

Systematic Study of the Blue Green Algae of Ceylon kept at the Herbarium of the Royal Botanical Gardens, Peradeniya

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THE collection of blue green algae kept at the herbarium of the Royal Botanical Gardens, Peradeniya, were collected by Ferguson more than 70 years ago. Since then many changes have taken place in the taxonomy of the blue green algae. West (1902), Lemmermann (1907), Wille (1915), Crow (1923), Bharadwaja (1934) and Holsinger (1935) had described some of the blue green algae of Ceylon. While examining the collections of blue green algae kept at the herbarium we found that most of the identifications were incorrect and required revision. In the present paper 20 blue green algae are described. The classification and key to the species are based on the characters given by Desikachary (1959). Blue green algae are important to fisheries since *Chanos* larvae feed on them.

Division	..	CYANOPHYTA
Class	..	CYANOPHYCEAE
Order 1	..	NOSTOCALES
Family	..	OSCILLATORIACEAE

Genus 1 *Trichodesmium* Ehrenberg

Trichodesmium erythraeum Ehrenberg ex Goment Ehrenberg in Poggendorffs Ann. Phys. Chem., 18 ; 506 ; 1830., Gomont, Monogr. Oscillariées, 196, pl. 5, fig. 27-30 ; 1892 ; Desikachary, Cyanophyta, 1959, p. 245. *Trichodesmium ehrenbergii* Mont., Menr. sur le phenom de la color de la mer Rouge, Ann. Sci. nat. ser. 3, Bot. 2 ; 260, pl. 10, fig. d, 1844.

Oscillatoria erythraea (Ehrenberg) Geitler, Kryptogamenflora, 968, figs. 617, d, 1932.

Skujella erythrea (Ehrenberg) De Toni, J. Diagnoses Algarum novarum, 1, Cent. 5 ; 477, 1938.

Trichodesmium erythraeum Ehrenberg, Ceylon algae 339.

Plants purplish red in colour, forming short bundles ; trichomes free swimming 7-11 μ , rarely up to 21 μ broad ; trichomes are straight, parallal, constricted at the joints with gradually tapering ends, cells as long as broad 5-11 μ in length ; cell contents granular ; convexed or depressed calyptra present at the apex.

Genus 2 *Lyngbya* C. Agardh

Key to The Species of *Lyngbya*

- | | | |
|--|----|---------------------------|
| 1. Trichomes not more than 3 μ in diameter | .. | <i>Lyngbya ferruginea</i> |
| Trichomes more than 3 μ in diameter | .. | 2 |

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- (2) Trichomes 8–24 μ in diameter, apex of trichome slightly tapering, capitate, apical cell truncate, rarely somewhat acute, conical cells 2.7–5.6 μ in length *Lyngbya aestuarii*

Trichomes 15–60 μ in diameter, apex trichome not tapering, not capitate, apical cell round, cells 2–4 μ in length *Lyngbya majuscula*.

Lyngbya aestuarii Liebm. ex Gomont Var. *arbustiva* Bruhl et Biswas

Biswas, Indian Bark Algae. J. Dept. Sci., Calcutta Univ., 5 : 5, pl. 2, figs. 9a–c, 1923.

Desikachary, Cyanophyta, 1959, p. 307, Pl. 51, fig. 10. *Lyngbya ferruginea* (Harvey) Dickie Ceylon algae 124, 383.

Plant bluish green in colour with long flexible filaments densely interwoven. Diameter varies from 20–30 μ . Outer surface rough, trichomes 15 μ to 18 μ in diameter, not constricted at the joints, cells 2.7–5.6 μ in length. Cell contents green and densely granular, small as well as larger granules, often crowded near the dissepiments.

2. *Lyngbya ferruginea* G.S. West

West Indian Fresh Water Algae, Journ. of Bot. 42 : 292. pl. 464, f. 20.1904 ; De Toni, Syll. Algar 5 ; 283, 1907 ; Tilden, Minnesota algae, 1910, p. 114, Plate V, fig. 27–24 ;

Lyngbya guianensis Kuetzing.

Ceylon algae 352 ; Harvey 85, 86, 87, 88.

Filament 1.8–2.5 μ in diameter with thin rust coloured sheaths. Trichomes 0.8 to 1 μ in diameter, continuous and not constricted at the joints ; Absence of calyptra in the apical cells. Cells 4 to 6 μ in length with distinct transverse walls, not granulated.

