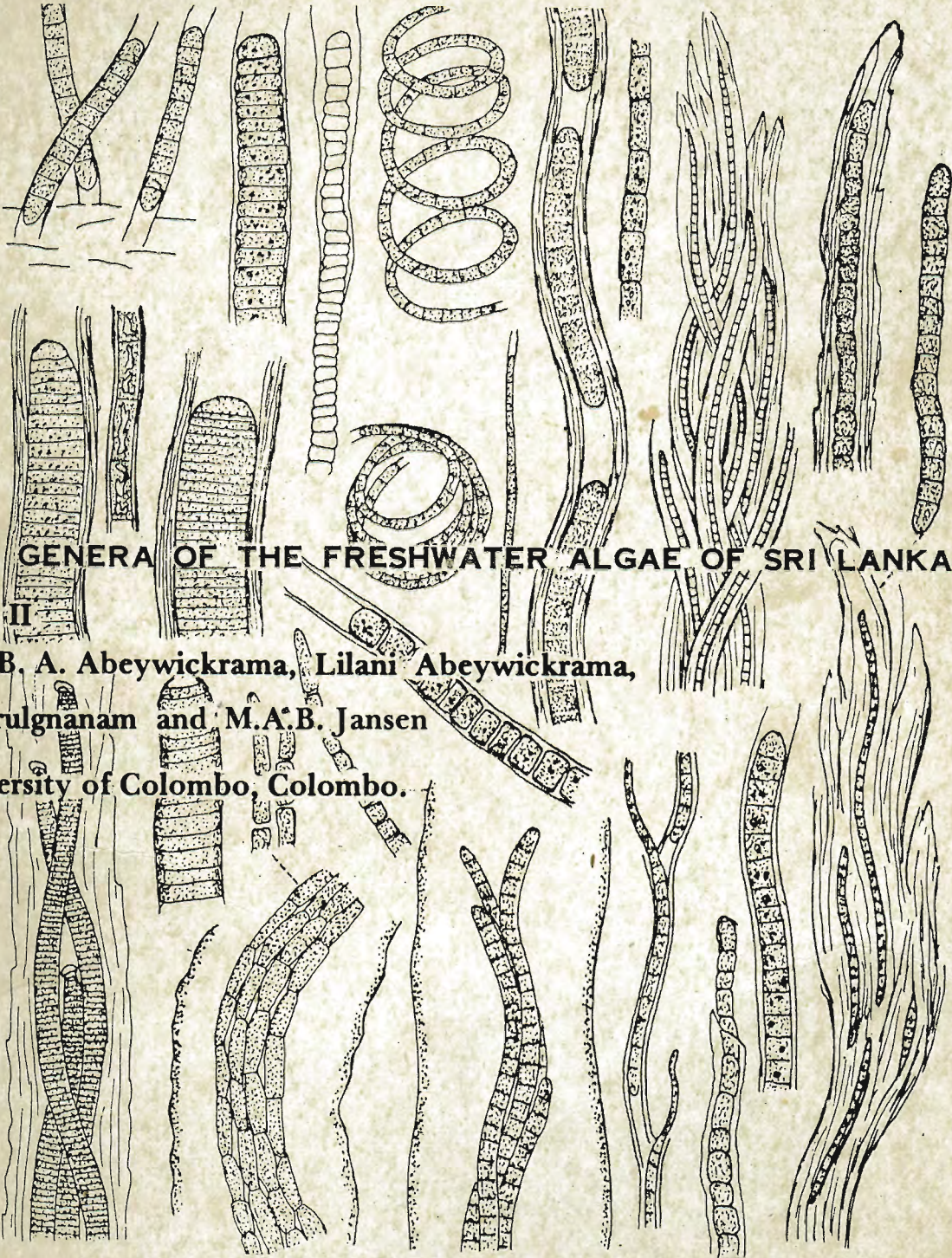


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THE GENERA OF THE FRESHWATER ALGAE OF SRI LANKA

Part II

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THE GENERA

OF

THE FRESHWATER ALGAE

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SRI LANKA

—
PART II

—
CYANOPHYCEAE

(Blue Green Algae)

by

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Lilani Abeywickrama,
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University of Colombo

Colombo

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INTRODUCTION

About 170 species of Blue-Green Algae have been recorded from Sri Lanka. A list of these species, a Key to the Genera and descriptions of the genera are given here. This work has been prepared on the same general lines as "The Genera of the Freshwater Algae of Sri Lanka - Part I" (Abeywickrama, 1979).

The Key has been prepared specifically for the taxa present in the island. Some sections of it have been adapted from Smith (1953) and from Desikachary (1959). The generic descriptions are based on Smith (1953), Tilden (1937) and Desikachary (1959). For easy reference the genera and the illustrations depicting their characteristic features have been given the same serial numbers. Some of the figures are from original drawings; others have been redrawn from Smith (1933), Prescott (1951), Desikachary (1959) and Huber-Pestalozzi (1938). For the convenience of students who may wish to make more definite identifications reference is made against each recorded species to the descriptions of the species in Desikachary (1959).

The authors wish to record their sincere thanks to Professor S.A. Kulasooriya for providing some unpublished information on the local Blue-Green Algae, and to Professor R.N. de Fonseka and the members of the Department of Botany of the University of Colombo, for assistance in various ways in the preparation of this paper.

KEY TO THE CLASSES OF THE

FRESH WATER ALGAE

1. Cells with pigments diffused and not localised in plastids. Colour usually blue-green, but sometimes masked by other pigments.
Nucleus absent.....Cyanophyceae*
Cells with pigments localised in definite plastids.
Colour usually not blue-green.
Nuclei regularly present in cells.....2
2. Plants always multicellular and filamentous; main axis differentiated into nodes and internodes, with whorls of branches of limited growth at the nodes.....3
Plants unicellular, or multicellular but not as above.....4
3. Plants grass-green in colourCharophyceae
Plants purplish, pink or olive-colouredRhodophyceae
4. Plants grass-green in colour. Food reserves present either as starch or as paramylum5
Plants yellow, yellow-green, golden-brown or brownish in colour. Food reserves present neither as starch nor as paramylum6
5. Food reserves present mainly as starchChlorophyceae
Food reserves present as paramylumEuglenophyceae

* This part deals only with the Cyanophyceae.

6. Plants golden-brown, or brownish. Cell-wall made up of two overlapping siliceous valves; valves variously ornamented with radial, transverse, longitudinal or irregular markingsBacillariophyceae
Plants not as above7
7. Cells fully or partly encircled by a transverse furrow; Walls composed of a definite number of articulated plates;
Plants yellow-brown or brownDinophyceae
Cells not as above; Plants yellow-greenXanthophyceae

CYANOPHYCEAE

(Myxophyceae or Blue-Green Algae)

Plants unicellular or multicellular; ranging from solitary cells, or regular or irregular colonies, or expanded sheets, to simple or branched filaments. Branching true or false. Branched filaments sometimes heterotrichous and differentiated into prostrate and erect systems; filaments of both systems uniseriate, or prostrate system multiseriate and erect system uniseriate, or both systems multiseriate.

Flagella always absent, but some filamentous forms exhibit forward or backward, gliding or oscillating, or undulatory movements.

Cell-wall consisting of two layers; outer layer of gelatinous pectin compounds, inner of cellulose; thin or thick; colourless or yellowish brown or reddish-blue or violet. Filaments often made up of an outer sheath, enclosing one or more uniseriate rows of protoplasts (=trichomes). Sheaths colourless, transparent, thin and inconspicuous; or coloured, transparent or opaque, thick, stratified, firm and very evident.

Protoplast with the photosynthetic pigments not in distinct plastids but diffused in outer region of cells. Nuclear material present in central part of cells but not forming a definite nucleus. True vacuoles absent but pseudovacuoles or gas-vacuoles sometimes present.

Pigments present: chlorophylla, xanthophylls, carotenes and two phycobilins, phycocyanin (blue) and c-phycoerythrin (red). Plants blue-green, or range from yellow-green or yellow-brown to brown, maroon or even violet depending on the pigments present and the colour of the sheath.

Principal photosynthetic product is a glycogen-like compound called cyanophycan starch. Oil droplets sometimes present.

Reproduction by cell division, fragmentation of colonies or filaments, or by

means of special asexual reproductive bodies, eg. endospores, exospores, akinetes or hormogones. Sexual reproduction is absent. Fresh water or terrestrial; a few marine. Mostly free living; a few symbiotic.

Some species fix nitrogen. These are unique in being the only autotrophic organisms which can simultaneously photosynthesize and also fix nitrogen under aerobic conditions.

About 45 genera have been recorded from the island.

List of Genera

CYANOPHYCEAE

- | | |
|--------------------|---------------------|
| 1. Microcystis | 23. Microcoleus |
| 2. Chroococcus | 24. Hydrocoleum |
| 3. Gloeocapsa | 25. Anabaenopsis |
| 4. Aphanocapsa | 26. Cylandrospermum |
| 5. Aphanothece | 27. Wollea |
| 6. Synechococcus | 28. Nostoc |
| 7. Synechocystis | 29. Anabaena |
| 8. Coelosphaerium | 30. Pseudanabaena |
| 9. Gomposphaeria | 31. Raphidiopsis |
| 10. Merismopedia | 32. Plectonema |
| 11. Dermocarpa | 33. Scytonema |
| 12. Xenococcus | 34. Tolypothrix |
| 13. Arthrospira | 35. Homoeothrix |
| 14. Spirulina | 36. Calothrix |
| 15. Oscillatoria | 37. Rivularia |
| 16. Trichodesmium | 38. Gloeotrichia |
| 17. Porphyrosiphon | 39. Nostochopsis |
| 18. Dasygloea | 40. Brachytrichia |
| 19. Phormidium | 41. Mastigocladus |
| 20. Lyngbya | 42. Hapalosiphon |
| 21. Schizothrix | 43. Westiellopsis |
| 22. Symploca | 44. Fischerella |
| 45. Stigonema | |

KEY TO THE GENERA

The numbers after the generic names refer to the serial numbers of the genera in the text.

