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; Pagey 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 µm 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 specimen 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>
<thead>
<tr>
<th>Station no.(S)</th>
<th>Place of collection</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Voucher no.</th>
<th>Habitat/area</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Satsanga vihar, Bhubaneswar, Orissa</td>
<td>20° 20' 4.4&quot; N</td>
<td>85° 44' 88&quot; E</td>
<td>B 33</td>
<td>Small pond (0.25 ha)</td>
</tr>
<tr>
<td>2</td>
<td>Nicco park, Acharya vihar, Bhubaneswar</td>
<td>20° 17' 07&quot; N</td>
<td>85° 50' 39.3&quot; E</td>
<td>B107</td>
<td>Small garden tank</td>
</tr>
<tr>
<td>3</td>
<td>Acharya vihar, Bhubaneswar</td>
<td>20° 17' 7.8&quot; N</td>
<td>85° 50' 59.3&quot; E</td>
<td>B110</td>
<td>Sewage tank (small)</td>
</tr>
<tr>
<td>4</td>
<td>Rameswar temple tank, Khurda, Orissa</td>
<td>20° 19' 54.6&quot; N</td>
<td>85° 59' 83.1&quot; E</td>
<td>144B</td>
<td>Pond (1 ha)</td>
</tr>
<tr>
<td>5</td>
<td>Kathajodi river, Cuttack, Orissa</td>
<td>20°27’ 28”N</td>
<td>85° 52' 46.6&quot; E</td>
<td>240, 246, 249</td>
<td>Perennial River</td>
</tr>
<tr>
<td>6</td>
<td>Manguli Dam, Cuttack, Orissa</td>
<td>20° 27' 22&quot;N</td>
<td>85° 52' 41.6&quot; E</td>
<td>547</td>
<td>Reservoir (20 ha)</td>
</tr>
<tr>
<td>7</td>
<td>Niali, Jagatsingpur Orissa</td>
<td>20° 07' 41.1&quot; N</td>
<td>86° 12' 8.8&quot; E</td>
<td>617</td>
<td>Pond (0.25 ha)</td>
</tr>
<tr>
<td>8</td>
<td>Gopinathpur, Jagatsingpur, Orissa</td>
<td>19° 42’ 22.9&quot;N</td>
<td>83° 22' 03.7&quot;E</td>
<td>675</td>
<td>Perennial river</td>
</tr>
<tr>
<td>9</td>
<td>Lani, Balasore, Orissa</td>
<td>21°26’ 59.2”N</td>
<td>84° 00' 12.6&quot; E</td>
<td>312</td>
<td>Perennial river</td>
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<tr>
<td>10</td>
<td>Road side, Padpadar, Baragarh, Orissa</td>
<td>21°19’ 52.3”N</td>
<td>83° 37' 13°E</td>
<td>444</td>
<td>Temporary water pool</td>
</tr>
<tr>
<td>11</td>
<td>Padpadar, Baragarh, Orissa</td>
<td>21°19’ 58.4”N</td>
<td>83° 37' 10.6&quot;E</td>
<td>445</td>
<td>Pond (0.5 ha)</td>
</tr>
<tr>
<td>12</td>
<td>Garabandha, Gajapati, Orissa</td>
<td>21° 20' 20.3”N</td>
<td>91° 43' 46.1&quot;E</td>
<td>351</td>
<td>Perennial stream</td>
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<tr>
<td>13</td>
<td>River Mahanadi, Sambalpur, Orissa</td>
<td>21°26’ 59.2”N</td>
<td>84° 00' 12.6&quot;E</td>
<td>436</td>
<td>Perennial river</td>
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<tr>
<td>14</td>
<td>Brahmaputra river, Guwahati, Assam</td>
<td>26° 10' 47.8&quot; N</td>
<td>82° 10' 15.3&quot; E</td>
<td>919, 920</td>
<td>Perennial river</td>
</tr>
<tr>
<td>15</td>
<td>Barik nagar, Cachar, Assam</td>
<td>24° 44’ 3.5”N</td>
<td>92° 47' 32.2&quot;E</td>
<td>933, 934</td>
