MATERIALS AND METHODS

Synoptical Description of Sampling Station

Banda District is located in the south of Uttar Pradesh, is the headquarter of Chitrakoot Dham Commissionary. Banda City is located on the bank of river Ken. Banda city lies between the latitudes of 24° 53' – 25° 55' N and the longitudes of 78° 07' – 80° 34' E. Ken flows from south to north along the Banda city (Map-1).

The river Ken is a hilly river. Its origin from the Ahrgawan village on the north-west slopes of the Kaimur hills of Vindhyan ranges in the Jabalpur district of Madhya Pradesh at an elevation of about 550 meters above mean sea level. The Ken is an interstate river between Uttar Pradesh and Madhya Pradesh. The total length of the river from its origin to confluence with the river Yamuna is 427 K.m., out of which 292 K.m. lies in Madhya Pradesh 84 K.m. in Uttar Pradesh and 51 K.m. forms the common boundary between Uttar Pradesh and Madhya pradesh. The river Ken confluences river Yamuna near Chilla town of Banda district in Uttar Pradesh at an elevation of about 95 K.m. The river is the last tributary of Yamuna before the Yamuna to joins the Ganga. The river basin lies between the latitudes of 23°12' N and 25°54' N and the longitudes of 78°30' E and 80°36' E. The total catchments area of the basin is 28058 sq. K.m., out of which 24472 sq. K.m. lies in Madhya Pradesh and the remaining 3586 sq. K.m. in Uttar Pradesh.

The basin course the areas of Jabalpur, Sagar, Damooh Panna, Satna, Chhatarpur and Raisen district of Madhya Pradesh, and Hamirpur and Banda district of Uttar Pradesh. It is bouded by Vindhyan range in
MAP - I - Map of Banda City Showing Ken River and Different Sampling Locations
the south, Betwa basin on west, free catchments of Yamuna below Ken on east, the river Yamuna on north. The important tributaries of Ken are Alone, Bearma, Sonar, Miashasan, Shyamari, Banne, Kutri, Urmil, Kail and Chandrawal. Urmil and Kail rivers have part of their catchments in Uttar Pradesh, while river Chandrawal has maximum catchment area in Uttar Pradesh.

At the confluence of Ken-Yamuna in the east-south Chilla town of Banda district and in the north Lalouli town of Fatehpur district are situated. Banda city is located south-east at the one side of the bank whereas Bhuragahs fort and village are situated on the north-west at another side. Some rocks near the bank of river at Banda city are very precious because special type of Sajar stone which have different types of plants impressions. The Sajar stones are very precious and used as ornaments with silver and gold. Besides this water of the river is used for irrigation through 21 Canals and drinking water supply. Historically, this site has its own importance because Pandawas stayed here for a period of one year during their Agyatwas. Besides occurrence of hill stream fishes in this river is a special feature of it. Due to all the above factors this hilly river has its own significance.

COLLECTION OF ALGAE, IDENTIFICATION AND ASSAY

An exhaustive collection of algae from different localities of Banda was made with a view to record periodicity, succession, distribution and taxonomy of algae (Photo 1-4). Algal samples were collected fortnightly during year 2001-2002 from Ken water. The algae were collected from these sites regularly in specimen tube. They were brought to the laboratory in living or simultaneously preserved condition in FAA in
PHOTO-1: VIEW OF KEN AT BANDA SHOWING CONCRETE BRIDGE.

PHOTO-2: VIEW OF KEN AT BANDA SHOWING RAILWAY BRIDGE.
specimen tubes. Physical characteristics and appearance including colour, shape and habitat. The samples were microscopically examined, cameralucida figures prepared and measurements recorded. On the basis of structure and measurements algae were identified using standard texts (Heurck, 1986; Tiffany and Britton, 1952; Desikachary, 1959; Randhawa, 1959; Philipose, 1970; Prescott, 1982). Succession, periodicity and distribution of algae at Banda were recorded.

Monthly water sampling was carried out in Ken waters at Banda. One litre of water sample was filtered through a bolting silknet of 20 XXX. Ten ml plankton concentrate obtained was preserved in 5-6 per cent formalin. The concentrate was assayed for plankton quantity using haemocytometer. quantitative infestation of algae at this station was assayed.

SAND CULTURE

Bottom sand from upper 6-8 cm of river bed was collected from different places and brought to the laboratory in sterilized polythene bags. Five gm of sand was cultured in sterilized 90 mm glass petridishes containing Beneck's or Chu 10 medium. Cultures were incubated in a BOD incubator maintained at 25 ± 1°C for 30 days. Algal growth was then examined carefully after 15 and 30 days under microscope, measurements recoded and camera lucida figures prepared. Specific identification was accomplished using standard texts.

Water culture

Water samples were collected from the midstream and bank of Ken river at Banda. Samples were carefully brought to the laboratory in sterilized bottles. Five ml of water was cultured in sterilized test tubes
PHOTO-3: VIEW OF KEN AT BHOORAGARH

PHOTO-4: VIEW OF KEN AT BANDA
containing 20 ml of Beneck's or Chu 10 medium. Cultures were kept in BOD incubator maintained at 30 ± 1°C exposed to fluorescent lamps supplying 375 lux light for 18 hrs a day. Algal growth was then microscopically examined after 15 and 30 days. Camera lucida figures of algae sketched and measurements recorded. Specific identification was done using standard texts.

**Statistical Analysis**

Nygaard's algal indices (1949; 1976) and Palmer's algal pollution indices (1969) for genera were computed to express the nature of water quality. Standard deviation, Coefficient of variation for species (Singh and Singh, 1990) and Correlation (Garrett and Woodworth, 1961) of different classes of planktonic and major benthic algae were calculated. Percentage occurrence of each species was also calculated.
RESULTS
I- SYSTEMATIC ENUMERATION

CHLOROPHYTA
CHLOROPHYCEAE
TERASPORALES
PALMELLACEAE

Genus SPHAEROCYSTIC Chodat


Colony often including both undivided and recently divided cells which form small spherical clusters within the colonial envelope.

Dimensions: Cells 7.70-21.4 μ in diameter.

Distribution: Planktonic free-floating colony in Ken water and in sand and water cultures.

Ulotrichales
Ulotrichaceae

Genus Ulothrix Kuetzing

Ulothrix zonata (Weber and Mohr) Kuetzing. Tiffany and Britton op. cit., 26, Pl.4, Fig. 1, 1952; Prescott, op. cit., 97, Pl.6, Fig. 14, 1982.

Vegetative cells cylindric or swollen; cell-wall thick at maturity; chrocoatophore usually a median band with several large pyrenoids.

Fig. 1.

Dimensions: Cells 12-34.8 μ broad and 10.4 μ long.

Distribution: Either attached or free-floating in Ken water.
CHAETOPHORACEAE

Genus CHAETOPHORA Schrank

Chaetophora incrassata (Hudson) hazen. Tiffany and Britton, op. cit., 32, Pl.6, Fig. 61, 1952.

Gelatinour colonies elongate, irregularly lobed and laciniate; main filaments elongate, bearing densely fascicled and usually setiferous branchlets; vegetative cells of main filaments, cylindric or swollen. Fig. 3.

Dimensions : Vegetative cells of main filaments 8-15.2 μ broad and 10-32 μ long.

Distribution : Attached on stones of river Ken.

Chaetophore elegans (Roth) C.A. Agardh. Tiffany and Britton, op. Cit, 32, Pl.6, Fig. 62, 1952.

Gelatinous colonies globose or subglobose; filaments with lax branching, radiating from centre of colony. Fig. 4.

Dimensions : Vegetative cells of main filaments 6.4-10.8 μ broad and 18-32 μ long.

Distribution : Attached on stones and wood.

Chaetophore elegans (Roth) C.A. Agardh. Tiffany and Britton, op. cit., 32, Pl.6, Fig. 62, 1952.

Gelatinous colonies globose or subglobose; filaments with lax branching, radiating from centre of colony. Fig. 7.

Dimensions : Vegetative cells of main filaments 6.4-10.8 μ broad and 18-42 μ long.

Distribution : Attached on stones and wood.
Fig. 1: Ulothrix zonata.
Chaetophora pisiformis (roth) C.A. Agardh. Tiffany and Britton, op. cit., 32, Pl.7, Fig. 63, 1952.

Gelatinous colonies globose to tuberculate; filaments radiating from centre of colony; branches with fasciculate and sometimes setiferous apices; vegetative cells of main filaments, cylindric. Fig. 8.

**Dimensions**: Vegetative cells of main filaments 5.8-8 μ broad and 16-26 μ long.

**Distribution**: mixed with *Chaetophora elegans*.

Protagocaceae

Genus **PROTOCOCCUS** C.A. Agardh


Cells solitary or in clumps of few cells, rounded or ellipsoid or angularly compressed, wall thick; chromatophore parietal, laminate, usually without pyrenoids. Fig. 2.

**Dimensions**: Vegetative cells 4.16-16.64 μ broad, 4.16-22.28 μ long.

**Distribution**: Mixed with other algae and in water culture.

Coleochaetaceae

Genus **COLEOCHAETE** Brebisson

*Coleochaete irregularis* Pringsheim. Tiffany and Britton, *op. cit.*, 44, Pl.10, Fig. 76, 1952.

Vegetative cells appearing quadrangular or polygonal; filaments irregularly branched, free or somewhat united, prostrate or nearly erect; oogonia ovoid, naked or corticate. **Fig. 13**.

**Dimensions**: Vegetative cells 18-24.82 μ broad and 18-34.24 μ long.
Fig. 2: Protococcus viridis; 3. Chaetophora incrassata.
Distribution: With other algae of river Ken.

Cladophorales

Cladophoraceae

genus **CLADOPHORA** Kuetzing

*Cladophora glomerata (Linnaeus) Kuetzing.* Tiffany and Britton, *op. cit.*, 45, Pl.13, fig. 97, 1952; Prescott, *op. cit.*, 138, Pl. 20, Figs. 8, 9, Pl.21, Figs. 1,2, 1982.

Branches often in glomerate clusters; transition from thick walls of main axis and primary branche to thin walls of branch clusters distinct: branching of main filments offent Y-shaped; plant mass light green to dark green. Fig. 7.

**Dimensions:** Cells of the main axis 28-46 μ broad and 170-320 μ long; cells of the branches 20-44 μ broad and 60-240 μ long.

**Distribution:** Attached or free-floating as entangled mass.

Genus **RHIZOCLONIUM** Kuetzing

*Rhizoclonium hieroglyphicum (Agardh) Kuetzing.* Tiffany and Britton. *op. cit.*, 46, Pl. 13, Fig. 91, 1952; Prescott, *op. cit.*, 142, Pl. 23, Fig. 3, 1982.

Vegetative cells usually simple, occasionally with 1 celled and nearly colourless rhizoidal branches; filaments slightly or not at all constricted at the cross-walls; cell-walls usually thin, but may be thick in terrestrial forms; plants unattached, aquatic, subaerial or terrestrial; floating forms grass-green or yellow-green, straight, thin-walled and without rhizoidal branches. Fig. 8.

**Dimension:** Vegetative cells 11.98-22.96 μ broad and 21.4-94.16 μ long.

**Distribution:** In stagnant water of the river Ken.
ODOGONIALESS

OEDOGONICEALE

Genus BULBOCHAETE Agardh

Bulbochaete rectangularis wittrock, Tiffancy and Britton, op. cit., 56, Pl.15, Fig. 105, 1952; Prescott, op. cit 153, Pl. 27, Figs. 9.10, 1982).

Dioecious, nananandroous, gynandrosporous; oogonium ellipsoid, patent or more rarely erect, below terminal seta or androsporangium or more rarely vegetative cell; outer oospore wall longitudinally costate; androsporangia scattered or epigynous, dwarf male near or occasionally on oogonium; antheridia exterior, 1-4. Fig. 11.


Distribution: With other algae of river Ken.

Bulbchaete varians Wittrock. Tiffany and Britton, op. cit., 56, Pl. 15, Fig. 102, 1952; Prescott. op. cit., 155, Pl.28, figs. 7, 9, 1982.

Dioecious, nananandroous, gynandrosporous; oogonium ovoid, patent or erect, below terminal seta or below androsporangial cell; outer oospore-wall with serrate, longitudinal costae; androsporangia scattered, epigynous or hypogynous 1-2; dwarf male on or near the oogonium, antheridia exterior 1-3. Fig. 10.

Dimensions: Vegetative cells 17.12-21-4 μ broad and 22.26-31.2 μ long; oogonium 30.82-34.24 μ broad and 44.51-51.36 μ long; dwarf male stipe 14.55-15.84 μ broad and 24.82-26.96 μ long; antheridal cell 8.13-9.42 μ broad and 5.99-6.85 μ broad.

Distribution: Attached to submerged plants in Ken water.

[23]
Fig. 4: Chaetophora elegans.
**Bulbochaete reticulate** Nordstedt. Tiffany and Britton, *op. cit.*, 57, Pl. 15, Fig. 110, 1952; Prescott, *op. cit.*, 154, Pl. 28, fig. 25, 1982.

Dioecious, nannandrous, gynandrosporous; oogonium ellipsoid, erect, below androsporangium or terminal seta or vegetative cell; outer wall of oospore reticulate-dentate, with doubly dentate, occasionally anastomosing, longitudinal ridges, the teeth united to one another by transverse ridges; androsporangia epigynous or scattered, 1-2; dwarf male on oogonium antheridium exterior. Fig. 12.

**Dimensions**: Vegetative cells 19.44-23.76 μ broad and 41.04-64.8 μ long; oogonium 45.36-51.84 μ broad and 66.96-84.24 μ long; dwarf male stipe 17.28-19.44 μ broad and 30.24-32.4 μ long; antheridium 11.88-12.96 μ broad and and 6.48-8.64 μ long.

**Distribution**: With other algae of river Ken.

**Genus OEDOGONIUM** Link

**Oedogonium gracillimum** Wittrock and Lundell. Tiffany and Britton, *op. cit.*, 82, Pl. 23, Fig. 217, 1952; Prescott, *op. cit.*, 190, Pl. 34, Figs. 13, 14, 1982.

Monoecious; oogonium 1, oblong, operculate, division superior; oospore oblong-ellipsoid, not filling oogonium, spore-wall smooth; antheridium 1; basal cell elongate. **fig. 9**.

**Dimensions**: Vegetative cells 4.16-6.66 μ broad and 18.12-39.94 μ long; oogonium 14.56-18.30 μ broad and 34.11-36.61 μ long; antheridium 3.4-4.71 μ broad and 4.28-6.85 μ long.

**Distribution**: Attached to aquatic plants with other algae.
Fig. 5: Chaetophora pisiformis.
CHLOROCOCuales
CHLOROCOCcaeAE

Genus **CHLOROCOCcum** Fries

**Chlorococcum humicola** (Naegeli) Rabenhorst. Tiffany and Britton, *op. cit.*, 102, Pl.29, Fig. 277, 1952; Prescott, *op. cit.*, 212, Pl. 45, Fig. 1, 1982.

Cell solitary or in small aggregates; forming thin coatings on moist places, especially on damp soil. **Fig. 22.**

**Dimensions**: Cell 7-24.64 μ in diameter.

**Distribution**: Planktonic and on submerged substrates in Ken water. Found in sand and water cultures.

**Chlorococcum infusionum** (Schrank) Meneghini. Philipose, M.T., Chlorococcales, 73, Fig. 1a, b, 1967.

Cells of variable shape and dimensions, solitary or in colonies; chloroplast a hollow sphere with a notch on one side, pyrenoid single. **Fig. 23.**

**Dimensions**: Cell 26-38 μ in diameter.

**Distribution**: Found on submerged substrates in Ken water and in sand culture.

MICRACTINIACEAE

Genus **GOLENKINIA** chodat

**Golenkina radiata** Chodat. Tiffany and britton, *op. cit.*, 104, Pl. 29, Fig. 279, 1952; Prescott, *op. cit.*, 213, Pl. 45, Fig. 3, 1982.

Cells spherical, solitary, with hyaline, slightly tapering setae; chromatophore single, cup-shaped,parietal, 1 pyrenoid. **Fig. 20.**

**Dimensions**: Cell 8.4-14.56 μ in diameter; setae upto 45.08 μ Long.
Fig. 7: Cladophora glomerata;
8. Rhizoclonium hieroglyphicum;
Distribution: Planktonic free-floating in Ken water and in sand culture.

CHARACIACEAE

Genus CHARACIUM A. Braun

Characium naegelii A. Broun. Tiffany and Britton, op. cit., 108, PL. 29, Fig. 284, 1952.

Cell ellipsoid, lanceolate, pyriform or ovoid, with rounded apex and short stipe, without basal thickening. Fig. 24.

Dimensions: Cell 8-18 µ broad and 22-42 µ long.

Distribution: Epiphytic on filamentous algae of Ken water.

HYDRODICTYACEAE

Genus HYDRODICTYON Roth

hydodictyon reticulatum (Linnaeus) Lagerheim. Tiffany and Britton, op. cit., 110, Pl 29, Fig. 289, 1952.

Cells macroscopic, usually elongate-cylindric, united into a with parietal chromatophores, reticulate at first and later diffuse, with pyrenoids; mesh of nets generally 4-7 sided.

Fig. 22.

Dimensions: Cells 6-22 µ in diameter.

Distribution: Free-floating in Ken water.

Genus PEDIASTRUM Meyen


Walls smooth or punctate, projections of marginal cells single; coenobia 8-64 celled, compact or perforate. Fig. 35.


Distribution: Free-floating in Ken water and in sand culture.
Fig. 10. Bulbochaete varians;
Pediastrum simplex var. duodenarium (Bailey) Rabenhost. Tiffany and britton, op. cit., 110, Pl. 30, Fig. 292, 1952.

Cells with smooth or finely punctate walls; perforations of coenobia large. fig. 36.

**Dimensions**: Cells 12-24 μ broad and 22-44 μ long.

**Distribution**: Free-floating in Ken water.

Pediastrum tetras (Ehrenberg) Ralfs. Tiffany and Britton, op. cit., 110, Pl. 30, Fig. 293, 1952.

Cells with smooth walls, marginal cells with 4 projections and a deep incisions and pronounced projections. Fig. 40.

**Dimensions**: Cells 8.56-14.55 μ in diameter.

**Distribution**: Free-floating in water and mixed with sandy material.

Pediastrum tetras var. tetraodon (Corda) Hanganir. Tiffany and Britton, op. cit., 112, Pl. 30, Fig. 294, 19052.

Cells with deep incisions and pronounced projections. Fig. 41.

**Dimensions**: Cells 8.8-14.98 μ broad and 13.2-17.98 μ long.

**Distribution**: Free-floating in Ken water and mixed with sandy material.

Pediastrum tetras var. excisum (Rabenh) hansgirg. Philipose, op. cit., 129, fig. 45t, 1967.

Lobes of the cells deeply concave. Fig. 42.

**Dimensions**: Cells 4.28-6.86 μ in diameter.

**Distribution**: Free-floating in Ken water.

Pediastrum duplex meyen. Tiffany an Britton, op. cit., 112, Pl. 30, Fig. 300, 1952; Prescott, op. cit, 223, Pl. 48, Fig. 4, 1982.
Fig. 12: Bulbochaete reticulata; 13. Coleochaete irregularies; 14: Chara excelsa.
Cells with smooth walls, outer half of marginal cells with 2 short projections. coenobia 8-128 celled, with lens-shaped performations among cells. Fig. 37.

**Dimensions**: Cells 11.76-21 μ in diameter.

**Distribution**: Planktonic free-floating in water and found in water culture.

**Pediastrum duplex var. clathratum** (A. Braun) Lagerheim.  
Tiffany and Britton, op. cit., 112, Pl. 30, Fig. 301, 1952;  
Prescott, op. cit., 223, Pl. 48, Fig. 6, 1982.

projections of marginal cells deeply emarginate. Fig. 38.

**Dimensions**: Cells 11.2-19.6 μ in diameter.

**Distribution**: Free-floating in Ken water and mixed with other ÿgæ.

**Pediastrum boryanum** (Turpin) Meneghini. Tiffany and Britton, op. cit., 112, Pl. 30, Fig. 295, 1952.

Cells with smooth or granulate walls, outer half of marginal cells with 2 short processes ending in short spines; coenobia 4-256-celled, usually compact. Fig. 39.

**Dimensions**: Cells 8-28 μ in diameter.

**Distribution**: Planktonic free-floating in water and mixed with sandy material.

**COELASTRACEAE**

**Genus COELASTRUM** Naegeli

**Coelastrum cambricum var. intermedium** (Bohlin) G.S. West.  
Philopose, op. cit., 231, Fig. 138b, 1967.

Colonies usually 8-16-32 celled, spherical; cells spherical and thickened at the poles, joined to one another by short, somewhat flattened projections.
Oter face of the external cels subspherical and gradually arched. Interspaces between cells more or less triangular. fig. 18a, b.

**Dimensions** : Diameter of 16 celled colony 36.28-40.04 μ; cells 8.58-12.87 μ in diameter.

**Distribution** : Planktonic mixed with other algae. found in sand and water cultures.

*Coelastrum proboscidium* Bohlin. Philipose, op. cit., 229, Fig. 137a, b, 1967.

Colonies of 4-8-16 cells usually, pyramidal in shape. Intercellular spaces usually large and polygonal. Cells conical, truncate and six sided. Fig. 19.

**Dimensions** : Colonies of 8 cells about 20.16-22.96 μ in diameter; cells 7.28-8.96 μ in diameter.

**Distribution** : Mixed with sandy material and in sand and water cultures.

**OOCYSTACEAE**

Genus *ANKISTRODESMUS* (Corda) Ralfs

*Ankistrodesmus falcatus* (Corda) Ralfs. Tiffany and Britton, op. cit., 114, Pl.31, Fig. 307, 1952; Prescott, op. cit., 253, Cells curved, with acute apices, solitary or in loose fasciculate bundles. Fig. 16.

**Dimensions** : Cells 2-4 μ board and 22-80 μ long.

**Distribution** : Planktonic and interminagled with other algae of river Ken and in water culture.

*Ankistrodesmus convolutus* corda. Prescott, op. cit., 253, Pl. 55, Fig. 3, 1982.

Solitary or in groups of 2-4 cellss, fusiform in shape, twosted, and sigmoid; apices sharply pointed and often twisted in opposite directions. Fig. 17.
Fig. 15: Closteriopsis longissima: 16: Ankistrodesmus falcatus; 17: Ankistrodesmus convolutus; 18: Coelastrum cambricum var. intermedium a, b; 19: Coelastrum proboscidium; 20: Golenkinia radiata; 21: Chlorella vulgaris; 22: Chlorococcum humicola; 23: Chlorococcum infusionum; 24: Characium naegeli; 25: hydrodictyon reticulatum.
Dimensions: Cells 3.6-48 μ broad and 16-26 μ long.

Distribution: Planktonic free-floating in water. Found in sand and water cultures.

Genus **CLOSTERIOPSIS** Lemmermann

*Closteriopsis longissima* Lemmermann. [Ankistrodesmus longissimus (Lemmermann) Wille]. Tiffany and Britton, op. Pl. 57, Fig. 1, 1982.

Cells long and very narrowly spindle-shaped, ending in hair-like apices. **Fig. 15.**

Dimensions: Cells 4.28-7.28 μ broad and 226.84-385.52 μ long.

Distribution: Planktonic and also found in sandy material of river Ken.

Genus **CHLORELLA** Beyerinck

*Chlorella vulgaris* Beyerinck. Tiffany and Britton, op. cit., 114, Pl. 29, Fig. 280, 1952; Prescott, op. cit., 237, Pl. 53, Fig. 13, 1982.

Cells spherical; chloroplast a parietal cup. **Fig. 21.**

Dimensions: Cells 5.6-10.64 μ in diameter.

Distribution: Planktonic mixed with other algae in sandy material and also found in sand and water cultures.

Genus **OOCYSTIS** Naegeli


Cells ovoid to ellipsoid, solitary or 2-8, with conspicuous polar nodules; chromatophores usually 12-25, parietal, disciform to polygonal, with or without pyrenoids. **Fig. 26.**

Dimensions: Cells 8.56-10.7 μ broad and 15.41-33.38 μ long.

Distribution: Among filamentous algae of water.

[36]
**Oocystis eremospaeria** G.M. Smith. Prescott, op. cit., 244, Pl. 51, Fig. 12, 1982.

Plants unicellular, usually solitary, sometimes in a group of 2 or 5 within the old mother cell wall; cells narrowly ovate, the poles broadly rounded and furnished with a large nodular thickening; chloroplasts numerous, each with a pyrenoid. Fig. 27.

**Dimensions**: Cells 22-32 μ broad and 36-44 μ long.

**Distribution**: In sandy material of river.

**Genus SLENASTRUM** Reinsch

**Selenastrum bibraianum** Reinsch. Tiffany and Britton, op. cit., 117, Pl. 32, Fig. 325, 1952; Prescott, op. cit., 256, Pl. 57, Fig. 9, 1982.

Cells crescent-shaped to sickle-shaped, in spherical to ovoid colonies of 4-16 more cells. Fig.28.

**Dimensions**: Cells 4.80-7.63 μ broad and 20.06-26.16 μ long.

**Distribution**: Mixed with other algae of river.

**Selenastrum gracile** Reinsch. Prescott, op. cit., 257, Pl. 57, fig. 11, 1982.

Colonies of 8-64 sickle-shaped cells in irregular arrangement, but with the convex surfaces apposed; apices of the cells sharply pointed; chloroplast a partitional plate along the convex wall, without a pyrenoid. Fig. 29.

**Dimensions**: Cells 2.57-4.29 μ broad and 19.26-27.82 μ long.

**Distribution**: Planktonic among other algae of river and in water culture.

**Genus TETRAEDRON** Kuetzing

**Tetraedron trigonum** var. minus Reinsch. Tiffany and Britton, op. cit., 118, Pl. 34, Fig. 342, 1952.
Cells with straight sides, angles gradually tapering. Fig. 33.

**Dimensions**: Cells 10.4-14 μ in diameter.

**Distribution**: In wet sand on the bank of river.

**SCENEDESMAECEAE**

Genus **ACTINASTRUM** Lagerheim

**Actinastrum hantzschii** Lagerheim. Tiffany and Britton, *op. cit.*, 120, Pl. 33, Fig. 327, 1952; Prescott, *op. cit.*, 181, Pl. 84. 64, figs. 10, 11, 1982.

Cells ovoid-cylindric, with truncate ends; chromatophore single, with 1 pyrenoid. **Fig. 30; Photo. 15.**

**Dimensions**: Cells 2.91-5.97 μ broad and 12.28-24.57 μ long.

**Distribution**: Planktonic found in sandy material of river or attached from filamentous algae and in water culture.

**Actinastrum hantzschii var. fluviatile** Schroeder. Tiffany and Britton, *op. cit.*, 120, Pl. 33, fig. 328, 1952; Prescott. *op. cit.*, 282, Pl. 65, fig. 1, 1982.

Cells with free ends pointed. **Fig. 31a, b.**

**Dimensions**: Cells 2.2-4.8 μ broad and 16.8-32 μ long.

**Distribution**: Planktonic and in moist sand of river and attached to filamentous algae.

Genus **CRUCIGENIA** Morren

**Crucigenia tetrapedia** (Kirchner) W. and G.S. West. Tiffany and Britton, *op. cit.*, 285, l. 66, Fig. 1, 1982.

Cells flat, triangular, with rounded corners, with a very small rectangular opening at the centre of the coenobium; cells contents homogeneous or with 1 chromatohore, with or without pyrenoids. **Fig. 32.**
Dimensions: Cells 5.51-8.7 μ in diameter.

Distribution: Lanktonic among other algae on the bank of river and in sand and water cultures.

Genus *SCENEDESMUS* Meyen

*Scenedesmus armatus* (Chodat) G.M. Smith. Tiffany and Britton, op. cit., 122, Pl. 35, Fig. 353, 1952; Prescott, op. cit., 276, Pl. 62, Figs. 13, 14, 1982.

Colonies 2-4 celled, arranged in a linear or subalternating series; cells ovoid to oblong-ellipsoid with rounded apices, a longitudinal ridge on each side of cell; terminal cells with a spine at each pole. Fig. 48.

Dimensions: Cells 4.06-6.52 μ broad and 8.7-13.05 μ long.

Distribution: Planktoner mixed with other algae on the bank of river and in sand and water cultures.

*Scenedesmus abundans* (Kirchner) Chodat. Tiffany and Britton, op. cit., 123, Pl. 35, Fig. 366, 1952; Prescott, op. cit., 274,

Colonies 2-4 celled arranged in a linear series: cells oblong outer face in addition to spines from the four corners of the colony. Internal cells with one spine at their poles. Fig. 49.

Dimensions: Cells 2.86-6.81 μ broad and 7.25-9.42 μ long.

Distribution: In sandy material of river and in water culture.

*Scenedesmus acuminatus* (Lagerheim) Chodat. Tiffany and Britton, op. cit., 123, Pl. 35, Fig., 368, 1952; Prescott, op. cit., 275, Pl. 62, Fig. 16, 1982.

Colonies 4-8 celled; cells fusiform, arcuate or lunate, with pointed ends; cell-wall smooth and without spines. Fig. 50.


[39]
Distribution: Mixed with other Scenedesmus sp. and in sand and water cultures.

Scenedesmus acutiformis Schroeder. Tiffany and Britton, op. cit., 123, Pl. 35, Fig. 356, 1952; Prescott, op. cit., 275, Pl. 62, Fig. 6, 1982.
Colonies 2 celled; cells fusiform, with acute apices, without spines or teeth; terminal cells with 2-4 longitudinal ridges, interior cells with 1 longitudinal ridge on each side. Fig. 52.

Dimensions: Cells 6-8 μ broad and 16.8-23.2 μ long.

Distribution: Mixed with other algae of river.

Scenedesmus arcuatus Lemmermann. Tiffany and Britton, op. cit., 123, Pl. 35, Fig. 360, 1952; Prescott, op. cit, 275, Pl. 62, Fig. 8, 1982.
Colonies usually 8 celled; cells ovoid or angular, in a double row, with small intercellular spaces between cells; cell-wall smooth, without teeth or spines. Fig. 59.

Dimensions: Cells 4.3-8.8 μ broad and 10-16.8 μ long.

Distribution: Mixed with other Scenedesmus sp.

Scenedesmus bijuga (Turpin) Lagerheim. Tiffany and Britton, op. cit., 123, Pl. 35, Fig. 371, 1952; Prescott, op. cit., 276, Pl. 63, Fig. 2, 1982.
Colonies flat 2-4-8 celled; to ovoid with broadly rounded ends, usually in a single series; cell-wall smooth, without teeth or spines. Fig. 47

Dimensions: Cells 3.82-6.88 μ broad and 7.34-15.3 μ long.

Distribution: Planktonic mixed with other Scenedesmus sp. or in sandy material of river and found in sand and water cultures.

Scenedesmus bijuga var. alternans (Reinsch) Borge. Tiffany and Britton, op. cit., 123, Pl. 35, Fig. 372, 1952; Prescott, op. cit., 277, Pl. 6m figs. 3,5, 1982.
Fig. 26: Oocystis solitaria; 27: Oocystis eremosphaeria; 28: Selenastum 29. Selenastrum gracile; 30: Actinastrum hanzschii; 31: Actinastrum hanzschii var. fluviatile a, b; 32: Crucigenia tetraapedia; 33: Tetraedron trigonum var. minus; 34: Ankistrodesmus falcatus var. aicularis.
Colonies 8 celled; cells alternately arranged. Fig. 58.

**Dimensions**: Cells 4.8-8 μ broad and 7.2-16 μ long.

**Distribution**: In sandy material of river and in sand and water cultures.

*Scenedesmus carinatus* (Lemmermann) Chodat. Tiffany and Britton, *op. cit.*, 122 Pl. 35, Fig. 362, 1952.

Colonies 5 celled; cells fusiform, with a longitudinal ridge on each side of the cell; each pole with 2-3 teeth. Fig. 46.

**Dimensions**: Cells 6.4-8.8 μ broad and 15.8-16.8 μ long.

**Distribution**: In ditches on the bank of river.

*Scenedesmus dimorphus* (Turpin) Kuetzing. Tiffany and Britton, *op. cit.*, 123, Pl. 35, Fig. 270, 1052.

Colonies 4-8 celled; cells arranged in a linear or alternating series; apices of cells arranged in a linear or alternating series; apices of cells attenuated; outer cells of the colony lunate. fig. 44.

**Dimensions**: Cells 2.17-4.93 μ broad and 12.61-20.3 μ long.

**Distribution**: Planktonic fund in sandy material or mixed with other algae of river and in sand and water cultures.

*Scenedesmus obtusus* (Turpin) Kuetzing. Tiffany and Britton, *op. cit.*, 123, Pl. 35, Fig. 369, 1952; Philopose, *op. cit.*, 2148, Fig. 2149a-c, 1967.

Colonies usually of 4 celled; cells fusiform, with acute apices, in a linear or sublinear series; outer sides of terminal cells concave or slightly convex; cell wall smooth. Fig. 43.

**Dimensions**: Cells 2.46-6.52 μ broad and 12.61-19.74 μ long.

**Distribution**: Planktonic found in sandy material or mixed with other algae of river and in sand and water cultures.

[42]
*Scenedesmus longues* var. *minutus* G.S. Smitth. Tiffany and Britton, *op. cit.*, 123, Pl. 35, Fig. 373, 1952.

Colonies usually 4 celled; cells oblong-cylindric with rounded ends each bearing a single spine. *Fig. 54.*


**Distribution**: In ditches on the bank of river.

*Scenedesmus prismaticus* Bruhl and biswas. Philipose, *op. cit.*, 259, Fig. 168a-c, 1967.

Colonies 2-4 celled arranged in a linear series; cells prismatic with pyramidal end faces; in side view, the longitudinal ridges in front and at the back appear as dark lines. *Fig. 45.*

**Dimensions**: Cells 3.62-4.64 μ broad and 10.85-13.05 μ long.

**Distribution**: Along with other algae and in sand and water cultures.

*Scenedesmus quadricauda* (Turpin) Brebisson. Tiffany and Britton, *op. cit.*, 122, Pl. 35, Fig. 357, 2952; Prescott, *op. cit.*, 280, Pl. 64, Fig. 2, 1982.

Colonies 4 celled; cells cylindric ovoid, with rounded ends, in a linear or subalternating series; poles of outer cells with spines, inner cells without spines. *Fig. 5.*

**Dimensions**: Cells 3.33-6.52 μ broad and 11.31-15.08 μ long; spines 10.87-11.6 μ long.

**Distribution**: Planktonic mixed with other algae of river and in sand and water cultures.

*Scenedesmus quadricauda* var. *quadrispina* (Chodat0 G.M. Smith. Tiffany and Britton, *op. cit.*, 122, Pl. 35, Fig. 1952; Prescott, *op. cit.*, 280, Pl. 63, Fig. 21, 1982; Philipose, *op. cit.*, 285, fig. 187d; f, 1967.
Colonies usually 2-4 celled; cells broadly ovoid, poles of terminal cells with a single short recurved spines. **Fig. 57a, b.**

**Dimensions:** Cells 3.62-7.25 μ broad and 8.7-16 μ long.

**Distribution:** Planktonic found in sandy material or mixed with other algae of river and in sand and water cultures.

*Scenedesmus quadricauda var. bicaudatus* Hansgirg. Philipose, op. cit., 284, Fig. 187 K1, 1967.

Colonies usually 4 celled; terminal cells with a long spine from one pole only. **Fig. 56.**

**Dimensions:** Cells 3.06-4.59 μ broad and 7.65-8.41 μ long; spines about 7.65 μ long.

**Distribution:** In sandy material of river and in sand and water cultures.


Colonies 2-4 celled; cells ovoid to cylindrical with long spines. **Fig. 55.**

**Dimensions:** Cells 2.75-3.78 μ broad and 7.34-9.45 μ long; spines 7.65-10.71 μ long.

**Distribution:** In sandy material of river and in sand and water cultures.

*Scenedesmus quadricauda var. westii* G.M. Smith. Tiffany and britton, o. cit., 122, Pl. 35, Fig. 358, 1952; Prescott, op. cit., 281, Pl. 64, **Figs. 7, 9, 1982.**

Colonies usually 4-8 celled. **Fig. 53.**

**Dimensions:** Cells 4.06-6.96 μ broad and 8.41-20.3 μ long; spines about 14-15.8 μ long.

**Distribution:** Mixed with other *Scenedesmus sp.* and in sand and water cultures.
ZYGNEMATALES

ZYGNEMATAEAE

Genus Mougeotia C.A. Agardh

mougeotia calcarea (Cleve) Wittrock. Tiffany and Britton, op. cit., 130, Pl. 38, Figs. 397-402, 1952; Randhawa, M.S., Zygmemataeae, 123, Fig. 10, 1959.

Cels elongating and becoming geniculate before the spore formation; zygote globose or angular-globose. wholly in the tube, or extending into 1 or both gametangia, spore-wall smooth, colourless. Fig. 60a, b.

Dimensions: Vegetative cells 8.4-13.44 μ broad and 40.88-89.6 μ long; zygote 21.84-26.32 μ broad and 27.4-35.84 μ long.

Distribution: Brownish filamentous mass in shallow water.

Mougeotia genuflexa (Dillwyn) C.A. Agardh. Tiffany and Britton, op. cit., 132, Pl. 39, fig. 423, Pl. 40, Fig. 417, 1982.

Vegetative cells often geniculate and attached to other similar cells, forming extensive nets, sometimes with rhizoidal branches; conjugation lateral much less frequently scalariform; zygotes quadrately ovoid to globose. spore wall smooth, brown. Fig. 62.

Dimensions: Vegetative cells 12.84-25.68 μ broad and 85.6-128.4 μ long; zygote 30.82-37.66 μ in diameter.

Distribution: Intermingled with other filamentous algae in shallow water.

Mougeotia sphaerocarpa Wolle. Tiffany and Britton, op. cit., 132, Pl. 38, Figs. 380-393, 1952; Prescott, op. cit., 305, Pl. 74, Fig. 6, 1982; Randhawa, op. cit., 129, Fig. 21a, b, 1959.
Vegetative cells usually with 4-6 pyrenoids, gametangia curved; zygote in the greatly enlarged conjugating tube or extending into the gametangia, ovoid or subglobose; spore-wall smooth, brown. Fig. 61a, b.

**Dimensions**: Vegetative cells 20-24 µ broad and 64-112 µ long; zygote 36.38-42.8 µ broad and 42.8-54.78 µ long.

**Distribution**: Brownish filamentous mass floating in shallow water.

**Genus Zygnema C.A. Agardh**


Conjugation scalariform, receptive gametangia inflated on the inner side near the middle; zygote globose, median spore-wall thick and marked by pits. Fig. 64a, b; .