1. Plants unicellular, colonial, filamentous, pseudo-filamentous, or pseudoparenchymatous; if filamentous never with a trichome organisation. Reproduction by cell-division, fragmentation of colonies, or by endospores or exospores.
Hormogones absent2
Plants filamentous and with a trichome organisation.
Reproduction by hormogones17
2. Plants unicellular colonial, or pseudofilamentous but with no differentiation into base and apex.
Endospores, if present, not formed in sporangia3
Plants unicellular and differentiated into base and apex; or parenchymatous and disc-like, and epiphytic on other algae; endospores formed in sporangia15
3. Plants colonial; with numerous cells in a colony4
Plants unicellular; or colonial with 2-8 cells, or more rarely with up to about 32 cells, in a colony.....11
4. Cells without any regular or definite arrangement in a colony5
Cells with a more or less regular and definite arrangement in a colony9
5. Colonial mucilage more or less homogeneous; individual cells with no separate envelopes or sheaths, or a few cells with definite sheaths around them6
Colonial mucilage not homogeneous; each cell with a definite envelope or sheath8

6.	Colonies mostly planktonic; microscopic or macroscopic; each with a definite shape and usually with cells closely packed	Microcystis	(1)
	Colonies planktonic or attached; generally macroscopic and with no definite shape, cells more loosely arranged	7	
7.	Cells spherical	Aphanocapsa	(4)
	Cells ellipsoidal to cylindrical	Aphanothece	(5)
8.	Sheaths vesicular	Gloeocapsa	(3)
	Sheaths not vesicular	Chroococcus	(2)
9.	Colony flat with cells in transverse and longitudinal rows	Merismopedia	(10)
	Colony a hollow sphere with cells near periphery...	10	
10.	Cells spherical to cordate; peripheral mucilage usually fibrillar	Coelosphaerium	(8)
	Cells usually ellipsoid to pear-shaped; peripheral mucilage usually homogeneous	Gomphosphaeria	(9)
11.	Cells spherical or hemispherical	12	
	Cells elongate	14	
12.	Each cell with a distinct mucilage envelope.....	13	
	Cells without distinct individual envelopes	Synechocystis	(7)
13.	Sheaths vesicular	Gloeocapsa	(3)
	Sheaths not vesicular	Chroococcus	(2)
14.	Ends of cells rounded	Synechococcus	(6)
	Ends of cells pointed	Dactylococcopsis*	

*Provisionally recorded by Schiemer (1980)

15.	Plants unicellular	Dermocarpa	(11)
	Plants disc-like and multicellular	16	
16.	Disc formed of coalescent unicells; cell contents wholly involved in endospore formation	Dermocarpa	(11)
	Disc formed of coalescent, short, erect branches or loosely arranged cells cut off from a basal disc; only apical cells of erect filaments involved in endospore formation	Xenococcus	(12)
17.	Filaments without true branches	18	
	Filaments with true branches	44	
18.	Heterocysts absent	19	
	Heterocysts present	34	
19.	Filaments with frequent false branches	Plectonema	(32)
	Filaments with no false branches or occasionally with false branches	20	
20.	Filaments without distinct sheaths	21	
	Filaments with distinct sheaths	26	
21.	Filaments forming regular and distinct coils	22	
	Filaments straight or in irregular coils	23	
22.	Transverse walls clearly visible	Arthrospira	(13)
	Transverse walls absent or indistinct	Spirulina	(14)
23.	Ends of filaments sharply pointed.....	Rhaphidiopsis	(31)
	Ends of filaments not sharply pointed	24	

24. Filaments in free floating bundles or wooly masses..... Trichodesmium (16)
Filaments not as above.....25
25. Filaments with marked constrictions at cross walls..... Pseudanabaena (30)
Filaments without deep constrictions between cells..... Oscillatoria (15)
26. Trichomes tapering and with terminal hairs..... Homeothrix (35)
Trichomes not as above.....27
27. Each sheath with a single (or rarely 2) trichomes..28
Each sheath with 2 or more trichomes31
28. Sheaths mucilaginous and laterally confluent.....29
Sheaths firm, not confluent30
29. Filaments mostly aggregated in erect tufts; false branches sometimes present Symploca (22)
Filaments not in erect tufts as above; false branches absent Phormidium (19)
30. Sheath purplish to reddish-brown;always lamellated Porphyridium (17)
Sheath colourless to brownish; homogeneous or lamellated Lyngbya (20)
31. Each sheath enclosing several trichomes, densely packed in rope-like bundles..... Microcoleus (23)
Each sheath with only a few trichomes, more loosely arranged32

32.	Sheath mucilaginous and soft	Hydrocoleum	(24)
	Sheath firm	33	
33.	Sheath narrow; trichomes close together.....	Schizothrix	(21)
	Sheath broad; trichomes remote from one another..	Dasygloea	(18)
34.	Trichomes simple, branches absent	35	
	Trichomes with false branches	40	
35.	Trichomes with firm sheaths	Aulosira*	
	Trichomes without firm sheaths	36	
36.	Intercalary heterocysts generally in pairs.....	Anabaenopsis	(25)
	Intercalary heterocysts generally single.....	37	
37.	Heterocysts generally terminal and single and next to a single large akinete	Cylindrospermum	(26)
	Heterocysts generally intercalary, rarely terminal but then not next to a large akinete,.....	38	
38.	Filaments free and separate or embedded in an amorphous gelatinous mass	Anabaena	(29)
	Filaments generally in a colony with a definite shape	39	
39.	Colony with trichomes arranged parallel	Wollea	(27)
	Colony with trichomes irregularly twisted	Nostoc	(28)
40.	Trichomes tapering from base to apex	41	
	Trichomes not tapering from base to apex	43	
41.	Filaments in spherical or hemispherical colonies ..	42	
	Filaments solitary or in irregular masses	Calothrix	(36)

* Recorded as present in Sri Lanka by S.A. Kulasooriya (1979)

42. Akinetes commonly present; solitary and large....Gloeotrichia (38)
Akinetes absentRivularia (37)
43. False branches usually single and arising
immediately next to a heterocystTolypothrix (34)
False branches usually in pairs, and if single
not next to a heterocystScytonema (33)
44. Both erect and prostrate filaments wholly
uniseriate45
Filaments of at least one system multiseriate ...48
45. Radial branches ending in hairsBrachytrichia (40)
Radial branches not ending in hairs.....46
46. Lateral branches arising from the angle
of a V-shaped bendMastigocladus (41)
Lateral branches not arising as above47
47. Pedicillate heterocysts presentNostochopsis (39)
Pedicillate heterocysts absentHapalosiphon (42)
48. Both prostrate and erect filaments partially
or wholly multiseriateStigonema (45)
Prostrate filaments multiseriate; erect
filaments uniseriate and sharply different from
prostrate ones49
49. Hormogones present on erect filamentsFischereilla (44)
Hormogones absentWestiellopsis (43)

GENERIC DESCRIPTIONS

1. *Microcystis* Kützing

Colonial; free floating in tanks, ponds, lakes or stagnant waters. Colonies minute to large; globose, elongate, irregularly overlapping or net-like; often with attached daughter colonies. Size ranging from 20-95 μ ; or sometimes up to even 210 μ in width, and 1-20 or more times as long as broad. Irregular branching may be present.

Each colony with numerous cells. Sheaths indistinct and confluent with colonial envelope. Individual cells spherical to elongate; pale to blue-green or olive-green, sometimes black or purplish; 0.5 - 10 μ in diameter; very densely aggregated within a more or less homogeneous, hyaline, often diffluent mucilage. Gas vacuoles generally present.

Cell division in all planes in spherical cells; division generally transverse in elongated cells. Nannocytes present in some species.

1. <i>M. viridis</i> (A.Br) Lemm.	2:87
2. <i>M. marginata</i> (Menegh.) Kütz.	2:87
3. <i>M. protocystis</i> Crow	2:91
4. <i>M. lamelliformis</i> Holsinger	2:91
5. <i>M. aeruginosa</i> Kütz.	2:93
6. <i>M. flos-aquae</i> (Wittr.) Kirchner	2:94
7. <i>M. pseudofilamentosa</i> Crow	2:94
8. <i>M. holsatica</i> Lemm.	2:96
9. <i>M. pulverea</i> (Wood) Forti.	2:96
var. <i>incerta</i> (Lemm.) Crow	2:96

2. *Chroococcus* Naegeli

Solitary, or more commonly forming small colonies, free floating or attached to damp substrata.

Colonies microscopic; variously shaped, rarely spherical; each with 2-16, or less commonly with up to 64 cells enclosed in the distended sheath of original mother cell and in a gelatinous or mucous matrix. Sheaths of individual cells distinct; homogeneous or lamellated; firm, thin or thick; hyaline to ochraceous; several generations of sheaths usually present as a result of successive divisions. Individual cells spherical to ellipsoidal or hemispherical; blue-green, olive-green or yellowish. Protoplast homogeneous or granular; 1.75 - 50 μ in diameter. Colonies multiplying by fragmentation. Cell division in three planes. Nannocytes occasionally present.

1. *C. turgidus* (Kutz.) Naeg. 2:101
2. *C. minutus* (Kutz.) Naeg. 2:103
3. *C. minimus* (Keissler) Lemm. 2:106
4. *C. dispersus* (Keissler) Lemm. 2:106
var. *minor* G.M.Sm. 2:107
5. *C. limneticus* Lemm. var. *subsalsus* Lemm. 2:107

3. *Gloeocapsa* Kutzing

Colonial; attached to wet rocks, moist walls, sides of drains, barks of trees etc., or to submerged objects.

