Desmids (Chlorophyceae, Conjugales, Desmidiaceae) from Foothills of Western Himalaya, India

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Forty-eight taxa of desmids belonging to Class Chlorophyceae (Order - Conjugales, Family - Desmidiaceae), collected from different aquatic habitats of Lalkuan, Kathgodam and Pantnagar areas of Uttaranchal state and Pilibheet district of Uttar Pradesh, which are regions of foothills of Western Himalaya, have been described. These taxa belong to 5 genera viz. Closterium Nitzsch (6 spp., 5 var., and 2 forma), Euastrum Ehrenberg (1 var.), Staurastrum Meyen (2 spp., 1 var., 1 forma), Cosmarium Cord ex Ralfs (19 spp. and 10 var.), Pleurotaenium Naegeli (1 sp.). Staurastrum pseudopacapycrynum Wolle (1884) is new record for desmid flora of India.

Key Words: algae, chlorophyceae, conjugales, desmids, foothills of Western Himalaya

INTRODUCTION


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MATERIAL AND METHODS

Random sampling technique has been applied in the algal collection procedure. Samples collections were made between November 2003 to January 2006 from aquatic habitats of Lalkuan, Kathgodam and Pantnagar area of Uttaranchal state and Pilibheet of Uttar Pradesh, India by using planktonic mesh net. The algal samples were preserved in 3-4% formalin (aqueous solution of formaldehyde), and slides were prepared by staining chlorophycean algae with iodine and mounted in glycerine. Detailed studies were made by examining specimens under a Nikon Labophot microscope E-400 with H-III photomicrographic attachment.

RESULTS AND DISCUSSION

Species identification has been done after Tiffany and Britton (1952), Scott and Prescott (1961) and Prasad and Misra (1992).

Order - Conjugales
Family - Desmidiaceae
Genus - Closterium Nitzsch 1817

1. Closterium acerosum (Sch.) Ehrenberg
(Pl. 1, fig. 17)
Prasad and Misra 1992, p. 97, pl. 16, fig. 15.
Cell 315.0 \( \mu \)m long, 40.0 \( \mu \)m broad and apex 5.0 \( \mu \)m.
Cells large, more or less straight or faintly curved, narrowly fusiform, 11-14 times longer than broad, outer margin curved with 30-36 degree of arc, inner margin almost straight, semi cells gradually tapering to the rounded-truncate apices, cell wall smooth; chloroplast with 3-5 ridges & 5-6 pyrenoids arranged in a row in each semi cell.

Collection number, date and site: UTFH 5; 8 Nov. 2003; Kalsia Nala, Gola Bairaj, Kathgodam.

2. Closterium acerosum (Schrank) Ehrenberg var. elongatum Brebisson
(Pl. 1, fig. 11)
Prasad and Misra 1992, p. 98, pl. 16, fig. 13
Cell 365.0 \( \mu \)m long, 40.0 \( \mu \)m broad and apex 5.0 \( \mu \)m.
Cells large, 16-17 times longer than broad, lateral, margins parallel abruptly attenuated near rounded apices; chloroplast with 4-5 ridges and 13-15 pyrenoids arranged in a row.

Collection number, date and site: UTFH 14; 21 Dec. 2004; Kalsia Nala, Gola Bairaj, Kathgodam.

3. Closterium acerosum (Schr.) Ehr. var. angolense West & West
(Pl. 1, fig. 13)
Prasad and Misra 1992, p. 98, pl. 16, fig. 13
Cell 365.0 \( \mu \)m long, 40.0 \( \mu \)m broad and apex 5.0 \( \mu \)m.
Cells large, 16-17 times longer than broad, lateral, margins parallel abruptly attenuated near rounded apices; chloroplast with 4-5 ridges and 13-15 pyrenoids arranged in a row.

Collection number, date and site: UTFH 1; 8 Nov. 2003; Kalsia Nala, Gola Bairaj, Kathgodam.