3. *Lyngbya majuscula* Harvey ex Gomont.

Harvey in Hookers English Flora, 5 (part 1) 370, 1833 ; Gomont, Monogr. Oscillariées, 151, pl. 3, figs. 3 and 4 1892 ; Forti in De Toni, Sylloge, Algarum 5 : 268 1907 ; Geitler, Kryptogamenflora 1060, figs. 672c, d, 1932 ; Boergesen, Mar. Alg. of Ceylon, Ceylon Journal of Science, 1936, p. 60 ; Dawson Pac. Naturalist 1 (57 ; 29 ; 1959 ; Desikachary, Cyanophyta, 1959, p. 313 ; Tanaka, Blue green Algae of Japan, Mem. Kyoto University, 1961, p. 54 ; Ceylon algae, Harvey 84.

Plants caespitose up to 7 cms. in length widely expanded ; colour blue green or yellowish green. Filaments very long, often curled in a circinate manner, slightly flexuous 25–65 μ in diameter ; sheaths hyaline, but later becoming wide, lamellate and rough on surface. 10–15 μ in thickness, trichomes 15–60 μ in diameter, not constricted at the joints, apices not attenuate apical cell rotunal with no calyptra ; cell walls not granulate or constricted ; cells 2–4 μ in length ; protoplasm dull grey.

Genus 3. *Schizothrix* Kuetzing

Key to the species of *Schizothrix*

- | | | | |
|-----------------------------------|----|----|------------------------------|
| 1. Sheath of filaments colourless | .. | .. | <i>Schizothrix lacustris</i> |
| 1. Sheath of filaments coloured | .. | .. | 2 |

2. Cells shorter than broad	..	..	<i>Schizothrix muelleri</i>
Cells longer than broad	..	..	3
3. Sheaths reddish			<i>Schizothrix telephoroides</i>
Sheaths yellowish to brownish, trichomes 3-6 μ . broad	....		4
4. End cells rounded	..	..	<i>Schizothrix fuscescens</i>
End cells conical			<i>Schizothrix ericetorum</i>

1. *Schizothrix lacustris* A. br. ex Gomont

Braun in Kuetzing, Species Algarum, 320, 1849; Gomont, Monogr. Oscillariées, 301, pl. 6, figs. 9-12, 1892; Desikachary, Cyanophyta, 1959, p. 325, pl. 5a, figs. 6-10.

Hyphaeothrix confervae Kuetzing

Ceylon Algae 173, 179, 186.

Schizothrix crinalis Dickie m.s. (*Lyngbya*, sp; *Calothrix* sp;)

(Herb Per. Prov. No. 4 (c.p.))

Filaments hyaline or slightly yellow; trichomes many in a common sheath in older filaments, but usually single or a few together in the younger filaments; cells up to 4 μ . long, longer than broad.

2. *Schizothrix telephoroides* (Montagne) Gomont

Monogr. Oscillariées. p. 319, pl. 10, figs. 1-4, 1892, De Toni, Syll. Algar. 5; 359, 1907; Tilden. Minnesota Algae. p. 151, pl. VI, fig. 19, 1910; Desikachary, Cyanophyta 1959, p. 330, pl. 57, figs. 2, 7 and 8, *Schizothrix smithii* Kuetzing; G.H.K. Thwaites 2 (Dolosbage).

Thallus caespitose, reddish or rust coloured. Filaments divided and branched into rarely dichotomous divisions forming spirally twisted tufts. Sheaths, thick, firm, lamellose, the inner layers red the outer colourless; trichomes 4-9 μ . in diameter, usually solitary but sometimes two in a sheath distinctly constricted at the cross walls. Cells 1-2 times as long as broad, 6-14 μ . long; cells contents coarsely granular; end cells rounded.

3. *Schizothrix muelleri* Nageli ex Gomont

Nageli in Kuetzing, species Algarum, 320, 1849, Gomont. Monogr. Oscill. 59, pl. 10, f. 5-7, 1903 De Toni, Syll Algar 5: 362. 1907, Tilden, Minnesota Algae, p.152, pl. VI, fig.23, 1910; Desikachary, Cyanophyta 1959, p. 330, pl. 57, figs. 9 and 10.