<td>Small pond (0.5 ha)</td>
</tr>
<tr>
<td>16</td>
<td>Silkuri, Near Baramahaha Mandir, Cachar, Assam</td>
<td>24° 43’ 49.3”N</td>
<td>92° 47' 15.3&quot;E</td>
<td>950</td>
<td>Pond (3 ha)</td>
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<tr>
<td>17</td>
<td>Machhhgat, Silchar, Cachar, Assam</td>
<td>24° 42’ 25”N</td>
<td>92° 46' 06.1&quot;E</td>
<td>963, 964</td>
<td>Puddle (0.2 ha)</td>
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<tr>
<td>18</td>
<td>Irongmona gaon, Silchar, Cachar, Assam</td>
<td>24° 40’ 59.2”N</td>
<td>92° 44' 32.2&quot;E</td>
<td>967, 968</td>
<td>Pond (0.5 ha)</td>
</tr>
<tr>
<td>19</td>
<td>Roskendi, Tea garden, Silchar, Assam</td>
<td>24° 41’ 12.2”N</td>
<td>92° 43' 22.3&quot;E</td>
<td>970</td>
<td>Pond (1 ha)</td>
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<tr>
<td>20</td>
<td>Dobanki (island) Tiger reserve, Sundarban, West Bengal</td>
<td>21° 59’ 21”N</td>
<td>88° 45' 17.4&quot;E</td>
<td>978, 979</td>
<td>Small pond (0.2 ha)</td>
</tr>
<tr>
<td>21</td>
<td>Pakhirala, South 24-Parganas, West Bengal</td>
<td>22° 07’ 47.8”N</td>
<td>88° 49' 21.9&quot;E</td>
<td>985, 987</td>
<td>Small pond (0.25 ha)</td>
</tr>
<tr>
<td>22</td>
<td>Pakhirala, South 24-Parganas, West Bengal</td>
<td>22° 07’ 47.8”N</td>
<td>88° 49' 21.9&quot;E</td>
<td>988</td>
<td>Temporary water pool</td>
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<tr>
<td>23</td>
<td>Masjibadi, South 24-Parganas, West Bengal</td>
<td>22°10’ 36.3”N</td>
<td>88° 46' 20.16&quot;E</td>
<td>994</td>
<td>Small pond (0.3 ha)</td>
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<td>24</td>
<td>Kalibartala, South 24-Parganas, West Bengal</td>
<td>22° 14’ 24.7”N</td>
<td>88° 41' 32.7&quot;E</td>
<td>1007</td>
<td>Temporary water pool</td>
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<tr>
<td>25</td>
<td>Sultanpur, Diomand habour, South 24-Parganas, West Bengal</td>
<td>22° 10’ 27.1”N</td>
<td>88° 12' 15.5&quot;E</td>
<td>1018</td>
<td>Sewage Temporary polluted water</td>
</tr>
<tr>
<td>26</td>
<td>Ratneswarpur, Diomand habour, South 24-Parganas, West Bengal</td>
<td>22° 11’ 34.8”N</td>
<td>88° 12' 36.3&quot;E</td>
<td>1025</td>
<td>Small pond (0.5 ha)</td>
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<td>27</td>
<td>Sultanpur, Diomand habour, South 24-Parganas, West Bengal</td>
<td>22° 19’ 11.4”N</td>
<td>88° 12' 12.8&quot;E</td>
<td>1028</td>
<td>Temporary water pool</td>
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<tr>
<td>28</td>
<td>Chiranjibipur, Haldia Purba Medinipur, West Bengal</td>
<td>22° 03’ 13.1”N</td>
<td>88° 05' 31.6&quot;E</td>
<td>1047</td>
<td>Temporary water pool</td>
</tr>
<tr>
<td>29</td>
<td>Sciencity, Salt lake, Kolkata, West Bengal</td>
<td>22° 32’ 29.7”N</td>
<td>88° 23' 47.4&quot;E</td>
<td>1068, 1069</td>
<td>Drain (Polluted water)</td>
</tr>
</tbody>
</table>
RESULTS AND DISCUSSION


