first record of the species from India.

14. Pl. hypocymatium West & West
West & West 1896, p. 234, pl. 13, fig. 1; Prescott et al. 1975, p. 119, pl. XLVII, figs. 1,2; Dillard 1990, p. 130, pl. 45, fig. 1.

Cells elongate, 15-25 times larger than broad; margin undulate, rounded with 3-4 tubercles visible at the apex, apex subtruncate; wall punctate.
The present specimen is shorter than the type.
Field No. 44.
Distribution: Probably this is the first record of the species from India.

15. *Pl. indicum* (Grunow) Lundell

Lundell 1871, p. 90, pl. I-V; Prescott *et al.* 1975, p. 119, pl. XLI, fig. 9; Dillard 1990, p. 130, pl. 45, fig. 2.

[Plate XI, Fig. 8]

Cells elongate, more than 20 times longer than broad, the basal inflation large, beyond which about 7 undulations; present apices truncate; wall punctate.
L. 657 μm, W. 26-30 μm, Isth. 24-26 μm.
Field No. 32.
Distribution: Kashmir (Suxena and Venkateswarlu 1968), Uttar Pradesh (Habib and Pandey 1989), This is the new record of the species from West Bengal.

16. *Pl. nodosum* (Bailey) Lundell. var. borgei Grönblad

Grönblad 1920, p. 27, pl. 4, fig. 28; Prescott *et al.* 1975, p. 125, pl. XLIV, figs. 6-9; Dillard 1990, p. 134, pl. 46, fig. 9.

[Plate XI, Fig. 11]

Cells elongate, 5-8 times longer than broad; semi cells with 4 evenly spaced ring of prominent circumferential nodules, slightly attenuated to the apex, apices bearing conical teeth; cell wall smooth.
L. 299 μm, W. 38-54 μm, Isth. 28 μm, Apex 26 μm.
Bando (1988) considered this variety as synonym of the typical because of the presence of intermediate forms between *Pl. nodosum* (Bailey) Lundell and *Pl. nodosum* var. borgei Grönblad in nature as well as in culture.
Field No. 1124.
Distribution: Probably this is the first record of the variety from India.

17. *Pl. ovatum* Nordstedt


[Plate XI, Fig. 14, Plate XVIII, Fig. 7]

Cells elongate, 3-4 times longer than broad; semi cells broadly convex in their lateral margins without a basal inflation; apex rounded truncate with 5 or 6 tubercles; wall punctate.
L. 96-204 μm, W. 30-68 μm, Apex 14-20 μm, Isth. 19-34 μm.
Systematic part

The present specimen is smaller than the type.

Field No. 1160.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Kashmir (Suxena and Venkateswarlu 1970), Maharashtra (Kamat 1975, Frietas and Kamat 1979), West Bengal (Lagerheim 1888, Turner 1892 as *Docidium latum*).

18. *Pl. ramanathanii* sp. nov.

[Plate XI, Fig. 12]

Cells slightly curved; basal inflation distinct, distinctly undulate walls from base to apex, apex rounded or slightly notched at the middle; cell wall with prominent scrobiculation.

L. 243 μm, W. 18 μm, Isth. 15 μm.

Field No. 1054.

Holotype: No. PM 1054, Oct. 22, 2002, Bishnupur, Bankura, Deep brown colour mass attached on rotting *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

This species is close in external morphology to *Pl. repandum* (Wolle) Krieger but differ from it in i) much smaller vegetable cell ii) distinctly undulate wall from base to apex iii) prominent scorbiculation on wall. iv) distinctly curved apex of one semicell.

This species has been named in the honour of Late in Dr. K.R. Ramanathan, an Indian phycologist who contributed much on desmids & Ulotrichales of India.


Krieger 1937, p. 405, pl. 41, fig. 9; Prescott et al. 1975, p. 129, pl. XLI, fig. 10.

[Plate XI, Fig. 9]

Cells elongated, 25 times longer than broad; semi cells slightly tapered to the apex, basal inflation very slight; apex truncate, margins undulate; wall punctate.

L. 550 μm, W. 22 μm, Isth. 18 μm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.
20. **Pl. sarmae** sp. nov.

[Plate XI, Fig. 15]

Cells 10 times longer than broad; semi cells gradually tapering towards the apex, apex with 7 tubercles in face view; margins slightly undulate; wall with closely spaced large scrobiculations arranged in distinct horizontal rows.

L. 209 µm, W. 18-22 µm, lsth. 18 µm.

Field No. 44.

Holotype: No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus. Sp.*) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is similar to **Pl. coronatum** (Bréb.) Rabenhorst but differs from it in following characters i) much smaller vegetative cells ii) closely spaced large scrobiculation arranged in distinct horizontal rows iii) gradually tapering semicell ending & tubercles in face view. The species has been named after our revered teacher Prof. Sarma of this department.

21. **Pl. subcoronulatum** (Turner) West & West f. *elongatum* Croasdale & Scott

Prescott *et al.* 1975, p. 132, pl. XLIX, fig. 5; Dillard 1990, p. 137, pl. 47, fig. 10.

[Plate XI, Figs. 24, 25]

Cells more than 25 times longer than broad; slightly undulate to the apex on which 12 rounded tubercles present, wall with scrobiculations.

L. 770-790 µm, W. 33 µm, lsth. 28 µm.

The present specimen is less broader than the type.

Field No. 44.

Distribution: Probably this is the first record of the form from India.

22. **Pl. subcoronulatum** var. *africanum* (Schmidle) Krieger

Krieger 1937, p. 423, pl. 46, fig. 8; Prescott *et al.* 1975, p. 132, pl. XLIX, figs. 6-9; Dillard 1990, p. 137, pl. 48, fig. 1.

[Plate XII, Fig. 1]

Cells long 15 times longer than broad; united into a fragile filament; semicell wall parallel, without undulations between the basal swelling and the inflated apex; wall smooth.

L. 355 µm, W. 24 µm, lsth. 25 µm.
Systematic part

Field No. 32.
Distribution: Probably this is the first record of the variety from India.

23. *Pl. subverrucosum* sp. nov.

[Plate XI, Fig. 2]
Cells cylindrical, 15 times longer than the broad; slightly attenuated to the apex, presence of distinct annulate elevations besides oval rather rectangular thinner areas; wall finely punctuate in horizontal rows, 7-9 granules.
L. 380 μm, W. 25-27 μm, Apex 12-14 μm.
Field No. 44.
Holotype: No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus*. Sp.) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present species is close in morphology to *Pl. verrucosum* (Bailey) Lundell. But differs from the its i) presence of distinct annulate elevations besides the oval rather rectangular thin area and fine punctuations in horizontal rows.

24. *Pl. subquantillum* sp. nov.

[Plate XI, Fig. 18]
Cells more than 10 times longer than broad; slightly tapered to the apex, basal inflation distinct, wall smooth.
L. 186 μm, W. 17 μm, Isth. 15 μm, Apex 12 μm.
Field No. 699.
Holotype: No. PM 699, Dec. 02, 2001, Jahajpur, Purulia, Creamish assemblages lodged on aquatic weeds. (pH 5.5, Temp. 20°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present specimen is similar in shape and size to *Pl. quantillum* (Turn.) W. West et G.S. West but differs from it in i) distinct basal inflations ii) wall smooth iii) gradually tapered semicell iv) apex rounded v) apical tubercles rounded in face view.


Prescott et al. 1975, p. 133, pl. XL, figs. 1-5.

[Plate XI, Fig. 5, Plate XVIII, Fig. 9]
Cells 18 times longer than broad; semi cells usually a little swollen in the mid region, basal inflation distinct, apex truncate, wall smooth.

L. 468-670 µm, W. 26-52 µm, Isth. 22-34 µm, Apex 22-33 µm.

Field No. 32.

Distribution: Karnataka (Gurudeva et al. 1983), Maharashtra (Agarkar 1969, Ashtekar and Kamat 1979), Uttar Pradesh (Pandey and Pandey 1980, Habib 1991), This is the new record of the variety from West Bengal.

26. *Pl. trabecula* var. *rectum* (Delponte) West & West

West & West 1904, p. 212, pl. 30, figs. 9-10; Prescott et al. 1975. p. 136, pl. XI, figs. 16,17; Dillard 1990, p. 138, pl. 48, fig. 6.

[Plate XI, Fig. 10]

Cells cylindrical, straight 11 times longer than the broad; tapered slightly towards the apex, apex truncate, no accessory swelling wall beyond basal inflation, wall with pore in transverse row.

L. 290 µm, W. 25-29 µm, Isth. 21 µm, Apex 16-18 µm.

Field No. 44.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Maharashtra (Kamat 1975), Karnataka (Sing 1966a, Bharati 1965), Kerala (Sindhu and Panikkar 1994), This is the new record of the variety from West Bengal.

27. *Pl. trochiscum* West & West

West & West 1896, p. 235, pl. 13, figs. 4, 5; Prescott et al. 1975. p. 136, pl. L, figs. 9-12; Dillard 1990, p. 138, pl. 48, fig. 7.

[Plate XI, Fig. 1, Plate XVIII, Fig. 10]

Cells cylindrical, nearly 10 times longer than the broad; very slightly tapered to the apex, single basal inflation, apex truncate; wall with 13 circle of rectangular thinner areas, each circle having 6-7 areas.

L. 178-312 µm, W. 30-32 µm, W. at apex 14-19 µm.

Field No. 32.

Distribution: Probably this is the first record of the species from India.
28. **Pl. turnerii** sp. nov.

