

Chlorococcales (Chlorophyceae) of Eastern and North-eastern States of India

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Fifty-six taxa of chlorococcales were recorded from different water bodies of eastern and north-eastern states of India. These belong to 21 genera, e.g. *Chlorococcum* (1), *Truebaria* (1), *Pediastrum* (9), *Hydrodictyon* (1), *Botryococcus* (1), *Coenochloris* (1), *Radiococcus* (1), *Coenocystis* (1), *Oocystis* (1), *Glaucocystis* (1), *Chlorella* (1), *Kirchneria* (2), *Kirchnerella* (1), *Ankistrodesmus* (10), *Coelastrum* (3), *Actinastrum* (2), *Tetrastrum* (1), *Crucigenia* (1), *Crucigeniella* (1), *Desmodesmus* (6) and *Scenedesmus* (9). All these species were recorded first time from this region and out of these 16 species reported first from India.

Key Words: Chlorococcales, fifty-six taxa, freshwater, India, Orissa

INTRODUCTION

There are few published records on the chlorococcales flora of India. Till date a total number of 101 species of chlorococcales belonging to 18 genera have been reported from various regions of the country (Philipose 1967; Chadha and Pandey 1977; Patel and Isbella 1977; Kant and Anand 1978; Isacs and Hegde 1980; Patel and George 1982; Sengar and Sharma 1982; Padey *et al.* 1983; Patel and George 1988a, 1988b; Hegde 1990; Patel and Daniel 1990; Srivastava and Odhwani 1990; Jose and Patel 1992; Chaturbedi and Habib 1996; Habib *et al.* 1998; Tarar and Bodke 1998; Habib and Chaturbedi 2000, 2001; Tiwari *et al.* 2001). Eastern and north eastern part of India possess bountiful of freshwater bodies including several rivers, lakes, reservoirs, ponds, streams, canals and waterlogged rice fields. However, the freshwater algal forms including chlorococcales flora of this region has not been documented. In this paper we reported for the first time the chlorococcalean taxa from eastern and north-eastern states of India.

MATERIALS AND METHODS

Totally 80 samples were collected from 64 sites comprising of various habitats, e.g. sewage, pond, ditch,

reservoir, river, stream, moist soil surface and waterlogged rice fields from Orissa, West Bengal, Assam, Meghalaya, Nagaland and Manipur during the period from October 2003 to March 2007. The location of each site was determined with Garmin 12 GPS receiver (Table 1). Samples were collected using plankton net (25 μ m pore size) and stored in sterilized Tarson specimen tubes. Samples were kept in cool ice chest while being transported to the laboratory. After initial observation of the materials were fixed in Lugol's iodine solution (0.5%) for immobilizing the cells to facilitate microscopic examination. Each sample was assigned with a voucher number along with the date of collection, preserved in (4% v/v) formaldehyde and deposited at the department of Botany, Utkal University, Bhubaneswar. Temperature, pH and conductivity of each collection site was measured on the spot using portable thermometer, pH meter (131E electronics, India) and conductivity meter (621E, Electronics, India) respectively. Microphotograph of each specimen was taken using Meiji trinocular research microscope fitted with Nikon coolpix 4500 digital camera. The organisms were identified following the monographs of Prescott (1961), Philipose (1967), Anand (1998), Hegewald and Silva (1988), Hindák (1977, 1980, 1984, 1988), Komárek and Fott (1983), Komárek and Jankovska (2001) and research publications on chlorococcales from India. The taxa were arranged following Komárek and Fott (1983).

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Table 1. List of the sites of collection showing latitude, longitude, voucher number, nature of the habitat/area (approx.) in hectare

Station no.(S)	Place of collection	Latitude	Longitude	Voucher no.	Habitat/area
1	Satsanga vihar, Bhubaneswar, Orissa	20° 20' 4.4" N	85° 44' 88" E	B 33	Small pond (0.25 ha)
2	Nicco park, Acharya vihar, Bhubaneswar	20° 17' 07"N	85° 50' 39.3" E	B107	Small garden tank
3	Acharya vihar, Bhubaneswar	20° 17' 7.8" N	85° 50' 59.3"E	B110	Sewage tank (small)
4	Rameswar temple tank, Khurda, Orissa	20° 19' 54.6"N	85° 59' 83.1" E	144B	Pond (1 ha)
5	Kathajodi river, Cuttack, Orissa	20°27' 28"N	85° 52' 46.6"E	240,244, 246,249	Perennial River
6	Manguli Dam, Cuttack, Orissa	20° 27' 27"N	85° 52' 41.6"E	547	Reservoir (20 ha)
7	Niali, Jagatsingpur Orissa	20° 07' 41.1"N	86° 08' 48.6"E	89	Pond (2 ha)
8	Gopinathpur, Jagatsingpur, Orissa	20° 19' 07.9"N	86° 11' 39.3" E	88	Pond (1 ha)
9	Maniakati, Ganjam, Orissa	19° 48' 78.8"N	84° 22' 46.3"E	107	Pond (1 ha)
10	Nirmalajhara, Ganjam, Orissa	19° 36' 14.1"N	85° 04' 03" E	125	Perennial stream
11	Chikiti, Ganjam, Orissa	20° 32' 23.2"N	83° 24' 42.0"E	737, 750	Pond (small)
12	Stream,Shilong, Meghalaya	25°20' 20.3"N	91° 43' 46.1"E	351	Perennial stream
13	River Mahanadi, Sambalpur, Orissa	21°26' 59.2"N	84° 00' 12.6"E	436	Perennial river
14	Road side, Padpadar, Baragarh, Orissa	21°19' 52.3"N	83° 37' 13"E	444	Temporary water pool
15	Padpadar, Baragarh, Orissa	21°19' 58.4"N	83° 37' 10.6"E	445	Pond (0.5 ha)
16	Garabandha,Gajapati, Orissa	18° 51' 06.7"N	84° 12' 8.8"E	617	Pond (0.25 ha)
17	Lanjigada, Kalahandi, Orissa	19° 42' 22.9"N	83° 22' 03.7"E	675	Pond (0.25 ha)
18	Lunung, Similipal Biosphere Reserve, Mayurbhanj, Orissa	22° 06' 15"N	86° 31' 11"E	762	Perennial stream
19	Joranda, Similipal Biosphere Reserve, Orissa	22° 12' 21"N	86° 28' 31"E	763	Perennial stream
20	Nawna, Similipal Biosphere Reserve, Orissa	22° 09' 23"N	86° 30' 21"E	764	Pond (0.25 ha)
21	Khairi rever , Similipal Biosphere Reserve, Orissa	22° 15' 20"N	86° 34' 23"E	766	Perennial river
22	Bhandan river, Similipal Biosphere Reserve, Orissa	22° 19' 23"N	86° 29' 27"E	767	Perennial river
23	West Deo river, Similipal Biosphere, Orissa	22° 10' 27"N	86° 38' 40"E	769	Perennial river
24	Rice field, Bhogarai, Balasore, Orissa	21°54' 36.4"N	87° 21' 05.1"E	197	Rice field (0.2 ha)
25	Krishna sayar park, Burdwan, West bengal	23° 14' 86.3"N	87° 50' 89.1"E	700,701, 702	Pond (2 ha)
26	Santiniketan, Birbhum, West bengal	23° 39' 39.6"N	87° 42' 20.8"E	711	Pond (1 ha)
27	Kalnabipass, Assam, Burdwan, West Bengal	23° 41' 28.8 "N	86° 59' 38"E	861	Polluted canal
28	Brahmaputra river, Guwahati, Assam	26° 10' 49"N	91° 40' 17.1"E	919, 920	Perennial river
29	Barik nagar, Cachar, Assam	24° 44' 3.5"N	92° 47' 32.2"E	933, 934	Small pond (0.5 ha)
30	Silkuri, Cachar, Assam	24° 43' 49.8"N	92° 47' 16"E	946, 948	Small pond (0.5 ha)
31	Silkuri, Near Baramhaha Mandir, Cachar, Assam	24° 43' 49.3"N	92° 47' 15.3" E	950	Pond (3 ha)
32	Machhghat, Silchar, Cachar, Assam	24° 42' 25"N	92° 46' 06.1" E	963, 964	Puddle (0.2 ha)
33	Irongmona gaon, Silchar, Cachar, Assam	24° 40' 59.2"N	92° 44' 32.2"E	967, 968	Pond (0.5 ha)
34	Roskendi, Tea garden, Silchar, Assam	24° 41' 12.2"N	92° 43' 22.3" E	970	Pond (1 ha)
35	Dobanki (island) Tiger reserve, Sudarban, West Bengal	21° 59' 21"N	88° 45' 17.4"E	978, 979	Small pond (0.2 ha)
36	Pakhirala, South 24-Parganas, West Bengal	22° 07' 47.8"N	88° 49' 21.9" E	985, 987	Small pond (0.25 ha)
37	Pakhirala, South 24-Parganas, West Bengal	22° 07' 47.8" N	88° 49' 21.9" E	988	Temporary water pool
38	Masjidbadi, South 24-Parganas, West Bengal	22° 10' 36" N	88° 46' 20.16"E	994	Small pond (0.3 ha)
39	Kalibartala, South 24-Parganas, West Bengal	22° 14' 24.7"N	88° 41' 32.7"E	1007	Temporary water pool
40	Sultanpur, Diomand harbour, South 24-Parganas, West Bengal	22° 10' 27.1" N	88° 12' 15.5"E	1018	Sewage Temporary polluted water)
41	Ratneswarpur, Diomand harbour, South 24-Parganas, West Bengal	22° 11' 34.8"N	88° 12' 36.3"E	1025	Small pond (0.5 ha)
42	Sultanpur, Diomand harbour, South 24-Parganas, West Bengal	22° 19' 11.4" N	88° 12' 12.8"E	1028	Temporary water pool
43	Chiranjibipur, Haldia Purba Medinipur, West Bengal	22° 03' 13.1" N	88° 05' 31.6"E	1047	Temporary water pool
44	Sciencity, Salt lake, Kolkata, West Bengal	22° 32' 29.7" N	88° 23' 47.4"E	1068, 1069	Drain (Polluted water)

Table 1. (continued)

