CHAPTER - V

TAXONOMY OF BLUE-GREEN ALGAE
5. TAXONOMY OF BLUE-GREEN ALGAE

5.1 CLASSIFICATION

Linnaeus (1753) was the first to use the term algae to lower plants. Since that time so many schemes for classifying algae had been proposed, basing on morphological similarities and evolutionary relationships.

Other major criteria for the classification of algae were based on chemical composition and relative amount of the photosynthetic pigments present, the chemical nature of the photosynthetic products, the chemical and physical nature of the cell wall and the number, morphology and orientation of flagella. However, the systems of classification differed widely in regard to the rank and status assigned to various taxa.

The classification proposed by Fritsch (1935) was most commonly followed, divided the algae into 11 classes. Whereas Chapman and Chapman (1962) classified them into 11 phylla including Cyanophyta as one of them. The number of orders within a class and number of families within an order also varied considerably in different systems of classification.

However, the word alga is used for non-vascular chlorophyllian cryptogams which may include Myxophyceae superfluously. Myxophyceae, on the basis of morphological, biochemical and biological nature, lie quite apart and it will not be surprising if in near future Myxophyceae is completely separated from algae. Even during present days, Fott (1959), Chadefaud (1960), and Round (1965) treat Myxophyceae as holding equal rank to true algae ‘Prokaryonta’ including Myxophyceae and ‘Eukaryonta’ including remaining group of algae. It is beyond doubt that
Myxophyceae are not at all true algae. During recent past, the term ‘Cynobacteria’ has been more widely accepted and all modern systems of classification include Myxophyceae under Monera (Prokaryotes) with bacteria. Daughterly and Allen (1960) suggested the term ‘Monera’ to include BGA and bacteria together.

From time to time different classifications of Myxophyceae were put forward by different algologists. Hence in this present account, only the most important ones of the classification will be dealt with.

Fritsch (1944, 1945) divides the blue green algae into five orders - Chroococcales, Chamaeiphonales, Pleurocapsales, Nostocales and Stigonematales. Desikachary (1959) accepts Fritsch’s classification in general though he departs from the same in a few points. Fritsch (1945) has included Mastigocladius into Stigonemataceae but, Iyenger and Desikachary (1954) have placed it into a distinct family, Mastigocladaceae, along with the genus Brachytrichia. Stanier & Cohen Bazire (1977) divided BGA into sub group Chroococcacean, Pleurocapsalean, Oscillatorian, Nostocacean and Rivularean.

Basing on the older taxonomic scheme (Stanier and Cohen Bazire, 1977), Rippka et al. (1979) divide the cyanobacteria into five sections. Rippka describes her first two sections, I and II, as “unicellular, cell single or forming colonial aggregates held together by additional outer cell wall layers”. Her other three sections, III to V, she describes as “Filamentous, a trichome (chain of cells) which grow by intercalary cell divisions.

In the taxonomic scheme according to Cavalier-Smith (2002), the division Cynanobacteria is under kingdom Bacteria, sub-kingdom Negibacteria and infra-Kingdom Glycobacteria. The two subdivisions are Gloeobacteria and Phycobacteria.

Taxonomic scheme according to NCBI Taxonomy website (2004), Cyanobacteria is divided into 5 orders, namely Chroococcales, Nostocales, Oscillatoriales, Pleurocapsales and Stigonematales.
Following the Desikachary's (1959) classification in this research, the synoptic arrangement of the families and orders are given below:

Phylum CYANOPHYTA Smith

Class Cyanophyceae Sachs

Order CHROOCOCCALES Wettstein
   Fam. Chroococcaceae Nägeli
   Fam. Entophysalidaceae Geitler

Order CHAMAESIPHONALES Wettstein
   Fam. Cyanidiaceae Geitler
   Fam. Chamaesiphonaceae Borzi
   Fam. Dermocarpaceae Geitler

Order PLEUROCAPSales Geitler
   Fam. Pleurocapsaceae Geitler
   Fam. Hyellaceae Borzi

Order NOSTOCALES Geitler
   Fam. Oscillatoriaceae (S.F Gray) Dumortie ex Kirchner
   Fam. Gomontiellaceae Elenkin
   Fam. Nostocaceae Kützing
   Fam. Scytonemataceae Rabenhorst ex Born et Flah.
   Fam. Microchaetaceae Lemmermann
   Fam. Rivulariaceae Rabenhorst

Order STIGONEMATALES Geitler
   Fam. Capsosiraceae Geitler.
   Fam. Pulvinulariaceae Geitler
   Fam. Nostochopsidaceae Geitler
Fam. Diplonemataceae (Borzi) Elenkin
Fam. Mastigocladaceae Geitler
Fam. Mastigocladopsidaceae Iyengar and Desikachary
Fam. Stigonemataceae Kirchner.

5.2 TAXONOMIC ENUMERATION

In the present research work a total number of 40 genera comprising of 142 species of myxophycean algae from the different habitats of greater Guwahati, Assam, have been reported. Identification of the specimens have been done with the help of keys given by Fritsch (1945), Smith (1950) and Desikachary (1959). In this thesis Desikachary’s (1959) classification has been followed so far as the arrangement of the families are concerned. However, in arranging the genera and species recorded under the families, alphabetic order has been followed and tabulated below:

<table>
<thead>
<tr>
<th>Division/Class/Order/Fam.</th>
<th>Genus</th>
<th>Species</th>
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<td>A. Order</td>
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<td>6. <em>A. microscopica</em> Näg</td>
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<td>3. Chroococcus Näg</td>
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<td>11. C. minutus (Kütz.) Näg</td>
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<td>22. G. samoensis Wille</td>
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<td>23. G. samoensis var. major Wille</td>
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<td>25. M. elegans A. Br.</td>
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<td>30. M. flos-aquae (Wittr.) Kirchner</td>
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<td>31. M. orissica West.W</td>
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<td>9. <strong>Synechococcus</strong> Nägeli</td>
<td>33. <strong>Synechococcus aeruginosus</strong> Nägeli</td>
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<td>100. C. indicum Rao, CB. orth.mut. De Toni</td>
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<td>101. C. majus ex. Born et. flah</td>
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<td>103. C. stagnale (Kütz) Born et. Flah.</td>
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<td>123. <em>C. fusc</em> (Kütz) Bornet et.Flah.</td>
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<td><em>Dichothrix orsiniana</em> (Kütz)</td>
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<td><em>Gloeotrichia atra</em> (Roth) Biswas</td>
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<td>129</td>
<td><em>G. echinulata f. brevispora</em></td>
<td>West et al.</td>
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<td><em>G. intermedia var. kanwaensis</em></td>
<td>Rao et al.</td>
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<td><em>G. natans</em> Rabenhorst ex Born et al. Flah</td>
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<td>133</td>
<td><em>G. pisum</em> Thuret ex Born et al. Flah</td>
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<td><em>Gloeotrichia</em> Ag</td>
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<td><em>Westiella intricata</em> Borzi</td>
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<td>142</td>
<td><em>Westiellopsis prolifica</em> Janet</td>
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**Order Stigonematales**

**Family 1. Nostochopsisidaceae**

**Geitler**

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<th>No.</th>
<th>Species</th>
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<td><em>Nostochopsis</em></td>
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<td><em>N. radians</em> Bharadwaja</td>
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**Family 2. Stigonemataceae**

**Kirchner**

<table>
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5.3 TAXONOMIC STUDIES

So far as the arrangement of the families are concerned, the classification of Desikachary (1959) has been followed in this thesis. However, in arranging the genera and species under the families alphabetic orders has been followed.

5.3.1 Class : Cyanophyceae Sach (1874, 248)

5.3.1.1 Key to the families

1. Plant unicellular or in colonies;

2. Never trichome organisation multiplication by cell division and by endospores:

   3. Cells single or forming colonies, with individual distinct sheath — Chroococcaceae

   3. Cells closely arranged together forming a thallus without individual sheath
      but a common mucilage sheath —— Entophysalidaceae

2. Unicellular or colonial epiphytes or lithophytes exhibiting marked polarity with
   base and apex; multiplication by endospores or exospores

4. With exospores ——— Chamaesiphonaceae

4. With endospores ——— Dermocarpaceae

1. Plant organization filamentous or filament like bodies

5. Thallus not forming filaments or at the most resembling filaments — Pleurocapsaceae

5. Plants with filaments and trichome organisation

6. Trichome unbranched

7. Without heterocyst ——— Oscillatoriaceae

7. With heterocyst ——— Nostocaceae

6. Trichome branched; true or false

8. Trichome false branched
9. Heterocysts generally basal, with a terminal hair or 
attenuated end cell ........................................ Rivulariaceae

9. Heterocysts intercalary or terminal, without terminal hair — Scytonemataceae

8. Trichomes truly branched and branching lateral

10. Heterocyst pedicellate ...................................... Nostochopsidaceae

10. Heterocyst not pedicellate ................................... Stigonemataceae

5.3.1.2 Taxonomic Description of the Species

ORDER: CHROOCOCCALES Wettstein (1924, 49)

Family : Chroococcaceae Nägeli.

Gatt. einzell, Algen, 44, 1848; em, Geitler, Beih. bot. centralbl; 4(abt. 2) 223, 1925;
Desikachary, Cyanophyta 78, ICAR, New Delhi, 1959.

Cells single or a few together or many in shapeless colonies, mostly spherical or 
subospherial, ellipsoidal and cylindrical with a thin to thick mucilaginous lamellated or 
unlamellated sheath. cell division in two or three directions in elongated cells often only 
in one direction - transverso, cells of many generation in a single parent sheath.

Key to the genera

1. Cells single or a few together in a shapeless colony

2. Cell elongate

3. with a vesicular sheath ........................................ 6. Gloeotchece

3. Without a vesicular sheath .................................... 9. Synechococcus

2. Cell spherical
4. With vesicular sheath ------------------------------------------- 5. Gloeocapsa

4. Without vesicular sheath ---------------------------------------- 3. Chroococcus

1. Cell generally many in a single colony

5. Cells without any definite mode of arrangement

6. Cells typically well packed into microscopic colonies of definite shapes, mostly planktonic --------------------------------------- 8. Microcystis

6. Cells loosely arranged, forming macroscopic colonies, mostly not planktonic

7. Cells spherical ----------------------------------------------- 1. Aphanocapsa

7. Cells ellipsoidal to cylindrical --------------------------------- 2. Aphanothece

5. Cells with definite mode of arrangement in distinct colonies:

8. Colony a hollow sphere with cells arranged along the margin uniformly homogeneous ---------------------------------- 4. Coelosphaerium

8. Colony with cells arranged in a tabular flat, transverse and longitudinal rows ------------------------------------------- 7. Merismopedia

Genus : APHANOCAPSA Näg.

Gatt, einzell, Algen, 52, 1849; Desikachary, op. cit. 130, 1959.

Cells spherical or nearly so, many loosely arranged without an order, forming a formless gelatinous mass; and sometimes many within a common mucilage envelope of the parent cell; nanocytes present.

Key to the species.

1. Planktonic species

2. Cells 5 - 8μm dia. --------------------------------------------- 4. A. roeseana
2. Cells 3.5 - 4.5μm dia. -------------------------------------------- 3. A. pulchra

1. Attached or aerophytic

3. Cells 5 - 8μm dia., colonies large, coloured ----------- 4. A. roeseana

3. Cells 4 - 6.2μm dia., colonies small, colourless -------- 1. A. banaresensis


A. banaresensis Bharadwaja


Pl. II, Fig. 1

Plant mass soft, gelatinous, spherical, hollow, hyaline, cells almost spherical, 4.5-5.7 μm in diameter; sheath thick, unstratified, hyaline, closely adpressed to the cells, upto 0.8 μm thick.

Habitat: Floating and attached to the mud of paddy field.

Month: August, pH 7.5 - 7.9, Tempr. 31.3 °C, LI 8200 Lux.

Hazarika, 491, Lokhra.

A. muscicola (Menegh) Wille.

Algalogische Notizen XXIX, Nyt. Mag. fNaturv. 56, 39, pl. 2, figs. 19-23, 1918.


Pl. II, Fig. 2

Colony microscopic, loosely attached with the sheath of Microcoleus, cells spherical, 2-3 μm dia, daughter cells are often together in a common colourless mucilaginous envelope.
Habitat: Attached to the sheath of Microcoleus sp. on the paddy stalk, mixed with Hapalosiphon sp.

Month: August  \( \text{pH}: 7.4 - 7.9, \quad \text{Tempr.}: 31.3 ^\circ \text{C}, \quad \text{LI}: 8200 \text{ lux.} \)

Hazarika, 493, Lokhra

**A. pulchra** (Kutz) Rahenh.

Forti in De Toni, Sylloge Algarum, 5: 73, 1907; Fremy, Myxo. d’Afr. èquat franc., 22, fig. 22, 1929; Geitler, *op. cit.* 155, fig. 69g. 1932; Fremy Cyano. Cotes d’ Eur. 14, pl.2. fig.3, 1933. Desikachary, *op.cit.*, 132, pl. 21, fig. 2, 1959.

Pl. II, Fig. 3

Thallus attached or free, gelatinous, blue green, homogeneous; cells spherical, 4.8 μm dia., loosely arranged, single or in two; individual sheath of cells indistinct.

Habitat: Floating in stagnant water mixed with Lyngbya, Oscillatoria and diatoms.

Month: August,  \( \text{pH}: 8.1, \quad \text{Tempr.}: 30 ^\circ \text{C}, \quad \text{LI}: 4500 \text{ lux.} \)

Hazarika, 487, Lokhra

**A. roeseana** de Bary.


Pl. II, Fig. 4

Thallus broad, irregularly spherical, blue-green in colour; cells 6-18 μm dia. pale blue green.

Habitat: Attached to the submerged stones of running water.

Hazarika, 366. Amtoli tea garden.

Genus: APHANOThECE Näg.


Cells oval, ellipsoidal to cylindrical, many in a more or less shapeless expanded thallus, mucilaginous, division transverse, nanocytes present.

Key to the species:

1. Thallus firm, gelatinous, spherical or hemispherical, 3.0-6.5 µm dia. — 5. A. stagnina

1. Thallus mucilaginous, expanded, amorphous:

   2. Cells smaller than 1 µm broad, clathrate ———— 1. A. clathrata

   2. Cells 3.5-8.0 µm broad ———— 4. A. pallida

3. Cells 3.5 - 5 µm broad:

   4. Subaerial ———— 3. A. naegelii

   4. Submerged, non thermal ———— 2. A. microscopica

A. clathrata W. et. G. S. West

Trans. Roy. Irish Acad., 33 : 111, pl. 10, figs. 9-10. 1906 ; Geitler. op. cit., 166, fig. 74 a, 1932. Desikachary, op.cit., 137, pl. 22, fig. 2, 1959.

Pl. I, Fig. 1

Thallus microscopic, irregular, clathrate with colourless homogenous mucilage; cells 0.68-0.7 µm broad and 2.55-3 µm long, cylindrical, straight, densely packed, light blue-green.
Habitat: Attached to wet rocks mixed with *Nostoc* and *Calothrix* spp.

Month: September.  \( p^H: 8.0, \quad \text{Tempr: } 31^\circ C, \quad \text{LI } 2300 \text{ lux.} \)

Hazarika, 511, Kamakhya hill.

*A. microscopica* Näg.

Forti in De Toni, *op. cit.*, 5: 83, 1907; Frémy, Myxo. d’Afr. équat. franc. 28, fig. 30, 1929; Geitler, *op. cit.*, 172, fig. 79, 1932. Desikachary *op. cit.*, 142, pl. 22, fig. 4, 5, 1959.

Pl. III, Fig. 1

Thallus small, blue green, gelatinous; cells oblong, 4.56 \( \mu m \) broad and 7.22 \( \mu m \) long, with distinct individual sheath, blue green; nanocytes present.

Habitat: Free floating in the stagnant water of roadside ditches.

Month: August - Sept. Oct.  \( p^H: 7.3-8.1, \quad \text{Tempr. } 30^\circ C, \quad \text{LI } 7900 \text{ lux.} \)

Hazarika, 182, Jalukbari, 249, Jurpukhuri.

*A. naegelli* Wartm.

Forti in De Toni, *op. cit.*, 5: 77, 1907; Lemmermann, Kryptogamenflora der Mark Brandenburg, 3:70, 1910; Geitler, *op. cit.*, 172, 1932; Desikachary *op. cit.*, 141, pl. 22, fig. 7, 1959.

Pl. III, Fig. 2

Thallus gelatinous, soft, brown to olive green, cells oval, after division spherical, 3.84 - 4.2 \( \mu m \) broad and 7.2 - 8.64 \( \mu m \) long and 3.84 \( \mu m \) in dia; cell division transverse, at the time of cell division upto ca 10.0 \( \mu m \) in long, content blue green; sheath diffuent.
Habitat: Collected from the moist soil of the paddy field mixed with other blue green algae.

Month: June, $p^H: 6.5 - 7.0$, Tempr.: $29^\circ C$ LI: 12800 lux

Hazarika,, 384, North Guwahati.

*A. pallida* (Kütz)

Forti in De Toni, *op. cit.*, 5: 83, 1907; Lemm., Kryptogamenflora der Mark Brandenburg, 3:77, 1907; Frémy, Myxo. d'Afr. équat. franc. 29, fig. 31, 1929; Geitler, *op. cit.*, 171, fig. 78, 1932; Frémy, Cyano. cotes d'Eur., 19, pl. 3, fig. 7, 1933; Desikachary *op.cit.*, 140, pl. 22, fig. 3, 1959.

Pl. III, Fig. 3

Thallus gelatinous mixed with *Oscillatoria* spp.; cells oblong 5.7 - 7.9 $\mu$m broad and 11.1 $\mu$m long, blue green; sheath distinct, yellow to brownish in colour.

Habitat: Attached to submerged stones of running water.

Month: December, $p^H: 6.1 - 7.5$, Tempr.: $21^\circ C$, LI: 1900 lux

Hazarika,, 618, Amtoli tea garden.

*A. stagnina* (Spreng) A.Br.

Forti in De Toni, *op. cit.*, 5: 76, 1907, Boye-Peterson, Freshwater Cyanophyceae of Iceland, Bot. of Iceland, 2, 1923; Frémy, Myxo. d'Afr. équat. franc. 26, fig. 26, 1929; Geitler, *op. cit.*, 164, fig. 72, 75a, b, 1932; Frémy, Cyano. cotes d’Eur., 18, pl. 3, fig. 5, 1933; Desikachary *op.cit.*, 137, pl. 21, fig. 10, 1959.

Pl. III, Fig. 4

Thallus gelatinous, upto many cm in dia, brownish; cells oblong 3.18-5.6 $\mu$m
broad and 6.1 - 8.6 μm long, pale blue green, densely arranged; without individual envelope, mucilage homogenous.

Habitat: Floating in the stagnant temporary rain water of paddy field.

Month: June - August, p$^H$: 7.0 - 8.4, Tempr.: 24 - 28 °C, LI: 3200 - 5300 lux

Hazarika, 558, Dharapur.

**Genus CHROOCOCCUS Näg.**


Cells spherical or subspherical, hemispherical, after division in small groups of 2-4 individuals, rarely single, in a gelatinous or mucous matrix; sheath of individual cells distinct or very thin, hardly visible; reproductions by cell divisions.

**Key to the Species:**

1. Cells forming a large thallus, cells without sheath 4-8 μm broad ——— 3. *C. pallidus*

1. Cells after division mostly 8-16 together :

   2. Cells without sheath, 4 -10 μm broad ———— 2. *C. minutus*

   2. Cells without sheath, 8 - 12 μm broad ———— 1. *C. hansgirgi*

**C. hansgirgi** Schmidle.


Pl. IV, Fig. 1
Cells almost spherical, violet blue, single, 10.36-12 μm in dia. sheath thin, hyaline, adhering; cell contents homogeneous.

Habitat: Epiphytes on submersed plants in stagnant water of roadside ditch mixed with Micr%c3%b3ystis aeruginosa and Aphanothece microscopica.

Month: Oct., pH: 8.0, Tempr.: 32°C, LI : 2800 lux

Hazarika,, 574, Deepar beel, Dharapur.