[Plate XII, Fig. 2]

Cells joined end to end to form filament, cells cylindrical, more than 10 times longer than broad; presence of single basal inflation, lateral wall more or less parallel basal isthmus swollen, apex truncate, wall smooth.

L. 274 μm, W. 26 μm, Isth. 27 μm.

Field No. 32.

Holotype : No. PM 32, Oct. 28, 2000, Birshingha, Bankura, Green filaments & some small algal patch attached on the aquatic grass stem (*Scirpus* sp.) (pH 6, Temp. 25°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is close to *Pl. subcoronulatum* (Turner) West & West but differs from it in i) wall without punctae ii) number of tubercles 6-7 iii) apex not bulbous – swollen iv) isthmus regions inflated. This species has been named after Turner the greatest contributor on Indian desmids.

29. **Pl. wolleanum** (Turner) Croasdale var. *bankurii* var. nov.

[Plate XI, Fig. 3]

Cells elongate, more than 10 times longer than broad; presence of single basal inflation, apex gradually tapered, apex truncate margins; slightly inflated, with more dense on fine hairs.


Field No. 44.

Holotype : No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus* sp.) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present variety differs from the type in having i) presence of distinct basal swelling ii) margin not concave rather slightly inflated iii) hairs more dense and fine iv) punctae on the vertical cell wall.

**XXI: Haploetaenium Bando 1988**

Cells straight, slender, more than 8 times longer than broad; shallow median incision, pole truncate, apices without tubercles; chloroplast single, axial, pyrenoid many in linear pattern.
Artificial key to the taxa described

1. Cells more than 290 \( \mu \text{m} \) long
   2. Cells more than 20 (29) times longer than broad, wall punctate... ... ... ... ... ... ... ... ... ... ... ...(6) *H. minutum* var. *punctatum*
   2. Cells less than 20 times (11 times) longer than broad, wall smooth... ... ... ... ... ... ... ... ... ... ... ... ...(7) *H. rectum* var. *foersteri* f. *indicum* f. nov.

1. Cell less than 290 \( \mu \text{m} \) long.
   3. Semi cells gradually attenuated to the apex
      4. Median constriction evident
         5. Wall with distinct punctae... ... ... ... ... ... ... ... ... ... ... ... ... ... (1) *H. bankurensis* sp. nov.
         5. Wall smooth
            6. Cells above 20 (26) times longer than broad... ... ... ... ... ... ... ... ... ... ... ... ... ... (5) *H. minutum* var. *excavatum*
            6. Cells less than 20 (17) times) longer than broad... ... ... ... ... ... ... ... ... ... ... ... ... ... (3) *H. indentatum* var. *latius*
      4. Median constriction negligible... ... ... ... ... ... ... ... ... ... ... ... ... ... ... (2) *H. bourrellyi*
         3. Semi cells with almost parallel sides... ... ... ... ... ... ... ... ... ... ... ... ... ... (4) *H. indicum* sp. nov.

1. *H. bankurensis* sp. nov.
   [Plate XII, Fig. 17]
   Cell cylindrical, slightly curved, 14 times longer than broad; slight basal inflation, semi cells gradually attenuated having single axial chloroplast with central chain of pyrenoid, cell wall with minute pore.
   L. 140 \( \mu \text{m} \), W. 9-10 \( \mu \text{m} \), W. at apex 6-7 \( \mu \text{m} \), lsth. 8-9 \( \mu \text{m} \).
   Field No. 364.
   Holotype: No. PM 364, Oct. 17, 2001, Bishnupur, Bankura, Green filament with some algal mass attached on the aquatic stem of *Jussiaea repens*. (pH 6, Temp. 33\(^{\circ}\)C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
   The present new species is close in morphology to *H. bourrellyi* (Grönlbl. et. Scott) Bando but differs from it in having i) apex not retuse ii) presence of distinct punctation on the wall.
2. *H. bourrellyi* (Grönbl. et. Scott) Bando

Bando 1988, p. 26, pl. 14, figs. 4-5, pl. 17, figs. 1-3.

[Plate XII, Fig. 15]

Cells cylindrical; elongated gradually tapering, basal inflation very small, median constriction very slight, chloroplast single with central row of 12 pyrenoids.

L. 138 μm, W. 6-7 μm, W. at apex 4 μm.

The present specimen is smaller than the type.

Field No. 190.

Distribution: Probably this is the first record of the species from India.

3. *H. indentatum* Kouwets var. latius

Kouwets 1991, p. 389, pl. 2, figs. 8-10

[Plate XII, Fig. 16]

Cell cylindrical; not tapered gradually, slight basal inflation present, pole truncate, pyrenoid in central row.

L. 138 μm, W. 7-9 μm, W. at apex 4-5 μm, Isth. 6-7 μm.

The present specimen is very close in morphology to *H. indentatum* Kouwets although it is smaller.

Field No. 364.

Distribution: Probably this is the first record of the variety from India.

4. *H. indicum* sp. nov.

[Plate XII, Fig. 12]

Cells almost cylindrical; 18 times longer than broad, with a distinct basal inflation & gradually tapering almost parallel, apex flat truncate apex.

L. 180 μm, W. 9 μm, W. at apex 6 μm, Isth. 6-7 μm.

Field No. 760.

Holotype: No. PM 760, Dec. 12, 2001, Bishnupur, Bankura, Deep green and brown colour assemblages lodged on floating *Utricularia* (pH 5.5, Temp. 23°C).

Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present species is close in shape and size to *H. minutum* (Ralfs.) Bando var. gracile (Wille) Bando but differs from it, in following characters i) distinct basal inflation and gradually tapering semi cells ii) apex flatly truncate. It is also similar to *H. rectum* (Delp.) Bando var. *rectum* but differs from it in size apex
and nature of wall. *Haploetaenium minutum* (Ralfs.) Bando var. *groenbladii* (Croasd.) G.H. Tom & W.W. Kow. has also distinct basal inflation but size and nature of apices are much different.


Prescott et al. 1975, p. 123, pl. XXXIX, figs. 7-8 as *Pleurotaenium minutum* var. *excavatum* Scott et Grönblad

[Plate XII, Fig. 14, Plate XVIII, Fig. 11]

Cell cylindrical; slightly bend in the mid region, 27 times longer than broad, no basal inflation, semi cells gradually tapered, apex truncate.
L. 154-158 μm, W. 6-10 μm, W at apex 4-5 μm.
Field No. 1054.

As the species *Pleurotaenium minutum* has been transferred to *Haploetaenium minutum*, the following variety is transferred to the same genus i.e. *Haploetaenium* Bando.

Distribution: Probably this is the first record of the variety from India.

6. *H. minutum* var. *punctatum* var. nov.

[Plate XII, Fig. 13]

Cell cylindrical, 29 times longer than broad; distinct basal inflation present, sides more or less parallel, apex truncate, wall with minute pore.
L. 290 μm, W. 10 μm, W at apex 6.5 μm, lsth. 9 μm.
Field No. 190.

Holotype: No. PM 190, Sept. 11, 2001, Bishnupur, Bankura, Green and whitish colour patch attached on *Hydrilla verticillata* (pH 6, Temp. 30°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is close in morphology to *H. minutum* (Ralfs) Bando *elongatum* (W. West) Bando but differs in having i) distinct punctae on wall ii) apex truncate iii) basal inflation distinct.


[Plate XII, Fig. 11]

Cells cylindrical; wider, 10 times longer than broad with slight basal inflation, poles with thickening; wall smooth.
L. 293 μm, W. 15-28 μm, lsth. 26 μm.
Field No. 32.
Holotype: No. PM 32, Oct. 28, 2000, Birshingha, Bankura, Green filaments & some small algal patch attached on the aquatic grass stem (Scirpus sp.) (pH 6, Temp. 25°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present form is similar to the typical except the thickening at poles, absence of punctae and broader cells.

**XXII: Docidium de Brébisson 1844**

Cells straight, cylindric, more than 8 times longer than broad; slightly constricted in the midregion, apex usually truncate, rounded; cell wall smooth, chloroplast axial with irregular longitudinal ridges, pyrenoids many.

**Artificial key to the taxa described**

1. Cells longer, 195-220 µm long, 11-12 µm width .... (1) *D. baculum* var. *baculum*
2. Cells shorter, 165 µm long, 9 µm width .... .... (2) *D. baculum* var. *gracillimum*

1. *D. baculum* Brébisson var. *baculum*

Prescott *et al*. 1975, p. 102, pl. 37, figs. 1-4; Dillard 1990, p. 122, pl. 42, fig. 1.

[Plate XII, Fig. 9, Plate XIX, Fig. 1]

Cell cylindric; 16 times longer than wide, apices smooth, rounded truncate; cell wall smooth, semicell bases with single inflation.
L. 178-192 µm, W. 10-16 µm, W. at apex 7-8 µm, Isth. 7-8 µm.
Field No. 536.
Distribution: Karnataka (Gurudeva *et al* 1983), This is the new record of the species from West Bengal.

2. *D. baculum* var. *gracillimum* Borge

Krieger 1937, p. 380, pl. 38, fig. 8.

[Plate XII, Fig. 10]

Cell cylindrical; 18 times longer than broad, poles truncate, semicell bases with single inflation distinct basal.
L. 165 µm, W. 9 µm, W. at apex 6-7 µm, Isth. 8 µm.
Field No. 536.
Distribution: Probably this is the first record of the variety from India.
XXIII: *Streptonema* Wallich 1860

Filaments are composed of large cells, each with a deep median constriction; the cells are joined by three slender apical appendages, triangular in end view; single stellate chloroplast in each lobe.

