

ALGAL FLORA OF HOWRAH DISTRICT, WEST BENGAL, INDIA

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ABSTRACT

The present study records occurrence of 238 algal taxa belonging to seven Classes - Chlorophyceae (103 spp.), Cyanophyceae (63 spp.), Bacillariophyceae (59 spp.), Euglenophyceae (10 spp.), Xanthophyceae (1 sp.), Dinophyceae (1 sp.) and Rhodophyceae (1 sp.) from Howrah District, West Bengal during 2005-2008. The species have been enumerated their currently accepted name along with brief description, distribution and voucher specimens.

Key words: Algae, Taxa, Howrah District, West Bengal.

INTRODUCTION

Howrah district lies between 20°12' and 22°48' north latitude and between 87°50' and 82°23' east longitude. The total area of the district is 1450.5 sq km. The district is bounded on the north by the Arambag and Srerampur subdivisions of Hooghly district; on the east by Barrackpur and Diamond Harbour subdivision of the 24-Parganas on the south by the Tamluk subdivision of Midnapur and on the west partly by Tamluk and Ghatal subdivisions of the latter district and partly by the Arambag subdivision of the Hooghly district. Howrah district is irregular in shape and extreme length from east to west is c.45 km. and from north to south is nearly 64.5 km hemmed in between the 'Hooghly' on the east and 'Rupnarayan' on the west, and intersected by 'Damodar'. The Howrah district consists of a flat alluvial plain, with a gradual flow of drainage being consistently to the south and south-east. The product of these rivers and their branches comprises two main divisions viz., the raised river banks and the large marshes of lowlands lying in between them. The entire drainage system comprises of – (1) 'Hooghly' and its tributary 'Saraswati'; (2) 'Damodar' with two tributaries, the Kana-Damodar or 'Kausiki' and the Old Damodar and (3) 'Rupnarayan'. The district is also intersected by numerous tributaries of the main rivers, which are generally called 'Khals' or 'Creeks'.

The algal flora of West Bengal studied by Brühl & Biswas (1922, 1923), Biswas (1925, 1927), Carter (1926), Kundu (1929, 1934, 1935), Banerjee (1936, 1938), Gupta (1965, 1975), Sinha & Mukherjee (1975), Mukhopadhyay & Chatterjee (1981), Pal & Santra (1982, 1985), Maity & Santra (1985), Kargupta & Sarma (1991), Pal (1990). Sabat & Nayar (1992) studied water pollution of the river Hooghly. Sau & Gupta (2005) studied algal flora of Indian Botanic Garden, Howrah.

In spite of the seemingly substantial work done in regards to algal floristics of West Bengal, very little work has been reported on the algal flora of Howrah district, West Bengal. In the present communication the author has reported 238 taxa under 7 classes, 19 orders & 39 families, belonging to 112 genera, 233 species and 5 varieties from Howrah district of West Bengal.

MATERIALS AND METHODS

The algal samples were collected quarterly and periodically at random, during winter (December-February), summer (March-May), monsoon (June-August) and post monsoon (September-November) seasons for c.3 years from 2002 to 2005 from the various localities of the district from diverse habitat like rivers, ponds, lakes, canals, ditches, paddy fields, swamps, marshes, scum of the moist soils, submerged bricks, logs, shell of molluscs, etc. The specimen tubes were filled with algal samples not more than quarter of their capacity. The corks have been removed immediately after return from collection site, so that they may be well aerated.

Method of collection of algal samples differs with the habit and habitat of algae. Phytoplanktons have been collected in the morning from different spots of water bodies with the help of plankton net of fine silk

(mouth area 0.25 sq m and mesh size 0.330 mm) fitted with wooden sticks. Certain smaller forms (nannoplanktons), however are not retained in this net; these are collected by subjecting a sample of water by gentle filtration through a millipore membrane filter of 0.45 μ m to 0.80 μ m pore size. Phytoplanktons adhering to the surface of the aquatic macrophytes, are collected after washing the submerged macrophytes with distilled water. All the samples were preserved in 4% Formalin, which is added immediately after phytoplankton collection. Filamentous algae were collected from mass growths by hand. The algae adhering to the submerged bricks, stones, logs and bathing ghats were collected with the help of a forcep and by scraping with a scalpel. Algae from scum of moist soil have been collected with the help of a sharp scalpel. The Tarsan specimen tubes of 30 ml capacity were used as containers for algal samples.

Total 182 algal samples were collected during the study with the field notes from the various localities of Howrah district. All the collected samples after proper labelling have been deposited in Cryptogmic Section, Botanical Survey of India, Howrah.

The specimens of varying morphological and structural characteristics, shape, size of cell, colonies, filaments, trichomes, heterocysts, sheath, protoplasm, sheath, striao, number of chloroplasts, number and length of flagella, nature of cell wall, pellicle, nucleus, pyrinoids, etc. were studied in detail and measurement recorded.

The classes, orders, families and genera of algae have been arranged as per the system of classification proposed by Fritsch (1935, 1945) and after following ICBN 2006 where as the species under each genus have been arranged alphabetically. Each species has been provided with up to date nomenclature, details of habitat and collection number. Taxonomic keys for classes, orders, families, genera and species have also been provided.

The specimens were identified consulting standard monographs, books, proceedings like West and West (1923), Hustedt (1930), Geitler (1932), Tiffany (1930), Tiffany and Britton (1952), Desikachary (1959), Randhawa (1959), Venkataraman (1961), Ramanathan (1964), Philipose (1967), Werner (1977), Gonzalves (1981), Iyengar and Desikachary (1981), Prescott (1982) and Kant and Gupta (1998).

RESULT AND DISCUSSION

Analysis of findings revealed that Chlorophyceae, Cyanophyceae and Bacillariophyceae were well represented than the other classes viz., Euglenophyceae, Xanthophyceae, Dinophyceae and Rhodophyceae during the study period.

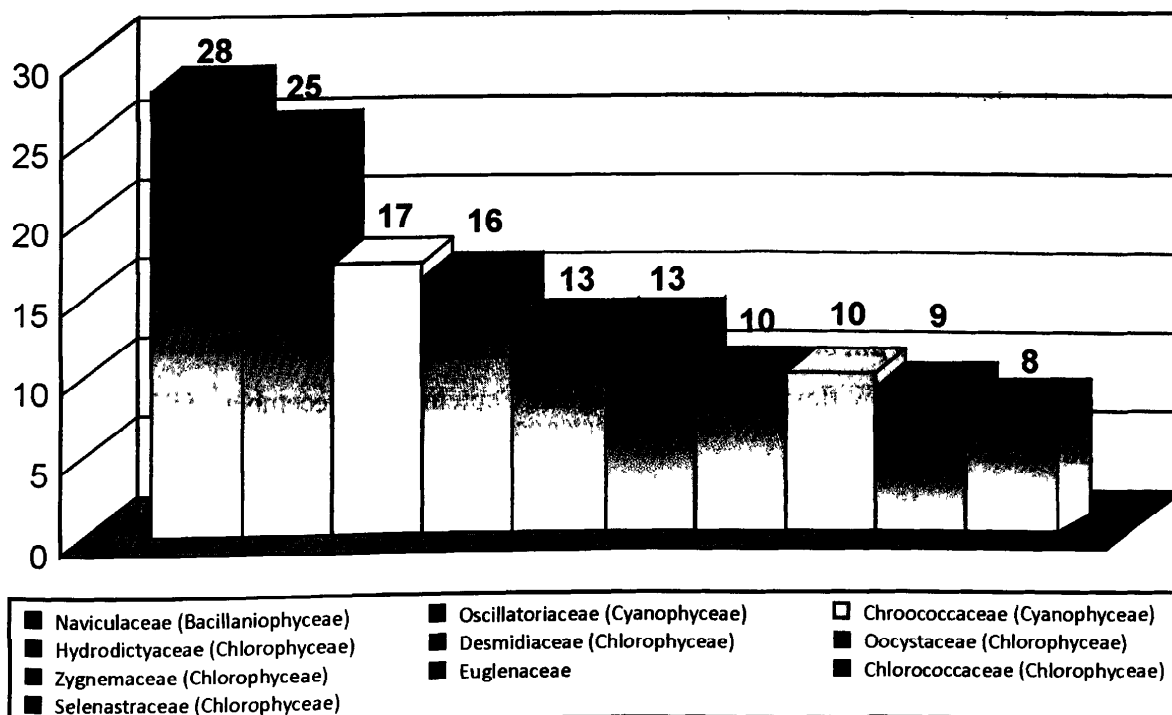
CLASS-WISE REPRESENTATIVES OF ALGAE FROM HOWRAH DISTRICT

Sl. No.	Class	Order	Family	Genera	Species	Variety
1.	Chlorophyceae	9	22	58	103	—
2.	Cyanophyceae	4	8	29	63	—
3.	Bacillariophyceae	2	5	19	54	5
4.	Euglenophyceae	1	1	3	10	—
5.	Xanthophyceae	1	1	1	1	—
6.	Dinophyceae	1	1	1	1	—
7.	Rhodophyceae	1	1	1	1	—
Total		19	39	112	233	5

During survey of algal flora of Howrah district, West Bengal, 58 genera and 103 species of Chlorophyceae; 29 genera and 63 species of Cyanophyceae; 19 genera, 54 species and 5 varieties of Bacillariophyceae; 3 genera and 10 species of Euglenophyceae; 1 genus and 1 species of Xanthophyceae; 1 genus and 1 species Dinophyceae; and 1 genus and 1 species of Rhodophyceae have been identified.

The ten dominant algal families of Howrah, according to the number of species under each family are given below:

1.	Naviculaceae (Bacillariophyceae)	—	28
2.	Oscillatoriaceae (Cyanophyceae)	—	25
3.	Chroococcaceae (Cyanophyceae)	—	17
4.	Hydrodictyaceae (Chlorophyceae)	—	16
5.	Desmidiaceae (Chlorophyceae)	—	13
6.	Oocystaceae (Chlorophyceae)	—	13
7.	Zygnemaceae (Chlorophyceae)	—	10
8.	Euglenaceae	—	10
9.	Chlorococcaceae (Chlorophyceae)	—	9
10.	Selenastraceae (Chlorophyceae)	—	8



The algal flora of Howrah is very rich not only in quantity but also in quality as these fresh water forms have tremendous impact on the productivity of aquatic system in addition to the nutrient recycling in varied habitats. The algal flora have tremendous scope for human welfare in near future. As the study of fresh water algal flora has great importance from various utilization perspectives viz., water pollution indexing, biomass production, biofertilizer, antibiotic/medicines, phytoremediation, etc. the present report provides information which could be used for future utilization in various ways for fresh water algae.

The dominant genera were *Chlorella*, *Closterium*, *Cosmarium*, *Scenedesmus*, *Microcystis*, *Fragillaria*, *Navicula*, *Euglena*, *Trachelomonas*, *Phacus*, *Oedogonium*, *Pithophora*, *Rhizoclonium*, *Stigeoclonium*, *Spirogyra*, *Zynema*, *Anabaena*, *Lyngbya*, *Oscillatoria*, *Phormidium*, *Chara*, *Nitella*, *Tolypella*, etc. There is a distinct seasonal changes of flora particularly with reference to phytoplankton flora in lakes, ponds, etc.

1. Class: CHLOROPHYCEAE

Thallus motile or non-motile and with great variety of forms: unicellular, colonial, palmellate, coccoid, heterotrichous, siphonaceous, branched or unbranched, filamentous; free living or attached. Cells are characterized by grass green chloroplasts, one to many in each cells or protoplasmic unit. In most forms the chloroplast contains one or more pyrenoids, in a few genera it is absent; nucleus one or many; vacuoles present, eye spot present or absent, flagella 2, 4 or 8 of equal length and attached in the anterior end; cell wall present, cellulose and pectose. The methods of reproduction, both asexual and sexual. Asexual reproduction by zoospore, akinete, aplanospore, hypnospore and auto spore, sexuality isogamous, anisogamous and autogamous.

1. Order: VOLVOCALES

Thallus unicellular, multicellular or colonial, cells or colonies motile either throughout vegetative phase or in some part of the life cycle, colonial members held together in gelatinous matrix, uninucleate, flagella 2 or 4 of equal length and anteriorly placed; chloroplast parietal, cup-shaped; pyrenoids one or more, eye spot single; asexual reproduction by cell division, zoospores; sexuality isogamous, anisogamous or oogamous.

1. Family: CHLAMYDOMONADACEAE

Vegetative cells solitary, sometimes palmelloid, with a definite homogeneous cellulose wall, biflagellate or quadriflagellate; reproduction isogamy, anisogamy and oogamy.

1. CHLAMYDOMONAS Ehrenb.

Chlamydomonas globosa J.Snow

Cells solitary, globose, 5 - 6 μm broad, 10 - 16 μm in length; papilla absent, gelatinous sheath not prominent; flagella two, slightly longer than the cell, nucleus 1, centrally placed; chloroplast parietal, cup-shaped; contractile vacuole 1, below the flagella, pyrenoid 1, axial.

Habitat: Planktonic in pond near Joypur, Howrah; July/August (AS 72327).

2. EUDORINA Ehrenb.

1. **Eudorina elegans** Ehrenb.

Colony spherical with 16 - 32 ovoid cells, evenly dispersed within a gelatinous envelope or arranged in transverse series. Cells 10 - 20 μm broad, colonies up to 200 μm diameter.

Habitat: Planktonic in slow flowing canal at Bagnan; September – December (AS 722150).

2. **Eudorina indica** M.O.P.Iyengar

Colonies subglobose, 48 - 52 μm long, 36 - 40 μm broad with mucilaginous layers, cells arranged in two tiers of different sizes, first two tiers of 12 cell 10 - 12 μm broad, rest cells 14 - 20 μm broad; chloroplast cup-shaped; contractile vacuoles 2; flagella 2, longer than the cell; pyrenoids 3 - 5.

Habitat: Free floating in a canal by the side of paddy field at Amta; December (AS 722151).

3. PANDORINA Bory

Pandorina morum (Müller) Bory

Colony usually ovate 180 - 220 μm broad; cells pyriform crowded, usually 16 in number, 10 - 14 μm broad, 12-15 μm long.

Habitat: Planktonic in pond of Khalna in Amta block of Howrah; July (AS 722150).

2. Family: SPHAERELLACEAE

VOLVOX L. (emend. Ehrenb.)

Volvox aureus Ehrenb.

Colonies spherical, numerous cells in colonies, cells ovoid, 6 - 7 μm broad, chloroplast cup-shaped, gonidia 6 - 8 per colony, each gonidium 50 - 60 μm broad.

Habitat: Plankton in a slow flowing canal at Bagnan, Dhobi pond and lotus pond of Indian Botanic Garden, Shibpur (AS 71135, 71128).

2. Order: CHLOROCOCCALES

The algae are unicellular, coenocytic or colonial. The shape of the cell varies considerably within the order. The cells are usually uninucleate, occasionally multinucleate. The chloroplast is single, parietal and in the form of a hollow sphere; cell wall smooth warty or spiny; reproduction by autospores, zoospores or aplanospores, sexuality isogamous to oogamous.

1. Family: CHLOROCOCCACEAE

Cells generally unicellular and uninucleate, chromatophores cup-shaped and parietal or stellate and axial, with 1 to many pyrenoids; reproduction by zoospores or 6 aplanospores, isogamy.

1. CHARACIUM A. Braun ex Kütz.

1. *Characium acuminatum* A. Braun ex Kütz

Cells oblong ovoid with acuminate apex, chloroplast single, parietal, laminate; pyrenoid 1-more, stalk short, cells 12 - 15 μm broad and 20 - 40 μm long.