### Table 1. (continued)

<table>
<thead>
<tr>
<th>Station no.(S)</th>
<th>Place of collection</th>
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<tbody>
<tr>
<td>45</td>
<td>Danuswari river, Dimapur, Nagaland</td>
<td>25° 54' 46.8&quot; N 93° 44' 36.1&quot; E</td>
<td>1084</td>
<td>Perennial river</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Purana Bazar, Dimapur, Nagaland</td>
<td>25° 53' 44.4&quot; N 93° 45' 16.7&quot;E</td>
<td>1089</td>
<td>Small pond (0.5 ha)</td>
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</tr>
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<td>47</td>
<td>Green park, Dimapur, Nagaland</td>
<td>25° 51' 30.7&quot;N 93° 45' 50.7&quot;E</td>
<td>1099</td>
<td>Temporary water pool</td>
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</tr>
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<td>48</td>
<td>Green park, Dimapur, Nagaland</td>
<td>25° 51' 30.7&quot; N 93° 45' 50.7&quot;E</td>
<td>1101</td>
<td>Temporary water pool</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>Imphal river, Imphal, Manipur</td>
<td>24° 48' 09&quot;N 93° 56' 53&quot;E</td>
<td>1112, 1113</td>
<td>Perennial river</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Loktak lake, Sedra, Manipur</td>
<td>24° 30' 26.7&quot;N 93° 47' 04.1&quot;E</td>
<td>1118</td>
<td>Largest lake (87,000 sq. miles)</td>
<td></td>
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<tr>
<td>51</td>
<td>Dikho river, Sibsagar, Assam</td>
<td>26° 58' 30&quot;N 94° 37' 46.9&quot;E</td>
<td>1133</td>
<td>Perennial river</td>
<td></td>
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<tr>
<td>52</td>
<td>Jaysagar, Jorhat, Assam</td>
<td>26° 57' 12.3&quot;N 94° 37' 37.4&quot;E</td>
<td>1134, 1135</td>
<td>Pond (5 ha)</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Road side canal, Jaysagar, Jorhat, Assam</td>
<td>26° 57' 12.3&quot;N 94° 37' 37.4&quot;E</td>
<td>1140</td>
<td>Canal (flowing water)</td>
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<tr>
<td>54</td>
<td>Jai river, Jorhat, Assam</td>
<td>26° 50' 49.6&quot;N 94° 26' 30.7&quot;E</td>
<td>1144</td>
<td>Perennial river</td>
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<tr>
<td>55</td>
<td>Mahi lake, Kajiranga National Park, Assam</td>
<td>26° 36' 41.1&quot;N 93° 22' 40.5&quot;E</td>
<td>1148</td>
<td>Lake (70 ha)</td>
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<td>56</td>
<td>Kaulimardi lake, Kajiranga Nation Park, Assam</td>
<td>26° 38' 45.3&quot;N 93° 20' 51.7&quot;E</td>
<td>1149</td>
<td>Lake (50 ha)</td>
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<td>57</td>
<td>Diffolo river, Kajiranga National Park, Assam</td>
<td>26° 38' 45.3&quot;N 93° 20' 51.7&quot;E</td>
<td>1153</td>
<td>Perennial river</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>Dhonsiri river, Numaligarh, Assam</td>
<td>26° 27' 51.4&quot;N 93° 43' 46.4&quot;E</td>
<td>1160, 1162</td>
<td>Perennial River</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>Brahmaputra river, Namati, Jorhat, Assam</td>
<td>26° 51' 34.5&quot;N 94° 14' 48.9&quot;E</td>
<td>1167</td>
<td>Perennial River</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Brahmaputra river, Majuli river island, Assam</td>
<td>26° 52' 49&quot;N 94° 17' 15.7&quot;E</td>
<td>1170</td>
<td>Perennial River</td>
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</tr>
<tr>
<td>61</td>
<td>Sri Sri Aunikati Sastra, Majuli river island, Assam</td>
<td>26° 56' 18.3&quot;N 94° 07' 24.0&quot;E</td>
<td>1178</td>
<td>Small pond (0.5 ha)</td>
<td></td>
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<tr>
<td>62</td>
<td>Kamadubedi, Jorhat, Assam</td>
<td>26° 56' 18.3&quot; N 94° 07' 24.0&quot;E</td>
<td>1179</td>
<td>Small pond (0.5 ha)</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Brahmaputra river, Fancy Bazar, Guwahati, Assam</td>
<td>26° 5' 52.7&quot;N 91° 30' 23.7&quot;E</td>
<td>1187, 1188</td>
<td>Perennial River</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>Utkal University, Bhubaneswar, Orissa</td>
<td>20° 20' 6.4&quot;N 85° 44' 48&quot;E</td>
<td>541</td>
<td>Temporary water pool</td>
<td></td>
</tr>
</tbody>
</table>