*S. trilobatum* Wallich

Scott & Prescott 1961, p. 125, pl. 63, figs. 10-16; Ling & Tyler 1986, p. 54, pl. 9, figs. 31-33.

Filaments are composed of large cells, each with a deep median constriction. The cells are joined by three slender apical appendages; zygospore elliptical; without ornamentation.

Field No. 1116.
Distribution: West Bengal (Turner 1892).

XXIV: *Hyalotheca* Ehrenberg (1840) 1841

The cells are subcylindric with slightly convex lateral margins, cells are united to form long filamentous colonies; apices broadly truncate; chloroplast axile one in each semicell, usually with a central pyrenoid.

**Artificial key to the taxa described**

1. Cells constricted in the middle
   2. Cells as long as broad or longer ... ... ... ... ... ... (3) *H. dissiliens* var. *tatrica*
   2. Cells as long as broad or broader
      3. Cells with small basal inflations ... ... ... ... ... (2) *H. dissiliens* f. *bidentula*
      3. Cells without basal inflations ... ... ... ... ... (1) *H. dissiliens* var. *dissiliens*
1. Cells not constricted in the middle ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... ... (4) *H. mucosa*

1. *H. dissiliens* (Smith) Brébisson ex Ralfs var. *dissiliens*

Brébisson, 1848, p. 51, pl. 1, fig. 1; Dillard 1993, p. 129, pl. 38, fig. 4.

[Plate XII, Fig. 20, Plate XIX, Fig. 3]

Cells quadrangular; indistinctly constricted, apices broadly truncate, single axial chloroplast in each semicell.
L. 11-26 μm, W. 14-31 μm.
Field No. 44.
Distribution: Probably this is the first record of the species from India.

2. *H. dissiliens f. bidentula* (Nordst) Boldt.

Croasdale et al. 1983, p. 28, pl. 460, fig. 13.

[Plate XII, Fig. 18]

Cells quadrangular; provided with small inflations at the base of the semi cells, poles nearly flat; wall smooth.

L. 15-21 μm, W. 20-23 μm, Isth. 16-19 μm.
Field No. 744.
Distribution: Probably this is the first record of the form from India.

3. *H. dissiliens* var. *tatrica* Raciborski

Raciborski 1885, p. 64, pl. 14, fig. 5; Croasdale et al. 1983, p. 29, pl. 461, fig. 4.

[Plate XII, Fig. 19, Plate XIX, Fig. 2]

Cells nearly as broad as long, distinctly constricted in the middle, apex flat.

L. 11-26 μm, W. 11-16 μm, Isth. 11-12 μm.
The present specimen is smaller than the type in every respect.
Field No. 44.
Distribution: Probably this is the first record of the variety from India.

4. *H. mucosa* (Mertens) Ehrenberg

Croasdale et al. 1983, p. 30, pl. 461, figs. 6-8.

[Plate XII, Fig. 21]

Cells rectangular; slightly or no constriction at the middle, apical region of each semicell showing slightly constriction, transverse series of tiny granules just beneath the apices, apices broad and truncate mucilage strand arises transversely.

L. 12-16 μm, W. 9-11 μm, Mucilage strand 19-20 μm long.
Field No. 1152.
Distribution: Probably this is the first record of the species from India.

**XXV : Spondylosium de Brébisson 1844**

Cells usually small, flattened and often deeply constricted; semi cells elliptic to oblong cells united into filaments; apices without granules or processes, often broadly truncate, chloroplast axile usually with a single pyrenoid.
**Artificial key to the taxa described**

1. Apex broad with an abrupt median depression  
   2. Lateral margins of semi cells evenly truncate,  
      sinus U-shaped ...................................................... (5) *S. tetragonum*  
   2. Lateral margins of semi cells rounded, sinus V-shaped ... ... ... (3) *S. planum*  
1. Apex elevated, not broad  
   3. Cell less than 10 μm long. ... ... ... ... ... ... ... ... (4) *S. pygmaeum* var. *monile*  
   3. Cell greater than 10 μm long  
      4. Cells elliptic, broader than long ... ... ... ... ... ... ... ... ... (1) *S. ellipticum*  
      4. Cells triangular, longer than broad ... ... ... ... ... ... ... ... ... (2) *S. javanicum*

1. *S. ellipticum* West et West  
   West et West 1902, p. 43, pl. 2, fig. 21; Croasdale et al. 1983, p. 18, pl. 459, figs. 1,2.  
   [Plate XIII, Fig. 5]  
   Cells in twisted filaments, without mucilaginous sheath elliptic, deeply constricted in the mid region, sinus open, apices convex; chloroplast axile with central pyrenoid.  
   L. 12-194 μm, W. 17-19 μm, 1sth. 7-8 μm. Th. 10-11μm.  
   The present specimen is smaller than the type.  
   Field No. 1029.  
   Distribution: Uttar Pradesh (Vedajanani and Sarma 1978)  

2. *S. javanicum* (Gutw.) Grönlblad  
   Croasdale et al. 1983, p. 19, pl. 457, figs. 14, 15; Dillard 1993, p. 125, pl. 38, fig. 2.  
   [Plate XIII, Fig. 4, Plate XIX, Fig. 5]  
   Cells quadrangular; deeply constricted, sinus open, apex rounded, chloroplast axial with central pyrenoid.  
   L. 21-52 μm, W. 22-48 μm, 1sth. 6-13 μm.  
   The end view in this specimen is quadrangular like *S. javanicum* var. *floridae*  
   Scott et Grönlblad but other feature are similar to the type. Therefore it has been treated as *S. javanicum*  
   Field No. 44, 1054.  
   Distribution: Probably this is the first record of the species from India.
3. *S. planum* (Wolle) West et West

West et West 1912, p. 430, pl. 19, figs. 5, 8; Croasdale *et al.* 1983, p. 21, pl. 456, figs. 6, 6a. 7.

[Plate XIII, Fig. 2]

Cells subquadrangular; deeply constricted, apex flat, cell wall smooth.
L. 11-16 μm, W. 11-25 μm, Isth. 6 μm, Th. 7-8.
Field No. 399.
Distribution: Bihar (Sinha and Mishra 1967), Kerala (Gurudeva *et al.* 1983), Tamil Nadu (Bharati and Pai 1972), This is the new record of the species from West Bengal.

4. *S. pygmaeum* var. *monile* (Turn.) West, West et Carter

West, West et Carter 1923, p. 221, pl. 160, figs. 20, 21; Croasdale *et al.* 1983, p. 25, pl. 456, figs. 5, 5a.

[Plate XIII, Fig. 3]

Cells relatively longer than the typical, semiglobular, slightly constricted in the middle, apex rounded; chloroplast 2 in each cell.
L. 7-8 μm, W. 4-5 μm, Isth. 3 μm.
Field No. 44.
Distribution: Probably this is the first record of the variety from India.

5. *S. tetragonum* West

West et West 1892, p. 115, pl. 19, fig. 2; Croasdale *et al.* 1983, p. 26, pl. 458, figs. 6-8.

[Plate XIII, Fig. 1]

Cells little longer than broad; slightly constricted, apices rounded. Chloroplast single in each cell.
L. 8-10 μm, W. 7-9 μm, Isth. 4-6 μm, Th. 5-7 μm.
Field No. 895.
Distribution: Probably this is the first record of the species from India.

**XXVI: Groenbladia Teiling 1952**

Cells cylindrical, 2-9 times longer than broad; with very shallow median constriction united end to end to form short filaments, semi cells more or less swollen at their base, chloroplast single per cell, axile, laminate with 1-8 pyrenoids.
Artificial key to the taxa described

1. Semicell globose-ovate, sinus shallow .............. (1) G. undulata var. undulata

1. Semi cells triangular, sinus not shallow .............. (2) G. undulata var. kriegeri

1. G. undulata (Nordstedt) Forster var. undulata

Forster 1972, p. 578, pl. 26, fig. 10; Lenzenweger 1997, P. 141, pl. 43, fig. 6; Dillard 1993, p. 132, pl. 39, fig. 9; Croasdale et al. 1983, p. 34, pl. 462, figs. 17, 18.

[Plate XIII, Fig. 7, Plate XIX, Fig. 7]

Semicell globose, ovate or cylindrical, 1.5 times longer than wide, apices flat and truncate; chloroplast axial with 1-2 pyrenoids.
L. 9-16 μm, W. 7-10 μm, Isth. 6-7 μm, Apex 5-6 μm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

2. G. undulata var. kriegeri Forster

Forster 1972, p. 578, pl. 26, fig. 10; Croasdale et al. 1983, p. 36, pl. 462, figs. 17, 18.

[Plate XIII, Fig. 6]

Semicell triangular, less than 1.5 times longer than wide, apices flat, chloroplast axial, pyrenoids 1-2.
L. 12-14 μm, W. 9-11 μm, Isth. 6-7 μm, Apex 7 μm.

Field No. 44.

Distribution: Probably this is the first record of the variety from India.

XXVII: Teilingia Bourrelly 1964

Cells are more or less flattened, elliptic or quadrangular; united to form filaments; well-marked median isthmus; cells bearing at the apex near each outer margin a pair of small granules; cell wall smooth or bearing granules.