**Dimensions**: Vegetative cells 18.4-24.8 µ broad and 34-80 µ long; zygote 26.4-39.2 µ broad and 26.4-40.8 µ long.

**Distribution**: Intermingled with other filamentous algae in shallow water and also found in sand culture.

*Zygnema tenue* Kuetzing. Tiffany and Britton, *op. cit.*, 139, Pl. 30, Fig. 431, 2952.

Conjugation scalariform; zygote globose to ovoid, often somewhat compressed, in 1 of the gametangia; median spore-wall brown, scrobiculate; receptive gametangia greatly enlarged or inflated toward the middle. Fig. 65.

**Dimensions**: Vegetative cells 18.2-24.92 µ broad and 21.06-68.80 µ long; Zygote 17.64-24.92 µ broad and 26.68-39.66 µ long.

**Distribution**: Mixed with other filamentous algae of river.
Fig. 35: Pediastrum simplex; 36: *Pediastrum simplex var. duodenarium*; 37: *Pediastrum duplex; 38: Pediastrum duplex var. clathratum*; 39: *Pediastrum boryanum*; 40: *Pediastrum tetras*; 41: *Pediastrum tetras var. tetraodon*; 42: *Pediastrum tetras var. excisum*. 
Zynema czurdae Randhawa. Randhawa, op. cit., 217, Fig. 144a-c, 1959.

Conjugatin scalariform, with globose zygospores in the conjugation canal; Fig. 63.

**Dimensions**: Vegetative cells 20-26 μ broad and 86-104 μ long; zygote 34-40 μ ing diameter.

**Distribution**: Free-floating in water and mixed with other species of Spirogyra and Zygemma.

**Genus SPIROGYRA Link**

**Spirogyra punctiformis** Transeau. Tiffany and britton, op. cit., 154, Pl. 47 Fig. 496, 1952, Randhawa, op. cit., 350 fig. 360a, b, 2959.

Vegetative cells with plane end walls and 1-2 narrow chromatophores making 3-6 turns in the cells; conjugation scalariform; zygote ovoid; median spore-wall punctate. Fig. 67.

**Dimensions**: Vegetative cells 27.82-29.96 μ broad and 145.52-222.56 μ long; zygote 41.94-47.08 μ broad and 64.2-5.6 μ long.

**Distribution**: Free-floating in shallow water on the bank of river.

**Spirogyra rectangularis** Transeau. Tiffany and britton, op. cit., 161, Pl. 49, Figs. 521, 522, 1952.

Vegetative cells with replicate end walls and 2-4 chromatophores making 25 turns in the cell; conjugation lateral and scalariform; zygote ovoid to cylindric ovoid. Fig. 67.

**Dimensions**: Vegetative cells 35.10-39.38 μ broad and 162.64-273.92 μ long; zygote 46.22-57.78 μ long.

**Distribution**: Mixed with other filamentous algae of river.

[48]
Fig. 43: Scenedesmus obliquus; 44: Scenedesmus dimorphus; 45: Scenedesmus Prismaticus; 46: Scenedesmus Carinatus; 47: Scenedesmus bijuga; 48: Scenedesmus armatus; 49: Scenedesmus abundans; 50: Scenedesmus acuminatus; 51: Scenedesmus quadricauda; 52: Scenedesmus acutiformis; 53: Scenedesmus quadricauda var. westii; 54: Scenedesmus longus var. minutus; 55: Scenedesmus quadricauda var. longispina; 56: Scenedesmus quadricauda var. bicaudatus; 57: Scenedesmus quadricauda var. quadrispina a, b; 58: Scenedesmus bijuga var. alternans; 59: Scenedesmus arcuatus.
**Spirogyra singularies** Nordstedt. Tiffany and Britton op. cit., 146, Pl. 43, Fig. 454, 1952; Randhawa op. cit., 295, Fig. 251, 1959.

One chromatophore making 4-8 turns; conjugation scalariform, tubes formed by both the gametangia; zygote ellipsoid. Fig. 92; Photo. 22.

**Dimensions**: Vegetative cells 28-38 μ broad and 84-136 μ long; zygote 27.2-34 μ broad and 47.2-8.8 μ long.

**Distribution**: Free-floating in shallow water on the bank of river.

**Spirogyra sp.**

Vegetative cells with plane and walls and 1 (rarely 2) chromatophores making 1-8 turns; spore not seen. Fig. 68.

**Dimensions**: Vegetative cells 17.36-2.4 μ broad and 81.2-117.6 μ long.

**Distribution**: Free-floating in shallow water of river.

**Spirogyra sp.**

Chromatophores 3, making 4-6 turns; zygote not seen. Fig. 72.

**Dimensions**: Vegetative cells 42.8-59.92 μ broad and 94.16-136.96 μ long.

**Distribution**: Free-floating in shallow water on the bank of river.

**Spirogyra sp.**

Chromatophores 2, making 5-8 turns; zygote not seen. Fig. 69, Photo. 19.

**Dimensions**: Vegetative cells 34.24-51.36 μ broad and 188.32-218.28 μ long.

**Distribution**: In shallow water on the bank of river.

**DESMIDACEAE**

**Genus** **CLOSTERIUM** Nitzsch

[50]
Fig. 60: Mougeotia calcarea a, b, ;  
61: Mougeotia sphaerocarpa a, b.
Closterium acerosum (Schrank) Ehrenberg. Tiffany and Britton, op. cit., 169, Pl. 52, Fig. 550, 1952.

Cells very slightly curved or almost straight, narrowly fusiform; chromatophores ridged; pyrenoids 7-12 in a median series; terminal vacuoles with a number of moving granules. Fig. 77.

**Dimensions:** Cells 26.5-50.88 μ broad and 296.8-461.1 μ long.

**Distribution:** Planktonic found in moist sand on the bank of river and in sand culture.

Closterium turgidum Ehrenberg. Tiffany and britton, op. cit., 170, Pl. 52, Fig. 553, 1952.

Cells slightly curved; chromatophore with 7-8 ridges; pyrenoids 7-10 in a median series; terminal vacuoles with many moving granules. Fig. 75.

**Dimensions:** Cells 51.1-73 μ broad and 620.05-788.4 μ long.

**Distribution:** Among other algae in ditches on the bank of river.

Closterium moniliferum (Bory) Ehrenberg. Tiffany and Britton, op. cit., 172, Pl. 52, fig. 549, 1952.

Cell stout, moderately curved, chromatophores with about 6 ridges; pyrenoids 6-7 in a median series; terminal vacuoles with numerous moving granules Fig. 76.

**Dimensions:** Cells 37.1-68.9 μ broad and 254.4-402.8 μ long.

**Distribution:** Among other algae of water.

Closterium venus Kuetzing. Tiffany and Britton, op. cit., 173, Pl. 51, Fig. 542, 1952.

Cells strongly curved; chromatophores ridged; pyrenoids 2 or rarely only 1; terminal vacuoles large, with a number of moving granules. Fig. 73.

**Dimensions:** Cells 7-9.52 μ broad and 51.8-81.2 μ long.
Fig. 62; Mougeotia genuflexa; 63: Zygnesia czurae.
**Distribution**: In moist sand on the bank of river.

Closterium parulum Naegeli. Tiffany and Britton, o. cit., 173, Pl. 51, Fig. 543, 1952.

Cells strongly curved; chromatophores with 4-5 ridges; pyrenoids 3-6 in a median series; terminal vacuoles with several moving granules. Fig. 74.

**Dimensions**: Cells 8.4-14 μ broad and 97.44-106.4 μ long.

**Distribution**: Mixed with other algae on the bank of river.

**Genus** EUASTRUM Ehrenberg (Rals)

*Euastrum inermius* (Nordst.) Nob. Turner, W.B. Fresh water Algae of East India, 86, Pl. 10, Fig. 51, 1892. Fig. 92.

**Dimensions**: Cells 46-50.5 μ broad and 57.8-60.34 μ long; isthmus 10.87-13.63 μ wide.

**Distribution**: Free-floating in water or mixed with other algae and in sand culture.

**Genus** COSMARIIUM Corda

Cosmarium curtum (Brebiisson) Ralfs. Tiffany and Britton, op. cit., 184, Pl. 53, Fig. 576, 1952.

Cells about 2 times as long as wide, slightly constricted, sinus shallow and ope, isthmus wide; semicells attenuated, sides convex, apex rounded and sometimes slightly thicKened; vertical view circular; cell-wall punctate; chromatophore axial, 1 in each semicell, consisting of a central mass with about 8 longitudinal ridges; pyrenoids several in an axial series. Fig. 90.

**Dimensions**: Semicells 11.2-30.8 μ broad and 22.4-56 μ long; isthmus 11.2-19.6 μ wide.

**Distribution**: In ditches on the bank of river.

[54]
**Cosmarium depressum** (Naegeli) Lundell. Tiffany and Britton, op. cit., 184, Pl. 53, fig. 564, 2952.

Cells somewhat wider than long; deeply constricted, sinus narrowly linear, the apex dilated, opening outward; isthmus very narrow; semicells transversely elliptic, depressed, lateral margins broadly rounded, the apices convex-truncate; vertical view elliptic; lateral view of semicells circular; cell-wall finely punctate; chromatophores axial; pyrenoid single, central. Fig. 78a, b.

**Dimensions**: Semicells 36.5-52.65 μ broad and 37.91-53.35 μ long; isthmus 8.42-13.34 μ wide.

**Distribution**: With other algae of water.

**Cosmarium nitidulum** DeNotaries. Tiffany and Britton, op. cit., 185, Pl. 53, Fig. 572, 1952.

Cells a little longer than wide, deeply constricted, sinus narrowly linear, the apex slightly dilated; semicells truncate subsemicircular, basal angle broadly rounded, sides convex and converging upward, upper angles slightly rounded, apex small, truncate convex, straight or slightly retuse; vertical view elliptic; lateral view of semicell subcircular; cell-wall minutely and often obscurely punctate; chromatophore axial, 1 in each semicell; pyrenoid single, central. **Fig. 80**.

**Dimensions**: Semicells 23.52-32.2 μ broad and 30.24-40.88 μ long; isthmus 8.4-10.64 μ wide.

**Distribution**: With other algae on the bank of river and in sand culture.

**Cosmarium constrictum** Delponte. Tiffany and Britton, op. cit., 185, Pl. 54, Fig. 594, 1952.

[55]
Cells broadly elliptic, longer than wide, deeply consticted sinus actuely angled and opening outward, wall smooth; semicells semicells semielliptic, basal angles rounded; lateral view of semicell broadly elliptic; vertical view elliptic; a single pyrenoid in each semicell. Fig. 85.

**Dimensions**: Semicells 22.4-37.52 μ broad and 30.8-47.6 μ long; insthmus 7-9.8 μ wide.

**Distribution**: Mixed with other algae of river.

**Cosmarium circular** Reinsch. Tiffany and Britton, *op. cit.*, 186, Pl. 55, Fig. 615, 1952.

Cells as long as wide, circular in outline, deeply constricted, sinus linear, somewhat dilated at the apex, isthmus narrow; semicells semicircular, basal angles rounded; vertical view narrowly elliptic; lateral view of semicells narrowly subcircular; cell-wall minutely punctate; chromatophores axial; pyrenoids 2 in each semicell. Fig. 82.

**Dimensions**: Semicells 38-72 μ broad and 48-94 μ long; isthmus 14-24 μ wide.

**Distribution**: In ditches on the bank of river.

**Cosmarium subimpressum** Borge. Tiffany and Britton, *op. cit.*, 186, Pl. 54, fig. 588, 1952.

Cells longer than wide, constriction deep, sinus narrow and linear; semicells transversely rectangular in lower part, pyramidate — truncate above, apex prominent, sides parallel below, attenuated upward, crenate, 4 crenatins on each side, in part acute and nearly forming right angles; vertical view elliptic, with a broad inflation on each side; lateral view of semicell ovate, apex truncate, tumid in the middle on both sides; cell-wall smooth. Fig. 89.
Fig. 64: zygnema collinsianum a, b;
65: Zygnesia tenue.
Dimensions: Semicells 21-26.88 μ broad and 28-37.52 μ long; isthmus 6.16-8.96 μ wide.

Distribution: With other lagaes of river.

Cosmarium meneghinii Brebisson. Tiffany and Britton, op. cit., 186, pl. 54, fig. 597, 1952.

Cells longer than wide, deeply constricted, sinus narrow and linear, semicells transversely rectangular in lower part, pyramide-truncate above, sides parallel below and strongly convergent upward, all sides retuse, the apex strongly so, angles rounded; vertical view elliptic; lateral view of semicell broadly elliptic or subcircular; cell – wall smooth; chromatophore axial, 1 in each semicell; pyrenoid single, central. Fig. 81.

Dimensions: Semicells 10.72-20.3 μ broad and 12.87-22.88 μ long; isthmus 3.15-5.72 μ wide.

Distribution: With other algae on the bank of river.

Cosmarium granatum Brebisson. Tiffany and Britton, op. cit., 186, Pl. 53, Fig. 565, 1952.

Cells longer than wide, subrhomboid-elliptic, deeply constricted, sinus linear, slightly dilated at the apex; semicells truncate pyramide, basal angles rounded, sides straight, slightly convex, or rarely slightly concave, subparallel at the base and converging toward the apex, upper angles obtuse, apex narrowly truncate and straight; vertical view elliptic; lateral view of semicell elliptic-ovate; cell-wall finely punctate; chromatophores axial; pyrenoid single, central. Fig. 79.

Dimensions: Semicells 19.6-29.68 μ broad and 27.44-50.4 μ long; isthmus 6.44-8.4 μ wide.

[58]
Fig. 66: Spirogyra punctiformis;
67. Spirogyra rectangularis.
**Distribution**: In moist sand on the bank of river or with other algae and in sand culture.

*Cosmarium punctulatum* Brebisson. Tiffany and britton, *op. cit.*, 188, Pl. 54, fig. Fig. 592, 1952.

Cells length slightly greater than width, deply constricted, sinus linear, with apex slightly dilated and outer extremity open, isthmus narrow; semicells oblong-trapeziform, somewhat reniform, or subpyramidate in outline, finely granular, basal and apical angles broadly rounded, apex truncate or slightly convex, lateral margins convex; lateral view of semicells circular; vertical view elliptic, sometimes with a very slight inflation at the middle on each side; cell-wall granulate, granules small and uniform, sometimes reduced or absent in the central area; chromatophores axial; pyrenoid single, central. **Fig. 83.**

**Dimensions**: Semicells 28-37.52 µ broad and 30.8-39.96 µ long; isthmus 7.84-11.76 µ wide.

**Distribution**: In ditches on the bank of river.

*Comarium reniforme* (Ralfs) Archer. Tiffany and britton, *op. cit.*, 188, Pl. 53, Fig. 586, 1952.

Cells length slightly greater than width, deeply constricted, sinus narrow and closed, open outward and widely dilated at the apex; isthmus narrow and somewhat elongate; semicells reniform, outline granulate; lateral view of semicells circular; vertical view elliptic; cell-wall with coarse granules arranged in obliquely decussating series and sometimes in indistinct vertical series; chromatophores axial; 2 pyrenoids in each semicell. Fig. 87.
Fig. 68: Spirogyra sp.; 69 Spirogyra sp.
Dimensions: Semicells 36.4-56 μ broad and 44.8-65.8 μ long; isthmus 134-19.6 μ wide.

Distribution: in wet sand on the bank of river and mixed with other algae.

Cosmarium formosulum var. nathorstii (Boldt) W. and G.S. West. Tiffany and Britton, op. cit., 190, Pl. 54, Fig. 590, 1952.
Cells with basal angles less rounded than in the species, lateral margins with 3-6 bigranulate or emarginate crenations, the granules of central tumor stronger and more pronounced. Fig. 84.

Dimensions: Semicells
42.12-49.14 μ broad and 44.93-52.65 μ long; isthmus 11.23-15.79 μ wide.

Distribution: With other algae of river and in moist sand.

Cosmarium botrytis Meneghini. Tiffany and Britton, op. cit., 191, pl. 53, fig. 568, 1952.
Cells longer than width, deeply constricted, sinus linear, with the apex slightly dilated and outer margin open, isthmus narrow; semicells truncate pyramidate, basal angles broadly rounded, sides convex, apex narrowly truncate or subtruncate, apical angles rounded; vertical view elliptic, sides inflated in the median portion; lateral view of semicells broadly elliptic; cell-wall coarsely granulate, the granules usually not forming a definite pattern, about 30-60 visible at the margin of each semicell; chromatophores axial, 2 in each semicell, each with 4-6 radiating plates with their peripheral edges flattened against the cell-wall; pyrenoid single, central. Fig. 88.
Dimensions: Semicells 52-72 μ broad and 62-104 μ long; isthmus 14.4-24 μ wide.

Distribution: With other algae of river.

Cosmarium broomei Thwaites. Tiffany and Britton, op. cit., 192, Pl. 53, Fig. 575, 1952.

Cells abot as long as wide, deeply constricted. Sinus narrowly linear, the apex slightly dilated; semicells oblong-rectangular or rectangular-trapeziform, the alges slightly rounded, sides convex and sometimes slightly convergent upward, apex straight or slightly retuse; vertical view narrowly elliptic, with a rounded inflation at th middle on each side; lateral view of semicells subcircular-depressed; cell-wall densely covered with small granules arranged in vertical series, about 30-34 visible at the margin of each semicell; chromatophores axial; pyrenoids 2 in each semicell. Fig. 86.

Dimensions: Semicells 32-44 μ broad and 42-50 μ long; isthmus 12-16 μ wide.

Distribution: In moist sand and mixed with other algae on the bank of river.

cosmarium sp.

Cells large, longer than broad, cell wall granulate, pyrenoids one in each semicell. Fig. 91.

Dimensions: Semicells 34-42 μ broad 52-64 μ long; isthmus 11.2-16.4 μ wide.

Distribution: mixed with other algae of river.
Fig. 70: Spirogyra singlaris; a, b; 71. Spirogyra ellipsosporan; 72. Spirogyra sp.
Genus *STAUARSTRUM* Meyen

*Stauastrum oxyacanthum* Archer. Tiffany and Britton, op. cit., 199, Pl. 54, Fig. 604, 1952.

Cells wider than long, including the process, deeply constricted, sinus almost rectangular, acute; semicells subfusiform or subcuneate, dorsal margin slightly convex, ventral margin tumid, angles produced to oong, slender, slightly convergent processes terminating with about 3 minute spines and 3-4 cocentric series of minute teeth; apex with a pair of fairly view 2-4 but usually 3-angled sides straight and smooth, a pair of stout spines projecting from within each margin, angles produced to denticulate processes; chromatophore axial, with a pair of plates extending into each angle; pyrenoid single, central. Fig. 93.

**Dimensions**: Cells (Including process) 36.4-39.76 μ broad and 26.32-28.56 μ long.

**Distribution**: With other algae of river.

*Stauastrum gracile* Ralfs. Tiffany and Britton, op. cit., 199, Pl. 55, Fig. 613, 1952.

Cells length often greater than the width, excluding the processes, deeply constricted, sinus with an acute apex and opeiing widely, isthmus narro; semicells broadly triangular to cup-shaped, dorsal margin slightly concave to convex with a row of small emarginate verrucae, below which there is sometimes a short row of granules; angle to the sides of the cell, the centre without ornamentation, processes with transverse rings of græules and terminating in 3 or 4 small spines; chromatophore axial, with 2 laminate blades extending to each angle or a short distance into the processes; pyrenoid single, central. Fig. 94a, b.
Fig. 76: Closterium venus; 74: Closterium parvulum; 75: closterium turgidum; 76: Closterium moniliferum; 77: Closterium acerosum.
Dimensions: Cells 44-86 μ broad and 28-78 μ long.

Distribution: In sandy material of river.

Staurastrum hexacerum (Ehrenberg). Tiffany and Britton, op. cit., 199, Pl. 55, fig. 611, 1952.

Cells slightly wider than long, deeply constricted, sinus open and acute at the apex; semicells fusiform, amrgins convex, tapering to the angles which and continued to very short processes terminating in 3 small spines; cell-wall covered with small granules arranged in concentric series around the angles, reduced in size and number on the apex and centre of the cell face; vertical view usually triangular, latral margin concave; chromatophore axial; pyrenoid single, central. Fig. 95.

Dimensions: Cells 22-23 μ broad and 16-24 μ long.

Distribution: In moist sand on the bank of river.

CHAROPHYCEAE

CHARALES

CHARACEAE

Genus CHARA Linnaeus

Chara excelsa Allen. Prescott, op. cit., 338, Pl. 81, Fig. 10, 1982.

Plants coarse and brittle, encrusted with lime; stems bearing 7-8 leaves and a double whorl of stipulodes of which the upper row is longer than the lower; contication of the internode prominent than the secondary laterals; 2-3 cells at the tip of the leaves uncorticated; sex organs monoecious, produced on the same node; inverting cells showing 7-10 turns, bracts subtending the oogonium longer than the fruit. Fig. 14.

Dimensions: Plants 6.2-14 cm high; oogonium 0.8-1.4 mm long; globule about 146.0-189.8 μ broad and nucule about 146.0-175.2 μ broad.
**Distribution**: In shallow water on the bank of river.

**CHRYSOPHYTA BACILLARIOPHYCEAE**

**CENTRALES**

**COSCINODISCINEAE**

**COSCINODISCACEAE**

**Genus CYCLOTELLA** Kuetzing

**Cyclotella meneghiniana** kuetzing. Tiffany and Britton, op. cit., 218, Pl. 58, fig. 660, 1952. Heurck, H.V., A Treatise On The Diatomaceae, 447, Pl. 22, fig. 656, 1896.

Outer zone of the cells broad; central zone smooth or finely radially punctate, often with a large isolated puncta. **Fig. 99**.

**Dimensions**: Cells 10.86-22.95 μ in diameter; about 7-9 striae in 10 μ.

**Distribution**: Planktonic in water and in wet sand. Fond in sand and water cultures.

**Cyclotella kuetzingiana** Thwaites. Tiffany and Britton, op. cit., 218, Pl. 58, Fig. 657, 1952.

Outer zone of the cell with striae; inner zone smooth or with fine, scattered punctae. **Fig. 100**.

**Dimensions**: Cells 10.01-35.75 μ in diameter; about 16-17 striae in 10 μ.

**Distribution**: Planktonic in water and in wet sand. Found in and and water cultures.

**Cyclotella operculata** (Agardh) Kuetzing. Tiffany and Britton, op. cit., 220, Pl. 58, fig. 661, 1952: Heurck, op cit., 447, Pl. 22, fig. 655, 1896.

Cells more or less tangentially undulate; outer zone with striae; inner zone smooth or very finaely and weakly punctate; punctae scattered. **Fig. 103a, b.**

[68]
Dimensions: Cells 8.56-27.82 µ in diameter; about 13-14 striae in 10 µ.

Distribution: Planktonic and in wet sand of river. Found in sand and water cultures.

**Cyclotella glomerata bachmann.** Tiffany and Britton, op. cit., 220. Pl. 58, Fig. 656, 1952.

Cells forming colonies of coiles and intertwining chains, cells not touching each other; outer zone with radial striae; inner zone smooth or with a ring of short striae in the central part Fig. 102a, b.

Dimensions: Cells 5.6-9.8 µ in diameter: about 14-15 striae in 10 µ

Distribution: Planktonic and in wet sand on the bank of river. Found in sand and water cultures.


Outer zone of the cells with pronounced striae; inner zone with several circular dots., Fig. 101.

Dimensions: Cells 7.65-19.86 µ in diameter; about 14-16 striae in 10µ

Distribution: Mixed with other diatoms of the river.

Genus MELOSIRA C.A. Agardh.

**Melosira granulata** (Ehrenberg) Ralfs. Tiffany and Britton, Op. cit., 221, Pl. 59, Fig. 667, 1952; Heurck, Op. cit., 444, Pl. 19, Fig. 621, 1896

Suclus shallow but acute; values with short marginal teeth and large scattered indistinct punctae; girdles coarsely punctate; striations parallel and straight. Fig. 97

Dimensions: Cells 6.16-29.6 µ in diameter; about 7-9 striae in 10µ

Distribution: Planktonic mixed with other diatoms of river.
Melosira granulata var. curvata Grun. Heurck, Op. cit., 444 Pl. 19, Fig. 622, 1896.

Valves very long; filament very narrow, curved. Fig. 98

Dimensions: Cells 5.6-12 μ in diameter.

Distribution: Planktonic and found in wet sand on the bank of river.


Valve with finely punctate disc, puncta scattered, margins showing numerous well marked denticulations; frustule much longer than broad, showing on the margin of the valves a slightly marked sulcus; striae, with striae generally somewhat oblique, consisting of somewhat elongated puncta. Fig. 96.


Distribution: Planktonic found in wet sand of river.

PENNALES

DIATOMACEAE

Genus Tetracyclus (Ralf) Grun.

Tetracyclus rupestris (A. Braun) Grun. Heurck, op. cit., 357 Pl. 11, Fig. 489a, 1896.

Valve elliptic-lanceolate; costae, transverse, robust; striae fine;
girdle face generally showing two pairs of internal septta; frustules solitary or united by two or three or more. Fig. 106

Dimensions: Cells 3.62-6.52 μ broad and 10.72-24.60 μ long;

about 3-5 costae in 10μ

Distribution: Found in ditches on the bank of river.

Genus Denticula Kutzing

[70]
**Denticula elegans** Kutz. Heurck, *Op. cit.*, 351, Pl. 31, Fig. 860, 1896.

Valve liner, lanceolate, with apices obtuse rounded; carina obscure; striae robust, strongly punctate; girdle face very broad, rectangular, with rounded angles, showing the apices of the costae, strongly capitate. Fig. 107.

Dimensions: Cells 8.29-9.29 μ broad and 22.88-29.74 μ long about 5 costae in 10μ

Distribution: Mixed with other diatoms and in wet sand of river.

**FRAGILARIACEAE**

Genus **FRAGILARIA** Lyngbye

**Fragilaria crotonensis** (A.M. Edwards) Kittum! Heurck, *Op. cit.*, 324, Pl. 11, Fig. 444, 1896.

Valve linear, very narrow, slightly inflated at the median portion, with apices capitate; girdle face strongly inflated at the median portion, and slightly enlarged at the apices; frustules united in ilaments at the middle. Fig. 105.

Dimensions: Cells 2.14-4.58 μ broad and 41.47-97.24 μ long; about 15 striae in 10μ

Distribution: In wet sand of river and in water culture.

**Fragilaria construens** (Ehr.) Grun.! Heurck, *Op. cit.*, 325, Pl. 11. Fig. 450. 1896; Tiffany and Britton. *Op. cit.*, 232, Pl. 62, Fig. 626, 1952.

Valve broadly oval, constricted somewhat below the median portion into rostrate-capitate apices, giving a cruciform appearance; pseudo-raphe lanceolate; striae fine. Fig. 104
Fig. 78. Cosmarium depressum a, b.; 79. Cosmarium granatum; 80. Cosmarium ritidulum; 81. C. menghinii; 82 C. circulare; 83. C. punctulatum; 84. C. formosulum var. nathorstii; 85. C. constrictum; 86. C. broomei.
Dimensions: Cells 6.12-9.94 μ broad and 9.18-18.36 μ long; about 14-16 striae in 10μ

Distribution: Mixed with other algae of water.

Genus **SYNEDRA** Ehrenberg

**Synedra ulna** (Nitzsch) Ehrenberg. Tiffany and Britton, op. cit., 237, Pl. 63, Fig. 713, 1952

Cells linear in girdle view, with widened extremities, solitary; valves linear to linear-lanceolate, gradually narrowed toward the ends, with broadly rounded poles; transverse striations finely but plainly punctate; pseudoraphe narrowly linear, with central area varying, often absent. Fig. 112.

Dimensions: Cells 5.6-8.8 μ broad and 72-320 μ long; about 9-12 striae in 10μ

Distribution: Planktonic and in wet sand of river. Found in sand and water cultures.

**Synedra ulna var. aequalis** (Kuetzing) Hustedt. Tiffany and Britton, op. cit., 237, Pl. 63, Fig. 714, 1952.

Cells with straight sides in valve view, scarcely narrowed toward the rounded ends. Fig. 111.

Dimensions: Cells 5.6-8 μ broad and 160-340 μ long; about 10-11 striae in 10 μ

Distribution: In wet sand of river.

**Synedra ulna var. danica** (Kuetzing) Grunow. Tiffany and Britton, op. cit., 237, Pl. 63, Fig. 715, 1952.

Cells scarcely attenuate toward the slightly capitate ends. Fig. 109.

[73]
Dimensions: Cells 4.8-6 μ broad and 120-280 μ long; about 8-10 striae in 10μ.

Distribution: Planktonic and in wet sand of river and in water culture.

*Synedra ulna* var. *longissima* W. Sm. Heurck, *Op. cit.*, 311, Pl. 10, Fig. 412, 1896.

Valve linear, narrow, and excessively elongated, with apices strongly capitate. Fig. 113.

Dimensions: Cells 6.4-20.6 μ broad and 180-312 μ long; about 6-9 striae in 10μ

Distribution: In wet sand of river.

*Synedra ulna* var. *lanceolata* Kutz. Heurck, *op. cit.*, 311, Pl. 10, Fig. 416, 1896

Narrowly lanceolate, and infinitesimally attenuate up to the apices. Fig. 108.

Dimensions: Cells upto 10 μ broad and about 152 μ long; about 9 striae in 10μ

Distribution: Mixed with other diatoms of the river.

*Synedra acus* (Kutz.) Grun. Tiffany and Britton, *Op. cit.*, 237, Pl. 63, Fig. 720, 1952: Heurck, *op. cit.*, 311, Pl. 10, Fig. 420, 1896.

Valve narrowly lanceolate, with apices slightly rostrate-capitate; pseudoraphe narrow; striae well marked, interrupted in the middle of the valve by a hyaline space, elongated, generally quadrangular. Fig. 110.
Fig. 87: Cosmarium reniforme; 88: Cosmarium botryies a, b; 89: Cosmarium subimpressulum; 90: Cosmarium curtum; 91. Cosmarium sp.; 92; Euastrum inermius; 93: Staurastrum oxyacanthum; 94: Staurastrum gracile a, b; 95: Staurastrum hexacerum.
Dimensions: Cells 5.6-7.2 μ broad and 108-208 μ long; about 12-14 striae in 10μ

Distribution: Planktonic and in wet sand of river and in water culture.

*Synedra radians* (Kutz) Grun. Heurck, *op. cit.*, 312, Pl. 10, Fig. 423, 1896

Valve very narrowly linear, lanceolate, with apices somewhat capitae; striae fine. Fig. 114.

Dimensions: Cells 1.45-2.9 μ broad and 42.9-87.23 μ long; about 16-18 striae in 10μ.

Distribution: Mixed with other diatoms of river.

*Synedra vaucheriae* var. *parvula* Kutz. Heurck, *op. cit.*, 310, Pl.10, Fig. 407, 1896.

Muh smaller, and more lanceolate. Fig. 115

Dimensions: Cells about 6.67 μ broad and 14.5-19.30 μ long about 14-15 striae in 10 μ

Distribution: Planktonic and in wet sand of river and in water culture.

*Synedra vaucheriae* var. *perminuta* Grun. Heurck, *op. cit.*, 310 Pl. 10, Fig. 408, 1896.

very small. Fig. 116.

Dimensions: Cells about 1.99 μ broad and 9.76-10.09 μ long about 18-19 striae in 10μ

Distribution: Planktonic and in wet sand of river.

*Synedra pulchella* Kutz. Heurck, *op. cit.*, 309, Pl. 10, Fig. 402, 1896; Tiffany and Britton, *op. cit.*, 236, Pl. 63, Fig. 718, 1952.

[76]
Valve narrowly lanceolate, with apices gently rostrate capitate; pseudonodule strongly marked, often reaching to the margin; pseudo-raphe narrow terminate by small but distinct nodules; striae distinctly punctate; girdle face narrow, linear, attenuate at the apices; frustules forming flabellla.

**Dimensions:** Cells 5.04-7.84 μ broad and 36.4-72.8 μ long about 13-14 striae in 10μ

**Distribution:** Mixed with other diatoms of river.

**ACHNANTHINEAE**

**ACHNANTHACEAE**

**Genus COCCONEIS Ehr. Grun**

*Cocconeis placentula* Ehrenberg. Heurck, *op. cit.*, 288, Pl. 8, Fig. 341, 1896; Tiffany and Britton, *op. cit.*, 241, Pl. 64, Figs. 734, 735, 1952.

Valve elliptic, plane or very slightly flexed; median hyaline zone of the superior valve enlarged at the centre of the valve and showing feeble traces of raphe and nodules; inferior valve furnished with an annulus covered with striae, punctate, distant, separated by a hyaline zone from the remainder of the valve, which is covered with radiating striae, fine, punctate Fig. 122.

**Dimensions:** Cells 9.42-26.1 μ broad and 11.6-34.8 μ long; about 22-23 striae in 10 μ

**Distribution:** Found in wet sand of river and in water culture.

*Cocconeis pediculus* Ehr. Heurck, *op. cit.*, 288, Pl. 8, Fig. 340, 1896.

Valve elliptic, plane or very slightly flexed; median hyaline zone of the upper valve enlarged at the centre of the valve, and showing feeble traces of raphe and nodules; lower valve furnished with a ring covered with
striae, punctate, distant, separated by a hyaline zone from the rest of the valve. Fig. 123.

**Dimensions:** Cells 8.7-24 µ broad and 12.32-34.8 µ long; about 15 striae in 10 µ

**Distribution:** Found in wet sand of river.

**Genus ACHNANTHES Bory**

*Achnanthes exilis* Kutz. Heurck, *op. cit.*, 281, Pl. 8, Fig. 333, 1896.

Valves narrowly lanceolate; apices rounded, subobtuse; striae somewhat radiate; the median more robust, more distant, and more strongly radiant, sortened and leaving an elongated hyaline area, larger in the lower than in the upper valve. Fig. 117a, b.

**Dimensions:** Cells 3.06-5.35 µ broad and 15.3-27.54 µ long about 25-27 striae in 10µ

**Distribution:** Planktonic and in wet sand of river and in water culture.

*Achnanthes minutissima* Kutz. Heurck, *op. cit.*, 282, Pl. 8, Fig. 334, 1896.

Valves very narrowly lanceolate, with apices gently produced, rostrate, obtuse, rounded; striae delicate, feebly radiant, the median shortened. Fig. 118.

**Dimensions:** Cells 2.9-7.25 µ broad and 15.95-20.59 µ long about 24-26 striae in 10 µ

**Distribution:** In wet sand of river.

*Achnanthes linearis* W. Sm. Heurck, *op. cit.*, 282, P; 8, Fig. 335, 1896.

Valves more linear, elongated somewhat produced, rostrate and its striae somewhat stronger and sub-parallel. Fig. 119.
Dimensions: Cells 1.53-3.82 μ broad and 10.71-14.53 μ long; about 25-27 in 10 μ.

Distribution: In wet sand of river.

Achnanthes lanceolata Breb. Heurck op. cit., 282, Pl. 8. Fig. 336, 1986; Tiffany and Britton, op. cig., 241, Pl. 64, Fig. 724, 1952.

Valves elliptic; the upper showing on one margin a hyaline space in the form of a horse shoe; the lower with median striae much shortened, and forming a pseudo-stauros. Fig. 120.

Dimensions: Cells 5.6-9.8 μ broad and 11.2-19.6 μ long; about 12-14 striae in 10 μ

Distribution: Planktonic and in wet sand of river and in sand culture.

Achnanthes lanceolata var. dubia. Heurck, op. cit., 283, Pl. 8, Fig. 337 1896.

Differs from the type form by its striae somewhat closer, by its lanceolate form, with produced rostrate apices, and by its somewhat shorter pseudo-stauros. Fig. 121a, b.

Dimensions: Cells 4.28-8.7 μ broad and 12.24-14.99 μ long; about 13-14 striae in 10 μ

Distribution: Mixed with other diatoms of river.
Genus **MASTOGLOIA** Thwaites

**Mastogloia smithii** Thwaites. Heurck, *op. cit.*, 154, Pi. 2, Fig. 60, 1896.

Valves elliptical with apices often slightly produced, rostrate; marginal plates broad; atenuate at the apices; showing from 6 to 8 loculi; central nodule slightly extended laterally; striae robust, distinctly punctate, radiant upto the extremity of the valves. Fig. 125.

**Dimensions:** Cells 7.84-12.6 μ broad and 30.8-44.8 μ long; about 15-17 striae in 10 μ

**Distribution:** Planktonic and in wet sand of river. Found in sand and water cultures.

Genus **NAVICULA** Bory

**Navicula protracta** (Grunow) Cleave. Tiffany and Britton, *op. cit.*, 254, Pl. 67, Fig. 775, 1952.

Valvers linear with broadly rostrate ends, axial area very narrow; transverse straitions slightly radial except at the extremities.

**Dimensions:** Cells 7.84-9.8 μ broad and 22.4-35 μ long; about 18-20 striae in 10μ.

**Distribution:** In wet sand on the bank of river.

**Navicula radiosa** Kuetzing. Tiffany and Britton. *op. cit.*, 255, Pl. 67, Fig. 780, 1952; Heurck, *op. cit.*, 180, Pl. 3, Fig. 112, 1896.

Valves lanceolate, gradually tapering to more or less pointed ends; transverse striations radial, except at the ends. Fig. 130.

**Dimensions:** Cells 10.64-16.8 μ broad and 42-70 μ long; about 11-12 striae in 10-μ

[80]
Distribution: Mixed with other algae of river.

**Navicula exigua** (Gregory) Muceller. Tiffany and Britton, op. cit., 256, Pl, 67, Fig. 770, 1952.

Valves elliptic-lanceolate with rostrate, sometimes slightly capitate ends; central area transversely widened, irregular; transverse striations radial, medianly alternately long and short. Fig. 134.

**Dimensions:** Cells 8.4-13.44 μ broad and 22.4-35 μ long; about 11-13 striae in 10μ

**Distribution:** Planktonic and mixed with other diatoms of the river.

**Navicula gastrum** Ehrenberg. Tiffany and Britton, op. cit., 256, Pl. 67, Fig. 786, 1952; Heurck, op. cit., 186, Pl. 3, Fig. 134, 1896.

Valves broadly elliptic, with short rostrate and broadly rounded ends; central area widened, irregular; transverse striations radial, medianly alternately long and short. Fig. 132.

**Dimensions:** Cells 14-21 μ broad and 28-50.4 μ long; about 8-1- striae in 10μ.

**Distribution:** Planktonic and mixed with other algae of water.

**Navicula platystoma** Ehrenberg. Tiffany and Britton, op. cit., 256, Pl. 67, Fig. 774, 1952.

Valves elliptic-lanceolate, with broadly and bluntly rostrate ends; central area widened, rhombo-elliptic; transverse striations radial.