4. Closterium acerosum (Schrank) Ehrenberg var. rectum Scott & Prescott
(Pl. 2, fig. 1)
Scott and Prescott 1961, p. 10, Pl. 3, fig. 2
Cell 730.0 \( \mu \)m long, 40.0 \( \mu \)m broad and apex 6.0 \( \mu \)m.
Axis of cell exactly straight, lateral margins uniformly and slightly curved, forming a gradual and uniform taper from the centre of the cell towards the poles which are narrowly rounded and with an internal thickening at the tip. Wall very finely striate colorless.

Collection number, date and site: UTFH 15, 29 Oct. 2005; Chatta Tal, Pilibheet.

5. Closterium acutum (Lyngb.) Breb. var. linea (Perty).
West & West
(Pl. 1, fig. 18)
Prasad and Misra 1992, p. 100, pl.16, fig. 2
Cell 164.0 \( \mu \)m long, 17.0 \( \mu \)m broad and apex 3.0 \( \mu \)m.
Cell straight, gradually attenuated to acute and faintly curved apices; cell wall smooth; chloroplast with 10 pyrenoids, arranged in a row.

Collection number, date and site: UTFH 1; 7 Nov.
2003; Pond near Railway line, Lalkuan.

6. **Closterium braunii** Reinsch (1867)
   (Pl. 2, fig. 2)
   Scott and Prescott 1961, p. 10, pl. 1, fig. 22
   Cell 560.0 µm long, 37.5 µm broad and apex 5.0 µm.
   Wall yellowish and very finely striate, becoming brown at the poles which are punctate.
   **Collection number, date and site:** UTFH 15; 29 Oct 2005; Chatta Tal, Pilibheet.

7. **Closterium croasdale** Nurul Islam
   (Pl. 1, fig. 12)
   Prasad and Misra 1992, p. 103, pl. 17, fig. 7
   Cell 250.0 µm long, 40.0 µm broad and apex 5.0 µm.
   Cells 4-6 times longer than broad, outer margin sharply curved, inner margin concave but slightly tumid in middle, apices slightly recurved with ends, cell wall smooth with a median girdle, chloroplast with ridges, containing numerous scattered pyrenoids.
   **Remark:** Smaller than the given type.
   **Collection number, date and site:** UTFH 31; 24 Jan 2006; Pond near Railway line, Lalkuan.

8. **Closterium cynthia** De Not.
   (Pl. 2, fig. 6)
   Prasad and Misra 1992, p. 103, pl. 16, fig. 25
   Long Cell 190.0 µm, Lateral cell 30.0 µm, Apex 4.0 µm.
   Cells rather small and stout, strongly curved, outer margin parallel to outer near apices but more or less straight in the middle, cell gradually attenuated obtusely rounded apices; cell wall straight; chloroplast with 6 pyrenoids, arranged in a row.
   **Remark:** Slightly longer and broader than the given type.
   **Collection number, date and site:** UTFH 19; 29 Oct 2005; Ghannai Tal, Pilibheet.

9. **Closterium leibeinii** Kuez. var. *recurvatum* West & West
   (Pl. 1, fig. 15)
   Prasad and Misra 1992, p. 109, pl. 17, fig. 3
   Long cell 215.0 µm, Lateral cell 33.0 µm, Apex 6.0 µm.
   Cells of medium size, 6-7 times longer than broad, strongly curved, outer margin with 115-120 degrees of arc, inner margin inflated in the middle, cell uniformly narrowed to obtusely rounded apices; cell wall smooth; chloroplast with 4-5 ridges & 8-10 pyrenoids arranged in a median series.
   **Collection number, date and site:** UTFH 14; 23 Dec 2004; Ghannai Tal, Pilibheet.

10. **Closterium littorale** Gay.
    (Pl. 1, fig. 14)
    Tiffany and Britton 1992, p. 173, pl. 51, fig. 544
    Cell 150.0 µm long, 20.0 µm broad and apex 3.0 µm.
    Cells 10 times longer than wide, slightly curved outer margin 35-55 degrees of arc, inner margin a little concave and slightly but widely tumid in the middle, gradually attenuated to the acute to obtusely rounded apices; cell wall smooth, colorless, chromatophores with 7-8 ridges; pyrenoids 4-5 in a median series, terminal vacuoles with a number of moving granules.
    **Collection number, date and site:** UTFH 10; 21 Dec 2004; Gola River, Lalkuan.