Habitat: Planktonic in paddy fields at Khalna and Kalyanpuri, September (AS 71119, AS 71132).

2. *Characium ambiguum* J. Herm. ex Rabenh.

Cells small elongated, apex slightly bent, hyaline beak, attached by a short stalk with basal thickening, cells 4 - 6 μm broad and 18 - 20 μm long.

Habitat: Epiphytic on *Pithophora* sp. in King's lake and Prain's lake of Indian Botanic Garden, Shibpur; epiphytic on *Oedogonium* sp. in a pond near Kushberia (AS 71121, 71126).

3. *Characium angustum* A. Braun

Cells straight, lanceolate, with short hyaline apical beak, stalk short, cells 16 - 26 μm broad and 42 - 108 μm long.

Habitat: Attached on *Oedogonium* sp. in a pond near Baniara. September (AS 71136).

4. *Characium apiculatum* Rabenh.

Cells ellipsoid, 68 - 82 μm long 20 - 25 μm broad with one margin more convex than other, apex rounded with stumpy apical point, chloroplast 1, parietal, laminate; pyrenoid 3 - 5, stalk thick, short and colourless with broad base.

Habitat: Epiphytic on *Spirogyra* in a slowly flowing water at Kalyanpur, September (AS 71136).

2. CHLOROCOCCUM Meneghini (emend Starr)

1. *Chlorococcum humicolo* (Nägeli) Rabenh.

Cells spherical, solitary, chloroplast a hollow sphere with a lateral notch, pyrenoid single, cells 10 - 24 μm broad.

Habitat: Plankton in lakes of Indian Botanic Garden, Shibpur; August (AS 71110, 71116).

2. *Chlorococcum infusionum* (Schränk) Menegh.

Cells solitary, spherical or in irregular colonies; chloroplast like a hollow sphere with onesided notch; pyrenoid single, cells 20 - 90 μm broad.

Habitat: Floating forming a thick bloom with *Chlorella vulgaris* in a pond near Santragachhi, May (AS 71136).

3. SCHROEDERIA Lemmerm.

1. *Schroederia indica* Philipose

Cells semicircular, outer side convex, inner side concave; spine brown, 12 - 20 μm long; chloroplast parietal with single pyrenoid; cells 2 - 4 μm broad and 25 - 40 μm long.

Habitat: Planktonic in a pond near Shibpur; September (AS 71124).

2. *Schroederia setigera* (Schröd.) Lemmerm.

Cells solitary, spindle-shaped, with ends turned into a long delicate straight seta or spine; chloroplast single, parietal with inconspicuous pyrenoid; cells 3 - 10 μm broad and 54 - 100 μm long.

Habitat: Rare; Free floating in a pond at Khalna; September (AS 71139).

4. TRÉBOUXIA Puym.

Trebouxia humicola (Treboux) West & Fritsch

Cells spherical, unicellular, chloroplast massive with lobed margins, pyrenoid single, cells 8 - 22 µm broad.

Habitat: Planktonic in a small pond near Mourigram rare; June (AS 71144).

2. Family: OOCYSTACEAE

Cells spherical, oblong, ellipsoid, naviculoide or reniform; usually enclosed by a gelatinous envelope; cell wall smooth or provided with a varying number of tubercles or bristles; chloroplast one to many; with or without pyrenoids.

1. Sub family: CHLORELLOIDEAE

Cells solitary or in small colonies, spherical to ellipsoid; cell membrane smooth or with tubercles, chloroplast usually one and with or without pyrenoids.

1. CHLORELLA Beijerinck

Aggregated in small colonies of irregular shape; free living or symbiotic; chloroplast usually single, parietal, cup-shaped or laminate, usually with a pyrenoid though it is not always clear.

Chlorella vulgaris Beijerinck

Cells solitary or in small colonies, spherical with thin membrane, chloroplast cup-shaped, parietal, cells 5 - 10 µm broad.

Habitat: Planktonic in pond near Belgachhia; February (AS 71127)

2. Sub family: OOCYSTOIDEAE

Cell membrane without bristle, usually colonies of 2 - 4 - 8 cells. Cells spherical, ellipsoid, sub cylindrical or reniform; chloroplast when present one or more, parietal and laminate or disc shaped, with or without pyrenoids.

1. GLOEOTAENIUM Hansg.

Gloeotaenium loitlesbergianum Hansg.

Cells spherical, usually in flat colonies of 4 cells, completely filling the space inside the mother cell wall; Gelatinous band broad; cells 20 - 30 µm broad.

Habitat: Planktonic in pond at Mankur (AS 71182)

2. NEPHROCYTIUM Nägeli

1. **Nephrocytium agardhianum** Nägeli

Cells reniform with rounded ends, colonies usually of 4 - 8, within a gelatinous envelope, chloroplast single, parietal and with one pyrenoid. Cells 14 - 20 µm broad and double as long, colonies 40 - 90 µm broad.

Habitat: In a moist wall near Bakshi, September (AS 71192).

2. **Nephrocytium lunatum** W. West

Cells sickle shaped or half moon-shaped with one side convex and the other concave and pointed ends. Cells spirally arranged with a oblong hyaline gelatinous envelope to form 4 - 8 celled colonies. Chloroplast single parietal with a pyrenoid; cells 4 - 6.5 µm broad and 14 - 20 µm long. Colonies 20 - 70 µm broad, 37 - 75 µm long.

Habitat: Free floating in a sewage pond near Bombay road (Kona); April (AS 71164).

3. OOCYSTIS Nägeli

1. **Oocystis elliptica** W. West

Cells oblong to ellipsoid with rounded ends, cell membrane thin, without thickenings; chloroplast parietal, cells 6-9 µm broad and 18 - 22 µm long.

Habitat: In paddy field at Kalagachhia; November (AS 71139).

2. Oocystis lacustris Chodat

Cells ellipsoid, about $1\frac{1}{2}$ times longer than broad, usually 4-8 celled colonies, with Polar nodules; cells 26-40 μm broad and 28-70 μm long.

Habitat: Planktonic in a cemented tank at Santragachhi; November. (AS 71127).

3. Oocystis solitaria Wittr.

Colony elongate, 24-26 μm long, 20-22 μm broad; cells ellipsoid, 16-18 μm long, 8-12 μm broad, wall thick, polar nodule present, chloroplast 12-15, disc shaped, pyrenoid 2-3.

Habitat: Planktonic in a pond at Bagnan; April (AS 71164).

3. Family: SELENASTRACEAE**1. ACTINASTRUM** Lagerheim**Actinastrum hantzschii** Lagerh.

Colonies of 4-8 radially arranged cells, sometimes cells spindle shaped, apices attenuated or slightly rounded. Cells 3-6 μm broad, 12-24 μm long, rarely present.

Habitat: Free floating in Lotus pond and Sadir lake of Indian Botanic Garden, Shibpur (AS 71107, 71135).

2. ANKISTRODESMUS Corda**1. Ankistrodesmus convolutus** Corda

Solitary or in groups of 2-4 cells, strongly curved or twisted with the ends; pointed, cells 2-4 μm broad and 3-25 μm long.

Habitat: Planktonic in pond at Mankur (AS 71157).

2. Ankistrodesmus falcatus (Corda) Ralfs

Cells acicular, ends tapering to acute apices, cells 2-6 μm broad, 20-110 μm long.

Habitat: Planktonic in pond at Shibpur (AS 71110).

3. KIRCHNERIELLA Schmidle**1. Kirchneriella contorta** (Schmidle) Bohlin

Colonies of 4-8 cells enclosed by a gelatinous envelope, cells vermiform, cylindrical with rounded ends, irregularly arranged within the envelope, 1-2 μm broad; 8-12 μm long.

Habitat: Planktonic in Pond at Panchla; November (AS 71177).

2. Kirchneriella lunaris (K. Kirchw.) Möbius

Colonies with cells enclosed within a homogeneous gelatinous envelope; cells lunate, elongate with pointed ends, irregularly arranged within the envelope, cells 3-7 μm broad and 6-18 μm long.

Habitat: Free floating in confined water in the road side canal near Kona; September (AS 71138).

3. Kirchneriella obesa (W. West) Schmidle

Colonies 4-8, irregularly arranged within a gelatinous envelope; cells strongly lunate, outside of the cell convex, inner side nearly parallel to it with rounded apices. Cells 2-8 μm broad, 6-14 μm long.

Habitat: Planktonic in Pond at Salkia; November (AS 71179).

4. SELENASTRUM Reinsch**1. Selenastrum bibraianum** Reinsch

Cells sickle shaped with sharply pointed ends in colonies of 4-8-16 cells, 5-7 μm broad, 16-36 μm long.

Habitat: Tree floating in pond at Andul (AS 71126).

2. *Selenastrum gracile* Reinsch

Colonies of 4 - 8 - 16 cells; cells sickle shaped with acute apices, 3 - 5 mm broad and 12 - 28 mm long.

Habitat: Free floating in pond at Baniara; November (AS 71161).

4. Family: HYDRODICTYACEAE

Free living, unicellular or in regular colonies; cells cylindrical, tetrahedral or polygonal, chloroplast single, parietal and laminate with a pyrenoid.

1. *Closteridium* Reinsch

Closteridium siamensis (W. West & G.S. West) G.M.Sm.

Cells solitary, semicircular with inner side straight, outer side convex. Each end with a spine, two spine are unequal. Cells 24 - 26 μm broad and 66 - 75 μm long (with the spine 15 - 50 μm long.)

Habitat: Free floating in pond at Joypur (AS 71188).

2. *Golenkinia* Chodat

Golenkinia radiata Chodat

Cells solitary, cell wall covered with ten long bristles, chloroplast cup-shaped; pyrenoid single, cells 8 - 14 μm broad, bristles 25 - 40 μm long.

Habitat: Planktonic in a tank at Munshirhat; March (AS 71124).

3. *Hydrodictyon* Roth

Hydrodictyon reticulatum (L.) Lagerh.

Colonies reticulate, meshes either pentagonal or hexagonal, cells hexagonal, cells elongated, cell wall two layered. Cells up to 52 - 54 μm long, 10 - 11 μm broad, chloroplast reticulate, multinucleate; pyrenoid many.

Habit: Common in paddy fields of Bagnan (AS 71109, 71138).

4. *Pediastrum* Meyen

1. *Pediastrum duplex* Meyen

Colonies usually 16 - 32 inner cells quadrate and not in contact at the central portion of the sidewalls; inner side of the marginal cells more or less concave, outer side, produce two short truncate process. Cells 8 - 12 μm broad.

Habitat: Planktonic in pond at Nazirgaunge; July (AS 71120).

2. *Pediastrum simplex* Meyen

Colonies circular of 4 - 8 - 16 cells, inner side of the marginal cells nearly straight and outer side gradually tapering, sides concave, inner cells polygonal, cell wall smooth, cells 8 - 12 μm broad, 18 - 25 μm long.

Habitat: Free floating in ponds of Fulleswar (AS 71157).

3. *Pediastrum tetras* (Ehrenb.) Ralfs

Colonies rectangular of 4 - 8 cells without inter cellular spaces, linear cells 4 - 6 sided and divided into two lobes; cells 5 - 15 μm broad.

Habitat: Planktonic, very common in ponds at Sankrail (AS 71109).

5. *Tetraedron* Kütz.

1. *Tetraedron muticum* (A. Braun) Hansg.

Cells small flat triangular, angles broadly rounded, cell wall smooth, cells 5 - 25 μm in diameter.

Habitat: Planktonic in pond at Udaynarayanpur; common; July (AS 71143).

2. Tetraedron trigonum (Nägeli) Hansg.

Cells triangular with rounded corners, side concave, each corner ended with a stout spine. Cell 18 - 25 μm broad, without spine, 5 - 8 μm long.

Habitat: Ponds and Tanks of Ranihati; March (AS 71173, 71182).

6. **TROCHISIA** Kütz.**Trochiscia aspera** (Reinsch) Hansg.

Cells spherical, cell membrane thick, covered with numerous fine papillae, cells 12 - 18 μm broad, cell wall 2 μm thick.

Habitat: Planktonic in paddy field soil at Bagnan; August (AS 71117).

5. Family: COELASTRACEAE

Members are free living and colonial, colonies globose or cubical, made up of 4 - 128 cells; cells spherical or ovoid, pyramidal or pyriform, connected to one another with mucilage bands; chloroplast single, parietal, pyrenoid one; reproduction by autocolonies.

1. **COELASTRUM** Nägeli**Coelastrum microsporum** Nägeli

Colonies spherical, composed of 8 - 64 cells; 24 - 40 μm broad; cells spherical to ovoid, interconnected by gelatinous processes, with small intercellular spaces, 5 - 8 μm broad; chloroplast parietal, pyrenoid 1.

Habitat: Planktonic in shallow canal associated with *Spirogyra* sp.; November (AS 71012).

2. **CRUCIGENIA** Morren**1. Crucigenia quadrata** Morren.

Colonies quadrate consisting of circular plate of 4 rectangular cells, 9 - 12 μm broad. Cells spherical with round corners cruciately arranged with a space at center; cells 2 - 5 μm broad, outer wall convex, lateral walls straight; chloroplasts parietal disc; pyrenoid present or absent.

Habitat: Planktonic in ponds at Uluberia, Howrah; March (AS 71301).

2. Crucigenia rectangularis (A. Braun) Gay

Colonies rectangular, 4-celled with small rectangular space at the center, 12 - 18 μm long, 8 - 12 μm broad; cells 5 - 9 μm long, 4 - 6 μm broad, elongate ovoid, contact with poles and sides. Chloroplast 1 - 4, parietal disc shaped; pyrenoid 1.

Habitat: In road side ditch at Dhulagarh, Howrah; August (AS 71331).

3. **SCENEDESMUS** Meyen**1. Scenedesmus acuminatus** (Lagerh.) Chodat

Colonies of 4 - 8 cells; cells fusiform with sharp pointed ends and without spines cells 2 - 7 μm broad and 12 - 42 μm between the apices.

Habitat: Ponds near Deulli, Howrah, Common (AS 71180).

2. Scenedesmus obliquus (Turpin) Kütz.

Colonies usually of 4 cells, arranged in a linear series. Cells fusiform with slightly rounded ends, 2 - 6 μm broad 6 - 20 μm long.

Habitat: Planktonic in filter beds near Domjur, Howrah (AS 71149).

3. Scenedesmus quadricauda (Turpin) Bréb.

Colonies usually of 4 cells. Cells oblong cylindrical with rounded ends, arranged in linear series, poles of terminal cells with a long slightly curved spine. Cells 3 - 7 μm broad, 9 - 18 μm long without spine.

Habitat: Free floating in paddy fields at Bagnan, Howrah, Common (AS 71180).

6. Family: RADIOCOCCACEAE

Cells spherical to ellipsoidal embedded in mucilage to form colonies; chloroplasts cup-shaped to parietal and with or without a pyrenoid; reproduction by autospores.

DISPORA Printz

Dispora cuneiformis (Schmidle) Printz.

Colonies 4 celled, quadrate, enclosed with gelatinous envelope, cells 4 μm broad and 6 - 8 μm long.

Habitat: Planktonic in a tank at Domjur; April (AS 71136).

7. Family: BOTRYOCOCCACEAE

Free floating, colonial, colonies irregularly spherical, united together by tough mucilaginous bands; cells arranged radially and close in the periphery of the envelop. Cells ovoid to ellipsoid; chloroplast reticulate or parietal having distinct or indistinct pyrenoid; reproduction by fragmentation or by autospores.

BOTRYOCOCCUS Kütz.

Botryococcus braunii Kütz.