Colonies single, or many together forming an expanded thalloid mass; each with 2-32 cells or with many cells within a number of concentric special envelopes; microscopic to macroscopic; crustaceous to mucilaginous; hyaline or variously coloured, homogeneous or lamellated, usually thickened and vesicle-like. Cells spherical; bluegreen to yellowish or olive-green; homogenous or granular; pseudovacuoles sometimes present.

Cell division regular and in three planes. Spores produced in some species, hyaline or coloured, walls thick or thin.

1. *Gloeocapsa* sp.

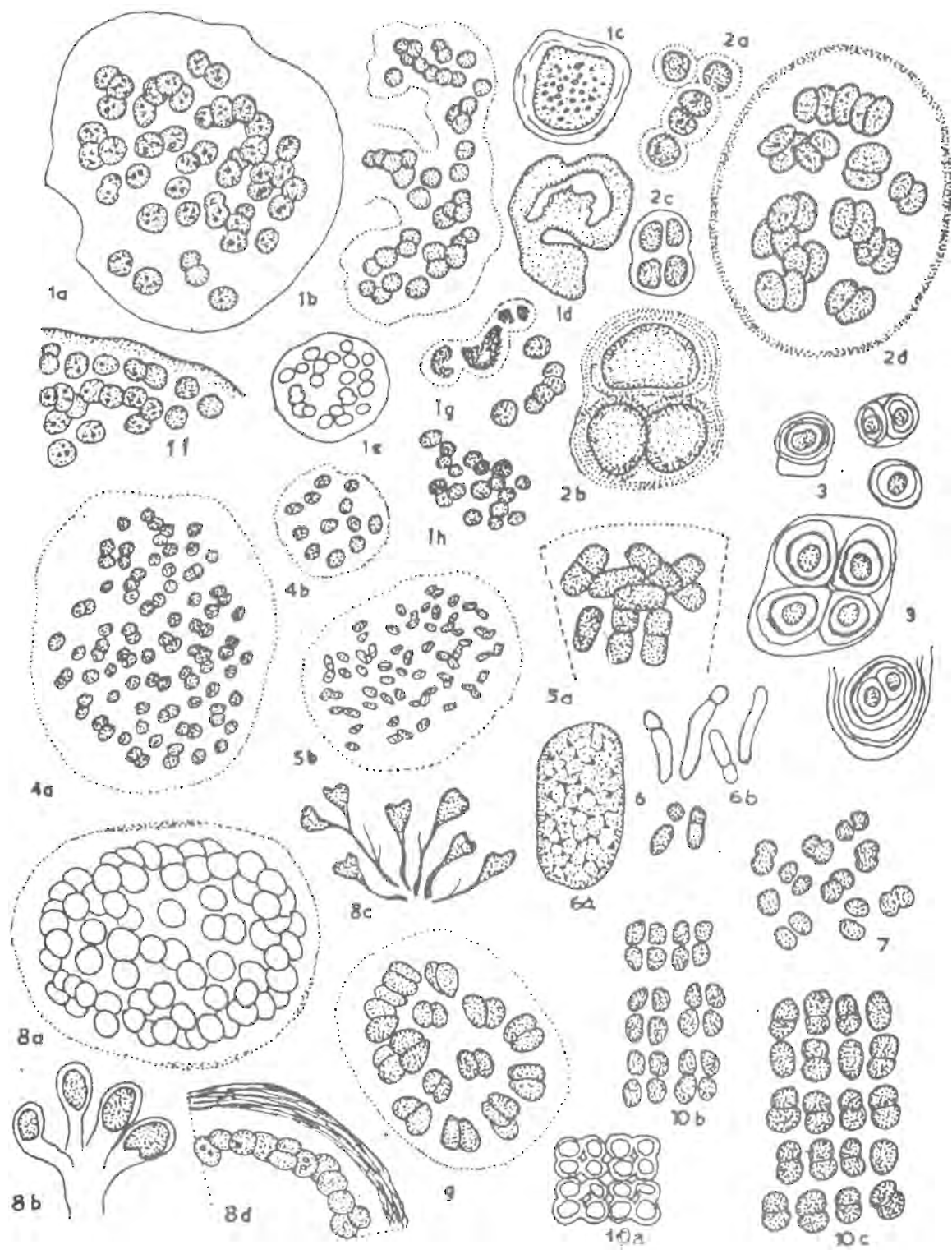


PLATE I

Plate I

1. Microcystis : a - *M. lamelliformis* (x1000); b, - *M. aeruginosa* (x825); c - *M. marginata* (x1800); d,e,f, - *M. viridis*, (d,x60; e,x400; f,x800); g - *M. pseudofilamentosa* (X60); h - *M. flos-aquae*(X825).
2. Chroococcus; a,c, - *C. minutus*; b- *C. turgidus*; d- *C. limneticus* (all x 825).
3. Gloeocapsa (X1000).
4. Aphanocapsa : a - *A. pulchra* (x825); b - *A. elachista* (X800).
5. Aphanothece : a - *A. stagnina* (x 825); b - *A. nidulans* (x 750).
6. Synechococcus spp., (a, x500; b, x1000).
7. Synechocystis pevalekii (x1000).
8. Coelosphaerium dubium (a,x800;b,x1250;c,x1200;d,x650).
9. Gomphosphaeria (x825).
10. Merismopedia : a - *M. punctata* (x750); b - *M. glauca* (x1000); c - *M. elegans* (x600).

4. *Aphanocapsa Naegeli*

Colonial; free floating, attached to submerged objects, or on wet rocks, moist soil etc.

Colonies microscopic to large; when young spherical; adult colonies made up of many cells, loosely and irregularly arranged, in a formless, gelatinous mass which may be a few cm in diameter. Mucilage homogenous, hyaline or coloured. Individual sheaths thin, more or less gelatinous and often not evident. Individual cells spherical, but becoming ellipsoid or hemispherical before and after division. Protoplasts bluegreen to pale grey, homogenous to finely granular.

Cell division generally in two planes. Nannocytes present in some species and formed by repeated divisions.

- | | |
|---|-------|
| 1. <i>A. pulchra</i> (Kutz.) Rabenh. | 2:132 |
| 2. <i>A. elachista</i> W. & G.S. West | 2:132 |
| 3. <i>A. delicatissima</i> W. & G.S. West | 2:133 |
| 4. <i>A. grevillei</i> (Hass.) Rabenh. | 2:134 |

5. *Aphanothece Naegeli*

Colonial; free floating; or less commonly attached to submerged plants or other objects.

Colony many-celled; cells densely but evenly arranged to form an expanded, more or less shapeless, mucilaginous, hyaline or coloured thallus. Thallus a few mm to several cm in diameter calcareous crystals sometimes present. Individual sheaths occasionally present; mostly diffluent, colourless or coloured. Individual cells oblong, ellipsoidal or cylindrical; straight or slightly bent, ends rounded; blue-green to grey.

Cell division generally transverse. Nannocytes present.

1. *A. stagnina* (Spreng.) A. Br. 2:137
2. *A. nidulans* P. Richter 2:138

6. *Synechococcus* Naegeli

Solitary; occasionally present in temporary chains of 2-4 cells. Aquatic or on moist soil.

Mucilage envelope absent or very thin. Cells oblong, ellipsoid or cylindrical; mostly straight; apices rounded; pale blue-green to yellowish.

Cell division generally transverse.

1. *Synechococcus* sp.

7. *Synechocystis* Sauvageau

Solitary or in groups of 2 to 4; free floating. Mucilage envelope indistinct. Cells spherical; blue-green. Cell division in one or two planes.

1. *S. pevalekii* Ercegovic 2:145

8. *Coelosphaerium* Naegeli

Colonial; free floating.

Colonies many-celled; spherical, ellipsoid, reniform or irregularly shaped; hollow. Colonial envelope thin or thick; mucilaginous; peripheral layer usually fibrillar; colourless. Individual cells spherical to cordate; with or without separate envelopes; closely arranged in colonial mucilage in a single (very rarely double)

peripheral layer a short distance below surface of common envelope; pale to bright blue-green in colour; gas vacuoles often present.

Colonies dividing by splitting up near the middle.

1. *C. dubium* Grunow 2.147
2. *C. confertum* W. & G.S. West 2.148

9. *Gomphosphaeria* Kutzing

Colonial; free floating or epiphytic on other aquatic plants.

Colonies many-celled, spherical, mucilaginous, hyaline.

Individual cells ellipsoid, pyriform, subglobose or more rarely spherical; dividing cells cordate or obtuseiform in lateral view; arranged in pairs or fours with long axes radiate, and in a single layer a little below the surface of the colonial envelope. Sheaths of individual cells stalked, and with cell division accompanied by a division of the distal portion of the stalk. Repeated cell division resulting in a radiately branched gelatinous stalk system with each branch terminating in a cell. Peripheral mucilage more homogeneous. Protoplasts homogeneous to finely granular, pale grey to bright blue-green.

Colonies dividing by fragmentation. Cell division in two planes.

1. *Gomphosphaeria* sp.

10. *Merismopedia* Meyen

Colonial; free floating in still or slow-running waters.

Colonies flat, microscopic or macroscopic; 4-16 cells or more in a homogeneous, hyaline mucilage; generally in fours and arranged in a single plane. Individual cells globose, oblong before division and hemispherical after division; pale blue-green to violaceous or reddish. Each cell rarely with a distinct mucilaginous envelope, more often with a homogeneous, hyaline, colonial envelope. Gas vacuoles sometimes present.

Cell division in two planes perpendicular to the plane of the colony.

- | | |
|-------------------------------------|-------|
| 1. <i>M. tenuissima</i> Lemm. | 2:154 |
| 2. <i>M. punctata</i> Meyen | 2:155 |
| 3. <i>M. glauca</i> (Ehrenb.) Naeg. | 2:155 |
| 4. <i>M. elegans</i> A. Br. | 2:156 |

11. *Dermocarpa* Crouan

Plant unicellular, solitary or aggregated in dense clusters; epiphytic on other algae.