(*Schizothrix* sp., *Calothrix* sp.) Herb. per. prov. No. 1

Schizothrix aurantaca Kutz. v. *variecola* (*Calothrix* species) (Herb. Per. Prov. No. 3. C.P.)

Filaments long and flexuous woven into an indefinite expanded blackish grey mass, forming decumbent tufts attached to mosses. Sheaths golden yellow, firm, irregular in outline with pointed apex; trichomes 7-13 μ . in diameter, slightly constricted solitary or a few within a sheath end cell obtuse, cells 4-9 μ . in length; cell contents coarsely granular.

4. *Schizothrix fuscescens* Kuetzing ex Gomont

Kuetzing Phyc. gene, 230, 1843, Gomont, Monogr. Oscillariées, 324, pl. figs. 4-5, 1892; Geitler Kryptogamenflora, 1112, fig. 717, 1932; Desikachary, 1959, p. 332, pl. 58, figs. 7, 8;

Scytonema muscicola Dickie m.s. (*Calothrix* sp.); Herb. per. Prov. No. 5 Ambagamuva.

Thallus brownish to yellowish in colour. Filaments branched and closely appressed. Sheaths golden yellow outside but colourless inside. Sheaths lamellated trichomes constricted at the cross walls, cells 7-14 μ long, end cell rounded.

5. *Schizothrix ericetorum* Lemmermann

Kryptogamenflora der Mark Brandenburg, 3; 153. fig. 10, n.p. 102, 1910; Geitler, Kryptogamenflora 1113, fig. 718, 1932, Desikachary, Cyanophyta, 1959, p. 332. pl. 58, figs. 5, 6.

Scytonema coerulescens Dickie M.S. (*Calothrix* sp.)

Herb Per. Prov. No. 8 (C.P.) 1968

Thallus dark brown, numerous filaments together, distinctly branched. Sheath yellowish brown distinctly lamellated and pointed at the ends. Trichomes 2-2.8 μ broad; cells longer than broad or of the same size, 3-5.5 μ long; and cells pointed and conical.

Genus 4. *Oscillatoria* Vaucher*Oscillatoria limosa* Ag. ex. Gomont

Agardh, Dispositio Algarum Sueciae 35, 1812; Gomont. Monogr. Oscill. 20, pl. 6, fig. 1892, De Toni, Syll. Algar. 5: 154. 1907, Tilden, Minnesota Algae 1909, p. 65; Desikachary, Cyanophyta, 1959, p. 206, pl. 42, fig. 11.

Calothrix radiosa Kutz. var. *aeruginea*. Herb. Per Prov. no. I (C.P.) Plant dark blue green; trichomes 10-20 μ in diameter, crowded, straight, not constricted at the joints; apical cells showing a convex somewhat thickened outer wall, cells 1/3-1/6 as long as broad. 2-5 μ in diameter; transverse walls frequently granulated; cell contents blue green or olive.

Family 2. Nostocaceae Kuetzing

Genus *Cylindrospermum* Kuetzing*Cylindrospermum stagnale* (Kuetzing) Born. et Flah.

Revision des Nostocacées hétérocystées. 250, 1888, Forti in De Toni, Sylloge Algarum, 5, 472 1907; Desikachary, Cyanophyta, 1959. p. 363, pl. 65, fig 9.

Anabaena stagnalis Kuetzing, Phyc. germ, 173, 1845. *Cylindrospermum macrospermum* Kuetzing, Phyc. germ, 173, 1845. *Cylindrospermum macrospermum* Kuetzing, Ceylon Algae 218 (Katugastota).

Plant mass floccose, expanded, attached or free floating, trichomes 3.8-4.5 μ in diameter, slightly constricted at the joints, cells 3-4 times the diameter in length; heterocysts oblong or subspherical up to 16 μ in length and 6 to 7 μ in diameter; gonidia 10-16 μ in diameter and 32-40 μ in length; cell contents pale blue green.

Family 3. Scytonemataceae Rabenhorst.

Genus *Scytonema* Agardh*Scytonema stuposum* (Kuetzing) Bornet ex Born. et Flah.

Bornet in Bornet and Thuret, Notes algologiques 2: 146, 1880; Bornet and Flahault, Revis des Nostoc. Ann. Sci. Nat. Bot. VII 5: 92. 1887; De Toni Syll. Alg. 5: 503. 1907; Desikachary, Cyanophyta 1959, p. 459. pl. 93, fig. 4.