Artificial key to the taxa described

1. Lateral margins of semi cells rounded

2. Lateral margins of semicell smooth

3. Cells as long as broad or longer .............. (1) T. excavata var. excavata

3. Cells as long as broad or broader

4. Sinus broadly V-shaped .............. (3) T. excavata var. subquadrata

4. Sinus broadly U-shaped .............. (4) T. exigua
2. Lateral Margins of semi cells with granules or spines

5. Lateral margins with granules ................................ (5) T. granulata

5. Lateral margins with spines ................................ (2) T. excavata var. echinata var. nov.

1. Lateral margins of semi cells truncate ................................ (6) T. wallichi var. anglica

1. T. excavata (Ralfs) Bourrelly var. excavata

Bourrelly 1964, p. 190, fig. 11; Dillard 1993, p. 119, pl. 34, fig. 1.

[Plate XIII, Fig. 8]

Semicell oblong-elliptic, sinus deep, apices rounded or flattened, bearing 2 small granule-like connecting processes.

L. 6-10 μm, W. 6-9 μm, Isth. 3-4 μm.

Field No. 536.

Distribution: Probably this is the first record of the species from India.

2. T. excavata var. echinata var. nov.

[Plate XIII, Fig. 13]

Cells are elliptic, sinus deep, apices rounded, bearing 2 granules. Cells bear large spine.

L. 8-10 μm, W. 8-9 μm, Isth. 4-5 μm, Spine 7-8 μm.

Field No. 1124.

Holotype: No. PM 1124, Jan. 20, 2003, Bishnupur, Bankura, Brown colour small algal patch attached on rotting Hydrilla verticillata (pH 6, Temp. 16°C).

Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen differs from the T. excavata (West et West) Stein in having larger spines and are irregularly arrange.

3. T. excavata var. subquadrata (West et West) Stein.

Croasdale et al. 1983, p. 8, pl. 450, figs. 6-10.

[Plate XIII, Fig. 9]

Cells as long as broad, more deep constricted, sinus narrow, pores rounded.

L. 9-11 μm, W. 10-12 μm, Isth. 4-5 μm.

Present specimen is smaller than the T. excavata (West et West) Stein.

Field No. 1124.

Distribution: Probably this is the first record of the variety from India.
4. *T. exigua* (Turn.) Bourrelly

Bourrelly 1964, p. 190; Croasdale et al. 1983, p. 9, pl. 451, figs. 1,2.

[Plate XIII, Fig. 10]

Semi cells elliptic; sinus widely open, not much constricted, wall smooth, poles rounded.

L. 11-15 µm, W. 12-15 µm, Isth. 3-5 µm.

Field No. 44.

Distribution: Probably this is the first record of the species from India.

5. *T. granulata* (Roy et Biss.) Bourrelly

Bourrelly 1964, p. 190; Prescott et al. 1983, p. 9, pl. 451, figs. 3-5.

[Plate XIII, Fig. 12, Plate XIX, Fig. 12]

Cells rounded, deeply incised; the sinus widely open, lateral margins rounded bearing a cluster of small granules in lateral view appearing as 6 granules & apices with 2 granules.

L. 11-26 µm, W. 11-26 µm, Isth. 5-8 µm, Th. 5-8 µm.

Field No. 1054.

Distribution: Probably this is the first record of the species from India.

6. *T. wallichi* (Jacobs.) Bourrelly var. anglica (West et West) Forster.

Forster 1972, p. 579, pl. 27, fig. 9; Bourrelly, 1964, p. 190; Prescott et al. 1983, p. 10, pl. 451, figs. 9-11.

[Plate XIII, Fig. 11, Plate XIX, Fig. 13]

Semi cells oblong, sinus deep U-shaped, 2-3 granules on the lateral margins and with 4-8 other granules scattered sparsely on the semicell.

L. 11-18 µm, W. 9-18 µm, Isth. 5-7 µm, Th. 4-6 µm.

Field No. 1124.

Distribution: Probably this is the first record of the variety from India.

XXVIII: *Onychonema* Wallich 1860

Cells small, compressed deeply constricted, with a narrow sinus; semi cells elliptic with stout lateral spines; wall smooth or in some plants showing pores; each semicell contain a single axial, laminate chloroplast with one pyrenoid.
Artificial key to the taxa described

1. Lateral margin of semi cells rounded ........................................ (1) *O. filiforme*

1. Lateral margins of the semi cells bearing a spine

2. Margin of the apex flat or slightly convex

3. Lateral spines long ................................................................. (2) *O. laeve* var. *laeve*

3. Lateral spines very short ....................................................... (4) *O. laeve* var. *micrancanthum*

2. Margin of apex elevated in the mid region or undulate

4. Apex with one apical hump .............................................................. (3) *O. laeve* var. *latum*

4. Apex without any hump

5. Wall smooth

6. Lateral margins with stout spines .......................................... (8) *O. uncinatum*

6. Lateral angles with papilla like spines ....................................... (7) *O. uncinatum* var. *americanum*

5. Wall with pores

7. Cells quadrangular, isthmus region is wider (7 μm)

........................................................................................................................................................................ (6) *O. uncinatum* f. *indicum* f. nov.

7. Cells elliptic, isthmus region is shorter (3 μm)

........................................................................................................................................................................ (5) *O. pseudofiliforme*


Croasdale et al. 1983, p. 13, pl. 452, figs. 1-5.

[Plate XIII, Fig. 21]

Cells elliptic; deeply constricted, sinus narrow, apex rounded, apical processes about as long as the semicell. Zygospore globose with sharp spine.

L. 11-15 μm, W. 10-17 μm, Isth. 4-7 μm, Th. 6, Zygospore dia. 33 μm.

Field No. 536, 1124.

Distribution: Probably this is the first record of the species from India.

2. *O. laeve* Nordstedt. var. *laeve*

Nordstedt 1870, p. 206, pl. 3, fig. 34; Croasdale et al. 1983, p. 14, pl. 452, figs. 6-10.

[Plate XIII, Fig. 17, Plate XIX, Fig. 9]

Cells broader than long, deeply constricted, semi cells oblong, apical processes about as long as the spines.

L. csp. 22-24 μm, ssp. 15-17 μm, W. csp. 32-36 μm, ssp. 22-28 μm, Isth. 3-5 μm.
Field No. 190.
Distribution: Kerala (Gurudeva et al. 1983), This is the new record of the variety from West Bengal.

3. *O. laeve* var. *latum* West et West

West et West 1896, p. 232, pl. 12, fig. 18; Croasdale et al. 1983, p. 14, pl. 453, figs. 1-6.

[Plate XIII, Fig. 18, Plate XXII, Fig. 6]

Cells compressed, subangular, apices slightly elevated, apical processes distinct. Zygospore globose with warts and long spine.

L. csp. 20-24 μm, ssp. 14-18 μm, lsth. 3-6 μm, csp. 30 μm, ssp. 22 μm, Apex 14 μm.

Field No. 536, 1116.
Distribution: Karnataka (Hegde and Bharati 1983), Tamil Nadu (Bharati and Pai 1972), This is the new record of the variety from West Bengal.


Nordstedt 1880, p. 16, pl. 1, figs. 2a-2f; Croasdale et al. 1983, p. 14, pl. 453, figs. 7-9.

[Plate XIII, Fig. 19]

Cells with apices flattened and lateral spines very short, median constriction very deep, sinus linear. Zygospore globose with long spine.

L. csp. 17-19 μm, ssp. 15-17 μm, W. csp. 21-24 μm, ssp. 18-21 μm, lsth. 4-6 μm, Zygospore csp. 30 μm, ssp. 18 μm.

Field No. 397, 536,
Distribution: Probably this is the first record of the variety from India.

5. *O. pseudofiliforme* sp. nov.

[Plate XIII, Fig. 16]

Cells elliptic; deeply constricted, sinus narrow, apex rounded, lateral spines small, apical processes distinct the present of pore on wall.

L. 21 μm W.15 μm, lsth. 3 μm.

Field No. 536.

Holotype: No. PM 536, Nov. 15, 2001, Onda, Bankura, some algal filaments with some brown colour mass associated with *Scirpus* stem. (pH 6, Temp. 33.5°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present species resembles *O. filiforme* (Ehr.) Roy et Bisset in general appearance but differs from it in having short spines on the lateral walls. It also
resemble *O. uncinatum* Wallich var. *americanum* Scott et Grönblad but in the present specimen margins are not undulate and are distinctly convex.

6. *O. uncinatum* Wallich var. *uncinatum*

Wallich 1860, p. 195, pl. 8, figs. 7-11; Dillard 1993, p. 123, pl. 36, fig. 1.

[Plate XIII, Fig. 20]

Cells quadrangular; broader than long, the sinus deep, spines curved hook-like, lateral margin serrate, apical processes 2, terminal position having little swelling.

L. 19-21 µm, W. csp. 40-43 µm, ssp. 32-35 µm, Isth. 5-6 µm.

Present specimen is slightly larger than the type.

Field No. 1118.

Distribution: Probably this is the first record of the variety from India.

7. *O. uncinatum* var. *americanum* Scott et Grönblad

Wallich 1860, p. 195, pl. 8, figs. 7-11; Scott et Grönblad 1957, p. 49, pl. 35, fig. 9; Croasdale et al. 1983, p. 15, pl. 454, fig. 3.

[Plate XIII, Fig. 14]

A form differing from typical, in the more convex apex, the more rounded lateral margins, spines are short, median constriction deep.

L. csp. 25-27µm, ssp. 16-18 µm, W. csp. 25-29 µm, ssp. 21 µm, Isth. 6 µm.

Field No. 364.

Distribution: Probably this is the first record of the variety from India.