Cells spherical, oval, club-shaped, or more rarely hemispherical; differentiated into base and apex; stalk cells sometimes present, but mostly without a stalk, or stalk small and mucilaginous; stalk cell if present, usually with wall thick and lamellated.

Vegetative cell division absent. Reproduction by endospores. Entire cell functioning as a sporangium and contents dividing to produce 4 to many endospores. Liberation by gelatinisation of sporangial wall.

- | | |
|---|---------------------|
| 1. <i>D. leibleiniae</i> (Reinsch.) | |
| | Born. & Thur. 2:173 |
| 2. <i>D. olivacea</i> (Reinsch.) Tilden | 2:174 |

12. *Xenococcus* Thuret

Plant pseudoparenchymatous; epiphytic on other algae in rivers and streams, or in coastal waters.

Thallus initially a few-celled pseudoparenchymatous basal disc; later developing into hemispherical or crustose flakes. Individual cells varying in shape and size; loosely arranged in groups of 4 or 8; or forming short, erect, few-celled, dichotomously or tetrachotomously branched, laterally adherent filaments.

Reproduction by endospores. Sporangia terminal on erect filaments.

Endospores many, liberated by gelatinisation of sporangial wall.

- | | |
|---|-------|
| 1. <i>X. acervatus</i> Setchell & Gardner | 2:182 |
|---|-------|

13. *Arthrospira* Stitzenberger

Filamentous; free floating in still or slow running waters.

Filaments simple, sheaths absent. Trichomes multicellular, cylindrical, usually of a relatively large diameter; loosely but regularly coiled, coils large but few. Apices of trichomes not tapering or tapering very slightly only; terminal cell rounded; calyptra absent. Individual cells pale blue-green; cross walls distinct. Gas vacuoles sometimes present.

Reproduction by hormogones.

1. *A. platensis* (Nordst.) Gomont 2:190

14. *Spirulina* Turpin em. Gardner

Filamentous; free floating in still waters, or on moist soil.

Filaments simple, motile; sheath absent. Trichomes unicellular, cylindrical, loosely or tightly coiled into more or less regular spirals; apex not attenuated; ends of cells rounded; calyptra absent.

Reproduction by hormogones.

1. *S. subsalsa* Oerst. ex Gomont 2:193
2. *S. princeps* W. & G.S. West 2:197

15. *Oscillatoria* Vaucher

Filamentous; in slow flowing or standing waters; in drains, lakes, ponds, tanks; or on road slime, moist soil, barks of trees etc.

Freshwater or marine.

Plant motile; exhibits a creeping movement involving rotation along long axis. Filaments simple; sheaths absent. Trichome multicellular, cylindrical, straight or twisted and entangled or loosely interwoven to form a spongy thallus; dull blue-green, yellow-green, dark green, olive-green, pale red, dark blue or even blackish; constrictions at cross walls sometimes present. Vegetative cells disc-shaped to

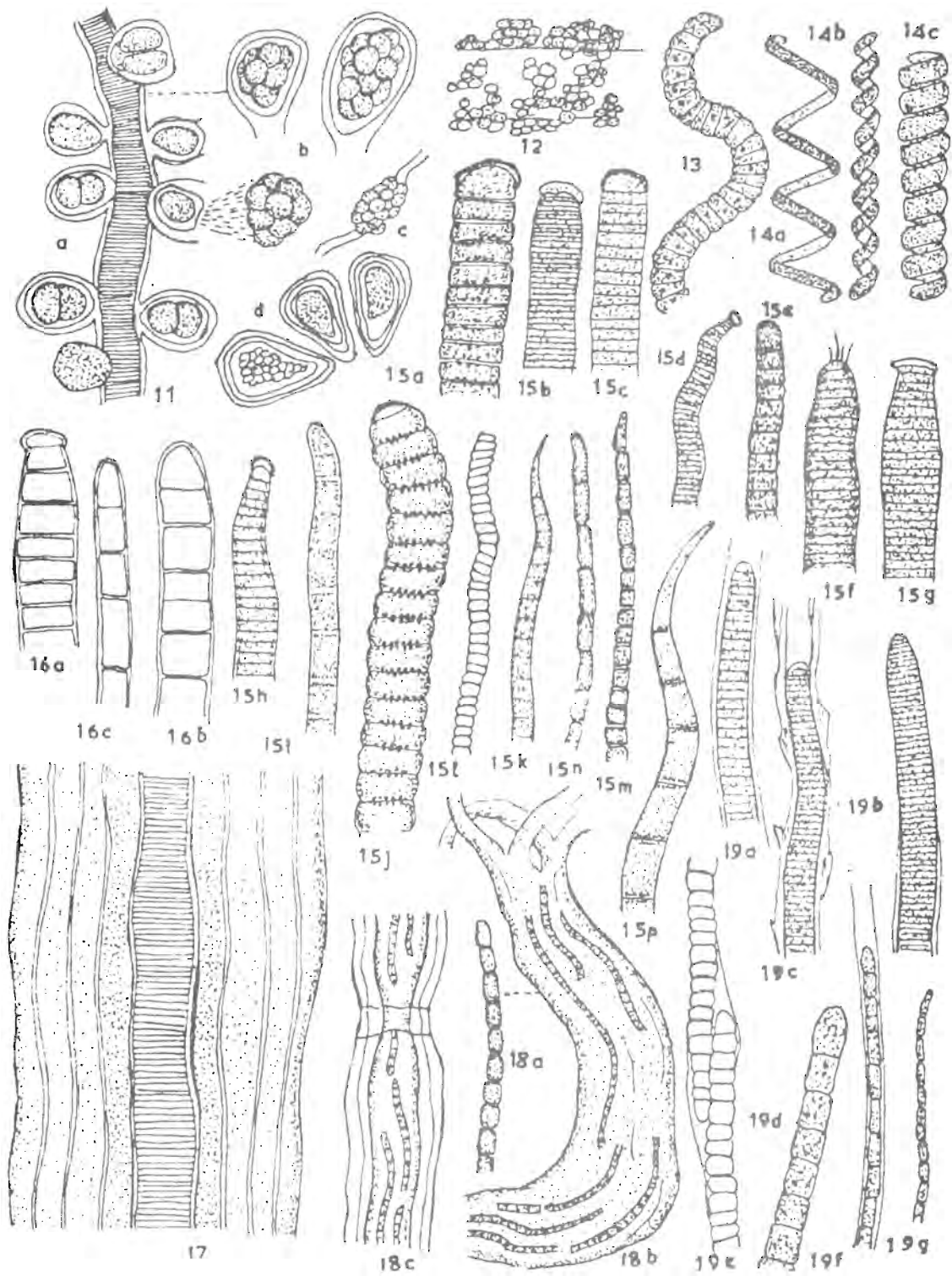


PLATE II

Plate II

11. *Dermocarpa* : a, b - *D. leibleinia* (x1000); c, d - *D. olivacea* (x1000).
12. *Xenococcus acervatus* (x500).
13. *Arthrospira platensis* (x750).
14. *Spirulina* spp. (a, x2000; b, x1000; c, x1000).
15. *Oscillatoria* : a - *O. margaritifera* (x 600); b - *O. princeps* (x 400); c - *O. limosa* (x750); d - *O. anguina* (x600); e - *O. chalybea* (x 600); f - *O. curviceps* (x 600); g - *O. princeps* (x400); h - *O. proboscidea* (x600); i - *O. chlorina* (x1000); j - *O. miniata* (x500); k - *O. animalis* (x1000); l - *O. corallinae* (x500); m - *O. cortiana* (x600); n - *O. limnetica* (x900); p - *O. acuminata* (x1000).
16. *Trichodesmium* : a - *T. hildebrandtii* (x500); b, c - *T. thiebautii* (x600).
17. *Porphyrosiphon notarisii* (x600).
18. *Dasygloea*: a, b, c - *D. amorpha* (a, x 900; b, c, x 450)
19. *Phormidium*: a, b, c - *P. ambiguum* (x750); d - *P. retzii* (x600); e - *P. ceylanicum* (x 1100); f, g - *P. tenue* (f, x1100; g, x750).

cylindrical. Extreme ends of trichomes sometimes tapering; ends distinctly marked, rounded, pointed, sickle-shaped, coiled, or more rarely like a screw; end cells sometimes capitate or calyptrate. Protoplast homogeneous or granulated. Gas vacuoles sometimes present. Reproduction by hormogones.

1. <i>O. margaritifera</i> (Kutz.) Gomont	2:202
2. <i>O. miniata</i> (Zanard.) Hauck ex Gomont	2:202
3. <i>O. limosa</i> Ag. ex Gomont	2:206
4. <i>O. curviceps</i> Ag. ex Gomont	2:209
5. <i>O. princeps</i> Vaucher ex Gomont	2:210
6. <i>O. anguina</i> (Bory) Gomont	2:210
7. <i>O. proboscidea</i> Gomont	2:211
8. <i>O. subtilissima</i> Kutz.	2:215
9. <i>O. chlorina</i> Kutz. ex Gomont	2:215
10. <i>O. chalybea</i> (Mertens) Gomont	2:218
11. <i>O. corallinae</i> (Kutz.) Gomont	2:221
12. <i>O. mougeotii</i> Kutz.	2:222
13. <i>O. temis</i> Ag. ex Gomont	2:222
14. <i>O. simplicissima</i> Gomont	2:224
15. <i>O. limnetica</i> Lemm.	2:226
16. <i>O. cortiana</i> Menegh. ex Gomont	2:233
17. <i>O. rubescens</i> DC. ex Gomont	2:235
18. <i>O. agardhii</i> Gomont	2:235
19. <i>O. animalis</i> Ag. ex Gomont	2:239
20. <i>O. acuminata</i> Gomont	2:240
21. <i>O. cruenta</i> Grun.	2:241

16. *Trichodesmium* Ehrenb.

