Observations on algal collections from Khasia and Jaintia Hills, Assam, India.

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(With 3 plates and 1 figur in Text.)

In October 1925, Dr. S. P. Agharkar, Professor of Botany, Calcutta University, made a small collection of partly fresh and partly preserved materials of mostly blue-green algae of subaerial habit from Shillong and Cherrapunji in the Khasia and Jaintia Hills of Assam, lying between 24° 58′ and 26° 7′ N. and 90° 45′ and 92° 51′ E., with an area of 6,027 square miles. His collection was placed at my disposal and for this act of kindness I tender my sincere thanks to Prof. Agharkar. Mr. A. C. Joshi, Assistant Professor of Botany of Benares Hindu University, gathered some more specimens in eight bottles from these parts during his botanical excursion in April 1932. He was kind enough to present his gatherings to me, and I am indeed thankful to Prof. Joshi for his taking the trouble of collecting algal specimens for me. Out of the eight bottles of Joshi's collection, all preserved in 3% aqueous formalin solution, Bottles No. 1, 2, 5 and 6 contain either sterile or fragmentary specimens which can not be determined. Bottle No. 3 contains pure material of the iron-bacterium *Lepthothrix ochracea*. Bottle No. 6 contains specimens of pure *Anaebena*-species but without any spore and hence cannot definitely be identified. This material of *Anabaena* species was collected from Krinoline falls in Shillong. Bottle No. 4 proves to have a rich collection of colonial members of green algae preserved in half a dram of formalin solution. The number of species found in this small bottle indicates the abundant growth of the representatives of the families of *Hydrodictyaceae, Coelastraceae* and *Oocystaceae* in the pools and puddles of the Khasia and Jaintia hills. Moreover, the presence of these members of algae in such pools as are near Companygunj dakbungalow suggests that the quality of the water of these pools is suitable for the growth of "oligosaprob" algae of unicellular and colonial type. A number of interesting

widely distributed species of Desmids has been discovered from a bottle containing algal material from a ditch in Shillong collected by Mr. P. Mojumdar in March 1924. My thanks are therefore due to Mr. Mojumdar for handing over his gathering to me.

The climatic conditions of Shillong and Cherrapunji have considerable bearing on the vegetation. Cherrapunji records the highest rainfall on the surface of the globe. "During four months in the year a great quantity of rain falls at Cherra, on an average about five hundred inches in the twelve months" Nevertheless it does not rain here for a greater space of time. "The maximum summer temperature is 83° F. and minimum 43° F."[1]). But Cherra is very much free from being constantly enveloped in clouds and mists than the hill stations as Mussiore and Darjeeling during the rains. "To the denuding force of these heavy and sudden falls of rain is also due to the almost total absence of any soil in the flat of the hills near the southern escarpment. All has in fact washed away and a thin crop of coarse grass alone finds sustenance on the rocky surface. The marked absence of trees, the growth of which is cut off with the axe along the edges of every flat is largely due to the same causes but also largely to the blighting storms which sweep over these hills. On the sloping sides of the valleys trees grow abundantly, and at

Tab. 1.

Shillong.

Five day normals of Relative Humidity at 8 hours Local time[2]).

Month	1st–5th	6th–10th	11th-15th	16th-20th	21st-25th	26th–end of the month
	%	%	%	%	%	%
January	72	73	73	73	73	73
February	69	68	67	66	64	62
March .	56	54	53	53	53	54
April	55	57	60	64	66	68
May	69	71	72	74	76	78
June	79	81	82	84	85	86
July	85	86	86	86	86	86
August	86	86	86	86	86	85
September	85	85	84	84	83	82
October	85	83	82	80	78	76
November	74	74	73	73	72	71
December	74	73	72	72	72	72

[1]) Assam Dist. Gazetteer, 10, p. 31—32.

[2]) I am grateful indebted to Dr. S. N. Sen, Meteorologist, Calcutta, for his very kindly supplying these climatological data.

many places luxuriantly; then they are sheltered and abundantly supplied with moisture. But though Shillong is only twenty miles as the crow flies from Cherrapunji the average rainfall there is only

Tab. 2.

Shillong.

Five day normals of Maximum Temperature in degrees Fahrenheit during the 24 hours of the day ending at 8 hours.