Station no.(S)	Place of collection	Latitude	Longitude	Voucher no.	Habitat/area
45	Danuswari river, Dimapur, Nagaland	25° 54' 46.8" N	93° 44' 36.1" E	1084	Perennial river
46	Purana Bazar, Dimapur, Nagaland	25° 53' 44.4" N	93° 45' 16.7" E	1089	Small pond (0.5 ha)
47	Green park, Dimapur, Nagaland	25° 51' 30.7" N	93° 45' 50.7" E	1099	Temporary water pool
48	Green park, Dimapur, Nagaland	25° 51' 30.7" N	93° 45' 50.7" E	1101	Temporary water pool
49	Imphal river, Imphal, Manipur	24° 48' 09" N	93° 56' 53" E	1112, 1113	Perennial river
50	Loktak lake, Sedra, Manipur	24° 30' 26.7" N	93° 47' 04.1" E	1118	Largest lake (87.000 sq. miles)
51	Dikho river, Sibsagar, Assam	26° 58' 30" N	94° 37' 46.9" E	1133	Perennial river
52	Jaysagar, Jorhat, Assam	26° 57' 12.3" N	94° 37' 37.4" E	1134, 1135	Pond (5 ha)
53	Road side canal, Jaysagar, Jorhat, Assam	26° 57' 12.3" N	94° 37' 37.4" E	1140	Canal (flowing water)
54	Jaji river, Jorhat, Assam	26° 50' 49.6" N	94° 26' 30.7" E	1144	Perennial river
55	Mahi lake, Kajiranga National Park, Assam	26° 36' 41.1" N	93° 22' 40.5" E	1148	Lake (70 ha)
56	Kaulimardi lake, Kajiranga Nation Park, Assam	26° 38' 45.3" N	93° 20' 51.7" E	1149	Lake (50 ha)
57	Diffolo river, Kajiranga National Park, Assam	26° 38' 45.3" N	93° 20' 51.7" E	1153	Perennial river
58	Dhonsiri river, Numaligarh, Assam	26° 27' 51.4" N	93° 43' 46.4" E	1160, 1162	Perennial River
59	Brahmaputra river, Namati, Jorhat, Assam	26° 51' 34.5" N	94° 14' 48.9" E	1167	Perennial River
60	Brahmaputra river, Majuli river island, Assam	26° 52' 49" N	94° 12' 55.7" E	1170	Perennial River
61	Sri Sri Aunikati Sastra, Majuli river island, Assam	26° 56' 18.3" N	94° 07' 24.0" E	1178	Small pond (0.5 ha)
62	Kamadubedi, Jorhat, Assam	26° 56' 18.3" N	94° 07' 24.0" E	1179	Small pond (0.5 ha)
63	Brahmaputra river, Fancy Bazar, Guwahati, Assam	26° 5' 52.7" N	91° 30' 23.7" E	1187, 1188	Perennial River
64	Utkal University, Bhubaneswar, Orissa	20° 20' 6.4" N	85° 44' 48" E	541	Temporary water pool

RESULTS AND DISCUSSION

Details about the sites of collection, habitat, pH, temperature and conductivity of water at the time of collection and voucher number of each sample have been depicted in Table 1. Totally 56 taxa of chlorococcales belonging to 21 genera were recorded from several fresh-water bodies of eastern and north-eastern states of India. Out of these 16 species, e.g. *Treubaria setigera* (Archer) G.M. Smith, *Pediastrum simplex* Meyen var. *biwaense* Fukushima, *Pediastrum simplex* Meyen var. *echinulatum* Wittrock, *Coenochloris polycoeca* (Koršikov) Hindák, *Radiococcus nimbatu* (De Wildeman) Schmidle, *Coenocystis reniformis* Koršikov and *Oocystis rhomboidea* Fott, *Glaucozystis simplex* Tarnogradskij, *Monoraphidium contortum* (Thuret) Komárková and Legnerová, *Ankistrodesmus densus* Koráikov, *Ankistrodesmus fusiformis* Corda, *Ankistrodesmus stipitatus* (Chodat) Komárek and Legnerova, *Ankistrodesmus tortus* Komárek et Comas, *Actinastrum aciculare* Playfair f. *Minimum* (Huber-Pestalozzi) Compère, *Tetrastrum elegans* Playfair, *Desmodesmus protuberans* (Fritsch et Ritz) Hegewald and

Scenedesmus pseudopoliensis Hortobagyi are reported first time from India. Description of each species and systematic enumeration is presented.

Family: Chlorococcaceae Lackman and Tansley 1902.

Sub family: Chlorococcoideae

Genus: *Chlorococcum* Meneghini 1842

1. *Chlorococcum humicolo* (Nägeli) Rabenhorst 1868 (Pl. 1, Fig. 1)

[Synonym: *Chlorococcum humicolum* (Nägeli) Rabenhorst 1915, *Cystococcus humiccolo* Nägeli 1849]

Philipose 1967, p. 73, fig. 3 (b), Prescott 1961, p. 212, pl. 45, fig. 1.

Cells spherical, solitary or number of cells crowded together to form a stratum; chloroplast a hollow sphere with a lateral notch, cells 6-25 µm in diameter, zoospores elliptical, 4.5 µm broad and 3-4 µm long.

Epiphytic in stream and planktic in river; Voucher number, date and site: 351; 6th Dec. 2004; Shilong, Meghalaya (S-12; Temp. 25°C; pH 7.1; Cond. 150 µs); 1170; 29th March 2007; Majuli river island, Assam (S-60).

Family: Treubariaceae (Koršikov) Fott 1960

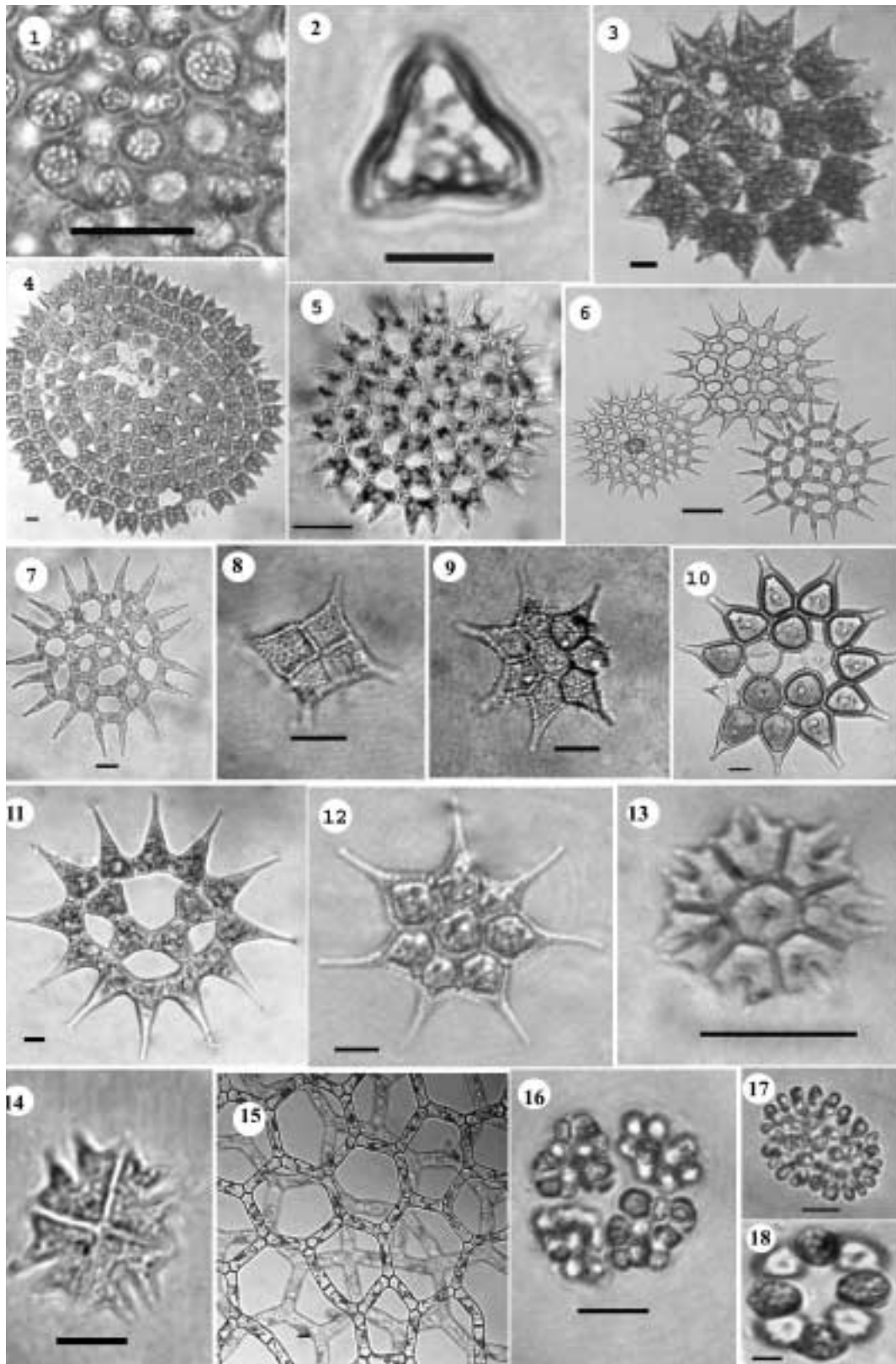


Plate 1. (Figs 1-18) 1. *Chlorococcum humicola* (Näg.) Rabenh., 2. *Treubaria setigera* (Arch.) G.M. Sm., 3. *Pediastrum duplex* Mey. var. *asperum* (A. Br.) Hansg. 4. *Pediastrum duplex* Mey. var. *cornutum* (Racib.) Sulek, 5. *Pediastrum duplex* Mey. var. *duplex* Sulek, 6-7. *Pediastrum simplex* Mey. var. *biwaense* Fukush., 8-9. *Pediastrum simplex* Mey. var. *echinulatum* Wittr., 10. *Pediastrum simplex* Mey. var. *pseudoglabrum* Parra, 11. *Pediastrum simplex* Mey. var. *simplex* Kom., 12. *Pediastrum simplex* Mey. var. *sturmii* (Reins.) Wolle, 13-14. *Pediastrum tetras* (Ehrenb.) Ralfs, 15. *Hydrodictyon reticulatum* (Linn.) Lagerh., 16-17. *Botryococcus braunii* Kütz. 18. *Coenochloris polycocca* (Korš.) Hind. (Scale bar; Figs 1-18 = 10 µm).

Sub-family: Treubarioideae Kořsikov

Genus: *Treubaria* Berbard emend Raymond 1979

[Synonym: *Borgea* G.M. Smith 1922]

2. *Treubaria setigera* (Archer) G.M. Smith 1933 (Pl. 1, Fig. 2)

[Basionym: *Tetrapedia setigera* W. Archer 1872]

[Synonym: *Tertraedron trilobulatum* (Reinsch) Hansgirg 1888]

Komárek and Fott 1983, p. 267, fig. 79.3, Philipose 1967, p. 137, fig. 50.