[Plate XIII, Fig. 15]

Cells quadrangular; median constriction deep, lateral spines small, divergent, wall with punctae.

L. ssp. 20 µm, W. csp. 28 µm, ssp. 20 µm, Isth. 7 µm.

Field No. 364.

Holotype: No. PM 364, Oct. 17, 2001, Bishnupur, Bankura, Green filament with some algal mass attached on the aquatic stem of *Jussiaea repens*. (pH 6, Temp. 33°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen differs from the typical due to i) vegetative cell much smaller ii) regularly arranged pores.
Systematic part

**XXIX: Sphaerozosma Corda 1835**

Cells small as long as broad, deeply constricted; semi cells elliptic, oblong, bearing two short rod like apical processes; wall smooth, chloroplast axile with central pyrenoid; cells united in filaments.

*S. vertebratum* (Brébisson) Ralfs.

Croasdale et al. 1983, p. 3, pl. 448, figs. 6-9, pl. 449, fig. 1; Dillard 1993, p. 118, pl. 33. fig. 4.

[Plate XIII, Fig. 22]

Cells small as long as broad; compressed, deeply constricted, semi cells sub-reniform, dorsal margin convex, sinus open; apical processes two, short rod-like; wall smooth.

L. 14-16 μm, W. 17-19 μm, lsth. 4-5 μm

Field No. 1122.

Distribution: Probably this is the first record of the species from India.

**XXX: Desmidium Agardh 1824**

Cells joined end to end in unbranched filaments, cells broader than long and never with a deep median constriction, cells triangular or quadrangular, poles of adjoining cells flattened; cell wall smooth, semi cells with single axial chloroplast and single pyrenoid.

**Artificial key to the taxa described**

1. Cells as long as broad or longer ... ... ... ........ ....... (3) *D. baileyi* f. *tetragonum*

1. Cells broader than long

2. Cells attached to each other by short processes

3. Cells more than 2 times broader than long

4. Cells with moderate or deep median constriction

5. Lateral angles of semi cells

   broadly rounded ... ... ... ... ... (11) *D. swartzii* var. *amblyodon*

5. Lateral angles of semi cells obliquely truncate ... (10) *D. swartzii* var. *swartzii*

4. Cells with shallow (except *D. swartzii* f. *tylari* f. nov.)

   median constriction
6. Lateral margins rounded

7. Apex broadly rounded ... ... ... (12) *D. swartzii* var. *bicristatum*

7. Apex flat or slightly elevated ... ... ... (9) *D. suboccidentale*

6. Lateral margins pointed or with several lobes

8. Cells having several crenulation

9. zygospore half ellipsoid ... ... ... (13) *D. swartzii* var. *indicum* var. nov.

9. zygospore globose .................. (6) *D. pseudostreptonema*

8. Cells without crenulation ... ... ... (14) *D. swartzii* f. *tylari* f. nov.

3. Cells less than 2 times broader than long

10. Lateral margin nearly parallel ... ... ... (4) *D. baileyi* var. *wallichii*

10. Lateral margins with distinct notch

11. Sinus shallow ..................... (1) *D. aptogonum* var. *aptogonum*

11. Sinus deep ........................... (2) *D. aptogonum* var. *acutius*.

2. Cells not attached to each other by short processes

12. Cells with narrow median constriction ... ... ... ... ... (8) *D. quadratum*

12. Cells with deep median constriction

13. Apex broad flat, sinus V shaped opening ...... (7) *D. quadrangulatum*

13. Apex rounded, sinus U shaped opening ... ... ... ... ... (5) *D. bengalicum*

1. *D. aptogonum* Brébisson var. *aptogonum*

Croasdale *et al.* 1983, p. 39, pl. 463, figs. 7-8; Dillard 1993, p. 136, pl. 41, fig. 6.

[Plate XIV, Fig. 5]

Cells wider than long, slightly constricted; semi cells with a small basal inflation on each side of the isthmus, the apices wide and concave in the midregion.


Field No. 44, 1122.

Distribution: Probably this is the first record of the species from India.

2. *D. aptogonum* var. *acutius* Nordstedt

Nordstedt 1878 p. 11, pl. 1, figs. 21,22; Croasdale *et al.* 1983, p. 39, pl. 464, figs. 1-3.

[Plate XIII, Fig. 24]
Cells wider than long, slightly constricted; the apices with slightly wide, midregion concave, differing from the typical in having the lateral angles slightly retuse.


The present specimen is smaller than the type.

Field No. 44, 190.

Distribution: Probably this is the first record of the variety from India.

3. *D. baileyi* (Ralfs) Nordstedt var. *tetragonum* Nordstedt

Ling & Tyler 1986, p. 25, pl. 9, figs. 11-13.

Cells quadrangular; median portion almost not constricted, present of an elliptic space in between two; apex convex with 4 arms. Zygospores semieliptical, smooth wall.


Field No. 44, 1124.

Distribution: Madhya Pradesh (Agarkar 1971), Uttar Pradesh (Pandey and Pandey 1980), This is the new record of the variety from West Bengal.

4. *D. baileyi* var. *wallichii* Turner (1892)

Turner 1892, p. 149, Pl. XIX, Fig. 4.

Cells medium sized, about as long as broad; faintly constricted, semi cells rectangular, presence of connecting processes.

L. 15-18 μm, W. 18-20 μm.

Field No. 44.

Distribution: Probably this is the first record of the variety from India.

5. *D. bengalicum* Turner

Turner 1892, p. 147, pl. 19, figs. 1-3.

Cells wider than long; slightly constricted, sinus of diverse shape, apices convex.

L. 16-31 μm, W. 29-68 μm, Isth. 26-56 μm.

Field No. 32.
Distribution: West Bengal (Wallich 1860 as *D. swartzii* var. Wallich; Turner 1892), Karnataka (Hegde and Bharati 1980).

6. *D. pseudostreptonema* West et West

West et West 1902, p. 193, pl. 22, figs. 35-37; Croasdale *et al.* 1983, p. 47, pl. 466, figs. 12-16.

[Plate XIII, Fig. 27]

Cells 2 times as broad as long, sinus open, apices rounded; Zygospores elliptical, smooth walled.


Present specimen is slightly differ in their apices and lateral lobes with crenulation, size is also larger.

Field No. 44.

Distribution: Karnataka (Gurudeva *et al.* 1983), Maharashtra (Ashtekar and Kamat 1979), This is the new record of the species from West Bengal.

7. *D. quadrangulatum* Ralfs

Ralfs 1845 p. 405, pl. 12, fig. 9; Croasdale *et al.* 1983, p. 47, pl. 467, figs. 2-3.

[Plate XIV, Fig. 8]

Cells quadrangular, constricted, sinus open; semi cells short, basal angel rounded, apices broad and truncate.


Field No. 44.

Distribution: Probably this is the first record of the species from India.

8. *D. quadratum* Nordstedt

Nordstedt 1873 p. 49, pl. 1, fig. 24; Croasdale *et al.* 1983, p. 48, pl. 467, figs. 4-7; Dillard 1993, p. 141, pl. 44, fig. 1.

[Plate XIV, Fig. 7]

Cells wider than long, slightly constricted; basal angles rounded, apices wide and truncate.

L. 12 µm, W. 21 µm, Isth. 15-17 µm, Apex 9 µm.

Present specimen is smaller than the type.

Field No. 744.

Distribution: Karnataka (Gurudeva *et al.* 1983), Tamil Nadu (Bharati and Pai 1972), This is the new record of the species from West Bengal.
9. *D. suboccurrente* Scott & Prescott

Scott & Prescott 1958, p. 125, pl. 63, fig. 7; Ling & Tyler 1986, p. 25, pl. 9, fig. 5.

[Plate XIV, Fig. 6]

Cells wider than long, slightly constricted, apex wide and slightly concave.
L. 16 μm, W. 31 μm, Isth. 26-27 μm.

Field No. 32.

Distribution: Madhya Pradesh (Agarkar 1971), Uttar Pradesh (Pandey and Pandey 1980). This is the new record of the species from West Bengal.

10. *D. swartzii* (C.A. Ag.) C.A. Agardh var. *swartzii*

Scott & Prescott 1958, p. 125, pl. 63, fig. 8; Croasdale *et al.* 1983, p. 48, pl. 467, fig. 9, pl. 468, figs. 1-2; Dillard 1993, p. 141, pl. 41, fig. 1.

[Plate XIV, Fig. 1, Plate XXII, Fig. 2]

Cells wider than long, constricted, sinus open, apices broadly truncate; zygospores elliptical, smooth walled.
L. 15-43 μm, W. 36-152 μm, Zygospore dia. 18-70 μm.

Field No. 32, 44.

Distribution: Very common.

11. *D. swartzii* var. *amblyodon* (ltz.) Rabenhorst

Croasdale *et al.* 1983 p. 49, pl. 468, figs. 5-10; Dillard 1993, p. 142, pl. 41, fig. 4.

[Plate XVI, Fig. 4]

Cells width is greater than long, lateral angles are distinctly and broadly rounded; zygospores elliptical, thick and smooth walled.

Field No. 744.

Distribution: Probably this is the first record of the variety from India.

12. *D. swartzii* var. *bicristatum* Scott et Prescott

Scott & Prescott *et al.* 1958, p. 125, pl. 63, fig. 9.

[Plate XVI, Fig. 3]

Cells broader than long, median region with slightly or no constriction, apex rounded, slightly convex.
L. 19-24 μm, W. 33 μm, Isth. 30 μm.
Field No. 744.
Distribution: Probably this is the first record of the variety from India.