Month	1st–5th	6th–10th	11th-15th	16th-20th	21st–25th	26th–end of the month
January	61.0	60.8	60.6	60.5	60.5	60.7
February	61.4	61.6	62.3	63.0	64.1	65.4
March .	66.6	68.1	69.7	70.8	71.6	72.3
April	72.5	72.8	73.2	73.2	73.2	73.3
May	73.6	73.6	73.8	74.3	74.5	74.6
June	74.9	74.8	74.6	74.4	74.5	74.7
July	74.5	74.7	75.4	75.0	75.5	75.6
August	75.8	75.6	75.1	74.8	74.6	74.5
September	74.1	74.2	74.3	74.4	74.1	73.6
October	73.4	72.7	71.7	70.8	69.9	69.0
November	68.6	67.7	66.9	65.9	65.1	64.5
December	63.2	62.4	61.8	61.4	61.1	60.6

Tab. 3.

Shillong.

Five day normals of Minimum Temperature in degrees Fahrenheit during the 24 hours of the day ending at 8 hours.

Month	1st–5th	6th–10th	11th-15th	16th-20th	21st–25th	26th–end of the month
January	39.0	39.0	39.1	39.6	39.9	40.5
February	40.7	41.3	41.9	42.7	43.7	44.8
March	46.1	48.1	49.9	51.6	52.9	54.1
April	54.7	55.6	55.9	56.6	56.8	57.2
May	57.9	58.1	58.5	59.0	59.6	60.2
June	60.8	61.8	62.8	63.4	63.8	64.0
July	64.5	64.5	64.5	64.4	64.1	64.0
August	64.2	64.0	63.8	63.7	63.5	63.3
September	62.7	62.4	61.8	61.2	60.6	59.7
October	59.3	57.6	56.1	53.3	52.0	50.8
November	49.7	48.4	47.2	45.2	43.8	42.4
December	41.7	40.6	40.0	39.5	39.1	38.8

82 inches in the year, a figure which for Assam is comparatively low. The climate of the higher hills is exceedingly salubrious. In the hottest days in summer the thermometer in a bungalow in Shillong

seldom rises above 80° F." Further details of climatological data such as relative humidity, maximum and minimum temperature and five day normals of accumulated rainfall in Shillong and Cherra-

Tab. 4.

Shillong.

Five day normals of accumulated rainfall at Shillong in inches.

Month	1st–5th	6th–10th	11th-15th	16th-20th	21st–25th	26th–end of the month
January	0.00	0.05	0.10	0.20	0.27	0.33
February	0.05	0.11	0.38	0.88	1.13	1.20
March .	0.09	0.36	0.62	0.97	1.54	1.93
April	0.56	1.66	2.55	3.44	4.34	5.38
May	1.70	3.75	5.48	6.81	8.22	10.57
June	2.13	5.22	8.64	12.16	14.41	16.37
July	1.75	4.94	8.44	10.33	12.30	14.48
August	1.64	4.28	7.97	9.96	11.83	14.36
September	1.67	3.18	4.55	6.51	8.71	10.73
October	1.35	2.38	3.17	4.53	5.62	6.80
November	0.77	0.95	1.20	1.38	1.51	1.58
December	0.00	0.00	0.03	0.08	0.13	0.19

Tab. 5.

Cherrapunjee.

Five day normals of Relative Humidity at 8 hours Local time.

Month	1st–5th	6th–10th	11th-15th	16th-20th	21st–25th	26th–end of the month
	%	%	%	%	%	%
January	70	71	72	72	72	71
February	72	70	69	68	68	68
March .	66	67	68	70	73	78
April	83	84	84	84	84	84
May	85	85	86	86	88	89
June	92	93	94	94	95	95
July	96	96	96	96	96	96
August	95	95	95	95	94	94
September	93	93	91	89	88	86
October	85	83	82	80	78	76
November	73	71	70	68	66	65
December	69	68	68	68	71	72

punji are given in the tables 1—8. These factors throw some light on the nature of the growth of algal and herbaceous associations in and about Shillong and Cherrapunji.

The geological factors of the country are also of particular interest and has much influence on vegetation. Shillong plateau includes most of the Khasia and Jaintia hills, part of the Garo hills

Tab. 6.

Cherrapunjee.

Five day normals of Maximum Temperature in degrees Fahrenheit during the 24 hours of the day ending at 8 hours.