Cells solitary, free floating, triangular, sides equal in length, and deeply concave, angles of cells broadly rounded; cell membrane thick and smooth; chloroplast single discoid form without pyrenoid; cells up to 25 μm in diameter.

Planktic in pond, river and canal; Voucher numbers, dates and sites: 737, 750; 14th Jan. 2006; Berhampur; Orissa (S-11; Temp. 27°C; pH 7.9; Cond. 445 μs); 1113; 24th March 2007; Imphal, Manipur (S-49; Temp. 26°C; pH 7.7; Cond. 201 μs).

Family: Hydrodictyaceae Cohn 1880

Genus: *Pediastrum* Meyen 1829

3. *Pediastrum duplex* Meyen var. *asperum* (A. Braun) Hansgirg 1886 (Pl. 1, Fig. 3)

[Synonym: *Pediastrum pertusum* var. *asperum* A. Braun 1855]

Philipose 1967, p. 121, fig. 43; Komárek and Fott 1983, p. 301-302, fig. 90.3; Komárek and Jankovska 2001, p. 58, fig. 34.

Coenobia 16-32-64 celled, 90 μm in diameter, small lens shaped perforation between cells, inner cells quadrate to angular and in contact at the central portion of the side wall, inner side of marginal cells concave, outer sides produced into two short truncate processes; chloroplast single and parietal with a pyrenoid; cells 8-18 μm in diameter.

Epiphytic (attached to leaf), epipellic in wet soil and sand in river; Voucher number, date and site: B33; 20th Jan. 2004; Bhubaneswar, Orissa (S-1; Temp. 28°C; pH 7.5; Cond. 300 μs); 246; 18th April 2004; Cuttack, Orissa (S-5; Temp. 30°C, pH 7.5; Cond. 221 μs).

4. *Pediastrum boryanum* (Turpin) Meneghini var. *cornutum* (Raciborski) Sulek 1969 (Pl. 1, Fig. 4)

[Basionym: *Pediastrum duplex* Meyen var. *conrutum* (Raciborski) Sulek 1890]

Komárek and Fott 1983, p. 296, fig. 87.2.

Coenobia 16-32-64 celled and more, coenobia 120 -214 μm in diameter, inner cells four cornered with a small

lens-shaped perforation in front and another at the back, marginal cells slightly longer than broad, lateral cells in contact along one third the length, processes of marginal cells ending in short spines; chloroplast single, parietal with a pyrenoid; cells 12-15 μm broad and 15-25 μm long.

Epiphytic in pond (attached to leaf); Voucher number, date and site: B33; 20th Jan. 2004; Bhubaneswar, Orissa (S-1; Temp. 28°C; pH 7.5; Cond. 300 μs).

5. *Pediastrum duplex* Meyen var. *duplex* Sulek 1969 (Pl. 1, Fig. 5)

[Synonym: *Pediastrum pertusum* Kützing 1845]

Komárek and Jankovska 2001, p. 58, fig. 32.

Coenobia 16 celled, 50 -70 μm in diameter, intercellular spaces large and oval in between the inner cells; cells more or less H-shaped with marginal sides, cells nearly parallel; chloroplast single and parietal with a distinct pyrenoid; cells 12-15 μm in diameter.

Epiphytic in pond (attached to leaf) and in lake; Voucher number, date and site: B33; 20th Jan. 2004; Bhubaneswar, Orissa (S-1; Temp. 28°C; pH 7.5; Cond. 300 μs); 1118; 25th March 2007; Loktak lake, Manipur (S-50; Temp. 25°C; pH 7.8; Cond. 123 μs); 1135; 27th March 2007; Jaysagar, Assam (S-52; Temp. 25°C; pH 7.5; Cond. 190 μs).

6. *Pediastrum simplex* Meyen var. *biwaense* Fukushima 1953* (Pl. 1, Figs 6 & 7)

Komárek and Fott 1983, p. 290, fig. 85.2.

Coenobia 16-32 or more celled, circular; large intercellular spaces or a single central space with the cells arranged in a ring at the periphery; inner face of marginal cells concave, outer face prolonged into a single tapering processes; side of marginal cells concave on nearly straight; inner cell cells similar to marginal cells but short in processes; cell wall smooth or slightly punctuate; cells 7- 20 μm broad and 10-35 μm long; coenobia up to 130 μm in diameter.

Planktic in river; Voucher number, date and site: 1162; 28th March 2007; Golaghat, Assam (S-58); 1167; 29th March 2007; Jorhat, Assam (S-59).

7. *Pediastrum simplex* Meyen var. *echinulatum* Wittrock 1983 (Pl. 1, Figs 8 & 9)

Komárek and Fott 1983, p. 288, fig. 85.1, Krienitz *et al.* 1998, p.66, fig. 6a.

Coenobia mostly 4-celled, the cells are arranged in a plate, which is continuous or with interstices; outer cells have one elongated outward pointing process, inner cell polygonal, cell wall surface of each cell is ornamented with teeth like protuberance; teeth 1-1.5 μm long; cells 6-

10 μm broad and 10-25 μm long.

Planktic in pond; Voucher number, date and site: 1101; 22nd March 2007; Dimapur, Nagaland (S-48; Temp. 28°C; pH 7.3; Cond. 170 μs).

8. *Pediastrum simplex* Meyen var. *pseudoglabrum* Parra 1979 (Pl. 1, Fig. 10)

Komárek and Jankovska 2001, p. 32, fig.12c.

Coenobia 8-16 celled, cells arranged in a ring round a central space with one or more interior cells and a number of marginal cells, perforate; central cell convex, cell wall smooth; chloroplast single parietal with a large pyrenoid; 8 celled coenobia up to 80 μm and 16 celled coenobia up to 100 μm in diameter; cells 8.5-18 μm broad and 14-37 μm long.

Epilithic in waterfall and planktic in pond; Voucher number, date and site: 617; 26th Oct. 2005; Garabandha, Gajapati, Orissa (S-16; Temp. 29°C; pH 7.6; Cond. 279 μs).

9. *Pediastrum simplex* Meyen var. *simplex* Komárek 1983 (Pl. 1, Fig. 11)

[Synonym: *Pediastrum ovatum* (Ehrenberg) A. Braun 1855]

Komárek and Jankovska 2001, p. 32-33, fig. 12.A.

Coenobia circular, 8-16 celled coenobia up to 80-85 μm in diameter; large intercellular spaces or a central space with the cells arranged in a ring at the periphery, inner side of marginal cells concave, outer surface prolonged into a single delicately tapering process, sides of marginal cells concave or straight, internal cells similar to marginal cells with shorter process, cell wall smooth; chloroplast single and parietal; cells 12-15 μm broad and 20-25 μm long.

Epilithic in pond, road side ditch and reservoir; Voucher number, date and site: 143B; 5th Feb. 2004; Khurda, Orissa (S-4; Temp. 27°C; pH 7.2; Cond. 275 μs); 444, 28th March 2005, Baragarh, Orissa (S-14; Temp. 30°C; pH 7.4; Cond. 400 μs); 547; 5th Oct. 2005; Cuttack, Orissa (S-6; Temp. 26°C; pH. 8.3; Cond. 121 μs); 988; 3rd March 2007; South 24-Parganas, West Bengal (S-37; Temp. 28°C; pH 7.3; Cond. 220 μs).

10. *Pediastrum simplex* Meyen var. *sturmii* (Reinsch) Wolle 1887 (Pl. 1, Fig. 12)

[Synonym: *Pediastrum sturmii* Reinsch 1867, *Pediastrum sturmii* var. *crenatum* Prescott 1965]

Komárek and Fott 1983, p. 288, fig. 84.2; Komárek and Jankovska 2001, p. 34, pl. 7.

Coenobia 8-16 celled, inner side of marginal cells nearly straight, outer side produced into a gradually tapering process, sides concave, cells polygonal, cells in contact

with adjacent cells without intercellular spaces; chloroplast single and parietal, cell wall smooth, cells 5-13 μm broad and 20-30 μm long.

Planktic in pond; Voucher number, date and site: 617; 26th Oct. 2005; Garabandha, Gajapati, Orissa (S-16; Temp. 29°C; pH 7.6; Cond. 279 μs).

11. *Pediastrum tetras* (Ehrenberg) Ralfs 1844 (Pl. 1, Fig. 13, 14)

[Basionym: *Micrasterias tetras* Ehrenberg 1838]

[Synonym: *Pediastrum rotula* Kützing 1845, *Pediastrum ehrenbergii* (Corda) A. Braun 1855, *Pediastrum incavatum* Turner 1892]

Philipose 1967, p. 128, fig. 45(b); Komárek and Jankovska 2001, p. 68, fig. 43.

Coenobia circular, 8 celled, 20-33 μm in diameter, coenobia a flat plate; cells without intercellular spaces; marginal cells divided into two lobes with a deep single linear incision, inner cells 4-6 sided with a single linear incision, cells 6-8 μm in diameter.

Epilithic and planktic in pond; Voucher number, date and site: 702; 28th Nov. 2005; Santiniketan, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μs); 985; 3rd March 2007; South 24-Parganas, West Bengal (S-36; Temp. 26°C, pH 7.7, Cond 210 μs); 994; 3rd March 2007; South 24-Parganas, West Bengal (S-38; Temp. 27°C; pH 7.3; Cond. 210 μs).

Genus: *Hydrodictyon* Roth 1800

12. *Hydrodictyon reticulatum* (Linnaeus) Lagerheim 1883 (Pl. 1, Fig. 15)

[Basionym: *Conferva reticulatum* Linnaeus 1753]

[Synonym: *Hydrodictyon pentagonum* Voucher 1800]

Philipose 1967, p. 134, fig. 48 (a); Komárek and Fott 1983, p. 317, fig. 95.2.

Coenobia reticulate net-like, meshes pentagonal or hexagonal, up to 15-20 cm long; cells elongate-cylindrical, coenocytes with large central vacuole, cell wall two layered; chloroplast single, parietal and with a single pyrenoid; cells up to 250 μm broad and up to 1.5-2 cm long.