C. minutus (Kutz). Næg.

Forti in De Toni, op. cit., 5: 14, 1907; Frémy op. cit. 39, fig. 42, 1929; Geitler, op. cit. 232, fig. 112 a, 113 c, 1932; Frémy, Cyano. cotes d' Eur., 24, pl. 4, fig. 6, 1933; Desikachary op.cit., 105, pl. 24, fig. 48, pl. 26, figs. 4, 15, 1959.

Pl. I, Fig. 2.

Cells spherical or oblong, single or in groups of 2-4, cell contents light blue-green, with sheath 8.6 - 10.2 μm in dia. and without sheath 5.13 - 6.02 μm in dia., individual sheath present; colonies 32.6 μm in dia. sheath not lamellated, colourless found in the mucilage of Anabaena variabilis var. ellipsospora.

Habitat: Attached to the wet rocks in the mucilage of other algae.


Hazarika, 556, 577, Kamakhya.

C. pallidus Næg.

Pl. IV, Fig. 2

Thallus gelatinous, colourless; cells single or 2, oblong, colonies without sheath 5.13 µm and with sheath 8.55 µm broad, blue-green; sheath colourless, unlamellated.

Habitat: Attached to the submerged stone of a culvert.

Month: Sept., pH : 8.4, Tempr. : 32°C, LI : 3320 lux

Hazarika, 531, North Guwahati.

Genus COELOSPHAERIUM Näg.

Gatt. einzell. Algen. 54, 1849; Desikachary op. cit., 146, 1959.

Cell spherical or hemispherical forming a hollow spherical or somewhat irregular free swimming colonies with or without individual envelops around cells, colonial mucilage homogeneous or heterogeneous.

C. kuetsingianum Näg.

Forti in De Toni, op. cit., 5: 100, 1907; Geitler, op. cit., 253, fig. 121c, d, 1932. Frémy, Cyano. cotes d’Eur., 31, fig. 35, 1933; Desikachary op.cit., 148, pl. 28, fig. 7,8, 1959.

Pl. IV, Fig. 3

Colony more or less spherical with a thin colonial envelope ca. 115.2-133.8 µm broad and 157.1-171.0 µm long, light blue in colour, cells spherical or subspherical, 3.01- 4.50 µm in dia., closely arranged.

Habitat: Planktonic and attached to soil with Chaetophora, Spirulina, diatoms and desmids.


Hazarika, 586, North Guwahati.
Genus *GLOEOCAPSA* Kutzing.

Phyc. generalis, 174, 1843, Desikachary *op. cit.*, 111, 1959.

Cells spherical, 2 - 8 µm, in colonies, seldom many, with a number of concentric special envelopes; colonies single or many together forming an expanded mass, individual sheaths lamellated or unlamellated, cell division very regular, in three directions, cells in large colonies.

**Key to the species:**

1. Sheath colourless

   2. Sheath unlamellated, cell broader 1. *G. atrata*

2. Sheath lamellated

   3. Cells without sheath, 2.5 µm broad 2. *G. gelatinosa*

   3. Cells without sheath, 3 - 5 µm broad 5. *G. polydermatica*

1. Sheath coloured

4. Sheath more or less reddish, cells without sheath, 2-4 µm broad 6. *G. quaternata*

4. Sheath yellow to brownish, fresh water

5. Cells without sheath, 6 - 11 µm broad 7. *G. rupestris*

5. Cells smaller

6. Sheath lamellated, cells without sheath, 5-10 µm broad 4. *G. pleurocapsoides*

6. Sheath unlamellated, cells without sheath, 4 µm broad 3. *G. luteo-fusca*

*G. atrata* (Turp) Kütz.

Forti in De Toni, *op. cit.* 5: 57, 1907; Wille, Mono gr. Chroococcaceen, P. 185, pl.
Thallus mucilaginous, attached cells without sheath 5.76 \( \mu \text{m} \) in dia., with sheath 9.6 \( \mu \text{m} \) in dia. pale blue green, mostly in a colony; colony 19.2 \( \mu \text{m} \) in dia.; sheath thick, unlamellated or indistinctly lamellated.

**Habitat:** Submerged and attached to dead leaf and twig in the paddy field.

**Month:** Dec. - Jan., \( \text{pH} : 7.9 \), \( \text{Temp} : 21 \, ^\circ\text{C} \), \( \text{LI} : 1800 \text{ lux} \)

Hazarika, 269, Lokhra.

**G gelatinosa Kutz.**

Forti in De Toni, *op. cit.*, 5: 54, 1907, Frémy, Myxo. d’ Afr. équat. franc. 47, fig. 52, 1929; Geitler, *op. cit.*, 187, 1932.; Desikachary *op.cit.*, 114, pi. 27, fig. 6, 1959.

**Pl. V, Fig. 2**

Cells without sheath 2.68 \( \mu \text{m} \) in dia. and with sheath 8-9.6 \( \mu \text{m} \) in dia. blue green, colonies about 22.3 \( \mu \text{m} \) in dia.; sheath colourless, thin when old lamellated.

**Habitat:** Attached to wet rocks mixed with *Nostoc muscorum* and *Aulosira bombayensis*.

**Month:** Sept., \( \text{pH} : 8.0 \), \( \text{Temp} : 31 \, ^\circ\text{C} \), \( \text{LI} : 2300 \text{ lux} \)

Hazarika, 511, Kamakhya.

**G luteo-fusca Martens**


**Pl. V, Fig. 2**
Thallus compact blackish to olive green; cells without sheath 4.4-5 μm broad and 5.5-6.0 μm long, with sheath 16 μm long and 12 μm broad, sheath dull brown or yellowish.

Habitat: Attached to the dead plants in paddy field.

Month: Sept., pH: 7.8, Temp.: 33 °C, LI: 4500 lux

Hazarika, 528, North Guwahati.

**G pleurocapsoides** Novacek

Prace Moravske Prirodo Moravya a Slezka Oddel, Bot., 7: 1, 1929; Skuja, Zur Susswarseralgenflora Burmens, 17, pl. figs 3-5, 1949; Desikachary, *op. cit.*, 118, pl. 24, fig. 3, 1959.

Pl. V, Fig. 3

Colony microscopically small more or less roundish or irregular; cells pale blue green, homogeneous granular, 8.6-9.6 μm broad, elongated or angular, loosely arranged; sheath thin, firm, simple, brownish in peripheral part, 2-3 μm thick and lamellated, 3-4 lamellae.

Habitat: Epiphytes on submerged angiospermic leaf in stagnant water mixed with *Hapalosiphon* and green algae.

Month: Oct., pH: 8.3, Temp.: 31.0 °C, LI: 4200 lux

Hazarika, 41, North Guwahati.

**G polydermatica** Kütz.

Forti in De Toni, *op. cit.*, 5: 51, 1907; Geitler, *op. cit.* 185, fig. 83 c, e, 1932.; Desikachary, *op.cit.*, 115, pl. 25, fig. 1, 1959.

Pl. IX, Fig. 2
Thallus mucilaginous, compact; cells almost spherical, without sheath cell 4.5-5.16 μm broad and 5.1-6.02 μm long, blue green; sheath colourless, very thick, very distinctly lamellated; colony 17.20 μm in dia.

Habitat: On wet rocks admist other gelatinous algae, in paddy fields with Lyngbya circumcresata.


Hazarika, 577, Kamakhya, 381, North Guwahati.

**G quaternata** (Brib.) Kütz.


Pl. I, fig. 3

Thallus brownish, expanded mixed with other algae; cells without sheath 2.85-3.0 μm in dia. and with sheath 7-7.1 μm in dia., blue green; sheath often lamellated; 2-4 cell in a colony, colony 11.18-12.04 μm in dia.

Habitat: Subaerial on moist rocks of the hill, mixed with the sheath of *Anabaena variabilis* var. *ellipsospora*, *Lyngbya contorta*, *Chroococcus minutus*, *Chamaesiphon*, *Aphanothece*, *Calothrix* and *Scytonema* spp.


Hazarika, 577, Kamakhya.

**G rupestris** Kutz.

Pl. V, Fig. 4

Thallus gelatinous, light brown, cells without sheath 11.5-12.04 μm in dia., sheath not smooth, brown in colour; outer daughter colonies pale yellow to nearly colourless, very distinctly lamellated, colonies 68.8-70 μm in dia.

Habitat: Attached to submerged dead plants in a permanent stagnant water of paddy field.

Month: Sept., pH : 8.4, Tempr. : 32 °C , LI : 4500 lux

Hazarika, 528, North Guwahati.

Genus GLOEOTHECE Näg.


Cells cylindrical to ellipsoidal, straight or bent, not attentuated at the ends, but broadly rounded, in small colonies or forming large thallus, division of cells at right angles to the longitudinal axis; sheath structure and colony structure as in Gloeocapsa; nanocytes present.

Key to the species:

1. Mucilage envelope coloured
   2. Envelopes yellow to brown, cells mostly larger ------- 1. G rupestris var. maxima

1. Mucilage envelope colourless:
   3. Cells without envelope, 2.5- 4.5μm broad, ellipsoidal — 2. G samoensis
   3. Cells without envelope, 5.7 μm broad, ellipsoidal —— 3. G samoensis var. major

G rupestris var. maxima West.

Cells ellipsoidal with rounded ends, 9-9.6 μm broad and 13.44-14 μm long, cells with sheath 15.36-23.04 μm broad and 23.04-32.0 μm long; mucilage sheath thick; cell contents blue green, granular; 2-4 in a oval colonies, colonies 32.4-42.24 μm long and 28.8 μm broad; mucilage envelope colourless, unlamellated, inside the colonies different.

Habitat: Attached to the wet stones with *Plectonema gracillimum* and in permanent stagnant water of paddy field with *Scytonema simplex*.


Hazarika, 531, 583, North Guwahati.

*G samoensis* Wille.


Pl. VI, Fig. 2

Cells ellipsoidal, without sheath 4.3-4.5 μm broad and 6.88-7.2 μm long, bluish green, often many uniting, mostly 2-4 in a common envelope, envelope colourless, unlamellated; with sheath 11.8 μm broad and 12.5 μm long.

Habitat: Attached to wet rocks mixed with other blue green algae.

Month: Sept., pH : 8.0, Temp: 31 °C, LI : 2300 lux

Hazarika, 511, Kamakhya.

*G samoensis var. major* wille

*in* Rechinger, loc. cit. 6, pl. 1, fig. 4, 1915; Geitler, *op. cit.*, 220, 1932. Desikachary,
Cells ellipsoidal, without sheath 5.7-6 μm broad and 11.4 μm long, 2-4 in a common envelope; with sheath 19 μm broad and 19-22.8 μm long; nanocytes present.

Habitat: Attached to wet rocks.

Month: Oct.-Nov., pH : 8.8, Tempr. : 32.0 °C, LI : 2400 lux

Hazarika, 71, Hatishila Hill, Bonda.

Genus **MERISMOPEDIA** Meyen.


Cells 4 -16 in tabular colonies arranged in a homogeneous mucilage, generally in fours, arranged in a single plane, free floating, cell globose, oblong, sub-spherical, ellipsoidal; individual sheath around the cells are in distinct, content blue-green.

**Key to the species:**

1. Thallus convulate  

1. Thallus not convulate, gas vacuoles absent, cells as long as or shorter than broad:

2. Cells upto 3.5 μm broad :

3. Cells 0.5 -0.8 μm broad  

3. Cells 1.3 - 2 μm broad  

2. Cells broader:

4. Cells 5-7 (-10) μm broad  

---

*op. cit.* 128, pl. 23, fig. 6, 1959.

Pl. VI, Fig. 3

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**M. convoluta** Brib.

Forti in De Toni, *op. cit.*, 5: 108, 1907; Geitler, *op. cit.*, 262, 1932; Fremy, *op. cit.*, p. 8, Pl. 1, fig. 4, 1933; Desikachary, *op. cit.* 152, Pl. 29, figs. 8, 12, 13; 1959.

Pl. I, Fig. 4

Cells spherical to oblong, 4.5-4.8 μm broad and 11-11.52 μm long, thallus long, broad flat, often leaf like, convulate, colonies yellowish.

Habitat: Collected from drain with cowdung, black in colour.

Month: Feb., pH : 7.6, Tempr.: 24.0 °C, LI : 1600 lux

Hazarika, 334, Hatishila Hill, Bonda.

**M. elegans** A. Br.

Forti in De Toni, *op. cit.*, 5: 104, 1907; Frémy, Myxo. d'Afr. équat. franc. 13, fig. 11, 1929; Geitler, *op. cit.*, 265, fig. 129 e, 1932. Frémy, Cyano. cotes d' Eur., 7, pl. 1, fig. 3, 1933; Desikachary *op. cit.*, 156, pl. 29, fig. 9, 1959.

Pl. I, Fig. 5

Thallus not convolute; colonies small or big; cells spherical or oblong, more or less loosely arranged in a definite manner, 6.5 -7.0μm broad and 6.8 - 7.3μm long; light blue-green in colour.

Habitat: Planktonic in a pond mixed with *Microcystis aeruginosa*.

Month: Nov., pH : 8.0, Tempr.: 32.0 °C, LI : 3600 lux

Hazarika, 235, Dighali Pukhuri.
**M. minima Beck.**


Pl. I, Fig. 6

Colony small, free swimming, cells 4-32, 0.6 μm broad, pale blue in colour.

**Habitat:** Planktonic in the stagnant water of paddy field.

**Month:** Oct.-Nov., \(p^H: 8.3\), \(\text{Tempr.: } 32^\circ C\), \(LI: 4500\) lux

Hazarika, 586, North Guwahati.

**M. tenuissima Lemm.**

Kryptogamenflora der Mark Brandenburg 3: 82, fig. 8, 1910; Forti in De Toni, *op. cit.*, 5: 108, 1907; Frémy, *op. cit.* 11, fig. 7, 1929; Geitler, *op. cit.*, 263, fig. 129 a, b; 1932; Frémy, *op. cit.*, 6, pl. 1, fig. 3, 1933; Desikachary *op.cit.*, 155, pl. 30, fig. 8, 9; 1959.

Pl. VI, Fig. 4

Cells sub-spherical, 2.3-2.58 μm long, division into two cells perpendicular to the plane of the colony, cells in a tabular colonies arranged in a homogenous mucilage, distance between the cells \(ca. 38.4\)μm; cell contents light blu-green.

**Habitat:** Attached to the wet rocks mixed with other blue green algae.

**Month:** Oct., \(p^H: 8.7\), \(\text{Tempr.: } 32^\circ C\), \(LI: 3200\) lux

Hazarika, 580, Kamakhya.

**Genus:** *MICROCYSTIS* Kützing.

Linnaea : 8, 372 pp., 1833 em Kützing, Tab. Phycologicae, 1: 7, 1846; Species
Eugan., 6, 1836; = Clathrocystis Henfrey, Micr. Journ., 53, 1856 = Polycystis Kütz., Tab.
Phycologicae, 1: 7, 1846; Desikachary op. cit., 81, 1959.

Cells spherical or elongated, many in spherical, ellipsoidal or irregularly overlapping
or net-like colony, free swimming, often with attached daughter colonies; cells in
homogeneous, colourless, often different mucilage, individual envelopes absent; cells
mostly very densely arranged, cell division in all directions, generally transverse in elongate
cells, gas vacuole present.

Key to the species

1. Cell spherical

2. Cells without gas vacuoles, not clathrate 5. M. pulverea

3. Colony clathrate 1. M. aeruginosa

4. Colony not clathrate 3. M. flos-aquae

1. Cell elongate

4. Cells 0.8 - 1 μm broad 4. M. orissica

5. Cells 2- 4.5 μm broad 2. M. elabens

M. aeruginosa Kütz.

Crow, Tax. genus Microcystis, New Phytol, 22: 61, fig. a, 1923a; Frémy, op. cit.
18, fig. 15, 1929; Geitler, op. cit., 137, fig. 59 d, 1932; Frémy, op. cit., 10, pl. 7, fig. 6,
1933; Desikachary op. cit., 93, pl. 17, figs. 1, 2, 6, 8 and Pl. 18, fig. 10, 1959.

Pl.VII, Fig. 1
Colonies blue green forming a carpet like scum on the surface of water body dominating the whole area, when young round or slightly larger, solid, when old becoming clathrate with distinct hyaline colonial mucilage, cells 3.8 –4.56 μm in dia., spherical, with gas vacuoles.

Habitat: Planktonic forming water bloom in the ponds mixed with *M. flos-aquae*, *Scytonema* and *Hapalosiphon* spp.

Month: Jan.- Mar.,  \( pH: 8.0 - 9.5 \),  Tempr. : 32.5 °C,  LI : 7500 lux

Hazarika, 235, 298, Dighali Pukhuri.

*M. elabens* (Bréb.) Kütz.

Forti in De Toni, *op. cit.*, 5: 88, 1907, Frémy, *op. cit.* 20, fig. 19, 1929; Geitler, *op. cit.*, 145, fig. 65, 1932. Frémy, *op. cit.*, 11, pl. 2, fig. 1, 1933; incl. var. major Bachmann, Beitr. Algenfl. West-grönland, Mitt. Naturf. Ges. Luzern, 8: 11, fig. 1, g. h. 1849; *Microhaloa elabens* Bréb. in Menighini, Nostoch., 104, *Polycystis elabens* Kützing, species Algarum 210, 1849; *Coccolithis elabens* (Bréb.) Drounet and Daily, Rev. Coccoid Myxophyceae, 46, 1956 (P.P.); Desikachary *op. cit.*, 97, pl. 18, fig. 12, Pl. 20, fig. 6, 7, 1959.

Pl. I, Fig. 7

Colony spherical mixed with other algae; cell contents blue green, oblong, 3-4.3 μm broad and 5.6-6.88 μm long, gas vacuoles present, not closely arranged, colony 17.2 -18.92 μm.

Habitat: Attached to stones mixed with other algae.

Month: Oct.,  \( pH: 7.7 \),  Tempr. : 32 °C,  LI : 1600 lux

Hazarika, 556, Kamakhya.
**M. flos-aquae** (Wittr.) Kirchner.


Colony roughly spherical or somewhat elongate, not clathrate, with indistinct colonial mucilage; cells 3.5 - 7.0 μm in dia., spherical with gas vacuoles; nanocytes present.

Habitat: Planktonic in pond with *M. aeruginosa, Hapalosiphon* and *Scytonema* spp. 

Month: July., pH : 9.5, Tempr. : 34.2 °C, LI : 3500 lux

Hazarika, 457, Dighali Pukhuri.

**M. orissica** West. W.

Descriptions of new spp. of algae etc. Journ. Asiatic Soc. Bengal, 7:84, fig. 9, 1911; Geitler, *op. cit.*, 144, fig. 62 d, 1932; *Coccochloris peniocystis* (Kütz) Drouet and Daily, Lloydia, 11: 78, 1948; Rev. Coccoid Myxophyceae, 32, 1956 (pp); Desikachary *op.cit.*, 97, Pl. 20, fig. 2, 1959.

Pl. I, Fig.8

Colony rounded, in the mucilage of *Anabaena variabilis*, 14.62*15.6 μm in dia. cells short ellipsoidal, 0.86-0.9 μm broad and 1.72μ long; cell contents blue green.

Habitat: Attached to wet stones, subaerial, in the mucilage of *Anabaena variabilis*.


Hazarika, 577, Kamakhya.
\textit{M. pulverea} (Wood)


Colony rounded to ellipsoidal, limits of colonial mucilage distinct, 17.20 x 18.92 μm; cells spherical to ellipsoidal, 2-2.6 μm broad, closely arranged, content blue green, without gas vacuole.

Habitat: Attached to wet rocks mixed with \textit{Chroococcus minutus} and \textit{Symploca}.


Hazarika, 556, Kamakhya.

\textbf{Genus \textit{SYNECHOCOCCUS} Näg.}


Cells oblong, cylindrical or ellipsoidal; single or in colonies of two, mucilage envelop very thin; division transverse.

\textit{S. aeruginosus} Näg.

Forti in De Toni, \textit{op. cit.}, 5: 27, 1907; Geitler, \textit{op. cit.}, 274, fig. 133d, e,1932; \textit{Synechococcus fuscus} Zeller, Hedwigia, 12: 109, 1873, Desikachary, \textit{op. cit.} 143, pl. 25, figs. 6, 12, 1959.
Cells cylindrical, 16 µm broad, upto 30 µm long single, pale blue-green.