11. **Closterium lunula** (Mueller) Nitzsch. var. *massartii* (Wildem.) Krieger
    (Pl. 1, fig. 19)
    Prasad and Misra 1992, p. 111, pl. 15, fig. 3
    Cell 220.0 µm long, 33.0 µm broad and apex 8.0 µm.
    Cell large, about 6 times longer than broad, more or less straight, outer margin more convex than inner and shows 60 degrees of arc, cell gradually and gently attenuated to slightly truncate spicies, cell wall smooth, chloroplast with 7 ridges and numerous scattered pyrenoids.
    **Collection number, date and site:** UTFH 1; 7 Nov 2003; Gola River, Pantnagar.

12. **Closterium moniliferum** (Borg.) Ehrenberg forma Bourrelly
    (Pl. 1, fig. 16)
    Prasad and Misra 1992, p. 113, pl. 12, fig. 4
    Cell 195.0 µm long, 35.0 µm broad and apex 6.0 µm.
    Cell of medium size, stout, 6-7 times longer than broad, moderately curved, outer margins 120-130 degree long arc, inner margin inflated in the middle, cell uniformly narrowed to obtusely, rounded apices, cell wall smooth, chloroplast with 4-5 ridges & 8-10 pyrenoid arranged in a median series.
    **Collection number, date and site:** UTFH 2; 7 Nov 2003; Gola River, Lalkuan.

13. **Closterium pritchardianum** Arch.
    (Pl. 1, fig. 10)
    Prasad and Misra 1992, p. 115, pl. 17, fig. 13
    Cell 250.0 µm long, 38.0 µm broad and apex 5.0 µm.
Cells of medium size or large, faintly curved to more or less straight, 7-14 times longer than broad, outer margin 24-40 degree of arc, inner margin straight or slightly concave, cell gradually attenuated to narrow, truncate and faintly recurved apices; cell wall striated, striations composed of the punctuate, punctuations more prominent in longer specimens, chloroplast with 5-7 ridges and 6-8 pyrenoids arranged in a row.

Collection number, date and site: UTFH 11; 21 Dec. 2004; Gola River, Lalkuan.

Genus - *Euastrum* Ehrenberg 1832

1. *Euastrum spinulosum* Delp. var. *bellum* Scott & Prescott
   (Pl. 2, fig. 4)
   Scott and Prescott 1961, p. 40, Pl. 10, fig. 5.
   Long cell 85 µm, lateral cell 75 µm, isthmus 20 µm.
   Cells very large, with widely rounded lobes and acute indentations between them; verrucae of the central rosettes unusually large.

Collection number, date and site: UTFH 11; 21 Dec. 2004; Chatta Tal, Pilibheet.

Genus - *Staurastrum* Meyen

1. *Staurastrum gracile* Ralfs
   (Pl. 1, figs 1 and 2)
   Tiffany and Britton 1952, p. 199, pl. 55, fig. 613
   Long cell – 25.0 µm, Breadth with processes – 30.0 µm.
   Isthmus – 10.0 µm Breadth without processes – 18.0 µm.
   Length of the cell often grater than the width, excluding the processed, deeply constructed, sinus with an acute apex and opening widely, isthmus narrow; semi-cells broadly triangular to cup-shaped, dorsal margin slightly convex with a row of small emarginate verrucae, below which there is sometimes a short row of granules; angles continued in processes of variable length which are slightly alternated, horizontal or sometimes slightly concave and angles continued in straight processes; cell wall with an intramarginal row of pairs of granules and sometimes with short row of granules at the right angles to the sides of the cell, the center without ornamentation, processes with transverse rings of granules and terminating in 3 or 4 small spines; chromatophore axial, with 2 laminate blades extending to each angles or a short distance into the processes pyramid singles, central.