Epiphytic in rice field, free floating in stagnant water in river; Voucher number, date and site: 197; 2nd March 2004; Balasore, Orissa (S-24; Temp. 29°C; pH 7.4; Cond. 395 μs); 249; 18th April, 2004; Cuttack, Orissa (S-5; Temp. 30°C, pH 7.5; Cond. 221 μs); 920; 2nd Dec. 2006; Guwahati, Assam (S-28; Temp. 24°C; pH 7.4; Cond. 186 μs); 1084; 22nd March 2007; Dimapur, Nagaland (S-45, Temp. 28°C, pH 7.7, Cond. 204 μs); 1112, 1113; 24th March 2007; Imphal, Manipur (S-49; Temp. 26°C; pH 7.7; Cond. 201 μs); 1149; 28th March 2007; Kajiranga National

Park, Assam (S-56); 1160, 1162; 28th March 2007; Golaghat, Assam (S-58); 1187, 1188; 30th March 2007; Guwahati, Assam (S-63).

Family: Botryococcaceae Wille 1909

Sub family Botryococcoidea

Genus: *Botryococcus* Kützing 1849

[Synonym: *Botryodictyon* Lemmermann 1903, *Botrysphaera* Chodat 1922]

13. *Botryococcus braunii* Kützing 1849 (Pl. 1, Fig. 16 & 17)

[Synonym: *Botryococcus giganteus* Reinsch 1877]

Komárek and Fott 1983, p. 379, fig. 113.4, Prescott, 1961, p. 232, pl. 52, fig. 1 and 2, Philipose 1967, p. 195, fig. 108, a and b.

Coenobia in irregular shape, often united in compound net like aggregates by long delicate mucilaginous projections from the colonial envelope; cells ovoid or ellipsoid and arranged radially at the periphery of the coenobia, cells 2-6 μm broad, 4-13 μm long; simple coenobia up to 100 μm in diameter.

Free floating in river; Voucher number; date and site: 1179; 29th March 2007; Jorhat, Assam (S-62); 1187, 1188; 30th March 2007; Guwahati, Assam (S-63).

Family: Radiococcaceae Fott and Komárek 1979.

(Synonym: Palmellaceae Lemmermann 1915, Loeocystidaceae Fott 1971, Palmogloecaceae Fott 1974).

Genus: *Coenochloris* Koršikov 1953

14. *Coenochloris fortii* (Hindák) Tsarenko 1990 (Pl. 1, Figs. 18)

[Basionym: *Coenococcus fottii* Hindák 1977]

[Synonym: *Eutetramorus fottii* (Hindák) Komárek, *Sphaerocystis schroeteri* Chodat]

Coenobia spherical to irregularly spherical, 8 or 16 celled, embedded in a mucilaginous slime layer; 18-30 μm in diameter; each cell 7-9 μm in diameter; chloroplast one, parietal, with one pyrenoid.

Planktic in pond and in river; Voucher number, date and site: B107; 25th April 2004; Bhubaneswar, Orissa (S-2; Temp. 30°C; pH 7.7; Cond. 500); 763; 25th Jan. 2005; Similipal Biosphere Reserve, Orissa (S-19; Temp. 26°C; pH 6.8; Cond. 140 μs); 768 & 769; 26th Jan. 2005; Similipal Biosphere Reserve, Orissa (S-23; Temp. 28°C; pH 7.0; Cond. 390 μs).

Genus: *Radiococcus* Schmidle 1902

15. *Radiococcus nimbatu* (De Wildeman) Schmidle 1902 (Pl. 2, Fig. 1)

[Basionym: *Pleurococcus nimbatu* De-Wildeman 1893]

Thompson 1959, p. 137, fig. 6.155; Komárek and Fott

1983, p. 399, fig.120.3.

Coenobia 4 celled 14-20 μm in diameter; cells more or less pyramidal and angular remaining in a group; chloroplast single, parietal without pyrenoid; cells 5-12 μm in diameter.

Epilithic in drain; Voucher number, date and site: B110; 25th April 2004; Bhubaneswar, Orissa (S-3; Temp. 27°C; pH 7.7; Cond. 349).

Genus: *Coenocystis* Koršikov 1953

16. *Coenocystis reniformis* Koršikov 1953 (Pl. 2, Fig. 2)

Komárek and Fott 1983, p. 412, fig. 124.3.

Cells asymmetric; ellipsoidal, cell wall smooth, cells 3-6 μm in diameter; chloroplast one with a small pyrenoid.

Planktic in pond and river; Voucher number, date and site: 764; 25th Jan. 2005; Similipal Biosphere Reserve, Orissa (S-20; Temp. 29°C; pH 7.1; Cond. 200 μs); 766; 25th Jan. 2005; Similipal Biosphere Reserve, Orissa (S-21; Temp. 28°C; pH 7.1; Cond. 300 μs); 769; 26th Jan. 2005; Similipal Biosphere Reserve, Orissa (S-23; Temp. 28°C; pH 7.0; Cond. 390 μs).

Family: Oocystaceae Bohlin 1901

Sub-family: Oocystoidea

Genus: *Oocystis* A. Braun 1855

17. *Oocystis rhomboidea* Fott 1933 (Pl. 2, Fig. 3)

[Synonym: *Didymogenes dubia* Fott 1923, *Oocystis submarina* Lagerheim var. *variabilis* Skuja 1956]

Hindák 1977, p. 67, pl. 26; Komárek and Fott 1983, p. 510, fig. 149.4.

Coenobia 4-celled; cells elongated-oval with rounded ends 2-3 times as long as broad, 9-15.6 μm broad and 15-25 μm long; 4-celled embedded in a single sheath; coenobia 25-35 μm broad and 30-50 μm long.

Planktic in pond; Voucher number; date and site: 541; 27th Sept. 2005; Utkal University, Bhubaneswar, Orissa (S-64).

Sub family: Glaucocystidoidea

Genus: *Glaucocystis* Itzigsohn in Rabenhorst 1868

18. *Glaucocystis simplex* Tarnogradskij 1959 (Pl. 1, Figs 4, 5 & 6)

Komárek and Fott 1983, p. 553, fig. 160.4.

Coenobia 2-4 celled, enclosed within a mother cell wall; cells oblong-ellipsoid and with a number of radiating chromatophore like bodies inside, cells 10-16 μm broad and 20-30 μm long, coenobium 25-50 μm broad and 40-65 μm long.

Epiphytic in pond and polluted drain; Voucher number, date and site: 946, 948; 3rd Dec. 2006; Silkuri, Assam (S-30; Temp. 23°C; pH 7.6; Cond. 290 μs); 1018; 4th March

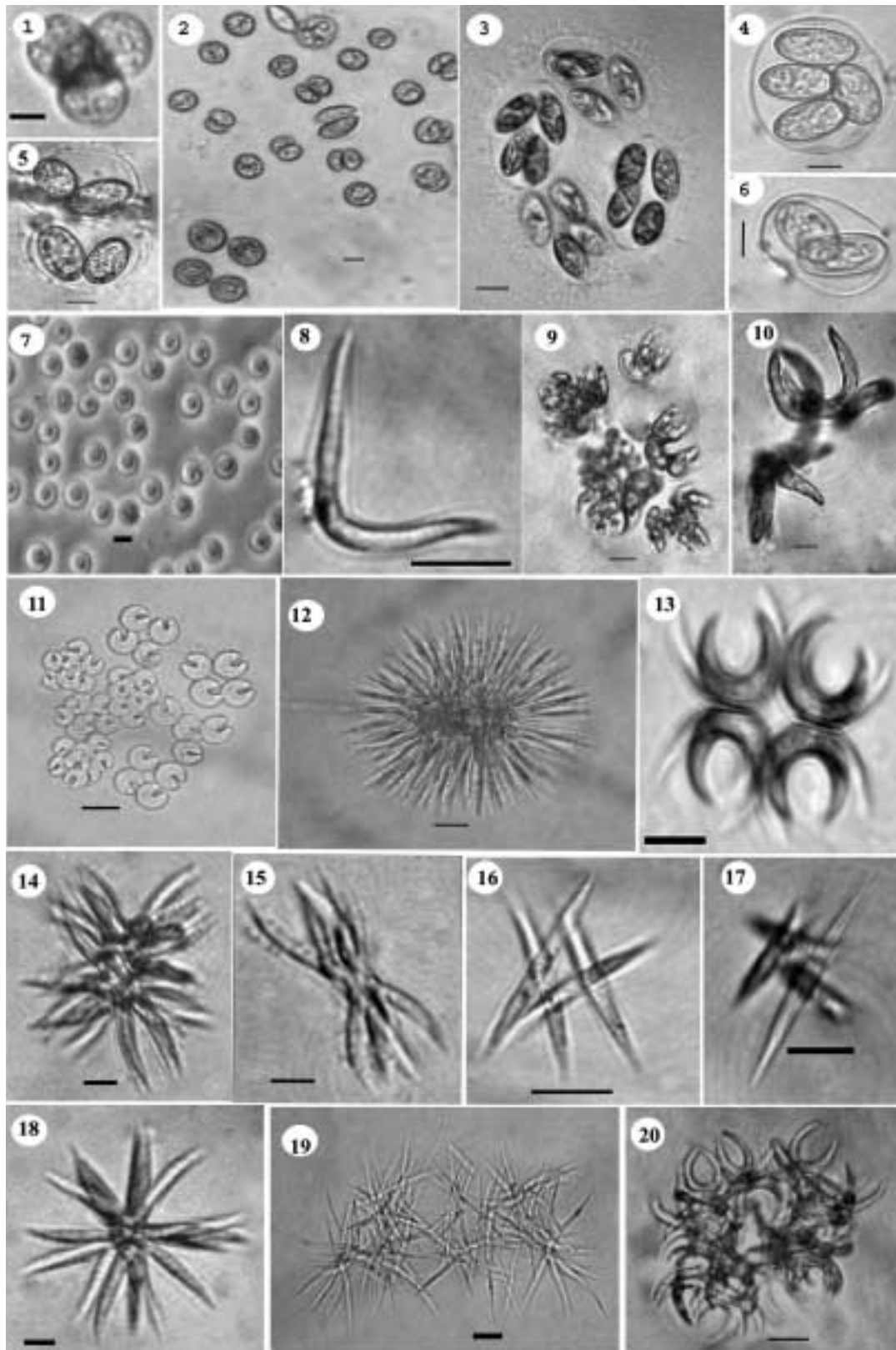


Plate 2. (Figs 1-20) 1. *Radiococcus nimbatu* (De Wild.) Schmid. 2. *Coenocystis reniformis* Korš. 3. *Oocystis rhomboidea* Fott, 4-6. *Glaucocystis simplex* Tarnograd., 7. *Chlorella vulgaris* Beij., 8. *Monoraphidium contortum* (Thur.) Kom.-Legn., 9. *Kirchneria irregularis* (G.M. Sm.) Hind., 10. *Kirchneria rotunda* (Korš.) Hind., 11. *Kirchneilla obesa* (W. West) Schmid., 12. *Ankistrodesmus bernardii* Kom., 13. *Ankistrodesmus bibraianus* (Reins.) Korš., 14-15. *Ankistrodesmus densus* Korš., 16-17. *Ankistrodesmus falcatus* (Cord.) Ralfs, 18. *Ankistrodesmus falcatus* (Cord.) Ralfs var. *radiatus* (Chod.) Lemm., 19. *Ankistrodesmus fusiformis* Cord., 20. *Ankistrodesmus gracilis* (Reins.) Korš. (Scale bar; Figs 1-18 = 10 μ m).