Month	1st–5th	6th–10th	11th-15th	16th-20th	21st–25th	26th–end of the month
January	60.7	60.5	60.4	60.5	60.6	60.6
February	61.0	61.1	61.8	62.2	63.1	64.3
March .	65.2	66.5	67.5	68.3	68.9	69.7
April	69.3	69.7	69.9	70.2	70.6	70.7
May	71.4	72.0	72.2	72.8	72.9	73.0
June	72.8	72.5	72.2	71.9	71.8	71.7
July	71.8	71.9	72.0	72.3	72.7	72.7
August	72.8	72.5	72.3	72.1	72.1	72.2
September	72.2	72.6	73.1	73.6	73.7	73.6
October	73.6	72.9	72.2	71.3	70.2	69.8
November	69.4	69.0	68.2	67.2	66.3	65.2
December	63.8	62.9	62.3	61.7	60.8	60.2

Tab. 7.

Cherrapunjee.

Five day normals of Minimum Temperature in degrees Fahrenheit during the 24 hours of the day ending at 8 hours.

Month	1st–5th	6th–10th	11th-15th	16th-20th	21st–25th	26th–end of the month
January	46.2	46.1	46.0	45.8	45.8	46.1
February	46.6	47.0	47.5	48.0	48.8	49.7
March .	50.6	52.0	53.1	55.0	56.2	57.1
April	57.0	57.3	57.6	57.6	57.7	57.9
May	59.4	59.8	60.4	60.8	61.4	62.3
June	62.5	63.1	63.9	64.4	64.9	65.0
July	64.7	64.8	64.8	64.8	64.7	64.7
August	65.0	65.0	65.0	65.0	65.1	65.1
September	64.6	64.6	64.5	64.1	63.6	62.8
October	62.4	61.7	60.8	59.8	58.8	57.9
November	57.0	56.0	54.8	53.2	51.8	50.7
December	49.5	48.6	47.8	47.1	46.5	46.2

and a small part of the North Cachar hills and it "consists of a great mass of gneiss, which is bare on the northern border, but in the central region is covered by transition or sub-metamorphic rocks.

To the south, in contact with the gneiss and submetamorphic, is a great volcanic outburst of trap which is stratified and brought to the surface south of Cherrapunji"[1]). "In the Khasi and Jaintia hills near Cherrapunji, the base of Cretaceous is usually an irregular conglomerate, up to 100 ft. thick, made up largely of metamorphic and igneous pebbles, and interbedded with thin sandstones" "In the Therria neighbourhood and elsewhere, the beds assigned to the cretaceous consist of shales and thin limestones overlying a thin massive sandstone" "Of considerable interest is the occurrence of

Tab. 8.

Cherrapunjee.

Five day normals of accumulated rainfall at Cherrapunjee in inches.

Month	1st–5th	6th–10th	11th-15th	16th-20th	21st–25th	26th–end of the month
January	0.00	0.04	0.09	0.14	0.24	0.45
February	0.26	0.51	0.96	1.71	2.36	2.72
March .	0.72	1.28	1.85	3.50	7.11	9.38
April	1.24	3.53	9.09	16.80	23.01	28.19
May	6.26	12.60	19.74	25.74	32.91	46.28
June	9.82	25.16	43.18	65.01	82.08	95.92
July	12.62	34.11	56.84	71.21	84.51	98.51
August	13.55	31.23	50.96	60.95	67.53	79.84
September	6.75	12.51	21.14	26.30	30.39	37.98
October	6.49	9.17	11.12	14.21	17.54	21.26
November	1.48	1.96	2.52	2.80	3.05	3.23
December	0.00	0.04	0.09	0.16	0.29	0.31

fossil (beds); these have been found in several localities near Cherrapunji and include a large fauna suggestive of Upper Senonian age and similar to the Cretaceous fossils of Madras, Madagascar and Natal"[2]).

Thus the edaphic and climatic conditions of these parts of India are to a certain extent favourable to the healthy growth of a large number of subaerial algae, especially during the moist seasons, on

[1]) Imperial Gazetteer of India, Eastern Bengal and Assam (1909), 482.