Collection number, date and site: UTFH 15; 29 Oct. 2005; Ghannai Tal, Pilibheet.

2. *Staurastrum pseudopachyrhyncum* Wolle (1884)
   (Pl. 1, figs 7 and 8)
   Scott and Prescott 1961, p. 104, pl. 52, fig. 13.

Collection number, date and site: UTFH 15; 29 Oct. 2005; Chatta Tal, Pilibheet.

Genus - *Cosmarium* Corda ex Ralfs 1848

1. *Cosmarium awadhense* Prasad & Mehrotra
   (Pl. 3, fig. 3)
   Prasad and Misra 1992, p. 153, pl. 21, fig. 27.
   Cell 30.0 µm long, 25.0 µm broad and isthmus 5.0 µm.
   Cells small, slightly longer than broad, constriction deep, sinus narrowly linear towards apex and slightly open towards; semi cells sub-semicircular, sides 4-5 crenate, apex truncate with more or less straight margin cell wall smooth; each semi cell with one massive chloroplast, containing one pyrenoid.

Collection number, date and site: UTFH 11; 27 May 2004; Gola River, Kathgodam.

2. *Cosmarium biretum* Breb.
   (Pl. 3, fig. 17)
   Prasad and Misra 1992, p. 154, pl. 23, fig. 19.
   Cell 64.0 µm long, 53.0 µm broad and isthmus 16.0 µm.
   Cell rather small, a little longer than broad, very
deeply constricted, sinus narrowly linear with slightly dilated extremity; semi cells sub rectangular with some what convex sides and apex, cell wall with granules arranged in indistinct curved vertical series each semi cell with an axile chloroplast and two pyrenoids.

**Collection number, date and site:** UTFH 2; 7 Nov. 2003; Gola River, Lalkuan.

3. *Cosmarium calcareum* Witter

(Pl. 3, fig. 10)

Prasad and Misra 1992, p. 156, pl. 24, fig. 18.

Cell 23.0 \(\mu\)m long, 19.0 \(\mu\)m broad and isthmus 5.0 \(\mu\)m.

Cells small, almost as long as broad, deeply constricted, sinus narrowly linear; semicells somewhat tropizoid, basal angles sub – rectangular, sides 4 – crenate, apex truncate with 6-7 faint and minute crenations; cell wall with minute granules and a small granulate tumour in the center; top view narrowly elliptic.

**Collection number, date and site:** UTFH 2; 7 Nov. 2003; Gola River, Lalkuan.

4. *Cosmarium circulare* Reinsch var. *messikomeri* Krieger & Gerloff

(Pl. 3, fig. 20)

Prasad and Misra 1992, p. 156, pl. 22, fig. 8.

Cell 50.0 \(\mu\)m long, 48.0 \(\mu\)m broad and isthmus 15.0 \(\mu\)m.

Semicells more or less semicircular, sinus narrowly linear and close; cell wall distinctly punctate; chloroplast axile with ridges and two pyrenoids in each semicell.

**Collection number, date and site:** UTFH 31; 22 Jan. 2006; Ghanai Tal, Pilibheet.


(Pl. 3, fig. 7)

Scott and Prescott 1961, p. 56, pl. 27, fig. 6.

Long cell 32.0 \(\mu\)m, Lateral cell 26.0 \(\mu\)m, Isthmus 8.0 \(\mu\)m.

**Collection number, date and site:** UTFH 31; 24 Jan. 2006; Gola River, Pantnagar.


(Pl. 3, fig. 12)

Tiffany and Britton 1952, p. 185, pl. 53, fig. 569.

Cell 30.0 \(\mu\)m long, 20.0 \(\mu\)m broad and isthmus 6.5 \(\mu\)m.

Cells longer than wide, deeply constricted, sinus linear, the apex rounded and slightly dilated; semi cells semi elliptic or widely truncate-ovate, basal angles rectangular and rounded, the apex rounded or slightly truncate; vertical view broadly elliptic-oblong; lateral view of semi cell obtusely ovate; cell wall smooth; chromatophores irregular parietal bands expanding from base to apex, 6-9 in each semi cell; pyrenoids several in each chromatophore.