2007; Diamand harbour, South 24-Parganas, West Bengal (S-40; Temp. 28°C; pH 8.2; Cond. 507 μ s).

Family: Chlorollaceae Brunththal 1910

Sub family: Chlorelloideae

Genus: *Chlorella* Beijerinck 1890

19. *Chlorella vulgaris* Beijerinck 1890 (Pl. 1, Fig. 7.)

[Synonym: *Chlorella pyrenoidosa* Chik var. *duplex* (Kützing) West]

Philipose 1967, p. 173, fig. 82(a); Komárek and Fott 1983, p. 594, fig. 168.2.

Cells solitary with a thin cell wall, spherical; chloroplast parietal, cup-shaped with a distinct central pyrenoid; cells 5-5.8 μ m in diameter.

Planktic in stream, river and in pond: Voucher number, date and site: 240; 18th April 2004; Cuttack, Orissa (S-5; Temp. 30°C; pH 7.5; Cond. 221); 762; 25th Jan. 2005; Similipal Biosphere Reserve, Orissa (S-18; Temp. 25°C; pH 6.6; Cond. 120); 767; 26th Jan. 2005; Similipal Biosphere Reserve, Orissa (S-22; Temp. 27°C; pH 7.0; Cond. 245 μ s); 1025; 4th March 2007; Diamand harbour, South 24-Parganas, West Bengal (S-41; Temp. 27°C; pH 7.9; Cond. 230 μ s); 1028; 4th March 2007; Diamand harbour, South 24-Parganas, West Bengal (S-42; Temp. 27°C; pH 8.2; Cond. 215 μ s).

Family: Chlorollaceae Brunththal 1910

Sub family: Ankistrodesmoideae

Genus: *Monoraphidium* 1969

20. *Monoraphidium contortum* (Thuret) Komárková-Legnerová 1969 (Pl. 2, Fig. 8)

[Bsaionym: *Ankistrodesmus contortus* Thuret in Brébisson 1856]

Hindák 1988, p. 200, pl. 74, figs. 1-2.

Cells solitary, arcuate, slightly sigmoid, some times helically twisted, ends pointed, cells 1.5-5 μ m broad and 20-32 μ m long.

Epiphytic in puddle: Voucher number, date and site: 963, 964; 3rd Dec. 2006; Silchar Assam (S-32; Temp. 24°C; pH 7.2; Cond. 202 μ s).

Genus: *Kirchneria* Hindák 1988

21. *Kirchneria irregularis* (G.M. Smith) Hindák 1988 (Pl. 2, Fig. 9)

[Synonym: *Kirchneriella lunaris* (Kirchner) Moebius var. *irregularis* G.M. Smith 1990, *Kirchneriella irregularis* (G.M. Smith) Koršikov 1953, *Kirchneriella irregularis* (G.M. Smith) Koršikov var. *spiralis* Koršikov 1953]

Hindák 1988, p. 226, pl. 82, fig. 2, Komárek and Fott 1983, p. 668, fig. 186.4c.

Coenobia 8-16-32 celled, cells spherical, markedly sigmoid with overlapping ends; chloroplast parietal, ventral side of cells without a pyrenoid; cells 3-5 μ m broad and 20-28 μ m long.

Epiphytic in pond; Voucher number, date and site: 950; 3rd Dec. 2006; Silkuri, Assam (S-31; Temp. 26°C; pH 7.6; Cond. 210 μ s).

22. *Kirchneria rotunda* (Koršikov) Hindák 1988 (Pl. 2, Fig. 10)

[Synonym: *Kirchneriella rotunda* (Koršikov) Hindák 1977, *Ankistrodesmus rotundus* Koršikov 1953]

Hindák 1988, p. 220, pl. 80, Komárek and Fott 1983, p. 664, fig. 186.1.

Cells solitary, sigmoid, usually with overlapping ends rarely, arcuately bent or horshoe-shaped with detached ends, ends bluntly pointed, cells 2.5-4.5 μ m broad and 20-50 μ m long; chloroplast relatively tiny, toughly on the ventral side of the cell, without pyrenoid.

Planktic in pond: Voucher number, date and site: 950, 3rd Dec. 2006; Silkuri, Assam (S-31; Temp. 26°C; pH 7.6; Cond. 210 μ s).

Genus: *Kirchneriella* Scmidle 1893

23. *Kirchneriella obesa* (W. West) Schmidle 1893 (Pl. 2, Fig. 11)

[Basionym: *Selenastrum obesum* W. West 1892]

[Synonym: *Kirchneriella intermedia* Koršikov 1953]

Komárek and Fott 1983, p. 670, fig. 187.4 a-b.

Hindák 1988, p. 210, pl. 75, fig. 3, 4 and pl. 76.

Coenobia 4-8 celled or more cells irregularly arranged, cells strongly lunate with the ends almost near each other, outer side convex, ends of cells tapering with rounded bluntly pointed apices, cells 2-8 μ m broad and 5-20 μ m long.

Epiphytic in canal; Voucher number, date and site: 1140; 27th March 2007; Jaysagar, Assam (S-53; Temp. 27°C; pH 7.9; Cond. 220 μ s).

Genus: *Ankistrodesmus* Corda 1838

[Synonym: *Raphidium* Kützing 1845, *Selenastrum* Reinsch 1867]

24. *Ankistrodesmus bernardii* Komárek 1983 (Pl. 2, Fig. 12)

[Synonym: *Raphidium polymorphum* var. *fasciculatm* Kützing sensu Bernard 1908]

Komárek and Fott 1983, p. 687, fig. 193.3d.

Coenobia of 50-200 celled, median portion of the cells in contact; apices free, cells 1-2 μ m broad and 30-70 μ m long; *coenobia* 70-120 μ m diameter.

Planktic in pond; Voucher number, date and site: 1135; 27th March 2007; Jaysagar, Assam (S-52; Temp. 25°C; pH

7.5; Cond. 190 μ s).

25. *Ankistrodesmus bibraianus* (Reinsch) Koršikov 1953 (Pl. 2, Fig. 13)

[Basionym: *Selenastrum bibraianum* Reinsch 1867]

Philipose 1967, p. 219, fig. 127 (b). Komárek and Fott 1983, p. 688, fig. 194.3.

Coenobia 4-8-16 celled; cells crescent to sickle-shaped with sharply pointed ends; chloroplast single, parietal without pyrenoid; cells 3-5 μ m broad and 20-35 μ m long Planktic in pond; Voucher number, date and site: 737; 14th Jan. 2006; Berhampur, Orissa (S-11; Temp. 27°C; pH 7.9; Cond. 445 μ s).

26. *Ankistrodesmus densus* Koršikov 1953 (Pl. 1, Figs 14 & 15)

[Synonym: *Ankistrodesmus spiralis* var. *fasciculatus* G.M. Smith 1922]

Hindák 1988, p.237, pl. 87.

Coenobia multicelled, denser with interlaced cells; relatively free, slightly detached from each other, colonies assume to spherical shape; cells are equal in length and width, normal from centre towards the ends, ends pointed, 2.5-4 μ m broad and 50-80 μ m long; coenobia 70-80 μ m in diameter.

Planktic in pond; Voucher number, date and site: 737; 14th Jan. 2006; Berhampur, Orissa (S-11; Temp. 27°C; pH 7.9; Cond. 445 μ s); 964; 3rd Dec. 2006; Silchar, Assam (S-32; Temp. 24°C; pH 7.2; Cond. 202 μ s); 1135; 27th March 2007; Jaysagar, Assam (S-52; Temp. 25°C; pH 7.5; Cond. 190 μ s).

27. *Ankistrodesmus falcatus* (Corda) Ralfs 1848 (Pl. 2, Figs. 16 & 17)

[Basionym: *Micrasterias falcata* Corda 1835]

[Synonym: *Ankistrodesmus biplex* (Reinsch) G.S. West 1904, *Ankistrodesmus lundbergii* Koršikov 1953]

Philipose 1967, p. 211, figs. 121 (a & e); Komárek and Fott 1983, p. 686, fig. 192.3.

Coenobia 2-4-8 celled, cells fasciculate bundles; cells acicular to narrowly fusiform with the ends tapering to acute apices; chloroplast single, parietal and without pyrenoid; cells 2-3 μ m broad and 20-165 μ m long.

Planktic in pond; Voucher numbers, dates and sites: 737, 750; 14th Jan. 2006; Berhampur; Orissa (S-11; Temp. 27°C; pH 7.9; Cond. 445 μ s); 700, 28th Nov. 2005; Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μ s); 1007; 3rd March 2007; South 24-Parganas, West Bengal (S-39; Temp. 26°C; pH 7.8; Cond. 180 μ s); 1135, 1136; 27th March 2007; Jaysagar, Assam (S-52; Temp. 25°C; pH 7.5; Cond. 190 μ s); 1144; 27th March 2007; Jorhat, Assam (S-54; Temp. 27°C; pH 7.3; Cond. 203 μ s);

1153, 28th March 2007; Kajiranga National Park, Assam (S-57); 1178; 29th March 2007; Majuli river island, Assam (S-61).

28. *Ankistrodesmus falcatus* (Corda) Ralfs var. *radiatus* (Chodat) Lemmermann 1908 (Pl. 2, Fig. 18)

[Synonym: *Raphidium polymorphum* var. *radiatum* Chodat 1902]

Philipose 1967, p. 213, fig. 121 (d).

Coenobia 4-8 celled, cells arranged in a radiating bundle, ends tapering to acute apices, straight; chloroplast single, parietal, without pyrenoid; cells 2-3 μ m broad and 40-100 μ m long.

Epiphytic in pond (attached to leaf); Voucher number, date and site: B33; 20th Jan. 2004; Bhubaneswar, Orissa (S-1; Temp. 28°C; pH 7.5; Cond. 300 μ s).