Scytonema aureum Menegh (*Oscillatoria* sp.)

(Herb. Per. Pro. No. 13, C. P.)

Plants cushion shaped and woolly ; widely expanded ; filaments 15–30 μ in diameter, 5–10 mm. long ; false branches solitary or in pairs and resemble the main filament ; sheaths thick and gelatinous ; trichomes 12–18 μ broad, cells subquadrate or two or three times shorter than the diameter, colour olive-violet heterocysts have the same diameter as the vegetative cells.

Genus *Tolypothrix* Kuetzing*Tolypothrix distorta* Kuetzing ex Born. et Flah.var. *penicillata* (Ag.) Lemm.

Kryptogamenflora der Mark Brandenburg, 3 : 218, 1910 ; Geitler, Kryptogamenflora, 719, fig. 461, 1932. *Tolypothrix penicillata* (Agardh) Thuret. Essai Class. Nostochinecs. Ann. Sci. Nat. Bot. VI. 1 : 380, 1875. Bornet and Thuret. Revis. des Nostoc. Ann. Sci. Nat. Bot. VII. 5 : 123. 1887, De Toni Syll Algar. 5 : 549. 1907. Desikachari Cyanophyta 1959, p. 497 *Scytonema ocellatum?* (*Calothrix* sp. ; *Scytonema stuposum* Bornet). Ceylon Algae 234 (1872).

Plant mass penicillate caespitose, deep brown in colour. Filaments 2 cms. long, repeatedly branched false branches erect at the base flexuously curved ; sheaths, firm and membranaceous, colourless or brownish ; trichomes 9–10 μ in diameter, cylindrical, cells 4–12 μ in length. Heterocysts single, spherical, cylindrical or quadrate.

Family Rivulariaceae Rabenhorst

Calothrix Agardh*Calothrix breviaticulata* W. et. G. S. West

Welwitsch's African Fresh water Algae. Journal of Bot. 35 : 240, 1897 ; De Toni Syll. Algar, 5.620, 1907 ; Geitler, Kryptogamenflora 616, fig. 389, 1932 ; Desikachary, Cyanophyta, 1959, p. 537, fig. 9.

Scytonema tomentosum Kuetz. (*Oscillatoria* sp. ; *Calothrix* sp. Herb. Per. Prov. nos. 9, 14, 14x (C.P. 1868) Ceylon Algae 224, 225

Filaments single or together 15–16 μ broad at base and 11.5–12.5 μ in the middle portions up to 380 μ in length, sheaths thick and lamellose, blackish brown in old plants ; trichomes 8.5 μ in diameter at the base 5.5–7.5 μ broad in the middle portions, constricted at the septa, cells to 5 times longer than their diameter ; heterocysts solitary, basal, hemispherical.

Order STIGONEMATALES Geitler

Family 1 Nostochopsidaceae Geitler.

Nostochopsis lobatus Wood em. Geitler

Wood, Prodromus, Study of fresh water Algae of Eastern North America, Proc. Amer. phil Soc. 11 : 119, 1869 ; Forti in De Toni, Syll. Algar, 5, 592, 1907 ; Desikachary, Cyanophyta 1959, P. 570. Pl. 120, figs 1–8. *Scytonema gracile?* Kuetz. (*Scytonema cinereum* Menegh.) ; Ceylon algae 228.

Thallus spherical or subspherical lobed up to 2 cms. in diameter ; trichomes 4–10 μ in diameter and 1 mm. in length ; branched from the base, flexuos constricted at the joints branches unilateral, cylindrical below, torulose in upper portions club shaped, cells up to twice as long as wide, heterocysts laterl and sessile or terminal and pedicellate on 2–3 or 4-celled lateral branch.

Family 2 *Mastigocladaceae* GeitlerGenus *Brachytrichia* zanardini

Brachytrichia quoyi (Ag.) Born et Flah. Revision des Nostocacées hétérocystées, 373, 1886 *Brachytrichia balani* (Lyoyd) Born and Flah ; Revision des Nostocacées hétérocystées, 372, 1886. Geitler, Kryptogamenflora, 554, figs. 347 and 348, 1932 ; Desikachary Cyanophyta, 1959, p. 580, pl. 125, figs. 1–9 and Pl. 124 figs. 1–16.