**Collection number, date and site:** UTFH 19; 19 May 2005; Gola River, Kathgodam.


(Pl. 3, fig. 6)

Scott and Prescott 1961, p. 58, pl. 26, fig. 7.

Long cell 28.0 \(\mu\)m Lateral cell 24.0 \(\mu\)m, Isthmus 8.0 \(\mu\)m.

**Collection number, date and site:** UTFH 12; 19 May 2005; Gola River, Lalkuan

8. *Cosmarium dubium* Borge (1896)

(Pl. 3, fig. 8)

Scott and Prescott 1961, p. 58, pl. 32, fig. 3.

Long cell 38.0 \(\mu\)m, Lateral cell 30.0 \(\mu\)m, Isthmus 10.0 \(\mu\)m.

**Collection number, date and site:** UTFH 31, 24 Jan. 2006; Locality: Gola River, Pantnagar.

9. *Cosmarium furcatospermum* West & West var. *maius* Prasad & Mehrotra

(Pl. 3, fig. 5)

Prasad and Misra 1992, p. 159, pl. 24, fig. 24.

Cell 40.0 \(\mu\)m long, 33.0 \(\mu\)m broad and isthmus 11.0 \(\mu\)m.

Cells rather small, slightly longer than broad, deeply constricted, sinus linear; semicells truncate, sub – semicircular, lateral margins 4-5 crenately – granulate, apex broadly within the whole margin, central region smooth; top view oblong – elliptic; each semicell with an axile chloroplast containing a large pyrenoid in the center.

**Collection number, date and site:** UTFH 19; 19 May 2005; Gola River, Kathgodam.

10. *Cosmarium granatum* Breb.

(Pl. 1, fig. 19)

Prasad and Misra 1992, p. 160, pl. 21, fig. 20.

Cell 30 \(\mu\)m long, 20 \(\mu\)m broad and isthmus 5 \(\mu\)m.

Cells small, slightly longer than broad, sub – rhombic to elliptic, deeply constricted, sinus linear with a dilated extremely; semicells truncate – pyramidate, basal angles rounded, apical angles rounded, apical angles obtuse, sides straight or slightly convex, apex narrowly truncate with faintly retuse margin; cell wall finely punctate; chloroplast axile with single pyrenoid.
11. Cosmarium lundelli Delp. var. subellipticum Prasad & Mehrotra 1977
(Pl. 3, fig. 4)
Prasad and Misra 1992, p. 165, pl. 22, fig. 9.
Cell 64.0 \( \mu \text{m} \) long, 47.0 \( \mu \text{m} \) broad and isthmus 15.0 \( \mu \text{m} \).
Semi cell sub elliptic with rounded to sub-truncate apices.

Collection number, date and site: UTFH 11; 27 May 2004; Gola River, Kathgodam.

12. Cosmarium margaritatum (Lund.) Roy & Biss. var. sablatum (Nordst) Krieger (1933)
(Pl. 2, fig. 8)
Scott and Prescott 1961, p. 63, pl. 29, fig. 4.
Long cell 50.0 \( \mu \text{m} \), lateral cell 45.0 \( \mu \text{m} \), Isthmus 15.0 \( \mu \text{m} \).

Collection number, date and site: UTFH 11; 27 May 2004; Gola River, Kathgodam.

13. Cosmarium nitidulum De Not.
(Pl. 3, fig. 15)
Prasad and Misra 1992, p. 168, pl. 22, fig. 21.
Cell 37.0 \( \mu \text{m} \) long, 27.0 \( \mu \text{m} \) broad and isthmus 10.0 \( \mu \text{m} \).
Cell small, slightly longer than broad, deeply constricted, sinus narrowly linear with slightly dilated apex, semi cells truncate-sub semicircular, tapering evenly from rounded basal angles to flattened apex with straight margin; cell wall minutely punctuate, top-view elliptic; chloroplast moncentric with one pyrenoid.