Filamentous; planktonic, marine or in brackish waters. Filaments simple, laterally joined to form bundles or flocculent masses through diffluent mucilage. Sheaths very delicate and imperceptible. Trichomes cylindrical, apices sometimes gently attenuated. Vegetative cells cylindrical to barrel-shaped; protoplasts homogeneous to granulated. Reproduction by hormogones.

1. *T. thiebautii* Gomont 2:243
2. *T. hildebrandtii* Gomont 2:245

17. *Porphyrosiphon* Kutzing

Filamentous; on submerged objects, wet barks of trees or on moist soil. Filaments simple, cylindrical; sometimes contorted and interwoven to form an expanded thallus. Sheaths distinct, firm, lamellated; red, reddish-brown, or purplish; closed at ends in young filaments but open and extending beyond trichome in older plants. Trichomes cylindrical; single or rarely two in a sheath.

Reproduction by hormogones.

1. *P. notarisii* (Menegh.) Kutz. ex Gomont 2:248

18. *Dasygloea* Thwaites

Filamentous; recorded once only from an artificial tank at Peradeniya. Filaments branched, coalescent to form a mucilaginous thallus. Sheath very broad, gelatinous or slimy, colourless to bluish green; firm and with divergent branched extremities; lamellated. Trichomes few in each sheath; laterally separated, cylindrical, constricted at cross walls; apices straight.

Reproduction by hormogones.

1. *D. amorpha* Thwaites ex Gomont 2:250

19. *Phormidium* Kutzing

Filamentous; primarily subaerial and attached to wet rocks, moist soil, barks of trees etc; sometimes planktonic in fresh or brackish waters, or the sea.

Filaments simple; many often coalescing to form a gelatinous or leathery thallus with torn margins. Sheaths more or less firm; agglutinated or partly diffluent; thin; colourless. Trichomes

cylindrical; one in each sheath; parallel or irregularly twisted. Vegetative cells barrel-shaped to cylindrical. Apical cells blunt-pointed, conical or capitate. Calyptra sometimes present.

Reproduction by hormogones.

1. <i>P. tenue</i> (Menegh.) Gomont	2:259
2. <i>P. luridum</i> (Kutz.) Gomont	2:263
3. <i>P. ambiguum</i> Gomont	2:266
4. <i>P. retzii</i> (Ag.) Gomont	2:268
5. <i>P. ceylanicum</i> Wille	2:272
6. <i>P. valderianum</i> (Delp.) Gomont	2:263

20. *Lyngbya* Agardh

Filamentous. Free floating in still or slow flowing waters or attached to wet rocks, tree trunks etc.

Filaments simple, solitary or in interwoven masses. Sheaths firm and distinct; thin or thick; mostly colourless, but sometimes yellow to brown, red, blue or purple-red; homogeneous or lamellated; extending beyond trichome in older filaments. Trichome cylindrical, one in each sheath; straight, flexed or in regular coils; apex usually rounded. Vegetative cells commonly disc-shaped to cylindrical; protoplast homogeneous, granulose or with numerous pseudovacuoles; pale or bright blue-green to variously coloured.

Reproduction by hormogones.

1. <i>L. infixa</i> Frey	2:282
2. <i>L. kuetzingii</i> Schmidle	2:282
3. <i>L. sordida</i> (Zanard.) Gomont	2:285
4. <i>L. gracilis</i> (Menegh.) Rabenh.	2:285
5. <i>L. distincta</i> (Nordst.) Schmidle	2:286
6. <i>L. contorta</i> Lemm.	2:290
7. <i>L. circumceta</i> G.S. West	2:291
8. <i>L. borgerti</i> Lemm.	2:293

Plate III

20. Lyngbya: a - *L. kuetsingii* (x1700);
b - *L. sordida* (x600); c - *L. gracilis*
(x600); d, e - *L. contorta* (x1000);
f - *L. limnetica* (9x10000); g - *L. borgerti*
(x1800); h, j - *L. majuscula* (x600);
i - *L. versicolor* (x 450); k - *L.*
putealis (x600).
21. Schizothrix: a, b, c - *S. telephoroides*
(a, c x 450; b, x 600); d, e - *S. muelleri*
(d, x600; e, x150).
22. Symploca: a, b, c - *M. hydroides* (x500).
23. Microcoleus: a, b, c - *M. chthonoplastes* (x450).
24. Hydrocoleum: a, b - *H. cantharidosum*
(a x 1500; b, x 600).

9. <i>L. limnetica</i> Lemm.	2:294
10. <i>L. ceylanica</i> Wille	2:299
11. <i>L. lutea</i> (Ag.) Gomont	2:310
12. <i>L. versicolor</i> (Wartm.) Gomont	2:311
13. <i>L. majuscula</i> Harvey ex Gomont	2:313
14. <i>L. cinerescens</i> Kutz.	2:315
15. <i>L. nigra</i> Ag. ex Gomont	2:317
16. <i>L. putealis</i> Mont. ex Gomont	2:317
17. <i>L. major</i> Menegh. ex Gomont	2:320

21. *Schizothrix* Kutzing

Filamentous; on wet rocks or soil, epiphytic on mosses etc., or more rarely planktonic.

Filamentous cylindrical, densely packed to form a soft to firm thallus; sometimes sparsely branched and forming tuft-like growths or erect bundles which are again further divided. Sheath distinct; thin or thick; often lamellated; colourless to yellowish-brown, red or violet; frequently forked and with ends of branches pointed. Main sheath enclosing two or more trichomes, more rarely a single trichome. An individual sheath often present round each trichome. Ultimate branches of sheath usually with only a single trichome. Trichomes cylindrical, usually spirally twisted round each other within the sheath. Vegetative cells quadrate to cylindrical or barrel-shaped. End cells conical or rounded.

Reproduction by hormogones.

1. <i>S. lardacea</i> (Ces.) Gomont	2:327
2. <i>S. delicatissima</i> W. & G.S. West	2:327

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|---|-------|
| 3. <i>S. muelleri</i> Naeg. ex Gomont | 2:330 |
| 4. <i>S. telephoroides</i> (Mont.) Gomont | 2:330 |
| 5. <i>S. confervae</i> (Kutz.) Desic. | 2:334 |

22. *Symploca* Kutz.

Filamentous; subaerial in moist habitats, wet rocks, moist soil, tree trunks etc., or in the sea.

Filaments simple, and with sheaths coalescent in the median region; at first prostrate but later forming erect tufts which are partly false-branched. Sheath firm but gelatinising as filaments get older. Trichome uniseriate and one in each sheath; straight, or sometimes attenuated at the ends. Vegetative cells quadrate or cylindrical, or slightly constricted at the cross walls. End cells not capitate; rounded and sometimes with a thickened membrane. Calyptra present or absent.

Reproduction by hormogones.

- | | |
|--|-------|
| 1. <i>S. hydroides</i> Kutz. ex Gomont | 2:335 |
| 2. <i>S. flaccida</i> Zanard. | 2:338 |
| 3. <i>S. parietina</i> (A.Br.) Gomont | 2:339 |

23. *Microcoleus* Desmazieres

Filamentous; on moist soil, damp walls etc., or with other algae in fresh or salt water.

Filaments cylindrical; unbranched or occasionally sparsely branched; solitary or coalescing to form an expanded, lamellated, thallus. Sheath thick; more or less regularly cylindrical; colourless; homogeneous and sometimes gelatinising when old. Trichomes many within each sheath; often coiled or contorted and densely interwoven. Vegetative cells broad, quadrate or cylindrical, with constrictions at the crosswalls. End cells often attenuated, conical or capitate.

Reproduction by hormogones.

- | | |
|--|-------|
| 1. <i>M. chthonoplastes</i> Thuret ex Gomont | 2:343 |
|--|-------|

24. *Hydrocoleum* Kutzing

Filamentous; on mud in mangrove swamps, and in standing waters. Filaments cylindrical; sparsely branched, with closely adpressed branches forming a tuft or a membranous thallus. Sheath gelatinous, mostly colourless; homogeneous, or more rarely lamellated; diffluent when old; each sheath enclosing one to a few trichomes. Trichomes cylindrical, loosely aggregated in sheath. Vegetative cells quadrate to disc shaped, with no constrictions at the cross walls. Ends more or less attenuated and usually capitate. Calyptra often present.

Reproduction by hormogones.

1. *H. cantharidosum* (Mont.) Gomont 2:347

25. *Anabaenopsis* (Wolosz.) Miller

Filamentous, planktonic.

Filaments short, circinate or irregularly coiled. Sheaths indistinct or absent. Trichomes of more or less the same breadth throughout; heterocysts terminal, or terminal and intercalary; vegetative cells spherical to subcylindrical or ovoid; gas vacuoles sometimes present. Reproduction by homogones and akinetes. Akinetes intercalary and not adjacent to a heterocyst, single or in series, ellipsoid, coloured or colourless.

1. *Anabaenopsis* sp. (4)

26. *Cylindrospermum* Kutzing

Filamentous; planktonic or attached; in still or flowing water of paddy fields etc., and on moist soil.

Filaments short, straight or curved; sheath absent; each filament

surrounded by a soft, mucilaginous film which is confluent with those of other filaments to form an expanded mass of indefinite shape. Trichomes uniformly broad with constrictions at cross walls. Vegetative cells ellipsoid to barrel shaped. Heterocysts ovate or ellipsoidal; terminal, one at either end or at one end only. Reproduction by hormogones and akinetes. Akinetes large, always adjacent to a heterocyst; ovate, ellipsoid or subcylindric; single or in series; colourless to yellowish or brown; enclosed in a smooth or papillose exospore.

1. *C. majus* Kutz. ex Born. & Flah. (4);2:360
2. *C. tropicum* W. & G.S. West 2:362
3. *C. gorakhpurensis* R.N. Singh (4);2:363
4. *C. stagnale* (Kutz.) Born. & Flah. 2:363
5. *C. muscicola* Kutz. ex Born. & Flah. (4);2:366

27. *Wollea* Born. & Flah.