Colonies free floating with irregular shape, completely enclosed by tough dark membrane that produces irregular wrinkles; cells ovoid to ellipsoid, arranged radially at periphery; chloroplast parietal, cup-shaped, cells 3-8 μm broad and 6 - 10 μm long.

Habitat: Forming reddish bloom in stagnant water in a pond near Andul; November (AS 71166).

3. Order: ULOTRICHALES

Thallus uniseriate, unbranched, filamentous, composed of cells joined end to end or slightly interrupted, cells uninucleate.

1. Family: CYLINDROCAPSACEAE

Plants unbranched, filamentous, cells oblong or cylindrical arranged uniseriately within a tough, lamellated mucilaginous envelope; cell wall several layered; chloroplast massive without any distinct pattern, pyrenoid single, nucleus one; reproduction by fragmentation and by biciliate or quadriciliate zoospores.

CYLINDROCAPSA Reinsch

Cylindrocapsa involuta Reinsch

Cells short cylindrical, round or elliptical, slightly constricted at the cross walls 20 - 28 μm broad, 1.5 times as long as broad, cell wall thick, hyaline, chloroplast massive, completely filling the cell with a central pyrenoid, filament monoecious, antheridia 1 or more in rows, pale brown in colour. Oogonia large, rounded 38 - 45 μm broad.

Habitat: As free floating entangled mass in lake of Santragachhi (AS 722114).

2. Family: MICROSPORACEAE

Plants unbranched, filaments uniseriately arranged, cylindrical, cell wall thin in some species, in others thick and lamellate, composed of 2 sections overlapping in the mid-region which fragment into 'H'-shaped piece, chloroplast dense or in the form of reticulum; reproduction by aplanospores.

MICROSPORA Thuret

Microspora amoena (Kütz.) Rabenh.

Filaments unbranched, composed of corticated 'H'-pieces, cells cylindrical, uninucleate, wall thin, chromatophores reticulate, covering the entire inner surface of the cell wall.

Habitat: Free floating in a pond of Baniara (AS 71106).

3. Family: ULOTRICHACEAE

Thallus filamentous to foliaceous, simple or branched, without or with differentiation of attached base and free apex, chloroplast single, parietal, pyrenoid present and uninucleate.

1. BINUCLEARIA Wittrock

Binuclearia tectorum (Kütz.) Beger ex Wichmann

Filaments uniseriate, unbranched, with cylindrical cells, not enclosed in a gelatinous sheath, cells 5 - 18 μm broad; chloroplast parietal plate like, covering 2/3 of the wall surface with conspicuous pyrenoid.

Habitat: Free floating in a pond at Shibpur along with other algae (AS 71119).

2. ULORHRIX Kütz.

Ulothrix zonata (Weber & Mohr) Kütz.

Filaments unbranched, cells uninucleate, barrel-shaped, chromatophore band-shaped, pyrenoid several, cells 12 - 42 μm in diameter.

Habitat: Free floating in King's Lake and Prain's Lake of Indian Botanic Garden, Shibpur (AS 71128, AS 71106).

3. URONEMA Lagerh.

1. **Uronema africanum** Borge

Filaments curved, 1 - 30 celled, up to 270 μm long; cells cylindrical, 3 - 7 μm broad and 2 - 6 times as long as broad.; terminal cell curved and pointed like a sickle; basal cell elongated, shorter than intercalary cells, slightly tapering towards the base.

Habitat: Attached on submerged aquatic plant in King's Lake of Indian Botanic Garden, Shibpur (AS 71108)

2. **Uronema gigas** Vischer

Filaments straight, cells 8 - 10 μm broad and 8 - 24 μm long, chloroplast parietal, terminal cell attenuated, pyrenoid 2 - 3.

Habitat: Attached on submerged aquatic plants of Sadir Lake, Indian Botanic Garden, Sibpur (AS 71108).

4. Order: CLADOPHORALES

Filaments branched or unbranched; attached or free floating, cells cylindrical, cell wall thick, apical cell rounded, seta or hair absent; chloroplast covering the whole cell, multinucleate, pyrenoids numerous; reproduction by fragmentation, zoospores or aplanospores; sexuality isogamous.

Family: CLADOPHORACEAE

Plants filamentous, branched with multinucleate cells, free floating and occurs as tangled mats; chloroplast parietal network or reticulum, pyrenoids many; reproduction by fragmentation or by akinetes; sexuality isogamous.

1. CLADOPHORA Kütz.

Cladophora glomerata (L.) Kütz.

Thallus feathery tufts, deep green, branches mainly towards upper portion of main axis, 200 - 230 μm long, 72 - 78 μm broad; cells slightly attenuated towards apices; apices pointed, cell wall thick, stratified, chloroplast reticulate, nucleus 10 - 12; pyrenoids 7 - 10; apices 130 - 160 μm long, 42 - 48 μm broad.

Habitat: In stagnant water of earthen pot and ponds in Indian Botanic Garden, Shibpur, Howrah - Throughout the year (AS 71110, 71134, 71135).

2. PITHOPHORA Wittr.

1. *Pithophora mooreana* Collins

Filaments highly branched, 110 - 116 μm long, 52 - 62 μm broad; lateral branched 106 - 108 μm long, 48 - 50 μm broad; chloroplast parietal; nucleus 6 - 8; pyrenoids 4 - 5; akinetes grayish green, cylindrical with rounded end, terminal and intercalary, 120 - 135 μm long, 78 - 86 μm broad.

Habitat: Attached on submerged brick associated with *Oedogonium* at Joypur, Howrah; December (AS 71202).

2. *Pithophora oedogonia* (Mont) Wittr.

Filaments slender, 435 - 440 μm long, 78 - 80 μm broad; cell wall thin, branch opposite. Cells cylindrical, 275 - 285 μm long, 66 - 72 μm broad; chloroplast parietal; nucleus 5 - 7; pyrenoids 5 - 8; akinetes cask-shaped, 98 - 110 μm long, 58 - 92 μm broad.

Habitat: Free floating in pond at Shyampur, Howrah, associated with *Microspora* sp.; during December (AS 71205).

3. *Pithophora varia* Wille

Filaments alternate and sparsely branched. 830 - 835 μm long, 80 - 82 μm broad; cells cylindrical, 450 - 462 μm long, 52 - 56 μm broad; cell wall thin, parietal chloroplast; nucleus 6-8, pyrenoids 3 - 7; inter akinetes cylindrical or angular, 174 - 176 μm long, 58 - 65 μm broad, terminal akinetes ovoid with blunt conical apex, 148 - 172 μm long, 62 - 72 μm broad.

Habitat: Free floating in a canal at Khalna, Howrah associated with Diatom mixture during September (AS 71208).

3. RHIZOCLONIUM Kütz.

1. *Rhizoclonium crassipellitum* W. West & G.S. West

Filaments coarse, unbranched, twisted, entangled; cells cylindrical, 226 - 244 μm long, 58 - 62 μm broad; cell wall thick and lamellate, chloroplast parietal; nucleus 6 - 8.

Habitat: Free floating in the form of tangled mass in a puddle at Dhulagori, Howrah; November (AS 71209).

2. *Rhizoclonium hieroglyphicum* (C.A. Agardh) Kütz.

Filaments unbranched, septa uncontracted; wiry, cell wall thin, 2 - 3 μm broad; lamination absent; cell cylindrical 276 - 320 μm long, 40 - 42 μm broad; chloroplast parietal, reticulate; nucleus 7 - 8, pyrenoids 4 - 8.

Habitat: Free floating in the form of entangled mass in shallow ponds of Abada, Howrah associated with diatom sp.; throughout the year (AS 71214).

5. Order: CHAETOPHORALES

Thallus heterotrichous, differentiated in prostrate and erect system of branched or unbranched filaments, setae present or absent, rhizoids present or absent. Chloroplast parietal, laminate or girdle shaped, uninucleate, pyrenoids one or more or absent; reproduction by zoospores or aplanospores, sexuality isogamous, anisogamous or oogamous.

1. Family: CHAETOPHORACEAE

Plants erect with branched filament, apical cell attenuated into hyaline setae or bristles enclosed in firm, copious mucilage forming macroscopic thallii or definite shape, branches attenuated.

1. CHAETOPHORA Schrank

Chaetophora elegans (Roth) C.A. Agardh

Colonies gelatinous, sub-globose to flattened, 430 - 450 μm broad; filaments radiating from common center; branches loose dichotomous fasciculate at top; apical cell cylindrical,

abruptly ending into acuminate apices. Cells 16 - 22 μm long, 6 - 8 μm broad, nucleus 1, pyrenoid 1, chloroplast parietal.

Habitat: Attached to submerged aquatic grass in rice fields at Baniara associated with certain Cyanobacteria; September (AS 71303).

2. DRAPARNALDIA Bory

Draparnaldia glomerata C.A. Agardh

Vegetative cells of main axis inflated, 50 - 125 μm broad, 30 - 200 μm long; filaments repeatedly branched; branchlets without a distinct main axis; chromatophore of cells of main axis narrowly zonate.

Habitat: In a pond at Shibpur, Howrah in association with *Rhizoclonium* sp (AS 71136).

3. PROTODERMA Kütz.

Protoderma viride Kütz.

Pseudoparenchymatous thallus; erect system rudimentary, prostrate system irregularly branched, with compact arrangement, terminal cells slightly narrow; cells quadrangular, 10 - 12 μm long, 3 - 6 μm broad; cell wall thin, chloroplast parietal; pyrenoids 7 - 9.

Habitat: Attached on long in moist shady place in a pond side at Khorop, Howrah; December (AS 71223).

4. STIGEOCLONIUM Kütz.

Stigeoclonium subsecundum Kütz.

Thallus heterotrichous, prostrate and erect system well developed, branching spares and solitary; tufts loose, pale green to yellowish, cells 12 - 26 μm broad, 13 - 150 μm long, chloroplast parietal; pyrenoids 3 - 7.

Habitat: Attached on submerged logs in Lotus pond of Indian Botanic Garden, Shibpur, Howrah associated with diatoms (AS 71106).

2. Family: COLEOCHAETACEAE

Plant a filamentous thallus, cells bearing sheathed setae either simple or branched, cells solitary, chloroplast parietal, plate with a single pyrenoid; reproduction by biflagellated zoospores, sexuality iso or heterogamous.

COLEOCHAETE de Breb.

Coleochaete soluta Pringsh.

Monostromatic thallus; branches radiating from common center, loosely spreading; filaments slightly tapering, cells cylindrical, 9 - 12 μm broad 16 - 18 μm long; apical cell with bluntly rounded end, chloroplast parietal, pyrenoid 1; oogonia globose, corticated, 110 - 116 μm broad, antheridia flask-shaped 12 - 15 μm broad.

Habitat: Epiphytic on aquatic plant in association with *Chara* sp. in a shallow pond at Bauria, Howrah, December (AS 71241).

3. Family: TRENTPOHLIACEAE

Thallus epiphytic; yellow or brick red.

TRENTPOHLIA Martius

Trentepohlia aurea (L.) Martius

Orange yellowish thallus; prostrate and erect branch well developed; branch opposite; cells cylindrical or barrel shaped, 14 - 22 μm long, 12 - 18 μm broad; chloroplast discoid 4 - 6; pyrenoids absent; wall parallel, smooth; multinucleate, cap cell present; gametangia globular, lateral or terminal, 22 - 32 μm broad, sporangia sessile, terminal 22 - 30 μm broad.

Habitat: Attached on submerged logs at Dhulagari; December (AS 709).

6. Order: OEDOGONIALES

Family: OEDOGONIACEAE

Plants attached, filamentous, cells cylindrical, chloroplast parietal, reticulum with several pyrenoids, uninucleated; reproduction by multiflagellate zoospores, sexuality heterogamous.

OEDOGONIUM Link

1. Oedogonium angustum (Hirn) Tiffany

Macrandrous, dioecious, vegetative cells elongate, 20 - 30 μm broad, 70 - 75 μm long; oogonia solitary, 42 - 52 μm broad, 82 - 110 μm long; oospore oblong-ovoid, wall smooth, 45 - 48 μm broad, 60 - 70 μm long; antheridia 18 - 20 μm broad, 7 - 10 μm long.

Habitat: Attached on submerged aquatics in Sadir Lake of Indian Botanic Garden, Shibpur in October to December (AS 71107).

2. Oedogonium anomalum Hirn

Macrandrous, dioecious, vegetative cell cylindrical, 40 - 50 μm broad, 80 - 85 μm long; oogonia solitary, subovoid, 55 - 65 μm broad, 65 - 75 μm long; oospore globose, not filling the oogonia, the oogonia 52 - 56 μm broad, 54 - 58 μm long, antheridia not observed in collected specimen.

Habitat: Attached on Submerged aquatic on Sadir Lake of Indian Botanic Garden, Howrah (AS 71109).

3. Oedogonium cardiacum (Hass.) Wittr.

Macrandrous, dioecious, vegetative cells 18 - 24 μm broad, 60 - 84 μm long; oogonia solitary, globose, 48 - 70 μm broad, 52 - 76 μm long; oospore globose, not filling the oogonia, 38 - 42 μm broad, antheridia 15 - 20 μm broad, 10 - 14 μm long.

Habitat: Attached with submerged aquatics in pond at Shibpur, Howrah (AS 71128).

4. Oedogonium epiphyticum Transeau & Tiffany

Macrandrous, dioecious, vegetative cells of female filaments 6 - 9 μm broad, 18 - 20 μm long; those of male filaments 5 - 8 μm broad, 16 - 45 μm long; oogonial solitary, ellipsoid to ellipsoid-ovoid, 16 - 20 μm broad, 20 - 30 μm long; oospore nearly globose, nearly filling the oogonium, 15 - 16 μm broad, 18 - 20 μm long, antheridia single rarely in twos, 5 - 7 μm broad, 5 - 10 μm long.

Habitat: Attached on submerged aquatics; Udaynarayanpur, Howrah (AS 72205)

5. Oedogonium globosum Nordst.

Macrandrous, monoecious, vegetative cells cylindric, 10 - 14 μm broad, 40 - 75 μm long; oogonia solitary, globose, 35 - 40 μm broad, 32 - 40 μm long; oospore globose, thick walled, smooth, 32 - 38 μm broad; antheridial cell 10 - 12 μm broad, 6 - 8 μm long.

Habitat: Growing on aquatic plants in ponds at Jujarsaha of Howrah (AS 71109).

6. Oedogonium majus (Hansg.) Tiffany

Macrandrous, dioecious, vegetative cells cylindrical, 35 - 45 μm broad, 80 - 180 μm long; oogonia 1 - 3, subovoid, 52 - 55 μm broad, 75 - 90 μm long, oospore filling the oogonia, 50 - 62 μm broad, 68 - 85 μm long; antheridia 30 - 35 μm broad, 10 - 16 μm long.

Habitat: Free floating in ponds in Salkia, Howrah (AS 71128).

7. Oedogonium rivulare A. Braun.

Macrandrous, dioecious, vegetative cells cylindrical, 40 - 45 μm broad, 160 - 180 μm long; oogonia solitary or 3 - 6 seriates; ovoid, ellipsoid, 70 - 80 μm broad, 110 - 150 μm long; oospore sub-globose, wall thick smooth, 66 - 70 μm broad, 80 - 100 μm long; male filaments with cells 30 - 35 μm broad, 120 - 250 μm long; antheridia 20 - 26 μm broad, 14 - 26 μm long.

Habitat: Epiphytic on submerged aquatics of Santragachhi Lake, Prain Lake of Shibpur, Howrah (AS 71106, AS 71128).

8. *Oedogonium tyrolicum* Wittr.

