CYANOPHYCEAEN AND CHLOROPHYCEAEN FLORA OF SIKKIM HIMALAYAS, INDIA

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ABSTRACT

The present paper enumerates 30 taxa of fresh water algae, in which 18 belong to the class Cyanophyceae, order Chroococcales and 12 Chlorophyceaen taxa, orders Cladophorales, Oedogoniales, Chaetophorales, Zygnematales and Ulotrichales. Species were identified from collected samples of high altitudinal zones of Sikkim Himalayas. All taxa have been reported for the first time from the study area.

Key words: Cyanophyceae, Chlorophyceae, Sikkim Himalayas.

INTRODUCTION

The study of fresh water algal flora of high altitudinal zones of India has not been given due attention. A few records of Alfred (1978) from eastern Himalaya, Singh and Gupta (2000) from Arunachal Pradesh, Gupta (2000) from Meghalaya, Khare and Suseela (2004) from Uttaranchal gave some accounts of fresh water algae. Algal flora of Sikkim state has not been well studied, except some cursory reports of Santra (1984), Prasad and Misra (1987) from Gangtok and its surrounding areas. This suggests that no serious effort has been made to explore the algal flora of Sikkim Himalayas.

Sikkim state due to its proximity to Himalayas faces extreme climatic conditions. On an average the maximum temperature records 20°C and minimum 12°C. Rainfall occurs throughout the year and state as a whole gets 80-90% of the annual rainfall during monsoon. The main source of water in small water bodies like pools, ditches, streams are from water falls and glaciers. Fresh water algal flora of different altitudinal ranges (1300-1700 m) of Sikkim has been surveyed.

MATERIALS AND METHODS

Samples were collected from pools, ditches, splashed rocks, slow-running streams, water falls and moist soils of three distinct places with different altitudinal ranges: Namchi, 1525 m; Gangtok, 1700 m and Rumtek Monastry, 1700 m during the year 2000 and 2001. These samples were preserved in 10% formaline and deposited at Phycology laboratory of National Botanical Research Institute, Lucknow. During microscopic observations micro photographs were taken in Lieca ATC 2000 research microscope.

The identification of taxa were done by following standard publications: Prescott (1951), Tiffany and Britton (1952), Desikachary (1959), Randhawa (1959), Anand (1998), Kant and Gupta (1998). The species arranged alphabetically with locality and sample numbers given in parenthesis.

SPECIES ENUMERATION

Class: Cyanophyceae

Order: Chroococcales

Family: Chroococcaceae

Anacystis rupestris (Lyng.) Drouet and Daily Pl. 1, Fig. 10

(Tiffany and Britton 1952, p. 331, Pl. 89, Fig. 1039)

Cells cylindrical, free floating, 6.2 µm in diameter, cell content blue green, homogeneous.

Locality: Small water stream at Namchi towards Namthang and Siliguri.

Sample No.: NBRI. ALSH-0188.

Aphanothece castagnei (Kutz.) Rabenh Pl. 1, Figs. 14 and 20

(Desikachary 1959, p. 106, Pl. 26, Fig. 13)

The cells are oval to cylindrical, 3.6 4 µm in diameter and 6.8 µm long surrounded by thick mucilaginous sheath, the cell content blue green and homogeneous.

Locality: Small water stream at Namchi towards Namthang and Siliguri.

Sample No.: NBRI. ALSH 0188.

Aphanothece stagnina Nag Pl. 1, Fig. 18

(Desikachary 1959, p. 142, Pl. 22, Figs. 4, 5 and 9)

Thallus small, gelatinous, cells longer than broad, oblong cylindrical, 4.5 µm in long, 2.3 µm broad, cell content blue green, homogeneous.

Locality: A small water tank at Gandhi market in Gangtok.

Sample No.: NBRI. ALSH 023.