Rivularia nitida var. *spiralis* Kuetz. Dickie Ceylon algae 114.

Colonies up to 6 cms. in diameter, plicate expanded, confluent, blackish green, sometimes hollow; filaments entangled in the lower portions giving rise to branches which are radial or more or less parallel ending in short or long hairs. In the basal portion of the trichomes cells are 4–5 μ . broad and cells twice as long as broad; cells of the radial filament are short barrel shaped 6–9 μ . broad; heterocysts broader than the trichome.

Family 3 Stigonemataceae Kirchner

Genus *Stigonema* Agardh

- | | | | |
|--|----|-----|------------------------------|
| 1. Sheaths coloured and lamellated | .. | .. | 2 |
| 1. Sheaths colourless and not lamellated | | ..3 | <i>Stigonema dendroideum</i> |
| 2. Filaments 2–26 μ . broad, hormogones terminal about 100 μ . long..... | | | <i>Stigonema panniforme</i> |
| 2. Filaments 2–45 μ . broad, hormogones 50–65 μ . long | | | <i>Stigonema ocellatum</i> |
| 3. Filaments with attenuated ends, 16–22 μ . broad | | | |

Stigonema Panniforme (Agardh) Bornoet Flah.

Bornet and Flahault, Revis des Nostoc. Ann. Sci. Nat. Bot. VII 5 : 71. 1887 Geitler, Kryptogamenflora, 503, fig. 304, Desikachary, Cyanophyta, 1959, p. 606, pl. 134, figs. 8–10 and Pl. 138, fig. 1.

Stigonema panniforme (ag.) Krichner, Algenflora

Non Schlesien, 230; *Sirosiphon truncicola* Rab. (*Scytonema* sp.) (Herb. Per. Prov. No. 6 C.P.) 1868

Thallus caespitose, olive black; filaments 1mm. in length 24–36 μ in diameter, decumbent flexuous, intricate, with broad attenuated ends, irregularly branched, branches erect, agglutinated laterally in fascicles, sheath thick lamellated, yellowish or yellowish brown, cells short separated in one series usually in a single row; heterocyst sparse, mostly intercalary; hormogones terminal 100 μ . in length and 20 μ . in diameter.

Stigonema ocellatum (Dillw.) Thuret ex Born. et. Flah. Thuret, Essai Class. nostoch Ann. Sci. Nat. Bot. ser. 6:1 : 380. 1875; Bornet and Flahault. Revised Nostoc. Ann. Sci. Nat. Bota. VII, 5. 69, 1887; De Toni. Syll. Algar. 5. 578. 1907 Desikachary, Cyanophyta, 1959, p. 607, pl. 138, fig. 2; *Sirosiphon pulvinatus* Breb. (*Scytonema* sp.).

Herb. Per. Prov. No. 2 (Dolesbage 1868)

Thallus cushion like, caespitose, brownish, wooly. filaments 3–8 mm. long, erect, decumbent at the base, irregularly branched, branches as broad as or smaller than the main filaments 35–45 μ . broad, all bearing hormogones sheaths thick, lamellose colourless or yellowish brown; trichomes consisting usually of one row or sometimes two rows of cells; 20–30 μ . broad usually wider than long; each cell surrounded by a special, coloured envelope; heterocysts rare, mostly lateral, 50–65 μ . long and 15 μ . broad.

Stigonema dendroideum Frey

Myxo. de. Afr. equat. franc. 405, figs. 329–330; Geitler, Kryptogamenflora, 512, figs. 310 and 311, 1932, Desikachary, Cyanophyta, 1959, p. 609; pl. 135, figs. 1, 2 and pl. 137, figs. 3, 4.

Schizothrix fuscescens Kuetz; (Herb. Per. Prov. No. 11 C.P.)

Thallus expanded brownish black. Filaments creeping 15–25 μ . broad with erect branches; matured branches as broad as main filament secondary branches gradually attenuated; Sheath colourless and close to trichome not lamellated; in the main filaments 2–3 rows of cells 14–20 μ . broad, single row of cells in the Secondary branches 7–14 μ . broad; heterocysts few, intercalary or lateral, hormogones 40–60 long μ . and 10–14 μ . broad.

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