Collection number, date and site: UTFH 12; 19 May 2005; Gola River, Lalkuan.

14. Cosmarium nymannianum Grun. in Rabenhorst (1868)
(Pl. 2, fig. 11)
Scott and Prescott 1961, p. 63, pl. 27, fig. 13.
Long cell 38.0 \( \mu \text{m} \), lateral cell 29.0 \( \mu \text{m} \), Isthmus 8.0 \( \mu \text{m} \).

Collection number, date and site: UTFH 15; 29 Oct. 2005; Chatta Tal, Pilibheet.

15. Cosmarium obsoletum (Hantzsch) Reinsch
(Pl. 3, fig. 19)
Prasad and Misra 1992, p. 170, pl. 22, fig. 16.
Cell 70.0 \( \mu \text{m} \) long, 70.0 \( \mu \text{m} \) broad and isthmus 30.0 \( \mu \text{m} \).
Cells of medium size, transversely elliptic, almost as long as broad, deeply constricted, sinus narrow with dilated apex and slightly open outwards; semicells depressed – semicircular, basal angles submamillate and slightly thickened, apex some what flattened; cell wall punctate; chloroplast axile with two pyrenoids in each semicell.

Collection number, date and site: UTFH 11; 27 May 2004; Gola River, Kathgodam.

(Pl. 2, fig. 12)
Scott and Prescott 1961, p. 64, pl. 25, fig. 5.
Long cell 52.5 \( \mu \text{m} \), lateral cell 41.5 \( \mu \text{m} \), Isthmus 15.0 \( \mu \text{m} \).

Collection number, date and site: UTFH 11; 27 May 2004; Gola River, Kathgodam.

17. Cosmarium pseudogranatum Nordst. var. rotundatum (Krieger) Meisik.
(Pl. 3, fig. 9)
Prasad and Misra 1992, p. 175, pl. 21, fig. 22.
Cell 30.0 \( \mu \text{m} \) long, 20.0 \( \mu \text{m} \) broad and isthmus 5.0 \( \mu \text{m} \).
Cell small; semi cells broadly truncate exhibiting rather prominently convex sides and truncate-rounded apex, cell wall minutely punctuate.

Collection number, date and site: UTFH 9; 8 Nov. 2003; Kalsia Nala, Gola Bairaj, Kathgodam.

(Pl. 2, fig. 7)
Scott and Prescott 1961, p. 67, pl. 27, fig. 2.
Long cell 55.0 \( \mu \text{m} \), lateral cell 35.0 \( \mu \text{m} \), Isthmus 12.0 \( \mu \text{m} \).

Collection number, date and site: UTFH 12; 27 May 2004; Gola River, Kathgodam.

19. Cosmarium pyramidatum Breb.
(Pl. 3, fig. 16)
Prasad and Misra 1992, p. 177, pl. 22, fig. 18.
Cell 37.5 \( \mu \text{m} \) long, 28.0 \( \mu \text{m} \) broad and isthmus 7.5 \( \mu \text{m} \).
Cells of medium size, about 1.2 times longer than broad, truncate-elliptic in outline, deeply constricted, sinus narrow and dilated towards the apex; semi cells truncate pyramidate, basal angles rounded; sides convex and converging upwards to narrowly truncate and flattened apex showing obtuse angles; cell wall finely scrobiculate, chloroplast axile and dicentric with two pyrenoids in each semi cell.
2004; Gola River, Kathgodam.

   (Pl. 3, fig. 18)
   Tiffany and Britton 1952, p. 193, pl. 53, fig. 580.
   Cell 64.0 μm long, 57.0 μm broad and isthmus 20.0 μm.
   Cells about as long as wide or slightly longer, quadrate in outline, deeply constricted, sinus linear and slightly dilated at the apex; semi cells sub rectangular, basal angles rounded, apical angles broadly rounded, sides almost straight or slightly convex, apex usually slightly retuse, sometimes; lateral view of semi cell sub circular; vertical view oblong-elliptic, the sides straight and parallel; cell wall granulate, the granules arranged in decussating oblique series and somewhat less distinct vertical series, 34-37 showing at margins of each semi cell, slightly reduced in middle of the apex; chromatophores axial; 2 pyrenoids in each semi cell.