[2]) Transactions Mining & Geological Inst. of India, 17 (1932), 167—168.

the valleys, hill-slopes and table-lands of the Khasia and Jaintia hills district of Assam. Dr. Agharkar makes the following remarks on the nature of the habitats of these algae. "The *Cyanophyceae* forms a fairly thick matted felt at the base of a number of species of Phanerogams which form a characteristic association which is found to be characteristic of the flat plateau like portions surrounding the dakbungalow at Cherrapunji and elsewhere. The phanerogamic species are very varied and are mainly composed of some grasses together with two species of *Impatiens*, one species of *Xyris*, two species of *Eriocaulon*, species of *Utricularia* (one yellow flowered and two rose coloured flowers) and others" The Phanerogams composing the characteristic association referred to above have subsequently been identified by the writer as follows: (1) *Xyris pauciflora* Willd., (2) *Xyris schaenoides* Mart., (3) *Xyris Wallichii* Kunth, (4) *Eriocaulon Brownianum* Mart., (5) *Eriocaulon nepalense* Presc., (6) *Eriocaulon Sieboldianum* Sieb., (7) *Fimbristylis bispicata* Nees and Mayeb., (8) *Mitraseme nudicaulis* Reinw., (9) *Utricularia orbiculata* Wall., (10) *Utricularia furcilata* Oliver, (11) *Utricularia Wallichiana* Wight and (12) *Impatiens Juripa* Ham. The algae other than the subaerial were collected from Krinoline falls, different pools and streams in and about Shillong and Cherrapunji. Mr. Joshi's collection is composed more or less of freshwater species from similar habitats. A few of the fresh blue-green subaerial algae were received from Dr. Agharkar with part of the matrix of the original substratum. These algae were cultivated in moist chambers under varying degrees of moisture and humidity. In these moist chambers all the algae thrived well. Within three to four weeks the algae under culture regained their normal freshness and without much difficulty several algae were separated from the cultures. *Lyngbya truncicola* var. *burmense* mixed with *Microcoleus chthonoplastes*, gathered from a meadow in Shillong, made their first appearance. Predominant development of *Stigonema aerugineum*, *Lyngbya aerugineo-coerulea* and *Porphyrosiphon Notarisii* and *Schizothrix telephoroides* indicates the subaerial nature and carpet-like spreading habit of these algae. Suitable humid atmosphere and sufficiently moist substratum are the main factors which control the lifehistory of these subaerial algae growing in their original habitats. This fact has also been confirmed by the artificial cultures of these algae inside moist chambers. It has also been found that abundant watery medium tends to disorganize the plantmasses of these subaerial algae and ultimately leads to decomposition. The nature of the growth of the subaerial algae as observed both in the field and in the cultures

in relation to atmospheric humidity and varying degrees of moist substrata may be illustrated in the table below:

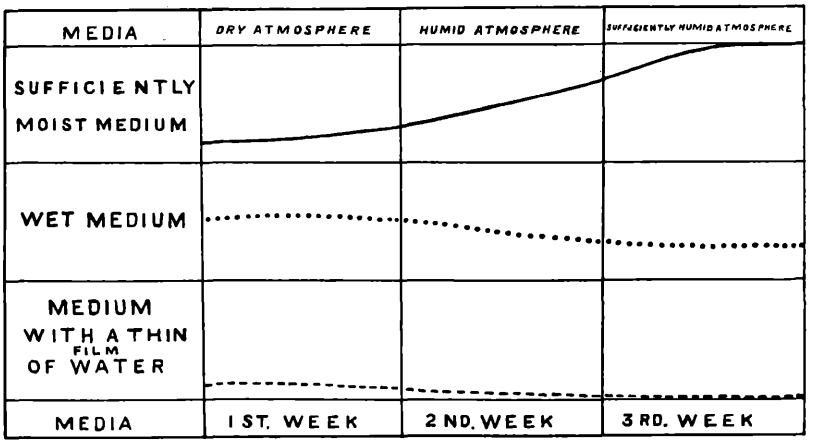

TABLE SHOWING THE GROWTH OF SUBAERIEL ALGAE UNDER VARYING DEGREES OF ATMOSPHERIC HUMIDITY AND MOIST MEDIA. AS INDICATED IN THE CULTURES AND IN THE FIELD.