Colonial; attached when young, mature colonies free floating; on submerged soils and in other shallow waters especially in paddy fields, rock pools etc.

Colony initially club-shaped, later becoming tubular and elongate; closed at one end; unbranched; up to 10 cm long. Sheaths confluent to form a soft colonial envelope; each sheath enclosing several trichomes. Trichomes straight or curved, compactly arranged. Vegetative cells ovate, cylindrical or barrel-shaped. Heterocysts large, barrel-shaped and intercalary but sometimes appearing terminal due to fragmentation of trichomes next to a heterocyst.

Reproduction by hormogones and akinetes. Akinetes broader than vegetative cells, ovate, solitary or in series, adjacent to heterocysts or remote from them.

1. *Wollea* sp. (4)

Plate IV

25. *Anabaenopsis*: a, b - (x500).
26. *Cylindrospermum stagnale* (x 400).
27. *Wollea* (x 1500).
28. *Nostoc* (x 1000).
29. *Anabaena*: a - *A. spiroides* var. *crassa* (x 825);
b - *A. azollae* (x600); c - *A. flos-aquae* (x825);
d - *A. cycadeae* (x 2000).
30. *Pseudanabaena* (x 1000).
31. *Rhaphidiopsis*: a, b - *R. recurvata* (x 1000);
c - *R. mediterranea* (x 1000).
32. *Plectonema wollei* (x 600).
33. *Scytonema*: a - *S. simplex* (x 1000);
b - *S. iyengari* (x 500); c - *S. dilatatum* (x 500);
d - *S. myochrous* (x 300); e - *S. hofmanni* (x 500);
f - *S. ocellatum* (x 500); g - *S. stuposum* (x500);
h - *S. mirabile* (x 530) i - *S. multiramosum* (x 1000);
j - *S. geitleri* (x 500)

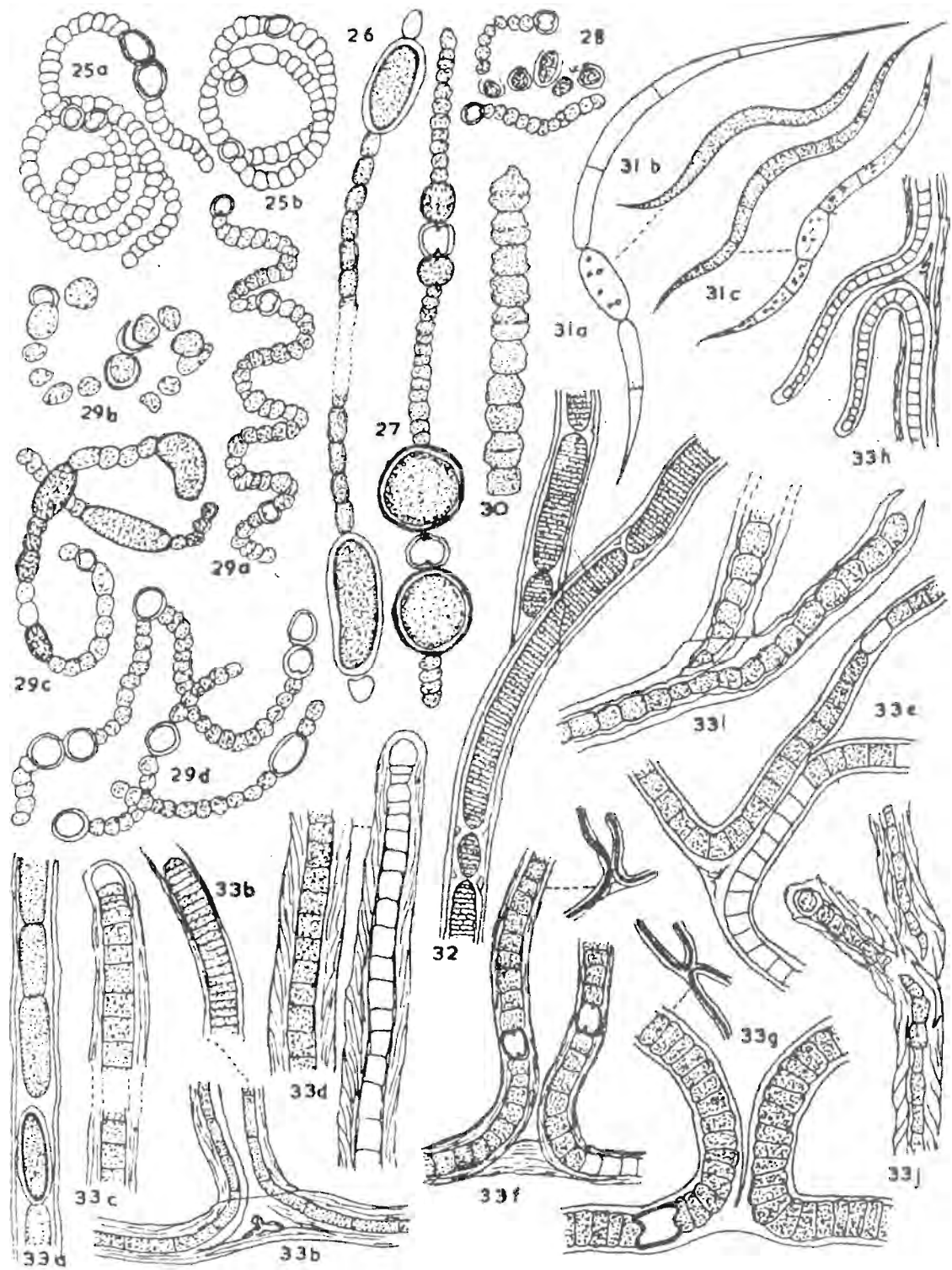


PLATE IV

28. *Nostoc* Vaucher

Colonial; shape variable; attached or free; on moist rocks, walls and soils or in still or slow flowing waters.

Colony mucilaginous, gelatinous or coriaceous with an outer envelope of very firm consistency. Young colonies microscopic and globose to oblong. Older ones bulbous to filiform or foliose with ruptured margins and reaching up to several cm in diameter; solid or hollow; dark coloured; free or attached. Filaments always uniseriate and unbranched; curved or much contorted and enclosed in a copious, thick, mucilage. Sheaths sometimes distinct, but generally diffluent. Trichomes torulose, uniformly broad. Vegetative cells spherical, barrel-shaped or cylindrical. Heterocysts intercalary in origin. Hormogones formed by rupture of trichomes next to a heterocyst. Akinetes developing in between heterocysts; spherical, oval or cylindrical; solitary or in series.

1. *N. maculiforme* Born. & Flah. 2:374
2. *N. punctiforme* var. *popularum* Geitl. (4);2:374
3. *N. paludosum* Kutz. ex Born. & Flah. (4);2:375
4. *N. linekia* var. *arvenese* C.B Rao (4);2:377
5. *N. rivulare* Kutz. ex Born. & Flah. (4);2:379
6. *N. spongiaeforme* var. *teme* C.B. Rao (4);2:380
7. *N. carneum* Ag. ex Born. & Flah. (4);2:381
8. *N. elliposporum* var. *violacea*
C.B. Rao (4);2:383
9. *N. passerinianum* (De Not.) Born. (4);2:385
10. *N. commune* Vauch. ex Born. & Flah. (4);2:387
11. *N. microscopicum* Carm. ex
Born. & Flah. (4);2:387

29. *Anabaena* Bory

Filamentous; free floating or attached; in slow running or still, shallow, fresh or brackish waters.

Filaments solitary, or many and much entangled and enclosed in an amorphous mucilage to form floccose colonies; sometimes forming films or gelatinous expansions on moist substrates; a few species endophytic. Sheaths absent, or confluent and hyaline. Trichomes cylindrical, uniformly broad or apices somewhat attenuated; straight, circinate, spirally twisted or irregularly contorted. Vegetative cells torulose, spherical to barrel-shaped; pseudovacuoles sometimes present. Heterocysts usually numerous, somewhat larger but of same shape as vegetative cells; generally intercalary and single.

Reproduction by hormogones and akinetes. Akinetes round, ovate or more rarely cylindrical; coloured or colourless; smooth or sculptured; single or in series, and either adjacent to or in between heterocysts.

1. *A. spiroides* Klebahn 2:395
var. *contracta* Klebahn 2:396
2. *A. orientalis* var. *ellipsospora*
C.B. Rao (4);2:406
3. *A. doliolum* Bharadwaja (4);2:410
4. *A. variabilis* var. *khasiensis*
(Bharad.) Fritsch (4);2:413
5. *A. laxa* (Raben.) A. Br. 2:413
6. *A. flos-aquae* (Lyngb.) Brab. 2:414
7. *A. oscillarioides* Bory ex
Born. & Flah. (4);2:417
8. *A. cycadeae* Reinke
9. *A. azollae* Strasb.
10. *A. bergii* (4)
11. *A. viguieri* Denis & Frey (4);3:206
12. *A. hieronymusii* Lemm. (4);3:216

30. *Pseudanabaena* Lauterborn

Filamentous; planktonic in tanks, lakes and ponds.

Filaments solitary, motile and showing brisk, creeping movements.

Sheath absent. Trichomes uniformly broad; cells spherical to cylindrical but rounded at the ends; deeply constricted at cross walls. Heterocysts absent.

1. *P. catenata* Lauterb. 2:419

31. *Raphidiopsis* Fritsch & Rich.

Filamentous; planktonic in tanks, lakes and ponds. Filaments solitary, or more rarely in bundles. Sheaths absent. Trichomes straight, bent or curved; not constricted at the cross walls; attenuated at one or both ends. Ends pointed and with solid or gelatinous bristles. Vegetative cells occasionally with gas vacuoles. Heterocysts absent. Akinetes ellipsoid, or barrel-shaped and with rounded ends; single or in pairs in the middle of the trichomes.