   Collection number, date and site: UTFH 16; 29 Oct. 2005; Gaushala Tal, Pilibheet.

   (Pl. 2, fig. 10)
   Prasad and Misra 1992, p. 179, pl. 24, fig. 17.
   Cell 50.0 μm long, 35.0 μm broad and isthmus 12.0 μm.
   Cell rather small, sub-hexagonal, slightly longer than broad, deeply constricted, sinus linear with slightly dilated apex and open outwards; semi cell broadly truncate-pyramidate with rounded based and sub acute apical angles, lateral margins slightly convex, apex truncate and somewhat flattened, margins of semi cells with 14-17 acute granules followed by a series of rounded granules within the out-line, centre of each semi cell with 2 transverse series of large granules, 3 in upper and 2 in lower series and 2 punctations between them; chloroplast axile with two pyrenoids.

   Collection number, date and site: UTFH 2; 7 Nov. 2003; Gola River, Lalkuan.

22. *Cosmarium radiosum* Wolle
   (Pl. 3, fig. 14)
   Prasad and Misra 1992, p. 179, pl. 24, fig. 12.
   Cell 48.0 μm long, 35.0 μm broad and isthmus 13.0 μm.
   Cell of medium size, about, almost 1.4 times longer than broad, deeply constricted, sinus narrowly linear with slightly dilated extremely; semi cells sub – semicircular, sides strongly convex, apex subtruncately rounded; cell wall finely granulate, granules in radiating and concentric series towards periphery, about 36-39 granules seen on the outline of each semi cell, each series with 7-8 granules gradually becoming reduced in size from periphery towards the centre, median basal part of each semi cell with 5-6 sub – vertical series of granules, each with 4-7 granules gradually diminishing in size from base upwards; chloroplast axile with 2 pyrenoids in each semi cell.

   Collection number, date and site: UTFH 2; 7 Nov. 2003; Gola River, Lalkuan.

23. *Cosmarium reniforme* (Ralfs) Arch. var. *elevatum* West & West
   (Pl. 2, fig. 13)
   Prasad and Misra 1992, p. 181, pl. 23, fig. 20.
   Cell 49.0 μm long, 35.0 μm broad and isthmus 14.0 μm.
   Cells of medium size, slightly longer than broad, constricted deep, sinus narrow and linear with widely dilated extremity; semi cells reniform; cell wall granulate; granules fairly regular, horizontal and in indistinct ventrical series (about 25-31 granules seen at margins of a semi cell); chloroplast axile with two pyrenoids in each semi cell.

   Collection number, date and site: UTFH 2; 7 Nov. 2003; Gola River, Lalkuan.

24. *Cosmarium subalatum* West & West
   (Pl. 3, fig. 13)
   Prasad and Misra 1992, p. 85, pl. 24, fig. 22.
   Cell 34.0 μm long, 28.0 μm broad and isthmus 8.0 μm.
   Cells small, slightly longer than broad, deep constricted, sinus narrowly linear; semi cells widely truncate to pyramidate, sides tricrinate, angles rounded, apex with two small crenations (excluding apical angles), crenations bigranulate, central tumour rounded with 7 granules arranged in circular fashion; top-view elliptic; chloroplast axile with one pyrenoid in each semi cell.

   Collection number, date and site: UTFH 15; 29 Oct. 2005; Chatta Tal, Pilibheet.

25. *Cosmarium scabrum* Trun. (1892)
   (Pl. 2, fig. 5)
   Scott and Prescott 1961, p. 68, pl. 29, fig. 3.
   Long cell 40.0 μm, lateral cell 38.0 μm, Isthmus 10.0 μm.

   Collection number, date and site: UTFH 15; 29 Oct. 2005; Chatta Tal, Pilibheet.