Habitat: On moist soil of rocks mixed with *Anabaena* sp.

Month: Sept., pH: 8.2, Tempr.: 34.2 °C, LI: 2870 lux

Hazarika, 518, Bonda.

**Family : Entophysalidaceae Geitler**


Thallus generally attached, free floating; cells arranged in erect radial rows, rarely in irregular rows or groups or without a formation of a typical filament; cells spherical or ellipsoidal seldom cylindrical, or without individual sheaths; sheath narrower or broad; nonocytes present; spores also present.

**Genus : CHLOROGLOEA Wille.**


Cells spherical or ellipsoidal mostly without individual envelopes or with a thin unlamellated sheath, in a common mucilage, in straight erect or radial rows, rows sometimes indistinct, forming more or less hemispherical or flat irregularly lobed thalli, sometimes with daughter colonies; cell divisions in three directions but generally in a single determined direction; gonidia and nanocytes present.

**C. microcystoides Geitler**

Neue Cyano. Gruppe Chamaesiphon; Arch. Protistenk. 51 : 359, fig. U, 1925;
Thallus thin, gelatinous, dull green, slightly lobed made up by the union of number of daughter colonies; cells spherical, very closely arranged in more or less indistinct rows, without a distinct individual sheath, 1.9 - 3.8 μm in dia. blue green; colonial mucilage colourless.

Habitat: Attached to the wet stones of the hill and field.

Month : June - July,  pH : 8.7-8.9,  Tempr. : 33.0-34.0 °C,  L1 : 8000-9000 lux

Hazarika, 381, North Guwahati, 423 Hatishila, Bonda.

Family : Chamaesiphonaceae Borzi

Plants single attached with differentiation into base and apex or forming a colony by the development of exospores attached to the mother cell; cells when young club shaped, later elongate and becoming a sporangium; reproduction by the formation of exospores continuously in a basipetal succession from the apex of the sporangium.

Genus : CHAMAESIPHON A.Br. et Gurnow.
Sporangia at first spherical, later ellipsoidal, club shaped or cylindrical, abstracting exospores at the apex; sporangia with a short mucilage stalk or without such stalk, attached by a mucilage disc; pseudovagina firm and gelatinous colourless or yellow to brown; exospores sometimes remaining attached at the apex of the sporangium and germinating, forming a filamentous or dendroid colony.

_C. siderophilus_ var. _glabra_ Rao, C. B.

Myxo. of the United Provinces, 111, Proc. Indian Acad. Sci, B, 6: 347, fig. 2B, 1937; Desikachary, _op. cit._ 169, pl. 33, figs. 6, 7, 1959.

Pl. VII, Fig. 3

Sporangia distributed on host either single or in dense clusters, cylindrical bent, or straight, 2.58-3.0 μm broad and 11.62-13.1 μm long, pale blue green homogeneous content; pseudovagina thin, hyaline and smooth; exospore one, 3.1 μm in dia.

Habitat: On _Cladophora_ in the stagnant water of paddy field in Amtoli. On _Cladophora_ which is an epizoophyte on submerged snail in the paddy field of Bonda.


Hazarika, 74, Amtoli; 197, Bonda.

**Family : Dermocarpaceae Geitler.**


Unicellular, attached with a differentiation of apex and base, the entire contents dividing to form endospores; sporangia more or less spherical or ellipsoidal, pyriform,
cylindrical with basal mucilaginous stalk.

**Genus: DERMOCARPA Crouan**


Cells spherical, club shaped, oval, seldom hemispherical, attached, single or gregarious and closely packed, mostly without stalk or with a small mucilage stalk, entire contents involved in endospore formation liberated by the gelatinization of the sporangial wall.

*D. olivacea* (Reinsch) Tilden.

Minnesota Algae, 1, Myxophyceae, 55, pl. 3, figs. 26, 27, 1910; Geitler, *op. cit.*, 401, fig. 226 b, c, 1932; Frémy, *Cyano. cotes d’Eur.*, 61, pl. 16, fig. 7, 1933; Desikachary *op.cit.*, 174, pl. 33, figs. 13, 14, 1959.

Pl. VII, Fig. 4

Plants single, sporangia pyriform with a slight stalk like elongation at the base, 11.4 - 15.2 µm broad and 15.2 - 22.8 µm long; wall 3.8 µm thick, lamellated; endospore many, spherical.

This variety differs in being a freshwater form.

Habitat: Attached to the submerged stem of *Ipomoea* sp. in the ditches of Jalukbari and epiphytes on *Lyngbya* spp.


Hazarika, 269, 574 Jalukbari.
ORDER: PLEUROCAPSALES GEITLER

Family : Pleurocapsaceae Geitler


Cells with a firm or gelatinous membrane, sometimes with a differentiation of base and apex, forming colonies which are attached or thallus with a filamentous condition, endospores formed in large cells.

Genus : MYXOSARCINA Printz.

E. Norske Vidensk. Solsk. Skrift. 35; pl. 16, figs 342-357 (1920), 1921; Desikachary, op. cit. 178, 1959.

Colony rounded, cubical, made of densely packed, nearly cubical or variously pressed cells, divisions regularly in three directions, generally remaining attached, when old segmented into parts, wall distinct, thin or very thick, endospores present.

Key to the species

1. Cells 6-10 μm diam. .................................................. 2. M. spectabilis

2. Cells 2-3 μm diam. .................................................. 1. M. burmensis

M. burmensis Skuja.


Pl. VIII, Fig. 1
Thallus aquatic, minute, microscopic, rounded, cells more or less angular or with rounded corners, often arranged in transverse and vertical series, 2.1-3.0 μm in dia; blue green, homogenous or finely granular, individual sheaths thin, hyaline; propagation by the division of the colony into two parts.

Habitat: Attached to submerged stones or culvert, mixed with *Calothrix*, *Phormidium*, *Symploca*, *Chroococcus* and *Aphanocapsa* spp.


Hazarika, 531, North Guwahati

*M. spectabilis* Geitler.


Pl. I, fig. 10

Plants attached with wet rocks, blue green; colonies 32.6 μm in diam., sheath thin, distinct, hyaline, cells with 8.6 μm broad and 11.8 m long without sheath 6.02 μm broad; sheath transparent and 1.7 μm thick; cell contents blue green; endospores present.

Habitat: Attached to wet rocks of Kamakhya (Nilachal hill), mixed with *Anabaena* sp. and *Calothrix* sp.


Hazarika, 556, Kamakhya.
ORDER: NOSTOCALES GEITLER

Family: Oscillatoriaceae Kirchner.

Schizophyceae in Engler and Prantl, Nat. Pflanzenfam, 1 Ed., 1a, P. 61, 1898; non sensu Elenkin 1936; Desikachary op. cit. 186, 1959.

Trichome with a single row of similar and uniformly broad cells only sometimes tapering at the extreme ends, straight or regularly or irregularly spirally coiled; without or with diffuent mucilage or a homogeneous or more or less lamellated firm sheath; heterocyst and spores absent; hormogones present, many showing a spiral movement by relation along the longitudinal axis.

Key to the genera:

1. Trichomes many in a sheath, sheath at the apex generally closing after hormogone formation:
   2. Sheath more or less slimy; filaments twisted into rope like bundles — 3. Microcoleus

1. Trichomes without sheath or single within a sheath; end sheath opens always

3. Trichomes without sheath:
   4. Trichomes more or less straight, not regularly spirally coiled — 4. Oscillatoria
   5. Cells of the bundles not visible or unicellular ———— 6. Spirulina
   5. Cells of the trichome clearly visible ———— 1. Arthrospira

3. Trichomes with a prominent sheath:
   6. Sheath mucilaginous ———— 5. Phormidium
   6. Sheath firm

7. Filaments not in bundles ———— 2. Lyngbya
7. Filaments mostly in erect bundles  --------------------------------- 8. *Symploca*

**Genus: ARTHROSPIRA** Stuzeberger.


Trichomes multicellular, cylindrical, without sheath, loosely or regularly coiled, usually of relatively large diameter and large spirals, with comparatively short and fewer coils; cross walls distinct, apices not tapering, terminal cell rounded, calyptra absent.

**Key to the species**

1. Spirals less than 20 μm broad:
   2. Spirals upto 6 μm broad  --------------------------------- 1. *A. gomontiana*

   Spirals slightly broader  --------------------------------- 1a. *A. gomontiana* var. *crassa*

2. Spirals upto 9-16 μm broad  --------------------------------- 2. *A. jenneri*

*A. gomontiana* Setchell.


Pl. VIII, Fig. 2

Free swimming trichome 2.5-2.88 μm broad, attenuated at the apices, regularly spirally coiled, spirals 5.7 μm broad and 22. 8 μm distant; cells 4.2-4.56 μm long, pale blue green.

The minor difference of this species from the typed one is the distance of spirals, which is little larger.
Habitat: Floating in stagnant water in the ditches of Jalukbari along with *Lyngbya* sp. *Aphanothece microscopica* and *Chroococcus minutus*.

Month: Aug., pH: 8.1, Tempr.: 30.0 °C, LI: 1900 - 7900 lux

Hazarika, 249, Dharapur; 182, Jalukbari.

*A. gomontiana var. crassa* (Gupta)

Gupta (1956, p. 78) described *V. crassa* (Gupta) comb. n. (=sp. *gonontiana* var. crassa) Desikachary *op.cit.* 192, 1959.

Pl. VIII, Fig. 3

Trichome pale blue green, 4.3-4.56 μm broad, attenuated at the apices, regularly spirally coiled; spirals *ca.* 9.12 μm broad and 15.8 -17.1 μm distant; cells 1.52 μm long.

This variety also differ in the distance of the spirals which are little broader and longer.

Habitat: Attached to submerged dead plant in the paddy field, mixed with *Gloeocapsa*, *Gloeotrichia*, *Nostoc*, and *Hapalosiphon* spp.

Month: Sept., pH: 7.8, Tempr.: 33.0 °C, LI: 2500 lux

Hazarika, 528, North Guwahati.

*A. jenneri* Stizenb. ex Gomont

*Spirulina jenneri* (Stizenb) Geitler, in Pascher’s *Süsswasserflora*, 12: 344, 1925; Geitler, *op. cit.*, 924, fig. 590c, 1932; Desikachary, *op.cit.*, 192, pl. 35, fig.3, 1959.

Pl. VIII, Fig. 4
Thallus blue green; trichomes deep blue green; unconstricted at the cross walls, 5.7 - 6.46 μm broad and 4 μm long, not attenuated at the ends, regularly spirally coiled, spirals 14.82 μm broad and distance between two spirals 25.84 μm; cells somewhat shorter than broad end cell broadly rounded; the cross wall granulated.

Habitat: Attached to submerged Eichornia plant in the confluence of Deepar beel and Bahini rivers associated with Oscillatoria annae, O. chlorina and O. limosa.


Hazarika, 594, Garchuk, Lokhra.

Genus *LYNGBYA* Ag.


Trichome single or free in a thin or very massive thick, firm sheath; sheath mostly colourless, seldom coloured yellow to brown to red, blue to purple red; filaments sometimes spirally coiled or attached at the base or in the middle or the entire filament attached, mostly without such attachment or free swimming or forming free thallus.

Key to the species:

1. Filaments erect, attached by the base

   2. Sheath thick, 1-2 granules in each cell --------------------------- 6. *L. mesotricha*

1. Filaments not erect, intermixed with other algae

   3. Filaments more or less spirally coiled

   4. Filaments narrower than 10 μm

   5. Cells 1-2μm broad, 3.5-5.5μm long, regularly coiled without granules ------------------------ 4. *L. contorta*
5. Cells 1.8-2.1 µm broad, 1-2 µm long, spirally and circularly coiled ........................................ 3. *L. circumcreta*

4. Filaments broader than 10 µm ........................................ 5. *L. laxespiralis*

3. Filaments not spirally coiled

6. Sheath yellow to brown

7. Trichomes broader, often with gas vacuoles, septa granulated, constricted ........................................ 2. *L. aestuarii* var. *constricta*

7. Trichomes narrower, without gas vacuoles, cross wall not granulated

8. Trichome yellow brown ........................................ 8. *L. truncicola*

8. Trichome reddish brown ........................................ 9. *L. truncicola* var. *burmense*

6. Sheath hyaline

9. Trichomes 3.5-6.0 µm broad ........................................ 1. *L. aerugineo-coerulea*

9. Trichome broader

10. Trichomes constricted at the cross walls ........................................ 7. *L. putealis*

*L. aerugineo-coerulea* (Kütz) Gomont


Pl. IX, Fig. 1

Filaments single, intermixed with other algae, 7.17 µm broad; sheath colourless, uniform, thin; trichome 5.7 µm broad and 2.8 - 3.1 µm long, unconstricted, dull blue green; cross wall granulated; end cell flattened.

Habitat: Attached to the dead leaves of submerged grass of paddy field mixed with *Gloeotrichia* sp.
Month: June, \( p^H : 9.2 \), Tempr.: 29.2 °C, LI: 2460 lux

Hazarika, 394, North Guwahati.

**L. aestuariz var. constricta** Ghose

On some Myxophyceae of Rangoon, J. Burm Res. Soc. 15: 248, pl. 6, fig. 10, 1926; Desikachary, *op. cit.*, 307, pl. 15, fig. 9, 1959.

Thallus brown coloured; filaments single, nearly straight, 24.96 \( \mu m \) broad; trichome 21.5 \( \mu m \) broad and cell 2.88 \( \mu m \) long; clearly constricted at the cross walls, septa not granulated, apex slightly attenuated; sheath thick, lamellated, 3.45 \( \mu m \) thick.

Habitat: Free floating and attached to rotten submerged angiospermic plants mixed with *Scytonema simplex*.

Month: Sept., \( p^H : 8.4 \), Tempr.: 32.0 °C, LI: 2450 lux

Hazarika, 23, North Guwahati.

**L. circumcreta** West, G. S.


Pl. IX, Fig. 2

Filaments single, free floating, short, 4.29 -5.0 \( \mu m \) broad, circularly coiled, mostly 2-2½ turns, spirals broad; sheath colourless, broad, trichome 1.9 - 2.5 \( \mu m \) broad and cell 1.1 \( \mu m \) long, not constricted, cross walls not granulated, pale blue green; end cell rounded.

Habitat: Free floating in the stagnant water of paddy field mixed with *Spirulina, Gloeotrichia, Wollea, Chloroglea* and *Oscillatoria* spp.

Month: May - June, \( p^H : 7.8 \), Tempr.: 32 °C, LI: 2400 lux
Hazarika, 381, North Guwahati.

*L. contorta* Lemm.

Forti in De Toni, *op. cit.*, 5: 288, 1907; Frémy, *op.cit.*, 202, fig. 172, 1929; Geitler, *op.cit.*, 1043, fig. 660 a, b, 1932; Frémy, Cyano. Cotes d’Eur., 109. pl. 29, fig.2, 1933, Desikachary, *op.cit.* 290, pl. 48, fig. 5. pl. 50, figs. 5, 9, 1959.

Pl. IX, Fig. 3

Filaments free floating, single, spirally coiled with a delicate sheath, 4.29μm broad; sheath narrow, colourless; cells 1.43 - 1.84μm broad and 2.86 - 3.1μm long, unconstricted not granulated, end cell rounded.

Habitat: Free floating in the stagnant water of paddy field mixed with other cyanophycean algae with *L. circumcreta*.

Month: May - June, p<sup>H</sup> : 7.8, Tempr. : 32 °C, LI : 2400 lux

Hazarika, 381, North Guwahati.

*L. laxespiralis* Skuja

Zur Süßwasseralgenflora Burmas, p. 53, pl.10, figs. 10-11, 1949; Desikachary *op. cit.*, 249, pl. 50, fig. 4, 1949.

Pl. IX, Fig. 4

Filaments intermixed with other algae coiled into loose spirals, sheath thick, 15.4-20.0μm broad, lamellated, light brown in colour, rough at the margins, 8.5-10μm broad, not distinctly constricted at the corss walls; cells shorter than broad, 3.84-4.29μm long, contents blue green, oil globules present; apical cell rotund.

Habitat: Attach to the moist rocks of the hills.
L. mesotricha Skuja

Zur Süßwasseralgenflora Burmas, 54, pl. 9, figs. 1-7, 1949; Desikachary, op. cit., 282, pl. 50, figs. 1,2., 1959.

Pl. X, Fig. 1

Filaments erect or more or less curved, dirty green, fixed to the substratum by the basal portion, 11.4μm broad, sheath thick diffuent, firm, trichomes 5.7μm broad, not constricted at the cross walls, 1-2 large granules on either side; septa not distinct; cells 4.29μm broad, slightly longer or equal to the breath, contents pale greenish in colour; homogenous; apical cells rotund. The species is bigger than the typed one.

Habitat: Attached to the wet rocks and the stones with Phormidium species.

L. putealis Mont. ex Gomont.

Forti in De Toni, op. cit., 5: 277, 1907; Frémy, 193, fig. 159, 1929; Geitler, op. cit., 1063, fig. 675, 1932; Desikachary, op. cit., 318, pl. 52, fig. 12, 1959.

Pl. X, Fig. 2

Thallus expanded, dull pale green to violet; filaments nearly straight, 11.4μm broad; intricate at the base, above more or less parallels; sheath thin; cells quadrate, 9.5μm broad 5.7 μ long, distinctly constricted at cross-walls, not attenuated; end cell rounded.
Habitat: Attached to the rock soil mixed with *Phormidium* sp.

Month: Oct, $p^H: 7.6 - 8.7$, Tempr.: $32.0^\circ C$, LI: 4800 lux

Hazarika, 679, Kamakhya.

*L. truncicola* Ghose


Thallus thin, expanded, blue-green; filaments more or less parallel, $14.2 - 15.2 \mu m$ broad; sheath firm, unlamellated yellowish brown; trichome blue-green; $11.4 - 12 \mu m$ broad; not constricted at the cross-walls and not granulated, cells short, $3.8 - 4.2 \mu m$ long, contents granular; apical cell rotund.

Habitat: Attached to surface soil of stones in the running water.

Month: June, $p^H: 7.3$, Tempr.: $33.0^\circ C$, LI: 9950 lux

Hazarika, 365, Amtoli.

*L. truncicola var. burmense* Ghose

Myxophyceae of Rangoon, 1, Ghose; J. Burma Res. Soc. 15: 247, 1926; Desikachary *op. cit.*, 309, pl. 51, fig. 7, 1959.

Pl. X, Fig. 3

Thallus bluish green when moist and more or less reddish brown when dry; filaments flexuous, intricate, $14 - 15.2 \mu m$ thick; sheath colourless first but becoming reddish brown later, not lamellated; trichome not constricted at the cross-walls; cells $11.4 \mu m$ broad and $10.64 \mu m$ long, apex rotund.
Habitat: In the bark of trees.

Month: Oct., \( p^H = 7.3 \), Tempr.: 33.5 °C, LI: 9000 lux

Hazarika, 682, Amtoli.

**GENUS: MICROCOLEUS Desmazieres**


Filaments unbranched; trichomes vary, many in a colourless sheath, densely aggregated, often coiled rope like.

**Key to the species**

1. In fresh water or salt water

2. Salt water

2. Fresh water, trichome pointed

1. **M. acutissimus**

**M. acutissimus** Gardner

Desikachary, *op. cit.* 344, pl. 60, fig.1, 1959.

Pl. XI, Fig. 1

A tuft of filament within a broad highly gelatinous sheath; sheath colourless, cylindrical, homogenous and tightly interwoven, trichomes constricted at the cross walls, ends long, attentuated and pointed 1.9-2.1μm broad; cells pale blue green to hyaline, 3.5-5.1μm long; end cell acutely conical.
Habitat: Attached to submerged angiospermic plant in stagnant water near hill mixed with *Plectonema nostocorum*, *Lyngbya* spp. and in the paddy fields.

Month: Sept. - Oct., \( pH \): 8.7 - 8.9, Tempr. : 32.0 °C, LI : 8900 lux

Hazarika, 681, Kamakhya, 653, North Guwahati paddy field.