13. *D. swartzii var. indicum var. nov.*

[Plate XVI, Fig. 2]

Cells broader than long, semi cells with crenulate margins, isthmus with deep constriction, zygospore half ellipsoid, brown in colour.


Field No. 44.

Holotype : No. PM 44, Nov. 19, 2000, Birshingha, Bankura, Orange yellow colour algal mass attached on aquatic grass (*Scirpus. Sp.*) (pH 5.5, Temp. 26°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present variety differs from all other varieties in i) much larger vegetative cells ii) much lobed semi cells iii) zygospore half ellipsoid.


[Plate XIII, Fig. 28]

Cells broader than long, lateral cell acute, isthmus with deep constriction, central region of the cells showing distinct junction, apices with slightly notch.

L. 15 µm, W. 27 µm, Isth. 12 µm.

Field No. 1160.

Holotype : No. PM 32, Oct. 28, 2000, Birshingha, Bankura, Green filaments & some small algal patch attached on the aquatic grass stem (*Scirpus sp.*) (pH 6, Temp. 25°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is similar to *D. swartzii* form Ling & Tyler in every respect except in smaller dimension.

XXXI : *Micrasterias Agardh ex Ralfs 1848*

Cells flat, strongly compressed; star like in front view, the median constriction is very deep; semi cells always incised; lateral lobes divided into lobules, having a single lobed chloroplast with many pyrenoids.
Artificial key to the taxa described

1. Polar lobe without horizontally furcated or accessory processes
2. Polar lobe very broad without a well marked median incision, lateral lobules horizontal
3. Angles of polar lobe extended laterally as far as the lateral lobes
   4. Lateral lobes tapering towards their extremities, terminating in 2 tooth, teeth horizontally directed ...(13) M. laticeps
   5. Width greater than length, upper lateral lobe not rectangular ... ...(26) M. zeylanica var. wallichiana
5. Length greater than width, upper lateral lobe distinctly rectangular ... ...(25) M. zeylanica var. rectangularis

3. Angles of polar lobe not extended as far as the lateral lobes
6. Apex flat or concave, margin entire
7. Polar lobe horizontally extended, extremities with two horizontally extended spine
   8. Sinus widely open, polar lobe horizontally directed ...(17) M. pinnatifida var. pinnatifida
   9. Cell wall with punctae throughout the body ...(5) M. ceratofera var. punctata
7. Polar lobe not horizontally extended, extremities with upwardly directed single spine.
9. Cell wall smooth ... ... ... ...(4) M. ceratofera var. ceratofera
6. Apex retuse, margin wavy
10. Lateral lobes gradually extended into two to three spines
11. Lateral lobes unequally divided into one long slender process and other stout short processes ...(24) M. tropica var. polonica
11. Lateral lobe otherwise
12. Wall with regularly arranged stout spines ... ...(21) M. tropica var. indica var. nov.
12. Wall with irregularly arranged granules and or spine

13. Polar lobe slender, lateral lobes
   with spines ... (22) *M. tropica* var. *kussamoensis*

13. Polar lobe stout, lateral lobes without spines

14. Arms of the polar lobes stout
   and short ... ... ... ... ... ... (23) *M. tropica* var. *lalbandhensis* var. nov.

14. Arms of polar lobe slender and long
   (20) *M. tropica* var. *bishnupurensis* var. nov.

10. Lateral lobes broad, not gradually
    extended into spines... ... ... ... ... (16) *M. moebii* var. *burmense*

2. Polar lobe with median incision of variable depth, lobules radially disposed

15. Lateral lobe divided not more than two times

16. Angles of polar lobe extended into long narrow
    processes and ending in short tooth

17. Laterai lobules very slender

18. Cell wall smooth... ... ... ... ... ... ... (1) *M. alata* var. *alata*

18. Cell wall with punctae ... ... ... ... ... (2) *M. alata* var. *punctata*

17. Lateral lobules stout

19. Incision shallow ultimate lobules
   as broad as long ... ... ... ... ... ... ... (6) *M. crux-melitensis*

19. Incision shallow ultimate lobules
   larger than broad... ... ... ... ... ... ... ... (19) *M. radians*

16. Angles of polar lobe not extended into long narrow
    process and ending in long tooth... ... ... ... (12) *M. johnsonii* f. *bispinata*

15. Upper portion of the lateral lobes divided more than two times

20. Cells square in outline, united by apical processes to form a filament

21. Semi cells with two large semi-ellipsoidal swelling at the
    base of the lateral lobes... ... ... ... (11) *M. foliacea* var. *quadrinflata*

21. Semi cells without such swelling on the lateral lobes

22. Cell wall smooth... ... ... ... ... ... ... (7) *M. foliacea* var. *foliacea*

22. Cell wall with punctae or spines

23. Cell wall with intermarginal spines
   and punctae ... ... ... (10) *M. foliacea* var. *punctata* var. nov.
23. Cell wall with punctae

24. Cells larger than broad ... ... ... (8) *M. foliacea* var. *elongata* f. *punctata* f. nov

24. Cells broader than long ... ... ... ... ... (9) *M. foliacea* var. *ornata* f. *punctata*

20. Cells more or less circular in outline, not united into a filament ... ... ... ... ... (3) *M. apiculata* var. *fimbriata*

1. Polar lobe horizontally furcated or with accessory processes

25. Semi cells with long cylindrical central protuberance ... ... ... ... (15) *M. mahabaleshwarensis* var. *surculifera*

25. Semi cells without long cylindrical central protuberance ... ... ... ... ... ... (14) *M. mahabaleshwarensis*

1. **M. alata** Wallich var. *alata*

   Wallich 1860, p. 279, pl. 13, fig. 11; Krieger 1939, p. 61, pl. 114, figs. 1-4; Prescott *et al.* 1977, p. 138, pl. CXII, figs. 3-8.

   [Plate XV, Fig. 14, Plate XX, Fig. 4]

   Cells longer than broad; sinus closed in inner quarter and then widely open, lateral lobes once divided, all divisions deep, lobules swollen at base & then abruptly tapering to tridentate extremities, polar lobe slender.


   Field No. 190.

   Distribution: Probably this is the first record of the species from India.

2. **M. alata** var. *punctata* var. *nov.*

   [Plate XV, Fig. 15]

   Similar to the typical but present specimen with distinct punctae on the wall.

   L. 156-167 μm, W. 133-144 μm, Isth. 18-19 μm, W. at apex 28-33 μm.

   Field No. 735.

   Holotype: No. PM 735, Dec. 10, 2001, Taldangra, Bankura, Deep orange colour mass attached on *Utricularia* (pH 6, Temp. 23°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.
The present variety differs from all the known varieties of *M. alata* having distinct punctae on the wall throughout.


Nordstedt 1888, p. 187, pl. 6, figs. 1, 2; Prescott *et al.* 1977, p. 142. pl. CXXII, figs. 1, 2; Dillard 1993, p. 83, pl. 27, fig. 2.

[Plate XV, Fig. 19, Plate XXI, Fig. 2]

Cells longer than broad, sinus closed; lateral lobes divided three times, lower later lobes narrower than the upper polar lobe, lacking the extra marginal spines on the apex; lower most lobule sometimes exerted; cell wall smooth.


Field No. 555.

Distribution: Andaman and Nikobar Island (Prasad and Misra 1992), Rajasthan (Patel and Rao 1975), Madhya Pradesh (Agarkar 1979), This is the new record of the variety from West Bengal.

4. *M. ceratofera* Joshua var. *ceratofera*

Scott & Prescott 1961, p. 48, pl. 15, figs. 2, 3, pl. 22, fig. 7; Islam, 1970, p. 919, pl. 10, fig. 9, pl. 21, fig. 1.

[Plate XV, Fig. 6, Plate XXI, Fig. 3]

Cells longer than broad, sinus deep and open; lateral lobes entire usually divided once, lobes smaller, swollen at base, deeply bidentate at the ends; the polar lobe normally exerted, strongly bidentate at the ends, spines long.

L. csp. 179-186 μm, ssp. 120-139 μm, W. csp. 104-109 μm, ssp. 76-80 μm, lsth. 15-16 μm.

The present specimen is smaller than the type.

Field No. 564.

Distribution: Probably this is the first record of the species from India.

5. *M. ceratofera* f. *punctata* Islam

Islam 1970, p. 919, pl. 10, fig. 10.

[Plate XV, Fig. 7]

The present specimen is the similar to the typical but it differs due to presence of distinct punctae throughout the wall.

L. csp. 195-201 μm, ssp. 144-149 μm, W. csp. 114-119 μm, ssp. 84-89 μm, lsth. 18-20 μm.

This is the first report of the taxon outside of Bangladesh.
Field No. 190.
Distribution: Probably this is the first record of the form from India.

6. *M. crux-melitensis* (Ehrenberg) Ralfs

Ralfs 1848, p. 73, pl. IX, fig. 3; Prescott *et al.* 1977, p. 148, pl. CXIII, fig. 1-3; Dillard 1993, p. 87, pl. 24, fig. 1.

[Plate XV, Fig. 16]

Cells a little longer than broad, very deeply constricted, sinus open, lateral lobes twice evenly divided; ends of lobules emarginate–bidentate, polar lobes sharply diverging, apex widely retuse.


Field No. 895.
Distribution: Karnataka (Gurudeva *et al* 1983), This is the new record of the species from West Bengal.