1. *R. curvata* Fritsch & Rich. 2:422
2. *R. mediterranea* Skuja 2:422

32. *Plectonema* Thuret

Filamentous; free floating or attached to submerged rocks or other objects in stagnant or flowing waters, or on damp walls, moist soil, tree trunks etc.

Filaments in wooly felt-like masses, or less commonly free and solitary; straight or variously bent; false-branched, branches single or in pairs. Sheath present, relatively thin, firm, colourless or coloured yellow with age; homogeneous or lamellated. Trichomes uniseriate, one in each sheath; cells discoid, cylindrical or barrel-shaped; with or without constrictions at cross walls. Heterocysts absent.

Reproduction by hormogones and pseudohormogones. Akinetes not known.

1. *P. wollei* Farlow ex Gomont 2:437

33. *Scytonema* Ag.

Filamentous, free floating or attached to submerged objects in paddy fields, tanks, ponds etc; or on moist soil surfaces, damp walls, dripping rocks, barks of trees etc.

Filaments falsely branched and loosely entangled to form expanded thalloid masses. Thallus thick; tomentose, floccose, caespitose, or crustaceous; brownish-green, blue-green, yellow-green, greenish-black or blue-black. False branches usually in pairs and formed in between heterocysts, occasionally single but then not adjacent to a heterocyst as in *Tolypothrix*. Sheath firm; hyaline or yellowish to brownish; homogeneous or with parallel or oblique lamellae; lamellae sometimes divergent and ending in wing-like expansions (= ochreae) at the outer margins. Trichomes uniseriate, one in each sheath, straight. Vegetative cells quadrate to short cylindric, constrictions sometimes present at the cross walls. Heterocysts subglobose or quadrangular-globose, intercalary in origin and borne singly. Hormogones terminal, solitary. Pseudohormogonia present. Akinetes formed only in a few species; globose or ovate; of same size or a little larger than the vegetative cells.

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| 1. <i>S. simplex</i> Bharadwaja | 2:455 |
| 2. <i>S. stuposum</i> (Kutz.) Bornet | 2:459 |
| 3. <i>S. millei</i> Bornet | 2:460 |
| 4. <i>S. javanicum</i> (Kutz.) Bornet | 2:461 |
| 5. <i>S. iyengari</i> Bharadwaja | 2:465 |
| 6. <i>S. dilatatum</i> Bharadwaja | 2:465 |
| f. <i>major</i> Bharadwaja | 2:467 |
| 7. <i>S. ocellatum</i> Lyngbye ex
Born. & Flah. | 2:467 |
| f. <i>minor</i> Bharadwaja | 2:468 |
| 8. <i>S. guyanense</i> (Mont.) Born. & Flah. | 2:469 |
| var. <i>prolifera</i> Bharadwaja | 2:471 |

1. *T. tenuis* (Kutz.) Johs. Schmidt em. 2:494
2. *T. distorta* var. *penicillata*
(Ag.) Lemm. 2:497
var. *samoensis* Wille 2:497
3. *T. phyllophila* W & G.S. West 2:499
4. *T. ceylonica* Schmidle 2:500
5. *T. magna* Bharadwaja 2:503
6. *T. crassa* W. & G.S. West 2:504

35. *Homeothrix* (Thuret) Kirchner

Filamentous; free floating or attached to aquatic plants or other submerged objects in paddy fields, lakes, ponds etc.

Filaments free and solitary or aggregated to form tufts or crustaceous or cushion-like thalli; unbranched or occasionally false branched.

Sheath present, close to trichome, thin, firm; colourless to yellowish brown; homogeneous or lamellated. Trichomes uniseriate; one in each sheath; apex attenuated to a hair. Heterocysts absent.

Reproduction by hormogones. Akinetes absent.

1. *H. juliana* (Menegh.) Kirchn. 2:519

36. *Calothrix* Ag.

Filamentous; epiphytic or attached to shells, dead coral stones, dead leaves, damp walls, sides of drains etc., or with other algae in still or running waters. Some species present in hot springs.

Filaments unbranched or with occasional false branches; free and solitary, or arranged more or less parallel to form caespitose, tomentose, stellate, pulvinate or penicillate tufts or strata. Thalli sometimes encrusted with lime. Sheath mostly firm, sometimes seen in basal region only; thin or thick; homogeneous or lamellated; hyaline or coloured. Trichome uniseriate, one in each sheath. Vegetative cells discoid near base, more cylindrical higher up; apical cells narrower

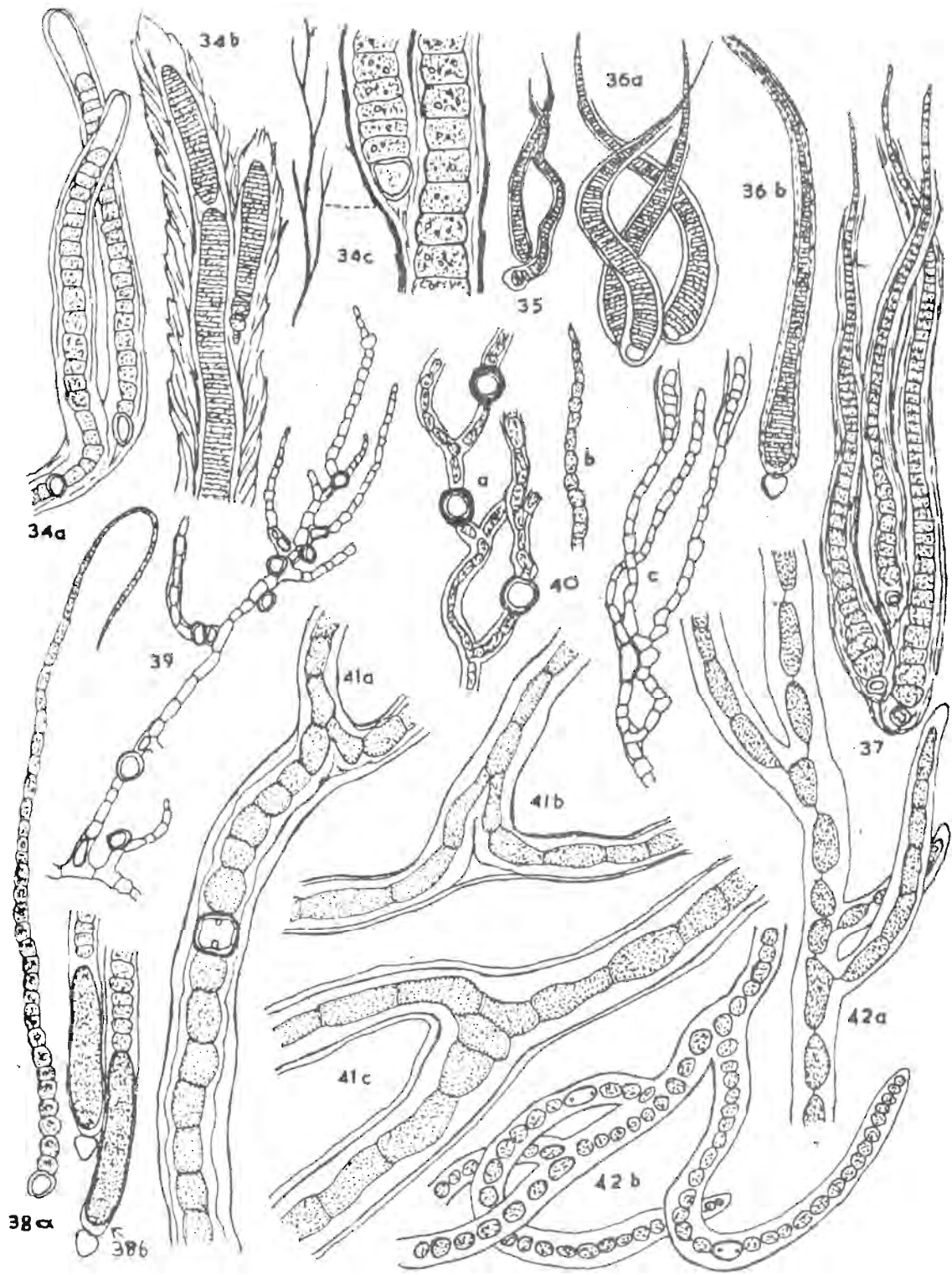


PLATE V

Plate V

34. Tolypothrix: a - *T. distorta* var. *samoensis* (x 300); b - *T. magna* (x 250); c - *T. tenuis* (x 500).
35. *Homeothrix juliana* (x 200).
36. *Calothrix*: a - *C. fusca* (x 450); b - *C. breviararticulata* (x 350).
37. *Rivularia* (x 500).
38. *Gloeotrichia echinulata* (a, b, x 400).
39. *Nostochopsis lobatus* (x 575).
40. *Brachytrichia quoyi* (a, b, c, x 1200).
41. *Mastigocladus* (a, b, c, x 1200).
42. *Hapalosiphon*: a - *H. delicatulus* (x 1000); b - *H. luteolus* (x 350).

and sometimes forming a hair-like point; cross walls with or without constrictions. Heterocysts usually basal, sometimes intercalary ones also present; subglobose to hemispherical. A few species never form heterocysts.

Reproduction by hormogones or akinetes. Akinetes adjacent to heterocyst, single or in series.

1. *C. fusca* (Kutz.) Born. & Flah. 2:527
2. *C. elenkinii* Kossinskaja (4);2:531
3. *C. brevissima* G.S. West (4);2:533
4. *C. breviararticulata* W. & G.S. West 2:537
5. *C. parietina* Thuret ex Born. & Flah. (4);2:538
6. *C. weberi* Schmidle 2:540
7. *C. membranacea* Schmidle (4);2:542

37. *Rivularia* (Roth) Ag.

Colonial; colonies free floating, or attached to submerged plants or other objects, or to wet rocks.

Filaments irregularly false-branched, arranged radially or parallel and embedded in a firm mucilage to form spherical or hemispherical colonies. Colonies microscopic or macroscopic; solid or hollow; sometimes encrusted with lime. Sheaths partially or wholly confluent; often distinct near lower portion of trichome only, homogeneous or lamellated. Trichomes attenuated from base to apex, false branched repeatedly at base, growth trichothallic. Heterocysts basal or intercalary.