**Dimensions:** Cells 15.68-1848 μ broad and 37.8-47.6 μ long about 16-17 striae in 10μ

**Distribution:** Mixed with other diatoms of the river.

[81]
**Navicula dicephala** (Ehrenberg) Wm. Smith. Tiffany and Britton, op. cit., 256, Pl. 67, Fig. 768, 1952: Heurck, op. cit., 188, Pl. 3, Fig. 138, 1896.

Valves broadly linear to linear-lanceolate, with ends abruptly rostrate and somewhat capitate; transverse striations radial, central area rectangular.

**Dimensions:** Cells 8.4-12.6 \( \mu \) broad and 22.4-39.2 \( \mu \) long; about 9-11 striae in 10\( \mu \).

**Distribution:** Planktonic and in wet sand on the bank of river and in sand culture.

**Navicula anglica** Ralfs. Tiffany and Britton, op. cit., 256, Pl. 67, Fig. 764, 1952; Heurck, Op. cit., 187, Pl. 3, Fig. 136, 1896.

Valves elliptic with short rostrate and slightly capitate ends; transverse striations radial, shortened on either side of the rounded central area. Fig. 131.

**Dimensions:** Cells 8.58-13.32 \( \mu \) broad and 20.-2-37.18 \( \mu \) long about 9-11 striae in 10\( \mu \).

**Distribution:** Planktonic and in wet sand of river and in sand culture.

**Navicula seminulum** Grunow. Tiffany and Britton, op. cit., 255, Pl. 67, Fig. 777, 1952; Heurck, op. cit., 227, Pl. 5, Fig. 228, 1896.

Valves linear-elliptic, with slight median expansion and broadly rounded poles; transverse striations radial.

**Dimensions:** Cells 4.00-4.86 \( \mu \) broad and 11.44-15.73 \( \mu \) long; about 19-20 striae in 10\( \mu \).

**Distribution:** In wet sand of river and in water culture.

**Navicula borealis** Ehr. Heurck, op. cit., 170, Pl. 2, Fig. 77, 1896.
Valves linear-elliptic, sometimes feebly attenuated at the apices, which are rounded or subtruncate costae rather robust, distant, and reaching almost to the raphe, except those in the middle, which are shorter; costae radiate at the median portion of the valve, becoming imperceptibly convergent towards the apices.

**Dimensions:** Cells 8-16 μ broad and 32-60 μ long; about 5-6 costae in 10μ.

**Distribution:** Mixed with other algae in ditches on the bank of river:

*Navicula hilseana* Janisch. Heurck, *op. cit.*, 171, Pl. 2, Fig. 81, 1896.

Valve linear, with rostrate-capitate apices; raphe without hyaline zone; central nodule surrounded by a pseudo-stauros rather broad, subcuneate; striae rather feeble, radiate in the centre, convergent at the apex of the valve.

**Dimensions:** Cells 4.48-10.08 μ broad and 36.96-40.04 μ long about 9-10 striae in 10 μ.

**Distribution:** In wet sand of river.

*Navicula cineta* (Ehr.!) Kutz. Heurck, *op. cit.*, 178, Pl. 3, Fig. 105, 1896.

Valves lanceolate, very narrow, with rounded obtuse apices; central nodule surrounded by a hyaline area somewhat extended transversely; striae delicate, those round the central nodule much more distant.

**Dimensions:** Cells 5.6-8.4 μ broad and 37.8-39.76 μ long about 11-13 striae in 10 μ

**Distribution:** mixed with after algae of river.

*Navicula cineta var. Heufleri* Grun. Heurck, *op. cit.*, 178, Pl. 3, Fig. 106, 1896.
Smaller with median hyaline space round; striae more robust and more distant.

**Dimensions:** Cells 2.8-7.28 μ broad and 21-25.2 μ long; about 10-11 striae in 10μ

**Distribution:** In wet sand on the bank of river.

*Navicula cryptocephala* Kuta.! Heurck, *op. cit.*, 180, Pl. 3, Fig. 122, 1896.

Valve lanceolate, elongate, with apices rostrate, slightly capitate; central nodule surrounded by a rounded hyaline area; striae rather robust, with very feeble transverse divisions, radiant at the median portion of the valve, scarcely convergent at the apices.

**Dimensions:** Cells 4.28-6.12.μ broad and 26.1-34.88 μ long; about 15-17 striae in 10μ

**Distribution:** Planktonic and in wet sand on the bank of river.

*Navicula humilis* Donk. Heurck, *op. cit.*, 182, Pl. 3, Fig. 127, 1896.

Valve linear, very inflated at the median portion, with apices rostrate capitate, truncate, rounded; raphe not surrounded by a hyaline area; costae very robust, radiant at the median portion, convergent at the apices; terminal nodules like hooks.

**Dimensions:** Cells 4.2-7.84 μ Broad and 15.4-19.88 μ long about 7-9 costae in 10 μ

**Distribution:** In wet sand on the bank of river.

*Navicula lanceolata* Kutz. Heurck, *op. cit.*, 186, Pl. 3, Fig. 139, 1896.

Valve lanceolate, with apices gently diminuate-rostrate; striae shortened round the central nodule, radials upto the apices of the valve.

[84]
Dimensions: Cells 8.12-9.8 μ broad and 30.8-40.6 μ long; about 15-16 striae in 10 μ

Distribution: In wet sand on the bank of river.

Navicula capitata Ehr. Heurck, op. cit., 187, Pl. 25, Fig. 719a, 1896.
Valve small, oblong, inflected in the median portion, abruptly inflated at the apices, which are rostrate not capitate; striae distinctly punctate, radiate, not reaching to the raphe, and leaving a rather large hyaline area round the central nodule.

Dimensions: Cells 6.12-7.96 μ broad and 20.19-39.78 μ long; about 6-7 striae in 10 μ

Distribution: In wet sand of river.

Navicula inaequilatera Lag. Heurck, op. cit., 190, Pl. 25, Fig. 727, 1896.
Valve lanceolate, narrow, with somewhat unequal margins; apices rostrate capitate; transverse striae radiate, rather fine; girdle face with straight margins, not inflated at the median portion.

Dimensions: Cells about 4.2-8.4 μ broad and 30.8-39.2 μ long about 12-14 striae in 10 μ

Distribution: Planktonic and in wet sand on the bank of river. Found in sand and water culture.

Navicula tuscula (Ehrenberg) Grunow. Tiffany and Britton, op. cit., 225, Pl. 67, Fig. 779, 1952; Heurck op. cit., 206, Pl. 4, Fig. 166, 1896.
Valves elliptic, with apices strongly rostrate-capitate; raphe surrounded by a narrow hyaline zone, dilated round the central nodule into a pseudo-
Fig. 9: Melosira distanse; 97. Melosira granulata; 98. Melosira granulata var. curvata; 99. Cyclotella meneghiniana; 100. Cyclotella kuetzingiana; 101. Cyclotella ocellata; 102. Cyclotella glomerata a, b; 103. Cyclotella operculata a, b;
stauros, irregularly subdivided; striae becoming radiate from the middle of the value, finely divided transversely and with frequent interruptions, the entirely forming irregular longitudinal lines.

**Dimensions:** Cells 12-22 μ broad and 20-64 μ long; about 10-12 striae in 10μ.

**Distribution:** In wet sand or river.

**Dimensions:** Cells 14.98-21.4 μ broad and 62.06-69-38 μ long

**Distribution:** In wet sand on the bank of river.

**Navicula sculpa** Ehr. Heurck, *op. cit.*, 216, Pl. 4, Fig. 194, 1896.

Valve elliptic, with tapering apices, then longly rostrate, rostrum obtuse; raphe surrounded by a considerable hyaline zone: striae teebly radiate, formed of coarse puncta, interrupted near the raphe by a broad depression of the value in such a manner as to leave against it only a single row of granules. The depression also continues but not so deep-near one of the margins of the valve in the form of a unilateral, indistinct, pseudo-stauros.

**Dimensions:** Cells 16-24.92 μ broad and 56-96 long; about 22-23 striae in 10 μ.

**Distribution:** In ditches on the bank of river.

**Navicula sphaerophora** Kutz. Herck, *Op. cit.*, 216, Pl. 4, Fig. 195, 1896.

Valve elliptic-lanceolate, with apices rotrate-capitate. Raphe surrounded by a considerable hyaline area; striae gently radiate, granular, interrupted by narrow longitudinal depressions and by a broad transverse depression, forming a very conspicuous pseudo-stauros. Fig. 126.

**Dimensions:** Cells 17.64-20 μ broad and 56-76 μ long; about 15-17 striae in 10 μ.

**Distribution:** In wet sand on the bank of river.
**Navicula ventricosa** (Ehr.?!) Donkin. Heurck, *op. cit.*, 220, Pl. 5, Fig. 209, 1896.

Inflations scarcely noticeable, its finer striae, and stauroneiform hyaline area which surrounds the central nodule. Figure. 128.

**Dimensions:** cells 12.32-12.6 μ broad and about 59.39-61.6 μ long; about 18-19 striae in 10 μ.

**Distribution:** In wet sand of river.

**Navicula pupula** Kutz. Heurck, *op. cit.*, 225, Pl. 5, Fig. 226, 1896.

Valve linear, inflated at the median portion and at the apices which are rounded; raphe surrounded by a narrow hyaline zone, abruptly enlarged into a pseudo-stauros round the central nodule; terminal nodules prolonged laterally. Fig. 127.

**Dimensions:** Cells 6-12 μ broad and 17.6-36 μ long; about 21-23 striae in 10μ.

**Distribution:** In wet sand of river.

**Navicula exilissima** Grun. Heurck, *op. cit.*, 229, Pl. 5, Fig. 234, 1896.

Valve linear-subelliptic; striae fine, radiate, the median ones somewhat more distant, details indistinct even with homogeneous objectives.

**Dimensions:** Cells 2.45-2.75 μ broad and 7.65-9.79 μ long about 35-40 striae in 10 μ.

**Distribution:** Mixed with other algae of river.

**Navicula perpusilla** Grun. Heurck, *op. cit.*, 229, Pl. 35, Fig.991, 1896.

Valve minute, oblong, with rounded apices, inflated at the median portion; transverse striae very delicate, subparallel, indistinct.

**Dimensions:** Cells 2.29-5.35 μ broad and 10.40-11.47 μ long.

**Distribution:** In wet sand of river and in water culture.

[88]
Navicula gallica (W. Sm.) H. van Heurck. Heurck, op. cit., 229, P.: 5, Fig. 237, 1896.

Valve linear-elliptic or linear, with median portion somewhat inflated, apices obtuse rounded, presenting throughout the length of the margin an appearance of coarse beads; raphe surrounded by a slight hyaline zone, somewhat dilated near the central nodule; striae gently radiate, very fine, distant; frustules with girdle face quadrangular, united into long filaments.

**Dimensions:** Cells 2.75-3.21 µ broad and 8.87-14.53 µ long; about 27-28 striae in 10 µ.

**Distribution:** In ditches on the bank of river.

Navicula oculata Breb! Heurck, op. cit., 201, Pl. 4, Fig. 155, 1896.

Valve linear-oblong, with broadly rounded apices; central nodule subquadangular; raphe surrounded by a narrow hyaline zone; sulci approximate to raphe, straight, gently incurred near the central nodule; striae finely punctate, straight at the median portion, then becoming little by little radiate.

**Dimensions:** Cells 4.2-7.28µ broad and 21.84-25.2 µ long; about 16-18 striae in 10 µ.

**Distribution:** Mixed with other algae of river.

Navicula exilis Grun. Heurck, op. cit., 217, Pl. 4, Fig. 198, 1896

Valve lanceolate, narrow, with apices rostrate-capitate; striae fine. Fig. 129.

**Dimensions:** Cells 4.00-5.00µ broad and 23.8-29.4 µ long; about 28-30 striae in 10 µ.

**Distribution:** In ditches on the bank of river.

[89]
Navicula cancellata var. ammophila Grun. Heurck, op. cit., 183, Pl. 25, Fig. 712, 1896.

Valve small narrow, linear or linear lanceolate, with apices tapering acute sub-acute; raphe surrounded by a narrow hyaline zone.

Dimensions: Cells 4.48-6.16 μ broad and 17.14-29.96 μ long; about 11-13 striae in 10 μ.

Distribution: In ditches on the bank of river.

Navicula mutica Kuetzing. Tiffany and Britton, op. cit., 254, Pl. 67, Fig. 773, 1952.

Valves lanceolate with broadly rounded ends, central area rectangular, with a single isolated puncta; transverse striations strongly punctate, radial, often difficulty visible in the middle of the valve.

Dimensions: Cells 7.19-11.47 μ broad and 15.3-30.6 μ long; about 15-17 striae in 10 μ.

Distribution: In wet sand on the bank of river.

Navicula salinarum Grunow. Tiffany and Britton, op. cit., 255, Pl. 67, Fig. 783, 1952; Heurck, op. cit., 178, Pl. 3, Fig. 108, 1896.

Valves lanceolate with more or less rostrate, often lightly capitate ends, central area round; transverse striations, medianly alternately long and short radia.

Dimensions: Cells 9.8-13.16 μ broad and 28-40.6 μ long; about 14-15 striae in 10 μ.

Distribution: In wet sand of river and in water cultre.

Navicula simplex Krasske. Hustedt, Pascher's Susswasser flora, Heft. 296, Fig. 500, 1930.
Valve lanceolate with sub-capitate ends; raphe straight and thin; axial area narrow, central area small, oval; striae radial in the middle and convergent at the ends.

**Dimensions:** Cells 8.26-9.18 μ broad and 27.54-33.66 μ long; about 13-14 striae in 10 μ.

**Distribution:** In wet sand on the bank of river.

**Genus Pinnularia Ehr.**

*Pinnularia undulata* Gregory. Hustedt, *op. cit.*, 314, Fig. 565, 1930.

Valve linear, slightly tapering to obtuse somewhat capitate ends; axial area broad; central area extending to the margin; transverse striations radial. Fig. 124.

**Dimensions:** Cells 6.38-7.25 μ broad and 35.52-37.7 μ long; about 12-14 striae in 10 μ.

**Distribution:** In ditches on the bank of river.

**Genus Stauroneis Ehrenberg**

*Stauroneis anceps* Ehrenberg. Tiffany and Britton, *op. cit.*, 266, Pl. 71, Fig. 822, 1952.

Cells solitary, without polar septum; valves elliptic to linear-lanceolate, with rostrate to capitate ends; raphe straight, usually narrow; axial area narrow; stauros a band, wider at the margins; transverse striations all radial finely punctate.

**Dimensions:** Cells 9.8-17.36 μ broad and 15.3-30.6 μ long; about 20-22 striae in 10 μ.

**Distribution:** Planktonic in water and in wet sand of river. Found in sand and water cultures.

**Genus Gyrosigma Hassall**
**Gyrosigma scalpoides** (Rabenhorst) Cleve. Tiffany and Britton, *op. cit.*, 269, Pl. 66, Fig. 762, 1952.

Valves lanceolate, sigmoid, gradually attenuated to rounded poles; transverse striations, usually perpendicular to the middle line, sometimes medianly radial.

**Dimensions:** Cells 5.35-9.94 μ broad and 26.01-69.77 μ long; transverse striations about 21-24 and longitudinal striations about 26-28 in 10 μ.

**Distribution:** Plantktonic and in wet sand on the bank of river.

**Gyrosigma spencerii** (Quekett) Cleve. Tiffany and Britton, *op. cit.*, 269, Pl. 66, Fig. 763, 1952.

Valves sigmoid, with arrowly rounded ends; transverse striations, parallel to the middle line.

**Dimensions:** Cells 11.2-22.4 μ broad and 71.12-148.4 μ long; transverse striations about 18-21 and longitudinal striations about 23-24 in 10 μ.

**Distribution:** In wet sand on the bank of river.

**Gyrosigma kuetzingii** (Grunow) Cleve. Tiffany and Britton, *op. cit.*, 269, Pl. 66, Fig. 761, 1952.

Valves sigmoid, lanceolate, tapering to narrowly rounded ends; transverse striations, radial in the middle, perpendicular to the middle line elsewhere.

**Dimensions:** Cells 11.48-14.56 μ broad and 81.2-119.28 μ long; transverse striations about 21-23 and longitudinal striations about 24-25 in 10 μ.

**Distribution:** In wet sand on the bank of river.
Genus **PLEUROSIGMA** Wm. Sm.

**Pleurosigma spencerii** var. **Smithii** Grun. ! Heurck, op. cit., 257, Pl. 7, Fig. 276, 1896.

Valves lanceolate-sigmoid; central nodule small, elongate.

**Dimensions:** Cells 7-11.2 μ broad and 80.64-90.27 μ long; transverse striations about 18 and longitudinal striations about 21 in 10 μ.

**Distribution:** In wet sand on the bank of river.

**Pleurosigma spencerii** var. **modifera** Grun. ! Heurck, op. cit., 257, P; 7, Fig. 278, 1896.

Central nodule elongated, with an oblique hyaline area; the median striae slightly radiate.

**Dimensions:** Cells 6-12 μ broad and 62-96 μ long; transverse striations about 17-20 and longitudinal striations about 22-23 in 10 μ.

**Distribution:** Planktonic and in wetsand on the bank of river.

**Pleurosigma scalproides** Rab. Heurck, op. cit., 259, Pl. 7, Fig. 284, 1896.

Valve short, linear-lanceolate, slightly sigmoid, with very obtuse apices; raphe scarcely sigmoid; transverse striae, rather more robust than the longitudinal striae, the median slightly radiate.

**Dimensions:** Cells 7.97-11.65 μ broad and 60.9-71.55 μ long; transverse striations about 22 and longitudinal striations about 28-29 in 10 μ.

**Distribution:** In wet sand on the bank of river.

**GOMPHONEMATACEAE**

Genus **GOMPHONEMA** C.A. Agardh

**Gomphonema sphaerophorum** Ehrenberg. Tiffany and Britton, op. cit., 272, Pl. 72, Fig. 847, 1952.
Valves elliptic-clavate, sharply narrowing toward a rounded and slightly capitate basal pole and with a much wider knob-like apical pole; axial area narrow, linear; central area small, with a dot at one side; transverse striaations more or less clearly punctate, slightly radial.

**Dimensions:** Cells 7.34-9.94 μ broad and 27.54-42.8 μ long; about 10-14 striae in 10 μ

**Distribution:** In ditches on the bank of river.

**Gomphonema augur** Ehr. Heurck, *op. cit.*, 271, Pl. 7, Fig. 301, 1896.

Valve cordate-cuneate, with upper apex obuse-apiculate, lower apex preceptible attenuate, slightly subrostrate; raphe with a distinct hyaline zone; median striae opposite the nodule very shortened, the others equally prolonged, radiate upto the apices.

**Dimensions:** Cells 7-12.6 μ broad and 32.48-49.28 μ long; about 9-11 striae in 10 μ

**Distribution:** In wet sand of river and in sand culture.

**Gomphonema montanum** Schumann. Heurck, *op. cit.*, 271, Pl. 7, Fig. 303, 1896.

Valve sometimes scarcely cuneate, more or less tri-undulate, with apices very rently narrow, produced raphe with rather broad hyaline zone; median striae much shortened, the others radiant up to the apices.
Fig. 104. Fragilaria construens.
Dimensions: Cells 7-14 μ broad and 44.8-78.4 μ long; about 9-11 striae in 10 μ

Distribution: In wet sand of river.

**Gomphonema montanum var. commutatum** Grun. Heurck, op. cit., 272, Pl. 7, Fig. 3-5, 1896.

Differs from the species, into which it passes imperceptibly, by its shorter and gently lanceolate form.

Dimensions: Cells 6.16-12.32 μ broad and 42-76 μ long; about 10-11 striae in 10 μ

Distribution: In ditches on the bank of river.

**Gomphonema parvulum** Kutz. Heurck, op. cit., 272, Pl. 7, Fig. 306, 1896.

Valve cuneate-lanceolate, with apices rostrate tapering; striae nearly reaching to the raphe, the median one much shortened, the others of equal length, radiant.

Dimensions: Cells 4.2-9.8 μ broad and 20.44-29.68 μ long; about 13-15 striae in 10 μ

Distribution: Planktonic and in wet sand on the bank of river.

**Gomphonema parvulum var. lanceolata.** Heurck, Op. cit., 272, Pl. 7, Fig. 307, 1896.

More elongate and more narrowly lanceolate.

Dimensions: Cells 3.36-8.96 μ broad and 23.8-29.12 μ long; about 14-15 striae in 10 μ

[96]
Fig. 105. Fragilaria crotonensis; 106. Tetracyclus rupestris; 107. Denticula elegans.
Distribution: Mixed with other diatoms of the river.

_Gomphonema parvulum_ var. _subcapitata_. Heurck, _op. cit._, 272, Pl. 7, Fig. 308, 1896.

With upper rostrum slightly capitulate.

**Dimensions:** Cells 2.8-7.28 μ broad and 22.12-33.6 μ long; about 13-14striae in 10 μ

**Distribution:** Mixed with other diatoms of river.

_Gomphonema gracile_ Ehr. Heurck, _op. cit._, 272, Pl. 7, Fig. 309, 1896; Tiffany and Britton, _op. cit._, 271, Pl. 72, Fig. 848. 1952.

Valve lanceolate, rhomboidal, elongate, with apices almost similar; raphe surrounded by a distinct area, dilated into a kind of pseudo-stauros at the median portion; nodules slightly distant from the apices; striae feebly radiant.

**Dimensions:** Cells 7-8.96 μ broad and 37.8-84.56 μ long; about 9-10striae in 10 μ

**Distribution:** In ditches on the bank of river.

_Gomphonema Gracile_ var. _dichotomum_. Heurck, _op. cit._, 273, Pl. 7, Fig.310, 1896.

Less naviculoid, upper apex of valve more obtuse and gently constricted; striae finer.

**Dimensions:** Cells 6.16-7.84 μ broad and 33.6-43.4 μ long; about 12-13striae in 10 μ

**Distribution:** In ditches on the bank of river.

_Gomphonema olivaceum_ var. _vulgaris_ Grun. Heurck _op. cit._, 275, Pl. 7, Fig. 316, 1896.

Smaller and more strongly calvate.
Dimensions: Cells 5.7-7 μ broad and 20.16-22.96 μ long; about 10 striae in 10 μ

Distribution: In wet sand of river.

_Gomphonema constrictum_ var. _capitatum_ (Ehrenberg) Grunow.

Tiffany and Britton, op. cit., 271, Pl. 72, Fig. 840, 1952.

Valves typically clavate, without transverse constriction.

Dimensions: Cells 9.8-12.32 μ broad and 28-61.6 μ long; about 10-12 striae in 10 μ

Distribution: In wet sand on the bank river. Found in sand and water cultures.

**CYMBELLACEAE**

Genus _AMPHORA_ Ehrenberg

_Amphora ovalis_ Kuetzing. Heurck, op. cit., 127, Pl. 1, Fig. 15, 1896;

Tiffany and Britton, op. cit., 274, Pl. 73, Fig. 855, 1952.

Frustule oval, very inflated at the median portion, then slightly attenuate; apices broadly truncate; valves arcuate at dorsal margin, concave at internal margin; raphe inflexed; striae strongly marked with coarse puncta.

Dimensions: Cells 17.98-59.92 μ broad and 51.36-72.76 μ long; about 10-12 striae in 10 μ

Distribution: In wet sand on the bank of river.

_Amphora ovalis_ var. _pediculus_ Kutz. Heurck, op. cit., 127, Pl. 1, Fig. 19, 1896

Frustule small, with apices slightly narrowed; pseudo-stauros very distinct; raphe more or less concave.
Dimensions: Cells 7-15.6 μ broad and 16.8-20.16 μ long; about 15-17 striae in 10 μ

Distribution: Planktonic and in wet sand of river.

Amphora ovalis var. pediculus forma minor, Grun. Heurck, op. cit., 127, Pl. 1, Fig. 20, 1896.

Still smaller.

Dimensions: Cells 4.59-7.65 μ broad and 25.2-35 μ long; about 19-20 striae in 10 μ

Distribution: Found in wet sand on the bank of river.

Genus ENCYONEMA Kutz.

Encyonema caespitosum Kutz. Heurck, op. cit., 150, Pl. 1, fig. 46, 1896.

Valve very broadly cymbiform, with apices straight, obtuse, scarcely constricted; dorsal margin broadly convex, ventral margin regularly inflated; raphe almost straight, surrounded robust.

Dimensions: Cells 7-15, 4 μ broad and 28-30, 8 μ long; about 10-12 striae in 10 μ.

Distribution: In wet sand on the bank of river.

Encyonema ventricosum Kutz. Heurck, op.cit, 150, Pl. 1, Fig. 49, 1896.

Valve cymbiform, somewhat elongated, apices often rather abruptly attenuate; dorsal margin rounded, ventral margin straight, or almost straight; raphe straight, surrounded by a narrow hyaline zone, not inflated round the central nodule; striae faint.

Dimensions: Cells 4.59-7.34 μ broad and 12.54-15.3 μ long; about 13-16 striae in 10 μ.
**Distribution**: In wet sand on the bank of river ken and in sand and water cultures.

**Genus** *EPITHEMIA* Brebisson

*Epithemia gibba* kutz. Heurck, *op. cit.*, 296, P1. 9, Fig. 352, 1896.
Valve linear, seen with difficulty with a row of coarse beads (extremities of costae ?); frustules always placed on its girdle face, with its dorsal margin showing in the middle of the median inflation a small inflexion, with a central nodule distinctly visible; ventral margin straight, but arcuate at the apex; costae parallel, except at the apices of the valve where they are radiant; striae finally moniliform.

**Dimension**: Cells 9.8-18.2 μ broad and 78.4-162.4 μ long; about 6-7 costae in 10 μ; about 12-14 striae in 10 μ.

**Distribution**: In wet sand on the bank of river.

*Epithemia gibba* var. *ventricosa* Kutz. Heurch, *op. cit.*, 296, P1. 9, Fig. 354, 1896.
Valve short, and strongly inflated at the median portion.

**Dimensions**: Cells 10-36 μ broad and 80-180 μ long; about 13-14 striae in 10 μ.

**Distribution**: In wet sand on the bank of river and in sand culture.

*Epithemia zebra* (Ehr.) Kutz. Heurck, *op. cit.*, 296, P1.9, Fig. 357, 1896.
Valve with dorsal margin slightly arcuate, ventral margin almost straight, apices very obtuse; girdle face not showing costae inflated at the apices; costae less robust, scarcely radiant; striae with more robust beads.

**Dimensions**: Cells 8.4-13.44 μ broad and 21.75-53.2 μ long; about 11-12 striae in 10 μ.

[101]
Distribution: In wet sand of river.

*Epithemia gibberual* var. *producta* Grun. Heurck, op. cit., 297, P1. 9, Fig. 361, , 1896.

Apices rostrate.

**Dimensions**: Cells 6.16-17.36 μ broad and 21.84-29.4 μ long; about 4 costae in 10 μ; about 15-17 striae in 10 μ.

**Distribution**: In wet sand of river ken and mixed with other diatoms.

*Epithemia sorex* Kutz. Heurckl, op. cit., 295, P1. 9 Fig.l. 351, 1896.

Valve strongly arcuate, with margins regularly flexed; apices rostrate and generally capitate; costae radiant; striae radiant, finely moniliform; girdle face strongly inflated at the central portion.

**Dimensions**: Cells 7-15.4 μ broad and 25.2-39.2 μ long; about 6-7 costae in 10 μ; about 11-14 striae in 10μ.

**Distribution**: In wet sand on the bank of river.

**Genus RHOPALODIA** Mueller

*Rhopalodia Iretricosa* (kuetzing) Mueller. Tiffany and Britton, op. cit., 282, P1. 75, Fig. 885, 1952.

Cells in girdle view elliptic, medially inflated; valves medially inflated on the dorsal side, ventrally straight, with reflexed end; striations granular.

**Dimensions**: Cells 19.72-21.75 μ broad and 37.7-72.5 μ long; about 6-7 costae in 10 μ; about 12-14 striae in 10 μ.

**Distribution**: In wet sand of river.

[102]
SURIRELLINEAE
NITZSCHIACEAE

Genus HANTZSCHIA Grunow

Hantzschia amphioxys (Ehr.) Grun. Heurck, op. cit., 381, P1. 15, Fig. 483b, 1896' Tiffany and Britton, op. cit., 289, P1. 75, Fig. 886, 1952.
Valves feebly arcuate, with apices more or less prolonged; keel with coarse short dots, the two median distant.

Dimensions: Cells 4.74-9.18 μ broad and 22.95-73.44 μ long; about 16 striae in 10 μ.

Distribution: In wet sand on the bank of river and in sand culture.

Hantzschia amphioxys var. intermedia. Heurck, op. cit., 381, P1 15, Fig. 485b, 1896.

Dimensions: Cells 6-10 μ broad and 72.96-80 μ long; about 2-4 carinal dots and about 10-12 striae 10 μ.

Distribution: In wet sand of river.

Genus NITZSCHIA Hassall

Nitzschia palea (Kutz.) W. Sm. Heurck, op. cit., 401, P1. 17, Fig. 554, 1896.

Valves more linear-lanceolate, with apices shortly rostrate; the median not distant; girdle face linear-lanceolate, with apices rounded or truncate.

Dimensions: Cells 4-6 μ broad and 28.0-64.8 μ long; about 10-12 cranial dots in 10 μ; about 32-34 striae in 10 μ.

Distribution: Planktonic in water and in wet sand of river. In sand and water cultures.

Nitzschia palea var. tenuirostris. Heurck, op. cit., 402, P1. 17, Fig. 556, 1896.
Fig. 108: Synedra ulna var. laneolata; 109: Synedra ulna var. danica; 110: Synedra acus; 111: Synedra ulna var. aequalis; 112: Synedra ulna; 113: Synedra ulna var. lonissima; 114: Synedra radians; 115: Synedra vaucheriae var. parvula; 116: Synedra vaucheriae var. perminuta
Apices with narrow, rather long rostrum.

**Dimensions**: Cells 4.76-5.32 μ broad and 28-61.6 μ long.

**Distribution**: In wet sand on the bank of river.

*Nitzschia palea* var. *fonticola* Grun. Heurck, *op. cit.*, 402, P1, Fig. 557, 1896.

Valves lanceolate, with rostrum well marked.

**Dimensions**: Cells 3.64-8.4 μ broad and 14.29-64 μ long; about 14-15 carinal dots in 10 μ.

**Distribution**: Planktonic and in wet sand on the bank of river.

*Nitzschia subtilis* var. *paleacea* Grun. var, paleacea Heruck, *op. cit.*, 401, P1. 17, Fig. 552, 1896.

Smaller and narrower valves: striae very fine.

**Dimensions**: Cells 3.08 - 4.2 μ. broad and 25.2-35 μ. long; kell with about 13-14 dots in 10 μ.

**Distribution**: In wet sand on the bank of river.

*Nitzschia tryblionella* var. *calida*. Heurck, *op. cit.*, 385, P1. 15, Fig. 495, 1896.

Valve linear, constricted at the median portion, with apices somewhat rostrate; sulcus scarcely visible; keely with points rather distinct.

**Dimensions**: Cells 9.8-11.2 μ. broad and 35-44.8 μ. long; about 17-18 striae in 10 μ.

**Distribution**: In wet sand on the bank of river.

*Nitzschia angustata* (W. Sm.) Grun. Heurck, *op. cit.* 385, P1. 15, Fig. 498, 1896.

[104]
Valve narrolwy linear, with apices produced; striae robust, not interrupted.

**Dimensions**: Cells 8.56-10.7 μ. broad and 8.132-89.88 μ. long.

**Distribution**: Planktonic and in wet sand on the bank of river and in water culture.

*Nitzschia apiculate* (Greg.) Grun. ! Heurck, op. cit., 387, Pl. 15, Fig. 505, 1896.

Valves generally smaller and narrower, the carinal dots being absent or indistinct.

**Dimensions**: Cells 7.84-9.8 μ. broad and 25.2-49 μ. long; about 16-18 striae in 10 μ. .

**Distribution**: In wet sand on the bank of river. Found in sand and water cultures.

*Nitzschia thermalis* (Kutz.) Grun! Heurck, op. cit., 389, Pl. 15, Fig. 509. 1896.

Valves narrow, round carinal dots, the two median of which are somewhat distant; striae fine.

**Dimensions**: Cells about 10.4 μ. broad and 84-100 μ. long ; about 26-28 striae in 10 μ. in 10 μ.; about 7-8 carinal dots in 10 μ. .

**Distribution**: In wet sand on the bank of river and in water culture.

*Nitzschia sinuata* (Wm. smith) Grunow. Tiffany and Britton, op. cit., 286. Pl. 76, Fig. 896, 1952; Heurck, op. cit., 390, Pl. 15 Fig. 516, 1896.

Cells rectangular in girdle view; valves lanceolate with undulate margins and rostrate-capitate poles.

**Dimensions**: Cells 5.07-7.97 μ. broad and 20.3-36.25 μ. long; kell punctae about 5-6 in 10 μ..

[105]
**Distribution**: In wet sand on the bank of river.

**Nitzschia dissipata** (Kutz.) Grun. ! Heurck, op. cit., 394, P1. 16, Fig. 525, 1896 Tiffany and Britton, op. cit., 288. P1. 76, Fig. 898, 1952.

Valve lanceolate, with apices very slightly rostrate; keel slightly eccentric; striae excessively faint.

**Dimensions**: Cells 4.29-6.86 μ. broad and 21.45-35.03 μ. long; keel punctae about 5-8 in 10 μ.

**Distribution**: Planktonic and in wet sand on the bank of river and in sand culture.

**Nitzschia dissipata** var. media. Heurck, op. cit., 395, P1. Fig. 526, 1896.

Valves larger, with apices sometimes subrostrate, capitate; keel somewhat more eccentric.

**Dimensions**: Cells 4.28-8.56 μ. broad and 42.8-69.34 μ. long; keel about 6-7 in μ. 10 μ.

**Distribution**: Planktonic and in wet sand on the bank of river and in water culture.

**Nitzschia vermicularis** is (Kutz.) Grun. ! Heurck, op. cit., 395, P1. 16, Fig. 529, 1896.

Valves smaller and narrower size, carinal dots closer and shorter at the margin of the valve, as well as by its finer striae.

**Dimensions**: Cells 5.04-7 μ. broad and 92.4-140 μ. long; about 32-33 striae in 10 μ.

**Distribution**: In wet sand on the bank of river.

**Nitzschia obtusa** W. Sm.! Heurck, op. cit., P1. 16, Fig. 537, 1896.

[106]
Valve linear, with apices rounded or abruptly attenuate unilaterally; median inflexion very visible.

**Dimensions**: Cells 8-9.2 μ broad and 118-140 μ. μ. long; about 26-28 striae in 10 μ.

**Distribution**: In wet sand on the bank of river.

*Nitzschia obtusa* var. *nana* Grun. Heurck, op. cit., 398, P1. 16, Fig. 539, 1896.

Quite small, sigmoid

**Dimensions**: Cells about 3.82 μ broad and about 40.08 μ long; about 9-11 carinal dots and 35 striae in 10 μ.

**Distribution**: In wet sand on the bank of river.

*Nitzschia linearis* (Ag.) W. Sm.! Heurck, op. cit., 399, P1. 16, Fig. 542, 1896; Tiffany and Britton, op. cit., 288, P1. 76, Fig. 891, 1952.

Valves longly linear, almost in the form of a boat, with apices rounded at the external, and attenuate at the internal portion; keel, the two median more distant than the others, the space between generally corresponding with a small inflexion of the valve; striae, finely punctate.

**Dimensions**: Cells 4.06-5.8 μ broad and 70.32-108.75 μ long; about 28-30 striae in 10 μ; keel about 8-10 in 10 μ; keel about 11-12 dots in 10 μ.

**Distribution**: Planktonic and in wet sand on the bank of river and in water culture.

*Nitzschia microcephala* Grun. ! Heurck, op. cit., 402, P1. 17, Fig.-558, 1896.

Very small; valves lanceolate, linear, with apices rostrate capitate.

**Dimensions**: Cells 2.75-3.37 μ broad and 10.10-14.99 μ long; about 33 striae in 10 μ; about 12-13 carinal dots in 10 μ.

[107]
**Distribution**: Planktonic and in wet sand on the bank of river and in water culture.

*Nitzschia acicularis* (Kuetzing) Wm. smith. Tiffany and Britton, *op. cit.*, 286, P1. 77 Fig. 904, 1952.

Cells medianly spindle-shaped with long attenuate poles, weakly silicified; striations very fine, scarcely visible. Fig 293.

**Dimensions**: Cells 3.08-5.04 μ broad and 50.05-121 μ long; keel punctae about 17-19 in 10 μ.

**Distribution**: Planktonic and in wet sand of river and in water culture.

**SURIRELLACEAE**

Genus *SURIRELLA* Turpin

**Surirella elegans** Ehr. Heurck, *op. cit.*, 370, P1. 12, Fig.576, 1896.

Valve more or less broadly oval, very large; with median line narrow, surrounded by a hyaline area, lanceolate, broad, with rather strong costae; striae fine, excessively delicate; girdle face cuneate, with apices obtuse, rounded; alae rather robust, very approximate to the margin.

**Dimensions**: Cells about 43.2-86.4 μ broad and 180.2-212 μ long; about 1-2 costae in 10 μ.

**Distribution**: In wet sand of river.

**Surirella robusta** Ehr. Heurck, *op. cit.*, 371, P1. 12, Fig. 577, 1896.

More considerable in size, the absence of a hyaline area round the median line, the more robust costae, the better marked striae, and by the alae being approximate to the connecting zone.

**Dimensions**: Cells 52-88 μ broad and 168-216 μ long; about 1-2 costae in 10 μ.

**Distribution**: In wet sand on the bank of river.
**Surirella ovalis** var. minuta Breb. Heurck. *op. cit.*, 373, P1. 13, Fig. 588, 1896.

Still smaller than the species and more elongated, with costae generally delicately prolonged as far as the median line.

**Dimensions**: Cells about 8.4-12.88 μ broad and 22.4-30 μ long: about 4-5 costae in 10 μ.

**Distribution**: In wet sand on the bank of river.

**EUGLENOPHYTA**

**EUGLENOPHYCEAE**

**EUGLENALES**

**EUGLENACEARE**

**Genus** *EUGLENA* Ehrenberg

**Euglena spirogyra** Ehrenberg. Tiffany and Britton, *op. cit.*, 320, P1. 87, Fig. 1011, 1952.

Cell cylindric or flattened, anterior end rounded and slightly narrowed, posterior end produced into an acute and frequently curved-lip, metabolic; periplast yellowish-brown, spirally striate with pyramidal to conical and frequently truncate processes, prominent striations often alternating with less prominent ones; eyespot prominent, lateral to posterior end of canal; chromatophores numerous, discoid, without prenoids; nucleus centrally located; paramylum bodies large, elongate-annular, 1 anterior and 1 posterior to nucleus, sometimes with small annular rectangular bodies.