*M. chthonoplastes* Thuret ex. Gomont

Forti in De Toni, *op. cit.*, 5: 371, 1907; Frémy, *op.cit.*, 78, fig. 78, 1929; Geitler, *op. cit.*, 1133, fig. 739, 1932; Desikachary, *op. cit.* 343, pl. 60, fig. 7-9, 1959.

Pl. X, Fig. 4

Filaments forming an expanded dark blackish green, lamellated thallus, coiled, 30.4 - 48.4 μm broad; sheath gelatinizing, uneven, 11.52 μm thick; trichomes many, closely grouped together in rope like bundles, unconstricted; cross wall non granulated; cells 2.5-3.8 μm broad and 5.95-7.9 μm long, blue green; end cell pointed, conical, tip 0.38 μm broad.

Habitat: Attached to moist surface soils of a stone in hill slopes.

Month: Sept. - Oct., \( pH \) : 7.3 - 8.6, Tempr. : 30 - 32.0 °C, LI : 2000 - 9830 lux

Hazarika, 523, 565, Hatishila Hill, Bonda.

**GENUS: OSCILLATORIA** Vaucher.

Hist. conf., 165, 1803; Gomont, Monogr. Oscillariées, 198, 1892; Desikachary, *op. cit.*, 198, 1959.

Trichome single, forming a flat or spongy free swimming thallus; sheath absent,
rarely very delicately sheathed, end of trichomes may be pointed, bent, coiled, more or less screw like; hormogones formed by the division of the trichomes.

**Key to the species**

1. Cells upto $\frac{1}{3}$ as long as broad
   2. Trichome distinctly attenuated ------------------------------- 14. *O. proboscidea*
   2. Trichome otherwise
      3. Cells constricted
         4. Trichome 7.5-8.0 $\mu$m broad ---------------------------- 2. *O. annae*
         4. Trichome broader, straight, slightly capitate
            5. Trichome 10-20 $\mu$m broad, trichome constricted —  15. *O. sancta*
            5. Trichomes unconstricted, 8 - 10 $\mu$m broad ——  19. *O. vizagapatensis*
      3. Cells unconstricted
         6. Trichome straight:
            7. End cell with thickened outer wall ------------------- 10. *O. limosa*
            7. End cell without thickened outer wall
               8. Trichomes about 4 $\mu$m broad ------------------- 11. *O. obscura*
               8. Trichomes 5- 6 $\mu$m broad ----------------------- 16. *O. subbrevis*
      6. Trichomes bent or spirally coiled
         9. Trichomes 4 $\mu$m broad ------------------------------- 11. *O. obscura*
     9. Trichomes broader
        10. End cell rounded --------------------------------- 7. *O. curviceps*
        10. End cell slightly capitate ------------------------ 13. *O. princeps*
1. Cells longer

11. Trichomes with a characteristic yellow colour

12. Trichomes attenuated, 3 - 5 μm broad -------------- 9. O. laetevirens

12. Trichomes not attenuated, broader

13. Trichomes with cells up to 2μm long -------------- 4. O. chilkensis

13. Trichomes with cells 4 - 8μm long -------------- 5. O. chlorina

11. Trichomes blue green

14. Apices or portions of the trichomes spirally coiled

15. Trichomes 3-6.5μm broad, unconstricted at cross walls — 18. O. terebriformis

15. Trichomes 6 - 8μm broad, costricted at cross walls — 3. O. boryana

14. Apices not so coiled, ends only bent or curved

16. Apices not distinctly attenuated:

17. Trichomes less narrower than 5μm ----------------- 8. O. jasorvensis

17. Trichomes 4 - 6μm broad, apical cell with a thickened outer membrane ------------------- 17. O. tenuis

    var. tergestina

16. Apices distinctly attenuated

18. End cell conical, attenuated

19. Cells up to \(1/2\) as long as broad ----------------- 12. O. okeni

19. Cells quadrate or longer ------------------------ 6. O. cortiana

18. End cell rounded, trichome 1.6 - 1.8μm broad

20. Cells longer than broad ------------------------ 1. O. acuminata

    f. tenuis
**O. acuminata f. tenuis** Parukutty.


**Pl. XI, Fig. 2**

Thallus blue green; trichomes more or less straight, not constricted at cross walls, ca $1.8\mu m$ broad; cells $4.6 - 5.1\mu m$ long, longer than broad, cell walls not clearly obvious; end cell sharply tapering bent.

Habitat: Mostly available in the temporary stagnant water of road side ditches, mixed with *Spirulina*, *Oedogonium* and *Mougetia* spp.

Month: May, $p^H: 8.7$, Tempr.: $36^\circ C$, LI: 17300 lux

Hazarika, 56, Garchuck, Jalukbari; 592, North Guwahati.

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**O. annae** Van Goor.


**Pl. XI, Fig. 3**

Trichome straight, light blue green, almost brown; cell $7.6 - 7.98\mu m$ broad and $2-3.04\mu m$ long, bent $1/3$ as long as broad; cell wall constricted, not granulated; end cell rounded.

Habitat: Attached to submerged *Eichornia* plant in the Bahini river along with *O. limosa*, *O. chlorina* and *Arthrospira jenneri*.


Hazarika, 594, Jalukbari.
**O. boryana** Bory ex Gomont

Forti in De Toni, *op.cit.*, 5: 188, 1907; Frémý, *op. cit.*, 227, fig. 201, 1929; Geitler, *op. cit.*, 945, fig. 607, 1932; Desikachary, *op. cit.*, 218, pl. 38, fig. 12, 1959.

Pl. XI, Fig. 4

Trichome light blue green, coiled at the apices, slightly constricted at the cross walls; cells 6.1 - 6.8μm broad and ca 4.2μm long; end cell rounded, obtuse, less pointed, not capitate, calyptra absent.

Habitat: Attached to the soil of the rocks in the hill, mixed with *Anabaena variabilis* var. *ellipsospora*, *Lyngbya contorta*, *Chroococcus minutus*, *Chloroglea microcystoides*, and *Aphanotoce* spp.

Hazarika, 577, Kamakhya; 257, Basistha stream.

**O. chilkensis** Biswas


Pl. I, Fig. 11

Trichome straight, densely packed, somewhat curved, apex very shortly tapering; cells 4μm broad and 2μm long, slightly constricted or unconstricted, apical cell obtusely rounded; cross walls not granulated; cell contents homogeneous, pale blue green in colour.

Habitat: Floating in the industrial effluents.

Month: Nov - Dec., pH: 7.6, Tempr.: 32.0°C, LI: 17800 lux
Hazarika, 232, Dharapur.
O. chlorina Kütz. ex Gomont.

Forti in De Toni, op.cit., 5: 172, 1907; Frémy, op. cit., 215, fig. 183, 1929; Geitler, op. cit., 951, fig. 611c, 1932; Desikachary, op. cit., 215, pl. 40, fig. 4, 1959. Oscillatoria tenuis Ag. var. chlorina (Kutz.) Playfair, Biol. of Richmond River, 132, pl. 6, fig. 10, 1914.

Pl. VIII, Fig. 4

Thallus yellowish green; trichome straight, unconstricted; cells ca. 4.56 µm broad and 4.1-4.7 µm long, gas vacuoles absent, septa not granulated; calyptra absent.

Habitat: Attached to the submerged Eichornia plant mixed with O. limosa, Arthrospira jenneri at the junction of the Bahini river and Deepar Beel.


Hazarika, 594, Garchuk, Lokhra.

O. cortiana Meneghini ex Gomont.

Forti in De Toni, op.cit., 5: 182, 1907; Frémy, op. cit., 227, fig. 199, 1929; Geitler, op. cit., 971, fig. 619c, 1932; Desikachary, op. cit., 233, pl. 38, fig. 14, 1959.

Pl. I, Fig. 12

Thallus floating, dull blue green; trichome straight, gradually tapering and bent at the apices; cells ca. 5.76 µm broad and 5.22 - 6.71 µm long, not granulated, unconstricted or slightly constricted; end cell attenuated, obtuse, 8.1 - 10.0 µm long, without calyptra.

Habitat: Floating in the temporary road side water, flowing slowly from the hill.

Month: July, Nov., pH: 8.0, Tempr.: 27.0-35.0 °C, LI: 2000 - 6000 lux

Hazarika, 426, 603 Bonda.
**O. curviceps Ag. ex Gomont.**

Forti in De Toni, *op. cit.*, 5: 157, 1907; Geitler, *op. cit.*, 947, fig. 598 e, 1932; Frémy, Cyano. cotes d’Eur., 117. pl. 30, fig.5, 1933, Desikachary, *op. cit.* 209, pl. 38, fig. 2, 1959.

Pl. XII, Fig. 1

Thallus light blue green; trichomes more or less straight, slightly bent at the end, very little attenuated, unconstricted or very little constricted at the cross walls, cross wall granulated; cells 12.16 -17.1 μm broad and 2.86- 3.8 μm long, end cell rounded.

Habitat: First attached to soils of submerged stones and later free floating.

Month: May, \( p^H : 8.2 \), \( \text{Temp.} : 30.0^\circ \text{C} \), \( \text{LI} : 5500 - 15600 \text{ lux} \)

Hazarika, 641, Deepar beel, Jalukbari.

The second specimen of *O. curvicep* Ag. ex Gomont. is collected from the sloping wet stones of a hilll.


Pl. XII, Fig. 2

Thallus dark blue green; trichome 7.4 - 10.1 μm broad, cells ca. 1.85 μm, long; cross walls unconstricted, granulated, tip cell curved.

Month: Aug , \( p^H : 8.3 \), \( \text{Temp.} : 35.6^\circ \text{C} \), \( \text{LI} : 17500 \text{ lux} \)

Hazarika, 463, Bonda.

**O. jasorvensis Vouk.**

Jugosl. Akad. Zagreb, 14: 133, fig. 1, 1919; Geitler, *op. cit.* 962, fig. 613, 1932;

Pl. XII, Fig. 3

Thallus pale blue-green, yellowish green trichome straight, end bent, not constricted, not capitate, not attenuated; cells 3.9 - 4.2\(\mu\)m broad and ca. 3.9\(\mu\)m long, cells as long as broad or nearly so; end cell rounded without calyptra.

Habitat: Attached to submerged *Eichornia* plant in the ditches, mixed with *O. limosa*, *Arthrospira jenneri*, and *Spirulina* sp.

Month: Nov.- Dec., \(p^H: 7.3\), Tempr.: 24.0 °C, LI: 2000 lux

Hazarika, 594, Garchuck, Lokhra.

*O. laete-virens* (Crouan) Gomont.

Forti in De Toni, *op. cit.*, 5: 177, 1907; Geitler, *op. cit.*, 949, fig. 603 c, 1932; Frémy, *op. cit.*, 126, pl. 31, fig. 12, 1933, Desikachary, *op. cit.* 213, 1959.

Thallus greenish, thin; trichome yellowish green, straight unconstricted or slightly constricted, apices briefly attenuated; cells ca. 3.8\(\mu\)m broad and 4.1-5.2\(\mu\)m long; cross-wall granulated; end cell not capitate, more or less obtuse or conical, without calyptra.

Habitat: Attached to the surface soil of wet rocks in hill slopes and with the submerged stones of the stream.


Hazarika, 251, Basistha stream, 565 Bonda.

*O. limosa* Ag. ex Gomont.

Forti in De Toni, *op. cit.*, 5: 154, 1907; Frémy Myxo. d’Afr. équat. franc. 212, fig.
Thallus dark blue green; trichome more or less straight, blue green to brown colour, unconstricted or slightly constricted; cells 11.18-15.2μm broad and 2.4-5.0μm long; cross walls frequently granulated; end cells flatly rounded with slightly thickened membrane.

Habitat: Attached to submerged *Eichornia* plant in the ditches mixed with *Spirulina* and *Lyngbya* spp.


Hazarika, 113, North Guwahati, 594, Garchuck, Lokhra road.

**O. obscura** Bruhl et. Biswas


Thallus dirty green, trichome attenuated at the apex, rounded, slightly bent or nearly straight; cells 4.8μm broad and 1.92μm long, not constricted at the cross walls, blue green in colour.

Habitat: Attached to the submerged brick wall of effluents of Goenka Wollen Mills.

Month: Nov., pH: 9.8, Tempr.: 32.0 °C, LI: 6080 lux

Hazarika, 606, Dharapur.
O. okeni Ag. ex Gomont.

Forti in De Toni, op. cit., 5: 185, 1907; Frémy, op. cit., 227, fig. 200, 1929; Geitler, op. cit., 969, fig. 608 a, 1932; Frémy, op. cit. 127, pl. 31, fig. 13, 1933, Desikachary, op. cit. 231, pl. 48, fig. 17, 1959.

Pl. I, Fig. 14

Thallus dirty green; trichome straight, attentuated at the apices, undulating, slightly bent; septa distinct, not granulated, cells ca. 5.76μm broad and 1.92 - 2.1μm long, at the end 7.6μm long; end cells subconical, slightly thickened at the tip; without calyptra.

Habitat: Attached to the concrete portion of a running water tap mixed with Phormidium sp.

Hazarika, 262, Jalukbari, 604, Amtoli.

O. princeps Vaucher ex Gomont.

Forti in De Toni, op. cit., 5: 150, 1907; Frémy, op. cit., 208, fig., 1929; Geitler, op. cit., 947, figs. 598 a, 601-cg, 1932; Desikachary, op. cit. 210, pl. 37, fig. 1, 10, 11, 13, 14, 1959.

Pl. XIII, Fig. 1

Trichomes blue green to dirty green, mostly forming a thallus, mostly straight not constricted at the cross walls, slightly or briefly attentuated at the apices and bent; cells ca. 13.3μm broad and 2.66 μm long, granulated; end cells flatly rounded, slightly capitate with slightly thickened membrane.

This species is smaller than the typed one.

Habitat: In the moist soils of the paddy field.

Month: May, pH:8.3, Tempr.: 33.0 °C, LI: 26000 lux
Hazarika, 364, Amtoli.

**O. proboscidea** Gomont.

Forti in De Toni, *op. cit.*, 5: 152, 1907; Frémy, *op. cit.*, 211, fig. 176, 1929; Geitler, *op. cit.*, 948, fig. 598 b, 1932; Desikachary, *op. cit.* 211, pl. 38, fig. 9, 1959.

Pl. XIII, Fig. 2

Thallus light to deep blue-green; trichomes more or less straight, broader, not constricted at the cross walls, at the ends distinctly attenuated, slightly curved or bent; brightly blue green; cells 21.12 - 27.36μm broad and 2.8 - 4.36μm long; septa indistinct, pigmented at the cross walls; end cell flatly rounded, attenuated, distinctly capitate with slightly thickened membrane.

This variety is bigger than the typed one, cross wall pigmented.

Habitat: Forming a bloom in the temporary standing rain water and in the effluents of Goenka Wollen Mills.

Month: June - July, pH: 7.9 - 9.4, Temp: 32.0 - 35.8°C, LI: 17800 - 18000 lux

Hazarika, 375, Lokhra, 412, Industrial effluents, Dharapur.

**O. sancta** (Kütz.) Gomont.

Forti in De Toni, *op. cit.*, 5: 153, 1907; Frémy, *op. cit.*, 211, fig. 177, 1929; Geitler, *op. cit.*, 943, fig. 598 c, 1932; Desikachary, *op. cit.* 203, pl. 42, fig. 10, 1959.

Pl. XIII, Fig. 3

Thallus dark blue green, gelatinous, shining; trichomes straight or bent admist of other myxophycean algae, dull blue green; cells 13.44 - 15.2μm broad and 2.88 - 3.8μm
long, granulated the cross walls; ends briefly attenuated with a thickened membrane.

Habitat: Epipelic in the paddy field mixed with *Spirulina* spp, diatoms, *O. subbrevis* and *P. bohneri*.

Month : Nov.,  $p^H:8.6$,  Tempr. : 26.0 °C,  LI : 3400 lux

Hazarika, 592, North Guwahati.

*O. subbrevis* Schmidle

Engler's Bot. Jahrb. 30: 243, pl. 4, fig. 7, 1901; Forti in De Toni, *op. cit.,* 5: 208, fig. 174, 1907; Frémy, *op. cit.,* 208, fig. 174, 1929; Geitler, *op. cit.,* 949, fig. 601 b, 1932; Desikachary, *op. cit.* 207, pl. 37, fig. 2. pl. 40, figs. 7, 1959.

Pl. XIII, Fig. 4

Trichome single, light blue green, nearly straight, apices not attenuated; septa not granulated, indistinct; cells 5.76 - 6.2μm broad and 0.96 - 1.9μm long, granulated; end cell rounded; calyptra absent.

Habitat: Epipelic in the stagnant water of paddy field, mixed with *Spirulina* spp. *O. sancta* and diatoms.

Month : Nov.,  $p^H:8.6$,  Tempr. : 26.0 °C,  LI : 3400 lux

Hazarika, 592, North Guwahati.

*O. tenuis* var. *tergestina* Rabenh.


Pl. XIV, Fig. 1
Thai Ins thin, blue green or olive green, gelatinous, trichome straight, fragile, slightly constricted at the cross walls, cells 4.29 - 5.7μm broad and 2.5 -3.8μm long; septa granulated; end cell more or less hemispherical with thickened outer membrane.

Habitat: Floating and attached to stagnant water of the paddy field mixed with *Aphanathece* sp., *Phormidium* sp., *Microcoleus*, *Arthrospira* sp. and *Oscillatoria* sp.

Month: June - Oct,  pH: 6.7,  Tempr.: 32.2 °C,  LI:  3910 lux
Hazarika, 653, North Guwahati, 61, Bonda.

**O. terebriformis** Ag. ex. Gomont.

Forti in De Toni, *op. cit.*, 5: 189, 1907; Geitler, *op. cit.*, 954, fig. 607 d, 1932; Desikachary, *op.cit.* 217, pl. 38, fig. 16, 1959.

Pl. XIV, Fig. 2

Thallus blue green, trichome end bent and slightly attenuated; unconstricted at the cross walls; cells 3.45 -3.8μm broad and 3.04μm long; end cell rounded, not capitate; calyptra absent.

Habitat: Attached to submerged wet rocks of the hill and stagnant water of paddy field.

Month: May - June,  pH: 8.1,  Tempr.: 26.0 °C,  LI:  2200 lux
Hazarika, 651, Kamakhya hill, 653, North Guwahati.

**O. vizagapatensis** Rao, C. B.

Myxophyceae of the Madras Presidency, J. Indian Bot. Soc. 17: 89; figs. 1-3, 1938 a; Desikachary, *op. cit.*, 205, pl. 39, figs. 16, 18, 1959.

Pl. XIV, Fig. 3
Thallus blue green; trichomes straight or bent, uniformly broad except at the extreme apex; cells 8.0 - 8.7μm broad and 1.8 - 2.1μm long, pale blue green; contents granular; cross wall slightly constricted; ends slightly attentuated; cell broadly rounded forming a cap in one side of the filament.

Habitat: Submerged in the paddy field mixed with Phormidium bohneri, O.sancta, O. subbrevis, Spirulina spp. and diatoms.

Month : Nov.- Dec., pH: 8.6, Tempr.: 26.0 °C, LI : 3340 lux

Hazarika, 592, 586, North Guwahati.

GENUS : PHORMIDIUM KÜTZ.


Thallus attached by the lower portion or floating; sheath colourless, thin or firm; trichomes cylindrical, straight or bent, never regularly spirally coiled, capitate or non-capitate; apical cells in many species with a calyptra.

Key to the species:

1. Trichomes constricted at the cross walls; ends not bent or capitate

2. Trichomes 1.5-2μm broad, in the mucilage of planktonic organisms — 4. P. mucicola

2. Trichome broader, 3.0 - 4.0μm broad ———————— ———— 6. P. usterii

1. Trichomes not constricted at the cross walls; ends often bent and capitate

3. Trichome 1.7 - 2.0μm broad ———————————— ———— 1. P. bohneri

3. Trichome broader

4. Trichome not attentuated at the apices, 5.8 - 6.4μm broad, forming a thick
calcified thallus —————————— 2. P. calcicola

4. Trichomes attentuated

5. Cells longer than broad —————————— 3. P. corium var. capitatum

5. Cells shorter than broad —————————— 5. P. subfuscum

P. bohneri Schmidle.


Pl. XIV, Fig. 4

Thallus blue green, thin, mucilaginous; trichome nearly straight, more or less parallel, not constricted at cross walls, 2.0 - 2.1 μm broad, not attentuated at the ends, not capitate; sheath hyaline, diffuent; cells shorter than broad, end cell rounded.