29. *Ankistrodesmus fusiformis* Corda ex Koršikov 1953 (Pl. 2, Fig. 19)

[Synonym: *Ankistrodesmus falcatus* (Corda) Ralfs sensu Printz 1914 and Hortobagyi 1969]

Komárek and Fott 1983, p. 686, fig. 192.2.

Coenobia intertwined to crosswise oriented; fusiform shaped cells with the ends tapering to acute apices usually in fasciculate boundless of 2-4-8 or more, cells 2-4 μ m broad and 20-50 μ m long.

Planktic or free floating in pond; Voucher number, date and site: 970; 3rd Dec. 2006; Silchar Assam (S-34; Temp. 24°C; pH 7.7; Cond. 247 μ s).

30. *Ankistrodesmus gracilis* (Reinsch) Koršikov 1953 (Pl. 2, Fig. 20 and Pl. 3, Fig. 1)

[Basionym: *Selenastrum gracile* Reinsch 1867]

[Synonym: *Selenastrum westii* G.M. Smith 1920]

Komárek and Fott 1983, p. 688, fig. 194.2.

Coenobia 4-8-16 celled, cells are markedly arcuate, semicircular to sub-circular, only slightly sigmoid, distance between the cells ends, ends acute, chloroplast without pyrenoid; cells 11.5-5 μ m broad and 15-50 μ m long.

Planktic or free floating or epiphytic in pond; Voucher number, date and site: 950; 3rd Dec. 2006; Silkuri, Assam (S-31; Temp. 26°C; pH 7.6; Cond. 210 μ s); 1007; 3rd March 2007; South 24-Parganas, West Bengal (S-39; Temp. 26°C; pH 7.8; Cond. 180 μ s).

31. *Ankistrodesmus spiralis* (Turner) Lemmermann 1908 (Pl. 3, Fig. 2)

[Basionym: *Raphidium spirale* Turner 1892]

Komárek and Fott 1983, p. 687, fig. 192.4.

Coenobia 4-8 celled; cells acicular with acute apices spirally twisted round one another in the median region but free at the ends; chloroplast single and without

pyrenoid; cells 1-3.5 μm broad and 20-50 μm long.

Planktic in pond; Voucher number, date and site: B33; 20th Jan. 2004; Bhubaneswar, Orissa (S-1; Temp. 28°C; pH 7.5; Cond. 300 μs); 1135; 27th March 2007; Jaysagar, Assam (S-52; Temp. 25°C; pH 7.5; Cond. 190 μs).

32. *Ankistrodesmus stipitatus* (Chodat) Komárek and Legnerova 1969 (Pl. 3, Fig. 3)

[Synonym: *Raphidium fasciculatum* status *stipitatus* Chodat 1902, *Ankistrodesmus falcatus* (Corda) Ralfs sensu G.M. Smith 1920 and Prescott 1951]

Komárek and Fott 1983, p. 684, fig. 191.2.

Coenobia 2-8 celled; cells parallel joined at the middle, curved towards the ends, pointed ends; cells 3-8 μm broad and 50-100 μm long.

Planktic in pond; Voucher number, date and site: 933; 3rd Dec. 2006; Barik nagar, Assam (S-29; Temp. 24°C; pH 7.9; Cond. 195 μs).

33. *Ankistrodesmus tortus* Komárek et Comas 1982 (Pl. 3, Fig. 4)

Hindák 1988, p. 233, pl. 85.

Coenobia 4-celled, cells are elongate, fusiform to cylindrically fusiform, ends pointed, straight to slightly or markedly arcuate and sigmoid, twisted around one another or overlapping, cells 1-2.5 μm broad and 30-60 μm long.

Epiphytic in pond and in puddle; Voucher number, date and site: 946; 3rd Dec. 2006; Silkuri, Assam (S-30; Temp. 23°C; pH 7.6; Cond. 290 μs); 964; 3rd Dec. 2006; Silchar Assam (S-32; Temp. 24°C; pH 7.2; Cond. 202 μs).

Family: Coelastraceae Wille 1909

Genus: *Coelastrum* Nägeli 1849

[Syn. *Hariotina* Dangeard 1889]

34. *Coelastrum astroideum* De -Notaris 1867 (Pl. 3, Fig. 5)

[Syn. *Coelastrum microporum* f. *astroidea* (De-Notaris) Nägeli 1949]

Komárek and Fott 1983, p. 725, fig. 202.4.

Coenobia 8-16 celled; 38-46 μm in diameter; cells oval, small intracellular spaces in coenobia, cells enclosed by a delicate gelatinous sheath and closely interconnected by gelatinous process; chloroplast cup-shaped to diffuse with pyrenoid; cells 10-15 μm in diameter.

Planktic in sewage and epiphytic in pond; Voucher number; date and site: B110, 25th April, 2004, Bhubaneswar, Orissa (S-3, Temp. 27°C; pH 7.7; Cond. 349 μs); 445, 28th March 2005, Baragarh, Orissa (S-15; Temp. 28°C; pH 7.2; Cond. 225 μs); 963; 3rd Dec. 2006; Silchar Assam (S-32; Temp. 24°C; pH 7.2; Cond. 202 μs).

35. *Coelastrum proboscideum* Bohlin 1896 (Pl. 3, Fig. 6)

[Syn. *Coelastrum microporum* f. *typica* Wolle 1887, *Coelastrum irregulare* Schröder 1897, *Coelastrum pseudocubium* Schröder 1897]

Philipose 1967, p. 229, fig. 137(a); Komárek and Fott 1983, p. 726, fig. 203.1.

Coenobia more or less pyramidal, 8-16 celled, 40-110 μm in diameter, intercellular spaces usually large and polygonal, cells truncate and six-sided with the lateral sides slightly concave, poles of thickened, 6-12 μm in diameter.

Epiphytic and planktic in pond; Voucher numbers; dates and sites: 445; 28th March 2005; Baragarh, Orissa (S-15; Temp. 28°C; pH 7.2; Cond. 225 μs); 737; 14th Jan. 2006; Berhampur; Orissa (S-11; Temp. 27°C; pH 7.9; Cond. 445 μs).

36. *Coelastrum reticulatum* (Dangeard) Senn 1899 (Pl. 3, Fig. 7)

[Basionym: *Hariotina reticulata* Dangeard 1889]

[Synonym: *Coelastrum distans* Turner 1892, *Coelastrum subpulchrum* Legerheim 1893]

Philipose 1967, p. 232, fig. 142(a); Komárek and Fott 1983, p.737, fig. 206.1.

Coenobia spherical, 8-16-32 celled, 30-70 μm diameter; cells spherical, enclosed by a gelatinous sheath, cells interconnected by 6-9 long gelatinous processes; chloroplast single, parietal, without pyrenoid; cells 7-15 μm diameter.

Epiphytic (attached to leaf); Voucher number, date and site: B33; 20th Jan. 2004; Bhubaneswar, Orissa (S-1; Temp. 28°C; pH 7.5; Cond. 300 μs).

Genus: *Actinastrum* Lagerheim 1882

[Synonym: *Cerasterias* Reinsch 1867]

37. *Actinastrum aciculare* Playfair f. *Minimum* (Huber-Pestalozzi) Compère 1976 (Pl. 3, Fig. 8)

[Synonym: *Actinastrum minimum* (Huber-Pestalozzi) 1929, *Actinastrum scroeteri* var. *minimum* (Huber-Pestalozzi) Fott 1977]

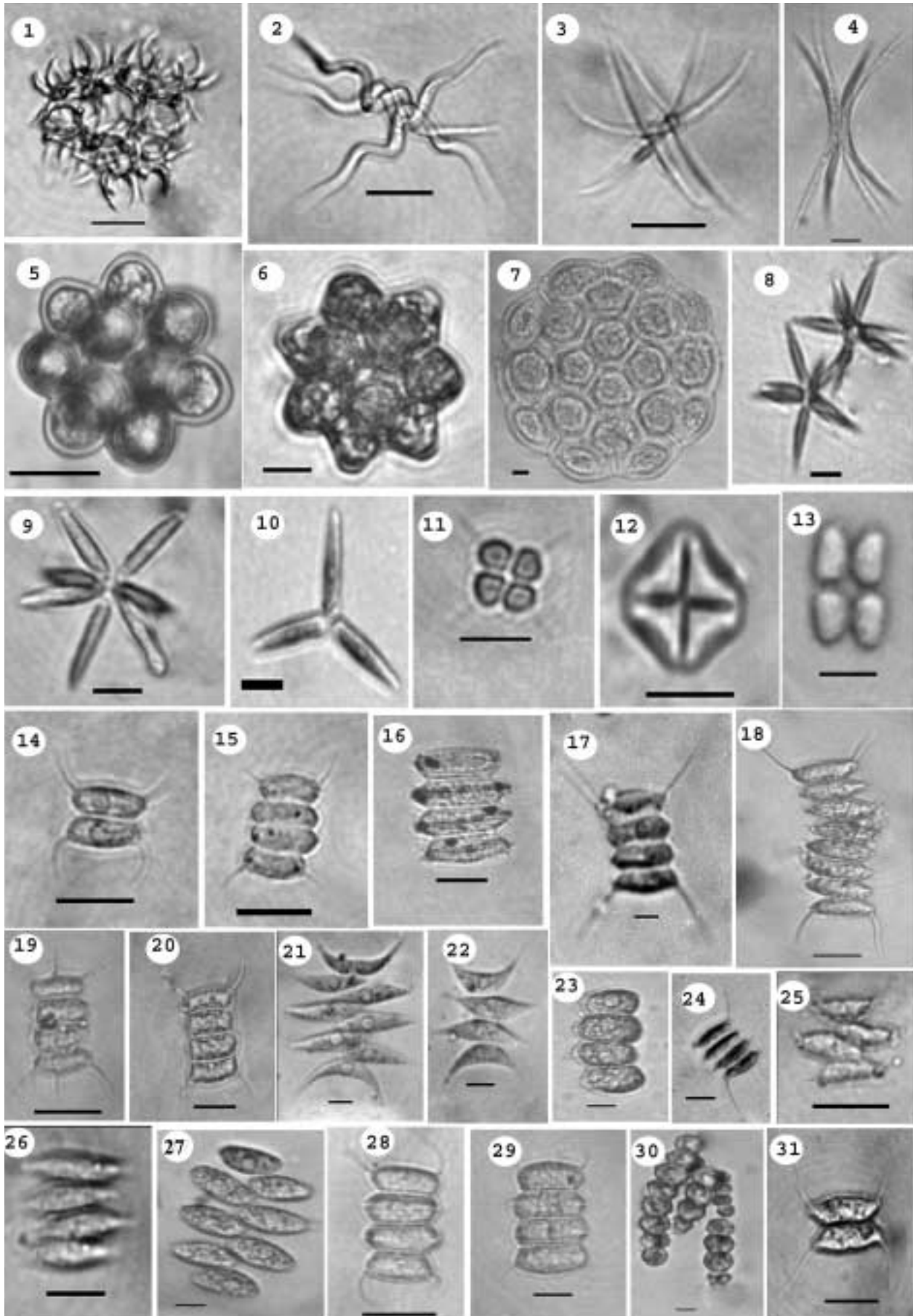
Komárek and Fott 1983, p. 744, Fig. 207.6a.