**Dimensions**: Cells 8.56-25.68 μ broad and 79.18-107 μ long.

**Distribution**: Found among other lagae in stagnant water on the bank of river and in sand culture.

[109]
Fig. 117: Achnanthes exills a, b; 118: Achnanthes minutissima; 119: Achnanthes linearis; 120: Achnanthes lanceolata a, b; 121: Achnanthes lanceolata var. dubia a, b, 122: Cocconeis placenta; 123 : Cocconies pediculus; 124: Pinnularia undulata; 125: Mastogloia smithii;
**Euglena gracilis** Klebs. Tiffany and Briton, op. cit., 322, P1. 87, Fig. 1012, 1952.

Cells cylindrically fusiform anterior end rounded, posterior end usually with a blunt tip or expanded due to metabolic movement, strongly metabolic, very active, periplast with delicate spiral striations; eyespot prominent, cup-shaped, lateral to body of reservoir, chromatophores numerous, lenticular fusiform, with pyrenoids; nucleus spherical, centrally located; paramylum bodies usually 2, annular, discoid, attached on either side of chromatophore, occasionally free in cytoplasm.

**Dimensions**: Cells 6.16-21 μ broad and 36.4-54.6 μ long.

**Distribution**: Found among other algae on the bank of river and in sand culture.

**Euglena minuta** Prescott. Prescott, op.cit., 393, P1. 85, Figs. 23, 24, 1982.

Cells highly metabolic, fusiform to somewhat pyriform, produced posteriorly into a short, blunt, often curved tip; flagellum ¾ the length of the cell; 1 plate-like chloroplast with a pyrenoid; paramylum bodies many small rods.

**Dimensions**: Cells 5.04-5.88 μ broad and about 12.32-14.56 μ long.

**Distribution**: Found in sand and water cultures.

**Genus PHacus** Dujardin

**RHODOPHYTA**

**RHODOPHYCEAE**

**BANGIOIDEAE**

**BANGIAES**

**ERYTHROTRICHIACEAE**

[110]
Genus **COMPSOPOGON** Montagne

**Compsopogon sp.** Main filaments very thick. In the younger parts, the filaments consist of a series of discoid cells. Sparsely to fairly branched; chromatophores thread like branched.

**Dimensions:** Thallus about 25 cm long; main filaments usually 154.08-235.4 μ broad, branches 21.4-57.78 μ broad.

**Distribution:** In stagnant water on the bank of river.

**CYANOPHYTA**

**CYANOPHYCEAE**

**CHROOCOCCALES**

**CHROOCOCCACEAE**

Genus **MICROCYSTIS** Kutzing

**Microcystis robusta** (Clark) Nygaard. Desikachary, T.V., Cyanophyta, 85, P1. 17, Figs. 7-10, 1959.

Colonies at first round, later irregularly elongate and clathrate; sheath distinct, later gelatinizing; cell spherical, without gas-vacuoles.

**Dimensions:** Cells 6-8.8 μ in diameter.

**Distribution:** Free-floating on the bank of river and in sand culture.

**Microcystis viridis** (A. Br.) Lemm. Desikachary, *op. cit.*, 87, P1. 18, Figs. 5, Figs. 5, 6, 1959.

Colonics round or rectangular, consisting of a large number of partial or daughter colonies surrounded by a common mucilaginous sheath, margins of colonial mucilage definite and highly refractive; cells spherical with gas-vacuoles.

**Dimensions:** Cells 3.06-6.89 μ in diameter.

**Distribution:** Free-floating in water.

[111]
**Microcystis protocystis** Crow. Desikachary, op. cit., 91, P1. 20, Fig. 4, 1956.

Colonies irregular, often diffuse, with limits of colonial mucilage not clearly delimited, sometimes disappearing (!); cells very numerous, varying in the mode of aggregation from closely packed to generally dissociated, spherical, with gas-vacuoles.

**Dimensions**: Cells 3.36-612 in diameter.

**Distribution**: Free-floating in water.

**Microcystis aeruginosa** Kutz. Desikachary, op. cit., 93 P1. 17, Figs. 1, 2, 6, 1959; Tiffany and Britton, op. cit., 336, P1. 91, Fig. 1054, 1952.

Colonies when young round or slightly longer than broad, solid, when old becoming clathrate, with distinct hyaline colonial mucilage; cells spherical, generally with gas-vacuoles.

**Dimensions**: Cells 3.06-6.8 μ in diameter.

**Distribution**: Planktonic and for ming water bloom in stagnant water. Found in sand and water cultures.

**Microcystis elabens** (Breb.) Kutz. Desikachary, op. cit., 97, P1. 18, Fig. 12, and P1. 20, Figs. 6, 7, 1959.

Colony spherical, or flat and expanding, blue-green or olive-green, when old together with a number of daughter colonies; cells oblong, with gas-vacuoles.

**Dimensions**: Cells 2.4-4.8 μ broad and 4.8-4.4 μ long.

**Distribution**: Free-floating in water and found in sand and water culture.

**Microcystis incerta** Lemmermann. Tiffany and Britton. op. cit., 339, P1. 91, Fig. 1055, 1952; Prescott, op. cit., 457, P1. 102, Fig. 5, 1982.

[112]
Cells pale blue-green, with small and inconspicuous pseudovcules; colonies spherical avoid or irregularly lobed.

**Dimensions**: Cells about 1.4-2 μ in diameter.

**Distribution**: Free-floating in water.

**Genus** *CHROOCOCCUS* Nag.

**Chroococcus macrococcus** (Kutz.) Rabenh. Desikachary, *op. cit.*, 101, P1. 27, Figs. 3, 9, 1959.

Thallus mucilaginous, somewhat broad, yellowish brown, more or less dilated; cells spherical, single; sheath thick colourless lamellated.

**Dimensions**: Cells 26-36 μ in diameter, with sheath 32-52 μ in diameter.

**Distribution**: In moist soil on the bank of river and in sand culture.

**Chroococcus turgidus** (Kutz.) Nag. Deiskachary, *op. cit.*, 101, P1. 26, Fig. 6, 1959.

Cells spherical or ellipsoidal single, or in groups of mostly 2-4, blue-green, or yellowish; sheath colourless, not distinctly lamellated.

**Dimensions**: Cells without sheath 9.8-24.64 μ and with sheath 14-31.36 μ in diameter.

**Distribution**: Planktonic and attached to submerged plants and mixed with other algae. Found in sand culture.

**Chroococcus minutus** (Kutz.) Nag. Desikachary, *op. cit.*, 103, P1. 24, Fig. 4 and P1. 26. Fig. 4. 1959.

Cells spherical or oblong, single or in groups of 2-4, light blue-green; sheath not lamellated, colourless
**Dimensions** : Cells without sheath 4.06-9.8 μ and with sheath 6.09-13.05 μ in diameter; colonies 10.87-13.63 μ in diameter and 14.21-17.4 μ long.

**Distribution** : In sand and mucilage of other cyanophycean forms.

*Chroococcus minor* (Kutz.) Nag. Desikachary, op. cit., 105, P1. 24, Fig. 1, 1959; Prescott. op. cit., 449, P1. 100, Fig. 12, 1982.

Thallus slimy, gelatinous, dirty blue-green, or olive green; cells spherical, singel or in pairs; sheath colourless, very thin, hardly visible.

**Dimensions** : Cells 3-4.15 μ in diameter.

**Distribution** : Planktonic and growing in moist substrates on the margins of the river and in water culture.

*Chroococcus varius* A. Br. Desikachary, op. cit., 107, P1 24, Fig. 5, 1959.

Thallus gelatinous dirty olive green or brownish; cells globular, single or 2-4 together, seldom more in small or big groups, irregularly arranged, pale blue or olive-green; sheath apparently thick, indistinctly lamellated, colourless.

**Dimensions** : Cells without sheath about 2.14-4-15 μ in diameter.

**Distribution** : Mixed with other algae of river and in sand culture.

*Chroococcus montanus* Hansgirg. Desikachary, op. cit., 108, P1. 26, Fig. 12, 12, 1959.

**Dimensions** : Cells 5.6-6.16 μ in diameter and with sheath 10.64-15-12 μ in diameter.

**Distribution** : In moist sand of the river.

*Chroococcus pallidus* Nag. Desikachary, op. cit., 109, P1. 26, Fig. 10, 1959; Prescott. op. cit., 450, P1. 100, Fig. 14., 1982.
Thallus gelatinous, yellowish or colourless; cells singel or 2-4, blue-green; sheath colourless, unlamellated.

**Dimensions**: Cells without sheath 5.3-7.96 μ and with sheath 8-11-13.00 μ in diameter.

**Distribution**: On stone found in water and in sand culture.

*Chroococcus indicus* Zeller. Desikachary, *op. cit.*, 109, P1. 26, **Fig.** 10, 1959.

Thallus gelatinous, thin, a pale brownish; cells single, oblong to subspherical, grenchish; sheath hyaline, conspicuous, contents granular.

**Dimensions**: Cells 4.00-7.44 μ in diameter.

**Distribution**: In moist soil on the bank of river.

*Chroococcus rufescene* (Kuetzing) Naegeli. Prescott *op. cit.*, 111, P1. 26, Fig 1049, 1952.

Cells homogeneous to coarsely granular, blue-green to yellowish or brownish; sheath homogeneous or lamellose, sometimes scarcely evident.

**Dimensions**: Cells 3.2-10.8 μ in diameter.

**Distribution**: In moist sand on the bank of river.

**Genus GLOEOCAPSA** Kutzin

*Gloeocapsa stegophila* (Itzigs.) Rabenh. Desikachary, *op. cit.*, 119, P1. 25, Fig. 2, 1959.

Cells 4-32 in globose groups, blue-green; sheath mostly unlamellated.

**Dimensions**: Cells without sheath 3.15-4 μ and with 4.86-8 μ in diameter.

**Distribution**: In moist sand on the bank of river.

*Gloeocapsa quaternata* (Breb.) Kutz. Desikachary, *op. cit.*, 120, P1. 20, Fig. 9, 1959.
Thallus pale green or yellowish, expanded or forming tubercels; cells blues-green; sheath often lamellated, colourless; cells single, 2-4 sometimes up to 8 in colonies.

**Dimensions**: Cells without sheath 3.15-5.07 and with sheath 7.15-10.87 in diameter; colonies 11.6-21.46 in diameter.

**Distribution**: Planktonic and in moist sand on the bank or river. Found in sand and water cultures.

**Genus Aphanöcapsa** Nag.

*Aphanöcapsa littoralis* Hansgirg. Desikachary, op. cit., 131, P1. 21, Fig. 1, 1959.

Thallus amorphous without any definite shape, mucilaginous, blue-green or yellowish; cells spherical to subspherical, single or in twos, densely or sparsely aggregated.

**Dimensions**: Cells 3.62-5.94 μ in diameter.

**Distribution**: In moist sand on the bank of river and in sand and water cultures.

*Aphanöcapsa elachista* var. *conferta* West and West. Prescott, op. cit., 453, P1. 101, Figs, 10, 11, 1982; Desikachary, op. cit., 133, P1. 22, Fig. 10, 1959.

Colonics ovate or globose, frequently irregular in shape; cells spherical crowded within a hyaline colonial mucilage, often with many cells in pairs,

**Dimensions**: Cells 1.53-2.29. μ in diameter.

**Distribution**: In moist sand of river.

*Aphanöcapsa biformis* A. Br. Desikachary, op. cit., 134, P1, 31, Fig. 9, 1959.
Thallus gelatinous, spherical or hemispherical, light blue-green; cells spherical, contents finely granular, blue-green, closely arranged in a homogeneous mucilage; individual envelopes not distinct.

**Dimensions**: Cells 3.92-5.82 µ in diameter.

**Distribution**: Found in stagnant water of the river and in water culture.

*Aphanocapsa montana* Cramer. Desikachary, *op. cit.*, 135, P1. 20, Fig. 8, 1959.

Thallus of no definite shape, gelatinous, blue-green, or colourless; cells spherical, light blue-green, single or in pairs; mucilage colourless, diffuse.

**Dimensions**: Cells 2.61-3.77 µ in diameter.

**Distribution**: Found on submerged objects of river and is sand culture.

*Aphanocapsa muscicola* (Menegh.) Wille. Desikachary, *op. cit.*, 135, P1. 21, Fig. 7, 1959.

Cells spherical, blue-green, 2-4 together, daughter cells often together in a common mucilage envelope, mucilage thick, colourless.

**Dimensions**: Cells 1.94-2.9 µ in diameter.

**Distribution**: Found on submerged objects of river and is sand culture.

**Genus** Aphanathece Nag.

*Aphanathece saxicola* Nag. Desikachary, *op. cit.*, 138, P1. 22, Fig. 11, 1959.

Thallus mucilaginous, colourless or yellowish; cells cylindrical, single or in pairs, seldom many in a common, mucilaginous envelope.

**Dimensions**: Cells 1-2 µ in diameter.

**Distribution**: Planktonic and mixed with other algae of river. Found in sand and water cultures.
Aphanothece bullosa (Menegh.) Rabenh. Desikachary, op. cit., 142, P1. 22, Fig. 12, 1959.

Thallus more or less spherical, irregularly lobed, greenish to yellow, soft; cells long cylindrical, blue-green.

**Dimensions**: Cells 3.57-5 \( \mu \) in broad and 6.00-11.44 \( \mu \) long.

**Distribution**: Free-floating in water and in sand culture.

**Genus** SYNECHOCOCCUS Nag.

Synechocystis pevalekii Ercegovic. Desikachary, op. cit., 145, P1. 25, Fig. 11, 1959.

Thallus indefinite; among other algae; cells spherical, after division hemispherical, single or two together, contents blue-green homogeneous.

**Dimensions**: Cells 2.60-3.45 \( \mu \) in diameter.

**Distribution**: Among other algae of river.

**Genus** COELOSPHAERIUM Nag.

Coelosphaerium kuetzingianum Nag. Desikachary, op. cit., 148, P1. 28, Figs. 7, 8, 1959; Prescott, op. cit., 470, P1. 106, Fig. 2, 1982; Tiffany and Britton; op. cit., 332, P1. 90. Fig. 2, 1982; Tiffany and Britton; op. cit., 332, P1. 90. Fig. 1045, 1952.

Colony more or less spherical with a thin colonical mucilage envelope; cells spherical or subspherical, cells closely or loosely arranged.

**Dimensions**: Colony 22.4-56 \( \mu \) in diameter; cells 2.24-4.48 \( \mu \) in diameter.

**Distribution**: Found in free-floating stage.

Coelosphaerium Pallidum Meyen. Prescott, op. cit., 471, P1, 106, Fig. 3, 1982.
A spherical or ovate colony of small, ovate cells crowded, but evenly arranged, within the periphery of the colonical mucilage; cell contenst pale blue-green, without pseudovacuoles.

**Dimensions**: Colony 30.6-39.78 μ in diameter; cells 1.53-2.45 μ broad and 2.1-3.06 μ long.

**Distribution**: Mixed with other algae in water.

**Genus MERISMOPEDEA Meyen**

**Merismopedia convoluta Breb.** Desikachary, op. cit., 152, P1. 29, Fig. 13, 1959; Tiffancy and Britton, op. cit., 334, P1. 91, Fig. 1051, 1952.

Cells spherical to oblong, rarely longer, flat, convolute colonies; blue-green, or yellowish.

**Dimensions**: Cells 4.2-5.04 μ broad and 8.12-9.52 μ long.

**Distribution**: Among other algae and in sand and water cultures.

**Merismopedia tenuissima Lemm.** Desikachary, op. cit., 154, P1. 29, Fig. 7, 1959.

Cells pale blue-green, closely packed in colonics of 16-100 cells, subspherical.

**Dimensions**: Cells 1.45-2.32 μ diameter.

**Distribution**: Planktonic and invariably in association with desmids and other algae. Found in sand and water cultures.

**Merismopedia punctata Meyen.** Desikachary, op. cit., 155, P1. 23, Fig. 5 and P1. 29. Fig. 6, 1959.

Colonies small, 4-64 cells not closely packed, spherical or ovoid, pale blue-green.

**Dimensions**: Cells 2.52-3.98 μ in diameter.
**Distribution**: Planktonic and in stagnant water of river or among other algae. Found in sand and water cultures.

*Merismopedia glauca* (Ehrenb.) Nag. Desikachary, op. cit., 155, P1. 29. Fig 5, and P1. 29. Fig.5, 1959; Tiffany and Britton. op. cit., 334, P1. 91, Fig. 1051, 1952.

Colonies mostly small with 16-44 cells, rarely more, cells oval or spherical, closely arranged, pale blue-green.

**Dimensions**: Cells 3.06-5.20 μ in diameter.

**Distribution**: As plankton in stagnant waters and among other algae of river. Found in sand and water cultures.

**PLEUROCAPSALES**

**PLEUROCAPSACEAE**

Genus *MYXOSARCINA* Printz.


Cells in three dimensional colonies; colonial sheath thin, distinct, hyaline; Cell contents blue-green.

**Dimensions**: Cells 6.61-9.94 μ in diameter.

**Distribution**: In moist sand of river and in sand and water cultures.

**NOSTOCALES**

**OSCILLATORIACEAE**

Genus *ARTHROSPIRA* Stizenberger

*Arthospira spirulinoides* Ghose. Desikachary, op. cit., 189, P1. 35. Fig. 1. 1959.

Trichome blue-green, straight or somewhat bent, not constricted at the cross-walls.
Dimensions: Cells 3.92-5.88 μ broad and 4.2-9.8. μ long.

Distribution: In stagnant water of the river mixed with other algae and in sand culture.

Genus SPIRULINA Turpin cm. Gardner

Spirulina labyrinthiformis (Menegh.) Gomont. Desikachary, op. cit., 195, P1. 36, Fig. 11, 1959.

Trichome green, very regularly coiled forming a dirty, dark-green thallus; spirals close to each other.

Dimensions: Trichome 1-1.44 μ broad spirals 2.14-2.86 μ baord.

Distribution: In stagnant water of the river and mixed with other algae and in sand culture.

Spirulina laxissima West. G. S. Desikachary, op. cit., 196, P1. 36. Fig. 5, 1959.

Trichome blue-green, spirals very loose, but regular, end-cells rounded, obtuse.

Dimensions: Trichome 0.71-1.14 μ broad; spirals 4.58-5.72 μ broad.

Distribution: Found in moist sand of river and in water culture

Spirulina subtilissima Kutx. ex Gomont. Desikachary, op. cit., 196, P1. 36, Fig. 13, 1959; Tiffany and Britton, op. cit., 354, P1. 97, Fig. 1124, 1952.

Trichome regularly spirally coiled, blue-green.

Dimensions: Trichomes 1.4-1.96 μ broad; spirals 2.8-3.92 μ broad and 2.8-4.76 μ distant.

Distribution: In stagnant water of river and mixed with other alage. Found in sand and water cultures.

[121]

Trichome deep blue-green, regularly spirally coiled, at the end conical attenuated.

Dimensions: Trichomes 3.2-4 µ broad; spirals 11.2-15.2 µ broad.

Distribution: Free-floating in water or mixed with other algae and in sand and water cultures.

Genus OSCILLATORIA Vaucher

Oscillatoria curviceps Ag. ex Gomont. Desikachary, op. cit., 209, P1, 39, Fig. 10, 1959.

Thallus light or dark blues-green; trichomes more or less straight, bent at the end or spirally coiled, not attenuated or very little attenuated, not constricted at the cross-walls, cross-walls sometimes granulated; end-cells flat rounde, not capitate.

Dimensions: Trichomes 7.10-11.2 µ broad and cells 1.68-2.24 µ long.

Distribution: Mixed with other cyanophycean forms.

Oscillatoria princeps Vaucher ex Gomont. Desikachary, op. cit., 210, P1, 37, Figs, 1, 10, 11, 1959.

Trichomes blue-green, more or less brownish, mostly forming a thallus, mostly straight, not constricted at the cross-walls, flatly rounded, slightly capitate.

Dimensions: Trichomes 16-36 µ broad; spirals 4-7.2 long.

Distribution: In moist sand of river and mixed with other algae and in sand culture.

Oscillatoria subbrevis Schmidle. Desikachary, op. cit., 207, P1. 37, Fig. 2, 1959.
Trichome single, nearly straight, not attenuated at the apices; cells not granulated at the cross-walls; end-cell rounded, calyptra absent.

**Dimensions**: Trichomes 5.69-8 μ broad; cells 1.4-2.24 μ long.

**Distribution**: Mixed with other cyanophycean forms of river and in sand and water cultures.

**Oscillatoria limosa Ag. ex Gomont.** Desikachary, op. cit., 206, Pl. 2, Fig. 11, 1959.

Thallus dark blue-green to brown; trichome more or less straight, dull blue-green, not constricted at the cross-walls or only slightly constricted, cross-walls frequently granulated; end-cell flatly rounded with slightly thickened membrane.

**Dimensions**: Trichomes 11.2-20 μ broad; cells 3.2-4.8 μ long.

**Distribution**: In stagnant water of river or mixed with other algae and in sand culture.

**Oscillatoria ornata Kutz. ex Gomont.** Desikachary, op. cit., 206, Pl. 37, Fig. 12, Pl. 93 Fig. 1077. 1952.

Thallus dark blue-green; trichome spirally coiled at the ends, constricted at the cross-walls, dull blue-green, cross-walls granulated; apices slightly attenuated; end-cells rounded, not capitates, without thickened membrane.

**Dimensions**: Trichomes 8.96-11 μ broad; cells 2.1-4.76 μ long.

**Distribution**: Among other cyanophycean forms of river.

**Oscillatoria nigroviridis Thwaites ex Gomont.** Desikachary, op. cit. 202, Pl. 49. Fig. 2, 1959.
Thallus expanding, dark green; trichome olive-green, constricted at the cross-walls, bent at the ends and attenuated, cross-walls granulated; end-cells slightly capitate with a slightly thickened convex outer membrane.

**Dimensions**: Trichomes 8.4-10.6 μ broad; cells 3.2-4.48 μ long.

**Distribution**: Mixed with other algae of river.

**Oscillatoria anguina** (Bory) Gomont. Desikachary, op. cit., 210, P1 38, Fig. 11, 1959; Prescott, op. cit., 485, P1, 108, Fig. 24, 1982.

Thallus dark blue-green; trichome straight, at the ends spirally coiled and distinctly attenuated, not constricted at the cross-walls, cross-walls sometimes granulated; end-cells capitate, with a slightly thickened membrane.

**Dimensions**: Trichomes 6.44-8.4 μ broad; cells 1.40-2.24 μ long.

**Distribution**: In stagnant water and in moist sand on the bank of river.

**Oscillatoria subuliformis** Kutz. ex Gomont. Desikachary, op. cit., 213, Pl. 49, Fig. 10, 1959.

Thallus dull green; trichomes yellow-green, very long flexuous, and bent, not constricted at the cross-walls, at the ends gradually attenuated and bent; cells nearly quadrate, obtuse, not capitate, calyptra absent.

**Dimensions**: Trichomes 4.76-6.16 μ broad; cells 4.76-6.16 μ long.

**Distribution**: Among other algae on the bank of river and in sand culture.


Trichomes pale blue-green, bent at the ends or screw-like, unconstricted at the cross-walls, ends not attenuated, not capitate; cells
not granulated at the cross-walls; end cell rounded without a thickened membrane.

**Dimensions:** Trichomes 2.73-3.52 μ broad; cells upto 3.52 μ long.

**Distribution:** In wet sand of river and in sand culture.

**Oscillatoria chalybea** (Mertens) Gomont Desikachary, *op. cit.*, 218, Pl. 38, Fig. 3, 1959; Tiffany and Britton, *op. cit.*, 344, Pl. 93, Fig. 1071, 1952.

Thallus dark blue-green; trichome straight or lightly or irregularly spirally coiled, slightly constricted at the cross walls, attenuated at the apex, and somewhat bent, septa not granulated; end cell obtuse, not capitate, without calyptra.

**Dimensions:** Trichomes 8-12.8 μ broad; cells 3.29-8 μ long.

**Distribution:** In moist sand on the bank of river.

**Oscillatoria foreaui** Fremy. Desikachary, *op. cit.*, 219, Pl. 40, Fig. 18, 1959.

Trichomes sparse, elongate, bent or suberect, apex gently curved, subfalsiform, distinctly constricted at the cross-walls, and more or less torulose, apex not attenuated not capitate; protoplasm granular, septa commonly inconspicuous, apical cell obtuse conical calyptra absent.

**Dimensions:** Trichomes 2.91-3.6 μ broad; cells about 1.53 μ long.

**Distribution:** In stagnant water of river and mixed with other algae and in sand culture.

**Oscillatoria corallianae** (Kutz.) Gomont. Desikachary, *op. cit.*, 221, Pl. 40, Fig. 16, 1959.
Trichome constricted at the cross-walls, slightly bent or curved at
the ends, a little attenuated; cells not granulated at the cross-walls: end
cells slightly capitate, with a convex slightly thickened membrane,

**Dimensions:** Trichome 5.81-7.65 μ broad; cells 2.14-3.06 μ long.

**Distribution:** Among other algae of Ken water.

*Oscillatoria tenuis* Ag. ex. Gomont. Desikachary, op. cit., 222 Pl. 38,
Fig. 8, 1959.

Thallus thin blue-green or olive-green slimy; trichome straight,
fragile slightly constricted at the cross-walls, blue-green, sometimes bent
at ends, not attenuated at the apices, not capitate; cells at the septa
mostly granulate; end cell more or less hemispherical with thickened
outer membrane.

**Dimensions:** Trichome 4.2-7 μ broad; cells 2.24-4.2 μ long.

**Distribution:** Planktonic and in moist sand on the bank of river and in
sand culture.

*Oscillatoria tenuis var. tergestina* Rabenh. Desikachary, op. cit., 42,
Figs. 7, 9, 1959.

Differs from the type from in its diameter.

**Dimensions:** Trichomes 4.48-5.32 μ broad; cells 2.8-4.2 μ long.

**Distribution:** In stagnant water and in moist sand on the bank of river.
Found in sand and water cultures.

*Oscillatoria limnetica* Lemmermann. Prescott, op. cit., 488, Pl. 109,
Fig. 16, 1982.

Trichomes solitary and straight or flexuous, not tapering toward
the apex; apical cell bluntly rounded and without a calyptra; cells not
constricted at the cross-walls, which are scarcely visible and are not marked by granules.

**Dimensions:** Trichomes 1.4-1.96 μ in diameter.

**Distribution:** Planktonic and intermingled with other algae of water. Found in sand and water cultures.

**Oscillatoria angustissima** West and West. Prescott, op. cit., 485, Pl. 109, Fig. 5, 1982.

Trichomes much entangled to form a thin, light blue-green plant mass, not tapering toward the apices; apical cell bluntly rounded, not capitate and without a calyptra; cells not constricted at the cross-walls which are scarcely discernible, especially in the anterior end of the trichome; cell contents almost colourless.

**Dimensions:** Trichomes 0.71-1.00 μ broad; cells 0.86-2.0 μ long.

**Distribution:** Among other algae and found in sand and water cultures.

**Oscillatoria acutissima** Kufferath. Prescott, op. cit., 484, Pl. 109, Fig. 1, 1982.

Trichomes solitary and scattered, or loosely entangled in the mucilage of other algae; gradually tapering to the apex, which is curved or bent slightly; apical cell acute-conical, with a calyptra; cells not constricted at the cross-walls, which are not granular.

**Dimensions:** Trichomes 1.53-1.84 μ broad; cells 3.06-3.21 μ long.

**Distribution:** In stagnant water of river and mixed with other algae.

**Oscillatoria pseudogeminata var. unigranulata** Biswas. Desikachary, op. cit., 229, Pl. 39, Fig. 19, 1959.

Trichomes tenuous straight or somewhat curved, not constricted at the cross-walls, not attenuated at the apices, obtusely rounded or truncate,
not capitate; calyptra none; cell-wall thick, distinct with one large granule situated at the centre of the partition walls on either side; cell contents finely uniformly granular, blue-green.

**Dimensions:** Trichome 2.00-2.9 μ broad; cells 2.00-3.57 μ long.

**Distribution:** In moist sand on the bank of river and mixed with other algae.


Trichome straight, usually of uniform thickness, and only rarely slightly tapering at the ends, without constrictions at the joints, septa indistinct, but with distinct granules closely arranged on either side; cells with homogeneous contents, end cells rounded rarely conical, sometimes with constrictions at the septum, not capitate, without any calyptra.

**Dimensions:** Trichome 5.04-5.88 μ broad; cells 4.2-5.9 μ long

**Distribution:** In submerged stones of river or in moist sand of river.

**Oscillatoria okeni** Ag. ex. Gomont. Desikachary, op. cit., 231, Pl. 38, Fig. 17, 1959.

Thallus dull blue-green; trichome straight, fragile distinctly constricted at the cross-walls, at the ends gradually attenuated, undulating, slightly bent; end cells obtuse or subconical not capitate, without calyptra.

**Dimensions:** Trichome 5.6-8.4 μ broad; cells 2.8-4.48 μ long.

**Distribution:** In moist sand on the bank of river and in sand culture.

**Oscillatoria formosa** Bory ex Gomont Desikachary, op. cit., 232, Pl. 40, Fig. 15, 1959; Prescott, op. cit., 487, Pl. 109, Figs. 10, 11, 1982; Tiffany and Britton, op. cit., 346 Pl. 94, Fix. 1084, 1952.
Thallus dull blue-green; Trichomes straight, slightly constricted at the cross-walls nearly quadrate, septa sometimes slightly granulated; end-cells nearly, obtuse, calyptra absent, not capitate.

**Dimensions:** Trichomes 4.2-5.9 μ broad; cells 2.8-4.48 μ long.

**Distribution:** In wet sand on the bank of river and mixed with other algae. Found in sand culture.

**Oscillatoria earlei** Gardner Desikachary, *op. cit.*, 238, Pl. 38, Fig. 15, 1959.

Trichome short, straight, curved or bent at the ends, attenuated, not constricted at the cross-walls; cells quadrate; end cells prominently pointed.

**Dimensions:** Trichome 2.29-2.45 μ broad; cells 3.36-4.90 μ long.

**Distribution:** In stagnant water of the river and in sand culture.


Trichomes either solitary or a number of them parallel to each other aggregated into bundles of moderate size, not constricted at the cross-walls, usually quite straight, narrow or acuminate towards the sub obtuse, non-capitate, non-calyptate apex, which may be straight but is more often rather abruptly bend aside; cells contents bluish green, finely granular, sometimes with some larger granules close to the surface.

**Dimensions:** Trichomes 4.2-6 μ broad; cells 2.4-4 μ long.

**Distribution:** In moist soil of river or mixed with other algae. Found in sand and water cultures.

**Oscillatoria minima** Gicklhorn. Prescott, *op. cit.*, 489, Pl. 107., Fig. 24, 1982.
Trichomes somewhat coiled and spirally twisted, not tapering toward the apex; apical cell not capitate and without a calyptra.

**Dimensions:** Trichomes about 2.24 μ broad; cells 5.04-5.9 μ long.

**Distribution:** Mixed with other cyanophycean forms and in sand culture.

**Oscillatoria lacustris** (Kleb.) Geitler. Prescott, op. cit., 488, Pl. 109, Fig. 15, 1982.

Trichome straight, not tapering at the apices; apical cell broadly rounded, without a calyptra; cells compressed globose or barrel shaped, sometimes semiquadratate, or a little longer or shorter than wide; cell contents with many pseudovacuoles.

**Dimensions:** Trichome 6.4-7.2 μ broad; cells 4.2-5.8 μ long.

**Distribution:** Mixed with other algae of water.


Trichomes, somewhat fragile, slightly constricted at the cross walls, apex of the trichome slightly tapering, more or less curved, and sinuous; not distinctly hooked; apical cell acute and somewhat pointed, not capitate, calyptra none; cross-walls granular, blue-green.

**Dimensions:** Trichome 2.61-3.19 μ broad; cells 1.45.2.036 μ long.

**Distribution:** Mixed with other algae of river.

**Oscillatoria minnesotensis** Tilden. Desikachary, op. cit., 225, Pl. 40, Fig. 19, 1959.

Thallus thin, dark blue-green; trichome more or less curved, especially constricted at the joints, apex of the trichome straight, or slightly bent, neither tapering nor capitate; apical cell round, calyptra none; transverse walls pellucid, cell contents homogeneous.
**Dimensions:** Trichome 2.2-4.58 μ broad; cells 3.36-4.29 μ long.

**Distribution:** Mixed with other algae of river.

**Genus** **PHORMIDIUM Kutz**

**Phormidium tenue** (Menegh.) Gomont. Desikachary, op. cit., 259, Pl. 43, Figs. 13, 15 and Pl. 44, Figs. 7-9, 1959; Prescott, op. cit., 496, Pl. 111, Fig. 7, 1982.

Thallus pale blue-green, thin, membranous, expanded; trichomes straight or slightly bent, densely entangled, slightly constricted at the cross-walls, attenuated at the ends, pale blue-green; sheath thin, diffluent; septa not granulated, cross-walls not commonly visible; end-cell acute-conical; calyptra absent.

**Dimensions:** Trichomes 1.07-1.99 μ broad; cells 2.75-4.59 μ long.

**Distribution:** Planktonic and mixed with other algae of water. Found in sand and water cultures.

**Phormidium purpurascens** (Kutz.) Gomont. Desikachary, op. cit., 262, Pl. 45, Figs. 1-4, 1959.

Thallus compact; trichome strongly bent, entangled, not constricted at the cross-walls; ends not attenuated; sheath more or less diffluent; cells nearly quadrate; cross-walls marked by two granules on either side; end-cell rounded; calyptra absent.

**Dimensions:** Trichome 1.57-2.46 μ broad; cells 2.00-4.29 μ long.

**Distribution:** Found on stones of river.


Thallus thick expanded, soft, mucilaginous, deep blue-green; trichome subparallel of uniform width: sheath thin, colourless; cells disc-shaped,
much broader than long; end cells bluntly rounded without cap or calyptra.

**Dimension**: Trichome 8.4-10.5 μ broad; cells 0.84-1.96 μ long.

**Distribution**: Mixed with other algae of river.

**Phormidium ambiguum** Gomont. Desikachary, op. cit., 266, Pl. 44, Fig. 16 and Pl. 45, Figs. 5, 6, 1959.

Thallus more or less expanded, bright blue-green, dark or yellowish green; filaments flexuous, variously entangled; trichomes slightly constricted at the cross-walls at the ends not attenuated, not capitate, blue-green; sheath thin, firm or diffusent sometimes thick and more or less lamellactated; cells shorter than broad, rarely granulated at the cross-walls, sometimes with gas-vacuoles; end cell rounded, calyptra absent.

**Dimensions**: Trichomes 4.35-5.94 μ broad; cells 1.59-2.61 μ long.

**Distribution**: Growing on side wall of the bank of river or mixed with other algae and in sand culture.

**Genus** **LYNGBYA** Ag.

**Lyngbya polysiphoniae** Fremy. Desikachary, op. cit., 287, Pl. 53, Fig. 5, 1959.

Filaments straight single; sheath very thin, colourless; trichome pale blue-green, constricted at the cross-walls, apices not attenuated; cross-walls visible, not granulated; end cells convex, not capitate.

**Dimensions**: Cells about 1.99-2.75 μ broad and about 0.92-1.22 μ long.

**Distribution**: Among other algae of river and in sand culture.

**Lyngbya contorta** Lemm. Desikachary, op. cit., 290, Pl. 48, Fig. 5 and Pl. 50, Figs. 5, 9, 1959.
Filaments single, free floating, regularly spirally coiled, with a delicate, nearly circular coils; sheath narrow, colourless; cells not constricted at the cross-walls, granulated with a single granule or without them; end cell rounded, not attenuated.

**Dimensions:** Cells 1.14-2.00 μ broad and 3.00-4.58 μ long.

**Distribution:** Mixed with other algae of river. Found is sand and water cultures.

*Lyngbya aestuarii* var. *arbustiva* Bruhl et Biswas. Desikachary, *op. cit.*, 307, Pl. 51, Fig. 10, 1959:

Filaments long, flexible, at the base more or less prostrate, sinuous more or less densely interwoven; sheath at first thin and colourless, later on greyish, rough on the outer surface, lamellose; trichomes scarcely or not at all constricted at the joints; cell contents pale green, densely granular, granules partly minute, partly somewhat larger, often more crowed near the dissepiments.

**Dimensions:** Cells 17.08-20.16 μ broad and 4.2-5.8 μ long; sheath 2.24-4.76 μ thick.

**Distribution:** Mixed with other algae on the bank of river.

*Lyngbya porphyrosiphonis* Fremy. Desikachary, *op. cit.*, 313, Pl. 53, Fig. 3, 1959.

Filaments flexuous, growing irregularly; sheath hyaline, homogeneous, thin; trichomes not constricted at the cross-walls, cell contents bluish-green, finely granular; cross-walls prominent; apical cell round or obtusely conical, not capitulate.

**Dimensions:** Cells 1.99-2.14 μ broad and about 2.75 μ long; filament upto 2.75 μ broad.
**Distribution**: Among other algae on the bank of river.

*Lyngbya confervoides* C. Ag. Ex Gomont. Desikachary, op. cit., 314, Pl. 49, Fig. 9 and Pl. 52, Fig. 13, 1959.

Thallus caespitose, fasciculate, yellowish brown or dull green; filament at the base decumbent, above ascending and entangled, straight; sheath colourless; trichome olive-green or blue-green, not constricted at the cross-walls, cross-walls commonly granulated, not attenuated at the apices; end cell rotund; calyptra absent.

**Dimensions**: Trichome 6.72-9.18 µ broad; cells 2.99-3.92 µ long; sheath upto 4.76 µ broad.

**Distribution**: Mixed with other cyanophycean forms of river.

**NOSTOCACEAE**

**ANABAENAE**

Genus *CYLINDROSPERMUM* Kutz.

*Cylindrosporum stagnale f. variabilis* Prasad, B.N. Desikachary, op. cit., 364, Pl. 64, Fig. 1, 1959.

Plant mass soft, dense, mucilaginous, light blue-green; trichomes single, blue-green, often entangled with each other, cylindrical or quadratic, slightly constricted at the septa; heterocysts at both ends of filaments, varying in shape, narrowly cylindrical, subelliptical or almost ellipsoidal; spores elongate, subcylindrical, broader at the heterocyst end and flattened slightly at the sides, formed singly, subterminally.

**Dimensions**: Trichomes 4.2-4.46 µ broad; cells 6.72-7.84 µ long; heterocysts 5.6-7.84 µ broad and 10.64-15.4 µ long; spores 16.24-17.36 µ broad and 29.4-35.28 µ long.