Macrandrous, monoecious, vegetative cells cylindrical, 16 - 18 μm broad, 52 - 74 μm long; oogonia solitary, ellipsoid-globose, 44 - 45 μm broad, 52 - 53 μm long, oospore globose, not filling the oogonia, 40 - 42 μm broad, 40 - 42 μm long; antheridia 1 - 4 in a series, 10 - 18 μm broad, 9 - 11 μm long.

Habitat: Epiphytic on submerged aquatic plants in pond at Shibpur Howrah (AS 71106).

9. *Oedogonium varians* Wittr.

Macrandrous, monoecious, vegetative cell cylindrical, 12 - 14 μm broad, 32 - 64 μm long; oogonia solitary or in twos, globose, 30 - 40 μm broad, 30 - 32 μm long, antheridia 10 - 12 μm broad, 5 - 6 μm long.

Habitat: Free floating in pond of Shibpur, Howrah (AS 71135).

7. Order: CONJUGALES

Thallus unicellular, colonial or unbranched filaments, slimy (known as 'pond scums'); motile cells absent, cell wall of 1 - 3 layers, smooth or ornamented; chloroplast bar shaped, aster shaped or spiral ribbon shaped, axial plate shaped or stellate, nucleus one, pyrenoids present or absent; reproduction by aplanospores or akinetes or by fragmentation, sexuality scalariform or lateral conjugation.

1. Family: MESOTAENIACEAE (Saccoderm desmids)

Cells uninucleate with various shapes, solitary or forming simple filaments, cell walls without pores and composed of 1 piece (saccoderm desmids); chromatophores spiral ribbons, axial plates or stellate bodies with or without longitudinal ribs; reproduction by the formation of amoeboid gametes generally fusing through conjugation tubes.

1. CYLINDROCYSTIS Menegh.

Cylindrocystis brebissonii Menegh.

Cells unicellular, without median constriction, cylindrical, 38 - 42 μm long 18 - 22 μm broad, rounded poles, cell wall smooth, chloroplast stellate, two; nucleus one; pyrenoids two.

Habitat: Planktonic in paddy field at Khurup, associated with some desmids during December to January (AS 71192).

2. GONATOZYGON De Bary

Gonatozygon brebissonii De Bary

Cells narrowly cylindric, 5 - 10 μm broad, 90 - 280 μm long, attenuated to narrowest width immediately below the capitate apices truncate, cell wall minutely and densely granulate, chromatophores two, axial, pyrenoids 5 - 16 in each chromatophore; zygote spherical, smooth, 19 - 20 μm broad.

Habitat: Free floating in pond at Shibpur (AS 71135).

3. MESOTAENIUM Nägeli

Mesotaenium caldariorum (Lagerh.) Hansg.

Cells straight, unicellular, oblong, end portion slight conical, 36 - 40 μm long 14 - 18 μm broad; cell wall smooth, chloroplast 1, axial plate shaped; nucleus 1; pyrenoids 4 - 6.

Habitat: Free floating in a paddy field at Jhikhira, associated with *Oscillatoria* sp. during December-January (AS 71183).

2. Family: ZYGNEMACEAE

Plants filamentous, unbranched, with uninucleate cylindric cells, cell wall without pores; chloroplast one or more, stellate, cushioned, discoid, plate-like or ribbon-shaped with or without pyrenoids; reproduction by

fragmentation, aplanospores, sexuality by conjugation of amaeoid gametes through or within a tube or sometimes by an opening between the adherant gametangia.

1. SPIROGYRA Link

1. *Spirogyra bichromatophora* (Randhawa) Transeau

Vegetative cells of filaments cylindrical, 154 - 160 µm long, 58 - 60 µm broad, septa plane; chloroplast 2 in each cell with 4 - 5 turns; conjugation scalariform, conjugation tube formed by both gametangia; zygospores ellipsoid, 70 - 72 µm long 48 - 58 µm broad, mesospore wall smooth, brown.

Habitat: Free floating in a drain water at Maju, associated with other members of Conjugales (AS 71199).

2. *Spirogyra condensata* (Vauch.) Kütz.

Filaments of vegetative cells cylindrical 85 - 95 µm long, 40 - 46 µm broad, septa plane; chloroplast 1 in each cell with 3 - 4 turns; conjugation scalariform, conjugation canal formed by both gametangia; zygospores ellipsoid, 48 - 52 µm long 32 - 38 µm broad, mesospore wall smooth, yellowish brown.

Habitat: Free floating in a pond at Narit, along with other *Spirogyra* sp. August-October (AS 72258, AS 72286).

3. *Spirogyra ellipsospora* Transeau

Filaments of vegetative cells cylindrical, 396 - 420 µm long, 56 - 94 µm broad; septa plane; chloroplast 3 - 5 with 4 - 5 turns; conjugation scalariform, conjugation canal formed by both gametangia; zygospores ellipsoid with pointed ends, 175 - 200 µm long, 43 - 70 µm broad, mesospore wall smooth, yellowish brown.

Habitat: Free floating in a canal at Deulti associated with *Closterium* sp.; August-December (AS 72279).

4. *Spirogyra gracilis* (Hassall) Kütz.

Filaments of vegetative cells cylindrical, septa plane; chloroplast one in each cell with 4 - 5 turns, 60 - 70 µm long, 15 - 16 µm broad; conjugation scalariform, tubes formed by both gametangia; zygospores ellipsoid, apex round, 42 - 44 µm long, 20 - 22 µm broad; mesospore wall smooth, yellowish brown.

Habitat: Free floating in a ditch at Nuntia associated with *Oedogonium* sp. and diatom mixture, during August-December (AS 72205).

5. *Spirogyra maxima* (Hassall) Witttr.

Filaments of vegetative cells cylindrical, septa plane, chloroplast 6 - 7 in each cell with 1 - 2 turns, 185 - 230 µm long, 118 - 140 µm broad; conjugation scalariform, tubes formed by both gametangia, zygospore lenticular, 72 - 90 µm long, 100 - 115 µm broad, mesospore wall reticulate, golden brown.

Habitat: Free floating in puddle at Dhulagori along with diatom mixture; throughout the year (AS 72203).

6. *Spirogyra paradoxa* C. Rao

Filaments of vegetative cells cylindrical with plane septa; chloroplast 3 in each cell with 2 - 3 turns, 60 - 65 µm long, 52 - 54 µm broad; conjugation scalariform, tubes formed by both gametangia, fertile cell swollen, zygospore ellipsoid, 56 - 62 µm long 60 - 62 µm broad, mesospore wall smooth, brown.

Habitat: Free floating in ditch at Jhamtia along with other *Spirogyra* sp.; May-November (AS 72257).

7. *Spirogyra rivularis* (Hassall) Rabenh.

Vegetative cells 36 - 40 × 100 - 400 µm, end walls plane, chloroplast 2 - 3, making 2.5 - 3.5 turns; conjugation scalariform, zygospore ellipsoid, 35 - 42 × 60 - 100 µm smooth, brownish yellow.

Habitat: Free floating in a canal at Baniara (AS 71196).

2. SIROGONIUM Kütz.

Sirogonium reticulatum Randhawa

Filaments of vegetative cells 45 - 52 μm broad, 90 - 102 μm long chloroplast 4, straight. Conjugating cells geniculate and shortened; fertile cells inflated; zygospores ellipsoid, 75 μm broad, 90 - 10 μm long, yellowish brown.

Habitat: Free floating in a pond at Narit and Kamargore in association with *Spirogyra* sp.; November (AS 72250, 71135).

3. ZYGNEMA C.A. Agardh.

Zygnema cyanosporum Cleve

Vegetative cells 20 - 22 μm broad, 60 - 82 μm long, chloroplast two, rounded in each cell with the nucleus in the middle. Conjugation is scalariform with the zygospore in the conjugation canal, zygospore rounded, 26 - 30 μm in diameter, mesospore smooth, bluish.

Habitat: Free floating in a yellowish green mass in river Hooghly and in a pond at Bagnan in associated with *Spirogyra* sp.; December (AS 72294, AS722122).

3. Family: MOUGEOTIACEAE

Plants filamentous, unbranched with uninucleate cylindrical cells, septa plane, chloroplast flat. Axial plate like with several pyrenoids; reproduction by fragmentation sexuality by scalariform or lateral conjugation.

MOUGEOTIA C. Agardh

1. **Mougeotia recurva** (Hassall) De. Toni

Vegetative cells 12 - 18 μm broad, 5 - 18 μm long; chloroplast 4 - 8 pyrenoids zygospores brown, globose, conjugation scalariform.

Habitat: Free floating in pond at Shibpur along with *Spirogyra* sp. Stagnant water of earthen pot (AS 71134).

2. **Mougeotia viridis** (Kütz.) Wittr.

Vegetative cells 6 - 9 μm broad and 40 - 150 μm long, chromatophores occupying most of the cell with 2 - 6 pyrenoids. Zygotes adjoined by 4 cells, quadrate with concave sides, 20 - 30 μm on the sides.

Habitat: Free floating in pond at Bagnan along with certain diatoms (AS 72252).

4. Family: DESMIDIACEAE (Placoderm Desmids)

Cells uninucleate, variously shaped, incised or ornamented, solitary or forming unbranched filaments; cell walls with pores and transversely segmented (placoderm desmids), often with 2 distinct and equal semicells separated by a constricted isthmus; chromatophores variable in appearance and number, with 1 or 2 or many pyrenoids in each semi cell; reproduction by aplanospores, parthenospores; amaeoid gametes uniting outside the gametangia and within a gelatinous envelope.

1. CLOSTERIUM Nitzsch

1. **Closterium acerosum** (Schrank) Ehrenb.

Cells narrowly fusiform, slightly curved in the middle, 420 - 495 μm long, 40 - 42 μm broad, outer margin curved with 30 - 35° arc; inner margin straight, semicells gradually tapering to rounded-truncate; wall smooth; chloroplast ridged, 3 - 4; nucleus 1; pyrenoids 5 - 6, arranged in row.

Habitat: Planktonic in a ditch at Bauria, associated with *Spirogyra* sp.; August-December (AS 72291).

2. **Closterium ehrenbergii** Menegh.

Cells curved moderately, gradually attenuated towards pole, 490 - 510 μm long, 70 - 75 μm broad, apices rounded, 10 - 11 μm broad, outer margin 90 - 110° arc; inner margin concave but inflated in middle portion, smooth walled, chloroplast 5 - 6, band shaped; pyrenoids 8 - 12, scattered.

Habitat: Planktonic in a puddle at Jujarsaha, associated with *Hydrodictyon reticulatum*; throughout the year (AS 72510).

3. *Closterium lanceolatum* Kütz.

Cells sublanceolate, almost straight, outer margin slightly curved, inner margin straight, gradually narrowed towards the acutely rounded apices, cell wall smooth, chromatophores with 7 - 8 ridges, pyrenoids 6 - 7 in a median series, cells 32 - 70 µm broad, 230 - 540 µm long.

Habitat: Planktonic in a Sadir lake of Indian Botanic Garden at Shibpur (AS 71107).

4. *Closterium moniliferum* (Bory) Ehrenb.

Cells medium size, stout, 6 - 7 times longer than broad, moderately curved, outer margin 120 - 130 degrees of arc, inner margin inflated in the middle, cell uniformly narrowed to obtusely rounded apices, cell wall smooth, chloroplast with 4 - 5 ridges and 8 - 10 pyrenoids arranged in a median series.

Habitat: Planktonic in Prains's lake of Indian Botanic Garden, Shibpur (AS 71116).

5. *Closterium pervulum* Nägeli

Cells small, both margins equally curved, decidedly narrowed to bluntly pointed apices; wall smooth, colourless, 7 - 14 µm broad, 95 - 165 µm long.

Habitat: Free floating in King's Lake of Indian Botanic Garden, Shibpur (AS 71128).

2. COSMARIUM Corda ex Ralfs

1. *Cosmarium circulare* Reinsch

Semi cells more or less semicircular, sinus narrowly linear and close; cell wall distinctly punctate; chloroplast axile with ridges and two pyrenoids in each semi cells, 51 - 55 µm broad, 64 µm long; isthmus 20 µm, wall coarsely punctate.

Habitat: Planktonic in a King's Lake of Indian Botanic Garden, Shibpur (AS 71128)

2. *Cosmarium connatum* Breb.

Cells rather small, moderately constricted, isthmus broad, sinus very widely open, semi cells transversely subelliptic, with broad and flat apex, cell wall finely scrobiculate, each semi cells with a chloroplast with two large pyrenoids.

Habitat: Free floating in Lotus pond of Indian Botanic Garden, Shibpur (AS 71110).

3. *Cosmarium obsoletum* (Houtzsch) Reinsch

Cells medium sized, transversely elliptic, as long as broad, deeply constricted, sinus narrow with dilated apex, semi cells semicircular, basal angles submamillate, slightly thickened; apex somewhat flattened, cell wall punctate, chloroplast axile with two pyrenoids in each semi cell; cell 48 - 54 µm long, 45 - 52 µm broad; isthmus 22 - 25 µm.

Habitat: Planktonic in a pond at Shibpur (AS 71129).

3. EUASTRUM Ehrenb.

Euastrum ansatum Ralfs. var. *pyxidatum* Delp.

Cells 36 µm broad, 70 µm long, lateral isthmus 8 µm.

Habitat: Squeezings from submerged aquatic plant in King's Lake of Indian Botanic Garden, Shibpur (AS 71128).

4. MICRASTERIAS C. A. Agardh

Micrasterias radians W.B.Turner

Cells 105 µm long, 95 µm broad, isthmus 15 µm.

Habitat: Free floating in Lerum Lake of Indian Botanic Garden, Shibpur (AS 71119).

5. *PENIUM* Bréb.***Penium polymorphum* Perty.**6. *PLEUROTAENIUM* Nägeli***Pleurotaenium ehrenbergii* (Bréb) De Bary**

Cells variable in proportions, short and stout or slender; lateral margins sub parallel beyond the basal swelling or the semi cells; wall punctate, with a circle of granules at the poles; 20 - 30 µm long.

Habitat: Squeezings from *Salvinia*, Shibpur (AS 71110).

7. *STAUSTRUM* Meyen***Staurostrum recurvatum* W.B. Turner**

Cells 53 µm broad without spine, 95 µm with spines, as long as wide (including spines)

Habitat: Free floating in Dhobi pond of Indian Botanic Garden, Shibpur associated with other desmids (AS 71135).

8. Order: SIPHONALES

Unicellular, multinucleate, elongate, branched tubes; thallus sparingly branched, chloroplast discoid or lenticular, pyrenoid single or lacking, largely marine, some fresh water; reproduction by akinetes, aplanospores or multiciliate zoospores; sexuality isogamous, anisogamous or oogamous.

Family: VAUCHERIACEAE

Filamentous thallus, filaments long, variously branched, unseptate, attached to the substratum by means of branched haptera or rhizoids.

1. *DICHOTOMOSIPHON* Ernst***Dichotomosiphon tuberosus* (A. Braun) Ernst**

Filaments dichotomously branched, 40 - 100 µm broad and up to 9 cm long; antheridia and oogonia at the ends of ultimate branches; antheridium 35 - 50 µm broad and 130 - 160 µm long oogonium globose, 280 - 300 µm broad; oospore dark green, 250 - 280 µm broad; akinetes straight and elongate or clavate and curved.

Habitat: Free floating in a pond at Shibpur; March-December (AS 71138).