Chroococcus minimus (Keiss.) Lemm Pl. 1, Figs. 12 and 19

(Desikachary 1959, p. 106, Pl. 26, Fig. 13)
Colonies 2-8 cells, enclosed by thin mucilaginous sheath, each cell spherical to ellipsoidal with 4.5 µm in diameter.

Locality: From stagnant water at the road side, Gangtok.

Sample No.: NBRI. ALSH-08.

Chroococcus minor (Kutz.) Nag Pl. 1, Fig. 1

(Desikachary 1959, p. 105, Pl. 24, Fig. 1)

Cells spherical in pairs, 4 µm in diameter, enclosed by thin mucilaginous sheath, cell content blue green, homogeneous.

Locality: On stagnant water at the road side, Gangtok.

Sample No.: NBRI. ALSH-08.

Chroococcus montanus Hansg Pl. 1, Fig. 7

(Desikachary 1959, p. 108, Pl. 26, Fig. 12)

Thallus mucilaginous, cells hemi-spherical in shape, 5.2 µm in diameter, enclosed by thin mucilaginous sheath, the cell wall thin and smooth.

Locality: Squeezed from submerged plants below the water fall towards Hanuman tok.

Sample No.: NBRI. ALSH-027.

Chroococcus schizodermaticus West Pl. 1, Fig. 23

(Desikachary 1959, p. 103, Pl. 26, Fig. 17)

Cells in groups of 2-4, oval in shape, 7.2 µm in diameter, enclosed by thick mucilaginous sheath, lamellated, cell content blue green with smooth cell wall.

Locality: A pool below the water fall in front of Rumtek Monastry.

Sample No.: NBRI. ALSH-049.

Chroococcus varius Braun Pl. 1, Figs. 16 and 24 (Prescott 1951, p. 451, Pl. 100, Fig. 15)

An irregular shaped colony of 2-8 spherical cells enclosed by thick hyaline mucilaginous sheath, cell content blue green, homogeneous, cells 2.8 µm in diameter.

Locality: From stagnant water at the road side, Gangtok.

Sample No.: NBRI. ALSH-08.

Gloeocapsa atrata (Turp.) Kutz Pl. 1, Fig. 5

(Desikachary 1959, p. 139, Pl. 27, Fig. 6)

Thallus mucilaginous with 2-4 cells, spherical, surrounded by thin mucilaginous sheath. 4.5 µm in diameter, cell content blue green, homogeneous.

Locality: Small water stream at Namchi towards Namthang and Siliguri.

Sample No.: NBRI. ALSH 188.

Gloeocapsa coracina Kutz Pl. 1, Fig. 8 and 13

(Desikachary 1959, p. 121, Pl. 24, Fig. 11)

Cells spherical, 3 µm in diameter, surrounded by thin mucilaginous sheath, cell wall thick and smooth.

Locality: Squeezed from submerged plants below the water fall towards Hanuman tok and on surface moist soil at the forest department of Gangtok.

Sample Nos.: NBRI. ALSH-013, 027.

Gloeocapsa decorticans (Abr.) Richter Pl. 1, Fig. 4

(Desikachary 1959, p. 114, Pl. 24, Fig. 9)

Cells spherical, single or upto 2-4 together, 6.2 µm in diameter, enclosed by thick gelatinous sheath, lamelated, cell content blue green, homogeneous.

Locality: A road side water tank at Gangtok and small water stream at Namchi towards Namthang and Siliguri.

Sample Nos.: NBRI. ALSH-03, 0188.

Gloeocapsa gelatinosa Kutz Pl. 1, Figs. 17 and 9

(Desikachary 1959, p. 139, Pl. 27, Fig. 6)

Cells spherical, 3.8 µm in diameter, enclosed by thick hyaline mucilaginous sheath, lamellated, cell content blue green, homogeneous.

Locality: Small water stream at Namchi towards Namthang and Siliguri.

Sample No.: NBRI. ALSH-0188.