7. *M. foliacea* Bailey var. *foliacea*

Bailey (in Ralfs) 1848, p. 210, pl. XXXV, fig. 3; Turner 1892, p. 94, pl. VI, figs. 12-14; Dillard 1993, p. 91, pl. 26, fig. 4.

[Plate XV, Fig. 21, Plate XXI, Fig. 1]

Cells united in filaments by the interlocking of polar lobes; cells as long as the broad, sinus sub-linear, lateral lobes divided to the second or third order; lower lobes horizontal, upper & middle diverging with bidentate extremities, depressed portions of apex bearing 2 stout spines on each side, unequal in size.

L. 60-130 μm, W. 67-156 μm, Isth. 12-27 μm, W. at apex 36-59 μm, Th. 18-37 μm.

Field No. 32.
Distribution: Very Common.


[Plate XV, Fig. 22, Plate XXII, Fig. 4]

Cells similar to the typical but differs in length, breadth ratio, length is greater than width, lateral lobes divided two-three times, horizontal polar lobe much longer, depressed apex bearing two stout spines on each side; punctae present throughout the wall; zygospore globose with large spiny wall.

L. 81 μm, W. 69 μm, Isth. 11 μm, W. at apex 39 μm. Zygospore dia 48 μm, spine 19-22 μm.

Field No. 749.
Holotype: No. PM 749, Dec. 12, 2001, Ranibandh, Bankura, Blackish to brownish in colour assemblages lodged on *Utricularia stellaris* (pH 6, Temp. 22°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen differs from the type in having distinct punctae on the vegetative wall throughout.

9. *M. foliacea* var. *ornata* Nordstedt. f. *punctata*

Nordstedt (1869) 1870, p. 221, pl. 2, fig. 16; Scott & Prescott 1961, p. 48, pl. 20, fig. 5; Prescott *et al.* 1977, p. 159, pl. CXL, figs. 1, 2.

[Plate XV, Fig. 24]

Cells similar to the typical, but differs in their smaller spines on the upper margin of the upper lateral lobe near its base and the lower margin of the lower lateral lobes near the isthmus; the incision between the polar and lateral lobes usually more widely open; sinus deep.

L. 63-68 μm, W. 62-68 μm, Isth. 11-12 μm, W. at apex 31-33 μm.

The present specimen differs from the type in having distinct fine punctae on the wall.

Field No. 190.

Distribution: Probably this is the first record of the form from India.

10. *M. foliacea* var. *punctata* var. nov.

[Plate XV, Fig. 23]

Present specimen similar to the typical but differing in having distinct punctae throughout the body.

L. 60-64 μm, W. 70-78 μm, Isth. 14-16 μm, W. at apex 28-39 μm, Th. 15-19 μm.

Field No. 32.

Holotype: No. PM 32, Oct. 28, 2000, Birshingha, Bankura, Green filaments & some small algal patch attached on the aquatic grass stem (*Scirpus* sp.) (pH 6, Temp. 25°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

Krieger (1939) & Prescott *et al.* (1977) are of opinion that such forms should be included within the typical. Therefore they have not considered the cushgman’s *M. foliacea* var. *granulifera* (Cushman 1904, I.c.) We have investigated a large number of specimens and observed that punctuate & non-punctate forms are
quiet different and therefore subscribe to the view that they should not be treated as ecotypes, rather new variety.

11. *M. foliacea var. quadrinflata* Scott & Prescott

Scott & Prescott 1961, p. 48-49, pl. 15, figs. 5-8.

[Plate XV, Fig. 20]

Cells as long as broad, sinus deep, semi-cells with two large and prominent semi ellipsoidal hollow swelling at the base of the lateral lobes each bearing a long spine at the narrow end; four other long spines on present each semi cell.

L. 60-63 \( \mu \)m, W. 66-67 \( \mu \)m, lsth. 12-13 \( \mu \)m, W. at apex 39-40 \( \mu \)m.

Field No. 190.

Distribution: Probably this is the first record of the variety from India.

12. *M. johnsonii* West et West f. *bispinata* Prescott & Scott

Prescott & Scott. 1952, p. 238, pl. 3, fig. 2; Prescott et al. 1977, p. 161, pl. 3, fig. 2; Dillard 1993, p. 93, pl. 26, fig. 1.

[Plate XV, Fig. 18]

Cells longer than the broad; sinus deep and open, lateral lobes divided twice, lateral and polar lobe stouter, both having bidentate extremities. Different pattern of spine arrangement across the face of the semi cell.

L. 150-162 \( \mu \)m, W. 120-141 \( \mu \)m, lsth. 22-24 \( \mu \)m, W. at apex 38-48 \( \mu \)m.

The present specimen is smaller than the type.

Field No. 190.

Distribution: Probably this is the first record of the form from India.

13. *M. laticeps* var. Nordstedt

Nordstedt 1870, p. 220, pl. 2, fig. 14; Krieger 1939, p. 13, pl. 97, figs. 12, 13, pl. 98, fig. 1; Dillard 1993, p. 94, pl. 14, fig. 4.

[Plate XV, Fig. 1, Plate XX, Fig. 3]

Cells slightly longer than broad, sinus narrow, opening widely to the outside lateral lobes entire, horizontally extended ends terminating in two short teeth, polar lobe bent slightly downward and terminating in a tooth.

L. 112-115 \( \mu \)m, W. 123-126 \( \mu \)m, lsth. 13-14 \( \mu \)m, Th. 36-39 \( \mu \)m.

Field No. 1114.

Distribution: Probably this is the first record of this variety from India.

14. *M. mahabuleshwarensis* Hobson var. *mahabuleshwarensis*

Hobson 1863, p. 168, fig. 169; Prescott et al. 1977, p. 164, pl. CXLIII, figs. 1,2,4,5; Dillard 1993, p. 94, pl. 12, fig. 14.
[Plate XV, Fig. 25, Plate XX, Fig. 2]

Cells longer than broad, sinus sharp angled opening widely, polar lobe in lower half quadrate with nearly erect accessory processes at their base, lateral lobes one divided; all processes with serrate or denticulate margin; incision between lateral lobes deep.

L. 135-141 μm, W. 112-116 μm, lsth. 24-25 μm, W. at apex 54-59 μm.

Field No. 190.

Distribution: Very Common.

15. *M. mahabuleshwarensis* var. *surculifera* Lagerheim

Lagerheim, 1888, p. 5, pl. 1, fig. 1; Krieger 1939, p. 53, pl. 111, figs. 1, 2; Prescott 1977. p. 166, pl. CXLIII, fig. 7.

[Plate XV, Fig. 26]

Cells longer than broad, sinus deep and open, incision between lateral lobules deep lobules relatively long and margins spiny; the protuberance of the semicell arising at right angles from the semicell wall with a row of conspicuous granules.

L. 150-161 μm, W. 120-127 μm, W. at apex 70-73 μm. Th. 27-30 μm including protuberance 52-58 μm.

Field No. 1118.

Distribution: Probably this is the first record of the variety from India.

16. *M. moebii* (Borge) West & West var. *burmense* West & West

West & West 1907. p. 199, pl. 14, fig. 19,20; Krieger 1939, p. 43, pl. 107, fig. 7.8.

[Plate XV, Fig. 13]

Cells longer than broad, sinus widely open, lateral lobes undivided, horizontally extended margin wavy each semicell with three distinct circular granules; cell wall with regular arrangement of granules.

L. 120 μm, W. 96 μm, lsth. 34 μm, W. at apex 79 μm.

Field No. 1169.

Distribution: Probably this is the first record of the variety from India.

17. *M. pinnatifida* (Kutz.) Ralfs var. *pinnatifida*

Turner 1892. p. 88, pl. V, fig. 3; Prescott *et al.* 1977, p. 173. pl. LXXXIX, figs. 6,8. pl. XC, figs. 1-8.

[Plate XV, Fig. 4, Plate XX, Fig. 6]
Cells mostly somewhat broader than long, deeply constricted, sinus open widely, lateral lobes single, undivided, horizontally extended, polar lobes also spreading horizontally bifid at the extremities, subpolar incision deep.
L. 42-63 µm, W. 45-63 µm, Isth. 12-16 µm, W. at apex 33-36 µm.
Field No. 40.
Distribution: Very Common.

18. *M. pinnatifida f. angusta* Prescott et Scott.

Prescott *et al.* 1977, p. 173-174, pl. XCI, fig. 1; Dillard 1993, p. 100, pl. 17, fig. 3.

[Plate XV, Fig. 5]

The present specimen differs from the typical in having the sinus linear and closed inwardly; upper margins of the lateral lobes nearly straight and horizontal, polar lobe extensions somewhat upwardly directed, bifid at their extremities.
L. 62 µm, W. 60 µm, Isth. 9 µm.

The present specimen is slightly smaller than the original type.
Field No. 1028.
Distribution: Probably this is the first record of the form from India.

19. *M. radians* Turner

Turner 1892, p. 91, pl. 5, fig. 6; Krieger 1939, p. 67, pl. 115, fig. 8, pl. 116, fig. 1; Islam 1970, p. 920, pl. 11, figs. 1-4.

[Plate XV, Fig. 17, Plate XX, Fig. 1]

Cells usually slightly longer than broad; sinus linear, lateral lobes evenly twice divided, lobules sometimes slightly swollen at base terminating in paired teeth, polar lobe slightly exerted; apex deeply concave, all incision rather widely open.
L. 112-120 µm, W. 91-110 µm, Isth. 10-14 µm, W. at apex 29-31 µm.
Field No. 190.
Distribution: Very Common.