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

Family: Chlorococccaceae Lackman and Tansley 1902.
Sub family: Chlorococccidae

**Genus: Chlorococcus Meneghini 1842**

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

[Synonym: *Chlorococcus humicolus* (Nägeli) Rabenhorst 1915, *Cystococcus humicolo* 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 \( \mu \text{m} \) in diameter, zoospores elliptical, 4.5 \( \mu \text{m} \) broad and 3-4 \( \mu \text{m} \) 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 \( \mu \text{s} \)); 1170; 29th March 2007; Majuli river island, Assam (S-60).
Sub-family: Treubarioidae Koříškov

Genus: Treubaria Berhard emend Reymond 1979

[Synonym: Borkea G.M. Smith 1922]

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

[Basionym: Tetrapedia setigera W. Archer 1872]

[Synonym: Tertraedron trilibulatum (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. cornutum (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; 29th 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-16; Temp. 29°C; pH 7.6; Cond. 279 µs).

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

[Synonym: Pediastrum sturmii Reinsch 1867, Pediastrum sturmii var. crenulatum 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]

[Basionym: 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); 547; 5th Oct. 2005; Cuttack, Orissa (S-5; Temp. 25°C; pH 8.3; Cond. 400 µs); 249; 18th April, 2004; Cuttack, 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).

Genus: Hydrodictyon Roth 1800

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

[Basionym: Confera reticulatum Linnaeus 1753]

[Basionym: 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; 22nd 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
Family: Botryococcaceae Wille 1909
Sub family Botrycocoidae

**Genus: Botryoccus** Kützing 1849

- [Synonym: Botryodiictyon Lemmermann 1903, Botryosphera Chodat 1922]

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

- [Synonym: Botryoccus giganteus Reinsch 1877]


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).


**Genus: Coenochloris** Korsíkov 1953

14. **Coenochloris forttii** (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 without pyrenoid; cells 5-12 µm in diameter.

Planktic in pond and 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 nimbatuy** (De Wildeman) Schmidle 1902 (Pl. 2, Fig. 1)

- [Basionym: Pleurococcus nimbatuy De-Wildeman 1893]

Thompson 1959, p. 137, fig. 6.155; Komárek and Fott 1983, p. 399, fig.120.3.

Coenobium 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** Koršíkov 1953

16. **Coenocystis reniformis** Koršíkov 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: B110; 25th April 2004; Bhubaneswar, Orissa (S-3; Temp. 27°C; pH 7.7; Cond. 349).

**Genus: Oocystis** A. Braun 1855

17. **Oocystis rhomboidea** Fott 1933 (Pl. 1, 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; coenobium 25-35 µm broad and 30-50 µm long.

Planktic in pond; 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 2005; Similipal Biosphere Reserve, Orissa (S-64).