2. *VAUCHERIA* DC.***Vaucheria sessilis* (Vaucher) DC.**

Filaments monoecious, 450 - 490 µm long, 58 - 68 µm broad; chloroplasts ovoid towards exterior end; pyrenoid absent; antheridia between two oogonia, hooked to circinate, 62 - 94 µm long, 32 - 33 µm broad; oogonia two, ovate, sessile, slightly oblique, 82 - 88 µm long 62 - 64 µm broad; beak oblique; oospore dark green, completely filling the oogonium, 74 - 92 µm long, 52 - 64 µm broad, wall 3 layered.

Habitat: Attached on moist soil at Baniara associated with certain diatoms; throughout the year (AS 72218).

9. Order: CHARALES

Thallus monoecious or dioecious, macroscopic, erect, branched dimorphic, rhizoids multicellular, chloroplasts numerous, discoid; uninucleate; pyrenoid absent; nodes and internodes present, whorls of laterals present at each node; internodes either corticated or not; stipulodes present; sex organs complex, enclosed by sterile sheath; oogonia large, ovoid or sub-globose, containing single ovum, oospore colourless or pale yellow to black; antheridia small globose; antherozoids biflagellate, spiral shaped; reproduction by amylum stars, bulbils or secondary protonema, sexuality oogamous.

Family: CHARACEAE

1. *CHARA* L.**1. *Chara brachypus* Braun and Nords.**

Stem slightly encrusted, internodes as long as branchlets; spine cells frequent, up to 60 mm long, stipulodes

in double whorls, twice as numerous as the branchlets, branchlets 9 - 12 in whorls; antheridia and oogonia at the 3 lowest nodes, solitary, at the same nodes; antheridia 320 μ m broad, oogonium 560 μ m long, 350 μ m wide, spiral cells 13 - 15 convoluted; coronula 120 - 150 μ m high, 170 μ m wide at the base, oospore black, 560 μ m long, 500 μ m wide with 12 - 13 ridges.

Habitat: As benthic in stagnant water of earthen pot (AS 71134).

2. *Chara braunii* Gmelin

Plant erect, monoecious, encrusted with lime; 10 - 16 cm long; stem 430 - 500 μ m broad, internodes 2 - 3 cm long; stem and branchlets ecorticate; stipulodes well developed, acute, 275 - 285 μ m long, 75 - 112 μ m broad; branchlets 8 - 10 with corona like termination, bract cells 3 - 4, acute, 120 - 124 μ m long, 55 - 60 μ m broad; spine cell absent, gametangia conjoined at 1 - 3 lowest branchlet node; antheridia globose, 225 - 390 μ m broad, corona cells 118 - 124 μ m long, 128 - 175 μ m broad; spiral cells 8 - 12 turns, oospores black, 434 - 490 μ m long, 338 - 375 μ m broad.

Habitat: Growing on marshy soil at Udaynarayanpur; June-December (AS 71165).

3. *Chara zeylanica* Willd.

Plant erect, monoecious, 8 - 17 cm long, stem 710 - 762 μ m broad; internodes 2 - 3 cm long; stipulodes acute, double whorl, cortex triplostichous; spine cell elongate, acute; solitary; whorls 11 - 12, lowest branchlet segment ecorticate; bract cells 7 - 8; antheridium globose, 425 - 455 μ m broad, spiral cells 14 - 15; coronula cells 112 - 118 μ m long, 205 - 245 μ m broad; oospores 650 - 655 μ m long, 315 - 325 μ m broad.

Habitat: Growing on edge of marshy ditch at Rupnarayan near Bakshi; December-April (AS 71168).

2. NITELLA C. Agardh

Nitella flagellifera Grooves & Allen

Stem 500 μ m broad, branchlets 6, three times forked, gametangia at the 2nd and 3rd nodes; oogonia solitary, 470 μ m long and 400 μ m broad; coronula 75 μ m broad and 50 μ m high; oospore dull orange yellow, 320 μ m long, antheridium 250 μ m broad.

Habitat: As benthos in King's Lake (AS 71148) at Shibpur (AS 71148).

3. TOLYPELLA Leonhardi

Tolypella prolifera Leonhardi

Branchlets 8 - 20 in whorl, unequal, sterile branchlets 3 - 5 celled, simple; fertile branchlets in dense heads, 1 - 2 furcate, rays 2 - 3 at each node, dactyls 3 - 5 celled; gametangia at branchlet nodes and base of the whorls; antheridia 300 μ m broad; oospore dull brown, 330 - 400 μ m long.

Habitat: As benthos in Prain's Lake at Shibpur (AS 71106).

2. Class : CYANOPHYCEAE

Thallus unicellular or multicellular without true nucleus or chromatophores, cell wall thin or gelatinization very thick, protoplast differentiated into peripheral zone with photosynthetic pigment and a central colourless portion; heterocysts present or absent; reproduction by fragmentation, hormogones, hormocysts, endospores, akinetes, exospore, sexuality absent.

Members of Cyanophyceae commonly known as blue-green algae.

1. Order: CHAMAESIPHONALES

Thallus unicellular or colonial; epiphytes or lithophytes; hormogones absent; reproduction by endospores or exospores.

Family: DERMOCARPACEAE

Reproduction by endospores.

STICHOSIPHON Geitler

Stichosiphon sansibaricus (Hieron) Drouet & Daily

Plant microscopic, attached to the host, at first clavate but later on cylindrical, 6 - 7 μm broad, 20 - 80 μm long; sheath thin, cell content divide into a series of endospores, spores spherical, 4 - 5 μm in diam.

Habitat: Epiphytic on *Cladophora* sp. In a paddy field of Birshibpur (AS 71190).

2. Order: CHROOCOCCALES

Thallus unicellular or colonial, trichome absent, exospores not present, sporangia do not have endospores, reproduction by cell division or nannocytes.

1. Family: CHROOCOCCACEAE

Cells mostly spherical, ellipsoid, cylindrical, single or in colonies, membrane thick, mucilaginous, often lamellated, with formation of amorphous mucilaginous masses, colony shapeless, spherical, ellipsoidal, tabular, cells of many generation in a single parent sheath; multiplication by division, sometimes by nanocytes.

1. APHANOCAPSA Nägeli

1. Aphanocapsa banaresensis Bharadwaja

Thallus soft, spherical, hollow; cells spherical, 4 - 6 μm broad; sheath colourless, thick unstratified, hyaline.

Habitat: Attached on moist soil at Fulleswar, associated with certain desmids during December-January. (AS 71192)

2. Aphanocapsa pulchra (Kütz.) Rabenh.

Thallus bluish green, homogeneous, cells sphe intermingled with *Spirogyra*; December. (AS 71139).

2. APHANOTHECE Nägeli

1. Aphanothece bullosa (Menegh.) Rabenh.

Thallus greenish yellow, large, spherical, 5 - 9 cm broad; cells cylindrical, with or without individual sheath, without sheath 4 - 5 μm broad and 5 - 9 μm long.

Habitat: From paddy fields at Amta; January (AS 72237).

2. Aphanothece microscopica Nägeli

Thallus small, gelatinous, blue-green, cells cylindrical, 4 - 5 μm broad and 7 - 10 μm long.

Habitat: From paddy fields of Uluberia; December (AS 72243).

3. CHROOCOCCUS Nägeli

Chroococcus turgidus (Kütz.) Nägeli

Cells spherical or ellipsoidal, single or in groups of 2 - 4, yellowish, 12 - 30 μm broad, sheath colourless.

Habitat: Planktonic in a pond at Amta (AS 722128).

4. COELOSPHAERIUM Nägeli

Coelosphaerium dubium Grunow

Colony spherical, 85 - 100 μm broad; colonial mucilage firm, 4 - 6 μm thick, not lamellate, cells closely arranged, spherical, 3 - 6 μm broad; gas vacuoles present.

Habitat: Free floating in a Khal (canal) near Dasnagar associated with certain other *Cyanophycean* algae; April (AS 74401).

5. GLOEOCAPSA Kütz.

1. *Gloeocapsa atrata* (Turp.) Kütz.

Thallus mucilaginous, blackish, cells without sheath 3 - 4 μm broad, with sheath 9 - 14 μm broad, lamella indistinct.

Habitat: On the moist wall near Dhobi pond of Indian Botanical Garden, Shibpur (AS 71134, AS 72290).

2. *Gloeocapsa decorticans* (A. Braun) Richter ex Wille

Thallus blue-green, cells spherical, solitary or in groups of 2, cells without sheath 6 - 8 μm broad and 7 - 10 μm long, sheath colourless, lamelloid.

Habitat: On wet soil near a pond at Panitras (AS 72214).

3. *Gloeocapsa montana* Kütz.

Thallus yellowish to blue-green, mucilaginous, cells spherical, with sheath 4 - 10.5 μm broad, without sheath 3 - 4.5 μm broad, colonies 15 - 27 μm broad, sheath lameloid, cell content homogeneous.

Habitat: From paddy field soil, Alampur (AS 72206).

4. *Gloeocapsa rupestris* Kütz.

Thallus blackish brown, colonies 15 - 75 μm broad, cells without sheath 6 - 8 μm broad.

Habitat: Epiphytic on some aquatic plant in ponds at Kalyanpur (AS 71135, AS 71110).

6. MERISMOPEDIA Meyen

1. *Merismopedia convoluta* Bréb.

Thallus blue-green, flat, often convolute, cells oblong, 4 - 5 μm broad, 6 - 8 μm long, arranged in single plane, in transverse and longitudinal rows.

Habitat: Planktonic in pond at Joypur; August (AS 72263).

2. *Merismopedia tenuissima* Lemnrm.

Cells subspherical, closely packed, 32 - 80 cells in a colony, 1.5 - 2 μm broad.

Habitat: From Paddy field of Udaynarayanpur (AS 72281).

7. MICROCYSTIS Kütz.

1. *Microcystis aeruginosa* Kütz.

Colonies rounded with mucilage, cells spherical with gas-vacuoles, cells 4 - 6 μm broad.

Habitat: Free floating as water bloom in stagnant water of pond at Andul & Kalyanpur; November-December (AS 72248, 71110).

2. *Microcystis bengalensis* J.C.Banerjee

Colonies irregular, length and bread with varying in form and size, sheath thick, distinct, daughter colonies elongated, irregularly branched, cells spherical with gas vacuoles, 3 - 5.5 μm broad.

Habitat: Planktonic in pond at Amta; January (AS 72231).

3. *Microcystis flos-aquae* (Wittr) Kirchner

Colonies roughly spherical or somewhat elongate, not clathrate, colonial mucilage indistinct, cells 3 - 6 μm broad, spherical.

Habitat: Planktonic as water bloom in pond at Khalna; November (AS 72212).

8. SYNECHOCOCCUS Nägeli

Synechococcus aeruginosus Nägeli

Colony with thin mucilage envelope, cells 2 - 4, pale blue green, cylindrical, 6 - 8 μm long and 5 - 6 μm broad, cell contents homogenous.

Habitat: On moist soil near a pond associated with *Chara* sp. during September (AS 72269).

9. RHABDODERMA Schmidle & Lautb.

Rhabdoderma gorskii Wolosz.

Cells blue-green, long cylindrical, slightly bent, 1.5 - 2 μ m broad, 9 - 12 μ m long, not in distinct rows.

Habitat: Planktonic in a pond at Salkia (AS 72231).

2. Family: ENTOPHYSAIDACEAE

Thallus generally attached or free floating, cells arranged in erect radial rows; cells spherical or ellipsoidal, often in a homogeneous mucilage with or without individual sheaths; nanocytes present, spores also present.

JOHANNESBAPTISTIA J. de Toni

Johannesbaptistia pellucida (Dickie) Taylor & Drouet.

Thallus filamentous, cells discoid, apices rounded, arranged in single row, 4 - 6 μ m broad and 2.5 - 4 μ m long, mucilage hyaline, firm, homogeneous.

Habitat: From paddy field soil, Bagnan (AS 72270).

3. Order: NOSTOCALES

Thallus filamentous, non-heterotrichous, free floating, attached or epiphytic, filaments or trichome simple, single or many, within common mucilaginous envelope; branching false, sheath simple, thin or thick; lamella may or may not present, confluent or hyaline; heterocysts present or absent, cell content homogeneous; granules and gas vacuoles present or absent; reproduction by hormocytes, hormogones, akinetes or endospores.

1. Family: OSCILLATORIACEAE

Trichomes with a single row of similar and uniformly broad cells, generally unbranched; trichomes straight or regularly or irregularly spirally coiled; heterocysts and spores absent, hormogones present.

1. ARTHROSPIRA Stizenb

Arthrospira platensis (Nordt.) Gomont, Mongr. Oscillarees 247. pl. 7. f. 27. 1892; Desikachary, Cyanophyta 190, pl. 35. fig. 4 & 11. 1959. *Spirulina platensis* Nordst, 1925.

Trichomes 6 - 8 μ m broad, spirals 32 - 40 μ m broad and distance between two spirals 38 - 44 μ m, cross wall not constricted, end cell rounded, cells 2 - 3 μ m long.

Habitat: From paddy field at Bagnan (Howrah) (AS 71113).

2. LYNGBYA Agardh

1. **Lyngbya aerugineo-coerulea** (Kütz.) Gomont

Trichomes 4 - 6 μ m broad, not constricted at the cross walls, cells 1 - 1.5 as long as broad; 2.5 - 3 μ m long, end cell flattened.

Habitat: Planktonic in a pond at Andul (AS 71135).

2. **Lyngbya aestuarii** Liebmann ex Gomont

Filaments free floating, often forming dark, blue-green colour of floccose masses, filaments straight, unbranched, cylindric, sheath hyaline, usually extending beyond the trichomes, cells 2.5 - 5 μ m broad, 8 - 24 μ m long, finely granulose, trichomes olive-green, not constricted at cross walls, apices tapering, terminal cell with slightly thickened outer membrane, cell contents homogeneous.

Habitat: Planktonic in a Khal (Canal) at Andul (AS 71128).

3. **Lyngbya allorgei** Frémy

Filaments solitary, fasciculated, elongated, sheath thin, trichomes not constricted at cross walls, 3 - 4 μ m broad, cells quadrate, cross wall not granulated, end cell rounded, calyptra absent.

Habitat: On moist soil near a pond at Deulti (AS 71130).

4. *Lyngbya bergei* G.M.Sm.

Thallus yellowish green, Trichomes 17 - 19 μ m broad, 4.5 - 8 μ m long, not constricted; filaments straight, free floating, 23 - 26 μ m broad, sheath firm, colour less, unlamellated but lamellated in the older part of the filaments, 2.5 - 5 μ m thick, end cells rounded, not capitate.

Habitat: Planktonic from paddy fields of Uluberia (AS 72172).

5. *Lyngbya ceylanica* Wille

Thallus olive-green, filaments 10 - 14 μ m broad, straight, sheath thick, colourless, trichomes blue-green, not constricted at cross-wall, ends not attenuated, cross-wall not granulated, cells quadrate, end cell rounded without calyptra.

Habitat: On moist soil near a pond at Nalpur (AS 209).

6. *Lyngbya semiplena* (C.Agardh) J.Ag. ex Gomont

Thallus yellowish green, trichomes not constricted at cross wall, cross-walls granulated, filaments at the base decumbent, growing erect, sheath slimy, mucilaginous, cells 6 - 13 μ m broad, 2 - 3 μ m long, end cell with calyptra.

Habitat: In stagnant water in pond (AS 71135).

3. MICROCOLEUS Desmazieres

Microcoleus chthonoplastes Thuret ex Gomont

Filaments with many trichomes, sheath gelatinizing, 16 - 30 μ m broad; trichomes arranged in rope like bundles, cross walls constricted, trichomes 2.5 - 3.5 μ m broad, cells 4 - 7 μ m long, end cell conical, pointed.

Habitat: From paddy field soils at Sitalpur and Khalna (AS 72247, 72283).