**Distribution**: In stagnant water of river.
**Cylindrospermum muscicola** Kutzing ex Born. et Flah. Desikachary, *op. cit.* 366, Pl. 65, Fig. 3, 1959; Tiffany and Britton, *op. cit.* 362, Pl. 100, Fig. 1147, 1952.

Thallus expanded, blue-green; trichome pale blue-green, mostly bent, sometimes straight, aggregated; cells quadrate or mostly bent, sometimes straight, aggregated; cells quadrate or mostly cylindrical, more or less constricted at the cross-walls; heterocyst nearly spherical oblong; spores single, broadly ellipsoidal, or oblong.

**Dimensions:** Cells 3.92-5.04 μ broad and 5.04-6.84 μ long; heterocysts 5.04-5.99 μ broad and 7-7.84 μ long; spores 8-12.84 μ broad and 12.41-16.8 μ long.

**Distribution:** Mixed with other *Cylindrospermum* sp.

Genus **NOSTOC** Vaucher

**Nostoc linckia** (Roth.) Bornet ex Born. et Flah. Desikachary, *op. cit.* 377, Pl. 69, Fig. 4, 1959.

Thallus gelatinous, blue-green or brown; filaments densely entangled, flexuous or highly coiled; sheath diffusent and colourless inside, distinct only in the peripheral portion; trichomes pale blue green; cells short barrel shaped; heterocysts subspherical; spores subspherical.

**Dimensions:** Trichomes 3.5-3.92 μ broad; heterocysts about 5.6-8.12 μ broad; spores 5.6-7 μ broad and 7-8.12 μ long.

**Distribution:** Free-floating in Ken water and in water culture.

**Nostoc carneum** Ag. *ex* Born. Et Flah. Desikachary, *op. cit.* 381, Pl. 69, Fig. 6, 1959; Tiffany and Britton, *op. cit.* 366, Pl. 101, Fig. 1154, 1952.
Thallus gelatinous, blue to olive green; filaments loosely contorted, flexuous; sheath indistinct, colourless; cells oblongo cylindrical; up to twice as long as broad; heterocysts oblong; spore oval to ellipsoidal.

**Dimensions:** Trichome 3.5-4.2 μ broad; heterocysts 5.6-6.16 μ broad; spores 5.88-6.16 μ broad and 5.6-9.52 μ long.

**Distribution:** Free-floating in Ken water and in water culture.

*Nostoc verrucosum* Vaucher ex Born. et Flah. Desikachary, *op. cit.* 388, Pl. 70, Fig. 1, 1959, Tiffany and Britton, *op. cit.*, 366, Pl. 101, Fig. 1155, 1952.

Thallus often gregarious, spherical, gelatinous, brownish green; filaments flexuous and densely entangled at the periphery; cells short barrel-shaped oval.

**Dimensions:** Trichome 3.2-4.2 μ broad; heterocysts about 5.6-6.16 μ broad; spores up to 5.04 μ broad and about 7 μ long.

**Distribution:** Mixed with other algae of river.

*Nostoc muscorum* Ag. ex Born. et Flah. Desikachary, *op. cit.*, 385, Pl. 70, Fig. 2, 1959; Tiffany and Britton, *op. cit.*, 366, Pl. 100, Fig. 1149, 1950.

Thallus gelatinous-membranous, irregularly expanded, tuberculate, dull olive or brown; filaments densely entangled; sheath distinct only at the periphery of the thallus, yellowish brown; cells short barrel-shaped to cylindrical; heterocysts nearly spherical; spores oblong, many in series.

**Dimensions:** Trichome 3.36-4.76 μ broad; heterocysts 6.16-7 μ broad; spores 4.2-7.84 μ broad and 7-10.64 μ long.

**Distribution:** In moist sand on the bank of river.

Genus **ANABAENA** Bory
Anabaena sphaerica, var. attenuata Bharadwaja. Desikachary, op. cit. 395, Pl. 71, Fig. 1959.

Thallus floccose, gelatinous thin, blue-green; trichomes curved or straight, more or less entangled with each other, slightly attenuated at the ends, with rounded end-cells, without a mucilage sheath; cells spherical or slightly barrel-shaped; heterocysts, spherical or oval.

**Dimensions:** Trichome 3.77-5.22 μ broad; cells 3.04-5.07 μ long; heterocysts 5.8-7.83 μ broad; spores 10.15-11.02 μ broad and 10.15-11.89 μ long.

**Distribution:** In moist sand on the bank of river and mixed with other algae.

Anabaena oryzae Fritsch. Desikachary, op. cit., 396, Pl. 72, Fig. 3, 1959.

Thallus soft, green, gelatinous, membranous; trichomes short, straight, densely aggregated, generally parallel; cells more or less barrel-shaped; heterocysts terminal and intercalary, broader than the vegetative cells, generally barrel-shaped, sometimes spherical, single; spores rarely single next to the terminal heterocyst, commonly away from the intercalary heterocysts or in series, subspherical or short ellipsoidal.

**Dimensions:** Trichomes 2.52-3.08 μ broad; heterocysts 3.08-3.64 μ broad; spores about 5.04 μ broad and about 7 μ long.

**Distribution:** Mixed with other cyanophycean forms in flowing water and in sand culture.

Anabaena fertilissima Rao, C.B. Desikachary, op. cit. 398, Pl. 74, Fig. 1, 1959.
Trichomes single, straight or bent, with almost rounded end cells; cells barrel-shaped; heterocysts almost spherical; spores in long chains, often making the whole trichome sporogenous, adjoining the heterocysts but formed centrifugally, almost spherical, with a smooth hyaline outer wall.

**Dimensions:** Trichomes 5.04-5.6 μ broad; cells 5.04-6.1 μ long; heterocysts 6.16-8.96 μ broad; spores 4.76-7.84 μ broad and 3.36-8.4 μ long.

**Distribution:** Mixed with other algae and in sand culture.

**Anabaena gelatinicola** Ghose. Desikachary, *op. cit.* 398, Pl. 76, Fig. 6, 1959.

Thallus thick, gelatinous; trichome mostly solitary, spirals densely arranged and coiled, not screw like, sometimes straight; cells subspherical, apex acute; heterocysts spherical; spores in series, away from the heterocysts, spherical.

**Dimensions:** Trichome 6.16-7 μ broad; heterocysts 7-7.8 μ broad; spores about 14.0 μ in diameter.

**Distribution:** In moist sand on the bank of river.

**Anabaena ivengarii** Bharadwaja. Desikachary, *op. cit.*, 406, Pl. 78, Fig. 2, 1959.

Trichome single or irregularly curved; end-cell conical with rounded apex; cells barrel-shaped; heterocysts barrel-shaped, rarely spherical; spores ellipsoidal often in long or short chains, rarely single on both sides of the heterocysts.

**Dimensions:** Trichome 5.6-6.72 μ borad; cells 3.36-4.76 μ long; heterocysts 7.28-8.4 μ broad and 7.28-9.52 μ long; spores 13.44-14 μ broad and 15.68-19.88 μ long.
Distribution: Mixed with other algae in stagnant water of the river Ken.

Anabaena ivengarii var. tenuis Rao, C.B. Desikachary, op. cit., 408, Pl. 76. Fig. 1, 1959.

Plant mass floccose, thin, pale blue-green; trichomes single, straight or irregularly curved; end cells conical with rounded apices; cells barrel-shaped; heterocysts more or less barrel shaped, sometimes spherical; spores ellipsoidal, or cylindrical, with rounded ends, single or in pairs on either side of a heterocysts.

Dimensions: Trichome 3.57-4.29 μ broad; cells 3.57-6.00 μ long; heterocysts 4.9-6.52 μ broad and 6.44-8.86 μ long; spores 7.58-9.15 μ broad and 9.13-18.85 μ long.

Distribution: In moist sand on the bank of river Ken and mixed with other algae.

Anabaena ivengarii var. attenuata Rao, C.B. Desikachary, op. cit. 408, Pl. 76, Fig. 5, 1959.

Plant mass mucilaginous, deep blue-green; trichomes single; straight or irregularly curved, tapering at the ends; cells barrel shaped; heterocysts barrel-shaped; spores ellipsoidal, single or in pairs, on either side of the heterocysts, with a smooth hyaline wall.

Dimensions: Trichome 4.03-4.76 μ broad; cells 3.36-5.6 μ long; heterocysts 5.6-6.16 μ broad and 6.16-8.96 μ long; spores 11.76-15.4 μ broad and 15.4-19.6 μ long.

Distribution: Mixed with other cyanophycean forms of river Ken.

Anabaena circinalis var. Crassa Ghose. Desikachary, op. cit., 414, Pl. 77, Fig. 5, 1959.
Trichome single, semi-circular, loosely coiled up to 4 times cells nearly spherical, heterocysts globose; spores not seen.

**Dimensions:** Cells 5.32-7 μ broad; heterocysts 7.56-8.12 μ long.

**Distribution:** Among other algae in stagnant water of river.

**Anabaena planctonica Brunnthaler.** Desikachary, *op. cit.*, 357, Pl. 98, Fig. 1128, 1959.

Filaments free-floating solitary, straight or slightly bent; cells rounded or broadly ellipsoid; heterocysts spherical akinetes solitary adjacent to heterocysts.

**Dimensions:** Cells 10-14 μ broad and 12-12 μ long; heterocysts 12.8-22 μ broad; spores 14-20 μ broad and 12.8-30 μ long.

**Distribution:** Mixed with other algae of river.

**Anabaena affinis Lemmermann.** Prescott, *op. cit.*, 513, Pl. 115, Fig. 10, 1982.

Trichomes straight, solitary and free-floating; cells spherical to spheroidal; heterocysts spherical slightly larger than vegetative cells;

**Dimensions:** Cells 5.04-7 μ broad; heterocysts 7.56-9.83 μ broad; spores 9.52-11.93 μ broad.

**Distribution:** Among other algae of river Ken.

**Anabaena oscillarioides Bory ex Born. et Flah.** Desikachary, *op. cit.*, 417, Pl. 71, Fig. 7, 1959; Tiffany and Britton, *op. cit.*, 357, Pl. 99, Fig. 1137, 1952.

Thallus gelatinous, dark green; cells barrel-shaped, end cells rounded; heterocysts spherical or oval; spores on both sides of the heterocysts; single or 2-3, at first oval, later rounded cylindrical.
Dimensions: Trichomes 4.29-5.72 μ broad; cells 3.43-5.43 μ long; heterocysts 6.0-8.00 μ broad and 6.52-10.00 μ long; spores 6.96-9.86 μ broad and 15.08-26.1 μ long.

Distribution: Mixed with other algae of river Ken.

Anabaena sp.

Trichome single, straight or slightly curved; cells quadrate or cylindrical, rarely slightly barrel-shaped; end-cell conical with rounded apex; heterocysts single, intercalary,

Dimensions: Trichome 2.8-3.92 μ broad; cells 3.22-4.76 μ long heterocysts 5.04-6.16 μ broad and 7.84-12.04 μ long.

Distribution: Mixed with other algae of river Ken.

Anabaena sp.

Thallus dense, soft, mucilaginous, deep green; trichomes blue-green, often irregular with each other, slightly constricted at the joints, attenuated at the ends; the terminal cell being conical with a sharp rounded apex, without mucilaginous sheath; cells cylindrical, rarely barrel-shaped, and almost as long as broad; heterocysts single intercalary, and distributed at regular intervals throughout the length of the trichome, cylindrical.

Dimensions: Trichome 3.19-4.20 broad; cells 4.25-8.41 μ long; heterocysts 4.208-5.8 μ broad and 8.7-10.87 μ long.

Distribution: Found on floating dead leaves on Ken water.

Anabaena sp. Cells constricted at the middle but complete septa absent.

Dimensions: Cells 6-84 μ broad and 6.9.4 μ long; heterocysts 6.8-8.8 μ broad.

Distribution: Planktonic and mixed with other algae of river Ken.
Genus **Raphidiopsis** Fritsch et Rich.

*Raphidiopsis sp.*

Cells often with pseudovacuoles; trichomes single or often in bundles, S shaped, circular, curved or straight, not constricted at the cross walls.

**Dimensions:** Cells 3.98-4.59 µ broad.

**Distribution:** Free-floating or mixed with sandy material of river and in sand culture.

Genus **Modularia** Mertens


Cells depressed-spherical; heterocysts scarcely larger than vegetative cells; akinetes depressed spherical 2-12 in a series; sheath thin, finally diffuent.

**Dimensions:** Cells 6.16-8.4 µ broad and 3.92-4.2 µ long; heterocysts 7-9.8 µ broad; akinetes 7.84-11.76 µ broad.

**Distribution:** In moist sand on the bank of river Ken and mixed with other cyanophycean forms.

*Modularia spumigena* Mertens. Tiffany and Britton, *op. cit.*, 362, Pl. 99, Fig. 1139, 1952.

Cells disciform; heterocysts scarcely larger than vegetative cells; akinetes spherical, solitary, few or many in series; filaments solitary, straight or curved.

**Dimensions:** Cells 8.96-11.2 µ broad and 3.36-5.04 µ long; akinetes 12.32-14.56 µ broad and 6.16-9.8 µ long; filaments 9.52-17.92 µ broad.

**Distribution:** Mixed with other algae of river.
Genus **AULOSIRA** Kirchner

*Aulosira bombavensis* Gonzalves. Desikachary, op. cit., 426. Pl. 82, Figs. 1,2, 1959.

Filaments yellowish to deep blue-green in colour; sheath firm, hyaline, unlamellated; trichomes constricted at the joints; cell contents blue-green; heterocysts intercalary, oblong with rounded ends; spores oblong to quadrate, with rounded ends.

**Dimensions:** Trichomes 2.41-2.08 μ broad; heterocysts 3.42-4.98 μ broad and 8.12-12.6 μ long; spores 4.2-6.16 μ broad and 6.44-12.6 μ long.

**Distribution:** Floating in Ken water.


Thallus blue-green or green in colour; filaments parallel, straight or slightly curved, becoming greenish yellow; sheath thin first homogeneous, later with an outer diffluent portion, and inner uniformly thick; trichomes markedly constricted at the cross-walls, apical cells tapering to the rounded apex; cells cylindrical generally longer than broad, rarely quadrate; heterocyst intercalary or terminal, broader than the trichome, bulging cut the sheath; intercalary heterocysts generally single, rarely in pairs, regularly placed, ellipsoidal; spores not seen.

**Dimensions:** Cells 3.36-5.04 μ broad and 7-14 μ long; heterocysts about 5.6 μ broad.

**Distribution:** Forming a dense mucilaginous scum on the surface of Ken water.

**RIVULARIACEAE**

Genus **CALOTHRIX** Ag.
**Calothrix geitons** Skkuja. Desikachary, *op. cit.*, 537, Pl. 109, Figs. 6-12, 1952.

Filaments solitary, erect or flexuous gradually attenuated into a long hyaline hair, base not dilated, but appears dilated by the broadening of the sheath; sheath colourless, sometimes mucilaginous partly lamellated, persistent, at the upper ends diffluent; cells distinctly constricted at the cross-walls; cells in the hair many times longer than broad; heterocysts basal, rounded cylindrical, barrel-shaped or hemispherical.

**Dimensions:** Cells at the base 7.10-8 μ broad; heterocysts 8-10 μ broad and 7-18.4 μ long; sheath upto 3.12 μ thick.

**Distribution:** Mixed with other cyanophycean forms.

**Calothrix gloeocola** Skuja. Desikachary, *op. cit.*, 542, Pl. 109, Figs. 15, 16, 1959.

Filaments solitary, simple, flexuous, in the mucilage of other algae, gradually attenuated into a moderately long hair, base dilated or clavate; sheath thin, colourless, more or less homogeneous, sometimes diffluent; heterocysts basal, solitary or geminate globose or truncate, hemispherical or subovoid, partly enclosed by the sheath.

**Dimension:** Cells at the base 5.32-6.44 μ broad, in the middle 2.8-3.08 μ broad; heterocysts 6.16-7.28 μ broad and 7-7.84 μ long; sheath about 1.12 μ thick.

**Distribution:** Mixed with *Gloeotrichia* balls or attached with submerged plants of river.

**Calothrix clavata** West, G.S. Desikachary, *op. cit.*, 542, Pl. 114, Fig. 2, 1959.
Filaments single, or a few together, straight, or slightly bent, prominently swollen at base; sheath close to the trichome, very thin, colourless; trichomes slightly constricted at the cross walls; cells discoid at the base; heterocysts basal, single hemispherical.

**Dimensions:** Trichomes at the base 4.28-5.50 μ broad in the middle 3.06-4.90 μ broad; heterocysts about 5.97-6.84 μ broad; filaments at the base 5.04-6.12 μ broad.

**Distribution:** Mixed with other cyanophycean forms of river Ken.

**Calothrix marchica** Lemmermann. Desikachary, op. cit., 543, Pl. 114, Fig. 4, 1959.

Filaments straight, or slightly bent, single, sheath thin, colourless; trichome blue-green, gradually attenuated into a hair, distinctly constricted at the cross-walls; cells nearly as long as broad, end cell conical, somewhat pointed; heterocyst single, basal nearly spherical or hemispherical.

**Dimensions:** Trichomes 8.4-12.6 μ broad; cells about 4.48 μ long; heterocyst 8.4-12.32 μ broad; filaments at the base about 9.8-14 μ broad.

**Distribution:** On submerged aquatic plants of river.

**Calothrix marchica var. intermedia** Rao C.B. Desikachary, op. cit., 544, Pl. 113, Figs. 1, 2, 1959.

Filaments placed singly or in groups of two or three, with slight attenuation, without a terminal hair; sheath thin, firm, hyaline; trichomes constricted at the cross-walls; cells quadratic, shorter or longer than broad; end cells rounded; heterocysts single, basal, usually spherical.

**Dimensions:** Trichomes 5.88-7.84 μ broad; cells 3.92-7.84 μ long; heterocystis 5.88-7.28 μ broad; filaments about 6.16-8.4 μ broad.
**Distribution:** On submerged aquatic plants and mixed with other algae of Ken water.

*Calothrix bharadwajae* De Toni, J. Desikachary, *op. cit.*,526, Pl. 112, Fig. 3, 1959.

Filaments straight or slightly bent; sheath very distinct thin, hyaline, closely depressed to the trichome; trichome constricted at the joints, and tapering into a long hair, the terminal portion of the hair without sheath; cells of the hair, very much elongated and almost rectangular; heterocysts basal, single, spherical; spores single, adjoining the basal heterocysts, cylindrical.

**Dimensions:** Trichome at the base about 15.65-6.23 μ broad; cells 3.62-4.52 μ long; heterocysts about 4.35-6.96 μ broad; spore 6.38-8.26 μ broad and 14.5-21.75 μ long; filaments about 9.13 μ broad.

**Distribution:** In stagnant water of river and mixed with other algae.

*Calothrix seytonemicola* Tilden. Desikachary, *op. cit.*,537, Pl. 112, Fig. 14, 1959.

Filaments isolated or in small groups; sheath not distinct; trichome terminates into a pointed hair; heterocysts globose, basal.

**Dimensions:** Trichomes 4.8-6.4 μ broad; cells 5.4-8.8 μ long; heterocysts 6.8-8.8 μ broad; filaments 6.4-8.4 broad.

**Distribution:** Growing on dead leaves in stagnant water of the river Ken and mixed with other cyanophycean forms.

**Genus RIVULARIA** (Roth) Ag.

*Rivularia hansgiri* Schmidle. Desikachary, *op. cit.*,549, Pl. 112, Fig. 7, 1959.
Thallus gelatinous, thin solid; trichome long, horizontally expanded, generally intricate and curved; rarely subparallel, at the end gradually tapering, distinctly torulose; sheath thin, colourless or pale yellow; cells rectangular or subquadrate; heterocysts basal, single or two together, hyaline,

**Dimensions:** Trichome in the middle 5.6-6.16 μ broad; heterocysts 7.84-8.4 μ broad.

**Distribution:** Mixed with other algae of river Ken.

**Genus GLOEOTRICHIA** Ag.


Thallus spherical, small; filaments with a firm, thick stratified, yellowish brown sheath; cells at the base barrel-shaped, higher up quadratic or cylindrical, at the apex long cylindrical; heterocysts single spherical, subspherical; spores cylindrical with a smooth hyaline outer wall.

**Dimensions:** Trichome 6.4-8.8 μ broad; cells 7.2-10 μ long; at the apex 10-12 μ long; heterocysts 9.4-12 μ broad; spores 9.4-14.4 μ broad, with sheath upto 20 μ broad and 68-128 μ long.

**Distribution:** On submerged aquatic plants on the bank of river Ken or free-floating.

**Gloeotrichia longicauda** Schmidle. Desikachary, *op. cit.*, 558, Pl. 117, Fig. 8, 1959.

Thallus hemispherical; sheath somewhat diffuse; not lamellated, colourless; trichome gradually attenuated into a long hair; cells as long as broad or somewhat longer or shorter than broad; heterocysts varying in
diameter; immature spores rounded, cylindrical or long ellipsoidal, later bent or curved.

**Dimension:** Trichome at the base about 5.04 μ broad; heterocysts 7-8.96 μ broad and 9.24-10.84 μ long; spores 11.2 -14 μ broad and 22.4-37.8 μ long.

**Distribution:** Free-floating in Ken water.

**Gloeotrichia indica Schmidle.** Desikachary, *op. cit.*, 560, Pl. 112, Figs. 5, 6, 1959.

Thallus spherical soft, hollow (or solid); filaments radiating; trichomes made of 2-3 cells, cells barrel -shaped and a long narrow hair with cylindrical cells; spores nearly cylindrical; sheath at first hyaline later yellowish brown and close to the trichome.

**Dimensions:** Trichome cells at the base about 8 μ broad; heterocysts upto 12 μ broad; spores 62.06-69.34 μ long, without sheath 18-20 μ broad, with sheath 20-26 μ broad.

**Distribution:** Free-floating on the bank of river Ken.


Thallus spherical, soft; filaments with a thin hyaline and closely t adpressed sheath; trichomes with constrictions at the joints; cells at the base of th trichome invariably flattened and barrel shaped higher up almost quadratic or cylindrical, in the hair long cylindrical broad, heterocysts spherical or sub-spherical, usually single, rarely in pairs; spores cylindrical, with smooth outer walls.

**Dimensions:** Trichome at the base 9.8-12.6 μ broad, higher up 4.2-5.88 μ broad, cells at the base 2.8-4.48 μ long; higher up 5.04-15.4 μ long;
heterocysts 8.96-11.2 μ broad; spores without sheath 12.04-14.56 μ broad with sheath about 14-16.8 μ broad and 56-65.8 μ longs sheath about 84-1.12 μ thick.

**Distribution:** Free-floating on the bank of river Ken.


Thallus spherical or almost ellipsoidal brown; filaments with a thin stratified and brown sheath; sometimes constricted at intervals; trichome constricted at the cross-walls, ending in a long hair; cells at the base barrel-shaped and much shorter than broad or almost quadratic; heterocysts single, spherical; spores long ellipsoidal with a hyaline smooth outer wall

**Dimensions:** Trichome at the base 9.42-12.84 μ broad, higher up 4.28-6.85 μ broad; cells at the base 3.85-6.85 μ longs lower up to 5.99-14.98 μ long; heterocysts 10.27-13.27 μ broad and 10.27-13.27 μ long; spores 14-17.12 μ broad and 55.64-65.05 μ long.

**Distribution:** Spherical ball like structure floating on the bank of Kenwater.


Thallus spherical, soft, bullate, hollow, olive green to brown; filaments loosely arranged; trichome olivaceous, attenuated into a long hair; cells at the base barrel-shaped, as long as broad or somewhat shorter, higher up to 4 times as long as broad; heterocysts basal more or less spherical; spores cylindrical, straight or bent, saccate, transversely constricted, hyaline, or brownish.
**Dimensions:** Trichome 7-8.4 μ broad; heterocysts 6.16-11.2 μ broad; spores without sheath 10.64-17.36 μ broad with sheath upto 44.8 μ broad and 40.32-106.4 μ long.

**Distribution:** Free-floating on the bank of river Ken.

**Gloeotrichia raciborskii Woloszynska.** Desikachary, op. cit., 562, Pl. 118, Fig. 14, 1959.

Thallus spherical, soft; trichome ending in a long hair; sheath at the base lamellated, dull brown; cells at the base of the trichome shorter than broad, higher up as long as broad, or longer, pale blue-green; heterocysts spherical; spores long ellipsoidal.

**Dimensions:** Trichome 7-7.84 μ broad; heterocysts 5.04-5.88 μ broad; spores 15.12-18.2 μ broad and about 50.4 μ long, with sheath upto 24.64 μ broad.

**Distribution:** Free-floating on the bank of river Ken.

**Gloeotrichia raciborskii var. bombayense Dixit.** Desikachary, op. cit., 563, Pl. 117, Figs. 13, 14, 1959.

Spores with brown sheath; sheath without distinct stratification.

**Dimensions:** Trichomes 4.2-6.44 μ broad; heterocysts 10.36-12.32 μ broad and 8.96-10.08 μ long; spores upto 12.32 μ broad and 42 μ long.

**Distribution:** Free-floating in stagnant water of river Ken.

**Gloeotrichia raciborskii var. kashiense Rao, C.B.** Desikachary, op. cit., 563, Pl. 117, Figs. 2-6, 1959.

Thallus large; Trichomes with constrictions at the joints; heterocysts single, spherical or ellipsoidal; spores ellipsoidal with a hyaline smooth outer wall.
Fig. 126: Navicula spaerophora; 127: Navicula sculpta; 128: Navicula pupula; 129: Navicula ventricosa; 130: Navicula exilis; 131: Navicula radiosa; 132: Navicula anglica; 133: Navicula gastrum; 134: Navicula platystoma; 135: Navicula exigua.
**Dimensions:** Trichome at the base 8.96 µ broad, higher up 5.05-6.44 µ broad; at the apex upto 3.92 µ broad; heterocysts 9.8-11.76 µ broad and 8.4-14.56 µ long; spores 11.76-15.4 µ broad and 42-67.2 µ long.

**Distribution:** Free-floating on the bank of river Ken.

*Gloecotrichia raciborskii* var *longispora* Rao C.S. op. cit., 564, Pl. 118, Figs. 4-6, 1959.

Trichomes constricted at the joints; cells at the base barrel shaped and quadratic, as long as braod or shorter, higher up cylindrical or barrel shaped; heterocysts single, spherical or ellipsoidal; spores cylindrical with a smooth outer wall.

**Dimensions:** Trichomes at the base 7.6-9.2 µ broad, higher up 4-6 µ broad; at the apex about 2 µ broad; cells at the base 8.4-11.6 µ long, higher up 48-10 µ long in the hair in 15.6 µ long; heterocysts 12.8 - 14.4 µ broad; spores 10.4-14 µ broad and 84-10 µ long is sheath 6.4-9.6 µ broad.

**Distribution:** Free floating bales on the bank of river Ken.

*Gloecotrichia raciborskii* var. *salsettense* Dixit, Desikachary, op. cit., 564, Pl. 117, Fig. 15, 1959.

**Dimensions:** Trichomes 4.28-8 µ broad; heterocysts 7.70-14 µ broad; spores 12.8-14.8 µ broad and about 60-67.2 µ long.

**Distribution:** Free-floating in Ken water.

[152]
II- DISTRIBUTION, PERIODICITY AND SUCCESSION OF ALGAE

QUALITATIVE DISTRIBUTION

Banda happens to be more or less infringed with human activity. Ken at this sampling station marked growth of 79 genera spread over 348 species. At this station dominance of bacillariophycean forms over chlorophycean, cyanophycean, charophycean, rhodophycean and euglenophycean forms was observed (Table-1)

Qualitatively algal species show sequential gradual increase from winter months to summer upto Apil (Table -2). Various classes of algae represented during different months show increase in number of algal species from November to April. But during May-August gradual decline in three classes (chlorophyceae, bacillariophyceae and cyanophyceae) and then marked by gradual increase from September-October (Table 3).

BENTHIC ALGAE

### TABLE: 1: TOTAL NUMBER OF BENTHIC ALGAE IN EACH CLASS FROM NOVEMBER TO OCTOBER

<table>
<thead>
<tr>
<th>CHLOROPHYCEAE</th>
<th>CHAROPHYCEAE</th>
<th>BACILLARIOPHYCEAE</th>
<th>EUGLENOPHYCEAE</th>
<th>RHODOPHYCEAE</th>
<th>CYANOPHYCEAE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>1</td>
<td>130</td>
<td>2</td>
<td>1</td>
<td>120</td>
<td>348</td>
</tr>
</tbody>
</table>

### TABLE: 2: TOTAL NUMBER OF BENTHIC ALGAE IN EACH MONTH

<table>
<thead>
<tr>
<th>CLASS</th>
<th>NOV.</th>
<th>DEC.</th>
<th>JAN.</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUNE</th>
<th>JULY</th>
<th>AUG</th>
<th>SEPT</th>
<th>OCT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHLOROPHYCEAE</td>
<td>101</td>
<td>114</td>
<td>136</td>
<td>165</td>
<td>210</td>
<td>278</td>
<td>247</td>
<td>205</td>
<td>58</td>
<td>9</td>
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<td>63</td>
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<tr>
<td>CHAROPHYCEAE</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>BACILLARIOPHYCEAE</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUGLENOPHYCEAE</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>RHODOPHYCEAE</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>CYANOPHYCEAE</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE: 3: TOTAL NUMBER OF BENTHIC ALGAE IN EACH CLASS AND MONTH

<table>
<thead>
<tr>
<th>CLASS</th>
<th>NOV.</th>
<th>DEC.</th>
<th>JAN.</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUNE</th>
<th>JULY</th>
<th>AUG</th>
<th>SEPT</th>
<th>OCT.</th>
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</thead>
<tbody>
<tr>
<td>CHLOROPHYCEAE</td>
<td>34</td>
<td>40</td>
<td>45</td>
<td>47</td>
<td>56</td>
<td>65</td>
<td>62</td>
<td>53</td>
<td>15</td>
<td>3</td>
<td>12</td>
<td>22</td>
</tr>
<tr>
<td>CHAROPHYCEAE</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>BACILLARIOPHYCEAE</td>
<td>32</td>
<td>36</td>
<td>47</td>
<td>56</td>
<td>78</td>
<td>116</td>
<td>107</td>
<td>90</td>
<td>29</td>
<td>2</td>
<td>17</td>
<td>23</td>
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<tr>
<td>EUGLENOPHYCEAE</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RHODOPHYCEAE</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CYANOPHYCEAE</td>
<td>33</td>
<td>36</td>
<td>41</td>
<td>59</td>
<td>74</td>
<td>94</td>
<td>76</td>
<td>60</td>
<td>14</td>
<td>4</td>
<td>12</td>
<td>18</td>
</tr>
</tbody>
</table>

Euglena gracilis, E. spirogyra and rhodophycean Compsopogon sp. were observed.


**PLANKTONIC ALGAE**

Twenty chlorophycean species comprising (Actinastrum hantzschii, Ankistrodesmus convolutus, A. falcatus, Chlorococcum humicola, Chlorella vulgaris, Closteriopsis longissima, Crucigenia tetrapedia, C. quadrata, Coelastrum cambricum var. intermedium, Closterium acerosum, Golenkinia radiata, Pediastrum boryanum, Scenedesmus armatus, S. bijuga, S. dimorphus, S. quadricula, S. quadricula var. quadrispina, Selenastrum gracile, S. westii and Sphaeroctis Schroeteri) were recorded as planktonic forms.

Among bacillariophycean planktons 28 species (Achnanthes exilis, Amphora ovalis var. pediculus, Cymbella microcephala, Cyclotella comta, C. glomerata, C. kuetzingiana, C. meneghiniana, C. operculata, Gyrosigma scalpoides, Gomphonema parvulum, Mastogloia smithii, Melosira crenulata, M. distans, M. granulata, M. granulata var. curvata, M. varians, Nitzschia acicularis, N. linearis var. tenuis, N. microcephala, N. palea, Navicula dicesphala, N. gregaria, N. inaequilatera, Synedra acus, S. ulna, S. ulna var. danica, S. vaucheriae var. parvula and Stauroneis anceps) were witnessed.

A numerical depletion in cyanophycean species was witnessed and only six species (Merismopedia glauca, M. punctata, M. tenuissima,
*Microcystis aeruginosa, Oscillatoria limnetica* and *Phormidium tenue*) could be observed as planktons.

**DISTRIBUTION OF ALGAE**

Algae were found distributed as well defined communities showing major infestation and are grouped into (a) Planktons (b) bottom and algae (c) algae growing on walls, pillars of bridge or other man-made structures (d) epiphytic, benthic, floating or detached algae.

**PERIODICITY AND SUCCESSION**

Diverse algal forms growing in the river exhibit a clearcut periodicity and succession. They may be broadly grouped into summer, winter and rain forms either annuals, perennials or epimerales. Algae may grow at certain period and thrive rest of the time as spores or other cells capable of tiding over adverse conditions.

Certain algae (*Scenedesmus bijuga, Spirogyra punctiformis, Nitzschia palea, Syndera ulna and Merismopedia glauca*) grow throughout the year. A algae like *Bulbochaete rectangularis, B. reticulata, B. varians, Cosmarium botrytis, C. constrictum, C. subimpressulum, C. speciosum, Cosmarium, sp., Coleochaete irregularis, Closterium turgidum, Mougeotia genuflexa, Oedogonium gracillimum, Scenedesmus carinatus, Cymbella navicoliformis, Gomphonema sphaerophorum, Pleurosigma scalpoides, Euglena spirigya, Anabaena circinalis var. crassa, A. iyengarii, var. tenuis, A. iyengarii var. attenuata, Coelosphaerium kuetzingianum, Gloeotrichia longicauda, Nodularia harveyana var. sphaerocarpa, Oscillatoria raoi, Phormidium ambiguum and Spirulina laxissima* were found growing distinctly in winter season: (*Ankistrodesmus convolutus, Actinastrum hantzschii var. fluviatile, Closterium moniliferum, C. parvulum, C. venus, Closteriopsis*
berhampurensis, G. ghosei, G. raciborskii var. bombayense, G. raciborskii var. kashiense, Lyngbya aestuarii var. arbustiva, L. contorta, L. confervoides, L. polysiphoniae, L. porphyrosiphonis, Microcystis elahens, M. protocystis, M. viridis, Myxosarcina spectabilis, Nostoc verrucosum, Oscillatoria acuta, O. acutissima, O. angustissima, O. curviceps, O. corallinae, O. chalybea, O. foreaui, O. lacustris, O. laevivires var. minimus, O. minnesotensis, O. nigroviridis, O. okeni, O. pseudogeminata var. unigranulata, Phormidium purpurascens, Rivularia hansgirgi and Spirulina labyrinthiformis) were observed in summer season: (Oocystis eremosphaeria, Navicula braunii and N. hilseana) were observed in rainy season. Apart from them certain forms (Actinastrium hantschii, Cladophora glomerata, Crucigenia tetrapedia, Chlorococcum infusionum, Cosmarium depressum, C. granatum, Characium naegelii, Hydrodictyon reticulatum, Mougeotia calcarea, M. sphaerocarpa, Pediastrum duplex var. clathratum, Rhizoclonium hieroglyphicum, Scenedesmus acuminatus, S. abundans, S. arcuatus, S. acutiformis, S. bijuga var. alternans, S. longus var. minutus, S. prismatieus, Selenastrum bibraianum, Spirogyra rectangularis, Spirogyra sp., Spirogyra sp.,lothrix zonata, Zygnema czurdae, Chara excelsa, Amphora ovalis, Cymbella cistula, C. cymbiformis, C. cuspidata, C. leptoceros, C. laevis, C. prostrata, Cyclotella glomerata, Epithemia sorex, Gomphonema olivaceum, Gyrosigma kuetzingii, G. spencerii, Melosira, Granulata, Navicula exigua, N. mutica, N. protracta, N. platystoma, N. sphaerophora, N. seminulum, N. ventricosa, Nitzschia angustata, N. dissipata var. media, N. microcephala, N. palea var. tenurostris, N. subtilis, N. thermalis, Rhopalodia gibba, R. ventricosa, Synera ulna var. danica, Surirella elegans, Compsopogon sp., Anabaena, affinis, A.
collinsianum, Z. tenue, Cymbella tumida, Cyclotella kuetzingiana, C. meneghiniana, Cocconeis placentula, Epithemia gibba, E. gibba var. ventricosa, E. gibberula var. producta, Encyonema caespitosum, Gomphonema augur, G. constrictum var. capitatum, G. montanum var. commutatum, Navicula anglica, N. cryptocephala, N. dicephala, N. gastrum, N. inaequaliatera, N. tuscula, Nitzschia acicularis, N. dissipata, N. linearis, Pleurosigma spencerii var. nodifera, Synedra acus, S. ulna var. aequalis, Stauroeis anceps, Anabaena fertilissima, A. oryzae, Anabaena sp., Aphanocapsa montana, Aphanathece saxicola, Chroococcus tenax, C. turgidus, Calothrix scytonemica, Merismopedia punctata, M. tenuissima, Microcystis aeruginosa, Nostoc carneum, Oscillatoria limosa, O. princeps, O. subbrevis, Phormidium tenue, Raphidiopsis sp., Spirulina gigantea and S. major) were observed sporidically in various seasons but not throughout the year. While others (Chaetophora inerassata, C. pisiformis, Closterium parvulum, Coleochaete irregularis, C. curtum, C. circulare, C. submipressulum, Cosmarium sp., Golenkinia radiata, Oocystis eremosphearia, Stauroastrum gracile, S. hexacerum, S. oxyacanthum, Tetraedron trigonum var. minus, Cymbella naviculiformis, Cyclotella ocellata, Navicula braunii, N. cancellata var. ammophila, N. cincta var. Heufleri, N. hilseana, N. simplex, N. sculpta, Nitzschia obtusa var. nana, Synedra ulna var. longissima, S. ulna var. lanceolata, Tetracyclus rupestris, Euglena gracilis, Anabaena gelatinicola, Aulosira bombayensis, A. prolifica, Aphanocapsa elachista, Calothrix gloeocola, Gloeotrichia ghosei, Lyngbya porphyrosophonis, L. polysiphoniae, Microcystis elabens, M. protocystis, Myxosarcina, spectabilis, Oscillatoria lacustris and O. rabi) were recorded only once during the year.
QUANTITATIVE DISTRIBUTION

BENTHIC ALGAE

For the sake of convenience quantitative distribution of algae has been ground into (1) Major algae showing profuse growth (2) Minor algae exhibiting common or rare growth. Quantitative assessments are based on statistical computation of "Percentage occurrence' and 'Standard deviation' for major and minor algae (Table-4). The first figure within brackets indicates 'Percentage occurrence and second 'Standard deviation; A detailed account of the two kinds of algae is given below:

Major algae

For the sake of brevity of text the major algae has been described under sub-heads of various seasons:

Winter: No algal species could be recorded during winter.
### TABLE-4: QUANTITATIVE DISTRIBUTION OF BENTHIC ALGAE.