Hormogones single or in series. Akinetes absent.

1. *Rivularia* sp.

38. *Gloeotrichia* Ag.

Colonial; aquatic, free floating or attached.

Filaments irregularly false branched, arranged radially or parallel and embedded in a soft mucilage to form spherical or hemispherical

colonies. Colonies microscopic or macroscopic, solid or hollow. Sheaths evident only near base of trichome, gelatinising and becoming confluent higher up; hyaline to yellow.

Trichomes repeatedly false-branched at base, attenuated from base to apex; growth trichothallic. Heterocysts solitary and basal, globose to oval.

Reproduction by hormogones and akinetes. Akinetes cylindric and adjacent to heterocyst, single to a few.

L.G. echimulata (J.E. Smith) P. Richter 1:556

39. *Nostochopsis* Wood em. Geitler

Colonial; free floating or attached to submerged objects in paddy fields, ponds etc., or in flowing water.

Colony spherical or subspherical to irregular, mucilaginous; solid at first, but later becoming hollow or expanded with margins torn; young stages attached. Filaments heterotrichous; erect filaments repeatedly and irregularly branched. Sheath wholly confluent, soft, colourless to coloured yellow or brown. Trichomes uniseriate, freely branched with one or two rows of branches. Branches of two types; one type long and many celled; other short and consisting of a 1 - 3 celled stalk and a terminal heterocyst, (=pedicillate heterocysts). Heterocysts terminal or intercalary; sessile, lateral heterocysts may also be present. Vegetative cells cylindrical to barrel-shaped.

Reproduction by hormogones. Akinetes not present.

L. N. lobatus Wood em. Geitler 2:570

40. *Brachytrichia* Zanardini

Colonial; marine attached to rocks.

Colony hemispherical to flat, gelatinous; solid at first but becoming

hollow later; Nostoc-like in habit. Filaments uniseriate, heterotrichous, much-branched; branching lateral, usually at angle of an inverted - V. Sheaths confluent to form a hard, homogeneous or, less commonly lamellated, mucilage envelope. Basal trichomes prostrate. Erect trichomes more or less parallel, radiating outwards and ending in hairs. False branching occasionally present. Heterocysts intercalary, broader than vegetative cells. Hormogones apical on radial branches.

1. *B. quoyi* (Ag.) Born. & Flah. 2:580

41. *Mastigococladus* Cohn

Thalloid; on mud, wet rocks etc. Some species thermophilic. Thallus made up of heterotrichous filaments aggregated to form gelatinous, membranous or spongy strata; thalli sometimes firm, due to impregnation with calcium carbonate. Sheath thin and firm or diffluent. Trichomes mostly uniseriate with branching generally on one side and forming an inverted-V at base; false branching also often present. Vegetative cells barrel-shaped to cylindrical. Heterocysts intercalary; quadrate or spherical to ellipsoid; single or in series. Hormogones not known.

1. *M. laminosus* Cohn (4);2:580

42. *Hapalosiphon* Naegeli

Thalloid; free floating, or attached to submerged water plants or other objects, or on moist soil, damp bricks etc. Thallus made up of interwoven filaments forming caespitose strata or woolly masses. Filaments heterotrichous and variously bent, not coalescent laterally. Sheath present, usually colourless, trichomes uniseriate to biseriate, very seldom multiseriate; branches irregularly lateral, often only on one side; main axes prostrate; branches erect

and as broad as and similar to main axes but with thinner sheaths. False branching also present. Vegetative cells mostly cylindrical and with deep constrictions at the cross walls. Heterocysts intercalary or more rarely lateral; oblong to quadrate-cylindrical. Hormogones formed mainly in lateral branches. Akinetes subspherical to oblong.

- | | |
|---|-----------|
| 1. <i>H. delicatulus</i> W. & G.S. West | 2:591 |
| 2. <i>H. hibernicus</i> W. & G.S. West | (4);1:593 |
| 3. <i>H. luteolus</i> W. & G.S. West | 2:593 |
| 4. <i>H. aureus</i> W. & G.S. West | (4) |

43. *Westiellopsis* Janet

Filamentous; on moist soil.

Filaments heterotrichous and with true branching, sheaths absent. Primary filaments more or less prostrate; uniseriate or with short lengths multiseriate; secondary filaments erect, mostly uniseriate, generally narrower than the main filaments. Heterocysts intercalary; oblong-cylindrical.

Hormogones absent. Reproduction by endospores formed in special rounded cells (=hormocysts) which arise by the repeated division of dilated terminal portions of erect branches.

- | | |
|------------------------------|-----------|
| 1. <i>W. prolifica</i> Janet | (4);1:596 |
|------------------------------|-----------|

44. *Fischerella* (Born. & Flah.) Gomont

Filamentous or thalloid; free floating, or attached to wet rocks, barks of trees etc., or on damp soil.

Filaments heterotrichous, loosely or densely interwoven to form prostrate thalli. Sheath present; gelatinous; colourless or yellow to brownish; thin and close to trichome in young filaments, much thickened in older ones; homogeneous or lamellated. Cells of old main filaments

sometimes with Gloeocapsa-like sheaths. Main filaments prostrate, uni- to biserial; cells spherical to subglobose, quadrate or cylindrical, usually loosely arranged. Branches erect and uniseriate; false branching sometimes present; cells narrower than in main filaments, elongate cylindrical. Heterocysts intercalary or lateral; globose to barrel-shaped.

Hormogones terminal on erect branches. Akinetes present in some species.

1. *F. muscicola* (Thuret) Gom. (4);1:601
2. *F. ambigua* (Naeg.) Gom. 1:601

45. *Stigonema* Ag.

Filamentous; free floating, or attached to wet rocks, trunks of trees etc., or on moist soil.

Filaments heterotrichous, irregularly branched, bi- to multiseriate, and aggregated to form membranous or wooly, tufted or cushion-like, brownish to blackish masses. Sheath firm, close to trichome when young, but becoming much broader later; hyaline to yellowish-brown, brown or black; smooth or rough; homogeneous or lamellate, older cells sometimes with Gloeocapsa-like individual sheaths. Main axis prostrate, bi- to multiseriate when old; branches erect but similar to main axis. Vegetative cells globose, but may have flattened sides in young trichomes due to mutual compression; cells always separate and spherical in older filaments. Intercellular connections sometimes present. Heterocysts intercalary or lateral.

Hormogones apical on young branches; 2- to few-celled, occasionally many-celled.

1. *S. panniforme* (Ag.) Born. & Flah. 1:606
2. *S. ocellatum* (Dillw.)
Thuret ex Born. & Flah. 1:607
3. *S. turfaceum* (Berk.) Cooke
ex Born. & Flah. 1:609

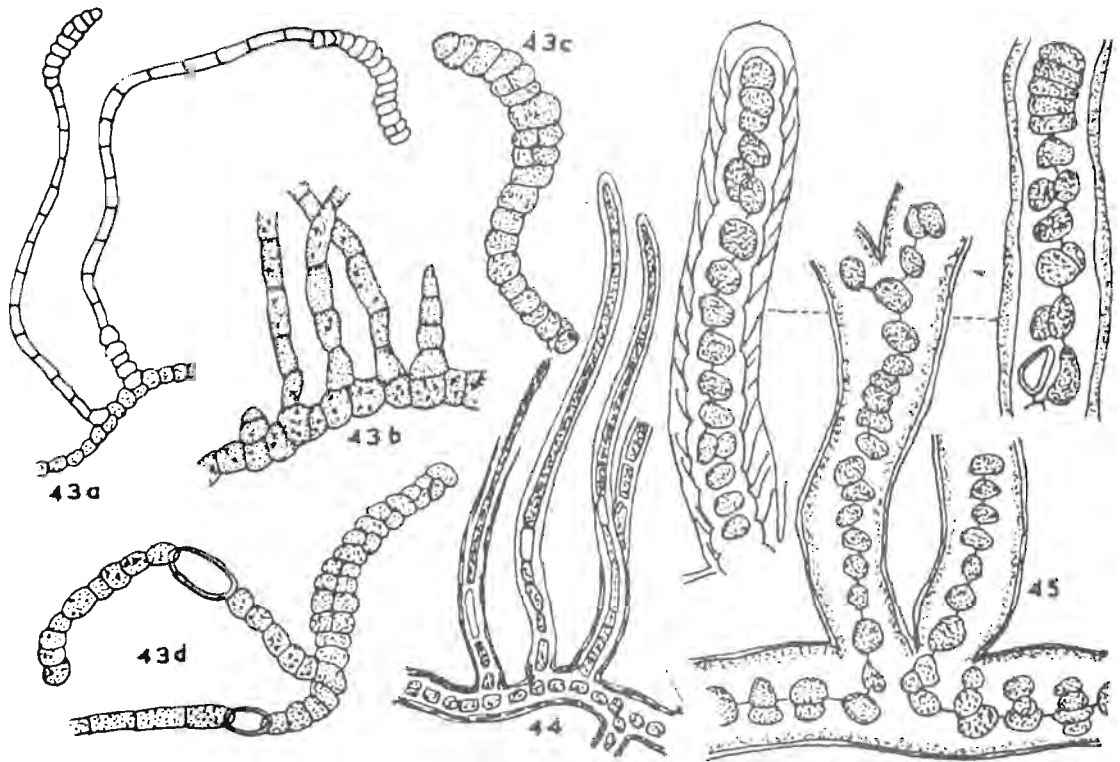


PLATE VI

Plate VI

43. *Westiellopsis prolifica* (a, x 175; b, x 350;
c,d, x 500).
44. *Fischerella ambigua* (x 500).
45. *Stigonema panniforme* (x 450).

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(See also the references at end of Part I, and also Wijesinghe (1981))

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