4. OSCILLATORIA Vaucher

1. *Oscillatoria acuminata* Gomont

Thallus blue green, trichome straight, not constricted at cross-walls; cross walls granulated, cells 5 - 8 μ m long, 3 - 5 μ m broad, end tapering; end cell without calyptra.

Habitat: Free floating in pond at Buxarah (AS 71110).

2. *Oscillatoria acuta* Brühl & Biswas in J. Dept. Sci. Calcutta Univ. 5: 3, pl. 1, figs 6 a-b. 1922; Geitler, Kryptogamenflora 978. 1932; Desikachary, Cyanophyta 240, pl. 39, fig. 5, 8. 1959.

Trichomes solitary or aggregated, not constricted at cross-walls, 4 - 6 μ m broad, 70 - 100 μ m long, straight, apex not capitate, cells 3 - 4 μ m long contents granular.

Habitat: On road slimes at Najirgaunje (AS 138).

3. *Oscillatoria amphibia* C.Agardh ex Goment

Thallus deep blue-green, trichomes straight or coiled, cross-walls not constricted, apex not attenuated, not capitate, calyptra absent, cells 4 - 8 μ m long with granules at the septa.

Habitat: Planktonic in pond, Dhulagarh (AS 722103).

4. *Oscillatoria limosa* C.Agardh

Thallus dark blue-green, trichomes straight, cross-walls not constricted, cross wall granulated, 12 - 16 μ m broad; cells 4 - 5 μ m long, end cells flatly rounded with thickened outer membrane.

Habitat: Planktonic in river Hooghly near Salkia (AS 722137).

5. *Oscillatoria princeps* Vaucher ex Goment

Thallus blue-green, trichomes straight, cross-walls not constricted, 24 - 48 μ m broad, apices straight or slightly bent, slightly attenuated, cells 4-6 μ m long, end cell capitate.

Habitat: From Paddy field soil at Panchla (AS 722143).

6. *Oscillatoria subbrevis* Schmidle

Trichomes single, 5 - 6 μm broad, more or less straight, apex not attenuated, cells 1 - 2 μm long, cross-wall not granulated, end cell rounded, calyptra absent.

Habitat: In stagnant water of earthen pot (AS 71134) and Lerum Lake of Indian Botanic Garden, Shibpur (AS 71112).

7. *Oscillatoria tenuis* C. Agardh

Trichomes straight, slightly constricted at cross-walls, 5 - 8 μm broad, cells 2 - 4 μm long, end cell rounded, with thickened outer membrane.

Habitat: From paddy fields at Baksi (AS 722177).

5. PHORMIDIUM Kütz.

1. *Phormidium ambiguum* Gomont

Thallus leathery, thin, pale blue-green, trichomes slightly constricted at cross-walls, ends not attenuated, not capitate, sheath thin, cells shorter than broad, 1 - 2 μm long, 4 - 6 μm broad, end cell rounded.

Habitat: From paddy field soil at Mankur; attached on submerged aquatic plants in pond near Gazipur (AS 72287, AS 226).

2. *Phormidium calcicola* Gardner

Thallus thick, densely entangled, filaments 7 - 8 μm broad, sheath thick; trichomes 5 - 6 μm broad, cross walls not constricted, not attenuated, end cell truncated, outer membrane rounded, thick.

Habitat: Attached on *Spirogyra* sp. filament in Prain's Lake, at Shibpur (AS 71106).

3. *Phormidium fragile* (Menegh.) Gomont

Thallus mucilaginous, lamellated, brownish blue-green, sheath diffuent; trichomes constricted at cross-walls, septa not granulated, ends attenuated, cells quadrate, 1 - 2 μm broad, 1 - 3 μm long, end cell acute-conical, calyptra absent.

Habitat: Free floating in pond near Shibganj. (AS 72236).

4. *Phormidium retzii* (C. Agardh) Gomont

Thallus compact, light blue-green; filaments straight, cross walls not constricted, trichomes attenuated at ends, 4 - 10 μm broad; sheath thin or diffuent; cells, 4 - 7 μm long, septa not granulated, end cell truncated; calyptra absent.

Habitat: Attached on submerged aquatic macrophytes in King's Lake of Indian Botanic Garden, Shibpur (AS 71128).

5. *Phormidium tenue* (Menegh.) Gomont

Thallus membranous, light blue green, filaments densely entangled, sheath thin, diffuent, trichomes 1 - 2 μm broad; cross-walls constricted, cells 3 - 5 μm long, end cell conical, calyptra absent.

Habitat: Stagnant water in earthen pots of *Nymphaea* sp. culture (AS 71134).

6. SPIRULINA Turpin

1. *Spirulina laxissima* G.S. West

Trichome 0.7 - 0.8 μm broad, blue-green, spirals very loose, regular 4.5 - 5 μm broad, 17 - 22 μm distant from each other, end cell rounded, obtuse.

Habitat: Phytoplanktonic in a pond at Bakultala (AS 72271).

2. *Spirulina major* Kütz. ex Gomont

Trichome 1.5 - 2 μm broad; spirals 3 - 4.5 μm broad and 3 μm distant, regularly coiled, blue-green in colour.

Habitat: From pond in Shibpur (Howrah) (AS 72269).

3. *Spirulina meneghiniana* Zanard. ex Gomont

Trichomes 1.5 - 2 μm broad, irregularly coiled, spirally 3 - 5 μm broad, distance between spirals ranges from 3 - 5 μm .

Habitat: From paddy fields at Kalyanpur (Howrah) (AS 72292).

4. *Spirulina princeps* West & G.S. West

Trichome blue-green, regularly spirally coiled; 4.5 - 5.5 μm broad; spirals 10.5 - 12.5 μm broad and 10 - 12 μm distant.

Habitat: From pond, Betai (AS 72249).

7. TRICHODESMIUM Ehrenb.

Trichodesmium thiebautii Gomont

Trichome 7 - 13 μm broad, cells up to 2 times as long as broad, cross-walls not constricted.

Habitat: Planktonic from water logged rice field as free-swimming bundles of trichome, Jagatballavpur (AS 72212).

2. Family: NOSTOCACEAE

Trichomes free or in a common mucilage, cells in a single row, cells general, similar, end cells sometimes attenuated; sheath thick and gelatinous or thin and firm; heterocysts present or absent, spores present or absent; hormogones present.

1. ANABAENA Bory

1. *Anabaena ambigua* C.B.Rao

Trichomes straight with slightly tapering end, enclosed in mucilaginous envelope; sheath absent; cells barrel-shaped with deep constrictions at cross-wall, 3 - 5 μm long, 5 - 6 μm broad, cell contents deep blue-green, granular, heterocyst spherical, 7 - 8.5 μm broad, spore ellipsoidal 8.5 - 9 μm broad, ends rounded.

Habitat: Attached on submerged plants at Shibpur (AS 71106).

2. *Anabaena circinalis* Rabenh.

Thallus floating, frothy, trichome circinate, sheath absent, 8 - 14 μm broad, cells barrel-shaped or spherical, with gas vacuoles, heterocysts spherical, 8 - 9 μm broad, spores cylindrical, ends rounded 10 - 12 μm broad, 32 μm long, episporium smooth and colourless, away from the heterocyst.

Habitat: Planktonic in stagnant water in earthen pots of *Nymphaea* sp. culture at Shibpur (AS 71134).

3. *Anabaena spiroides* Klebahn

Thallus floccose, blue green; trichomes straight, moniliform, 5 - 6 μm broad, arranged parallel within indistinct mucilaginous sheath, cells spherical, end cell rounded, heterocysts subspherical, 6 - 7 μm broad, spores subspherical to oval, 8 - 12 μm broad and 12 - 16 μm long, one to few together, episporium smooth, yellowish brown, spores on one or both sides of the heterocysts.

Habitat: In stagnant water of pond, Shibpur (AS 71110) and river Hooghly near Shibpur (AS 115).

2. AULOSIRA Kirchner

1. *Aulosira fertilissima* S.L.Ghosh

Thallus dark blue green; trichomes straight, parallel, 4.5 - 7.5 μm broad; cells 7 - 10 μm long; quadrate to slightly cylindrical, sheath thick, heterocysts intercalary, elliptical, 8 - 8.5 μm broad, 9 - 14 μm long; spores alternating with dead cells, 8-11 μm broad, 13-18 μm long, in long chain.

Habitat: From paddy field at Bhatara (AS 178).

2. *Aulosira prolifera* Bharadwaja

Thallus blue-green forming a mucilaginous scum, filaments 6 - 8 μ m broad, sheath firm, unlamellated, trichomes with slightly constricted or unconstricted cross-wall, 4 - 5 μ m broad; cells 4 - 10 μ m long, end cells narrowly elongated with rounded apex; heterocysts intercalary, 5.5 - 6 μ m broad and 14 - 22 μ m long, ellipsoidal, hormogones rarely seen, spores not seen.

Habitat: From paddy fields at Bhatora (AS 72201).

3. CYLINDROSPERMUM Kütz.

Cylindrospermum doryphorum Bruhl & Biswas

Thallus floating, cloud-like, indefinite outline, trichomes green, slightly constricted, 2 - 4 m broad, apices attenuated, cells cylindrical, 4 - 8 μ m long, heterocyst at either end, 2 - 4 μ m broad, 4 - 8 μ m long; spores single, adjacent to the terminal heterocyst, coarsely granular, 4 - 6 μ m broad, 8 - 12 μ m long.

Habitat: Floating, in stagnant water of earthen pot (AS 71135) at Shibpur (AS 71135).

4. NOSTOC Vaucher

1. *Nostoc ellipsosporum* (Desm.) Rabenh. ex Born. & Flahault

Thallus gelatinous, dark blue-green, trichomes loosely arranged 3.5 - 4 μ m broad, cross-walls constricted; cells cylindrical 6 - 7.5 μ m long; heterocyst subspherical to oblong, 5.5 - 6.5 μ m broad, 6 - 7.5 μ m long; spores ellipsoidal to oblong, 6.5 - 8 μ m broad, 12 - 16 μ m long, episore smooth.

Habitat: From paddy fields of Kushberia (AS 722290).

2. *Nostoc linckia* (Roth) Born. ex Born. & Flahault

Thallus expanded, gelatinous, trichomes densely arranged, coiled, 4.5 - 5 μ m broad enveloped by mucilaginous yellowish brown sheath; cells spherical or barrel-shaped, sometimes moniliform, 4 - 5 μ m length; heterocyst spherical, 5 - 5.5 μ in diam., spores in chain, spherical, 6 - 8 μ diam.

Habitat: From paddy field soils, Bauria (AS 72219).

5. WOLLEA Born. & Flahault

Wollea bharadwajae RamaN.Singh

Thallus attached or free floating, soft, cylindrical; trichomes few cm long, arranged in parallel, 4 - 5 μ m broad, cross walls with distinct constrictions; cells 3.5 - 5.5 μ m long, apical cell slightly conical, barrel shaped heterocyst, 5.5 - 6.5 μ m broad, 5 - 7.5 μ m long; spores on either side of the heterocyst, spherical, 10 - 15 μ m diam, exospore thick, yellowish green to yellowish brown.

Habitat: From water logged paddy fields of Bator (AS 72291).

3. Family: RIVULARIACEAE

Trichomes with single row of cells, apices attenuated or tapering in a hair, unbranched or false branched, heterocysts present or absent, when present basal, in some intercalary heterocyst also seen; hormogones present; spores present or absent in some.

1. CALOTHRIX C. Agardh.

Calothrix castellii (Massal.) Born. & Flahault, Revision des Nostocacees heterocystees, 369. 1886; Geitler, Kryptogamenflora 611, f. 385. 1932; Desikachary, Cyanophyta 529, pl. 114, f. 7. 1959; Santra, Biology of Rice fields Blue-Green Algae 136, pl. 31, fig. 10. 1993.

Thallus blue-green, ends of filaments projected outside; filaments aggregated; sheath thin, hyaline; trichome broad at the base 8 - 9 μ m broad near heterocyst, ending into a long hair; cells 3 - 4 μ m long near heterocyst, heterocyst basal; 4 - 6 μ m long and 5 - 7 μ m broad; spore absent.

Habitat: From paddy fields at Domjur (AS 71173) attached on other algae.

2. GLOEOTRICHIA J.C. Agardh.

1. *Gloeotrichia natans* Rabenh. ex Born. & Flahault

Thallus spherical, 1 - 4 cm broad, blue green, trichomes 7 - 9 μm broad towards base and 4.5 - 5 μm broad towards hair, gradually attenuated into a long hair, cells 4 - 5 μm long towards base, 7.5 - 10 μm towards hair; heterocysts basal, spherical, 12 - 14 μm broad; spore cylindrical, straight or bent, without sheath 10 - 15 μm broad and 55 - 82 μm (- 110 μm) long, with sheath 35 - 40 μm broad, sheath saccate.

Habitat: Free floating from paddy fields at Jhikira (AS 71121).

2. *Gloeotrichia pisum* Thuret ex Born. & Flahault

Thallus globose, 3 - 4 μm broad, dark blue-green, filaments densely arranged, trichomes 6 - 7.5 μm broad towards base, terminating into a hair, cells 3 - 4 μm long towards base, 6 - 9 μm long towards apex, heterocysts spherical, 8 - 10 μm broad, spores cylindrical, 10 - 12 μm broad and 55 - 80 μm long, wall smooth.

Habitat: Free floating from paddy fields at Manuchak (AS 71252).

3. RIVULARIA (Roth) C. Agardh.

Rivularia aquatica de Wilde

Thallus spherical, filaments compactly arranged, sheath thin, unlamellated, colourless, attenuated at end; trichome with thin hair; 7 - 8.5 μm broad, cells 8.5 - 12 μm long, 6.5 - 7 μm broad, heterocysts oval, 8 - 12 μm long, 7 - 8.5 μm broad.

Habitat: Attached on *Nitella* sp. at Balapai (AS 71136).

4. Family: SCYTONEMATACEAE

Filaments thick with firm sheath; sheath lamellated; lamellation parallel, divergent of funnel-shaped; false branched, branches single or geminate; trichomes with single row of cells, heterocysts intercalary general and 2-pored; hormogones and pseudohormogonia present.

1. SCYTONEMA C. Agardh

1. *Scytonema cincinnatum* Thuret ex Born. & Flahault in Ann. Sci. Nat. Bot. 1: 380. 1875; Born. & Flahault, Rev. des Nostocacées heterocystées 89. 1887; Desikachary, Cyanophyta 453, pl. 93, fig. 1. 1959. *Lyngbya cincinnata* Kütz., 1843. *Scytonema crispum* (Ag.) Bornet, 1889. (Photo pl. 5; fig. 4)

Thallus caespitose; filaments 22 - 24 μm broad, false branches geminate; sheath firm, homogeneous; trichomes constricted at cross wall, 15.5 - 17.5 μm broad, cells 5.5 - 8 μm long, 5 - 7 μm broad, heterocysts elliptical.

Habitat: Attached on submerged brick in a pond at Joypur associated with other blue-green algae (AS 71199).

2. *Scytonema ocellatum* Lyngbye ex Born. & Flahault

(Photo pl. 5; fig. 5)

Thallus cushion-shaped, grayish-blue; filaments 12 - 14 μm broad, false branches not agglutinated; sheath lamellated, firm; trichomes olive green, 8 - 12 μm broad, cells quadrate, 5 - 12 μm broad, heterocyst yellowish, subquadrate.

Habitat: Free floating in a ditch at Khalna, associated with other members of blue green algae (AS 71120).