20. *M. tropica* Nordstedt var. *bishnupurensis* var. nov.

[Plate XV, Fig. 12]

Cells longer than broad; sinus widely open, lateral lobes undividedly downward, polar lobe with two arms, upwardly directed, base of the arm with sharp spine, both lateral & polar lobe ending with sharp spine at their extremities; cell wall with distinct granules, arranged in row, margin wavy.
L. 118 µm, W. 81 µm, Isth. 19 µm.
Field No. 555.
Holotype : No. PM 555, Nov. 16, 2001; Radhanagar Bankura, Orange colour mass associated with some bluish green scum on *Utricularia* (pH 6, Temp. 28°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is close in external appearance to *M. tropica* var. *crassa* West et West but differs from it in following aspects i) semi cells much smaller than the type ii) arms of the polar lobes shorter iii) distinct spines on apices of polar lateral lobes.

21. *M. tropica* var. *indica* var. nov.

[Plate XV, Fig. 9, Plate XX, Fig. 5]

Cells longer than broad; sinus widely open, lateral lobes undivided, horizontally extended, polar lobe bifurcate, apex with shallow depression, small stout spines are present at the extremities of both lateral & polar lobe.


Field No. 536.

Holotype : No. PM 536, Nov. 15, 2001, Onda, Bankura, Deep some algal filaments with some brown colour mass associated with *Scirpus* stem. (pH 6, Temp. 33.5°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is close in morphology to *M. tropica* var. *borgei* Krieger but differs from it in having i) less broader semi cells ii) shallow depression at the apex iii) more larger in size and distinct spines at polar lobes iv) regular arrangement of spines at polar v) apex, narrower.

22. *M. tropica* var. *kussamoensis* Grünblad

Grünblad 1924, p. 7, pl. 2, figs. 26, 27; Krieger 1939, p. 59, pl. 113, figs. 5, 6.

[Plate XV, Fig. 10]

Cells larger than broad; sinus widely open, lateral lobes undivided, slightly downwardly curved polar lobes with two arms, arms ending with distinct spines, wall with distinct spines, wall with distinct granules & margin possessing sharp angled stout spines; base of the polar lobe with 2-3 rows of spines.

L. csp. 102 μm, ssp. 99μm, W. 84 μm, Isth. 18 μm.

The present specimen is larger than the type.
Systematic part

Field No. 555.
Distribution: Probably this is the first record of the variety from India.

23. *M. tropica* var. *lalbandhensis* var. nov.

[Plate XV, Fig. 11]
Cells little longer than broad; sinus widely open, lateral lobes undivided, horizontally extended; the polar lobe arms short & upwardly directed, the extremities of the polar & lateral lobes with distinct spines; cell wall with distinct granules, arranged irregularly, outer margin entire.

L. 108 µm, W. 76 µm, lsth. 19 µm, W. at Apex 37 µm.

Field No. 555.

Holotype : No. PM 555, Nov. 16, 2001, Radhanagar Bankura, Orange colour mass associated with some bluish green scum on *Utricularia* (pH 6, Temp. 28°C). Kept in the algae herbarium of the Department of Botany, The University of Burdwan (BURD), West Bengal, India.

The present specimen is close in morphology to *M. tropica* var. *borgei* Krieger but differs from it in following aspect on the both i) granules are arranged in irregular row on the body ii) upwardly directed arms of polar lobes iii) shorter arms of the polar lobes.

24. *M. tropica* var. *polonica* Eichler et Raciborski

Krieger 1939, p. 60, pl. 113, figs. 2, 4; Ling & Tyler, 1986, p. 33, pl. 21, figs. 1-4.

[Plate XV, Fig. 8, Plate XXI, Fig. 4]
Cells longer than broad; sinus deep and widely open, semi cells extended to an elongate process, incision deep, lateral lobes slender with sharp spines polar lobe bifurcate, cell wall with a row of conspicuous granules.

L. csp. 140-146 µm, ssp. 113-118 µm, W. csp. 102-126 µm, ssp. 64-87 µm. lsth. 20-23 µm, W. at apex 48-52 µm.

The present specimen is slightly larger than the type.

Field No. 555.

Distribution: Probably this is the first record of the variety from India.


Scott & Prescott 1961, p. 53, pl. 21, figs. 5-7.

[Plate XV, Fig. 3, Plate XX, Fig. 7]
Cells width is greater than length; sinus deep and widely open; lateral lobes undivided, horizontally exerted terminating into a long spine, polar lobe with
long terminal spine horizontally exerted; cells wall with granules throughout the body.

L. 51-56 μm, W. csp. 57-60 μm, ssp. 51-52 μm, Isth. 15-18 μm.

Field No. 190.

Distribution: Probably this is the first record of the variety from India.


Krieger 1939, p. 38, pl. 101, figs. 14-16; Islam 1970, p. 922, pl. 8, fig. 7.

[Plate XV, Fig. 2]

Cells width is greater than length; sinus deep, slightly open, outwardly, lateral lobes undivided horizontally exerted, entire polar lobe with short spines; lateral and polar lobe spines, downwardly curved; cells wall with granules throughout the body.

L. 51-52 μm, W. csp. 60-61 μm, ssp. 54-56 μm, Isth. 10-13 μm.

The present specimen is larger than the type.

Field No. 190.

Distribution: Probably this is the first record of the variety from India.

XXXII: *Triploceras* Bailey 1851

Cells elongate, subcylindric, 8-19 times longer than broad, with little or no incision at the isthmus and slightly tapered to the apex, lateral margin undulate with 9-15 transverse whorls of protuberances each bears simple or bifid spines; chloroplast axial, with longitudinal lamellae and an axial row of pyrenoids.

*T. gracile* Bailey

Bailey 1851, p. 38, pl. 1, fig. 10; Prescott *et al.* 1975, p. 143, pl. Li, figs. 7-14; Dillard 1990, p. 140, pl. 49, fig. 6.

[Plate XIV, Figs. 9, 10, Plate XXIV, Figs. 2]

Cells sub cylindric, 12-18 times longer than broad, semi cells with mammillate protuberances, each bearing a single stout spine, apex divided into two to four short processes. Zygosporo spherical wall smooth or with long radiating.

L. 300-370 μm, W. csp. 22-34 μm, ssp. 13-19 μm, W. at apex 26-32 μm.

Field No. 44, 190, 744, 1123.

Distribution: Karnataka (Gurudeva *et al* 1983, Bharati 1965), Tamil Nadu (Ramanathan 1962), This is the new record of the species from West Bengal.
XXXIII: *Triplastrum* Iyengar et Ramanathan 1942

Cells sub-cylindric with slight median constriction, poles truncate, at the apex 3 short lobes each bearing 2-4 spines; chloroplast with longitudinally ridges and 3-4 pyrenoids.

**Artificial key to the taxa described**

1. Terminal end truncated and inflated
   2. Each lobe with single spine, chloroplast stellate... ...(1) *T. abbreviatum*
   2. Each lobe with four spine, chloroplast axial plat... ...(2) *T. indicum*

1. Terminal end not inflated, slightly or strongly divergent

   3. End strongly divergent, each lobe with
      2-3 spines, chloroplast stellate... ...(4) *T. spinulosum*
   3. End slightly divergent, each lobe with
      2 spines chloroplast axial plate with longitudinal ridges... ...(3) *T. simplex*

1. *T. abbreviatum* (Turner) Iyengar et Ramanathan

   Iyengar and Ramanathan 1942, p. 228, fig. 6
   [Plate XIV, Fig. 13]

   Cells with a shallow median constriction, semi cells straight, cylindrical end truncated and inflated forming 3 shallow lobes; each lobe bearing single spine; chloroplast stellate in median series, pyrenoid 2 in each semicell.
   L. 69-75 µm, W. 11-12 µm, Isth. 8-9 µm, Apex 14 µm.
   Field No. 190.
   Distribution: Probably this is the first record of the species from India.

2. *T. indicum* Iyengar et Ramanathan

   Iyengar and Ramanathan 1942, p. 228, pl. II, figs.1-3
   [Plate XIV, Fig. 12]

   Cells well defined median constriction, semi cells straight, cylindrical ends inflated, trilobed; each lobe broadly rounded and bearing 4 short spines, chloroplast two, axile plate with pyrenoids two in each semicell.
   L. 82 µm, W. 11 µm, Isth. 8 µm, Apex 13-14 µm.
   The present specimen is slightly narrower than the type.
   Field No. 1116.
   Distribution: Probably this is the first record of the species from India.
3. *T. simplex* (Allorge) Iyengar et Ramanathan

Iyengar and Ramanathan 1942, p. 229, figs. 7-9

[Plate XIV, Fig. 11]

Cells cylindrical, margin inflated, apices triangular, each angle with two short spines; chloroplast in each semicell with a variable number of longitudinal ridges; 2 pyrenoids in each semicell.

L. 75-90 μm, W. 8-9 μm, lsth. 7-8 μm.

Field No. 190, 1116.

Distribution: Probably this is the first record of the species from India.

4. *T. spinulosum* (Kisselev) Gauth-liev

Gauthier-lièvre 1960, p. 64,

[Plate XIV, Fig. 14, Plate XIX, Figs. 10,11]

Cells with shallow median constriction, ends inflated with three lobes, each lobe with 2-3 spines, spines strongly divergent, semi cells with two stellate chloroplast.

L. 69-88 μm, W. 9-11 μm, lsth. 8-10 μm.

Field No. 190.

Distribution: Probably this is the first record of the species from India.