Prasad and Misra 1992, p. 182, pl. 24, fig. 16.
Cell 24.0 \(\mu \text{m}\) long, 22.0 \(\mu \text{m}\) broad and isthmus 7.0 \(\mu \text{m}\).
Cell small, slightly longer than broad, deeply constricted, sinus narrow and linear with slightly dilated apex; semicells subquadrangular with rounded angles, sides with 3 broad undulations, apex truncate with straight or faintly undulate margin; cell wall furnished with 2-3 curved and horizontal series of granules with in the margin, each series exhibiting 18-20 granules, centre with 3 protuberances made up of relatively larger granules; top view elliptic; chloroplast axile with a central pyrenoid in each semicell.

Collection number, date and site: UTFH 4; 23 Dec. 2004; Ghannai Tal, Pilibheet.

27. \textit{Cosmarium speciosum} Lund.
(Pl. 2, fig. 9)
Cell 48.5 \(\mu \text{m}\) long, 36.5 \(\mu \text{m}\) broad and isthmus 8.0 \(\mu \text{m}\).
Cells of medium size, about 1.5 times longer than broad; moderately constricted, sinus narrowly linear; semicells sub – rectangular or subpyramidate with rounded angles, sides slightly convex and very gradually attenuated upwards to broadly truncate apex, margin with 4 apical and 7 lateral crenations; cell wall granulate, granules in regular, radial and concentric series, each showing 3-4 granules, space across the base and just above the isthmus exhibits 5-6 vertical series of 6-7 granules; chloroplast axile with two pyrenoids in each semicell.

Collection number, date and site: UTFH 15; 29 Oct. 2005; Chatta Tal, Pilibheet.

28. \textit{Cosmarium spiniferum} West & West (1902)
(Pl. 3, fig. 11)
Scott and Prescott 1961, p. 69, pl. 29, fig. 6, 7.
Long cell 30.0 \(\mu \text{m}\), Lateral cell 25.0 \(\mu \text{m}\), Isthmus 5.0 \(\mu \text{m}\).

Collection number, date and site: UTFH 11; 27 May 2004; Gola River, Kathgodam.

(Pl. 3, fig. 1)
Prasad and Misra 1992, p. 186, pl. 24, fig. 23.
Cell 30.0 \(\mu \text{m}\) long, 24.0 \(\mu \text{m}\) broad and isthmus 5.0 \(\mu \text{m}\).
Cell small, a little longer than broad, sinus narrowly linear; semicells trapiziform, upper half narrowed to broadly truncate apex, sides with 3 faintly bigranulate crenations and apex with 3 or 4 slight undulations; cell wall with some what radially arranged granules within the margin, generally in pair above but single further away, centre with a tumour above the isthmus, consisting of relatively larger granules disposed in irregular, vertical series; chloroplast axile with one pyrenoid in each semicell. Collection number, date and site: UTFH 15; 29 Oct. 2005; Chatta Tal, Pilibheet.

Genus - \textit{Pleurotaenium} Naegeli 1849

1. \textit{Pleurotaenium trabecula} (Ehernberg) Naegeli
(Pl. 8, fig. 3)
Tiffany and Britton 1952, p. 178, pl. 55, fig. 609.
Cell 540.0 \(\mu \text{m}\) long, 30.0 \(\mu \text{m}\) broad, isthmus 30.0 \(\mu \text{m}\) and apex 20.0 \(\mu \text{m}\).
Cells 11-15 times longer than wide; semi cells cyllindric, slightly and gradually attenuated towards the apices, with a single well defined basal inflation and rarely with a single undulation above it, lateral margins straight or slightly convex; apices truncately rounded without tuberules; cell wall colorless, punctate.

Collection number, date and site: UTFH 16; 29 Oct. 2005; Gaushala Tal, Pilibheet, Uttar Pradesh.

Forty-eight taxa of desmids are described from foothills of Western Himalaya, India. \textit{Staurastrum pseudopachyrhyncum} Wolle (1884) is new addition to the desmid flora of India.

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