3. *Scytonema rivulare* Borzi ex Born. & Flahault

Thallus expanded, blackish brown; filaments sparsely false branched, variously bent, 30 μm broad; sheath firm, close, homogeneous, smooth, cells quadrate or shorter than broad, heterocysts as broad as vegetative cells, orange, spore globose, blackish.

Habitat: On moist soils (AS 71106).

4. *Scytonema simplex* Bharadwaja

Thallus dark blue-green, filaments 12 - 15 μm broad, loosely entangled false branching,

branches long; sheath firm, hyaline, 12 - 25 μm long, heterocysts single, as broad as trichome, 10 - 11 μm broad, 25 - 40 μm long.

Habitat: From paddy fields of Amragore (AS 127).

2. TOLYPOTHRIX Kütz.

Tolypothrix tenuis (Kütz.) Johs.

Thallus blue-green, filaments branched, 16 - 18 μm broad, sheath colour less to yellowish brown, sometime lamellated; trichomes 9 - 12 μm broad, unstricted, cells quadrate to slightly cylindrical, 6 - 13 μm long, heterocysts discoid, 9 - 13 μm broad, single.

Habitat: From moist soils at Narit (AS 102).

4. Order: STIGONEMATALES

Thallus filamentous; true branching; heterotrichous, trichomes uniseriate to multiseriate; pit connection between cells present; heterocysts terminal, lateral or intercalary; reproduction by hormogones or endospores.

Family: STIGONEMATACEAE

Thallus with free filament; filaments irregularly, laterally branched with one or more rows of cells; lateral branches short with longer cells, main filaments prostrate, heterocysts intercalary or lateral and sessile, hormogonia present.

STIGONEMA C. Agardh

Stigonema ocellatum (Dillw.) Thuret ex Born. & Flahault

Thallus wooly, brownish, filaments with prostrate and erect portions, 18 - 40 μm broad; branches irregular, filaments branched, as broad as the main filament, sheath thick, lamellated, colourless to yellowish brown; cells in a single or in two rows, 5 - 10 μm broad; heterocyst 6 - 8 μm broad, 9 - 12 μm long; hormogones formed at the end of the branches, without sheath 8 - 10 μm broad, 50 - 62 μm long.

Habitat: Attached on other algae in Prain's lake of Indian Botanic Garden, Shibpur (AS 71106), paddy field soils of Narit (AS 110).

3. Class : BACILLARIOPHYCEAE

Thallus unicellular, colonial or loose chains, cells constituted by epitheca and hypotheca; striae present or absent, cell wall impregnated with silica, polar nodules and vacuole present, nucleus one, chloroplasts disc or stellate shaped; pyrenoids one to many; reproduction by cell division, auxospore, microspores or statospores; sexuality isogamous, anisogamous or oogamous.

The members are commonly known as diatoms.

1. Order : CENTRALES

Valves circular, raphe present or absent, striae present or absent, chloroplasts discoid; Pyrenoid present; reproduction by anospores formed without conjugation.

1. Family : COSCINODISCACEAE

Cells discoid, longer than broad, valve ornamentation radial, girdles with or without ornamentation, chromatophores small, discoid, numerous.

1. COSCINODISCUS Ehrenb.

1. Coscinodiscus locustris Grun.

Valves evenly ornamented with intramarginal circle of spines; valves 6 - 12 μm broad; striae 12 - 14 in 10 μm .

Habitat: Free floating in a pond at Shibpur (AS 71128).

2. Coscinodiscus radiatus Kütz.

Valves 4 - 6 μm broad, striae 6 - 7 in 10 μm .

Habitat: Free floating in pond of Alampur (AS 71011).

2. CYCLOTELLA Kütz.

1. *Cyclotella comta* (Ehrenb.) Kütz.

Cells 10-15 μm broad, outer zone with prominent striae, 13 - 15 in 10 μm , dots between radial striae, inner zone with scattered centrally places punctae.

Habitat: Free floating in a pond at Shibpur (AS 71135).

2. *Cyclotella meneghiniana* Kütz.

Frustules discoid, valve radially symmetrical, 12 - 16 μm broad, central zone finely punctate, striae 8 - 10 in 10 μm .

Habitat: Free floating in canal at Bagnan with *Oscillatoria* sp. (AS 142).

3. MELOSIRA C.A. Agardh

1. *Melosira granulata* (Ehrenb.) Ralfs

Frustules robust, cylindrical, united to form chains, 5 - 7 μm broad, punctate, arranged parallel semicells 7 - 12 μm long, end cell with spines, areoles rows spiral, 10 - 14 in 10 μm .

Habitat: Free floating in puddle at Unsani along with other diatom mixture (AS 72219).

2. *Melosira islandica* O. Müll.

Valves 97 - 120 μm long, 4 - 6 μm broad, striae 4 - 5 in 10 μm .

Habitat: Free floating in King's Lake of Indian Botanic Garden, Shibpur (AS 71128).

2. Order: PENNALES

Valves iso-bilateral, valve view boat or acicular; chloroplasts laminate; pirenoid present; reproduction by auxospores.

1. Family: FRAGILARIACEAE

Valves isobilateral, either rectangular or narrowly linear, cells closely appressed together in ribbon, stellate colonies; chloroplast laminate, pyrenoid present, reproduction by auxospores.

1. FRAGILARIA Lyngbye

1. *Fragilaria brevistriata* Grunow

Frustules rectangular, attached together to form chain; valves linear, elliptic, tapering towards ends 14 - 16 μm long, 4 - 6 μm broad; pseudoraphe elliptic, lanceolate, striae marginal. 12 - 15 in 10 μm .

Habitat: Free floating in a puddle at Abada associated with members of other algae; September (AS 71201).

2. *Fragilaria capucina* Desmazieres

Frustules rectangular, attached together to form chain; valves linear, narrow towards ends, 18 - 120 μm long, 3 - 4 μm broad, ends slightly constricted, pseudoraphe linear lanceolate; central area not formed, striae 16 - 18 in 10 μm .

Habitat: Free floating in river Damodar attached on members of Chlorophyceae (AS 131).

3. *Fragilaria intermedia* Grunow

Frustules attached together to form chain; valves rectangular, linear, 75 - 77 μm long, 3 - 5 μm broad, ends slightly capitate; gradually tapering; axial area narrow, linear, striae 12 - 14 in 10 μm .

Habitat: Free floating in stagnant water of a pond at Dhulagori (AS 177).

2. SYNEDRA Ehrenb.

1. *Synedra acus* Kütz.

Valves linear to lanceolate, poles becoming needle like, transverse striations 14 - 15 in μm , pseudoraphe linear, narrow with central area which is rectangular, valves 75-85 μm long, 3-5 μm broad.

Habitat: Free floating in pond at Shibpur (AS 71135).

2. *Synedra pulchella* (Ralfs) Kütz.

Valves solitary, lanceolate with rounded ends with central nodule, 45 - 52 μm long, 3 - 4 μm broad, striae 12 - 14 in 10 μm .

Habitat: Scrapping of submerged brick in a pond at Mankur (AS 72120).

3. *Synedra rumpens* Kütz.

Cells solitary, narrowly linear, 42 - 44 μm long, 3 - 4 μm broad, striae.

Habitat: Free floating in King's Lake of Indian Botanic Garden, Shibpur (AS 71106).

4. *Synedra ulna* (Nitzsch) Ehrenb.

Valves, 112 - 130 μm long, 7 - 8 μm broad, linear to linear lanceolate, tapering at poles, ends rounded, axial area linear, striae 9 - 11 in 10 μm .

Habitat: Planktonic in pond at Buxarh (AS 71131).

2. Family : EUNOTIACEAE

Cells solitary or in filaments or cluster, free-floating or sessile. Valves curved with dissimilar sides and eccentric pseudoraphe.

EUNOTIA Ehrenb.

1. *Eunotia major* (W.Sm.) Rabenh.

Valves 62 - 68 μm long, 7 - 7.5 μm broad, slightly arcuate, dorsal margin slightly tapering from center, ventral margin slightly concave; ends inflated dorsally and rounded, polar nodules very small, raphe invisible, striae 13 - 14 in 10 μm , not regular.

Habitat: Free floating in a pond at Shibpur (AS 71135).

2. *Eunotia pectinalis* (Dillw.) Rabenh.

Valves elongated, slightly curved in the middle, dorsal margin convex with two undulations, ventral side somewhat concave, 120 - 125 μm long, 6-8 μm broad, terminal nodule and raphe small, distinct, striae thin, 12 - 14 in 10 μm .

Habitat: Free floating in a pond at Kalyanpur (AS 71139).

3. *Eunotia pectinalis* (Dillw) Rabenh. var. *minor* (Kütz.) Rabenh.

Valves linear, slightly curved with ventral margin slightly concave, dorsal margin convex with two shallow undulations, ends narrow, rounded, terminal nodule and raphe small distinct, 40 - 42 μm long, 3 - 5 μm broad; striae lineate, irregularly arranged, 14 - 17 in 10 μm .

Habitat: Free floating in a pond at Alampur (AS 366).

4. *Eunotia tschirchiana* O.Müll.

Valves linear, arcuate, dorsal side strongly convex with deep constrictions towards ends; ventral side sharply bent towards the extremity, ends obliquely truncate; terminal nodules and raphe small, distinct at the ends on ventral side, 38 - 40 μm long 5 - 8 μm broad, striae lineate, irregular and distinctly arranged in the middle but dense and radiate towards apices, 13 in 10 μm .

Habitat: Free floating in a ponds at Ushumpur (AS 71128).

3. Family: ACHNANTHACEAE

Valves linear-elliptic, ends rounded, central area slightly wider, striae radial.

1. ACHNANTHES Bory

Achnanthes exigua Grunow

Valves small, linear, elliptical with parallel margins and deeply constricted, slightly produced rostrate

ends, raphe median, linear, gradually widening towards center, central area stauros, reaching the side; valve length 12 - 14 μm , breadth 4 - 5 μm , striae 28-30 in 10 μm .

Habitat: Free floating in a pond at Bauria (AS 7223).

2. COCCONEIS Ehrenb.

Cocconeis placentula Ehrenb.

Valves small elliptical, raphe not seen, pseudoraphe distinct, narrow and linear, striae radially arranged, cell 18 - 20 μm long, 11 - 12 μm broad, striae 22 - 25 in 10 μm .

Habitat: Epiphytic on submerged aquatic plant in Rupnarayan river near Baksara (AS 72289).

4. Family: NAVICULACEAE

Well developed raphe in both valves with distinct central and polar nodules valves shape varies from elliptical linear or narrowly linear-lanceolate to naviculoid, usually symmetrical in both axis except in sigmoid forms; raphe thin or thick, in girdle view, generally rectangular and symmetrical in both axis, intercalary bands, pseudosepta may or may not present.

1. NAVICULA Bory

1. **Navicula bacillum** Ehrenb.

Valves linear with broadly rounded ends, 30 - 38 μm long, 7 - 9 μm broad, linear with straight or slightly convex sides, raphe thin and straight, axial area wide, central area large, striae 21 - 22 in 10 μm .

Habitat: found in scrapings of submerged bricks in a pond at Abada (AS 129).

2. **Navicula cuspidata** Kütz.

Valves linear, lanceolate, tapering to rounded ends, 74 - 78 μm long, 14 - 17 μm broad, axial area narrow linear, central area rounded, striae perpendicular in middle, 14 - 16 in 10 μm .

Habitat: Free floating in a pond a Joypur associated with Chlorophycean members (AS 71117).

3. **Navicula pusilla** W.Sm.

Valves 32 - 34 μm long and 8 - 12 μm broad, striae 16 - 17 in 10 μm .

Habitat: Free floating in King's lake of Shibpur (AS 71106).

4. **Navicula radiosa** Kütz.

Valves linear, lanceolate with gradually tapering rounded ends 13 - 18 μm long, 4 - 6 μm broad, striae radial in middle, 13 - 14 in 10 μm .

Habitat: Free floating in pond at Manuchak (AS 175).

5. **Navicula viridula** Kütz.

Valves linear-lanceolate with broadly rounded ends, central pores unilaterally bent, terminal fissures distinct, central area wide, striae 7 - 8 in 10 μm , radial in the middle, convergent at the poles.

Habitat: Found in scrapings of submerged bricks in Dhobi pond of Indian Botanic Garden, Shibpur (AS 129).

6. **Navicula viridula** var. **capitata** Meyer

Valves linear-lanceolate with capitate ends, valves 52 - 57 μm long, 12 - 15 μm broad, striae 8 - 9 in 10 μm .

Habitat: Free floating in Prain's Lake of Indian Botanic Garden, Shibpur (AS 71109).

7. **Navicula viridula** var. **rostellata** (Cleve) Meister

Valves broadly linear, somewhat lanceolate with suddenly narrowed subrostrate ends, 49 - 52 μm long, 11 - 13 μm broad, striae 8 - 10 in 10 μm , strongly radial in the middle and convergent at the poles.

Habitat: Free floating in King's Lake of Indian Botanic Garden, Shibpur (AS 71128).

2. CALONEIS Cleve

Caloneis bacillum (Grunow) Cleve

Valves 31 - 34 μm long, 5 - 6 μm broad, linear with broadly rounded ends, striae about 20 - 22 in 10 μm .

Habitat: Free floating in Dhobi pond at Shibpur (AS 71135).

3. PINNULARIA Ehrenb.

1. Pinnularia borealis Ehrenb.

Valves 10 - 34 μm long, 6 - 7 μm broad, striae 4 - 5 in 10 μm .

Habitat: Free floating in Prain's Lake of Indian Botanic Garden, Shibpur (AS 71109).

2. Pinnularia viridis (Nitzsch) Ehrenb.

Valves 94 - 97 μm long, 17 - 21 μm broad, striae slightly radial in middle and convergent at ends 10 - 12 in 10 μm .

Habitat: Floating in a pond at Makalpur (AS 71191).

4. PLEUROSIGMA Smith

1. Pleurosigma angulatum (Quekett) W.Sm.

Valves flattened, gently sigmoid or almost straight, outline lanceolate, valves 150 μm - 165 μm long, 35 - 48 μm broad, transverse striations 18 - 20 in 10 μm .

Habitat: Planktonic from Kushberia (AS 124).

2. Pleurosigma elongatum W.Sm.

Valves 172 - 180 μm long and 18 - 20 μm broad, slightly sigmoid, elongated, narrowly lanceolate with acutely rounded ends; raphe thin sigmoid, axial area sigmoid, narrowly linear, central area small, elliptical in long axis. Striae 18 - 20 in 10 μm , the diagonal striae about the same in number as transverse, intersecting at an angle of 63 - 65°.

Habitat: Ditches form through effluents from sewage farm at Ramrajatala (AS 295).

3. Pleurosigma salinarum Grunow

Valves solitary, free floating, slightly sigmoid, linear-lanceolate, gradually attenuated towards obtusely rounded ends. Valves 135 - 145 μm long 18 - 21 μm broad, transverse striae 20 - 21 in 10 μm , oblique striae 23 - 24 in 10 μm .

Habitat: Free floating in a pond at Shibpur (AS 71135).

5. CYMBELLA C.A. Agardh

1. Cymbella aspera (Ehrenb.) Cleve

Valves 130 - 135 μm long, 28 - 30 μm broad, striae 7 - 10 in 10 μm .

Habitat: Free floating in Lerum Lake of Indian Botanic Garden at Shibpur (AS 71112).

2. Cymbella cesatii (Rabenh.) Grunow

Valves 33 - 35 μm long, 6 - 7 μm broad, striae 20 - 22 in 10 μm .

Habitat: Free floating in a pond of Mourigram (AS 71112).

3. Cymbella cuspidata Kütz.

Valves 34 - 36 μm long, 11 - 13 μm broad, striae 11 - 12 in 10 μm .