Coenobia 4-8 celled, radially arranged; joined together to form multiple coenobia; cells from joining attenuated towards apices and ends pointed, cells irregular in size; cells 1-3 μm broad and 5-20 μm long.

Epilithic or planktic in pond; Voucher number; date and site: 701; 28th Nov. 2005; Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μs).

38. *Actinastrum hantzschii* Lagerheim 1882 (Pl. 3, Figs. 9 & 10)

[Synonym: *Actinastrum hantzschii* var. *japanicum* Bernard 1908, *Actinastrum hantzschii* var. *intermedium*



Teiling 1912]

Philipose 1967, p. 216, figs. 125 (a-c); Komárek and Fott 1983, p. 742, fig. 207.2.

Coenobia 4-8 celled, 50 μm in diameter, radially arranged from a common centre; cells spindle-shaped, middle of the cell slightly broad, apices attenuated, slightly rounded; chloroplast single, parietal without pyrenoid; cells 3.2-4 μm broad and 16-19 μm long.

Epilithic or planktic in pond; Voucher numbers; dates and sites: 701; 28th Nov. 2005; Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μs); 988; 3rd March 2007; South 24-Parganas, West Bengal (S-37, Temp. 28°C; pH 7.3; Cond. 220 μs).

Family: Scenedesmaceae Oltmanns 1904

Sub family: Crucigenioideae

Genus: *Tetrastrum* Chodat 1895

[Synonym: *Cohniella* Schröder 1897]

39. *Tetrastrum elegans* Playfair 1917 (Pl. 3, Fig. 11)

[Synonym: *Tetrastrum hastiferum* (Arnoldi) Koršikov 1953, *Tetrastrum tetracanthum* (G.S. West) Braunth sensu Hortobagyi 1943]

Komárek and Fott 1983, p. 770-771, fig. 214.5

Coenobia 4 celled, cells spherical, each cell with transparent appendage from the outer side of the wall, about three times longer than the diameter of the cell; chromatophore green, one parietal chloroplast with a central pyrenoid; cells 5-6 μm in diameter and appendage 12-15 μm long.

Planktic in pond; Voucher number, date and site: 711; 19th Dec. 2005; Santiniketan, West Bengal (S-26; Temp. 27°C; pH 2.4; Cond. 300 μs).

Genus: *Crucigenia* Morren 1930

[Synonym: *Staurogenia* Kützing 1849, *Lemmermannia* Chodat 1900]

40. *Crucigenia tetrapedia* (Kirchner) West et West 1902 (Pl. 3, Fig. 12)

[Basionym: *Staurogenia tetrapedia* Kirchner 1880]

[Synonym: *Tetrapedia kirchneri* Lemmermann 1899, *Lemmermannia tetrapedia* (Kirchner) Lemmermann 1904, *Crucigenia excavata* Conrad 1949]

Philipose 1967, p. 240, fig. 151 (a); Komárek and Fott 1983, p. 787, fig. 219.1.

Coenobia four celled, 7-12 μm diameter, quadrate with an open space in the centre, joined by an inconspicuous mass; cells flattened and triangular with rounded end, outer sides of the cell always concave; chloroplast 1-4, parietal, without pyrenoid; cells 4-8 μm diameter.

Epilithic or planktic in pond; Voucher number, date and site: 700; 28th Nov. 2005; Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μs).

Genus: *Crucigeniella* Lemmermann 1900

41. *Crucigeniella rectangularis* (Nägeli) Komárek 1974 (Pl. 3, Fig. 13)

[Basionym: *Crucigenia rectangularis* (Nägeli) Gay 1891]

Philipose 1967, p. 238, fig. 148, Komárek and Fott 1983, p. 779, fig. 217.1.

Coenobia 4-celled, 7-14 μm broad and 8-20 μm long, rectangular space at the centre, sometimes united together forming multiple coenobia; cells elongated, contacts exist with adjacent ones at the poles; chloroplast single, parietal, without pyrenoid; cells 4-7 μm broad and 4-10 μm long.

Planktic in pond; Voucher number, date and site: 675; 7th Nov. 2005; Kalahandi, Orissa (S-17; Temp. 28°C; pH 7.9; Cond. 472 μs).

Family: Scenedesmaceae Oltmanns 1904

Sub family: Scenedesmoideae

Genus: *Desmodesmus* An 1999

42. *Desmodesmus armatus* (Chodat) var. *spinosus* (Fritsch et Ritch) Hegewald 2000 (Pl. 3, Figs 14 & 15)

[Basionym: *Scenedesmus armatus* (Chodat) var. *spinosus* (Fritsch et Ritch) 1929]

[Synonym: *Scenedesmus armatus* var. *brevicaudatus* (L. Píterfi) Hegewald 1982, *Scenedesmus armatus* var. *boglar-*

Plate 3. (Figs 1-31) 1. *Ankistrodesmus gracilis* (Reins.) Korš., 2. *Ankistrodesmus spiralis* (Turn.) Lemm., 3. *Ankistrodesmus stipitatus* (Chod.) Kom.-Legn., 4. *Ankistrodesmus tortus* Kom. et Com., 5. *Coelastrum astroideum* De-Not., 6. *Coelastrum proboscideum* Boh., 7. *Coelastrum reticulatum* (Dang.) Senn., 8. *Actinastrum aciculare* Playf. f. *Minimum* (Hub.-Pest.) Comp., 9-10 *Actinastrum hantzschii* Lagerh., 11. *Tetrastrum elegans* Playf., 12. *Crucigenia tetrapedia* (Kirch.) W. and G. S. West, 13. *Crucigeniella rectangularis* (Näg.) Kom., 14-15. *Desmodesmus armatus* (Chod.) var. *spinosus* (Fritsch et Ritch) Hegew., 16. *Desmodesmus brasiliensis* (Boh.) Hegew., 17. *Desmodesmus communis* (Hegew.) Hegew., 18. *Desmodesmus protuberans* (Fritsch et Ritch) Hegew., 19. *Desmodesmus spinosus* (Chod.) Hegew., 20. *Desmodesmus tropicus* (Crow) Hegew., 21. *Scenedesmus acuminatus* (Lagerh.) Chodat var. *acuminatus* Kom. and Fott, 22. *Scenedesmus acuminatus* (Lagerh.) Chod. var. *minor* G.M. Sm., 23. *Scenedesmus acunae* Com., 24. *Scenedesmus bicaudatus* Dedus., 25-26 *Scenedesmus obliquus* (Turp.) Kütz., 27. *Scenedesmus obtusus* Mey. f. *obtusus* Mey., 28. *Scenedesmus opoliensis* P. Ritch var. *brevicaudatus* Hortob., 29-30. *Scenedesmus prismaticus* Brühl et Biswas, 31. *Scenedesmus pseudopoliensis* Hortob. (Scale bar; Figs 1-31 = 10 μm).

ensis f. *brevicaudatus* L. Piterfi 1961]

Hegewald *et al.* 1990, p. 21, pl. 30, fig. 2a, and pl. 32b.

Coenobia 2-4 celled; cells oblong to ellipsoid, arranged in a linear series; single short spine arising from each pole of terminal cells, spine sometimes curved towards tips; cells 2-4 μm broad and 5-13 μm long.

Planktic in polluted drain; Voucher number; date and site: 1068; 6th March 2007; Kolkata, West Bengal (S-44; Temp. 28°C; pH 7.9; Cond. 427 μs).

43. *Desmodesmus brasiliensis* (Bohlin) Hegewald 2000 (Pl. 3, Fig. 16)

[Basionym: *Scenedesmus brasiliensis* Bohlin]

[Synonym: *Scenedesmus denticulatus* var. *linearis* f. *semicostatus* (Hortobagyi) Uherkovich 1966, *Scenedesmus armatus* var. *ecornis* Woloszynska sensu Hortobagyi 1939]

Komárek and Fott 1983, p. 870, fig. 235.2, Hegewald *et al.* 1990, p. 29, pl. 73 (c, d, e, f.) and pl. 74, Hegewald 2000, p. 7.

Coenobia 4-celled, cells cylindrical or slightly ellipsoid with attenuated apices, longitudinal ridge from pole to pole on each side of the cell, ends of each cells with 1-3 small teeth; cells 2-7 μm broad and 10-25 μm long.

Epiphytic or planktic in polluted canal, river and pond; Voucher number, date and site: 1133; 27th March 2007; Sibsagar, Assam (S-51; Temp. 26°C; pH. 7.3; Cond. 175 μs); 1140; 27th March 2007; Jaysagar, Assam (S-53; Temp. 27°C; pH 7.9; Cond. 220 μs); 1179, 29th March 2007, Jorhat, Assam (S-62).

44. *Desmodesmus communis* (Hegewald) Hegewald 2000 (Pl. 3, Fig. 17)

[Basionym: *Scenedesmus communis* Hegewald 1977]

[Synonym: *Scenedesmus quadricauda* (Turpin) Brébisson sensu *logispina* (Chodat) G.M. Smith 1913, *Scenedesmus longus* Meyen 1829, *Scenedesmus caudatus* Corda 1835, *Scenedesmus westii* (G.M. Smith) Chodat 1926]

Komárek and Fott 1983, p.828, fig. 249.2; Hegewald and Silva 1988, p. 429, fig. 687, Hegewald 2000, p. 8.

Coenobia 2-4 celled; cells oblong cylindrical with rounded ends, long curved spine; cell wall smooth, cells broader than long; chloroplast single and parietal without pyrenoid; cells 9.6-10.6 μm broad and 24.5-27.3 μm long.

Planktic in pond; Voucher number; date and site: B107; 25th April 2004; Bhubaneswar, Orissa (S-2; Temp. 30°C; pH 7.7; Cond. 500 μs); 700; 28th Nov. 2005, Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μs).