Habitat: Submerged in stagnant water, epipelic, mixed with *Spirulina, Oscillatoria* and diatom spp.

Month: Nov., pH: 8.6, Tempr.: 26.0 °C, LI: 3400 lux

Hazarika, 592, North Guwahati.

P. calcicola Gardner.

New Myxophyceae from Porto Rico, Mem. N. Y. Bot. Gdn, 7: 44, pl. 9, fig. 87, 1927; Geitler, op. cit. 1013, fig. 646a, 1932; Desikachary, op. cit. 267, pl. 43, fig. 4,5, 1959.

Pl. XV, Fig. 1
Thallus thick, densely entangled filaments, 7.1-7.5μm broad; sheath thick, firm, unlamellated, colourless; trichomes not constricted at the cross walls, not attentuated; cells 5.9 - 6.1μm broad and 3.57 - 3.78μm long, quadratic, slightly shorter than broad or longer, end cell rounded, with a thickened outer membrane.

Habitat: Attached to wet rock, mixed with Lyngbya sp.

Month : Oct.,  p[H] : 8.7,  Tempr. : 32.0 °C,  LI :  4800 lux

Hazarika, 679, Kamakhya.

**P. corium var capitatum** Gardner


Pl. XV, Fig. 2

Thallus expanded, dirty green, attached; trichome pale blue green, not constricted, not granulated at the cross walls, slightly attentuated at the tip, septa distinct, sheath thin, firm and smooth, cells nearly quadrate, 3.84 - 4.5μm broad and 4.22μm long; end cell obtuse, slightly bent, conical with distinctly thickened outer membrane.

Habitat: Attached to the stones under running water tap along with Oscillatoria okeni and O. cortiana.


Hazarika, 604, Amtoli.

**P. mucicola** Hub.- Pestalozzi et. Naumann.

Filaments short, blue green, in a mucilaginous sheath of other algae, 10.01-19.71μm long and straight but sometimes up to 50-60μm long and slightly curved; sheath very thin; trichome not attenuated, septa indistinct; cells 1.57-1.92μm broad, contents granulated; end cell not attenuated, rounded and slightly thickened.

Habitat: Attached to moist stone in the mucilage of other algae (not identified).

Month: June - July, pH: 8.7, Tempr.: 34.4 °C, LI: 4300 lux

Hazarika, 433, Bonda.

_P. subfuscum_ Kütz. ex Gomont.

Forti in De Toni, _op. cit._, 5: 247, 1907; Frémy, _op.cit._, 161, fig. 141, 1929; Geitler, _op. cit._, 1022, figs. 652 d-g, 1932; Frémy, Cyano. cotes d'Eur., 92, pl. 23, fig. 8, 1933, Desikachary, _op. cit._ 273, pl. 44. figs. 22, 23, 1959.

Thallus expanded, dark olivaceous; filaments straight, ca. 7.6μm broad, fragile; sheath thin, hyaline, different into a lamellose mucous; trichome olive green, septa not constricted; cells 5.72μm broad and 2.7μm long, granular; ends more or less briefly attenuated, capitate; end cell straight, 3.1μm long and 0.71μm broad, acute, conical.

Habitat: Attached to submerged stones of a culvert along with _Calothrix sp._, _Myxosarcina burmensis_ and _Chroococcus pallida_.

Month: Sept., pH: 8.4, Tempr.: 32.0 °C, LI: 3300 lux

Hazarika, 531, North Guwahati.

_P.usteri_ Schmidle.

Forti in De Toni, _op. cit._, 5: 238, 1907; Geitler, _op. cit._, 1016, 1932;

Pl. XVI, Fig. 1

Thallus mucilaginous amidst of *Anabaena* species lacerated at the margins; trichomes bent, 3-4\(\mu\)m broad; sheath thick and diffluent; cells shorter than broad, contents homogenous, blue green; ends not attenuated, straight; end cell broadly rounded.

Habitat: Attached to the wet stones of a stream mixed with *Anabaena* sp.

Month: Nov.-Dec., \(pH\): 9.1, Tempr: 26.0 °C, LI: 5200 lux

Hazarika, 605, Amtoli.

**GENUS**: *SPIRULINA* Turpin em. Gardner.


Trichomes unicellular or multicellular, cylindrical, loosely or tightly coiled into a more or less regular spiral; cross wall if present, obscured; sheath and calyptra absent.

**Key to the Species**

1. Spirals close to each other
   
2. Spirals broader than 3.0\(\mu\)m
   
5. *S. subsalsa*

2. Spirals 2.0-2.7\(\mu\)m broad

2. *S. labynrhithiformis*

1. Spirals distant, regular

3. Trichomes 1.2 -1.7\(\mu\)m broad

3. *S. major*

3. Trichomes broader than 2\(\mu\)m
4. Trichomes 4.5 - 5.0μm broad ------------------------------- 4. *S. princeps*

4. Trichomes narrower ------------------------------------------- 1. *S. gigantea*

*S. gigantea* Schmidle.


Pl. XVI, Fig. 2

Trichome deep blue green, 3.7- 3.9μm broad, regularly spirally coiled, at the end slightly attentuated; spirals 8-8.58μm broad and ca 7.8μm separated.

The breath of the spiral is similar to the form described by Skuja's (1949, pl. 7, figs. 20-22) plant.

Habitat: Free floating in the stagnant water of roadside ditch and paddy field mixed with *Cylindrospermum* sp., *Oedogonium* and diatoms.

Month: Oct.-Nov., pH: 5.8 - 8.6, Tempr.: 24.0 - 26.0 °C, LI: 2800 - 3400 lux

Hazarika, 56, 90, 592. Jalukbari, Tetelia, North Guwahati.

*S. labyrinthiformis* (Menegh.) Gomont.

Forti in De Toni, *op. cit.*, 5: 215, 1907; Frémy, *op. cit.*, 237, fig. 212, 1929; Geitler, *op. cit.*, 928, 1932; Frémy, *op. cit.* 134, pl. 31, fig. 25, 1933; Desikachary, *op. cit.* 195, pl. 36, fig. 11. pl. 49, figs. 1, 1959.

Pl. XVI, Fig. 3

Thallus dirty, dark green, trichome 1.0μm broad, regularly spirally coiled; spirals
very close to one another, spirals 2.4 µm broad.

Habitat: Mixed with *Chaetophora* sp., *Chlorella* sp., *Spirulina major* and diatom submerged in the pond of a paddy field.

Month: Oct - Nov,  \( \text{pH} : 8.3 \),  \( \text{Tempr.} : 32.0 ^\circ \text{C} \),  \( \text{LI} : 8010 \text{ lux} \)

Hazarika, 587, North Guwahati.

**S. major** Kütz. ex. Gomont

Forti in De Toni, *op. cit.*, 5: 210, 1907; Frémy, *op. cit.*, 234, fig. 208, 1929; Geitler, *op.cit.*, 930, fig. 595, 1932; Desikachary, *op. cit.* 196, pl. 36, fig. 13, 1959.

Pl. XIV, Fig. 3

Trichome blue-green, regularly spirally coiled, 1.29 - 1.48µm broad; spirals 2.4-3.7µm broad and 2.4 - 3.7µm distant; terminal cell round, upward movement seen.

Habitat: Attached to the moist soil of paddy field and in the stagnant water of Deepar beel.

Month: Oct - Nov,  \( \text{pH} : 6.8 - 8.6 \),  \( \text{Tempr.} : 28.0 - 32.0 ^\circ \text{C} \),  \( \text{LI} : 8000 - 8100 \text{ lux} \)

Hazarika, 93, Jalukbari, 586, North Guwahati.

**S. princeps** W. et G. S. West.

A contribution to the fresh water algae of Ceylon, Trans. Linn. Soc. (Lond.) Bot., 2 ser. 6: 205, 1902; Forti in De Toni, *op. cit.*, 5: 211, 1907; Frémy, *op. cit.*, 236, fig. 210, 1929; Geitler, *op. cit.*, 931, fig. 593 d, 1932; Desikachary, *op. cit.* 197, pl. 36, fig. 7, 1959.

Pl. XI, Fig. 2

Trichome 3.57- 4.3µm broad, regularly spirally coiled, blue green in colour,
spirals 8 - 8.6µm broad and 8.6µm distant; terminal cell round, upward movement of the filament is seen.

The species is highly variable. This species is similar to the Madras form (Parukutty; 1940, 119) except the distant of the spiral.

Habitat: In the mud of paddy field mixed with other myxophycean algae.

Month: Oct - Nov,  pH: 8.3 - 8.6,  Tempr.: 26.0 - 32.0 °C,  LI: 3400-8010 lux

Hazarika, 587, 592, North Guwahati.

S. subsalsa Oerst. ex Gomont.

Forti in De Toni, op.cit., 5: 214, 1907; op. cit., 236, fig. 211, 1929; Geitler, op. cit., 927, fig. 593 a, 1932; Frémy, op. cit., 133, pl. 31, fig. 24, 1933; Sp. turfosa Cramer, Hedwigia, 2: bl., pl. 12, fig. 1, 1863. Sp. tenuissima Kütz., Alg. Aq. dulc., 14, no. 131, 1836: Phyc. gene., 183, 1843; Phyc. germ., 156, 1845; Tab. Phycologicae, 1: 26, pl. 37, fig. 4, 1845 non Nordst; Desikachary, op. cit., 193, pl.36, figs. 3, 9, 1959.

Pl. XVI, Fig. 4

Trichome single, among other algae, 2.0-2.7µm broad, somewhat irregularly densely spirally coiled, sometimes loosely coiled; spirals very close to each other, 4.3-5.0µm distant, 5.72-6.43µm broad, blue green to reddish violet.

This algae differs from the typed one for broader trichome and spirals.

Habitat: Epipelic submerged in the stagnant water of paddy field along with Oscillatoria sancta, O. subbrevis, Phormidium bohneri and diatoms.

Month: Nov.,  pH: 7.6 - 8.6,  Tempr.: 26.0 °C,  LI: 3400 lux

Hazarika, 592, North Guwahati.
GENUS: SYMPLICA Kütz.

Phyc. gene., 201, 1843; Gomont, Monogr. Oscillariées, 104, 1892; Desikachary, op. cit., 334, 1959.

Trichome single in a thin sheath; filaments mostly forming erect bundles, partly false branched; sheath firm or later gelatinising; trichome straight, sometimes slightly attentuated; end cell not capitate, sometimes with a thickened outer membrane.

Key to the species

1. Bundles anastomosing:
   2. Trichomes 1.3-2μm broad, slightly constricted ——— 1. S. elegans

1. Bundles not anastomosing:
   3. Trichomes 1.2-2μm broad, constricted ——— 2. S. thermalis

S. elegans Kützing ex Gomont.


Pl. XVII, Fig. 1

Hair like bundles, erect, anastomosing, deep blue green; filaments parallel, agglutinated, bent, flexuous; sheath seemingly thick; trichome light blue green, apices pointed; cells 1.72μm broad and 4.1μm long; septa not distinct, not granulated; end cell subconical, calyptra absent.

Habitat: Attached to the submerged roots and stem of Eichornia plant in the road side ditches.

Month: Aug. - Sept., pH: 8.0, Temp.: 31.0 °C, LI: 4100 lux

Hazarika, 490, Garchuk, Lokhra.
S. thermalis (Kütz.) Gomont.

Forti in De Toni, op. cit., 5: 307, 1907; Frémy, op. cit., 131, fig. 114, 1929; Geitler, op. cit., 1127, fig. 736, 1932; Desikachary, op. cit. 339, 1959.

Pl. XVII, Fig. 2

Bundles erect, densely arranged, bright blue green; densely intricate at the base, above almost parallel; sheath very thin, sometimes slimy; trichomes blue green, constricted at the cross wall, with a single granule; cells ca 1.71 μm broad and 1.7 - 4.29 μm long; end cell rounded with a thickened outer membrane.

Habitat: Floating or attached to the submerged stem of aquatic plants in the paddy field.

Month: Aug., pH: 8.7, Tempr.: 34.0 °C, LI: 3300 lux

Hazarika, 482, North Guwahati.

Family: Nostocaceae Kützing


Trichome free or in a common mucilage, end cells sometimes attenuated; sheath thin and firm or thick and gelatinous; heterocysts present or absent, when present they may be terminal or intercalary, single or more or than one; spores present or absent, single or in series, contiguous or remote from heterocyst, on one side or on either sides of the heterocyst.

Key to the Genera

1. Trichomes without firm sheath

2. Heterocyst absent, trichome with uniform cells

8. Pseudanabaena
2. Heterocyst present
   3. Intercalary heterocysts generally in pairs ----------------------- 2. *Anabaenopsis*
   3. Intercalary heterocyst generally single
   4. Heterocysts commonly terminal with a single large spore
      adjoining -------------------------- 5. *Cylindrospermum*
   4. Heterocysts rarely terminal, generally intercalary
   5. End cells elongated, hair like, colourless ----------------- 3. *Aphanizomenon*
   5. End cells not so
   6. Filaments single or in a formless gelatinous mass ------- 1. *Anabaena*
   6. Filaments generally in a definite colony
      7. Thallus finger shaped attached at first ------- 9. *Wollea*
      7. Thallus otherwise -------------------------- 7. *Nostoc*

1. Trichomes with a firm sheath
   8. Trichomes in parts of the thallus more than one in a sheath --- 6. *Hormothamnion*
   8. Trichomes within a firm sheath, cells not discoid ------------------- 4. *Aulosira*

**GENUS: ANABAENA Bory**


Trichomes uniformly broad or apices alone somewhat attenuated, single or more than one in a common mucilaginous sheath; sheath generally absent; heterocysts generally intercalary, single; spores single or in long series, remote or contiguous to the heterocyst.

**Key to the species**

1. Trichome endophytic ---------------------------------------- 2. *A. azollae*
   1. Trichome not endophytic
      2. Akinets usually contiguous to the heterocysts
3. Akinets spherical to oval ———— 8. *A. sphaerica* var. *attenuata*

3. Akinets ellipsoidal

4. Akinets on one side of the heterocyst with smooth epispore

5. Akinets 15 - 21μm broad, gas vacuoles absent ——— 10. *A. volzii*

5. Akinets 7-18μm broad, gas vacuoles present ———— 1. *A. aphanizomenoides*

4. Akinets on both sides of the heterocysts, 8.0 - 10.5 μm broad

6. Trichome 2.5-4.0μm broad, about twice as long as broad — 6. *A. orientalis*

6. Trichome 5.3-6.3μm broad, as long as broad, akinets in chain — 4. *A. iyengarii*

2. Akinets usually away from the heterocyst

7. Akinets cylindrical, 6-10μm broad ———— 5. *A. laxa*

7. Akinates ellipsoidal

8. Akinets short ellipsoid ———— 7. *A. oryzae*

8. Akinets ellipsoidal with rounded ends, about twice as long as broad

9. Trichomes not so coiled, constricted, cells as long as broad — 3. *A. doliohum*

9. Trichome not markedly constricted, cells longer than broad — 9. *A. variabilis* var. *ellipsospora*

*A. aphanizomenoides* Forti

- Atti Mem. ac. d'agric. Sc. lett. arti e comm. Verona, der. 4,12: 126, fig. 2, 1912; Geitler, *op. cit.*, 875, fig. 556, 1932; Desikachary, *op. cit.*, 405, pl. 71, fig. 4, 1959.

Pl. XVII, Fig. 3

Thallus dark blue green, soft, gelatinous; trichome single, straight or slightly bent;
cells 4.8-5.0 μm, broad and 9.6-10.0 μm long, slightly constricted at the cross-walls, cylindrical, barrel-shaped with gas vacuoles; heterocysts cylindrical, 5.56-6.1 μm broad and 7.1-9.6 μm long; spore 9.6-11.52 μm broad and 32.64 μm long.

The spore is longer than the typed one.

Habitat: Floating in the stagnant water of paddy field.

Month: Aug., pH: 9.0, Tempr.: 32.0 °C, LI: 7700 lux

Hazarika, 477, North Guwahati.

*A. azollae* Strasb.


Pl. I, Fig. 15

Endophytic on *Azolla pinnata*; filaments short; sheath indistinct; cells spherical, small, 2.5-3.5 μm in dia; heterocyst smaller than vegetative cells; 2-2.2 μm in dia.; spores ellipsoidal, thick, exospore brown in colour, endospore thin and hyaline.

Habitat: Endophytic on *Azolla pinnata* floating on the permanent water of the roadside ditches and paddy fields.

Month: July-Aug., pH: 6.5-7.6, Tempr.: 25.0-31.0 °C, LI: 2000-3000 lux

Hazarika, 454, Lokhra, 170, North Guwahati.

*A. doliolum* Bharadwaja


Pl. XVII, Fig. 4
Thallus attached, plant mass mucilaginous, pale blue green; trichome single, straight or slightly coiled, tapering at the ends, markedly constricted at the cross walls; cells barrel shaped, 3.8 - 4.8μm broad and 4.1- 5.6μm long, as long as broad or shorter than the broad, tip cell 5.1μm long; heterocysts barrel shaped, 5.7-6.1μm broad and 6.2-7.7μm long; spores ellipsoidal, with almost pointed apices in short and long chains, away from the heterocysts with rounded ends, 5.7-6.2μm broad and 6.3- 7.6μm long, epispore thick, smooth and light brown.

Habitat: Brown coloured ball like structure attached to stones mixed with other Myxophyceae.

Month : Oct., pH: 8.2, Tempr.: 32.0 °C, LI : 2400 lux

Hazarika, 577, Kamakhya.

A. iyengarii Bharadwaja


Pl. XVIII, Fig. 1

Thallus free swimming, mucilaginous, trichome single or irregularly curved; cells ca. 5.2- 5.8μm broad and 5.6-7.6μm long, slightly longer than the broad; heterocyst barrel shaped 7.5-7.8μm broad and 7.5-10.4μm long; spores in chain in both sides of the heterocysts, 8.5- 9.5μm broad and 10.7-15.2μm long, epispore thick, smooth and yellowish brown.

Habitat: Free floating in the stagnant water of paddy field.

Month : Sept., pH: 7.5 - 8.5, Tempr.: 30.2 - 34.0 °C, LI : 5800 - 7500 lux

Hazarika, 535, North Guwahati.
A. laxa (Rabehn)

Forti in De Toni, op. cit., 5: 446, 1907; Frémy, op. cit. 365, fig. 301, 1929; Geitler, op. cit. 896, fig. 578, 1932. non Coake, 1884; A. oblonga Wildemann, Ann. Jardin Buitenz, 1:50, 1887; A. kuetzingiana De Toni, J. Natereile di nomencl. algol. 8: 2, 1936; Desikachary, op. cit. 413, 1959.

Pl. XVIII, Fig. 2

Thallus mixed with other algae, light blue green; trichomes straight, single, parallel, free, with a mucilaginous sheath; cells 2.8- 3.44μm broad and 4.2- 5.75μm long, cylindrical, apices hardly attenuated, end cell rounded, heterocyst 5.7μm broad or elongate upto 9.5μm; spores many, away from the heterocyst, 5.7- 6.0μm broad and 11.4 μm long, epispore smooth.

Habitat: Attached to stones mixed with other blue green algae.

Month: Oct, pH: 8.7, Tempr.: 32.0 °C, LI: 8900 lux

Hazarika, 681, Kamakhya.

A. orientalis Dixit


Pl. XVIII, Fig. 3

Trichome single, straight or slightly curved, blue green, attached; cells quadrate or cylindrical, rarely slightly barrel shaped, 2.8- 3.0μm broad and 3.44- 4.6μm long, constricted, end cell with rounded apex; heterocysts single, intercalary, slightly ellipsoidal with rounded end walls, 3.84μm broad and 5.7μm long; spores one on each side of the heterocyst, ellipsoidal, 3.84μm broad and 5.76μm long.
In this species the heterocyst and the spores are smaller in the size than the typed one.