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>NAME OF SPECIES</th>
<th>PERCENTAGE OCCURRENCE</th>
<th>STANDARD DEVIATION</th>
<th>COEFFICIENT OF VARIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Actin astrum hantzschii</td>
<td>0.712</td>
<td>±7.826</td>
<td>99.907</td>
</tr>
<tr>
<td>2.</td>
<td>Actin astrum hantzschii var. fluviatile</td>
<td>0.235</td>
<td>±5.053</td>
<td>195.622</td>
</tr>
<tr>
<td>3.</td>
<td>Ankistrodesmus convolutus</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
</tr>
<tr>
<td>4.</td>
<td>Ankistrodesmus falcatus</td>
<td>0.197</td>
<td>±2.329</td>
<td>107.491</td>
</tr>
<tr>
<td>5.</td>
<td>Bulbochaete rectangularis</td>
<td>0.167</td>
<td>±3.486</td>
<td>190.143</td>
</tr>
<tr>
<td>6.</td>
<td>Bulbochaete reticulata</td>
<td>0.091</td>
<td>±2.374</td>
<td>237.410</td>
</tr>
<tr>
<td>7.</td>
<td>Bulbochaete varians</td>
<td>0.023</td>
<td>±0.621</td>
<td>248.633</td>
</tr>
<tr>
<td>8.</td>
<td>Cladophora glomerata</td>
<td>2.386</td>
<td>±17.406</td>
<td>66.318</td>
</tr>
<tr>
<td>9.</td>
<td>Cladophora eiegans</td>
<td>0.038</td>
<td>±0.996</td>
<td>238.898</td>
</tr>
<tr>
<td>10.</td>
<td>Cladophora incrassata</td>
<td>0.023</td>
<td>±0.866</td>
<td>346.400</td>
</tr>
<tr>
<td>11.</td>
<td>Cladophora pisiformis</td>
<td>0.030</td>
<td>±1.155</td>
<td>346.445</td>
</tr>
<tr>
<td>12.</td>
<td>Crucigenia tetrapedia</td>
<td>0.121</td>
<td>±1.435</td>
<td>107.980</td>
</tr>
<tr>
<td>13.</td>
<td>Chlorella vulgaris</td>
<td>0.242</td>
<td>±2.462</td>
<td>92.316</td>
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<tr>
<td>14.</td>
<td>Chlorococcum humicola</td>
<td>0.432</td>
<td>±5.754</td>
<td>121.145</td>
</tr>
<tr>
<td>15.</td>
<td>Chlorococcum infusionum</td>
<td>0.144</td>
<td>±1.730</td>
<td>109.259</td>
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<tr>
<td>S.NO.</td>
<td>NAME OF SPECIES</td>
<td>PERCENTAGE OCCURRENCE</td>
<td>STANDARD DEVIATION</td>
<td>COEFFICIENT OF VARIATION</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------</td>
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<td>--------------------</td>
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</tr>
<tr>
<td>16.</td>
<td>Closterium acerosum</td>
<td>0.242</td>
<td>±4.271</td>
<td>160.164</td>
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<td>17.</td>
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<td>0.053</td>
<td>±1.379</td>
<td>236.396</td>
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<tr>
<td>18.</td>
<td>Closterium parvulum</td>
<td>0.023</td>
<td>±0.866</td>
<td>346.400</td>
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<td>19.</td>
<td>Closterium turgidum</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<td>20.</td>
<td>Closterium venus</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<tr>
<td>21.</td>
<td>Coleochaete irregularis</td>
<td>0.038</td>
<td>±1.443</td>
<td>346.388</td>
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<tr>
<td>22.</td>
<td>coelastrum cambricum var. intermedium</td>
<td>0.227</td>
<td>±3.424</td>
<td>136.980</td>
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<tr>
<td>23.</td>
<td>Coelastrum proboscidium</td>
<td>0.114</td>
<td>±1.712</td>
<td>136.976</td>
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<td>24.</td>
<td>Closteriopsis longissima</td>
<td>0.144</td>
<td>±2.392</td>
<td>151.052</td>
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<tr>
<td>25.</td>
<td>Cosmarium broomei</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<td>26.</td>
<td>Cosmarium botrytis</td>
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<td>±1.505</td>
<td>258.015</td>
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<td>27.</td>
<td>Cosmarium constrictum</td>
<td>0.038</td>
<td>±0.996</td>
<td>242.976</td>
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<tr>
<td>28.</td>
<td>Cosmarium curtum</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>29.</td>
<td>Cosmarium circulare</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>30.</td>
<td>Cosmarium depressum</td>
<td>0.083</td>
<td>±1.443</td>
<td>157.456</td>
</tr>
<tr>
<td>31.</td>
<td>Cosmarium formosulum</td>
<td>0.470</td>
<td>±6.926</td>
<td>134.051</td>
</tr>
<tr>
<td>32.</td>
<td>Cosmarium formosulum var. nathorstii</td>
<td>0.129</td>
<td>±2.151</td>
<td>152.086</td>
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<tr>
<td>33.</td>
<td>Cosmarium granatum</td>
<td>0.788</td>
<td>±8.424</td>
<td>97.200</td>
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<td>34.</td>
<td>Cosmarium meneghinii</td>
<td>0.068</td>
<td>±1.545</td>
<td>205.973</td>
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<tr>
<td>35.</td>
<td>Cosmarium nitidulum</td>
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<td>±4.700</td>
<td>85.456</td>
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<td>36.</td>
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<td>0.023</td>
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<tr>
<td>37.</td>
<td>Cosmarium reniforme</td>
<td>0.136</td>
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<td>128.733</td>
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<tr>
<td>38.</td>
<td>Cosmarium speciosum</td>
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<td>±0.389</td>
<td>232.934</td>
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<tr>
<td>39.</td>
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<td>±0.289</td>
<td>348.579</td>
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<td>Cosmarium sp.</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>41.</td>
<td>Cosmarium naegelii</td>
<td>0.098</td>
<td>±1.379</td>
<td>127.287</td>
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<tr>
<td>42.</td>
<td>Euastrum inermius</td>
<td>0.083</td>
<td>±1.240</td>
<td>135.279</td>
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<tr>
<td>43.</td>
<td>Golenkinia radiata</td>
<td>0.007</td>
<td>±0.289</td>
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<td>44.</td>
<td>Hydrodictyon reticulatum</td>
<td>1.992</td>
<td>±21.360</td>
<td>97.460</td>
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<td>45.</td>
<td>Mougeotia calcarea</td>
<td>0.545</td>
<td>±8.079</td>
<td>134.652</td>
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<tr>
<td>46.</td>
<td>Mougeotia genuflexa</td>
<td>0.129</td>
<td>±2.575</td>
<td>181.732</td>
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<tr>
<td>47.</td>
<td>Mougeotia sphaerocarpa</td>
<td>0.568</td>
<td>±8.081</td>
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<tr>
<td>48.</td>
<td>Oedogonium gracillimum</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<td>49.</td>
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<td>±0.289</td>
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<td>50.</td>
<td>Oocystis solitaria</td>
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<td>±0.389</td>
<td>232.934</td>
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<td>51.</td>
<td>Pediastrum boryanum</td>
<td>0.174</td>
<td>±1.505</td>
<td>78.520</td>
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<tr>
<td>52.</td>
<td>Pediastrum duplex</td>
<td>0.045</td>
<td>±1.000</td>
<td>200.000</td>
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<tr>
<td>53.</td>
<td>Pediastrum duplex var. clathratum</td>
<td>0.030</td>
<td>±0.651</td>
<td>195.409</td>
</tr>
<tr>
<td>54.</td>
<td>Pediastrum simplex</td>
<td>0.167</td>
<td>±1.586</td>
<td>86.505</td>
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<td>55.</td>
<td>Pediastrum simplex var. doudenarium</td>
<td>0.023</td>
<td>±0.622</td>
<td>248.640</td>
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<tr>
<td>56.</td>
<td>Pediastrum tetrass</td>
<td>0.091</td>
<td>±1.859</td>
<td>185.860</td>
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<tr>
<td>57.</td>
<td>Pediastrum tetrass var. excisum</td>
<td>0.061</td>
<td>±1.073</td>
<td>160.957</td>
</tr>
<tr>
<td>58.</td>
<td>Pediastrum tetrass var. tetraodon</td>
<td>0.061</td>
<td>±1.231</td>
<td>184.626</td>
</tr>
<tr>
<td>59.</td>
<td>Protococcus viridis</td>
<td>0.030</td>
<td>±0.651</td>
<td>195.409</td>
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<tr>
<td>60.</td>
<td>Rhizoclonium hieroglyphicum</td>
<td>0.939</td>
<td>±10.307</td>
<td>99.752</td>
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<tr>
<td>61.</td>
<td>Scenedesmus armatus</td>
<td>0.977</td>
<td>±8.433</td>
<td>78.446</td>
</tr>
<tr>
<td>62.</td>
<td>Scenedesmus acuminatus</td>
<td>0.167</td>
<td>±2.588</td>
<td>141.189</td>
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<tr>
<td>63.</td>
<td>Scenedesmus abundans</td>
<td>0.061</td>
<td>±0.985</td>
<td>147.698</td>
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<tr>
<td>64.</td>
<td>Scenedesmus arcuatus</td>
<td>0.053</td>
<td>±0.900</td>
<td>154.346</td>
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<tr>
<td>65.</td>
<td>Scenedesmus Acutiformis</td>
<td>0.083</td>
<td>±1.621</td>
<td>172.477</td>
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<tr>
<td>66.</td>
<td>Scenedesmus Bijuga</td>
<td>1.272</td>
<td>±13.824</td>
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<tr>
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<td>NAME OF SPECIES</td>
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<tr>
<td>67.</td>
<td>ScenedesmusBijuga var. alternans</td>
<td>0.030</td>
<td>±0.778</td>
<td>233.573</td>
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<td>68.</td>
<td>Scenedesmus carinatus</td>
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<td>±0.389</td>
<td>233.473</td>
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<tr>
<td>69.</td>
<td>Scenedesmus dimorphus</td>
<td>0.636</td>
<td>±7.471</td>
<td>39.691</td>
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<tr>
<td>70.</td>
<td>Scenedesmus longus var. minutus</td>
<td>0.023</td>
<td>±0.622</td>
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<tr>
<td>71.</td>
<td>Scenedesmus obliquus</td>
<td>0.515</td>
<td>±7.265</td>
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<td>72.</td>
<td>Scenedesmus prismaticus</td>
<td>0.114</td>
<td>±1.712</td>
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<tr>
<td>73.</td>
<td>Scenedesmus quadricula</td>
<td>0.773</td>
<td>±8.437</td>
<td>99.258</td>
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<tr>
<td>74.</td>
<td>Scenedesmus quadricula var. bicaudatus</td>
<td>0.129</td>
<td>±2.778</td>
<td>196.118</td>
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<tr>
<td>75.</td>
<td>Scenedesmus quadricula var. longispina</td>
<td>0.136</td>
<td>±2.844</td>
<td>189.600</td>
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<tr>
<td>76.</td>
<td>Scenedesmus quadricula var. quadrispina</td>
<td>0.553</td>
<td>±6.748</td>
<td>110.930</td>
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<tr>
<td>77.</td>
<td>Scenedesmus quadricula var. Westii</td>
<td>0.439</td>
<td>±5.540</td>
<td>114.632</td>
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<tr>
<td>78.</td>
<td>Sphaerocystis Schroeteri</td>
<td>0.038</td>
<td>±0.996</td>
<td>239.069</td>
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<tr>
<td>79.</td>
<td>Staurastrum gracile</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>80.</td>
<td>Staurastrum hexacerum</td>
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<td>±0.289</td>
<td>346.579</td>
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<td>81.</td>
<td>Staurastrum oxyacanthum</td>
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<td>±0.289</td>
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<tr>
<td>82.</td>
<td>Selenastrum bibraianum</td>
<td>0.053</td>
<td>±0.900</td>
<td>154.346</td>
</tr>
<tr>
<td>83.</td>
<td>Selenastrum gracile</td>
<td>0.114</td>
<td>±2.633</td>
<td>210.624</td>
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<tr>
<td>84.</td>
<td>Spirogyra punctiformis</td>
<td>1.257</td>
<td>±13.490</td>
<td>97.520</td>
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<tr>
<td>85.</td>
<td>Spirogyra rectangularis</td>
<td>0.326</td>
<td>±5.374</td>
<td>140.203</td>
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<td>86.</td>
<td>Spirogyra singularis</td>
<td>2.801</td>
<td>±28.600</td>
<td>92.757</td>
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<td>87.</td>
<td>Spirogyra sp.</td>
<td>1.113</td>
<td>±12.114</td>
<td>98.890</td>
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<td>88.</td>
<td>Spirogyra sp.</td>
<td>0.629</td>
<td>±10.414</td>
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<td>89.</td>
<td>Spirogyra sp.</td>
<td>2.742</td>
<td>±24.465</td>
<td>81.098</td>
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<td>90.</td>
<td>Tetraedron trigonum var. minus</td>
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<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>91.</td>
<td>Ulothrix zonata</td>
<td>0.197</td>
<td>±2.329</td>
<td>107.476</td>
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<tr>
<td>92.</td>
<td>Zygnema collinsianum</td>
<td>2.204</td>
<td>±23.557</td>
<td>97.142</td>
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<tr>
<td>93.</td>
<td>Zygnema czurdae</td>
<td>2.106</td>
<td>±23.029</td>
<td>99.404</td>
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<tr>
<td>94.</td>
<td>Zygnema tenue</td>
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<td>95.</td>
<td>Chara excelsa</td>
<td>1.803</td>
<td>±17.709</td>
<td>73.817</td>
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<td>96.</td>
<td>Amphora ovalis</td>
<td>0.288</td>
<td>±5.828</td>
<td>184.050</td>
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<tr>
<td>97.</td>
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<td>0.030</td>
<td>±0.651</td>
<td>195.409</td>
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<tr>
<td>98.</td>
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<td>0.023</td>
<td>±0.622</td>
<td>248.640</td>
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<td>99.</td>
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<td>100.</td>
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<td>0.068</td>
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<tr>
<td>101.</td>
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<td>0.53</td>
<td>±0.996</td>
<td>176.839</td>
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<td>102.</td>
<td>Achnanthes lanceolata var. dubia</td>
<td>0.061</td>
<td>±1.231</td>
<td>184.626</td>
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<tr>
<td>103.</td>
<td>Achnanthes minutissima</td>
<td>0.030</td>
<td>±0.778</td>
<td>233.573</td>
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<td>104.</td>
<td>Cymbella affinis</td>
<td>0.061</td>
<td>±1.303</td>
<td>195.395</td>
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<td>105.</td>
<td>Cymbella amphicephala</td>
<td>0.038</td>
<td>±0.668</td>
<td>160.427</td>
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<tr>
<td>106.</td>
<td>Cymbella cistula</td>
<td>0.454</td>
<td>±6.809</td>
<td>136.182</td>
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<tr>
<td>107.</td>
<td>Cymbella cymbiformis</td>
<td>0.598</td>
<td>±8.050</td>
<td>122.287</td>
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<tr>
<td>108.</td>
<td>Cymbella cuspidata</td>
<td>0.174</td>
<td>±2.778</td>
<td>144.957</td>
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<td>109.</td>
<td>Cymbella leptoceros</td>
<td>0.220</td>
<td>±2.193</td>
<td>90.756</td>
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<tr>
<td>110.</td>
<td>Cymbella leptoceros var. elongata</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<td>111.</td>
<td>Cymbella laevis</td>
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<td>±1.357</td>
<td>108.544</td>
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<td>112.</td>
<td>Cymbella microcephala</td>
<td>0.182</td>
<td>±2.558</td>
<td>127.920</td>
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<td>113.</td>
<td>Cymbella naviculiformis</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>114.</td>
<td>Cymbella obtusa</td>
<td>0.303</td>
<td>±6.513</td>
<td>195.404</td>
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<td>115.</td>
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<td>±0.577</td>
<td>233.934</td>
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<td>116.</td>
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<td>117.</td>
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<td>±2.860</td>
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<td>118.</td>
<td>Cymbella tumida</td>
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<td>±8.436</td>
<td>94.606</td>
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<td>119.</td>
<td>Cymbella ventricosa</td>
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<td>±0.904</td>
<td>180.900</td>
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<td>120.</td>
<td>Cocconeis Placentula</td>
<td>0.068</td>
<td>±0.754</td>
<td>100.507</td>
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<tr>
<td>121.</td>
<td>Cocconeis Pediculus</td>
<td>0.015</td>
<td>±0.389</td>
<td>233.473</td>
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<tr>
<td>122.</td>
<td>Cyclotella Glomerata</td>
<td>0.326</td>
<td>±5.299</td>
<td>147.892</td>
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<tr>
<td>123.</td>
<td>Cyclotella Kuetzingiana</td>
<td>0.273</td>
<td>±3.247</td>
<td>108.247</td>
</tr>
<tr>
<td>124.</td>
<td>Cyclotella meneghiniana</td>
<td>0.492</td>
<td>±5.791</td>
<td>106.914</td>
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<tr>
<td>125.</td>
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<td>0.121</td>
<td>±1.969</td>
<td>147.716</td>
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<tr>
<td>126.</td>
<td>Cyclotella ocellata</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
</tr>
<tr>
<td>127.</td>
<td>Denticula elegans</td>
<td>0.129</td>
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<tr>
<td>128.</td>
<td>Epithemia gibba</td>
<td>2.083</td>
<td>±22.605</td>
<td>98.639</td>
</tr>
<tr>
<td>129.</td>
<td>Epithemia gibba var. ventricosa</td>
<td>1.394</td>
<td>±14.531</td>
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<tr>
<td>130.</td>
<td>Epithemia gibberula var. producta</td>
<td>1.295</td>
<td>±13.498</td>
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<tr>
<td>131.</td>
<td>Epithemia sorex</td>
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<td>±7.497</td>
<td>142.800</td>
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<tr>
<td>132.</td>
<td>Epithemia zebra</td>
<td>0.068</td>
<td>±1.545</td>
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<td>133.</td>
<td>Encyonema caespitosum</td>
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<td>±2.535</td>
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<td>134.</td>
<td>Encyonema prostratum</td>
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<td>135.</td>
<td>Encyonema ventricosum</td>
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<td>±1.084</td>
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<td>136.</td>
<td>Fragilaria crotonensis</td>
<td>0.318</td>
<td>±6.201</td>
<td>177.177</td>
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<tr>
<td>137.</td>
<td>Fragilaria construens</td>
<td>0.015</td>
<td>±0.389</td>
<td>233.515</td>
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<tr>
<td>138.</td>
<td>Gomphonema augur</td>
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<td>±7.464</td>
<td>98.438</td>
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<tr>
<td>139.</td>
<td>Gomphonema constrictum var. capitatum</td>
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<td>±7.317</td>
<td>98.651</td>
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<tr>
<td>140.</td>
<td>Gomphonema gracile</td>
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<td>±0.389</td>
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<tr>
<td>141.</td>
<td>Gomphonema gracile var. dichotomum</td>
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<td>±0.389</td>
<td>233.473</td>
</tr>
<tr>
<td>142.</td>
<td>Gomphonema montanum</td>
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<td>±5.565</td>
<td>166.952</td>
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<tr>
<td>143.</td>
<td>Gomphonema montanum var. commutatum</td>
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</tr>
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<td>144.</td>
<td>Gomphonema olivaceum</td>
<td>0.136</td>
<td>±2.645</td>
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<tr>
<td>145.</td>
<td>Gomphonema parvulum</td>
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<td>±6.895</td>
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<td>146.</td>
<td>Gomphonema parvulum var. lanceolata</td>
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<td>±2.678</td>
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</tr>
<tr>
<td>147.</td>
<td>Gomphonema parvulum var. subcapitata</td>
<td>0.151</td>
<td>±3.172</td>
<td>190.304</td>
</tr>
<tr>
<td>148.</td>
<td>Gomphonema sphacrophorum</td>
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<td>±0.389</td>
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<td>149.</td>
<td>Gyrosigma kuettzingii</td>
<td>0.159</td>
<td>±2.179</td>
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<td>150.</td>
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<td>Gyrosigma scalpoides</td>
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<td>152.</td>
<td>Hantzschia amphioxys</td>
<td>0.144</td>
<td>±2.745</td>
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<tr>
<td>153.</td>
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<td>±0.621</td>
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<tr>
<td>154.</td>
<td>Melosira distans</td>
<td>0.204</td>
<td>±3.493</td>
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<tr>
<td>155.</td>
<td>Melosira granulata</td>
<td>0.114</td>
<td>±1.602</td>
<td>128.200</td>
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<tr>
<td>156.</td>
<td>Melosira granulata var. curvata</td>
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<td>±0.778</td>
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<tr>
<td>157.</td>
<td>Mastogloia smithii</td>
<td>0.098</td>
<td>±1.881</td>
<td>173.627</td>
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<tr>
<td>158.</td>
<td>Navicula anglica</td>
<td>0.356</td>
<td>±6.052</td>
<td>154.523</td>
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<tr>
<td>159.</td>
<td>Navicula braunii</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>160.</td>
<td>Navicula borealis</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<tr>
<td>161.</td>
<td>Navicula capitata</td>
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<td>±1.621</td>
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<td>162.</td>
<td>Navicula cryptocephala</td>
<td>0.318</td>
<td>±3.966</td>
<td>113.309</td>
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<tr>
<td>163.</td>
<td>Navicula cincta</td>
<td>0.083</td>
<td>±1.243</td>
<td>248.640</td>
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<tr>
<td>164.</td>
<td>Navicula cincta var. Heufleri</td>
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<td>±0.577</td>
<td>346.311</td>
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<tr>
<td>165.</td>
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<tr>
<td>166.</td>
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<td>±6.000</td>
<td>100.000</td>
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<td>167.</td>
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<td>Navicula exilis</td>
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<tr>
<td>169.</td>
<td>Navicula gastrum</td>
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<td>±5.997</td>
<td>189.393</td>
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<tr>
<td>170.</td>
<td>Navicula humilis</td>
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<td>195.409</td>
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<tr>
<td>171.</td>
<td>Navicula hilseana</td>
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<td>±0.289</td>
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<tr>
<td>172.</td>
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<td>±7.833</td>
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<tr>
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<td>±0.793</td>
<td>190.305</td>
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<tr>
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<td>Navicula mutica</td>
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<td>±0.793</td>
<td>135.951</td>
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<tr>
<td>175.</td>
<td>Navicula oculata</td>
<td>0.030</td>
<td>±0.651</td>
<td>195.409</td>
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<tr>
<td>176.</td>
<td>Navicula platystoma</td>
<td>0.144</td>
<td>±2.392</td>
<td>151.052</td>
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<tr>
<td>177.</td>
<td>Navicula protracta</td>
<td>0.174</td>
<td>±1.881</td>
<td>98.132</td>
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<tr>
<td>178.</td>
<td>Navicula pupula</td>
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<td>±1.000</td>
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<tr>
<td>179.</td>
<td>Navicula perpusilla</td>
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<td>Navicula radiosa</td>
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<td>±0.622</td>
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<td>181.</td>
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<td>±8.489</td>
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<td>182.</td>
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<td>±0.289</td>
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<td>183.</td>
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<td>185.</td>
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<td>±0.289</td>
<td>346.579</td>
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<td>186.</td>
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<td>±0.389</td>
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<tr>
<td>188.</td>
<td>Nitzschia acicularis</td>
<td>0.454</td>
<td>±6.382</td>
<td>127.636</td>
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<tr>
<td>189.</td>
<td>Nitzschia angustata</td>
<td>0.114</td>
<td>±1.712</td>
<td>136.976</td>
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<td>190.</td>
<td>Nitzschia apiculata</td>
<td>0.106</td>
<td>±1.801</td>
<td>154.341</td>
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<tr>
<td>191.</td>
<td>Nitzschia dissipata</td>
<td>0.560</td>
<td>±7.791</td>
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<tr>
<td>192.</td>
<td>Nitzschia dissipata var. media</td>
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<tr>
<td>193.</td>
<td>Nitzschia linearis</td>
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<td>±3.447</td>
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<td>194.</td>
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<td>195.</td>
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<td>196.</td>
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<td>0.144</td>
<td>±2.745</td>
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<tr>
<td>197.</td>
<td>Nitzschia obtusa var. nana</td>
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<td>±0.577</td>
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<tr>
<td>198.</td>
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<td>1.947</td>
<td>±17.016</td>
<td>79.451</td>
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<tr>
<td>199.</td>
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<td>0.273</td>
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<td>Nitzschia subtilis</td>
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<tr>
<td>202.</td>
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<td>±0.389</td>
<td>233.473</td>
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<tr>
<td>203.</td>
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<td>0.204</td>
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<td>121.533</td>
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<td>204.</td>
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<td>205.</td>
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<td>±0.778</td>
<td>233.784</td>
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<td>Pleurosigma scalpoides</td>
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<td>±2.678</td>
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<td>±3.756</td>
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<td>210.</td>
<td>Rhopalodia ventricosa</td>
<td>0.045</td>
<td>±1.243</td>
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<td>211.</td>
<td>Synedra acus</td>
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<td>±7.240</td>
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<td>212.</td>
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<td>±1.084</td>
<td>185.771</td>
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<tr>
<td>213.</td>
<td>Synedra radians</td>
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<td>±0.389</td>
<td>233.473</td>
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<td>214.</td>
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<td>215.</td>
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<td>±6.443</td>
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<td>216.</td>
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<td>±9.005</td>
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<td>217.</td>
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<td>±0.577</td>
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<tr>
<td>218.</td>
<td>Synedra ulna var. lanceolata</td>
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<td>219.</td>
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<td>0.174</td>
<td>±3.088</td>
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<td>±1.000</td>
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<td>221.</td>
<td>Stauroneis anceps</td>
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<td>±8.897</td>
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<td>222.</td>
<td>Surirella elegans</td>
<td>0.038</td>
<td>±0.793</td>
<td>190.305</td>
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<tr>
<td>223.</td>
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<td>±0.778</td>
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<td>±0.389</td>
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<td>226.</td>
<td>Euglena gracilis</td>
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<td>±0.289</td>
<td>346.579</td>
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<td>227.</td>
<td>Euglena spirogyra</td>
<td>0.023</td>
<td>±0.622</td>
<td>248.640</td>
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<td>228.</td>
<td>Compsopogon sp.</td>
<td>0.788</td>
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<td><strong>CYANOPHYCEAE</strong></td>
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<td>229.</td>
<td>Anabaena affinis</td>
<td>0.106</td>
<td>±1.527</td>
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<td>Anabaena circinalis var. crassa</td>
<td>0.159</td>
<td>±2.896</td>
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<tr>
<td>231.</td>
<td>Anabaena fertilissima</td>
<td>0.523</td>
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<td>232.</td>
<td>Anabaena gelatinicola</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
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<td>S.NO.</td>
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<td>0.523</td>
<td>±9.137</td>
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<td>234.</td>
<td>Anabaena iyengarii var. attenuata</td>
<td>0.068</td>
<td>±1.865</td>
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<td>235.</td>
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<td>±2.151</td>
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<td>236.</td>
<td>Anabaena oscillarioides</td>
<td>0.454</td>
<td>±7.198</td>
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<tr>
<td>237.</td>
<td>Anabaena oryzae</td>
<td>0.144</td>
<td>±1.929</td>
<td>121.809</td>
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<td>238.</td>
<td>Anabaena planctonica</td>
<td>0.644</td>
<td>±7.378</td>
<td>104.172</td>
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<td>239.</td>
<td>Anabaena sphaerica var. attenuata</td>
<td>0.856</td>
<td>±9.268</td>
<td>98.418</td>
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<tr>
<td>240.</td>
<td>Anabaena sp.</td>
<td>0.394</td>
<td>±7.024</td>
<td>162.089</td>
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<td>241.</td>
<td>Anabaena sp.</td>
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<td>±1.497</td>
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<td>242.</td>
<td>Anabaena sp</td>
<td>0.030</td>
<td>±0.778</td>
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<td>243.</td>
<td>Aulosira bombayensis</td>
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<td>±0.866</td>
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<td>244.</td>
<td>Aulosira prolifica</td>
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<td>±0.577</td>
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<tr>
<td>245.</td>
<td>Aphanocapsa biformis</td>
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<td>±1.403</td>
<td>168.415</td>
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<td>246.</td>
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<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>247.</td>
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<td>0.167</td>
<td>±3.774</td>
<td>205.853</td>
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<td>248.</td>
<td>Aphanocapsa montana</td>
<td>0.394</td>
<td>±3.391</td>
<td>78.257</td>
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<td>249.</td>
<td>Aphanocapsa muscicola</td>
<td>0.174</td>
<td>±2.968</td>
<td>154.865</td>
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<td>250.</td>
<td>Aphanotheca bullosa</td>
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<td>±1.782</td>
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<tr>
<td>251.</td>
<td>Aphanotheca saxicola</td>
<td>0.379</td>
<td>±4.218</td>
<td>101.222</td>
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<tr>
<td>252.</td>
<td>Arthrospira spirulinoides</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<td>253.</td>
<td>Chroococcus indicus</td>
<td>0.114</td>
<td>±2.179</td>
<td>174.272</td>
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<tr>
<td>254.</td>
<td>Chroococcus macrococcus</td>
<td>0.045</td>
<td>±0.674</td>
<td>134.840</td>
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<tr>
<td>255.</td>
<td>Chroococcus minutus</td>
<td>0.144</td>
<td>±2.745</td>
<td>173.404</td>
</tr>
<tr>
<td>256.</td>
<td>Chroococcus minor</td>
<td>0.144</td>
<td>±3.604</td>
<td>227.657</td>
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<tr>
<td>257.</td>
<td>Chroococcus montanus</td>
<td>0.257</td>
<td>±4.802</td>
<td>169.488</td>
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<tr>
<td>258.</td>
<td>Chroococcus pallidus</td>
<td>0.076</td>
<td>±1.337</td>
<td>160.458</td>
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<tr>
<td>259.</td>
<td>Chroococcus rufescens</td>
<td>0.295</td>
<td>±4.413</td>
<td>135.794</td>
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<tr>
<td>260.</td>
<td>Chroococcus tenax</td>
<td>0.750</td>
<td>±7.817</td>
<td>94.751</td>
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<tr>
<td>261.</td>
<td>Chroococcus turgidus</td>
<td>0.652</td>
<td>±8.932</td>
<td>124.038</td>
</tr>
<tr>
<td>262.</td>
<td>Chroococcus varius</td>
<td>0.144</td>
<td>±2.575</td>
<td>162.010</td>
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<tr>
<td>263.</td>
<td>Cylindrospermum muscicola</td>
<td>0.682</td>
<td>±7.379</td>
<td>98.387</td>
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<tr>
<td>264.</td>
<td>Cylindrospermum michailovskoanse</td>
<td>0.470</td>
<td>±7.802</td>
<td>151.015</td>
</tr>
<tr>
<td>265.</td>
<td>Cylindrospermum stagnale</td>
<td>0.477</td>
<td>±7.288</td>
<td>138.817</td>
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<tr>
<td>266.</td>
<td>Coelosphaerium kuetzingianum</td>
<td>0.015</td>
<td>±0.389</td>
<td>233.473</td>
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<td>267.</td>
<td>Calothrix clavata</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<tr>
<td>268.</td>
<td>Calothrix geitonos</td>
<td>0.007</td>
<td>±0.389</td>
<td>232.934</td>
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<tr>
<td>269.</td>
<td>Calothrix gloeocola</td>
<td>0.015</td>
<td>±0.577</td>
<td>346.311</td>
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<tr>
<td>270.</td>
<td>Calothrix marchica</td>
<td>0.227</td>
<td>±4.834</td>
<td>193.344</td>
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<tr>
<td>271.</td>
<td>Calothrix marchica var. intermedia</td>
<td>0.015</td>
<td>±0.389</td>
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<tr>
<td>272.</td>
<td>Calothrix scytonemica</td>
<td>0.795</td>
<td>±8.740</td>
<td>99.885</td>
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<tr>
<td>273.</td>
<td>Gloeocapsa nigrescens</td>
<td>0.038</td>
<td>±0.668</td>
<td>160.427</td>
</tr>
<tr>
<td>274.</td>
<td>Gloeocapsa quaternata</td>
<td>0.220</td>
<td>±3.423</td>
<td>141.656</td>
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<td>275.</td>
<td>Gloeocapsa stegophila</td>
<td>0.098</td>
<td>±1.730</td>
<td>159.688</td>
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<td>276.</td>
<td>Gloeotrichia echinulata var. berhampurense</td>
<td>0.273</td>
<td>±6.453</td>
<td>215.087</td>
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<tr>
<td>277.</td>
<td>Gloeotrichia ghosei</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
</tr>
<tr>
<td>278.</td>
<td>Gloeotrichia intermedia var. kanwaensis</td>
<td>0.288</td>
<td>±6.562</td>
<td>207.219</td>
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<tr>
<td>279.</td>
<td>Gloeotrichia indica</td>
<td>1.106</td>
<td>±11.637</td>
<td>95.644</td>
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<tr>
<td>280.</td>
<td>Gloeotrichia longicauda</td>
<td>0.068</td>
<td>±1.865</td>
<td>248.627</td>
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<tr>
<td>281.</td>
<td>Gloeotrichia natans</td>
<td>0.947</td>
<td>±9.848</td>
<td>94.542</td>
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<tr>
<td>282.</td>
<td>Gloeotrichia raciborskii</td>
<td>0.667</td>
<td>±7.303</td>
<td>99.591</td>
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<tr>
<td>283.</td>
<td>Gloeotrichia raciborskii var. bombayense</td>
<td>0.030</td>
<td>±0.778</td>
<td>233.573</td>
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<tr>
<td>S.NO.</td>
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<td>285.</td>
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<td>0.765</td>
<td>±8.262</td>
<td>98.162</td>
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<td>286.</td>
<td>Gloeotrichia raciborskii var. salsettense</td>
<td>0.242</td>
<td>±4.228</td>
<td>158.559</td>
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<tr>
<td>287.</td>
<td>Lyngbya aestuarii var. arbustiva</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<tr>
<td>288.</td>
<td>Lyngbya contorta</td>
<td>0.038</td>
<td>±0.996</td>
<td>239.069</td>
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<tr>
<td>289.</td>
<td>Lyngbya confervoides</td>
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<td>±2.610</td>
<td>240.903</td>
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<td>290.</td>
<td>Lyngbya porphyrosiphonis</td>
<td>0.015</td>
<td>±0.577</td>
<td>346.311</td>
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<tr>
<td>291.</td>
<td>Lyngbya polysiphoiae</td>
<td>0.015</td>
<td>±0.389</td>
<td>346.311</td>
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<tr>
<td>292.</td>
<td>Merismopedia convoluta</td>
<td>0.386</td>
<td>±4.159</td>
<td>97.854</td>
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<tr>
<td>293.</td>
<td>Merismopedia glauca</td>
<td>1.060</td>
<td>±9.257</td>
<td>79.351</td>
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<tr>
<td>294.</td>
<td>Merismopedia punctata</td>
<td>1.030</td>
<td>±11.081</td>
<td>97.774</td>
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<tr>
<td>295.</td>
<td>Merismopedia tenuissima</td>
<td>0.515</td>
<td>±7.439</td>
<td>131.262</td>
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<tr>
<td>296.</td>
<td>Microcystis aeruginosa</td>
<td>0.583</td>
<td>±6.317</td>
<td>98.443</td>
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<tr>
<td>297.</td>
<td>Microcystis elabens</td>
<td>0.015</td>
<td>±0.577</td>
<td>346.311</td>
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<tr>
<td>298.</td>
<td>Microcystis incerta</td>
<td>0.038</td>
<td>±0.668</td>
<td>160.427</td>
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<tr>
<td>299.</td>
<td>Microcystis protocystis</td>
<td>0.015</td>
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<td>346.311</td>
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<tr>
<td>300.</td>
<td>Microcystis robusta</td>
<td>0.386</td>
<td>±6.450</td>
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<td>Microcystis viridis</td>
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<td>±0.778</td>
<td>233.573</td>
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<td>302.</td>
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<td>0.007</td>
<td>±0.289</td>
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<td>303.</td>
<td>Nostoc carneum</td>
<td>0.833</td>
<td>±9.064</td>
<td>99.967</td>
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<td>304.</td>
<td>Nostoc linckia</td>
<td>0.454</td>
<td>±7.447</td>
<td>148.936</td>
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<td>305.</td>
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<td>0.242</td>
<td>±4.27i</td>
<td>160.164</td>
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<td>306.</td>
<td>Nostoc muscorum</td>
<td>0.220</td>
<td>±3.895</td>
<td>160.967</td>
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<td>307.</td>
<td>Nostoc verrucosum</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<td>308.</td>
<td>Nodularia harveyana var. sphaerocarpa</td>
<td>0.333</td>
<td>±6.527</td>
<td>178.016</td>
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<td>309.</td>
<td>Nodularia spumigena</td>
<td>0.523</td>
<td>±8.966</td>
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<td>310.</td>
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<td>±0.389</td>
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<td>±0.793</td>
<td>190.305</td>
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<td>Oscillatoria acuta</td>
<td>0.447</td>
<td>±8.371</td>
<td>170.267</td>
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<td>313.</td>
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<td>0.023</td>
<td>±0.622</td>
<td>248.640</td>
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<td>314.</td>
<td>Oscillatoria corallinae</td>
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<td>±0.389</td>
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<tr>
<td>315.</td>
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<td>±0.622</td>
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<td>316.</td>
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<td>±0.904</td>
<td>180.900</td>
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<tr>
<td>317.</td>
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<td>0.265</td>
<td>±6.097</td>
<td>209.041</td>
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<tr>
<td>318.</td>
<td>Oscillatoria formosa</td>
<td>0.432</td>
<td>±7.557</td>
<td>159.101</td>
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<td>319.</td>
<td>Oscillatoria foreaui</td>
<td>0.030</td>
<td>±0.651</td>
<td>195.409</td>
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<td>Oscillatoria limosa</td>
<td>0.333</td>
<td>±4.313</td>
<td>117.640</td>
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<tr>
<td>321.</td>
<td>Oscillatoria lacustris</td>
<td>0.007</td>
<td>±0.289</td>
<td>346.579</td>
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<tr>
<td>322.</td>
<td>Oscillatoria limnetica</td>
<td>0.083</td>
<td>±1.564</td>
<td>170.645</td>
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<tr>
<td>323.</td>
<td>Oscillatoria laeter-virens var. minimus</td>
<td>0.015</td>
<td>±0.389</td>
<td>232.934</td>
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<td>Oscillatoria minnesotensis</td>
<td>0.023</td>
<td>±0.621</td>
<td>248.633</td>
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<td>325.</td>
<td>Oscillatoria minima</td>
<td>0.015</td>
<td>±0.389</td>
<td>233.473</td>
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<tr>
<td>326.</td>
<td>Oscillatoria nigroviridis</td>
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<td>±0.389</td>
<td>232.934</td>
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<tr>
<td>327.</td>
<td>Oscillatoria okeni</td>
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<td>±0.778</td>
<td>233.634</td>
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<td>328.</td>
<td>Oscillatoria ornata</td>
<td>0.206</td>
<td>±3.753</td>
<td>155.286</td>
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<td>329.</td>
<td>Oscillatoria princeps</td>
<td>0.735</td>
<td>±7.821</td>
<td>96.763</td>
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<td>330.</td>
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<td>0.061</td>
<td>±1.303</td>
<td>195.395</td>
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<td>331.</td>
<td>Oscillatoria raii</td>
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<td>±0.289</td>
<td>346.579</td>
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<td>332.</td>
<td>Oscillatoria subbrevis</td>
<td>0.780</td>
<td>±8.447</td>
<td>98.418</td>
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<td>0.045</td>
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</table>

Major algae: ≈0.652 %
Common algae: 0.204-0.652 %
Rare algae: <0.204 %
Summer: No major algae could be observed.