45. *Desmodesmus protuberans* (Fritsch et Ritch) Hegewald 2000 (Pl. 3, Fig. 18)

[Basionym: *Scenedesmus protuberans* Fritsch et Ritch

1920]

[Synonym: *Scenedesmus protuberans* f. *minor* Ley 1947, *Scenedesmus aristatus* Chodat 1926, *Scenedesmus protuberans* var. *danubianus* Uherkovich 1956]

Komárek and Fott 1983, p. 913, fig. 246.5, Hegewald 2000, p. 16.

Coenobia 2-8 celled; cells in linear series, laterally in close contact with adjoining cells except at the ends; long spine arising from outer side of each ends of terminal cells; inner cells end slightly truncate, inner edge with very minute spine or granular thickening; cells 5-7 μm broad and 10-25 μm long; spines 25-30 μm long.

Planktic in pond; Voucher number; date and site: 968; 3rd Dec. 2006; Silchar Assam (S-33, Temp. 25°C; pH 7.9; Cond. 236 μs).

46. *Desmodesmus spinosus* (Chodat) Hegewald 2000 (Pl. 3, Fig. 19)

[Basionym: *Scenedesmus spinosus* R. Chodat 1913]

[Synonym: *Scenedesmus brevicauleatus* R. Chodat 1926, *Scenedesmus corallinus* R. Chodat 1926]

Hegewald *et al.* 1990, p. 38, pl. 104d., Hegewald 2000, p. 17.

Coenobia 2-4 celled; cells oblong-ellipsoid, arranged in a linear series; single short spine arising at each pole of terminal cells, straight, one spine at the middle of terminal cell; cells 2-4 μm broad and 8-15 μm long; spines 5-12 μm long.

Planktic in pond; Voucher number, date and site: 968; 3rd Dec. 2006; Silchar Assam (S-33; Temp. 25°C; pH 7.9; Cond. 236 μs).

47. *Desmodesmus tropicus* (Crow) Hegewald 2000. (Pl. 3, Fig. 20)

[Basionym: *Scenedesmus tropicus* Crow 1923]

[Synonym: *Scenedesmus perforatus* var. *arnatus* Lemmermann f. *cornatus* Massjuk 1962, *Scenedesmus perforatus* var. *oahuensoides* Massjuk 1926]

Jeon and Hegewald 2006, p. 570, figs. 6, 29 and 30, Hegewald 2000, p. 18.

Coenobia 4-celled and sub-quadrate, cells more or less biconvex in the middle attenuated towards the ends and with inflated poles, adjacent cells connected to each other by two narrow processes leaving a linear intercellular perforation, long spine arising from terminal cells pole, recurved spine; cells 6-8 μm broad and 15-25 μm long; spine 17-28 μm long.

Planktic in pond; Voucher number, date and site: 1101; 22nd March 2007; Dimapur, Nagaland (S-48; Temp. 28°C; pH 7.3; Cond. 170 μs).

Genus: *Scenedesmus* Meyen 1829

48. *Scenedesmus acuminatus* (Lagerheim) Chodat var. *acuminatus* Komárek and Fott 1902 (Pl. 3, Fig. 21).

[Synonym: *Selenastrum acuminatum* Lagerheim 1883, *Scenedesmus falcatus* f. *tortuosus* Skuja 1927, *Scenedesmus hungaricus* Hortobagyi 1941, *Scenedesmus acuminatus* f. *tortuosus* (Skuja) Koršikov 1953]

Komárek and Fott 1983, p. 842, fig. 229.1.

Coenobia 4-8 celled, arranged in linear to sub alternating series, outer cells of the coenobia more or less lunate apices of the cells attenuated; chloroplast single and parietal with a pyrenoid at the centre; cells 18-23 μm long and 3.2-8.6 μm broad.

Planktic in river; Voucher number, date and site: 436; 27th March 2005; Sambalpur, Orissa (S-13; Temp. 29°C; pH 7.3; Cond. 300 μs).

49. *Scenedesmus acuminatus* (Lagerheim) Chodat var. *minor* G.M. Smith 1916 (Pl. 3, Fig. 22)

[Synonym: *Scenedesmus falcatus* Chodat 1894]

Komárek and Fott 1983, p. 841, fig. 228.4.

Coenobia 4 celled; outer cell of the coenobia less lunate, the central cell of the colony at an angle to the axes of the terminal cells instead of the being parallel to them; chloroplast single and parietal with a pyrenoid; cells 3-7 μm broad and 20-34 μm long.

Epilithic in pond; Voucher numbers; dates, sites: 701; 28th Nov. 2005; Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μs); 1007; 3rd March 2007; South 24-Parganas, West Bengal (S-39; Temp. 26°C; pH 7.8; Cond. 180 μs); 1101; 22nd March 2007; Dimapur, Nagaland (S-48; Temp. 28°C; pH 7.3; Cond. 170 μs).

50. *Scenedesmus acunae* Comas 1980 (Pl. 3, Fig. 23)

Komárek and Fott 1983, p. 833, fig. 226.8; Hegewald and Silva 1988, p. 56, fig. 71.

Coenobia slightly curved, 2-4 celled, arranged in single linear series, cells oblong-ellipsoid or long cylindrical with the ends broadly rounded; chloroplast single, parietal with a pyrenoid at the centre; cells 5-7 μm broad, 7-23 μm long.

Epilithic in pond; Voucher number; date, site: 701; 28th Nov. 2005; Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μs).

51. *Scenedesmus bicaudatus* Dedussenko 1925 (Pl. 3, Fig. 24)

[Synonym: *Scenedesmus quadricauda* var. *bicaudatus* Hansgirg 1892, *Scenedesmus longispina* Chodat sensu Woloszyńska, *Scenedesmus diagonalis* Fang 1933, *Scenedesmus bicaudatus* (Hansgirg) Chodat 1926]

Komárek and Fott 1983, p. 890, fig. 240.5; Hegewald and Silva 1988, p. 114, fig. 181.

Coenobia two or four celled, 8.3-12 μm broad and 10-18.5 μm long; a long spine from one of the poles of the terminal cell only, the spine of the two terminal cells alternating with each other, longitudinal ribs seen in the internal cells, chloroplast single and parietal with a small pyrenoid at the centre; cells 2.5-4.6 μm broad and 8.3-12 μm long.

Epilithic or planktic in pond and in polluted drain; Voucher number; date, site: 701; 28th Nov. 2005; Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 μs); 711; 19th Dec. 2005; Santiniketan, West Bengal (S-26; Temp. 27°C; pH 2.4; Cond. 300 μs); 1068; 6th March 2007; Kolkata, West Bengal (S-44; Temp. 28°C; pH 7.9; Cond. 427 μs).

52. *Scenedesmus obliquus* (Turpin) Kützing 1833 (Pl. 3, Fig. 25-26)

[Basionym: *Achnanthes obliqua* Turpin 1820]

[Synonym: *Scenedesmus bijugatus* Kützing 1833, *Scenedesmus acutus* var. *obliquus* (Turpin) Rabenhorst 1868, *Scenedesmus oblongus* Chodat 1913]

Komárek and Fott 1983, p. 837, fig. 227.3, Hegewald *et al.* 1990, pl. 2-4.

Coenobia usually 4-celled, cells arranged in a linear on sub-linear series, fusiform with acute or slightly rounded ends; cells 2-8 μm broad and 10-20 μm long.

Planktic in pond; Voucher number; date, site: 967, 968; 3rd Dec. 2006; Silchar, Assam (S-33; Temp. 25°C; pH 7.9; Cond. 236 μs).

53. *Scenedesmus obtusus* Meyen f. *obtusus* Meyen 1829 (Pl. 3, Fig. 27)

[Synonym: *Scenedesmus bijugatus* var. *arcuatus* Lemmermann 1898, *Scenedesmus arcuatus* (Lemmermann) Lemmermann 1899, *Scenedesmus alternans* var. *arcuatus* (Lemmermann) Fott and Komárek 1960, *Scenedesmus alternans* var. *platydiscus* (G.M. Smith) Fott and Komárek 1960]

Komárek and Fott 1983, p. 828, fig. 225.8; Hegewald and Silva 1988, p. 341, fig. 557.

Coenobia 4-8 celled, cells oblong-ellipsoid, obtuse poles, arranged in an alternating series, adjacent cells in contact only along a short portion of their length; chloroplast single and parietal with a pyrenoid at the centre; cells 10-14 μm long and 4-5 μm broad.

Epipellic in river and in pond; Voucher number, date and site: 436; 27th March 2005; Sambalpur, Orissa (S-13; Temp. 29°C; pH 7.3; Cond. 300 μs).

54. *Scenedesmus opoliensis* P. Ritch var. *brevicaudatus* Hortobagyi 1969 (Pl. 3, Fig. 28)

[Synonym: *Scenedesmus opoliensis* var. *carinatus* f. *bre-*

vispina Roll 1927]

Hegewald *et al.* 1990. p. 27, pl. 65, figs. i, j and k.

Coenobia 4-celled; cells arranged in a linear series; terminal cell with long spine at the pole or one spine at the pole alternative side, inner cell with ridge at the middle; cells 2.5-5 μm broad and 10-23 μm long; spines 15-25 μm long.

Planktic or epilithic in pond; Voucher number, date and site: 968; 3rd Dec. 2006; Silchar Assam (S-33; Temp. 25°C; pH 7.9; Cond. 236 μs).

55. *Scenedesmus prismaticus* Brühl et Biswas 1922 (Pl. 3, Figs. 29 & 30)

Philipose 1967, p. 259, fig. 168 (b); Komárek and Fott 1983, p. 848, fig. 230.6; Hegewald and Silva 1988, p. 404, fig. 650.

Coenobia 4-8 celled, cells oblong, arranged in a single linear series, cell prismatic with pyramidal end faces, terminal cell mostly shorter and slightly convex; chloroplast single, without pyrenoid; cells 7-11 μm long and 3-6 μm broad.

Epizoidic (surface of fish scale) in river; Voucher number, date and site: 244; 18th April 2004; Cuttack, Orissa (S-5; Temp. 30°C; pH 7.5; Cond. 221).

56. *Scenedesmus pseudopoliensis* Hortobagyi 1969 (Pl. 3; Fig. 31)

[Synonym: *Scenedesmus columnatus* var. *sexangularis* Hortobagyi 1969]

Komárek and Fott 1983, p. 910, fig. 245.9.

Coenobia 2-4 celled, arranged in a linear series; cells oblong, slightly truncate at the end; long spine arising at each pole of the terminal cells, spine curved; cells 3-7 μm broad and 5-20 μm long; spine 20-32 μm long.

Planktic in pond; Voucher number, date and site: 968; 3rd Dec. 2006; Silchar Assam (S-33; Temp. 25°C; pH 7.9; Cond. 236 μs).

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