Habitat: Free floating in Prain's Lake of Indian Botanic Garden, Shibpur (AS 71106).

4. Cymbella cymbiformis (C. Agardh) van Heurck.

Valves 80 - 82 μm long, 14 - 15 μm broad, striae 8 - 19 in 10 μm .

Habitat: Free floating in pond at Andul (AS 71119).

5. *Cymbella lanceolata* (Ehrenb.) van Heurck

Valves 158 - 160 μm long, 31 - 33 μm broad, striae 9 - 10 in 10 μm .

Habitat: Free floating in a small puddle at Nalpur, associated with *Oscillatoria* sp.

6. *Cymbella tumida* (Bréb) van Heurck.

Valves 82 - 92 μm long and 18 - 20 μm broad, ends bluntly rostrate, truncate, striae 7 - 10 in 10 μm lineate, lineations about 14 - 16 in 10 μm .

Habitat: Attached on Submerged aquatics in the pond of Nuntia (AS 257).

7. *Cymbella turgida* (Greg.) Cleve

Valves 24 - 27 μm long, 8 - 12 μm broad; striae 8 - 9 in 10 μm .

Habitat: Free floating in a pond at Birshibpur associated with certain desmids (AS 139).

6. STAURONEIS Ehrenb.***Stauroneis anceps* Ehrenb. f. *gracilis* Rabenh.**

Length of the valve 18 - 21 μm , breadth 3 - 4 μm , striae 32 - 34 in 10 μm .

Habitat: Free floating in a pond at Dhulagarh (AS 71107).

7. GOMPHONEMA Agardh**1. *Gomphonema acuminatum* Ehrenb. var. *turris* (Ehrenb.) Cleve**

Valves linear, 36 - 38 μm long, 5 - 6 μm broad, striae 16 - 18 in 10 μm .

Habitat: Floating in a pond at Udaynarayanpur (AS 71119).

2. *Gomphonema lanceolatum* Ehrenb.

Valves lanceolate with rounded apex and base, 46 - 52 μm long, 9 - 11 μm broad; raphe thick and straight, axial area narrow, linear, central area unilateral with isolated stigma on opposite sides; striae radial, lineate, 11 - 12 in 10 μm .

Habitat: Epiphytic on *Pithophora* sp. in a pond at Santragacchi (AS 268).

3. *Gomphonema montanum* var. *acuminatum* Meyer.

Valves 70 - 76 μm long, 12 - 13 μm broad, striae 8 - 9 in 10 μm .

Habitat: Free floating in a pond at Fulleswar (AS 393).

4. *Gomphonema olivaceum* (Lyng.) Kütz.

Valves 20 - 22 μm long 6 - 7 μm broad, axial area narrow, central area without punctate, striae radial, 10 - 14 in 10 μm .

Habitat: Free floating in a ditch at Fulleswar associated with blue green algae (AS 392).

5. *Gomphonema parvulum* (Kütz.) Grunow

Valves lanceolate, clavate with constricted rounded ends, 12 - 18 μm long, 4 - 5 μm broad; raphe thin and straight, axial area narrow, central area unilateral with stigma on opposite side, striae radial, 11 - 13 in 10 μm .

Habitat: Free floating in a ditch at Andul associated with *Rhizoclonium* sp. (AS 236).

6. *Gomphonema subclavatum* (Grunow) Grunow

Valves ovate clavate with constricted truncate apex, 23 - 25 μm long, 5 - 6 μm broad, striae radial, punctate, 14 - 18 in 10 μm .

Habitat: Free floating in pond at Kalyanpur (AS 711021).

8. RHOPALODIA Miller

Rhopalodia gibba (Ehrenb.) O.Müller

Valves 32 - 36 μm long, 12 - 16 μm broad, striae 18 - 20 in 10 μm .

Habitat: Free floating in pond at Unsani (AS 113).

5. Family: NITZSCHACEAE

Cells solitary, free floating, epiphytic and within gelatinous tubes. Valves straight or sigmoid, transversely symmetric and longitudinally asymmetric; raphe on one lateral margin in each valve, concealed within an excentric keel; chromatophores two, laminate, separated at the gridle.

NITZSCHIA Hassall

1. **Nitzschia amphibia** Grunow

Valves linear with convex margin, 22 - 28 μm long, 3 - 5 μm broad, end round, striae 19 - 20 in 10 μm .

Habitat: Free float in a pond at Shibpur (AS 71128).

2. **Nitzschia angustata** Grunow

Valves 50 - 67 μm long 5 - 6 μm broad, 15 - 16 striae in 10 μm .

Habitat: Free floating in Sadir Lake of Indian Botanic Garden, at Shibpur (AS 71107).

3. **Nitzschia apiculata** (Greg.) Grunow

Valves linear, 37 - 38 μm long, 5 - 6 μm broad, striae 14 - 15 in 10 μm .

Habitat: Free floating in King's Lake at Shibpur (AS 71128).

4. **Nitzschia linearis** W.Sm.

Valves 38 - 42 μm long, 8 - 11 μm broad; striae 16 - 17 in 10 μm .

Habitat: Free floating in pond at Fulleswar (AS 718).

5. **Nitzschia palea** (Kütz) W.Sm.

Valves linear, sub lanceolate with convex margin, 22 - 24 μm long 3 - 4 μm broad, ends capitate, striae 30 - 35 in 10 μm .

Habitat: Free floating in a slowly flowing water in a drain at Kushberia (AS 923).

6. Family: SURIRELLACEAE

Cells solitary, free floating. Valves generally symmetrical in both axes, flat with undulate or curved faces, transverse costae prominent at the margins of the valves, raphe concealed in keel at the margins. Gridle view rectangular; chromatophore single, laminate.

SURIRELLA Turpin

Surirella ovata Kütz.

Valves ovate to ovate lanceolate with narrow base, 32 - 54 μm long and 22 - 30 μm broad, heteropolar present; costae 40 - 55 in 100 μm , striae 16 - 20 in 10 μm .

Habitat: Free floating in a drain associated with diatom mixture (AS 322).

7. Family: DIATOMACEAE

Cells solitary or forming zigzag or flat chains; free floating clls bilaterally symmetrical; in gridle view both axes symmetric or only longitudinally symmetrical; chromatophores numerous, small and discoid, pseudophores distinct or not; transverse septa present.

DIATOMA De Condolle

Diatoma vulgare Bory

Cells united into zigzag colonies with rounded ends; valves elliptic-lanceolate with narrow pseudoraphe, 24 - 25 μm long, 7 - 8 μm broad; costae 6 - 8 in 10 μm ; striations 15 - 16 in 10 μm .

Habitat: Free floating in ponds at Shibpur (AS 71109).

4. Class: EUGLENOPHYCEAE

Cells unicellular; flagella one or two arise from gullet, cell wall absent, pellicle present; chloroplasts of different shape, nucleus single, pyrenoids present; reserve food paramylon of different shape; reproduction by longitudinal cell division.

Order: EUGLENALES

Flagella two at anterior end of cells; only one emerges from reservoir or canal, paramylon of diverse shape; reproduction by longitudinal cell division.

Family: EUGLENACEAE

Cells in various shapes, motile with the help of flagella or amoeboid movement; flagella usually one or lacking; periplast smooth or ornamented, soft or rigid; highly metabolic or slightly or not at all metabolic; protoplast usually naked (or in some genera within a lorica); usually with chromatophores and an eyespot.

1. EUGLENA Ehrenb.

1. Euglena acus Ehrenb.

Cells rigid, elongated, posterior end pointed; anterior end truncate; chloroplast numerous; disc-shaped; paramylon 7 - 10, rod shaped; cells 142 - 148 μm long and 10 - 12 μm broad.

Habitat: Free floating in pond at Kushberia (AS 72280).

2. Euglena breviflagellum Prescott and Gojdics.

Cells slightly metabolic, elongate, fusiform, curved, periplast striated, chloroplast numerous, ovoid, pyrenoid absent, cells 120 - 124 μm long, 10 - 12 μm broad.

Habitat: Free floating; in pond at Santragachhi (AS 72287).

3. Euglena elastica Prescott

Cells highly metabolic [Cells swollen in the middle], periplast smooth, chloroplast ovoid, pyrenoids absent; cells 82 - 93 μm long, 9 - 10 μm broad.

Habitat: Free floating in a canal in Santragachhi (AS 72286).

4. Euglena gracilis G.A.Klebs

Cells metabolic, ovoid, chloroplast many, disc shaped, pyrenoid present, cells 39 - 42 μm long, 8 - 12 μm broad.

Habitat: Free floating in a pond at Santragachhi (AS 72287).

5. Euglena oxyuris Schmarda

Cells slightly metabolic, elongate, cylindrical, periplast longitudinally striated; chloroplast numerous, disc-shaped, paramylon many; cells 78 - 83 μm long and 16 - 18 μm broad.

Habitat: Free floating in a canal in Santragachhi (AS 72289).

6. Euglena polymorpha Dangeard

Cells highly metabolic, ovoid, pyriform; periplast with spiral striations, chloroplast many; disc-shaped; pyrenoid 1; cells 82 - 85 μm long and 2 - 22 μm broad.

Habitat: Free floating in a pond in Kushberia (AS 72280).

7. *Euglena tripteris* (Duj.) Klebs

Cells slightly metabolic elongate, cylindric, twisted, periplast striated; Chloroplast numerous, disk-shaped; paramylon 2, rod-shaped; cells 45 - 48 μ m long, 7 - 9 μ m broad.

Habitat: Free floating in Dhobi pond of Indian Botanic Garden, Shibpur (AS 71135).

2. *Phacus* Dujardin

1. *Phacus caudatus* Hübner

Cells ovoid, pyriform, spirally twisted caudus, straight, Periplast longitudinally striated, paramylon 1, disc-shaped, cells 35 - 42 μ m long, 18 - 22 μ m broad.

Habitat: Free floating in a pond at Nalpur; July-September (AS 72211).

2. *Phacus longicauda* (Ehrenb.) Dujardin

Vegetative cells flat ovoid to pyriform, 85 - 87 μ m long 45 - 62 μ m broad; caudus straight, sharp pointed 9 - 13 μ m long, anterior portion rounded; periplast longitudinally striated, flagella not observed, chloroplasts 2, ovoid in shape, paramylon body 1 circular plate, 7 - 8 μ m broad.

Habitat: Planktonic in a canal at Bauria in association with members of desmids; August-September (AS 72230).

3. *Trachelomonas* Ehrenb.

Trachelomonas volvocina Ehrenb.

Lorica globose, flagellum smooth, aperture without collar, lorica 17 - 18 μ m broad.

Habitat: Free floating in Lotus pond at Indian Botanical Garden Shibpur and in a ditch at Uluberia (AS 71110, AS 72205).

5. Class: XANTHOPHYCEAE

Thallus unicellular, colonial, filamentous or coenocytic vesicles; yellowish green, two flagella, heterokonlae, chloroplast parietal or disc-shaped, uninucleate, pyrenoid absent, 'H'-shaped pieces present in filamentous forms; reproduction by fragmentation, autospores, aplanospores, zoospores or resting spores; sexuality isogamous or anisogamous.

Order: HETEROTRICHAELES

Thallus filamentous, unbranched, cells cylindrical or barrel-shaped, chloroplast parietal, discoid; pyrenoid absent; cell-wall overlapped; nucleus one to many; reproduction by fragmentation, zoospores or aplanospores; sexuality isogamous.

Family: TRIBONEMACEAE

Filaments unbranched; thickness of cell wall and articulation of 'H'-pieces.

TRIBONEMA Derbes & Solier

Tribonema bombycinum (C.Agardh) Derbes & Solier

Filaments unbranched, grayish-yellow, cells cylindrical or slightly constricted at cross-wall, 42 - 46 μ m long, 10 - 12 μ m broad, wall overlapping at mid region; 'H'-pieces clearly visible, chloroplasts 4 - 6, disc-shaped, pyrenoid absent.

Habitat: Free floating in a pond at Shibpur (AS 71135).

6. Class: DINOPHYCEAE

Members are mostly marine although a few genera occur in freshwater. Cells solitary, unicellular, dorsiventrally flattened, flagella two of equal length, pellicle thick, chloroplast thick, parietal or rod-shaped; pyrenoids present; nucleus large, moniliform; epitheca and hypotheca present, thecal plates or horny projection present; reproduction by longitudinal cell division, aplanospores, autospores, or zoospores, sexuality isogamous.

Order: DINOFLAGEALES

Cells solitary, subcircular, ovoid or pyramidal biflagellate, composed of definite number of plants, arranged in specific manner, reproduction by longitudinal cell division, zoospores; sexuality isogamous.

Family: CERATIACEAE

Cells strongly asymmetric, somewhat flattened dorsiventrally; epitheca prolonged into a single long apical horn with or without a pore; hypotheca bearing 1 - 3 stout horns which are shorter than the apical horns.

CERATIUM Dujardin

Ceratium hirundiniella (O.F.Mull) Dujard.

Cells fusiform with horns, flattened, epitheca and hypotheca present, cells 105 - 120 μ m long, 20 - 26 μ m broad.

Habitat: Collected as plankton in Prain's Lake of Indian Botanic Garden of Shibpur (AS 71106).

7. Class: RHODOPHYCEAE

Thallus unicellular, filamentous or Thalloid; attached; pit connection present or absent, food reserve floridean-starch which is iodine negative; cell wall two layered, flagella absent, chloroplast axial; pyrenoid present, reproduction by monospores, carpospores or tetraspores, sexuality advanced oogamous.

Order: BANGIALES

Thallus unicellular, colonial, filamentous or parenchymatous; uninucleate, chromatophores single, axile, stellate; pyrenoids present; pit connection absent; reproduction by fission or monospores.

Family: ERYTHROTRICHIACEAE

Plants bushy, grayish to greenish, filaments slender, alternately tapering to uniseriate tips.

COMPSOPOGON Montagne

Compsopogon coeruleus (Bulbis) Mont.

Thallus bluish to violet green, erect, coarse; 5 - 7 cm long; branches making 30 - 60° angle with subtending axis. Main axis multiseriate, 170 - 180 μ m broad, constituted by central cells, surrounded by corticating cells. Central cells 25 - 42 μ m long, 44 - 62 μ m broad; corticating cells unilayered excepting in main axis, 14 - 24 μ m long and 10 - 22 μ m broad; uniseriate branches 42 - 48 μ m broad, cells of branches 6 - 22 μ m long, 18 - 44 μ m broad. Lateral wall of uniseriate filaments thick and double layered, Inner layer rigid and outer layer gelatinized. Apices of the terminal cells of uniseriate branches rounded. Macrosporangia and microsporangia present.

Habitat: This alga is very commonly found in submerged pucca ghats of ponds or attached on submerged logs at Dhulagori (AS 722101, AS 72230).

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हावड़ा जिला, पश्चिम बंगाल के शैवाल

उ. साहू

सार संक्षेप

पश्चिम बंगाल के हावड़ा जिला के विभिन्न आवासों में शैवालों का अध्ययन 2002 से 05 के मध्य किया गया जिसमें 238 शैवाल प्राप्त हुए जो कि 7 वर्गों से सम्बद्ध हैं-क्लोरोफाइसी (103), सायनोफाइसी (63), बेसीलेरियोफाइसी (59), युग्लोनोफाइसी (10), जेन्थेफाइसी (1), डायनोफाइसी (1) एवं रोडोफाइसी (1)। वर्गिकी एवं अभिनिर्धारण के पश्चात् विभिन्न वर्गों के शैवालों का विस्तृत विवरण का वर्णन प्रस्तुत लेख में दिया गया है।