Gloeocapsa montana Kutz Pl. 1, Figs. 2, 3, 15 and 21.

(Desikachary 1959, p. 123, Pl. 24, Fig. 14)

Cells spherical, 5.2 µm in diameter, single or two together in a colony, enclosed by thick hyaline mucilaginous sheath, lamellated, cell content blue green, homogeneous.

Locality: Small water stream at Namchi towards Namthang and Siliguri and in stagnant water of roadside pool in Gangtok.

Sample Nos.. NBRI. ALSH 08, 0188.

Gloeocapsa polydermatica Kutz Pl. 1, Fig. 22

(Desikachary 1959, p. 115, Pl. 25, Fig. 1)

Thallus mucilaginous, compact, cells spherical, 4.5 µm broad, cell content blue green, homogeneous.

Locality: Small water stream at Namchi towards Namthang and Siliguri.

Sample No.: NBRI. ALSH- 0188.

Gloeocapsa kuetzingiana Nag Pl. 1, Fig. 11

(Desikachary 1959, p. 119, Pl. 23, Fig. 4)

Thallus mucilaginous, consists 4 small cells, spherical, 3.2 µm broad, enclosed by thin mucilaginous sheath, cell content blue green, homogeneous.

Locality: Small water stream at Namchi towards Namthang and Siliguri.

Sample No.: NBRI. ALSH 0188.

Merismopedia glauca (Ehr) Nag Pl. 1, Fig. 6

(Desikachary 1959, p. 155, Pl. 29, Fig. 5)

Cells regularly arranged in rectangular structure with crenate margin, cells ovate, hemispherical, 2-2.3 µm in diameter, cell content blue green, homogeneous.

Locality: On rocks with splashed water near water fall in front of Rumtek Monastry.

Sample No.: NBRI. ALSH-049.

Merismopedia elegans A. Br Pl. 1, Fig. 25

(Desikachary 1959, p. 156, P1. 29, Fig. 9)

Colonies small with 16 celled, cells oblong, closely arranged having 5.5-6 µm in diameter, free floating.

Locality: On rocks splashed by water at Rumtek Monastry.

Sample No.: NBRI. ALSH-0131.

Microcystis bengalensis Benerji Pl. 1, Fig. 26

(Desikachary 1959, p. 89, P1. 19, Fig. 56)

Colonies irregularly branched, cells cylindrical, 3.5 µm in diameter, sheath distinct, surrounds the number of daughter colonies.

Locality: A small tank on the roadside at Gangtok view point.

Sample No.: NBRI. ALSH-0113

Class: Chlorophyceae

Order: Cladophorales

Family: Cladophoraceae

Cladophora glomerata (Linn.) Kuetz Pl. 2, Fig. 13

(Tiffany and Britton, 1952, p. 45, Pl. 13, Fig. 93)

Cells of main axis 205.2 µm long, 15.8 µm broad and branching in Y shaped structure, 11.5 µm long, 12.2 µm broad often a glomerate clusters with reticulate chloroplast.

Locality: A small pool at the Gangtok view point.

Sample No.: NBRI. ALSH-0106.

Cladftphora laetevirens (Dillw.) Kuetz Pl. 2, Fig. 6

(Prasad and Misra 1992, p. 54, P1. 7, Fig. 6)

Epilithic, branching of the filament pseudo-dichotomous, cells of main axis 315 µm long, 60 µm in diameter, cells of branchlets 50.6 µm long, 25.2 µm in diameter.

Locality: On rocks in the stream at Namchi.

Sample No.: NBRI. ALSH-092.

Order: Oedogoniales

Family: Oedogoniaceae

Oedogonium gracillus (Tiffany) Wittrock Pl. 2, Fig. 10

(Prescott 1951, p. 170, Pl. 29, Fig. 2)

Vegetative cells cylindrical, 18.5 µm in diameter, 42.8 µm long, oogonia solitary ovoid, globose, 38.5 µm in diameter, 35 µm long with a superior opening pore, oospore globose, 30 µm in diameter, filling the oogonium.