**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 2005; Similipal Biosphere Reserve, Orissa (S-64).
2007; Diamand harbour, South 24-Parganas, West Bengal (S-40; Temp. 28°C; pH 8.2; Cond. 507 µs).

Family: Chlorollaceae Brunnthal 1910
Sub family: Chlorсоlloidae
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; chloro-
   plast parietal, cup-shaped with a distinct central
   pyrenoid; cells 5-5.8 µm in diameter.
   Planktic in stream, river and in pond; Voucher num-
   ber, 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 µs); 1025; 4th March 2007; Diamand harbour,
   South 24-Parganas, West Bengal (S-41; Temp. 27°C;
   pH 7.9; Cond. 230 µs); 1028; 4th March 2007; Diamand har-
   bour, South 24-Parganas, West Bengal (S-42; Temp. 27°C;
   pH 8.2; Cond. 215 µs).

Family: Chlorollaceae Brunnthal 1910
Sub family: Ankistrodesmoideae
Genus: *Monoraphidium* 1969
20. *Monoraphidium contortum* (Thuret) Komárková-
   Legnerová 1969 (Pl. 2, Fig. 8)
   [Synonym: *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 µm broad and
   20-32 µm 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 µs).

Genus: *Kirchneria* Hindák 1988
   2, Fig. 9)
   [Synonym: *Kirchneriella lunaris* (Kirchner) Moebius var.
   *irregularis* G.M. Smith 1990, *Kirchneriella irregularis* (G.M.
   Smith) Korsíkov 1953, *Kirchneriella irregularis* (G.M.
   Smith) Korsíkov var. *spiralis* Korsíkov 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 sig-
moid with overlapping ends; chloroplast parietal, ventral
side of cells without a pyrenoid; cells 3-5 µm broad and
20-28 µm long.
   Epiphytic in pond; Voucher number, date and site:
   950; 3rd Dec. 2006; Silikuri, Assam (S-31; Temp. 26°C; pH
   7.6; Cond. 210 µs).

22. *Kirchneria rotunda* (Korsíkov) Hindák 1988 (Pl. 2, Fig.
   10)
   [Synonym: *Kirchneriella rotunda* (Korsíkov) Hindák
   664, fig. 186.1.
   Cells solitary, sigmoid, usually with overlapping ends
   rarely, arcuately bent or horseshoe- shaped with detached
   ends, ends bluntly pointed, cells 2.5-4.5 µm broad and
   20-50 µm 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; Silikuri, Assam (S-31; Temp. 26°C; pH 7.6;
   Cond. 210 µs).

Genus: *Kirchneriella* Scmidle 1893
23. *Kirchneriella obesa* (W. West) Schmidle 1893 (Pl. 2,
   Fig. 11)
   [Synonym: *Selenastrum obesum* W. West 1892]
   [Synonym: *Kirchneriella intermedia* Korsíkov 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 µm broad and
   5-20 µm long.
   Epiphytic in canal; Voucher number, date and site:
   1140; 27th March 2007; Jayaagar, Assam (S-53; Temp. 27°C;
   pH 8.2; Cond. 215 µs).

Genus: *Ankistrodesmus* Corda 1838
24. *Ankistrodesmus bernardii* Komárek 1983 (Pl. 2, Fig.
   12)
   [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 µm broad and 30-70 µm
   long; coenobia 70-120 µm 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 μs).

25. *Ankistrodesmus bibraianus* (Reinsch) Koršík 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 μm broad and 20-35 μm 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 μs).

26. *Ankistrodesmus densus* Koršík 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 μm broad and 50-80 μm long; coenobia 70-80 μm 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 μs); 964; 3rd Dec. 2006; Silchar, Assam (S-32; Temp. 24°C; pH 7.2; Cond. 202 μs); 1135; 27th March 2007; Jaysagar, Assam (S-52; Temp. 25°C; pH 7.5; Cond. 190 μs).