Rain: The flow of water was very rapid and therefore, no major algal growth could be recorded.

Winter-Summer: The season witnessed growth of Actinastrum hantzschii (0.712 ± 7.826), Cladophora glomerata (2.386 ±17.406), Cosmarium granatum (0.788 ±8.424), Hydrodictyon reticulatum (1.992 ±21.360), Rhizoclonium hieroglyphicum (0.939 ±10.307), Spirogyra sp. (1.113 ±12.114), Zygema czurdae (2.106 ±23.029), Chara excelsa (1.803 ±17.409), Compsopogon sp. (0.788 ±13.963), Anabaena sphaerica var. attenuata (0.850 ±9.268), Cylindrospermum muscicola (0.682 ±379), Gloeotrichia Indica (1.106 ±11.637), G. natana (0.947±9.848), G. raciborankii (0.667 ±7.303) and G. raciborskii var. longispora (0.765±8.262).

Rain-winter: No algae was observed during this period.

Summer-rain: Under this category no algae was recorded.

All three seasons: Scenedesmus armatus (0.977 ±8.433), S. quadricauda (0.773±8.437), Spirogyra singularis (2.801 ±28.600), Spirogyra sp. (2.742 ±24.465), Zygema collinslanum (2.204 ±23.557), Cymbella tumida (0.810 ±8.436), Epithemia gibba (2.083 ±22.605), E. gibba vr. ventricosa (1.394 ±14.531), E. gibberula var. producta (1.295 ±13.498), Comphonema augur (0.689 ±7.464), G. constrictum var. capitatum (0.674 ±7.317), G. montanum var. commutatum (0.689 ±7.329), Navicula inaequilatera (0.720 ±7.833), N. tuscula (0.674 ±7.192), Pleurosigma spencerii var. Nodifera (1.121 ±12.070), Synedra acus (0.667 ±7.240), Stauroneis anceps (0.848 ±8.897), Calothrix scytonemica (0.795 ±8.740), Chroococcus

[186]
Tenax (0.750 ±7.817), Merismopedia punctata (1.030 ±11.081), Nostoc carneum (0.833 ±9.064), Oscillatoria princeps (0.735 ±7.821), O. subbrevis (0.780 ±8.447), Spirulina gigantea (0.901 ±9.239) and Spirulina major (0.788±8.381) were observed in all seasons of the year.

Algae throughout the year: Scenedesmus bijuga (1.272 ±13.824), Spirogyra punctiformis (1.257 ±13.490), Nitzschia palea (1.947 ±17.016), Synedra unla (2.287 ±20.034) and Merismopedia glauca (1.060 ±9.257) were witnessed throughout calendar year.

Common algae

Winter: Only Nodularia harveyana var. sphaeroarpa (0.333 ±6.527) was recorded as common algae.

Summer: Actinastrum hantshchii var. fluviatric (0.235 ±5.053), Cymbella obtusa (0.303 ±6.513), C. pusilla (0.242 ±4.207), Gomphonema montanum (0.303 ±5.565), Nitzschia linearis var. tenuis (0.235 ±4.522), Calothrix marchica (0.227 ±4.834), Chroococcus montanus (0.257 ±4.802), Glocotrichia echinulata var. berhampurense (0.273 ±6.453), Oscillatoria earlei (0.265 ±6.097), O. acuta (0.447 ±8.371) and Spirulina labyrinthisformis (0.234 ±5.562) were recorded during this season.

Rain: Due to rapid flow of water no common algal growth could be recorded.

Winter-summer: The season witnessed growth of Mougeotia calcarea (0.545 ±8.079), M. Sphaeroarpa (0.568 ±8.081), Spirogyra rectangularis (0.326 ±5.374), Spirogyra sp. (0.629 ±10.414), Amphora ovalis (0.288 ±5.828), Cymbella cistula (0.454 ±6.809), C. cymbiformis (0.598 ±8.050) C. leptoceros (0.220 ±2.193), Cyclotella [187]
glomerata (0.326 ± 5.299), Epithemia sorex (0.477 ± 7.497), Gyrosigma spencerii (0.379 ± 5.237), Navicula exigua (0.644 ± 7.960) N. sphaerophora (0.606 ± 8.489), N. seminulum (0.273 ± 3.977), Nitzschia dissipata var. media (0.204 ± 3.194), N. palea var. tenuirostris (0.386 ± 6.047), N. thermalis (0.204 ± 2.734), Rhopalodia gibba (0.318 ± 3.756), Synedra ulna var. danica (0.636 ± 9.005), Anabaena iyengarii (0.523 ± 9.137), A. oscillarioides (0.454 ± 7.198), A. planctonica (0.644 ± 7.378), Chroococcus rufescens (0.295 ± 4.413), Cylindrospermum michailovskoense (0.470 ± 7.802), C. stagnale (0.477 ± 7.288), Gloeocapsa quaternata (0.220 ± 3.423), Gloeotrichia raciborskii var. salsetense (0.242 ± 4.228), Merismopedia convoluta (0.386 ± 4.159), Microcystis robusta (0.386 ± 6.450), Nostoc linckia (0.454 ± 7.447), N. linckia var. arvensis (0.242 ± 4.271), N. muscorum (0.220 ± 3.895), Nodularia spumigena (0.523 ± 8.966), Oscillatoria formosa (0.432 ± 7.557), O. ornata (0.206 ± 3.753) O. tenuis (0.530 ± 7.420) and O. tenuis var. tergestina (0.303 ± 4.271).

Rain-winter: During this period no algae was recorded.

Summer-rain: Closterium acerosum (0.242 ± 4.271), Fragilaria crotonensis (0.318 ± 6.201), Gomphonema parvulum (0.371 ± 6.895), Gyrosigma scalpoides (0.227 ± 4.622), Navicula perpusilla (0.265 ± 5.977) Nitzschia palea var. fonticola (0.273 ± 4.178), and Gloeotrichia intermedia var. kanwaensis (0.288 ± 6.562) were witnessed.

All three seasons: Chlorella vulgaris (0.242 ± 2.462), Chlorococcum humicola (0.432 ± 5.754), Coelastrum cambricum var. intermedium (0.227 ± 3.424), Cosmarium formosulum (0.470 ± 6.926), C. nitidulum (0.500 ± 4.700), Scenedesmus dimorphus (0.636 ± 7.471), S. obliquus
(0.515 ±7.265), S. quadricula var. quadrispina (0.553 ±6.748), S. quadricula var. westii (0.439 ±5.540), Zygnema tenue (0.621 ±8.200), Cyclotella kuetzingiana (0.273 ±3.247), C. meneghiniana (0.492 ±5.791), Navicula anglica (0.356 ±6.052), N. cryptocephala (0.318 ±3.966), N. dicephala (0.545 ±6.000), N. gastrum (0.288 ±5.997), Nitzschia acicularis (0.454 ±6.382), N. dissipata (0.560 ±7.791), N. linearis (0.303 ±3.447), Synedra ulna var. aequalis (0.424 ±6.443), Anabaena fertilissima (0.523 ±7.665), anabaena sp. (0.394 ±7.024), Aphanothece saxicola (0.379 ±9.218), Aphanocapsa montana (0.394 ±3.391), Chroococcus turgidus (0.652 ±8.932), Merismopedia tenuissima (0.515 ±7.439), Microcystis aeruginosa (0.583 ±6.317), Oscillatoria limosa (0.333 ±4.313) and Phormidium tenue (0.636 ±6.150) were observed during all three seasons but not throughout the year.

Rare algae

**Winter:** Bulbochaete rectangularis (0.167 ±3.486), B. reticulata (0.091 ±2.374), B. varians (0.023 ±0.621), Cosmarium botrytis (0.053 ±1.505), C. constrictum (0.038 ±0.996), C. subimpressum (0.007 ±0.289), C. speciosum (0.015 ±0.389), Cosmarium sp. (0.007 ±0.289), Closterium turgidum (0.015 ±0.389), Coleochaete irregularis (0.038 ±1.443), Mougeotia genuflexa (0.129 ±2.575), Oedogonium gracillimum (0.015 ±0.389), Scenedesmus carinatus (0.015 ±0.389), Cymbella naviculiformis (0.007 ±0.289) Gomphonema sphaerophorum (0.015 ±0.389), Pleurosigma scalpoides (0.144 ±2.678), Euglena spirogyra (0.023 ±0.622) Anabaena cicinalis var. crassa (0.159 ±2.896), A. iyengarii var. attenuata (0.068 ±1.865), A. iyengarii var.
tenuis (0.083 ±2.151), Coelosphaerium kuetzingianum (0.015 ±0.389), Gleotrichia longicauda (0.068 ±1.865), Oscillatoria raoi (0.007 ±0.289), Phormidium ambiguum (0.151 ± 2.807), and Spirulina laxissima (0.151 ±0.389) were recorded during this season.

**Summer:** Auklastrodesmus convolutus (0.015 ±0.389), Closterium moniliferum (0.053 ±1.379), Closteriopsis longissima (0.144 ±2.392), cosmarium broomei (0.015 ±0.389), C. curtum (0.007 ±0.289), C. circulare (0.007 ±0.289), C. punctulatum (0.023 ±0.622), Chaetophora elegans (0.038 ±0.996), C. incrassata (0.023 ±0.866), C. pisiformis (0.030 ±1.155), Closterium venus (0.015 ±0.389), C. parvulum (0.023 ± 0.866), Golenkinia radiata (0.007 ±0.289), Oocystis solitaria (0.015 ±0.389), Pediasstrum duplex (0.045 ±1.000), P. simplex var. doudenarium (0.023 ±0.622), P. tetras (0.091 ±1.859), P. tetras var. tetraodon (0.061 ±1.231), Protococcus viridis (0.030 ±0.651), Selenastrum gracile (0.114 ±2.633), Stauroastrum gracile (0.007 ±0.289), S. hexacerum (0.007 ± 0.289), S. oxyacanthum (0.007 ±0.289), Scenedesmus quadricauda var. bicauatus (0.129 ±2.778), S. quadricauda var. longispina (0.136 ±2.844), Sphaerocystis schroeteri (0.038 ±0.996), Tetraedron trigonum var. minus (0.007 ±0.289), Amphora ovalis var. pediculus (0.030 ±0.651), A. ovalis var. pediculus forma minor (0.023 ±0.622), Achnanthes lanceolata var. dubia (0.061 ±1.231), A. minutissima (0.030 ± 0.778) Cymbella affinis (0.061 ±1.303), C. amphicephala (0.038 ±0.668), C. leptoceros var. elongata (0.015 ±0.389), C. parva (0.015 ± 0.577 ) C. ventricosa (0.045 ±0.904), Cyclotella ocellata (0.007 ±0.289), Cocconeis pediculus (0.015 ±0.389), Denticula elegans (0.129 ±2.575), Epithemia
zebra (0.068 ±1.545), Encyonema prostratum (0.068 ±1.865), E. ventricosum (0.053 ±1.084), Fragilaria construens (0.015 ±0.389), Gomphonema parvulum var. lanceolata (0.144 ±2.678), G. parvulum var. subcapitta (0.151 ±3.172), G. gracile (0.015 ±0.389), G. gracile var. dichotomum (0.015 ±0.389), Hantzschia amphioxys var. intermedia (0.023 ±0.621), Melosira granulata var. vurvata (0.030 ±0.778), Navicula borealis (0.015 ±0.389), N. braunii (0.007 ±0.289), N. cincta (0.083 ±1.243), N. cincta var. Heufleri (0.015 ±0.577), N. cancellata var. ammophila (0.007 ±0.289), N. exilis (0.023 ±0.452), N. humilis (0.030 ±0.651), N. hilseana (0.007 ±0.289), N. lanceolata (0.038 ±0.793), N. oculata (0.030 ±0.651), N. pupula (0.045 ±1.000), N. radios a (0.023 ±0.622), N. salinarum (0.076 ±1.527), N. simplex (0.007 ±0.289), N. sculpta (0.007 ±0.289), Nitzschia obtusa (0.144 ±2.745), N. obtusa var. nana (0.015 ±0.577), N. sinuata (0.015 ±0.389), N. vermicularis (0.030 ±0.778), Pinnularia undulata (0.015 ±0.389), Synedra pulchella (0.053 ±1.084), S. radians (0.015 ±0.389), s. ulna var. longissima (0.015 ±0.577), S. ulna var. lanceolata (0.007 ±0.289), S. vaucheriae var. perminuta (0.045 ±1.000), Surirella ovalis var. minuta (0.030 ±0.778), s. robusta (0.015 ±0.389), Tetracyclus rupestris (0.007 ±0.289), Euglena gracilis (0.007 ±0.289), Anabaena gelatinicola (0.007 ±0.289), Anabaena sp. (0.030 ±0.778), Aulosira bombayensis (0.023 ±0.866), A. prolifica (0.015 ±0.577), Aphanocapsa biformis (0.076 ±1.403), A. clachista (0.007 ±0.289), A. muscicola (0.174 ±2.968), Arthospira spiruloides (0.015 ±0.389), Chroococcus minor (0.144 ±3.604), Calothrix clavata (0.015 ±0.389), c. marchica var. intermedia (0.015 ±0.389), C. gloecola (0.015 ±0.577),
C. geitionos (0.007 ± 0.389), Glocotrichia ghosei (0.007 ± 0.289), G. raciborskii var. bombayense (0.030 ± 0.778), G. raciborskii var. kashiense (0.083 ± 1.881), Glococapsa nigrescens (0.038 ± 0.668), Lyngbya aestuarii var. arbutiva (0.015 ± 0.389), L. contorta (0.038 ± 0.996), L. confervoides (0.098 ± 2.610), L. porphyrosiphonis (0.015 ± 0.577), L. polysiphoniae (0.015 ± 0.389), Microcystis elbens (0.015 ± 0.577), M. protocystis (0.015 ± 0.577), M. viridis (0.030 ± 0.778), Myxosarcina spectabilis (0.007 ± 0.289), Nostoc verrucosum (0.015 ± 0.389), Oscillatoria angustissima (0.23 ± 0.622), O. acutissima (0.015 ± 0.389), O. chalybea (0.023 ± 0.622), O. curvipes (0.045 ± 0.904), O. corallinae (0.015 ± 0.389), O. foreai (0.030 ± 0.651), O. laete-virens var. minimus (0.015 ± 0.389), O. lacustris (0.007 ± 0.289), O. minnesotensis (0.023 ± 0.621), O. nigroviridis (0.015 ± 0.389), O. okeni (0.030 ± 0.778), O. pseudogeminata var. unigranulata (0.061 ± 1.303) O. willei (0.144 ± 3.175), Phormidium purpurascens (0.151 ± 0.389) and Rivularia hansgirgi (0.151 ± 0.389) were observed during this season.

Rain: Only Oocystis eremosphaeria (0.007 ± 0.289) was recorded during the season.

Winter-summer: The season witnessed growth of Chlorococcum infusionum (0.144 ± 1.730), Crucigedia tetrapedia (0.12 ± 1.435), Cosmarium depressum (0.083 ± 1.443), Characium naegelii (0.098 ± 1.379), Pediastrum duplex var. clathratum (0.030 ± 0.651), Scenedesmus acuminatus (0.167 ± 2.588), S. abundans (0.061 ± 0.985), S. arcuratus (0.053 ± 0.900), S. acutiformis (0.083 ± 1.621), S. bijuga var. alternans (0.030 ± 0.778), S. longus var. minutus (0.023 ± 0.622), S. prismaticus (0.114 ± 1.712), Selenastrum bibraianum (0.053 ± 0.900),
Ulothrix zonata (0.197 ± 2.329), Cymbella cuspidata (0.174 ± 2.778), C. laevis (0.114 ± 1.357), C. prostrata (0.182 ± 2.860), Gomphonema olivaceum (0.136 ± 2.645), Gyrosigma kuetzingii (0.159 ± 2.179), Melosira granulata (0.114 ± 1.602), Navicula mutica (0.053 ± 0.793), N. platystoma (0.144 ± 2.392), N. protrata (0.174 ± 1.881), N. ventricosa (0.007 ± 0.389), Nitzschia angustata (0.114 ± 1.712), N. microcephala (0.098 ± 1.621), N. subtilis (0.121 ± 1.923), Rhopalodia ventricosa (0.045 ± 1.243), Surirella elegans (0.038 ± 0.793), Anabaena affinis (0.106 ± 1.527), Anabaena sp. (0.061 ± 1.497), Aphanothece bullosa (0.083 ± 1.782), Chroococcus rufescens (0.295 ± 4.413), C. varius (0.144 ± 2.575), Gloeocapsa stegophila (0.098 ± 1.730), Oscillatoria anguina (0.038 ± 0.793), Phormidium anomala (0.038 ± 0.668), Synechocystis aquatilis (0.038 ± 0.798) and S. pevalekii (0.045 ± 0.719).

Rain -Winter: Under this category no algae was recorded.

Summer-rain: Cosmarium formosulum var. nathorstii (0.129 ± 2.151), C. meneghini (0.068 ± 1.545), C. reniforme (0.136 ± 1.931), Euastrum inermis (0.083 ± 1.240), Achnanthes exilis (0.159 ± 2.896), A. linearis (0.068 ± 1.545), A. lanceolata (0.053 ± 0.996), Cymbella microcephala (0.182 ± 2.558), Cyclotella operculata (0.121 ± 1.969), Hantzschia amphioxys (0.144 ± 2.745), Melosira distans (0.204 ± 3.493), Mastogloia Smithii (0.098 ± 1.881), Navicula capitata (0.083 ± 1.621), Nitzschia apiculata (0.106 ± 1.801), N. tryblionella var. calida (0.045 ± 0.798), Synedra vaucheriae var. parvula (0.174 ± 3.088), Aphanocapsa littoralis (0.167 ± 3.774), Chroococcus indicus (0.114 ± 2.179), C. macrococcus (10.076 ± 1.337), Microcystis incerta (0.144 ± 2.745), C.
pallidus (0.045 ±0.674), _C. minutus_ (0.038 ±0.668), _Oscillatoria limnetica_ (0.083 ±1.564), _O. minima_ (0.015 ± 0.389) and _O. subuliformis_ (0.091 ±1.651) were observed during this season.

All three seasons: _Ankistrodesmus falcatus_ (0.197 ±2.329), _Coelastrum proboscidiunum_ (0.114 ±1.712), _Pediastrum boryanum_ (0.174 ± 1.505), _P. simplex_ (0.167 ±1.586), _Cocconeis placentula_ (0.068 ±0.754), _Encyonema caespitosum_ (0.151 ±2.535), _Anabaena oryzae_ (0.144 ±1.929) and _Raphidiopsis sp._ (0.182 ±2.132) were recorded in all three seasons but not throughout the year.

PLANKTONIC ALGAE

Generic quantitative distribution of phycoplanktons in different seasons has been described in Table -5. Quantitative assessments are based on statistical computation of 'Percentage occurrence' "Standard deviation" and 'Coefficient of variation' for genera belonging to different classes described in Table 6. The first figure within brackets indicates 'Percentage occurrence' and second 'Standard deviation'.

For the sake of brevity of text the planktonic genera have been described under sub heads of various seasons:

**Winter:** _Closterium_ (0.207 ±59.130), _coelastrum_ (0.009 ±346.410), _Golenkinia_ (0.155 ±41.280), _Sphaerocystis_ (0.828 ±224.313) and _Gyrosigma_ (0.051 ±19.052) were observed during this season.

**Summer:** _Closteriopsis_ (0.206 ±43.221) and _Amphora_ (0.102 ±25.690) were witnessed.

**Rain:** No planktonic genera could be recorded.

**Winter-summer:** _Actinastrum_ (1.035 ±240.011), _Pediastrum_ (1.138 ±221.472), _Selenastrum_ (3.986 ±945.888), _Cymbella_ (0.671 ±100.209), _Gomphonema_ (0.205 ±32.496), _Masto_
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<td>216.383</td>
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<td>28.</td>
<td>Oscillatoria</td>
<td>0.931</td>
<td>±219.140</td>
<td>219.322</td>
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<td>29.</td>
<td>Phormidium</td>
<td>2.174</td>
<td>±366.780</td>
<td>157.247</td>
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</tbody>
</table>
Rain- winter: During this period no planktonic genera could be recorded.

Summer-rain: Only _Microcystis_ (3.934 ±474.107) was recorded during this season.

All three seasons: _Ankistrodesmus_ (1.758 ±183.879), _Chlorococcum_ (0.826 ±128.100), _Crucigenia_ (2.225 ±419.207), _Chlorella_ (2.277 ±346.185), _Achnanthes_ (0.617 ±56.819), _Melosira_ (23.869 ±2859.794), _Synedra_ (3.623 ±350.208), _Merismopedia_ (3.829 ±888.972) and _Phormidium_ (2.174 ±366.780), were observed in all three seasons of the year.

Throughout the year: _Scenedesmus_ (11.598±1438.587), _Cyclotella_ (23.406 ±2344.689) and _Nitzschia_ (0.800 ±546.047) were witnessed throughout calender year.
III - WATER AND SAND CULTURE
OF ALGAE

QUALITATIVE DISTRIBUTION

In view to depict the totality of algal profile the collection of algae from nature as well as water and sand culture is crucial. Algae coming up in culture are indicative of futuristic algal growth if suitable circumstances appear simulating cultural conditions. Seventy seven algae from water culture and 80 species from sand culture were observed.

WATER CULTURE ALGAE

Among chlorophycean forms 27 species (Ankistrodesmus convolutus, A. falcatus, A. falcatus var. acicularis, Actinastrum hantzschii, Chlorella vulgaris, Crucigenia quadrata, C. tetraptera, Chlorococcum humicola, C. infusionum, Coelastrum cambricum var. intermedium, C. proboscidium, Pediastrum duplex, Selenastrum gracile, S. westii, Scenedesmus armatus, S. acuminatus, S. abundans, S. bijuga, S. dimorphus, S. obliquus, S. prismaticus, S. quadricauda, S. quadricauda var. bicaudatus, S. quadricauda var. longispina, S. quadricauda var. quadrispina, S. quadricauda var. westii and Sphaerocystis Schroeteri) were observed.

Bacillariophycean forms consisting 27 species (Cyclotella glomerata, C. kuettzingiana, C. meneghiniana, C. operculata, Cocconeis placentula, Fragilaria crotonensis, Gomphonema constrictum var. capitatum, Mastogloia smithii, Melosira varians, Navicula cryptocephala var. veneta, N. inaequilatera, N. perpusilla, N. seminulum, Nitzschia
acicularis, N. apiculata, N. angustata, N. dissipata var. media, N. Linearis var. tenuis, N. microcephala, N. palea, Pleurosigma spencerii, var. nodifera, Synedra acus, S. acus, var. delicatissima, S. ulna, S. ulna var. danica, S. vaucheriae parvula and Stauroneis anceps) could be recorded. No euglenophycean form was observed.

Cyanophycean forms spread over 23 species (Aphanotheca saxicola, Aphanocapsa grevillei, A. littoralis, Anabaena ambigua, Chroococcus dispersus, Lyngbya lagerheimii, L. versicolor, Merismopedia glauca, M. punctata, M. tenuissima, Microcystis aeruginosa, Myxosarcina spectabilis, Nostoc calcicola, N. linckia, N. piscinale, Oscillatoria angustissima, O. acuta, O. cortiana, O. limnetica, O. subbrevis, O. tenuis var. tergestina, Phormidium tenue and Synechococcus aeruginosus) were observed.

SAND CULTURE ALGAE

Among chlorophycean forms 20 species (Coelastrum cambricum var. intermedium, C. proboscidium, Chlorococcum humicola, C. infusionum, Crucigenia quadrata, C. tetrapedia, Chlorella vulgaris, Golenkinia paucispina, Quadrigula lacustris, Scenedesmus armatus, S. acuminatus, S. bijuga, S. dimorphus, S. obliquus, S. prismaticus, S. quadricauda, S. quadricauda var. quadrispina, S. quadricauda var. westii, Selenastrum westii and Sphaerocystis Schroeteri) were observed.

Bacillariophycean forms consisting 19 species (Cyclotella glomerata, C. kuetzingiana, C. meneghiniana, C. operculata, Cymbella microcephala, Encyonema ventricosum, Gomphonema constrictum var. capitatum, Hantzschia amphioxys, Mastogloia smithii, Navicula anglica, N. dicephala, N. gregaria, N. inaequilatera, N. pygmaea, N. tuscula, Nitzschia apiculata, N. palea, Synedra ulna and Stauroneis anceps) could
be recorded. Among euglenophycean forms only 2 species (Euglena gracilis and E. spirigera) were observed.


QUANTITATIVE DISTRIBUTION

Quantitative assessments are based on statistical computation of 'Percentage occurrence' and 'Standard deviation' for water and sand culture algae (Table- 7, 8). A detailed account of water and sand culture algae is given below. The first figure within brackets indicates 'percentage occurrence' and second 'Standard deviation.

WATER CULTURE ALGAE

Chlorophyceae [Ankistrodesmus convolutus (5.496 ±2.529). A. falcatus, (0.428 ± 0.675), A. falcatus var. acicularis (0.214 ± 0.407),

[203]
<table>
<thead>
<tr>
<th>S.NO.</th>
<th>NAME OF SPECIES</th>
<th>PERCENTAGE OCCURRENCE</th>
<th>STANDARD DEVIATION</th>
<th>COEFFICIENT OF VARIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ankistrodesmus convolutis</td>
<td>5.496</td>
<td>±2.529</td>
<td>49.265</td>
</tr>
<tr>
<td>2.</td>
<td>Ankistrodesmus falcatus</td>
<td>0.428</td>
<td>±0.675</td>
<td>168.667</td>
</tr>
<tr>
<td>3.</td>
<td>Ankistrodesmus falcatus var. acicularis</td>
<td>0.214</td>
<td>±0.407</td>
<td>203.419</td>
</tr>
<tr>
<td>4.</td>
<td>Actinastrum hantzschi</td>
<td>0.428</td>
<td>±0.724</td>
<td>180.993</td>
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<td>5.</td>
<td>Chlorella vulgaris</td>
<td>0.535</td>
<td>±0.630</td>
<td>125.945</td>
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<tr>
<td>6.</td>
<td>Crucigenia quadrata</td>
<td>0.214</td>
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</tr>
<tr>
<td>7.</td>
<td>Crucigenia tetrapedia</td>
<td>0.285</td>
<td>±0.450</td>
<td>168.455</td>
</tr>
<tr>
<td>8.</td>
<td>Chlorococcum humicola</td>
<td>0.428</td>
<td>±0.724</td>
<td>180.990</td>
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<tr>
<td>9.</td>
<td>Chlorococcum infusionum</td>
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<td>±0.484</td>
<td>242.117</td>
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<tr>
<td>10.</td>
<td>Coelastrum cambricum var. intermedium</td>
<td>0.357</td>
<td>±0.547</td>
<td>164.166</td>
</tr>
<tr>
<td>11.</td>
<td>Coelastrum proboscidium</td>
<td>0.214</td>
<td>±0.484</td>
<td>242.117</td>
</tr>
<tr>
<td>12.</td>
<td>Pediastrum duplex</td>
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</tr>
<tr>
<td>13.</td>
<td>Selenastrum gracile</td>
<td>0.785</td>
<td>±0.691</td>
<td>94.337</td>
</tr>
<tr>
<td>15.</td>
<td>Scenedesmus armatus</td>
<td>4.782</td>
<td>±1.456</td>
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<td>PERCENTAGE OCCURRENCE</td>
<td>STANDARD DEVIATION</td>
<td>COEFFICIENT OF VARIATION</td>
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<tr>
<td>16.</td>
<td>Scenedesmus acuminatus</td>
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<td>±0.682</td>
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<tr>
<td>17.</td>
<td>Scenedesmus abundans</td>
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<td>±0.407</td>
<td>203.419</td>
</tr>
<tr>
<td>18.</td>
<td>Scenedesmus bijuga</td>
<td>7.138</td>
<td>±2.883</td>
<td>43.251</td>
</tr>
<tr>
<td>19.</td>
<td>Scenedesmus dimorphus</td>
<td>3.640</td>
<td>±1.589</td>
<td>46.726</td>
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<td>20.</td>
<td>Scenedesmus obliquus</td>
<td>1.463</td>
<td>±1.129</td>
<td>82.607</td>
</tr>
<tr>
<td>21.</td>
<td>Scenedesmus prismaticus</td>
<td>2.320</td>
<td>±1.533</td>
<td>70.757</td>
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<tr>
<td>22.</td>
<td>Scenedesmus quadricauda</td>
<td>1.142</td>
<td>±1.015</td>
<td>95.134</td>
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<tr>
<td>23.</td>
<td>Scenedesmus quadricauda var. bicaudatus</td>
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<td>±0.596</td>
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<tr>
<td>24.</td>
<td>Scenedesmus quadricauda var. longispina</td>
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<td>±0.430</td>
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<td>25.</td>
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<td>4.318</td>
<td>±1.671</td>
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<tr>
<td>26.</td>
<td>Scenedesmus quadricauda var. westii.</td>
<td>0.714</td>
<td>±0.548</td>
<td>82.117</td>
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<tr>
<td>27.</td>
<td>Sphaerocystis schroeteri</td>
<td>0.250</td>
<td>±0.504</td>
<td>216.312</td>
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<td><strong>BACILLARIOPHYCEAE</strong></td>
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<td>28.</td>
<td>Cyclotella glomerata</td>
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<td>±1.522</td>
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<td>Cyclotella kuetzingiana</td>
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<td>±1.220</td>
<td>76.281</td>
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<td>30.</td>
<td>Cyclotella meneghiniana</td>
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<td>±1.337</td>
<td>58.998</td>
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<td>31.</td>
<td>Cyclotella operculata</td>
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<td>±1.380</td>
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<td>32.</td>
<td>Cocconeis placentula</td>
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<td>±0.434</td>
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<td>33.</td>
<td>Fragilaria crotonensis</td>
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<td>±0.504</td>
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<tr>
<td>34.</td>
<td>Gomphonema constrictum var. capitatum</td>
<td>0.214</td>
<td>±0.484</td>
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<tr>
<td>35.</td>
<td>Mastogloia smithii</td>
<td>0.285</td>
<td>±0.640</td>
<td>239.582</td>
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<td>36.</td>
<td>Melosira varians</td>
<td>0.357</td>
<td>±0.711</td>
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<td>Navicula cryptocephala var. veneta</td>
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<td>±0.254</td>
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<td>38.</td>
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<td>±0.450</td>
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<td>39.</td>
<td>Navicula perpusilla</td>
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<td>±0.521</td>
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<td>Navicula seminulum</td>
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<td>Nitzschia acicularis</td>
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<td>±0.583</td>
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<td>Nitzschia apiculata</td>
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<td>±0.355</td>
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<td>Nitzschia angustata</td>
<td>0.107</td>
<td>±0.305</td>
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<td>44.</td>
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<td>±0.606</td>
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<td>46.</td>
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<td>Pleurosigma spencerii var. nodifera</td>
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<td>Synedra acus</td>
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<td>±0.615</td>
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<td>Synedra acus var. delicatissima</td>
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<td>53.</td>
<td>Synedra vaucheriae var. parvula</td>
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<td>Aphacathece saxicola</td>
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<td>±1.155</td>
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<td>59.</td>
<td>Chroococcus dispersus</td>
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<td>60.</td>
<td>Lyngbya lagerheimii</td>
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<td>±1.137</td>
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<td>61.</td>
<td>Lyngbya versicolor</td>
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<td>±0.974</td>
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<td>62.</td>
<td>Merismopedia glauca</td>
<td>1.784</td>
<td>±0.884</td>
<td>53.034</td>
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<td>63.</td>
<td>Merismopedia punctata</td>
<td>1.392</td>
<td>±0.750</td>
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<td>64.</td>
<td>Merismopedia tenuissima</td>
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<td>±1.135</td>
<td>147.995</td>
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<tr>
<td>S.NO.</td>
<td>NAME OF SPECIES</td>
<td>PERCENTAGE OCCURRENCE</td>
<td>STANDARD DEVIATION</td>
<td>COEFFICIENT OF VARIATION</td>
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<td>Microcystis aeruginosa</td>
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<td>Myxosarcina spectabilis</td>
<td>0.250</td>
<td>±0.568</td>
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<td>Nostoc calcicola</td>
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<td>±1.016</td>
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<td>68.</td>
<td>Nostoc linckia</td>
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<td>±1.061</td>
<td>159.121</td>
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<td>69.</td>
<td>Nostoc piscinale</td>
<td>1.142</td>
<td>±1.048</td>
<td>98.244</td>
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<td>70.</td>
<td>Oscillatoria angustissima</td>
<td>0.749</td>
<td>±1.149</td>
<td>164.173</td>
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<td>71.</td>
<td>Oscillatoria acuta</td>
<td>1.642</td>
<td>±1.408</td>
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<td>72.</td>
<td>Oscillatoria cortiana</td>
<td>0.214</td>
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<td>73.</td>
<td>Oscillatoria limnetica</td>
<td>10.814</td>
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<td>76.</td>
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<td>2.677</td>
<td>±1.592</td>
<td>63.680</td>
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<td>77.</td>
<td>Synechococcus aeruginosus</td>
<td>0.107</td>
<td>±0.305</td>
<td>305.128</td>
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</table>
# TABLE 8: QUANTITATIVE DISTRIBUTION OF ALGAE IN SAND CULTURE