Habitat: Attached to the stem of submerged *Justicia* sp.

Month: Aug., $p^H: 9.4$, Tempr.: 32.2 °C, LI: 6700 lux

Hazarika, 472, North Guwahati.

*A. oryzae* Fritsch


Pl. XVIII, Fig. 4

Thallus soft, gelatinous; trichomes short, straight, densely aggregated; cells barrel shaped, 2.88-3.4 μm broad and 5.76-6.84 μm long; heterocysts terminal and intercalary, broader than vegetative cell; 3.84 μm broad and 6.84-7.68 μm long; terminal one conical and twice longer than broad; akinets 2 or 3 celled away from the intercalary heterocyst, little bigger than the vegetative cell, 3.26 μm broad and 7.68 μm long; spores 5-7 in series, next to the terminal heterocyst, a diffluent sheath is seen.

Habitat: Attached to the mud of the rice field.

Month: May-Nov., $p^H: 8.4-8.5$, Tempr.: 26.0 °C, LI: 2100-2200 lux

Hazarika, 225, North Guwahati, 644, Kamakhya.

*A. sphaerica* var. *attenuata* Bharadwaja

Thallus soft, thin, gelatinous, free floating, pale blue green; trichomes moniliform, curved or straight, more or less entangled with each other; cells spherical, 3.84-5.1μm broad and 5.1-8.0μm long, tip cell 4.8μm broad and 6.72μm long; spores one in each sides of the heterocyst, spherical or oval, 10.2-11.3μm broad and 10.2-12.6μm long, with smooth yellowish outer wall.

Habitat: Attached to the filaments of Spirogyra in the temporary stagnant water.

Month: July-Aug., pH: 8.7, Tempr.: 34.0 °C, LI: 3300 lux
Hazarika, 195, North Guwahati.

A. variabilis var. ellipsospora Fritsch.

The genus Anabaena etc., J. Indian Bot. Soc., 28, 142, figs. 40-50, 1949; Desikachary, op. cit., All, pi. 72, fig. 1, 1959.

Pl. XIX, Fig. 2

Thallus attached, gelatinous; trichomes slightly flexuous with diffuent sheath, short, loosely aggregated, constricted at the cross walls; apical cell rounded, sometimes obtuse; cells 3.8- 4.0μm broad and 5.7- 6.0μm long, slightly barrel shaped, sometimes later isodiametrical and torulose or moniliform, barrel 3.85μm in dia.; heterocysts intercalary, solitary, spherical or barrel shaped, 5.1- 5.76μm broad and 5.76- 7.68- 9.6μm long, 5.76 μ in dia., sometimes terminal, hemispherical; spores in catenate series, away from the heterocysts, ellipsoidal, more or less oblong, 5.3- 5.7 μm broad and 5.7-11.4 μm long; endospore thin, exospore separated from endospore.

In this species the trichome is thinner than the typed one.

Habitat: Attached to the wet stones of the hill.

Hazarika, 331, Bonda; 557, Kamakhya.

A. volzii Lemm.


Pl. XIX, Fig. 3

Trichome single, straight or curved, without a mucilaginous sheath; cells 3.8-4.3 μm broad and 7.68-9.32 μm long; cylindrical, constricted at the cross walls, end cell rounded; heterocysts cylindrical, 4.3-6.02 μm broad and 9.6-10.20 μm long; spores single, ellipsoidal, on one side of the heterocyst, 8.0-11.12 μm broad and 19.2-27.5 μm long, with a smooth colourless membrane.

This specimen is little smaller than the typed one.

Habitat: Attached to Justicia sp. and Salvinia in parmenent stagnant water of the ditches associated with Lyngbya, Oscillatoria and unicellular myxophycean algae.

Month: Aug.-Oct.,  pH: 8.0,  Tempr.:  32.0 °C,  LI:  2800 lux

Hazarika, 165, 574, Garchuk, Lokhra roadside ditches.

GENUS: ANABAENOPSIS (Walosz) Miller sensu strict.

Zur Systematik der Gattung Anabaena Bory, Arch. Soc. russe Protistal. 2: 125, 1923; Woloszynska, Das Phytoplankton einiger javanischer Seen mit Berucksichtigung...

Trichomes free swimming, short, spirally coiled, like in *Anabaena*; heterocysts terminal and intercalary, intercalary ones in pairs formed by the unequal division of two adjoining vegetative cells; spores intercalary and formed away from the heterocyst.

*A. circularis* (G. S. West) Wolosz. et Miller.


Pl. XIX, Fig. 4

Thallus deep blue green, gelatinous, flattened ball like structure; trichomes very short, mostly spirally coiled, with 1½ spirals; cells 4.29 - 5.1 μm broad and ca. 5.7 μm long, somewhat longer than the broad and when spherical 4.29 - 5.72 μm in dia., with a large granule; heterocysts in pairs, spherical, 5.72 μm in dia.; spores not known.

Habitat: Collected from the ditch and beel.

Month: June.,  
\[p^H: 7.5 - 7.6, \text{ Tempr. : } 30.0 - 32.0 ^\circ\text{C}, \text{ LI : } 2800 \text{ lux}\]

Hazarika, 382, Lokhra, 408, Dharapur.

**GENUS: APHANIZOMENON Morren.**

Trichomes without sheath, more or less straight forming feathery, plate like or spindle shaped bundles; cells elongate, at the ends attenuated; heterocysts intercalary; spores single, away from the heterocyst.

A. flos-aquae (Linn.) Ralfs ex Born. et Flah.


Trichomes in a bundle, seldom single, straight; cells 5.0-5.6μm broad, 10.0-11.6μm long with gas vacuoles, blue green in colour; heterocysts nearly cylindrical, 6.0-6.1μm broad and 16.0-18.0μm long; spores cylindrical, with rounded ends, 6.0-6.5μm broad, 60μm long; epispores smooth and hyaline.

Habitat: Floating in the stagnant water of paddy field.


Hazarika, 477, North Guwahati.

GENUS: AULOSIRA Kilrehner

Kryptogamenflora bon Schlesien, 238, 1878; Bornet and Flahault, Revision des Nostocacées hétérocystées, 256, 1888; Desikachary, op. cit. 424, 1959.

Key to the species

1. Filaments 4-5.2μm broad, trichomes 2.4 - 3.2μm broad 1. A. bombayensis

1. Filaments broader, trichome 6.0 - 11.0μm broad 2. A. fertilissima var. tenuis

A. bombayensis Gonzalves

On the structure and the life history of Aulosira bombayensis sp. nov. Indian Bot.
Filaments forming a thick, tangled felt-like expansion, dark blue green (blackish) in colour, 3.84-5.76 μm broad; sheath firm, hyaline, unlamellated; trichomes slightly constricted at the joints, 2.3-2.7 μm broad; cells ca. 7.98 μm long, cell contents light blue green; heterocysts intercalary, oblong with rounded ends, ca. 3.84 μm broad and ca. 7.68 μm long; spores quadrate, with rounded ends, 3.23-5.76 μm broad and 6.6-9.6 μm long, in a chain of 2-8 spores, double walled, reddish brown in colours.

Habitat: Attached to moist rock.

Month: July-Oct., pH: 8.8 - 8.9, Tempr.: 32.0 - 34.0 °C, LI: 3200 - 8000 lux

Hazarika, 423, Hatichila Hill, Bonda; 581, Kamakhya.

A. fertilissima var. tenuis Rao. C. B.


Plant mass fibrous, greyish blue; filaments straight or a little flexuous, parallel, closely crowded together; 8.0- 9.6 μm broad; sheath thin, firm and brown; cells 6.0-6.72 μm broad and 9.0- 9.6 μm long cylindrical; heterocyst cylindrical, with rounded end walls, 9.0- 9.6 μm broad and 12.5- 19.2 μm long.

The specimen is slightly broader than the typed one.

Habitat: Attached to the decaying leaves of water hyacinth in stagnant water of road side ditches.
Month: Nov., pH: 6.5, Tempr.: 28.0 °C, LI: 3600 lux
Hazarika, 95, Lokhra.

**GENUS: CYLINDROSPERMUM Kütz.**

Phyc. gene. 211, 1843; Borne and Flahult, Revision des Nostocacées hétérocystées, 249, 1888; Desikachary, *op. cit.*, 359, 1959.

Thallus mucilaginous, mostly dull blue green; trichome uniformly broad; cells cylindrical, constricted at the cross walls; heterocysts terminal, single or rarely more than one at one end only or at both ends; spores single or in series next to the heterocyst, much bigger than the vegetative cells.

**Key to the species**

1. Spores with sculptured epispore and papillae:
   
   2. Spores 10-15 x 20-30μm  
   3. C. majus
   
   2. Spores 19 x 42-43μm  
   6. C. tropicum

1. Spores with a smooth epispore, without papillae:

3. Spores cylindrical  
5. C. stagnale

3. Spores ellipsoidal:

4. Spores broader, 9-12μm broad, 10-20μm long  
4. C. muscicola

4. Spores narrower:

5. Spores 4 - 6μm broad, 8-12μm long  
1. C. doryphorum

5. Spores 8.8 - 9μm broad, 15-18.5μm long  
2. C. indicum
**C. doryphorum Bruhl et. Biswas**


Pl. XX, Fig. 3

Thallus floating, blue green, mucilaginous; trichomes slightly constricted, 1.9-2.8μm broad; cells barrel shaped, cylindrical 5.7μm long; heterocyst lanceolate, at either ends, pale blue green, 2.8-3.55μm broad and 5.1-5.7μm long, ciliated; spores scarce, nearly always single, adjacent to the terminal heterocyst, ellipsoidal, somewhat cylindrical, densely granular, 5.0-6.1μm broad with sheath, 3.8μm broad without sheath and 11.44-11.78μm long; epispore firm, smooth, hyaline and sometimes light brown in colour.

Habitat: Submerged in the stagnant water of paddy field.

Month: Dec., pH: 7.5, Tempr.: 24.0 °C, LI: 3800 lux

Hazarika, 609, Bonda.

**C. indicum Rao, C.B. orth. mut. De Toni.**


Pl. XX, Fig. 4

Trichome single, deep constrictions at the joints, blue green; cells 2.1-3.04μm broad and 2.88-4.18μm long, almost quadrate, more or less barrel shaped; heterocyst spherical or almost ellipsoidal one at each end of the trichome, 2.99μm broad and 4.8μm long; spores almost ellipsoidal, sometimes cylindrical with rounded ends, subterminal at either end of the trichome, with a thick yellowish brown outer membrane possessing
a smooth outer margin, without membrane 6.88μm broad and 10.32-12.04μm long and with membrane 7.15-10.32μm broad and 13.76-15.48μm long.

This specimen is smaller than the typed one.

Habitat: Attached to the soil of hill.

Month: July, p^H: 8.3, Tempr: 35.6 °C, LI: 4500 lux

Hazarika, 422, Hatichila Hill, Bonda.

C. majus Kützing ex Born et Flah.

Forti in De Toni, op. cit., 5: 474, 1907; Frémy, op. cit., 378, fig. 315, 1929; Geitler, op. cit., 815, fig. 520 b, 1932; Desikachary, op. cit. 362, pl. 80, fig. 1, 1959.

Pl. XXI, Fig. 1

Thallus mucilaginous, expanded, blackish green; trichomes constricted at the cross walls, light blue green, cells 3.85-4.0μm broad and 5.0-5.72μm long; heterocysts oblong, 4.29μm broad and 5.76-10.0μm long; spores ellipsoidal, 7.6-13.44μm broad and 13.44-29.66μm long, epispore brownish with distinct papillae.

Habitat: In the moist soil of paddy field near tea garden.

Month: Oct, p^H: 8.2, Tempr: 32.0 °C, LI: 2400 lux

Hazarika, 77, Amtoli tea Garden.

C. muscicola Kützing ex Born et Flah

Forti in De Toni, op. cit., 5: 477, 1907; Frémy, op. cit., 376, fig. 313, 1929; Geitler, op. cit., 822, fig. 520 d, 1932; Desikachary, op. cit. 367, pl. 65, fig. 3, 1959.

Pl. XXI, Fig. 2
Thallus expanded, mucilaginous, deep blue green in colour; trichomes constricted at the cross walls, light blue green; cells 2.8- 3.1μm broad and 3.45- 4.0μm long, nearly quadrate; heterocysts oblong, 2.9- 3.3μm broad and 3.4- 3.8μm long; spores oval, 9.6 μ broad and 17.28 μ long, epispore smooth, yellowish brown.

In this species the trichome and heterocysts are smaller than the typed one.

Habitat: Damp soil of the paddy field and attached with the rocks.

Month : Oct., pH : 7.8, Tempr. : 31.0 °C, LI : 3290 lux

Hazarika, 559, Bonda.

*C. stagnale* (Kütz.) Born et Flah.

Forti in De Toni, *op. cit.*, 5: 472, ; Frémy, *op.cit.*, 375, fig. 311, 1929; Geitler, Kryptogamenflora der Mark Brandenburg, 819, fig. 520 c, 1932. *Anabaena stagnalis* Kütz., Phyc. gene, 210, 1843; *Cylindrospermum macrospermum* Kützing, Phyc. germ, 173, 1845; Desikachary *op. cit.*, 363, pl. 65, fig. 9, 1959.

Pl. XXI, Fig. 3

Thallus floccose, expanded, attached or free floating, blue green; trichome constricted at the cross walls; cells 3.8- 4.0μm broad and 4.56- 6.4 long, nearly quadrate or cylindrical; heterocysts subspherical or oblong, 5.7- 6.1μm broad and 7.6- 8.0μm long; spores cylindrical with rounded ends, 8.3-11.4μm broad and 21.45-26.22μm long, with a smooth brownish outer layer.

Habitat: Attached with moist soil of the rocks and the stagnant water of paddy field.


Hazarika, 287, Kamakhya, 576, Bonda.
C. tropicum W. et G. S. West


Pl. XXI, Fig. 4

Thallus blue green, gelatinous mass; trichomes constricted at the cross walls; cells cylindrical, 3.5- 3.8μm broad and 5.76- 6.2μm long, heterocysts broadly ellipsoidal, 5.7- 6.0μm broad and 9.0- 9.6μm long; spores single, ca. 19.2μm broad and 32.6- 42.0μm long with dark brownish pappilose episporie.

Habitat: Free floating in the stagnant water of paddy field.

Month : Aug., pH : 8.7, Tempr. : 34.0 °C, LI : 3300 lux

Hazarika, 479, North Guwahati.

GENUS: HORMOTHAMNION Grunow


Thallus made of parallel filaments, sometimes forming a mucilaginous expanded layer or filaments sometimes erect, branched without a common mucilage; filaments with a thin membranous often diffusent, colourless sheath; trichomes moniliform, heterocysts intercalary; spores not known.

H. enteromorphoides Grunow ex Born. et Flah.

Forti in De Toni, op. cit., 5: 486, 1907; Geitler, op. cit., 677, fig. 436, 1932;
Desikachary, *op. cit.* 433, pl. 61. figs. 6, 7, 8., 1959

Pl. XXII, Fig. 1

Thallus mucilaginous, confluent, agglutinated, green or yellowish green, soft, fasciculate, filaments parallel; erect, sometimes in a common mucilage, sheath hyaline, thick, gelatinous, trichome 3.8- 4.1μm broad; cells barrel shaped, 3.8- 5.1μm long, variable in size; heterocysts 7.0- 7.22μm broad and 9.0- 9.5μm long.

Habitat: Attached with the wet stones of the hill mixed with *Nostoc* and *Lyngbya* spp.

Month: Oct., pH: 8.7, Tempr.: 34.0 °C, LI: 8900 lux

Hazarika, 681, Kamakhya hill.

**GENUS: NOSTOC** Vaucher


Thallus mucilaginous, gelatinous or not, first globose to oblong, later globose, foliose, filiform, bulbose, solid or hollow, free or attached, the periphery dense and darkly coloured; filaments flexous, curved or entangled; sheath sometimes distinct generally diffluent, trichome torulose, cells depressed, spherical, barrel-shaped to cylindrical; heterocysts intercalary, spores spherical or oblong, formed centrifugally in series in between the heterocysts.

**Key to the species**

1. Trichomes very densely coiled, hardly seen, 2.4- 4.4μm broad ——— 3. *N. punctiforme* var. *populorum*

1. Trichomes less densely coiled, visible
2. Trichomes 2.2-3.0µm broad, spores oblong ———————- 1. *N. humifusum*

2. Trichomes 3.5-5.0µm broad with no definite mode of arrangement — 2. *N. muscorum*

*N. humifusum* Carnichael ex Born. et Flah.


Pl. XXII, Fig. 2

Thallus mucilaginous, variable in size, attach by the under surface; filaments flexuous, densely entangled; sheath mostly indistinct; trichomes 2.88-3.0µm broad, blue-green; cells subspherical to oblong, constricted, tip cell conical and entangled, 5.67µm long; heterocysts subspherical, 4.0-4.6 µm broad and 2.84µm long; spores sub-spherical, 3.85-4.03µm broad and 3.84-6.14µm long, spores in series, epispore brown in colour.

Habitat: Attached with the moist soils of hill slop.

Month: Sept., pH: 7.7, Temp.: 31.0 °C, LI: 3100 lux

Hazarika, 521, Hatichilla hill, Bonda.

*N. muscorum* Ag. ex Born et Flah.

Forti in De Toni, *op. cit.*, 5: 400, 1907; Frémy, *op. cit.*, 340, fig. 281, 1929; Geitler, *op. cit.*, 844, fig. 535, 1932; Desikachary, *op. cit.*, 385, pl. 70, fig. 2, 1959.

Pl. XXII, Fig. 3

Thallus gelatinous, ball like, irregularly expanded, attached by the lower surface, dull olive or brown; filaments densely entangled; sheath distinct only at the periphery of the thallus, yellowish brown; trichome 3.4-3.8µm broad; cells short, barrel-shaped, 3.8-4.3-
5.0μm long, terminal cell 3.8μm broad and 6.8μm long; heterocysts nearly spherical, short barrel-shaped, intercalary and terminal, 4.3- 5.1μm broad and 4.86- 6.02μm long; spores not seen for long time.

Habitat: Gelatinous ball like structure attached with the rocks.

Hazarika, 511, Kamakhya hill, 563, Hatichilla Hill, Bonda.

**N. punctiforme** var. **populorum** (Kütz) Hariot

J. de. Bot. 5: 31, 1891; Forti in De Toni, *op. cit.*, 388, 1907; Frémy, *op. cit.*, 331 fig. 274, 1929; Geitler, *op. cit.*, 834; 1932; Desikachary, *op. cit.*, 374, pl. 69, fig. 1, 1959.

Pl. XXV, Fig. 4

Thallus attached, sub-globose, scattered, light blue-green; filaments densely entangled; sheath delicate, hyaline, mucous; trichome 3- 4μm broad, cells short, barrel-shaped or ellipsoidal, blue-green; heterocysts 4.1- 6.3μm broad.

Habitat: Attached to the wet stones of hill mixed with *Calothrix fusca*.

Month: Oct., $p^H$: 8.2, Tempr.: 32.0 °C, LI: 2400 lux
Hazarika, 576, Kamakhya.

**GENUS: PSEUDANABAENA** Lauterborn


**P. schmidlei** Jaag. O.

Dei Kryptogamenflora des Rheinfalls und des Hochrheins von Stein bis Englisou,

Pl. XXII, Fig. 4

Trichome single, without firm sheath, 6.84-7.6 μm broad, up to 300μm long, light blue green; cells distinctly placed from one another, cylindrical, 6.84-7.0μm long, after division about $1/2$ diam, at the ends rounded or oval.

Habitat: Free floating in the stagnant water of ditches in hillside.

Month: Aug., $pH: 8.7 - 8.8$, Temper. : 35.6 °C, LI : 2400 lux

Hazarika, 463, Bonda.

GENUS: **WOLLEA** Born. et Flah.


Thallus tubular, cylindrical, soft; filaments suberect, parallel, to slightly curved agglutinated; sheath confluent; heterocysts intercalary; spores in series continuous with the heterocysts or remote from it.