Locality: On rocks splashed by water at Namchi.

Sample No.: NBRI. ALSH-0192.

This species is narrower than those reported by Prescott (1951), in which the vegetative cell 20-25 µm and oogonia 44-46 µm in diameter.

Oedogonium subaerolatum Tiffany and Button Pl. 2, Figs. 5 and 12

(Prasad and Misra 1992, p. 223, Pl. 1, Fig. 10)

Macrandrous, monoecious, vegetative cells cylindrical, 13 µm diameter, 40 µm long, oogonium solitary, ellipsoidal, 36.2 µm long, 34 µm broad, oospore broadly ellipsoidal, fill the oogonium.

Locality: On rocks splashed by water at Namchi.

Sample No.: NBRI. ALSH-0192.

Oedogonium varians Wittr et Lund Pl. 2, Fig. 3

(Prasad and Misra 1992, p. 73, Pl. 11, Fig. 6)

Vegetative cells cylindrical, 13.5 µm in diameter, 50-55 µm long, oogonia solitary, depressed, globose, 38.5 µm broad, 32.8 µm long, oospore globose and 29.5 µm in diameter, fill the oogonium.

Locality: A small pool at the Gangtok view point.

Sample No.: NBRI. ALSH-0106.

Order: Chaetophorales

Family: Chaetophoraceae

Stigeoclonium tenue (Agar.) Kuetz Pl. 2, Fig. 1

(Kant and Gupta 1998, p. 109, Pl. 108, Fig. 3)

Filament dichotomously branched, branches always solitary, opposite, cells 5-6.8 µm long and 7.2 µm in diameter.

Locality: Small stream on the way of Gangtok view point.

Sample No.: NBRI. ALSH-0148.

Order: Zygnematales

Family: Zygnemataceae

Spirogyra exilis W. et. W.S. West Pl. 2, Fig. 4

(Randhawa 1959, p. 323, Fig. 305)

Vegetative cells long, cylindrical, 70 µm long and 20.5 µm in diameter with plane end wall, the chloroplast 3-5 turns, conjugation scalariform, fertile cell cylindric, zygospore oblong with rounded ends having 40 µm length and 24.2 µm width.

Locality: A small ditch on road side at Gangtok taxi stand.

Sample No.: NBRI. ALSH-0129.

The diameter of vegetative cell and zygospore are smaller than those reported by- Prasad and Misra (1992) from Andaman Nicobar having 24.5-27 µm in diameter and 29-32 µm broad.

Spirogyra indica Rao. Pl. 2, Fig. 2

(Anand 1998, p. 54, Fig. 167)

Filaments long, cylindrical, cells 73.8 µm long, 22.5 µm in diameter with plane end wall chloroplast single, solitary, spirally arranged in ribbon like structure with 2-3 turns, conjugation by tubes from both gametangia, fertile cell cylindric (some times slightly swollen), zygospores spherical, laterally compressed with 32.5 µm in diameter.

Locality: A small ditch on road side at Gangtok taxi stand.

Sample No.: NBRI. ALSH-0129.

Spirogyra pratensis Transeau Pl. 2, Fig. 9

(Prasad and Misra 1992, p.87, Pl.14, Figs. 5, 7)

Vegetative cells 18.2 µm in diameter, 60 µm long with plane end walls having single spiral chloroplast making 2-3 turns, conjugation scalariform, tubes formed by both gametangia, fertile cell fusiform inflated upto 34.5 µm in diameter, zygospores ellipsoid 21 µm broad, 40 µm long.

Locality: In the water stream near water fall towards Hanuman tok.

Sample No.: NBRI. ALSH-029.