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 lundbargii* Koršík 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 μm broad and 20-165 μm 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 μs); 700, 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); 1135, 1136; 27th March 2007; Jaysagar, Assam (S-52; Temp. 25°C; pH 7.5; Cond. 190 μs); 1144; 27th March 2007; Jorhat, Assam (S-54; Temp. 27°C; pH 7.3; Cond. 203 μs); 1153, 28th March 2007; Kajiranga National Park, Assam (S-57); 1178; 29th March 2007; Majuli river island, Assam (S-61).

28. *Ankistrodesmus falcatus* 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 μm broad and 40-100 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).

29. *Ankistrodesmus fusiformis* Corda ex Koršík 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 μm broad and 20-50 μm 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 μs).

30. *Ankistrodesmus gracilis* (Reinsch) Koršík 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 fasciculate bundles; cells acicular to narrowly fusiform with the ends tapering to acute apices; chloroplast single, parietal and without pyrenoid; cells 2.5-4 μm broad and 20-165 μm long.

Planktic or free floating or epiphytic in pond; Voucher number, date and site: 350; 20th Dec. 2005; Kajiranga National Park, Assam (S-31; Temp. 26°C; pH 7.6; Cond. 396 μs).

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 Legenerova 1969 (Pl. 3, Fig. 3)


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)


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)


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; 26th 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) Compéré 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-105; Temp. 25°C; pH 7.6; Cond. 379 µs).

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

[Synonym: *Actinastrum hantzschii* var. *japonicum* 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) Korsík 1953, *Tetrastrum tetracanthum* (G.S. West) Braunth sensu Ritch var. brevicaudatus (Pl. 3, Fig. 13)]

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

*Coenobia* 4 celled, spherical, each cell with transparent appendage from the outside 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, *Lemmanninia* Chodat 1900]

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

[Synonym: *Staurogenia tetraptera* Kirchner 1880]

**Genus: Crucigeniella** Lammermann 1900

41. *Crucigeniella rectangularis* (Nägeli) Komárek 1974

(Pl. 3, Fig. 13)

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


*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)

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

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


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. 170 µS); 1140; 27th March 2007; Jorhat, Assam (S-62).

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

[Basionym: *Scenedesmus communis* Hegewald 1977]


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]


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]


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]


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).


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

Coenobia 4-8 celled, arranged in liner 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 \(\mu m\) long and 3.2-8.6 \(\mu m\) broad.

Planktic in river; Voucher number, date and site: 436; 27\textsuperscript{th} March 2005; Sambalpur, Orissa (S-13; Temp. 29°C; pH 7.8; Cond. 236 \(\mu s\)); 22\textsuperscript{nd} March 2006; Silchar, Assam (S-33; Temp. 25°C; pH 7.9; Cond. 427 \(\mu s\)).

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 \(\mu m\) broad and 20-34 \(\mu m\) long.

Epilithic in pond; Voucher numbers; dates, sites: 701; 28\textsuperscript{th} Nov. 2005; Birbhum, West Bengal (S-25; Temp. 25°C; pH 8.6; Cond. 379 \(\mu s\)); 1101; 22\textsuperscript{nd} March 2007; Kolkata, West Bengal (S-44; Temp. 28°C; pH 7.9; Cond. 427 \(\mu s\)).

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 \(\mu m\) broad, 7-23 \(\mu m\) long.

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

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


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 \(\mu m\) broad and 10-18.5 \(\mu m\) 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 \(\mu m\) broad and 8.3-12 \(\mu m\) long.

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

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

[Basionym: *Achnanthes obliqua* Turpin 1820]


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

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

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


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 \(\mu m\) long and 4-5 \(\mu m\) broad.

Epipelic in river and in pond; Voucher number, date and site: 436; 27\textsuperscript{th} March 2005; Sambalpur, Orissa (S-13; Temp. 29°C; pH 7.3; Cond. 300 \(\mu s\)).

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

[Synonym: *Scenedesmus opoliensis* var. *carinatus* f. *brevicaudatus* Hortobagyi 1969 (Pl. 3, Fig. 28)
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.

Epizoic (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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