**W. bharadwajae** Singh, R. N.

_Wollea bharadwajae_ sp. nov., and its Autecology, Ann. Bot., Lond. n. a 6: 593-606, 1942. Prasad, (some Nostocaceae from U.P., J. Indian Bot. Soc. 31: 360, figs. 9-13, 1952) described a form; Desikachary, op. cit., 372, pl. 66, figs. 1-18, pl. 73, fig. 1 1959.

Pl. XXIII, Fig. 1

Thallus more or less cylindrical, attached, free floating, light brown, gelatinous; trichomes loosely arranged, no definite arrangement; cells barrel shaped, loose, sometimes cylindrical, 4.8-5.7μm broad and 7.1-9.5μm long; heterocyst barrel shaped, 6.8-7.6μm
broad and 7.8-9.5μm long; spores are formed on either side of the heterocyst, spores without sheath 15.2μm broad and 19.0μm long, with sheath 17.1μm broad and 20.9μm long; thickness of the sheath 1.9μm.

Habitat: Attached or floating in the stagnant water of paddy field mixed with *Lyngbya*, *Spirulina*, *Gloeotrichia* and *Oscillatoria* spp.

Month: June, \(p^H: 7.3\), Tempr. : 34.3 °C, LI : 6320 lux

Hazarika, 381, North Guwahati.

**Family:** Scytonemataceae Rabenhorst

*Fil. Eur. Alg. 2. 246, 1865; Desikachary, op. cit. 434, 1959.*

Filaments with a thick, firm sheath; sheath often lamellated, parallel, divergent, or funnel shaped lamellation; false branched, branches single or germinate trichomes with a single row of cells; heterocysts intercalary, two pored, basal and terminal and one pored situated next to a single false branch; hormogones present; pseudohormogonia present.

**Key to the Genera.**

1. Heterocysts absent ------------------------------------------ *Plectonema*

1. Heterocysts present

2. Sheath mostly with parallel lamellation, false branches common

3. False branches usually formed in between the heterocysts ------- *Scytonema*

3. False branches usually arising next to the terminal heterocyst --- *Tolypothrix*

**GENUS: PLECTONEMA** Thuret

Trichomes variously bent, with a thin, firm sheath; false branched, branches single or germinate; heterocysts absent; hormogones present; spores not known.

**Key to the species**

1. Filaments narrower, below 4μm broad:
   2. Filaments in the mucilage of other algae
      2. *P. nostocorum*

2. Filaments free

3. Cells up to 3 times as long as broad, filaments 2-4μm broad
   1. *P. gracillimum*

**P. gracillimum** (Zopf) Hansgirg.


Pl. VI, Fig. 1

Thallus thin, expanded, pale blue, mostly slimy, filaments ca 3.8μm broad; false branches single or germinate; cells 1-2 times longer than broad, dull blue green, nearly colourless; sheath thin, mostly colourless.

Habitat: Attached to the wet stones of a culvert mixed with *Gloeocapsa rupestris var. maxima*.

Month: Sept., pH: 8.4, Tempr.: 32.0 °C, LI: 3200 lux

Hazarika, 531, North Guwahati.

**P. nostocorum** Bornet ex Gomont


Filaments nearly straight or flexuous; false branches sparse, single or germinate;
sheath thin colourless; cells cylindrical, constricted at the cross walls, septa not granulated, 1.5μm broad and 1.7-2.4μm long, pale blue green; end cell rounded.

Habitat: In the mucilage of *Dichothrix* sp.

Month: Aug.-Sept., pH: 8.0, Tempr.: 31.0°C, LI: 2300lux

Hazarika, 511, Kamakhya.

**GENUS: SCYTONEMA Ag.**

Systema Algarum, 26, 1824; Bornet and Flahault, Revision des Nostocacées hétérocystées, 85, 1887; Desikachary, *op. cit.* 450, 1959.

Filaments false branched, false branches single or germinate, formed laterally in between heterocysts; trichomes single in each sheath, straight; hormogones terminal, solitary; pseudohormogonia present; spores known only in a few species, spherical or ovate, exospore thin and smooth.

**Key to the species**

1. Sheath with slightly divergent lamellation

2. Filaments 15-21μm broad, trichomes 6-12μm broad ———— 3. *S. mirabile*

2. Filaments 10-15μm broad, trichomes 8-12μm broad ———— 7. *S. tolypothricoides*

1. Sheath homogeneous with parallel lamellation

3. Aquatic, cells quadrate or longer than broad

4. Filaments 14-15.7μm broad, trichomes 9.4-11.7μm broad ——— 6. *S. simplex*

4. Filaments 15-20μm broad, trichomes 7-8μm broad ———— 1. *S. fritschii*

3. Terrestrial

5. Cells longer than broad
6. Filaments 15-18.9μm and trichomes 8.4-9.5μm broad — 4. *S. pseudoguyanense*

6. Filaments 7-13μm and trichomes 5-10μm broad ————— 2. *S. hofmanni*

5. Cells shorter than broad, filaments narrower, trichomes constricted

7. Trichomes 9-12μm broad —------------------------------- 5. *S. schmidtii*

*S. fritschii* Ghose.


Pl. XXIII, Fig. 2

Thallus floccose, greenish brown filaments thin, elongate, 14.3-15.73μm broad; trichome 7.15-8.58μm broad; cells 8.58μm long, contents granular, cross walls distinct; false branches germinate, remote, as broad as the main filaments; sheath firm, parallel lamellation hyaline, slightly brownish at the edge; heterocysts intercalary, 8.0-9.4μm broad, single, cylindrical and upto 27.1μm long; cell contents granulated.

Habitat: Adhering the lower submerged side of the *Azolla* plant in the stagnant water mixed with *Tolypothrix* sp.

Month: Oct-Nov., pH: 7.1, Tempr.: 34.0 °C, LI: 3300 lux

Hazarika, 584, North Guwahati.

*S. hofmanni* Ag. ex. Born. et Flah.

Forti in De Toni, *op. cit.*, 5: 513, 1907; Frémy, *op. cit.*, 313, fig. 266, 1929; Geitler, *op. cit.* 772, fig. 495, 1932; Frémy, Cyano. Cotes d' Eur., 170, pl. 53, fig. 4, 1933; Desikachary, *op. cit.*, 476, pl. 91, fig. 2, 1959.
Pl. XXIII, Fig. 3

Thallus blackish blue green, amethyst green, expanded; filaments 12.5-12.87 (13.44)μm broad, aggregated in vertical bundles; false branches aggregated; sheath firm, membranaceous; trichome 7.15-8.5 (-11.52) μm broad, olive green; cells unequal in length; heterocyst oblong to cylindrical.

Habitat: Terrestrial, attached to the dry soil of paddy field.

Month: Sept.-Oct., pH: 8.5, Temp.: 32.0 °C, LI: 4200 lux

Hazarika, 670, North Guwahati.

*S. mirabile* (Dillw.) Born

Forti in De Toni, *op. cit.* 5: 517, 1907; Frémy, *op. cit.* 319, fig. 269, 1929; Geitler, *op. cit.* 775, figs. 497, 498, 1932; Frémy, *op. cit.* 171, pl. 54, fig. 1. 1933; Desikachary, *op. cit.* 483, pl. 91, fig. 3, 1959.

Pl. XXIII, Fig. 4

Thallus expanded, spongy, blackish green or more or less blue green; filaments tortuous intricate, 15.73-17.16μm broad, mostly false branched; sheath lamellated with slightly divergent lamellation, yellowish brown, sometimes outside colourless or slightly gelatinous; trichome ca 7.58-8.58μm broad, blue green; cells cylindrical, at the ends discoid or more or less barrel shaped; heterocyst nearly quadratic, or longer than the broad, ca 7.58μm broad, brownish.

Habitat: Attached to the *Azolla* plant mixed with *S. fritschii* and *Tolypothrix byssoida*

Month: Oct.-Nov., pH: 7.1, Temp.: 34.0 °C, LI: 3300 lux

Hazarika, 584, North Guwahati.
**S. pseudoguyanense** Bharadwaja

The taxonomy of *Scytonema* and *Tolypothrix*, Rev. algol Paris. 7: 164, fig. 3A, 1934; Desikachary *op. cit.* 472, pl. 89, fig 2. 1959.

Pl. XXIV, Fig. 1

Thallus attached to the rocks, thick cushion, deep brownish green with long erect threads; filaments densely entangled, irregularly curved, main filament 17.16-18.59μm broad; false branches numerous, slightly narrower than the main filament, ca 12.87μm broad, forming secondary branches at an early stage; sheath firm, 2.8-4.3μm thick, pigmented with parallel stratification; trichome 8.4μm, when old narrowed down to 5.72μm; cells almost quadratic 8.4μm long, cylindrical in the older parts upto 14.3μm long and flattened in the growing apices; heterocysts quadratic or cylindrical; lesser in number, 10.1-11.2μm broad and 8.5-14.3μm long.

Habitat: Attached to the moist rocks of a hill.

Month: Oct., pH: 7.7, Tempr.: 32.0 °C, LI: 1300 lux

Hazarika, 556, Kamakhya.

**S. schmidtii** Gom.


Pl. XXIV, Fig. 2

Thallus brownish black, extensive, crustaceous with wrinkled surface; filaments irregularly wavy, intricate, 11.44-12.50μm broad, lower down about 18.59μm broad;
prostrate, abundantly false branched; sheath yellowish brown, lower down broad and wrinkled; trichome extremely torulose, 10.01-12.87µm broad; cells compressed subquadrate, 7.15-10.01µm long; heterocyst quadrate to compressed, colourless.

Habitat: Attached to the moist rocks.


Hazarika, 576, Kamakhya.

*S. simplex* Bharadwaja

The Taxonomy of *Scytonema* and *Tolypothrix*, Rev. algol; Paris, 7: 157, fig. 1A, B, 1934; Desikachary, *op. cit.*, 455, pl. 89, fig. 1, 1959.

Pl. XXIV, Fig. 3

Thallus dirty blue green, or blue green; filaments 14.0-15.2µm broad, loosely entangled, irregularly bent; false branches long, germinate and single in equal numbers; sheath firm, hyaline, unstratified, 2.14µm thick; trichomes with indistinct septa, unconstricted or slight constrictions, ca. 9.4µm broad; cells usually elongate, *ca.* 10.26µm long, cylindrical, up to four times as long as broad, sometimes quadratic, at the growing region flattened; heterocysts single, elongate, cylindrical, with convex end walls thicker than longitudinal one, as broad as the trichome 9.4µm broad and 32.64µm long.

Habitat: Free floating in the stagnant water of paddy field.

Month: Sept., pH: 8.2-8.3, Tempr.: 31.0-33.0 °C, LI: 3200 lux

Hazarika, 529, 533, North Guwahati.


Forti in De Toni, Sylloge Algarum, 5: 516, 1907; Frény, Myxo. d'Afr. équat. franc. 317,
Thallus floating, brownish green; filaments ca. 14.3 μm broad, false branches similar to main filament; sheath orange brown, lamellated, outermost lamellae often colourless; trichome 8.76- 9.01 μm broad, olivaceous yellow; cells subquadrate, 7.29-10.01 μm long, densely granulated; heterocyst varied, sometimes short, and sometimes long, rose coloured.

Habitat: Floating in the stagnant water of paddy field.

Month: Oct.- Nov., pH: 7.1, Tempr.: 34.0 °C, LI: 3300 lux

Hazarika, 584, North Guwahati.

GENUS: **TOLYPOTHRIX** Kützing

Phyc. gene. 227, 1843; Bornet and Flahault, Revision des Nostocacées hétérocystées, 118, 1887; Desikachary *op. cit.*, 493, 1959.

Filaments with a firm, thin or thick sheath with a single trichome in each sheath; false branched, mostly free; prostrate or erect; false branches single mostly subtending a heterocyst; occasionally germinate as in Scytonema; hormogonia formed from the tips; trichomes with apical growth, apices often broader with shorter cells; spores known in some species.

**T. byssoides** (Berk.) Kirchner

In Engler and Prantl, Natürlichen Pflanzenfam, 1, 1a: 80, 1900; Geitler, *op. cit.*, 728, fig. 470, 471a, 1932; Frény, *op. cit.*, 292, fig. 255, 1929; Frény, *op. cit.*, 167, pl. 53, fig. 1a, 1933; Desikachary, *op. cit.*, 502, pl. 103, figs. 3, 4, 7, 1959.
Pl. XXV, Fig. 1

Thallus woolly, attached, cushionlike, brownish; filaments 10.05-15.73\(\mu m\) broad, irregularly false branched; false branches short erect, curved; sheath thin, 1.4-2.1\(\mu m\) thick, close to the trichome, fragile, tubular, somewhat ocreaceous; trichome 8.58-10.01\(\mu m\) broad, torulose; cells barrel shaped, 2.8-4.29 \(\mu m\) long; heterocysts basal, single; spores 11.44\(\mu m\) broad and 8.58-10.01\(\mu m\) long, yellowish.

Habitat: Attached to the upperside of the submerged \textit{Azolla} plant with \textit{Scytonema} spp.

Month: Oct.-Nov., pH: 7.1, Tempr.: 34.0 \(^\circ\)C, LI: 3300 lux

Hazarika, 584, North Guwahati.

**Family: Rivulariaceae Rabenhorst.**


Trichomes with a single row of cells, apices generally attenuated or tapering in a hair, unbranched or false branched, sometimes with a distinct intercalary meristematic region and trichothallic growth; hair with elongated, more or less vacuolated cells; heterocysts present or absent, when present basal, intercalary heterocysts also present in some; hormogones present; spores present or absent, when present single or in series.

**Key to the genera**

1. Filaments in a spherical or hemispherical thallus:
   
   2. Spores not known  -------------------------------  4. \textit{Rivularia}
   
   2. Spores commonly single, large  ---------------------  3. \textit{Gloeotrichia}

1. Filaments free, simple or forming dichotomously branched corymbose thallus:
3. Trichomes single in a sheath, simple or distinctly false branched, false branches free .......................... 1. Calothrix

3. More than one trichome in a sheath, filaments branched, false, branches coalescent .......................... 2. Dichothrix

GENUS: CALOTHRIX

Agardh, Syst. Alg., 24, 1824; Bornet and Flahault, op. cit., 345, 1886; Desikachary, op. cit., 522, 1959.

Filaments single or in small bundles, caspitose; unbranched or branched; sheath firm; heterocysts mostly basal, seldom intercalary, one or two spores next to the basal heterocysts, single or in series.

Key to the species

1. Spore not known

2. Filaments distinctly swollen at the base

3. Filaments 10µm or more thick at the base

4. Trichomes 7-8µm broad .......................... 3. C. fusca

3. Filaments narrower, about 7µm broad

5. Trichomes with a hair

6. Trichomes very short, free .......................... 2. C. clavata

5. Trichomes without a hair

7. Trichomes short, not gradually attenuated .......................... 1. C. brevissima

2. Filaments not so swollen at the base:

8. Filaments broader than 10µm, trichomes 5-10µm broad .......................... 5. C. parietina
8. Filaments narrower than 10μm, trichomes 4-4.5μm broad — 4. *C. marchica* var. *intermedia*


**C. brevissima** West, G. S.

Freshwater Alg. Tanganyika, J. Linn. Soc. Bot., Lond., 38: 180; pl. 10, fig. 8, 1907; Geitler, *op. cit.*, 624, fig. 396, 1932; Desikachary, *op. cit.*, 533, pl. 114, fig. 1, 1959.

Pl. XXV, Fig. 2

Filaments epiphytic, very short, 6.4-7.1μm long; sheath firm, close to the trichome, thin, nearly cylindrical, pale yellow colour; trichome 4.9-5.1μm broad, 65μm long, little attenuated with rounded end cells, slightly constricted at the cross walls, olive green; cells nearly as long as broad, 2.9-4.2μm long; tip cell 2.2μm broad; heterocysts basal, seldom many, 4.6x 5.0μm to 4.8x 2.4μm, rounded, hemispherical or subspherical.

Habitat: Attached to the wet stones of paddy field mixed with other myxophycean algae.

Month: Sept., pH: 8.4, Tempr.: 32.0 °C, LI: 3200 lux

Hazarika, 531, North Guwahati.

**C. clavata** West. G. S.

In Fuhrmann et Mayor, Voyage d’explor. Colombie, 1019, pl. 21, figs. 6-7, 1914; Frémy, *op. cit.*, 257, fig. 229, 1929; Geitler, *op. cit.*, 609, fig. 382, b,c, 1932; Frémy, *op. cit.*, 142, pl. 36, fig. 1, 1933; Desikachary, *op. cit.*, 542, pl. 114, fig. 2, 1959.

Pl. XXV, Fig. 3

Filaments single or a few together, upto 60μm long, straight or slightly bent, prominently swollen at the base, 6.88-7.15μm broad; sheath very thin, close to the
trichome, colourless; trichomes 5.1-5.72μm broad at the base, at the tip 0.86- 1.72μm broad, slightly constricted at the cross walls, cells 2.29 - 6.02μm long; heterocysts basal, single, 5.16- 5.72μm broad and 2.86- 4.30μm long, hemispherical.

Habitat: Attached to the wet rocks of hill mixed with Chroococcus minutus and Microcystis pulverea.


Hazarika, 556, 576, Kamakhya.

C. fusca (Kütz.) Bornet et Flahault

Forti in De Toni, op. cit., 5: 617, 1907; Frémy op. cit., 249, fig. 222, 1929; Geitler, op. cit., 610, fig. 384, 1932; Frémy, op. cit.145, pl. 3b, fig. 2, 1933; Desikachary, op. cit., 527, pl.107, fig. 10, 1959.

Pl. XXV, Fig. 4

Filaments single, seldom gregorious in the mucilage of other algae, 10.26-11.97μm broad,bent at the base and inflated upto 15μm broad; sheath broad, colourless at the apices diffluent; trichome ca 8.0μm broad ending in a long thin hair; cells discoid, 2.57μm long, shorter than broad; heterocysts basal, hemispherical, 5.13μm broad and 2.57μm long, smaller than the basal cell at the trichome.

Habitat: On the mucilage of other algae in stagnant water of paddy field.


Hazarika, 582, North Guwahati, 576, Kamakhya.

C. marchica var. intermedia Rao, C. B.

Filaments single or in groups of 2 or 3, 7.3-8.0\(\mu\)m broad, up to 171\(\mu\)m long, with slight attenuation, without a terminal hair; sheath thin and firm, hyaline; trichome ca. 5.72\(\mu\)m broad, at the base, tip cell 2.3\(\mu\)m broad, constricted at the cross walls; cells quadratic shorter or longer than broad, 3.41-4.25\(\mu\)m long, light blue green, end cell rounded; heterocysts single, basal, 5.72\(\mu\)m broad and 5.72\(\mu\)m long.

Habitat: In the moist soil of the paddy field of North Guwahati with other algae.

Month: Oct., \(p^H\) : 7.3, Tempr. : 32 °C, LI : 1600 lux

Hazarika, 411, North Guwahati.

**C. parietina** Thuret ex Born. et Flah.

Forti in De Toni, *op. cit.*, 5: 62, 1907; Frémy *op. cit.*, 259, fig. 232, 1929; Geitler, *op. cit.*, 604, fig. 380, 1932; Frémy, *op. cit.* 144, pl. 37, 1933; Desikachary, *op. cit.*, 538, pl.108, fig. 6-8 & pl. 115 fig. 1, 1959.

Habitat: Attached to the wet rocks with *Nostoc sp.*, *Lyngbya sp.* and *Plectonema nostocorum.*

Hazarika, 681, Kamakhya.

**Calothrix sp. Ag.**

Syst. Alg., 24, 1824; Bornet and Flahault, Revision des Nostocacées hétérocystées, 345, 1886.

Pl. XXVI, Fig. 3

Thallus crustaceous, compact, white, gelatinous, ball like structure, filaments densely arranged, long, false branched, parallel, erect, flexuous, at the base 10.26$\mu$m broad; sheath thick, lamellated, yellowish brown and dilated like a funnel; trichome 5.16$\mu$m broad, not attenuated; cells 5.16$\mu$m long, tip cell attenuated, conical; heterocysts 6.88$\mu$m broad and 10.26-12$\mu$m long, 1-2, basal; spores 8.55$\mu$m broad and 10.26$\mu$m long.

Habitat: Attached to the wet rocks mixed with *Aphanothece clathrata*, *Nostoc* sp. *Gloeotheca samoensis*.