Zygnema mucigenum Randhawa Pl. 2, Fig. 7

(Kant and Gupta 1998, p. 122, Pl. 56, Fig. 6)

The vegetative cells elongated, cylindrical, 18 µm in diameter, 100 µm long, each cell having two star shaped choloroplasts with single pyrenoid.

Locality: A small pool at Gangtok view point.

Sample No.: NBRI. ALSH-0106.

Zygnema pectinatum (Vaucher) C.A. Agardh. Pl. 2, Fig. 8

(Tiffany and Britton 1952, p. 138, Pl. 42, Fig. 446)

Vegetative cells are cylindrical, 80 µm long, 25.8 µm in diameter, each cell having two star shaped chloroplast with single pyrenoid, the zygospore globose to ovoid 45.5 µm broad in the conjugation tube with median spore wall which is thick and smooth.

Locality: On rocks splashed by water at Namchi.

Sample No.: NBRI. ALSH-0192.

Order: Ulotrichales

Family: Ulotrichaceae

Ulothrix tenuissima Kuetz Pl. 2, Fig. 11

(Kant and Gupta 1998, p. 102, Pl. 32, Fig. 5)

Vegetative cells much broader than length, quadrate, 20 µm in diameter, 12.8 µm long, chromatophore usually in a median band with 2-4 pyrenoids.

Locality: A small water spring at Namchi.