<table>
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<th>S.NO.</th>
<th>NAME OF SPECIES</th>
<th>PERCENTAGE OCCURRENCE</th>
<th>STANDARD DEVIATION</th>
<th>COEFFICIENT OF VARIATION</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Coelastrum cambricum var. intermedium</td>
<td>0.435</td>
<td>±0.608</td>
<td>156.217</td>
</tr>
<tr>
<td>2.</td>
<td>Coelastrum proboscidium</td>
<td>0.248</td>
<td>±0.428</td>
<td>192.699</td>
</tr>
<tr>
<td>3.</td>
<td>Chlorococcum humicola</td>
<td>0.869</td>
<td>±0.732</td>
<td>94.098</td>
</tr>
<tr>
<td>4.</td>
<td>Chlorococcum infusionum</td>
<td>0.248</td>
<td>±0.548</td>
<td>246.990</td>
</tr>
<tr>
<td>5.</td>
<td>Crucigenia quadrata</td>
<td>0.373</td>
<td>±0.594</td>
<td>178.405</td>
</tr>
<tr>
<td>6.</td>
<td>Crucigenia tetrapedia</td>
<td>0.435</td>
<td>±0.502</td>
<td>128.954</td>
</tr>
<tr>
<td>7.</td>
<td>Chlorella vulgaris</td>
<td>0.869</td>
<td>±0.732</td>
<td>94.098</td>
</tr>
<tr>
<td>8.</td>
<td>Golenkinia paucispina</td>
<td>0.559</td>
<td>±0.707</td>
<td>141.420</td>
</tr>
<tr>
<td>9.</td>
<td>Quadrigula lacustris</td>
<td>0.869</td>
<td>±1.215</td>
<td>156.217</td>
</tr>
<tr>
<td>10.</td>
<td>Scenedesmus armatus</td>
<td>0.994</td>
<td>±0.758</td>
<td>85.309</td>
</tr>
<tr>
<td>11.</td>
<td>Scenedesmus acuminatus</td>
<td>0.497</td>
<td>±0.784</td>
<td>176.537</td>
</tr>
<tr>
<td>12.</td>
<td>Scenedesmus bijuga</td>
<td>2.360</td>
<td>±1.132</td>
<td>53.616</td>
</tr>
<tr>
<td>13.</td>
<td>Scenedesmus dimorphus</td>
<td>1.056</td>
<td>±0.539</td>
<td>57.130</td>
</tr>
<tr>
<td>14.</td>
<td>Scenedesmus obliquus</td>
<td>0.497</td>
<td>±0.616</td>
<td>138.671</td>
</tr>
<tr>
<td>15.</td>
<td>Scenedesmus prismaticus</td>
<td>0.745</td>
<td>±0.767</td>
<td>114.987</td>
</tr>
<tr>
<td>S.NO.</td>
<td>NAME OF SPECIES</td>
<td>PERCENTAGE OCCURRENCE</td>
<td>STANDARD DEVIATION</td>
<td>COEFFICIENT OF VARIATION</td>
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<td>16.</td>
<td>Scenedesmus quadricauda</td>
<td>0.994</td>
<td>±0.832</td>
<td>93.628</td>
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<tr>
<td>17.</td>
<td>Scenedesmus quadricauda var. quadrispina</td>
<td>0.932</td>
<td>±0.985</td>
<td>118.269</td>
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<tr>
<td>18.</td>
<td>Scenedesmus quadricauda var. westii</td>
<td>0.745</td>
<td>±0.594</td>
<td>89.055</td>
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<tr>
<td>19.</td>
<td>Selenastrum westii</td>
<td>0.497</td>
<td>±0.616</td>
<td>138.789</td>
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<tr>
<td>20.</td>
<td>Sphaerocystis Schroeteri</td>
<td>0.248</td>
<td>±0.548</td>
<td>246.990</td>
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<tr>
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<td><strong>BACILLARIOPHYCEAE</strong></td>
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<tr>
<td>21.</td>
<td>Cyclotella glomerata</td>
<td>0.869</td>
<td>±0.732</td>
<td>94.098</td>
</tr>
<tr>
<td>22.</td>
<td>Cyclotella kuetzingiana</td>
<td>0.497</td>
<td>±0.616</td>
<td>138.671</td>
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<tr>
<td>23.</td>
<td>Cyclotella meneghiniana</td>
<td>0.932</td>
<td>±0.786</td>
<td>94.346</td>
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<tr>
<td>24.</td>
<td>Cyclotella operculata</td>
<td>0.621</td>
<td>±0.705</td>
<td>127.027</td>
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<tr>
<td>25.</td>
<td>Cymbella microcephala</td>
<td>0.248</td>
<td>±0.428</td>
<td>192.699</td>
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<td>26.</td>
<td>Encyonema ventricosum</td>
<td>0.310</td>
<td>±0.574</td>
<td>206.659</td>
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<tr>
<td>27.</td>
<td>Gomphonema constrictum var. capitatum</td>
<td>0.373</td>
<td>±0.594</td>
<td>178.405</td>
</tr>
<tr>
<td>28.</td>
<td>Hantzschia amphioxys</td>
<td>0.435</td>
<td>±0.608</td>
<td>156.217</td>
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<td>29.</td>
<td>Mastogloia smithii</td>
<td>0.869</td>
<td>±0.878</td>
<td>112.880</td>
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<td>30.</td>
<td>Navicula anglica</td>
<td>0.621</td>
<td>±0.705</td>
<td>126.989</td>
</tr>
<tr>
<td>31.</td>
<td>Navicula dicephala</td>
<td>0.745</td>
<td>± ±0.767</td>
<td>114.987</td>
</tr>
<tr>
<td>S.NO.</td>
<td>NAME OF SPECIES</td>
<td>PERCENTAGE OCCURRENCE</td>
<td>STANDARD DEVIATION</td>
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<tr>
<td>32.</td>
<td>Navicula gregaria</td>
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<td>±0.594</td>
<td>178.405</td>
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<tr>
<td>33.</td>
<td>Navicula inaequilatera</td>
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<td>±0.707</td>
<td>47.140</td>
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<td>34.</td>
<td>Navicula pygmaea</td>
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<td>±0.705</td>
<td>158.737</td>
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<td>35.</td>
<td>Navicula tuscula</td>
<td>0.559</td>
<td>±0.707</td>
<td>141.421</td>
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<td>36.</td>
<td>Navicula apiculata</td>
<td>0.373</td>
<td>±0.594</td>
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<tr>
<td>37.</td>
<td>Navicula palea</td>
<td>4.224</td>
<td>±1.396</td>
<td>36.942</td>
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<tr>
<td>38.</td>
<td>Synedra ulna</td>
<td>0.559</td>
<td>±0.618</td>
<td>123.669</td>
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<tr>
<td>39.</td>
<td>Stauroneis anceps</td>
<td>0.435</td>
<td>±0.698</td>
<td>179.384</td>
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<td><strong>EUGLENOPHYCEAE</strong></td>
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<td>40.</td>
<td>Euglena gracilis</td>
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<td>±0.616</td>
<td>138.256</td>
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<tr>
<td>41.</td>
<td>Euglena spirogyra</td>
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<td>±0.594</td>
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<td><strong>CYANOPHYCEAE</strong></td>
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<td>42.</td>
<td>Aphanоthece bullosa</td>
<td>0.745</td>
<td>±0.970</td>
<td>145.449</td>
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<td>43.</td>
<td>Aphanоthece microscopica</td>
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<td>±1.060</td>
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<td>44.</td>
<td>Aphanоthece saxicola</td>
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<td>±0.855</td>
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<td>Aphanоcapsa montana</td>
<td>1.118</td>
<td>±0.970</td>
<td>97.014</td>
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<td>46.</td>
<td>Chroоcoccus dispersus</td>
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<td>±0.786</td>
<td>157.181</td>
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<td>S.NO.</td>
<td>NAME OF SPECIES</td>
<td>COEFFICIENT OF VARIATION</td>
<td>STANDARD DEVIATION</td>
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<tr>
<td>0.869</td>
<td>Chroococcus pallidus</td>
<td>121.181</td>
<td>±0.943</td>
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<tr>
<td>0.683</td>
<td>Chroococcus tenax</td>
<td>127.258</td>
<td>±0.777</td>
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<td>0.869</td>
<td>Chroococcus turgidus</td>
<td>121.184</td>
<td>±0.943</td>
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<td>Lyngbya contorta</td>
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<td>±0.686</td>
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<td>Lyngbya lagerheimii</td>
<td>85.341</td>
<td>±1.137</td>
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<tr>
<td>2.236</td>
<td>Lyngbya martensiaria</td>
<td>97.014</td>
<td>±1.940</td>
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<tr>
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<td>Lyngbya polysiphonae</td>
<td>246.990</td>
<td>±0.548</td>
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<tr>
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<td>Lyngbya versicolor</td>
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<td>±1.166</td>
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<td>Microcystis aeruginosa</td>
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<td>±1.079</td>
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<td>0.248</td>
<td>Microcystis elabens</td>
<td>246.990</td>
<td>±0.548</td>
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<tr>
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<td>Microcystis flos-aquae</td>
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<td>±0.594</td>
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<td>Merismopedia convoluta</td>
<td>138.671</td>
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<tr>
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<td>Merismopedia glauca</td>
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<td>±0.970</td>
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<tr>
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<td>Merismopedia punctata</td>
<td>84.906</td>
<td>±0.802</td>
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<td>0.497</td>
<td>Merismopedia tenuissima</td>
<td>158.717</td>
<td>±0.705</td>
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<tr>
<td>0.373</td>
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<td>±0.686</td>
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<td>1.553</td>
<td>Oscillatoria angustissima</td>
<td>74.651</td>
<td>±1.037</td>
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<tr>
<td>S.NO.</td>
<td>NAME OF SPECIES</td>
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<td>COEFFICIENT OF VARIATION</td>
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<tr>
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<tr>
<td>64.</td>
<td>Oscillatoria acuta</td>
<td>4.410</td>
<td>±3.472</td>
<td>88.026</td>
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<tr>
<td>65.</td>
<td>Oscillatoria chlorina</td>
<td>0.248</td>
<td>±0.548</td>
<td>246.990</td>
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<tr>
<td>67.</td>
<td>Oscillatoria limosa</td>
<td>1.304</td>
<td>±1.098</td>
<td>94.098</td>
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<tr>
<td>68.</td>
<td>Oscillatoria okeni</td>
<td>0.621</td>
<td>±0.705</td>
<td>126.989</td>
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<tr>
<td>69.</td>
<td>Oscillatoria princeps</td>
<td>1.863</td>
<td>±1.572</td>
<td>94.301</td>
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<tr>
<td>70.</td>
<td>Oscillatoria subuliformis</td>
<td>0.932</td>
<td>±0.857</td>
<td>102.940</td>
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<tr>
<td>71.</td>
<td>Oscillatoria subbrevis</td>
<td>4.224</td>
<td>±2.365</td>
<td>62.608</td>
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<tr>
<td>72.</td>
<td>Oscillatoria tenuis</td>
<td>0.994</td>
<td>±0.900</td>
<td>101.237</td>
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<tr>
<td>73.</td>
<td>Oscillatoria tenuis var. tergestina</td>
<td>3.851</td>
<td>±2.572</td>
<td>74.666</td>
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<tr>
<td>74.</td>
<td>Oscillatoria willei</td>
<td>0.745</td>
<td>±1.029</td>
<td>154.271</td>
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<tr>
<td>75.</td>
<td>Phormidium ambiguum</td>
<td>0.621</td>
<td>±0.705</td>
<td>126.989</td>
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<tr>
<td>76.</td>
<td>Phormidium tenue</td>
<td>4.907</td>
<td>±2.660</td>
<td>60.604</td>
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<tr>
<td>77.</td>
<td>Raphidiopsis sp.</td>
<td>0.310</td>
<td>±0.461</td>
<td>165.911</td>
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<tr>
<td>78.</td>
<td>Spirulina gigantea</td>
<td>1.304</td>
<td>±0.76</td>
<td>67.344</td>
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<tr>
<td>79.</td>
<td>spirulina labyrinthiformis</td>
<td>1.118</td>
<td>±0.767</td>
<td>76.696</td>
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<tr>
<td>80.</td>
<td>Spirulina major</td>
<td>1.242</td>
<td>±0.900</td>
<td>81.008</td>
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</table>
Actinastrum hantzschii (0.428 ±0.724), Chlorella vulgaris (0.535 ±0.630), Crucigenia quadrata (0.214 ±0.407), C. tetrapedia (0.285 ±0.450), Chlorococcum humicola (0.428 ±0.724), C. infusionum (0.214 ±0.484), Coelastrum cambricum var. intermedium (0.357 ±0.547), C. proboscidium (0.214 ±0.484), Pediastrum duplex (0.214 ±0.484), Selenastrum gracile (0.785 ±0.691), S. westii (6.638 ±1.219), Scenedesmus armatus (4.782 ±1.456), S. acuminatus (0.535 ±0.682), S. abundans (0.214 ±0.407), S. bijuga (7.138 ±2.883), S. dimorphus (3.640 ±1.589), S. obliquus (1.463 ±1.129), S. prismaticus (2.320 ±1.533), S. quadricula (1.142 ±1.015), S. quadricula var. bicudatus (0.321 ±0.596), S. quadricula var. longispina (0.250 ±0.430), S. quadricula var. quadriscina (4.318 ±1.671), S. quadricula var. westii (0.714 ±0.548) and Sphaeroestis Schroeteri (0.250 ±0.504).

Bacillariophyceae [Cyclorella glomerata (3.854 ±1.522), C. kuetzingiana (1.713 ±1.220), C. meneghiniana (2.427 ±1.337), C. operculata (3.640 ±1.380), Cocconeis placentula (0.143 ±0.434), Fragilaria crotonensis (0.250 ±0.504), Gomphonema constrictum var. capitatum (0.214 ±0.484), Mastogloia smithii (0.285 ±0.640), Melosira varia (0.357 ±0.711), Navicula cryptocephala var. veneta (0.250 ±0.254), N. inaequilatera (0.285 ±0.450), N. perpusilla (0.285 ±0.521), N. seminulum (0.214 ±0.484), Nitzschia acicularis (0.285 ±0.583), N. apiculata (0.321 ±355), N. angustata (0.107 ±0.305), N. dissipata var. media (0.357 ±0.606), N. linearis var. tenuis (0.357 ±0.547), N. microcephala (0.107 ±0.305), N. palea (6.067 ±1.971), Pleurosigma
spencerii var. nodifera (0.428 ± 0.563), Synedra acus (0.678 ± 0.615), S. acus var. delicatissima (0.107 ± 0.305), S. ulna (1.106 ± 0.964), S. ulna var. danica (0.214 ± 0.482), S. vaucheriae var. parvula (0.107 ± 0.305) and Stauroneis aniceps (0.214 ± 0.265)]

Cyanophyceae [Aphanothece saxicola (1.142 ± 1.048), Aphanocapsa grevillei (0.214 ± 0.551), A. littoralis (0.714 ± 1.155) Anabaena ambiguа (1.249 ± 1.053), Chroococcus dispersus (0.250 ± 0.504), Lyngbya lagerheimii (0.928 ± 1.137), L. versicolor (0.535 ± 0.974), Merismopedia glauca (1.784 ± 0.884), M. punctata (1.392 ± 0.750), M. tenuissima (0.821 ± 1.135), Microcystis aeruginosa (1.178 ± 0.759), Myxosarcina spectabilis (0.250 ± 0.568), Nostoc calcicola (1.035 ± 1.016), N. linckia (0.714 ± 1.061), N. piscinale (1.142 ± 1.048), Oscillatoria angustissima (0.749 ± 1.149), O. acuta (1.642 ± 1.408), O. cortiana (0.214 ± 0.484), O. limnetica (10.814 ± 5.020), O. subbrevis (1.463 ± 0.999), O. tenuis var. tergestina (1.071 ± 1.114), Phormidium tenue (2.677 ± 1.592) and Synechococcus aeruginosus (0.107 ± 0.305)].

SAND CULTURE ALGAE

Chlorophyceae [Coelastrum cambricum var. intermediun (0.435 ± 0.608), C. proboscidium (0.248 ± 0.428), Chlorococcum humicola (0.869 ± 0.732), C. infusionum (0.248 ± 0.548), Crucigenia quadrata (0.373 ± 0.594), C. tetrapedia (0.435 ± 0.502), Chlorella vulgaris (0.869 ± 0.732), Golenkinia paucispina (0.559 ± 0.707), Quadrigula lacustris (0.869 ± 1.215), Scenedesmus armatus (0.994 ± 0.758), S. acuminatus (0.497 ± 0.784), S. bijuga (2.360 ± 1.132), S. dimorphus (1.056 ± 0.539), S. obliquus (0.497 ± 0.616), S. prismaticus (0.745 ± 0.767), S.
quadricula (0.994 ± 0.832), S. quadricula var. quadrispina (0.932 ± 0.985), S. quadricula var. westii (0.745 ± 0.594), Selenastrum westii (0.497 ± 0.616) and Sphaerocystis Schroeteri (0.248 ± 0.548)].

Bacillariophyceae [Cyclotella glomerata (0.869 ± 0.732), C. kuetzingiana (0.497 ± 0.616), C. meneghiniana (0.932 ± 0.786), C. operculata (0.621 ± 0.705), Cymbella microcephala (0.248 ± 0.428), Encyonema ventricosum (0.310 ± 0.574), Gomphonema constrictum var. capitatum (0.373 ± 0.594), Hantzschia amphioxys (0.435 ± 0.608), Mastogloia smithii (0.869 ± 0.878), Navicula anglica (0.621 ± 0.705), N. dicephala (0.745 ± 0.767), N. gregaria (0.373 ± 0.594), N. inaequilatera (1.677 ± 0.707), N. pygmaea (0.497 ± 0.705), N. tuscula (0.559 ± 0.707), Nitzschia apiculata (0.373 ± 0.594), N. palea (4.224 ± 1.396), Synedra ulna (0.559 ± 0.618) and Stauroneis anceps (0.435 ± 0.698).

Euglenophyceae [Euglena gracilis (0.497 ± 0.616) and E. spirogyra (0.373 ± 0.594)].

Cyanophyceae [Aphanathece bullosa (0.745 ± 0.970), A. microscopica (1.366 ± 1.060), A. saxicola (1.739 ± 0.855), Aphanocapsa montana (1.118 ± 0.970), Chroococcus dispersus (0.559 ± 0.786), C. pallidus (0.869 ± 0.943), C. tenax (0.683 ± 0.777), C. turgidus (0.869 ± 0.943), Lyngbya contorta (0.373 ± 0.686), Lyngbya lagerheimii (1.491 ± 1.137), L. martensiana (2.236 ± 1.940), L. polysiphoniae (0.248 ± 0.548), L. versicolor (0.869 ± 1.166), Microcystis aeruginosa (1.242 ± 1.079), M. elabens (0.248 ± 0.548), M. flos-aquae (0.373 ± 0.594), Merisnopedia convoluta (0.497 ± 0.616), M. glauca (1.118 ± 0.970), M.
punetata (1.056 ± 0.802), M. tenuissima (0.497 ± 0.705), Myxosarcina spectabilis (0.373 ± 0.686), Oscillatoria angustissima (1.553 ± 1.037), O. acuta (4.410 ± 3.472), O. chlorina (0.248 ± 0.548), O. limnetica (20.621 ± 4.668), O. limosa (1.304 ± 1.098), O. okeni (0.621 ± 0.705), O. princeps (1.863 ± 1.572), O. subuliformis (0.932 ± 0.857), O. subbrevis (4.224 ± 2.365), O. tenuis (0.994 ± 0.900), O. tenuis var. tergestina (3.851 ± 2.572), O. willei (0.745 ± 1.029), Phormidium ambiguum (0.621 ± 0.705), P. tenue (4.907 ± 2.660), Raphidiopsis sp. (0.310 ± 0.461), Spirulina gigantea (1.304 ± 0.786), S. labyrinthiformis (1.118 ± 0.767), and S. major (1.242 ± 0.900)
IV - ALGAE AND POLLUTION

Algae are involved in water pollution in multiple of significant ways. Pollution may bring about enrichment of algal nutrients in water and thus may selectively stimulate the growth of few species that in turn changes water quality. Certain algae are able to flourish in water polluted with organic wastes and play an important role in "self - purification' of water. The selective types of algae that exist in polluted water are used as indicators of pollution. The polluted water algae may frequently include certain forms toxic to man or animals drinking the water or getting in contact. The Ken water at Banda shows a very broad spectrum of algae. Algae are of use in multiple ways. The topic has been divided for the sake of convenience in to following subheads : (1) Algae as indicators of high acidity, (2) Algae causing natural softening of water, (3) Eutrophic algae, (4) Sewage algae, (5) Algae of allergenic significance, (6) Clean water algae, (7) Pollution algae, (8) Taste and odour algae, (9) Algae causing colouration of water, (10) Toxic algae. This broad spectrum of chapter is aimed to pin-point importance of algae in biology and water pollution.

ALGAE AS INDICATOR OF HIGH ACIDITY

Changes in pH of water due to natural causes greatly modifies the algal population. Following acid tolerant algae have been reported from Banda. Such algal indicators of high acidity include 4 chlorophycean (Cladophora, Closteriopsis, Mougeotia and Ulothrix zonata) and 1 bacillariophycean (Stauroneis aniceps).
ALGAE CAUSING NATURAL SOFTENING OF WATER

Following algae have been reported for causing natural softening of Ken water at Banda. Two chlorophycean (Cosmarium and Scenedesmus), 1 bacillariophycean (Synedra) and 1 cyanophycean genera (Anabaena) were recorded.

EUTROPHIC ALGAE

Algae invariably cause part or most of the increased growth stimulated by eutrophication. The quantitative and qualitative assessment of algae in Ken river shows growth of following algae indicating eutrophic state of water. Twelve chlorophycean (Actinastrum, Ankistrodesmus, Closterium, Cosmarium, Mougeotia, Oocystis, Pediastrum, Staurastrum, Scenedesmus, Spirogyra, Sphaerocystis, Ulothrix), 7 bacillariophycean (Asterionella, Diatoma, Fragilaria, Gyrosigma, Nitzschia, Synedra and Surirella), 1 euglenophycean (Euglena) and 6 cyanophycean forms (Anabaena, Microcystis, Calothrix, Lyngbya, Oscillatoria and Spirulina) were recorded as eutrophic algae from Ken water.

SEWAGE ALGAE

Following algae have been recorded from river Ken at Banda indicating the presence of sewage discharge in the river. Out of 37 sewage algae 17 chlorophycean (Ankistrodesmus falcatus, Actinastrum, Chlorococcum humicola, Characium, Chlorella, Cladophora, Cosmarium botrytis, Golenkina radiata, Oocystis, Pediastrum, Scenedesmus dimorphus, Selenastrum, Sphaerocystis Schroeteri, Stigeoclonium, Spirogyra, Tetradedron and Zygnema), 11 bacillariophycean (Cymbella, Cyclotella, Epithemia, Fragilaria, Gomphonema, Hantzschia amphioxys, Melosira, Navicula, Nitzschia, Surirella and Synedra), 2 euglenophycean
(Euglena and Phacus), and 7 cyanophycean forms (Anabaena, Calothrix, Lyngbya, Microcystis, Oscillatoria, Phormidium and Spirulina subtilissima) were recorded.

ALGAE OF ALLERGENIC SIGNIFICANCE

Following algae recorded during investigation are reported to cause allergenic diseases of skin, bronchial tract and eye inflammation. Allergenic algae of Banda have been recorded in Table - 9. Observations reveal that out of 25 species of allergenic algae 11 chlorophycean (Chlorococcum humicola, C. infusionum, chlorella, vulgaris, Scenedesmus acuminatus, S. arcuatus, S. abundans, S. bijuga, S. dimorphus, S. obliquus, S. prismaticus and S. quardricauda) and 14 cyanophycean forms (Anabaena fertilissima, A. ivengarii var. tenuis, A. oscillarioides, A. planctonica, Microcystis aeruginosa, Nostoc linckia var. arvense, Nodularia spumigens, Oscillatoria anguina O. formosa, O. limnetica, O. princeps, O. okeni, O. Pseudogeminata var. unigranulata and O. subbrevis) were recorded as allergenic species.

CLEAN WATER ALGAE

Water free from sewage water or other organic enrichment due to waste discharge usually shows the presence of clean water organisms. These organisms particularly algae are typical of the oligotrophic zone where self-purification process of water or the mineralization of the waste material has been completed. Following algae have been recorded from Ken water at Banda which indicate the cleaner quality of water at place. Two chlorophycean (Cladophora glomerata and Rhizoclonium hieroglyphicum), 4 bacillariophycean (Amphora ovalis, Cocconeis placentula, Navicula gracilis and Nitzschia linearis) and 1 euglenophycean (Euglena spirogyra) were recorded as clean water algae.
<table>
<thead>
<tr>
<th>S.NO.</th>
<th>NAME OF SPECIES</th>
<th>ALLERGENIC DISEASE CAUSED</th>
<th>PERIODICITY</th>
<th>QUANTITATIVE ABUNDANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Chlorococcum humicola</td>
<td>Rhinitis, bronchial asthma, hypersensitivity and pneumonitis</td>
<td>All three seasons</td>
<td>Common</td>
</tr>
<tr>
<td>2.</td>
<td>Chlorococcum infusionum</td>
<td>&quot;</td>
<td>Winter - summer</td>
<td>Rare</td>
</tr>
<tr>
<td>3.</td>
<td>Chlorella vulgaris</td>
<td>&quot;</td>
<td>All three seasons</td>
<td>common</td>
</tr>
<tr>
<td>4.</td>
<td>Scenedesmus acuminatus</td>
<td>Bronchial provocations</td>
<td>Winter - summer</td>
<td>Rare</td>
</tr>
<tr>
<td>5.</td>
<td>Scenedesmus abundans</td>
<td>&quot;</td>
<td>Winter - summer</td>
<td>Rare</td>
</tr>
<tr>
<td>6.</td>
<td>Scenedesmus bijuga</td>
<td>&quot;</td>
<td>Throughout the year</td>
<td>Major</td>
</tr>
<tr>
<td>7.</td>
<td>Scenedesmus dimorphus</td>
<td>&quot;</td>
<td>All three seasons</td>
<td>Common</td>
</tr>
<tr>
<td>8.</td>
<td>Scenedesmus obliquus</td>
<td>&quot;</td>
<td>All three seasons</td>
<td>Common</td>
</tr>
<tr>
<td>9.</td>
<td>Scenedesmus prismaticus</td>
<td>&quot;</td>
<td>Winter - summer</td>
<td>Rare</td>
</tr>
<tr>
<td>10.</td>
<td>Scenedesmus quadricauda</td>
<td>Bronchial provocations</td>
<td>All three seasons</td>
<td>Major</td>
</tr>
<tr>
<td>S.NO.</td>
<td>NAME OF SPECIES</td>
<td>ALLERGENIC DISEASE CAUSED</td>
<td>PERIODICITY</td>
<td>QUANTITATIVE ABUNDANCE</td>
</tr>
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<td>-------</td>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>11.</td>
<td><em>Scenedesmus arcuatus</em></td>
<td>Mortality in cattle and fish. affected Animals show symptoms like partial paralysis, loss of balance, hard stool covered with blood, reduced milk yield, general weakness and photosensitization of skin.</td>
<td>Winter - summer</td>
<td>Rare</td>
</tr>
<tr>
<td>12.</td>
<td><em>Microcystis aeruginosa</em></td>
<td>&quot;</td>
<td>All three seasons</td>
<td>Common</td>
</tr>
<tr>
<td>13.</td>
<td><em>Oscillatoria subbrevis</em></td>
<td>&quot;</td>
<td>All three seasons</td>
<td>Major</td>
</tr>
<tr>
<td>14.</td>
<td><em>Oscillatoria princeps</em></td>
<td>&quot;</td>
<td>All three seasons</td>
<td>Major, Common</td>
</tr>
<tr>
<td>15.</td>
<td><em>Oscillatoria anguina</em></td>
<td>&quot;</td>
<td>Winter - summer</td>
<td>Rare</td>
</tr>
<tr>
<td>16.</td>
<td><em>Oscillatoria limnetica</em></td>
<td>&quot;</td>
<td>Summer - rain</td>
<td>Rare</td>
</tr>
<tr>
<td>17.</td>
<td><em>Ocillatoria pseudogeminata var. unigranulata</em></td>
<td>&quot;</td>
<td>Summer</td>
<td>Rare</td>
</tr>
<tr>
<td>18.</td>
<td><em>Oscillatoria formosa</em></td>
<td>&quot;</td>
<td>Winter - summer</td>
<td>Common, Major</td>
</tr>
<tr>
<td>S.NO.</td>
<td>NAME OF SPECIES</td>
<td>ALLERGENIC DISEASE CAUSED</td>
<td>PERIODICITY</td>
<td>QUANTITATIVE ABUNDANCE</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
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<td>------------------------</td>
</tr>
<tr>
<td>19.</td>
<td>Oscillatoria calcuttensis</td>
<td>Mortality in cattle and fish. Affected animals show symptoms like partial paralysis, loss of balance, hard stool covered with blood, reduced milk yield, general weakness and photosensitization of skin.</td>
<td>Summer</td>
<td>Rare</td>
</tr>
<tr>
<td>20.</td>
<td>Nostoc linckia var. arvense</td>
<td>&quot;</td>
<td>Winter - summer</td>
<td>Common</td>
</tr>
<tr>
<td>21.</td>
<td>Anabaena planctonica</td>
<td>Mortality in cattle and fish. Affected animals show symptoms like partial paralysis, loss of balance, hard stool covered with blood, reduced milk yield, general weakness and photosensitization of skin and contact causes dermatitis</td>
<td>Winter - summer</td>
<td>Common</td>
</tr>
<tr>
<td>S.NO.</td>
<td>NAME OF SPECIES</td>
<td>ALLERGENIC DISEASE CAUSED</td>
<td>PERIODICITY</td>
<td>QUANTITATIVE ABUNDANCE</td>
</tr>
<tr>
<td>-------</td>
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<td>---------------------------</td>
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<td>------------------------</td>
</tr>
<tr>
<td>22.</td>
<td>Anabaena fertilissima</td>
<td>Mortality in cattle and fish. Affected animals show symptoms like partial paralysis, loss of balance, hard stool covered with blood, reduced milk yield, general weakness and photosensitization of skin and contact causes dermatitis</td>
<td>All three seasons</td>
<td>Common, Major</td>
</tr>
<tr>
<td>23</td>
<td>Anabaena iyengarii var. tenuis</td>
<td>&quot;</td>
<td>Winter -</td>
<td>Rare</td>
</tr>
<tr>
<td>24.</td>
<td>Anabaena oscillarioides</td>
<td>&quot;</td>
<td>Winter - summer</td>
<td>Common</td>
</tr>
<tr>
<td>25.</td>
<td>Nodularia spumigena</td>
<td>Unconsciousness and rigid spasm in sheep, horses, dogs and pigs.</td>
<td>Winter - summer</td>
<td>Common</td>
</tr>
</tbody>
</table>
POLLUTION ALGAE

The variation in algal population at different points or under different conditions of organic pollution constitutes one of the indices applied to any desired location in the stream to determine the presence or absence of domestic sewage or other putrescible wastes or to measure the degree of recovery from pollution with these wastes. The algae represent a conspicuous and significant group in this continuously changing population in a stream. Following algae have been recorded from Ken river at Banda indicating the pollutational load in river and indicate nature of pollution. Such pollution indicators include 20 chlorophycean (Actinastrum hantzschii, Ankistrodesmus falcatus, Chlorella vulgaris, Closterium acerorum, Coelastrum microporum, Pediastrum boryanum, P. duplex, P. simplex, P. tetras, Scenedesmus acuminatus, S. arcuatus, S. abundans, S. bijuga, S. dimorphus, S. obliquus, S. prismaticus, S. quadricalva, Stigeoclonium glomeratum and S. tenue), 17 bacillariophycean (Achnanthes minutissima, Cymbella affinis, C. cymbiformis, Cymatopleura solea, Cocconeis placentula, Cyclotella meneghiniana, Fragilaria crotonensis, Gomphonema parvulum, Hantaschia amphioxys, Melosira granulata, M. varians, Navicula Cryptocephala, Nitzsahia acicularis, N. palea, N. obtusa, Synedra acus and S. ulna, I euglenophycean Euglena gracilis and 18 cyanophycean forms (Anabaena fertilissima, A. iyengarii var. tenuis, A. planctonica, Chroococcus turgidus, Lyngbya martensiana, L. putealis, M. flos-aquae, Oscillatoria chalybea, O. chlorina, O. formosa, O. limosa, O. princeps, O. tenuis, Spirulina laxissima and S. major).

TASTE AND ODOUR ALGAE

Taste and odour occurrence is linked with the presence of algal blooms with few exceptions noted during decline of dense algal growth.
A considerable proportion of all decaying vegetation is often composed of dead algal cells. The odour produced as a result of the activities products formed during the decomposition or special substances synthesized within the cell of the micro-organisms. Following algae are the indicators of specific taste and odour and have been observed growing in Ken river. Such taste and odour algae have been listed. They include 12 chlorophycean (Cladophora glomerata, Chlorella vugaris, Cosmarium reniforme, Hydrodictyon reticulatum, Pediastrum boryanum, P. duplex, P. simplex, P. tetras, Staurastrum gracile, Scenedesmus abundans, S. bijuga and S. quadricauda). 6 bacillariophycean (Asterionella gracillima, Cyclotella comta, C. meneghiniana, Fragilaria construens, Melosira, granulata and Synedraulna), 1 euglenophycean (Euglena spirogyra) and 11 cyanophycean forms (Anabaena planctonica, A. spiroides, Cylindrospermum muscicola, Gloeotrichianatans, Microcystis aeruginosa, M. protocystis, Oscillatoria curviceps, O. okeni, O. princeps, O. tenuis and Symploca muscorum.

**ALGAE CAUSING COLOURATION OF WATER**

Following algae recorded during investigation are reported to impart colouration of water and have also been reported from Ken water at Banda. Two chlorophycean (Chlorella and Cosmarium) and only 1 cyanophycean genera (Microcystis) were recorded.

**TOXIC ALGAE**

Following algae have been recorded from Ken river of Banda and reported as indicators of toxicity in water. Such toxic algae include 4 cyanophycean forms (Lyngbya contoria, Microcystis aeruginosa, Microcystis flos-aquae and Nodularia spumigena).
V – UTILIZATION OF ALGAE OF KEN WATER

Algae have manifold uses described herein this chapter. Present investigation has been an endeavour to focus attention and describe the significance as reported elsewhere in the literature. The description is aimed to pin point focal points for prospective utilization of algal flora of Banda for socio-economic, public health and domestic-industrial development of the area.

KEN WATER AS A SOURCE OF GENETIC STOCK OF ALGAE

Ken water at Banda shows the presence of a very large number of algae that are used in multiple ways. The algae may serve as inoculum for raising the mass cultures used for various commercial, industrial, medicinal and agricultural purposes.

PHYCOHORMONES IN RELATION OF AGRICULTURE

Existance of growth promoting substances in various plants have been known. In Ken water the alga like Phormidium tenue has been observed. It can be isolated for raising mass culture of algae for extaction of growth hormones.

ALGAE AS A SOURCE OF ANTIBIOTIC SUBSTANCES

Out of a vast array of algae recorded from Banda, some of them are known to yield antibiotic substances. Fresh water algal species of Banda endowed with antibiotic significance. Observations are suggestive of the fact that with known pockets of growth and time during a calendar year these forms may be collected utilized as a source for isolation of material for in vitro culture and subsequent extraction of antibiotic
substances. Chlorellin is extracted from Chlorella which inhibits growth of certain bacteria and algae like Nitzschia palea is known to reduce the growth of bacteria Escherichia coli. It has also been reported that extracts of Cladophora and Lyngbya posses antiviral properties and kill the strains of certain bacteria (Pseudomonas and Mycobacterium). Microcystis is popularly known for its inhibitory action to Staphylococcus and Closteridium. Algae like Hydrodictyon reticulatum, Chlorella vulgaris and Oscillatoria princeps can be also used for extraction of antibiotics.

ALGAE AS A SOURCE OF SUBSIDIARY PROTEIN FOOD

Some of the green and blue-green algal species of digestive nature can be exploited for extraction of proteins. Chlorella vulgaris, Scenedesmus arcuatus, S. abundans, S. acuminatus, S. bijuga, S. dimorphus, S. obliquus, S. prismaticus, S. quadricauda var. bicaudatus, S. quadricauda var. westii and Spirulina major are the forms which could be used as a source of subsidiary protein food for human consumption.

ALGAE AS A SOURCE OF VITAMINS

The algae are considered rich in vitamin A, B, C, D, E, K and B₁₂. The vitamins A and D are commercially obtained from the livers of Shark and similar fish, originally synthesized by the planktonic algae particularly form the food of the fish Nitzschia rich in vitamin A. algae like Chlorella in vitamin B and Euglena gracilis in vitamin B₁₂ are found in waters can be exploited for extraction of corresponding vitamins.

ALGAE AS A SOURCE OF NITROGEN FIXATION

One of the role ascribed to algae is the fixation of atmospheric nitrogen. Certain blue-green algae like Anabaena ambigu, A. fertilissima, A. iyengarii var. attenuata, A. oryzae, A. spiroides, Cylindrospermum licheniforme, C. muscicola, Calothrix elenkinii, Mastigocladus

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laminosus, Nostoc calcicola, N. ellipsosporum, N. linckia, N. linckia var. arvense N. muscorum N. piscinale and Nodularia harveyana var. sphaerocarpa have the capacity to fix atmospheric nitrogen. They can be used as an inoculum to raise mass cultures of such algae can be applied in fields of rice, wheat and other crops to boost productivity.

In general, the majority of heterocystous forms are capable of nitrogen fixation. Of these, three genera of Nostocaceae-Nostoc, Anabaena and Cylindrospermum and a few forms of Rivulariaceae are of great importance. However, only in recent years some non-heterocystous forms such as Oscillatoria princeps and Gloeocapsa sp. have also been reported to fix atmospheric nitrogen. Such algae have been recorded from Ken water.

ALGAE AS A SOURCE OF FISH FOOD

Role of algae as a food for fish has been well emphasized in the literature. It is known that the phytoplanktons, certain filamentous and multicellular algae serve as a source for fish food. Fish exhibit a preferential algal feeding. The fish may feed on variety of large but it is not likely to digest all algae. It has been recorded that perhaps diatoms are most easily digested by fish and serve as ideal food. Following algae growing in the river Ken at Banda may be used in fish farming.

During present investigation 10 chlorophycean (Ankistrodesmus falcatus, Chlorella vulgaris, Scenedesmus acuminatus, S. arcuatus, S. abundans, S. bijuga, S. dimorphus, S. obliquus, S. prismaticus and S. quadricauda), 26 bacillariophycean (Cyclotella meneghiniana, Cocconeis placentula, Cymbella affinis, C. cymbiformis, C. tumida, C. turgida, Epithemia gibberula var. producta, Gyrosigma acuminatum, G. kuetzingii, G. scalpoides, Gomphonema, constrictum var. capitatum, G.
olivaceum, G. spaerophorum, Melosira granulata, Navicula cryptocephala, N. dicephala, N. gastrum, N. lanceolata, N. salinarum, N. simplex, Nitzschia acicularis, N. pala, Pinnularia undulata, Rhopalodia gibba, Synedra ulna and Surirella elegans) and 5 cyanophycean (Anabaena fertilissima, A. iyengarii var. tenuis, A. planctonica, Microcystis aeruginosa and Spirulina major) forms were found growing in Ken water. These algae, especially diatoms appear to be of considerable significance as a source of fish food.
VI - ALGAE AND SELF-PURIFICATION

The process of self-purification of lotic waters of Ken exhibits a high degree of retrieving capacity form pollution and in the process assimilating and digesting the pollutants spilled into the river. In this context algae play a very vital role in self-purification process.

The pollutants in flowing waters are in the form of particulate matter causing turbidity, chemical substances of dissolved or undissolved nature showing toxic effects and also biological organisms causing problem of deoxygenation of water, making it unhealthy for use. Certain disease-spreading organisms interlinked with oxygen level of the water. It may be pointed out that suspended undissolved pollutants can be removed by sieving and filtration of water but dissolved substances and micro-organisms pose severe threats and problems of pollution. The group of coliform bacteria are known to cause enteric diseases in both cattle and human beings. The growth and infestation of coliforms appear linked with oxygen level of water. Therefore, healthy waters with high oxygen contents are prone to lesser coliform menace. The group of fungi is responsible for degradation of organic matter, converting it into simpler substances. Some of the fungi cause severe diseases of allergenic natures in both human beings or cattle. Some of the fungi cause severe keratinophilic diseases of hair, horns, hooves or nales because of their keratin degradation ability. Unfortunately, as fungi are nongreen, nonphotosynthetic organisms, they only consume oxygen present in water

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during respiration as such, are responsible for depletion of oxygen enabling water unhealthy.

However, during present investigation a very large number of algal species amounting 348 at Banda has been recorded. Algae show problems of pollution as well as purification attributes. Among problems which contribute to degradation of water quality are toxic effect of aglea (Lyngbya controta, Microystis aeruginosa, M. flos-aquae and Nodularia spumigena), allergic disease spreading algae (Chlorococcum bmiccola, C. infusionum, Chlorella vulgaris, Scenedesmus acumatus, S. arcuatus, S. abundans, S. bijuga, S. dimorphus, S. obliquus, S. prismaticus, S. quadricauda, Anabaena fertilissima, A. iyengarii var., tenuis; A. plantonica, A. oscillarioides, Microcystis aeruginosa, Nostoc linckia var. arvense, Nodularia spumigena, Oscillatoria anguina, O. formosa, O. limnetica, O. princeps, O. okeni, O. pseudogeminata var. unigranulata and O. subbrevis), colour producing algae (Chlorella, Cosmarium and Microcystis), taste and odour producing algae (Cladophora glomerata, Chlorella vulgaris, Cosmarium reniforme, Hydrodictyon reticulatum, Pediastrum boryanum, P. duplex, P. simplex, P. tetras, Staurastrum gracile, Scenedesmus abundans, S. bijuga, S. quadricauda, Asterionella gracillima, Cyclotella comta, C. meneghiniana, Fragilaria construens, Melosira granulata, Synedra ulna, Euglena spirogyra, Anabaena plantonica, A. spiroides, Microcystis aeruginosa, M. protocystis, Gloetochria natans, Cylindrospermum musicola, Oscillatoria curviceps, O. princeps O. okeni O. tenuis and Symploca muscorum). On the other hand algae invariably contribute oxygenation of water. During photosynthetic activity they consume carbondioxide producing oxygen. The released oxygen dissolves in water and increases oxygen level. Algae

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play a vital role in oxygenation of water. Some of the deissolved chemical substances toxic otherwise polluting water are absorbed by algae as nutrient for their growth. Substances like calcium, magnesium, nitrate, nitrite, potassium and iron are consumed as nutrients by algae during their growth. Thus these dissolved substances get eliminated from water and brought into the body of the algae and can be removed and brought into the body of the algae and can be removed mechanically by sieving or filtration of water.

Conclusively it can be said that algae perform a good deal of self-purification of water, helpin removal of dissolved polluting substances and oxygenation of water.