Month: Sept.,  $p^H: 8.0$,  Tempr.: 31.0 $^\circ$C,  LI: 2300 lux

Hazarika, 511, Kamakhya.

**GENUS: DICOTHRIX Zanardini**

Plant Maris rubri enum, 89,1858; Bornet and Flahault, Revision des Nostocacées hétérocystées, 376, 1886. Desikachary, op. cit. 544, 1959.

Thallus caespitose, penicillate or cushion like (Pulvinate); filaments subdichotomously false branched, at the base of false branches often many trichomes in a common sheath; trichomes generally ending in a hair; heterocysts mostly basal.
D. orsiniana (Kütz) Born et. Flah.

Forti in De Toni, op.cit., 5: 641, 1907; Frémy, op. cit., 266, fig. 239, 1929; Geitler, op.cit., 588, 1932; Desikachary, op.cit., 548, pl.107, fig. 4, 1959.

Pl. XXVI, Fig. 4

Thallus fasciculate, gelatinous greenish brown; filaments flexuous, 8.55-10.20µm broad at the base; with false branches, erect, radiating, false branches adpressed; sheath close to the trichome, thick, yellow, brownish in older parts, many trichomes in a common sheath; trichomes 5.16-6.10µm broad at the base, olive green gradually attentuated into a long hair; cells 2.57-2.59µm long, shorter than broad; heterocysts basal, 5.13µm broad and 2.57µm long.

Habitat: Attached to the wet rocks.


Hazarika, 511, Kamakhya.

GENUS: GLOEOTRICHIA Ag.

Alg. Maris et Adriati, 8, 1842; Bomet and Flahault, Revision des Nostocacées hétérocystées, 365, 1886; Desikachary, op. cit., 553, 1959.

Thallus spherical or hemispherical; solid, sometimes when old inflated and hollow; filaments radial, more or less parallel, often with flase branches, sheath at the base firm, only gelatinizing on the outside, soft to mostly diffuent, trichomes with a distinct trichothallic growth, heterocysts basal; spores at the base of the trichome, single or a few next to the heterocyst; homogones present.

Key to the species

1. Thallus embedded in the mucous of other algae, heterocyst 2-4 µm in dia. - 1. G atra
1. Thallus not embedded in the mucous of other algae, heterocyst larger

2. Thallus hard

6. G. pisum

2. Thallus soft

3. With gas vacuoles

2. G. echinulata

f. brevispora

3. Without gas vacuoles

4. Trichomes few cells below the hair

4. G. indica

4. Trichomes many celled below the hair

5. Sheath more or less close to the spores, not saccate

3. G. intermedia

var. kanwaensis

5. Sheath more or less succate at the base

5. G. natans

G. atra (Roth) Biswas

Observations on the algal collections from the Khasia and Jaintia hills, Assam, India, Hedwigia, 74: 17, pl. 1, fig. 9, 1934; Desikachary, op. cit. 565, 1959 (appendix).

Pl. XXVII, Fig. 1

Thallus spherical, somewhat embedded in a mucous sheath; filaments not very long, ca. 76.8\(\mu m\) long, widened towards base ending in broader cells with spore and distinct hemispherical basal heterocysts; sheath close; trichome compressed held up in mucous sheath; cells 3.86- 4.0\(\mu m\) broad; heterocysts basal, contiguous to the spore, hemispherical or rather compressed, 3.86- 4.0\(\mu m\) in diam; spore elliptic or oblong, 15.28- 18.0\(\mu m\) broad and 20.0- 36.0\(\mu m\) long, wall of the spores smooth; contents granular, pale blue green.

The spore is longer than the typed one.
Habitat: Attached to the submerged angiospermic leaf mixed with *Gleocapsa pleurocapsoides* and *Westiella intricata*.

Month: Oct, $\text{pH} : 8.3$, Tempr. : $31.0 \degree C$, LI : 4200 lux

Hazarika, 41, North Guwahati.

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*G. echinulata f. brevispora* West et. West


Pl. XXVII, Fig. 2

Thallus light brown, ball like; filaments loosely arranged, elongated; sheath delicate, not lamellated, more or less distinct in the long filaments; trichome 5.2-5.96$\mu m$ broad; cells cylindrical, mostly with gas vacuoles, ca. 9.60$\mu m$ long; spore 12.9-13.44 $\mu m$ broad and 34.56-35.1$\mu m$ long; heterocysts spherical, ca. 9.60$\mu m$ broad.

Habitat: Attached to the fresh leaves of paddy field.

Month: June., $\text{pH} : 8.4$, Tempr. : $29.7 \degree C$, LI : 17300 lux

Hazarika, 399, North Guwahati.

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*G. indica* Schmidle


Pl. XXVII, Fig. 3

Thallus ball like, soft, attached, solid or hollow, light green to brown; filaments radiating 200-300 $\mu m$ long; trichomes made of 2-3 cells, with a narrow hair with
cylindrical cells; cells barrel shaped, 5.7-8μm broad and 9.6μm long; longer than broad, heterocysts 5.76-7.68μm broad and 9.60μm long, 7.68μm in diam., spore with sheath 13.44μm broad without sheath 11.52μm broad and 76.80μm long; sheath close to the trichome, 104.44-105.56μm long.

The size of the spore is smaller than the typed one.

Habitat: Epiphytic on grass blades of paddy field.

Hazarika, 171,191, North Guwahati.

G intermedia var. kanwaensis; Rao, C. B.


Pl. XXVII, Fig. 4

Thallus sperical, soft, brownish; filaments with a thin, hyaline and closely adpressed sheath; trichomes with constrictions at the joints; cells next to the spore 10.0-11.5μm broad and 3.7-4.0μm long, cells at the base of the trichome invariably flattened and higher up almost quadratic or cylindrical 5.55μm broad and 13.0-14.8μm long, heterocysts spherical, single, 7.68-8.1μm in diam. spores cylindrical with smooth outer walls, with sheath 16.1-17.28μm broad and without sheath 12.5-13.44μm broad, 51.84-70μm long, sheath 0.8μm thick.

Habitat: Floating in the stagnant water of paddy field mixed with Arthrospira gomentiana var. crassa.

Month: June - Aug., pH: 7.8, Tempr.: 29.0 °C, LI: 1800-2500 lux
Hazarika, 401, 528 North Guwahati.
**G natans** Rabenhorst ex Born et. Flah.

Rabenhorst, Kryptogamenflora, 90, 1847; Frémy, *op. cit.*, 275, fig. 246, 1929; Geitler, *op. cit.*, 639, figs. 406, 407, 1932; Desikachary, *op. cit.*, 561, pl. 118, figs 7,15, 1959.

Pl. XXVIII, Fig. 1

Thallus ball like, soft, brown, filaments loosely arranged; trichome 7-9μm broad, olivaceous, attentuated into a long hair; cells at the base barrel shaped, as long as broad or somewhat shorter, higher up ca. 5.7μm broad and 9.6-11.44μm long, heterocysts basal, spherical, ca. 9.60μm in dia.; spores cylindrical, ca. 9.6μm broad without sheath, 13.44-18.20μm with sheath and 34.56-40.0μm long, sheath hyaline or brownish, saccate and lamellated.

Habitat: Attached to the fresh leaves of paddy.

Month: June-July, \( pH : 8.4 \), \( \text{Tempr.}: 29.7 \degree C \), \( LI : 17300 \text{ lux} \)

Hazarika, 399, North Guwahati.

**G pisum** Thuret ex Born et. Flah.

Frémy, *op. cit.*, 273, fig. 244, 1929; Geitler, *op. cit.*, 632, fig. 401, 1932; Frémy, *op. cit.*, 158, pl. 47, fig. 1, 1933; Desikachary, *op. cit.*, 556, pl. 116, figs 4,5, 1959.

Pl. XXVIII, Fig. 2

Thallus spherical, up to 10μm in diam.; dull brown; filaments densely arranged 400-500μm long, sheath thin, colourless, trichome 3.8-5.76μm broad, ending in long hair; basal cell somewhat shorter but middle and tip cell longer, 11.4-13.49μm long, tip cell pointed; heterocysts more or less spherical, *ca.* 7.18μm in dia., 10.5-11.28μm long; spores cylindrical, *ca.* 13.44μm broad and 17.28-57.44μm long, slightly bent, smooth.

Habitat: Floating and attached to dead *Justicia sp.* in the stagnant water of roadside ditches.
Month: Aug.-Sept., \(p_H: 7.6\), Tempr.: 31.0 °C, LI: 11000 lux

Hazarika, 496, Lokhra.

**GENUS: RIVULARIA** (Roth) Ag.

Systema Algarum, 19, 1824; Bomet and Flahault, Revision des Nostocacée hétérocystées, 345, 1887; Desikachary *op. cit.* 548, 1959.

Trichomes unbranched; filaments more or less radial or parallel in a hemispherical or spherical mucilaginous colony, hollow or solid; sheath more of less gelatinizing; trichomes ending in a hair, often with distinct trichothallic growth; heterocysts basal or intercalary, often false branching at the base; hormogonia single or in series gradually progressing towards the base from the meristematic zone; spores absent.

*R. globiceps* West. G. S.


Pl. XXVIII, Fig. 3

Thallus small, soft, 1.4-2.0mm broad, bluish green, globular, without calcium incrustation; filaments adpressed; sheath colourless, thick, unlamellated; trichome ending in a long hair; cells 4.8-6.1µm broad, and 7.68-8.2µm long, constricted at the cross walls, 8.2-10.5µm long in the hair; heterocysts single, spherical, 9.6-10.2µm in dia.

Habitat: Attached to the roots of submerged grasses.

Month: Aug., \(p_H: 9.3\), Tempr.: 34.0 °C, LI: 7500 lux

Hazarika, 47, North Guwahati.
ORDER STIGONEMATALES Geitler


Key to the families

1. Branching true and lateral:
   2. Pedicellate heterocyst present ------------------------------------ Nostochopsidaceae
   2. Pedicellate heterocyst absent -------------------------- Stigonemataceae

Family : Nostochopsidaceae Geitler


Thallus made of erect or variously bent filaments; filaments repeatedly irregularly branched, often branched unilaterally, lateral branches generally two kinds, one long and many celled, the other with limited growth with a few cells, 1-4, mostly 1-2 celled, with a terminal heterocyst; ends of long branches with or without a hair, hormogon present; spores not known.

GENUS : NOSTOCHOPSIS Wood em. Geitler


Thallus attached at first, later free floating with erect filaments with soft diffliuent
sheath, mucilaginous, more or less hemispherical, at first solid, later hollow, torn and expanded; trichome a single or two rows of branches, branches of two types, one long and many celled, the other one of limited growth with a pedicellate heterocyst made up of 1-3 pedicells; heterocysts intercalary or terminal or pedicellate, or lateral and sessile; hormogones present; spores not known.

**Key to the species**

1. Thallus solid when young and hollow when old  1. *N. lobatus*

1. Thallus solid throughout, intercalary heterocysts absent  2. *N. radians*

*N. lobatus* Wood em. Geitler


Pl. XXIII, Fig. 4

Thallus attached, later free floating, firm gelatinous texture, irregularly lobed; hollow in old stage and solid, spherical in young stage, 2- 4 cm in diam; deep blue green, shining filaments branched, branching unilateral, branches straight or bent, irregularly or in a zig-jag manner, more or less radially arranged and are of two types, long ones with a larger number of cells and short ones with 1- 4 cells which is usually terminated by a heterocysts ends of trichomes gradually attenuated or club shaped; cells 3.5- 4.5μm broad and up to 7.5- 8.5μm, long; contents blue green; heterocysts lateral or at the apices of short branches, spherical, 6.5- 7.5μm in dia. hormogonia formed at the ends of trichomes, 2- 4μm broad and cells 10-15, barrel shaped.
Habitat: Free floating and attached to the wet stones of Basistha stream.

Month: Nov.-Dec., \( \text{pH} : 7.1-8.6, \quad \text{Tempr.} : 32.0 \quad ^\circ\text{C}, \quad LI : 7500 \text{ lux} \\

Hazarika, 251, 354, Basistha.

\textbf{\textit{N. radians} Bharadwaja}


\textit{Pl. XXIX, Fig. 1}

Thallus spherical, solid, with firm mucilaginous texture; light blue green in colour; filaments irregularly curved or bent, densely aggregated and richly branched; trichomes richly branched with distinct, hyaline, thin sheaths, slightly constricted at the cross walls, 3.5- 6.8\( \mu \text{m} \) broad; cells cylindrical or barrel shaped, 2- 3\( \mu \text{m} \) broad and 7.2\( \mu \text{m} \) long, with deep blue green contents; heterocysts sessile or slightly pedicillate on a short 4- 5 celled branches, 5.5- 8.2\( \mu \text{m} \) broad and 9.2- 12.5\( \mu \text{m} \) long.

Habitat: Attached to the rock surface of a stream.

Month: Feb.- Mar., \( \text{pH} : 7.3, \quad \text{Tempr.} : 29.0-31.0 \quad ^\circ\text{C}, \quad LI : 1300-2400 \text{ lux} \\

Hazarika, 358, Basistha stream, 348, Dharapur.

\textbf{\textit{Family: Stigonemataceae} Kirchner}

\textit{Schizophyceae in Engler and Prantl, Die natürlichen Pflanzenfam. 1, la, p. 80, 1898; Desikachary, \textit{op. cit.} 581, 1959.}

Thallus made up of free variously bent filaments; filaments irregularly laterally branched with one or more rows of cells; often with main and lateral filaments; lateral
branches erect, short with longer cells, forming hormogones, main filaments often prostrate, heterocysts intercalary or lateral and sessile, pedicellate heterocysts absent; hormogonia present; spores and hormocysts occasionally present.

**Key to the genera**

1. Older filaments with a single row of cells or many rows only for short portions:

   2. Hormocysts present ———————————————————— 2. *Westiella*

   2. Hormocysts absent:

      3. Hormogones present ———————————————————— 1. *Hapalosiphon*

      3. Hormogones not known, endospores present ———— 3. *Westiellopsis*

**GENUS: HAPALOSIPHON Næg.**

In Kützing, Species Algarum, 894, 1849; Bornet and Flahault, Revision des Nostocacées hétérocystées, 54, 1887; Desikachary, op. cit., 585, 1959.

Thallus caespitose, floccose, thin, aquatic; filaments truly branched, continuous, branches erect from the primary prostrate filaments, erect branches as broad as and similar to the main filaments; heterocysts intercalary; cells in one or two rows, spores present.

**Key to the species**

1. Sheath colourless

2. Lateral branches short:

   3. Main filaments 5.5–7.5μm broad ———————————————————— 4. *H. welwitschii*

2. Lateral branches long
4. Filaments 7.2- 9.5μm broad:
   5. Sheath thin ---------------------------------------------------- 1. *H. hibernicus*
   5. Sheath thick --------------------------------------------------- 3. *H. stuhlmannii*

1. Sheath coloured

6. Main filament upto 11.5μm broad, as broad as the side branches - 2. *H. luteolus*

**H. hibernicus** W. et. G. S. West

Forti in De Toni, *op. cit.*, 572, 1907; Geitler, *op. cit.* 533, fig. 331, 1932; Desikachary, *op. cit.*, 593, 1959.

Pl. XXIX, Fig. 2

Filaments single admist other algae, 7.2- 7.68μm broad, richly branched; sheath closed, prominent; lateral branches thinner than main filament arises alternately, long false branches seen; cells cylindrical to rounded, equal with the main filament, 3.9-4.5μm broad; heterocysts cylindrical, 5.76μm broad and 17.28μm long.

Habitat: Epiphytic, attached to the dead leaves of paddy.

Month: Oct., pH : 7.6, Tempr. : 31.0 °C, LI : 11100 lux

Hazarika, 44, North Guwahati.

**H. luteolus** W. & G. S. West.

Forti in De Toni, *op. cit.*, 5: 570, 1907; Frémy, *op. cit.*, 429, 1929; Geitler, *op. cit.* 537, fig. 333, 1932; Desikachary, *op. cit.*, 593, pl. 130, fig. 1, 1959.

Pl. XXIX, Fig. 3

Thallus caepitose, yellowish brown, densely interwoven; filaments 7.6- 11.4μm
broad; lateral branches single, sometimes short and straight as broad as and similar in appearance as the main filament, tip blunt, not attenuated; sheath firm broad, yellowish; cells cylindrical to subquadrangular, 5.7-6.0μm broad, 5.7-11.4μm long, contents pale blue green; heterocysts intercalary, cylindrical, ca. 7.6μm broad and 11.4μm long; length and breadth of the spore same.

Habitat: Moist soil of stream.


Hazarika, 526, Basistha stream.

**H. stuhlmannii Hieron**

Frémy, *op. cit.*, 429, 1929; Geitler, *op. cit.* 534, 1932; Desikachary, *op. cit.*, 593, pl. 129, fig. 4-7, 1959.

Pl. XXIX, Fig. 4

Thallus blue green; filaments interwired, richly branched, main filaments ca. 9.60μm broad, sheath prominent, attenuated, cells rounded at the tip; lateral branches erect, 4.8-7.0μm broad, repeatedly branched, cylindrical; cells 9.6-13.44μm long, heterocyst not abundant oblong, 6.72-8.0μm broad and 13.44 μm long.

Habitat: Attached to stones and rotten angiospermic leaves (floating).

Month: Sept., pH: 7.6, Temp.: 31.0 °C, LI: 11000 lux

Hazarika, 42, North Guwahati. 581, Kamakhya.

**H. welwitschii W. et. G. S. West.**

Freshwater algae from Burma including a few forms from Bengal and Madras,
Filaments somewhat flexuous, blue green, 5.76-7.65μm broad; sheath prominent, very close, colourless, hardly visible; cells elongated, 3.84-5.76μm broad and ca.13.44μm long; rectangular; lateral branches short, narrower, flexuous, 3.84-4.1μm broad; cells not equal in length. The gap between trichome and sheath is narrow; heterocysts long, cylindrical, 5.76-7.65μm broad and ca. 17.28μm long, spores sub spherical, 5.6μm broad.

Heterocyst is longer than the typed one.

Habitat: Epiphytic, attached to roots and stem of grasses.

Month: Aug., pH: 7.6, Tempr.: 31.5°C, LI: 3200 lux

Genus Westiella Borzi.


Thallus made up of free, regularly laterally branched filaments; trichomes with a single series of cells; lateral branches sometimes attenuated, main branches uniformly cylindrical; sheath close to the trichome, homogenous; heterocysts intercalary, hormogones formed at ends of branches; hormocysts terminal and intercalary, single or a few together, 2-12 celled; spores present.
**W. intricata** Borzi.


Pl. XXX, Fig. 2

Filaments long; creeping amongst other algae, flexuous, irregularly branched, ca 7.68 μm broad, somewhat attenuated at the ends; cells cylindrical, 15.3 μm long; sheath colourless; heterocysts intercalary, elongate, 7.68 μm broad and 11.52 μm long; hormocysts with 2-6 cells.

Habitat: Attached to the dead angiospermic leaf in the stagnant water of paddy field.


Hazarika, 140, North Guwahati.

**GENUS: WESTIELLOPSIS** Janet


Thallus filamentous with true branching filaments of two kinds, primary filaments slightly thicker and more or less creeping, secondary filaments generally thinner and growing erect, filaments without a sheath and consisting of a single row of cells; heterocysts intercalary; the dilated terminal portions of secondary branches by profuse transverse and longitudinal divisions forming chains of rounded cells (Pseudo hormocysts), the contents escaping as gonidia (endospores) and develop as into new plants.

**W. prolifica** Janet.

Thallus filamentous with true branching; main filaments torulose, with short barrel-shaped cells; 8.6-11.0μm broad and as long as broad; branch filaments thinner and elongate, not constricted at cell wall; cells 3.8μm broad and elongate; heterocysts oblong - cylindrical, 7.6μm broad and 11.4μm long; gonidia formed singly in each cell of the pseudohormocysts, 7.6μm in dia.

Habitat: Attached to the soil of paddy field.

Month: Nov., pH: 7.5 - 8.2, Tempr.: 30.0 - 32.0 °C, LI: 2500 - 3000lux

Hazarika, 585, North Guwahati.