Sample No.: NBRI. ALSH-0186

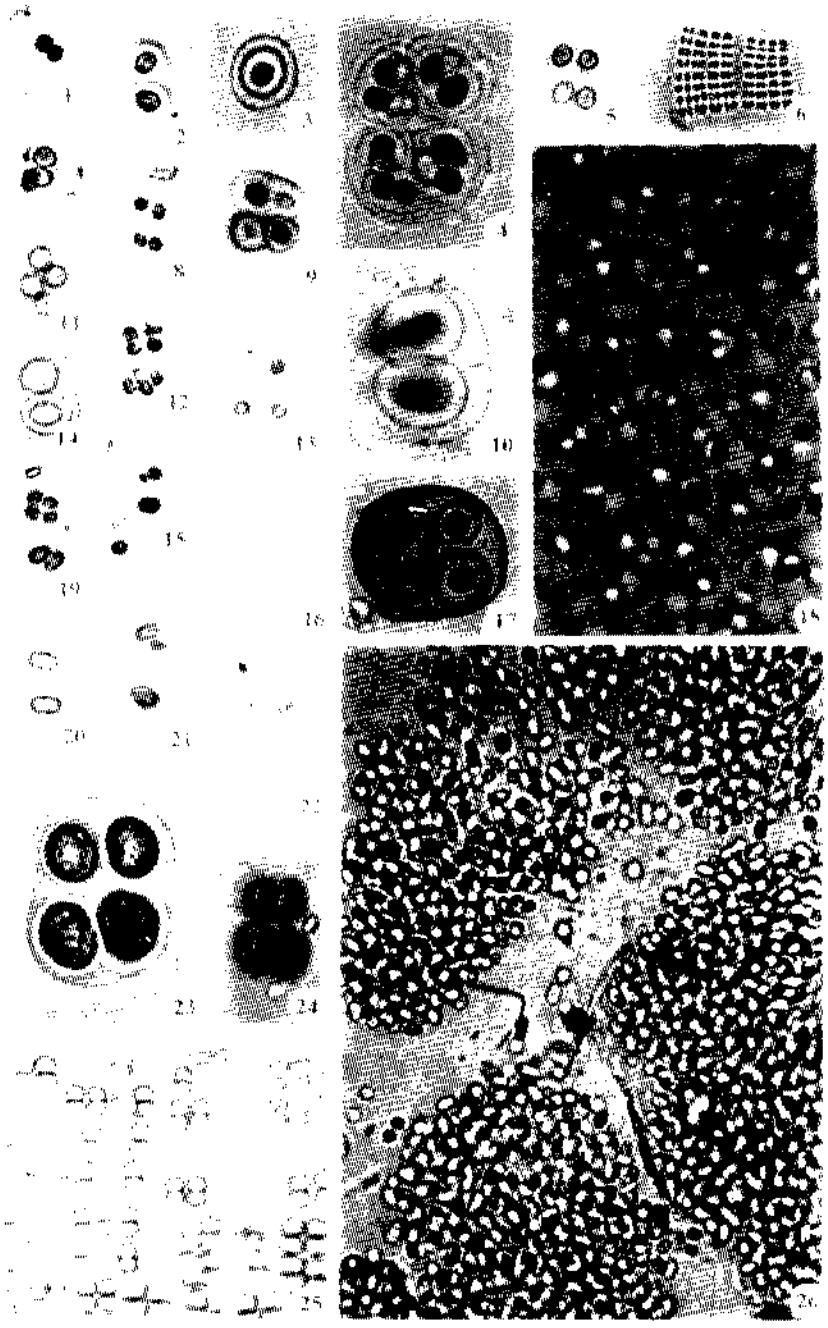

Plate I. (Fig. 1. *Chroococcus minor* (Kutz.) Nag., Figs. 2, 3, 15 and 21. *Gloeocapsa montana* Kutz., Fig. 4. *Gloeocapsa decorticans* (A. Br) Richter., Fig. 5. *Gloeocapsa atrata* (Turp.) Kutz., Fig. 6. *Merismopedia glauca* (Ehr.) Nag., Fig. 7. *Chroococcus montanus* Hansgirg., Figs. 8 and 13. *Gloeocapsa coracina* Kutz., Fig. 10. *Anacystis rupestris* (Lyng.) Drouet and Daily., Fig. 11. *Gloeocapsa kuetzingiana* Nag., Figs. 12 and 19. *Chroococcus minimus* (Keiss.) Lemm., Figs. 14 and 20. *Aphanothece castagnei* (Kutz.) Rabenh., Figs. 16 and 24. *Chroococcus carus* Braun., Figs. 17 and 9. *Gloeocapsa gelatinosa* Kutz., Fig. 18. *Aphanothece stagnina* Nag., Fig. 22. *Gloeocapsa polydermatica* Kutz., Fig. 23. *Chroococcus schizodermaticus* West., Fig. 25. *Merismopedia elegans* A. Br., Fig. 26. *Microcystis bengalensis* Benerji).

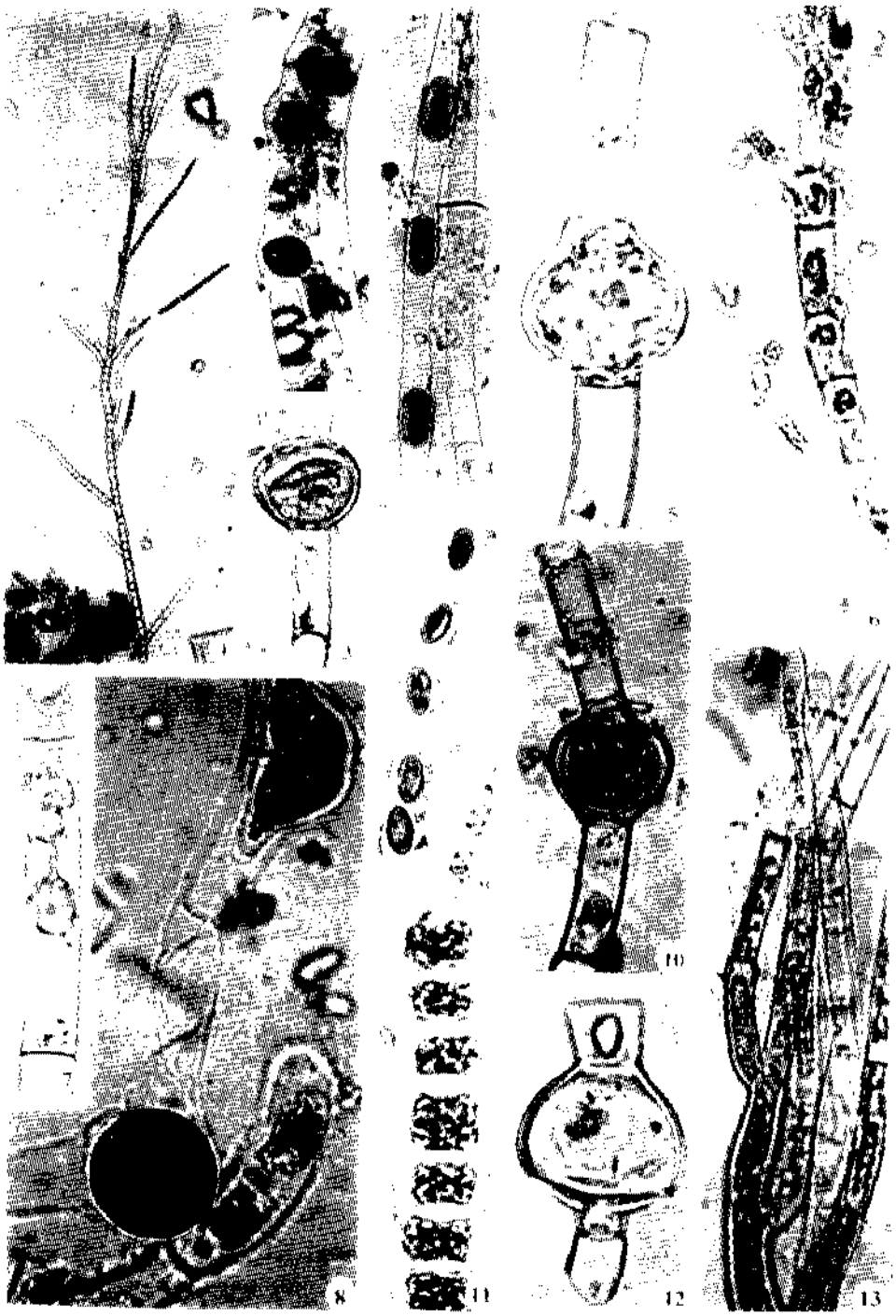

Plate 2. (Fig. 1. *Stigeoclonium tenue* (Agardh) Kuetz., Fig. 2. *Spirogyra indica* Rao., Fig. 3. *Oedogonium varians* Wittrock et Lundell., Fig. 4. *Spirogyra exilis* W. et. W. S. West., Figs. 5 and 12. *Oedogonium subacerolatum* Tiffany and Britton., Fig. 6. *Cladophora lucteivirens* (Dillw.) Kuetz., Fig. 7. *Zygnema mucigenum* Randhawa., Fig. 8. *Zygnema pectinatum* (Vaucher)Agardh., Fig. 9. *Spirogyra pratensis* Transeau. Fig. 10. *Oedogonium gracillus* (Tiffany) Wittrock. Fig. 11. *Ulothrix tenuissima* Kuetz., Fig. 13. *Cladophora glomerata* (Linn.) Kuetz.).

RESULTS AND DISCUSSION

During the course of the present investigation, a total of 30 taxa of two different classes Cyanophyceae and Chlorophyceae have been studied on the basis of morpho-taxonomic observations. Out of thirty taxa, the genus *Gloeocapsa, Chroococcus, Oedogonium* and *Spirogyra* are common in occurrence. While, the genus *Merismopedia, Aphanothece, Cladophora, Zygnema, Anacystis, Microcystis, Stegioclonium* and *Ulothrix* occurred in dominant form. The morpho-taxonomic variations are also observed in some taxa with that of rest of Indian algal flora. This variation could be due to the high altitude, low temperature and other climatic and ecological conditions of the locality.

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