The subaerial algae mentioned above were mainly collected from a flat meadow in Cherapunji at an elevation of about 300 m. The species referred to illustrate characteristic habit and nature of their occurrence. *Lyngbya aerugineo-coerulea* the cosmopolitan amphibious alga, along with *Porphyrosiphon Notarisii* with its well marked thick lamellose or fibrillose pink or deep brownish pink sheath, *Schizothrix telephoroides*, *Stigonema aerugineum* and other members of *Scytonemataceae* formed an interesting mixed association of carpet-like expanded algal formation at the bases of the trailing herbaceous association of the meadow formation. The preserved material of the freshwater *Rhodophyceae* from Krinoline falls at Shillong proved to be of particular interest as it represents an interesting dwarf form of *Sirodotia cirrhosa* of considerable cytological importance as suggested by Dr. H. S k u j a of the Latvia University, who is at present engaged in the monographic study of the freshwater *Rhodophyceae*. The genus *Sirodotia* is more primitive than *Batrachospermum*. The new genus *Sirodotia* has been established by K y l i n in 1912, and although very closely allied to *Batrachospermum*, it has been considered a separate genus from *Batrachospermum*. My best thanks are due to Dr. H. S k u j a for his opinion on this specimen of freshwater red alga.

Out of the fortyfive species mentioned in this paper *Gloecapsa montana*, *Oscillatoria terebriformis*, *Lyngbya rivularianum*, *L. aureo-*

Specific names of species found	Europe	America	Indo malayan	Africa	East Asia	Shillong, Assam (India)
1. *Gloeocapsa montana*	+	+	—	—	—	—
2. *Oscillatoria princeps*	+	+	+	+	+	—
3. *O. pseudogeminata*	+	—	+	—	—	—
4. *O. terebriformis*	+	—	—	—	—	—
5. *O. splendida*	+	+	+	+	+	—
6. *Spirulina major*	+	+	+	+	+	—
7. *Lyngbya rivularianum*	+	—	—	—	—	—
8. *L. ochracea*	+	+	+	+	+	—
9. *L. ceylanica*	—	—	+	—	—	—
10. *L. truncicola*	—	—	+	—	—	—
11. *L. aureo-fulva*	—	—	—	+	—	—
12. *L. aerugineo-coerulea*	+	+	+	+	+	—
13. *Porphyrosiphon Notarisii*	+	+	+	+	+	—
14. *Schizothrix telephoroides*	—	+	+	+	—	—
15. *Microcoleus cthonoplastes*	+	+	+	+	+	—
16. *Scytonema crispum*	+	+	+	+	+	—
17. *Petalonema crustaceum*	+	+	—	—	—	—
18. *Stigonema aeruginеum*	—	+	—	—	—	—
19. *Gloetrichia atra*	+	—	—	+	+	—
20. *Chlorococcum humicolum*	+	+	+	+	+	—
21. *Pediastrum duplex*	+	+	+	+	+	+
22. *P. tetras*	+	+	+	+	—	+
23. *Oocystis elliptica*	+	—	+	+	—	—
24. *O. solitaria*	+	+	+	+	—	—
25. *Tetrastrum tetracanthum*	—	—	—	+	—	—
26. *Scenedesmus obliquus*	+	+	+	+	+	—
27. *S. acuminatus*	+	+	+	+	+	+
28. *S. spinulatus*	—	—	—	—	—	—
29. *S. brasiliensis*	+	+	+	+	+	+
30. *S. quadricauda*	+	+	+	+	+	+
31. *S. bijugatus*	+	+	+	+	+	+
32. *Coelastrum sphaericum*	+	+	+	+	+	—
33. *C. proboscideum*	+	—	—	+	—	—
34. *Spirogyra communis*	+	+	—	—	—	—
35. *Penium Navicula*	+	+	+	+	+	—
37. *Closterium Jenneri*	+	+	+	+	+	—
38. *Cl. Leibleinnii*	+	+	+	+	+	+
39. *Cl. peracerosum*	+	—	+	+	+	—
36. *Cl. intermedium*	+	+	+	+	+	—
40. *Cl. rostratum*	+	+	+	+	+	+
43. *Cosmarium connatum*	+	+	+	+	+	—
42. *C. granatum*	+	+	+	+	+	+
41. *C. tenue*	+	+	+	—	+	—
44. *Staurastrum punctulatum*	+	+	+	+	+	—
45. *Hyalotheca dissiliens*	+	+	+	+	+	+

fulva, Petalonema crustaceum, Stigonema aerugineum, Gloeotrichia atra, Tetrastrum tetracanthum, Spirogyra communis, are new records. *Scenedesmus spinulatus* appears new to Science and var. *khasianum* of *Tetrastrum tetracanthum* has been considered a new variety. The distribution of the species found shows predominance of European and Indo-Malayan element. About 44% of the species are cosmopolitan, 85% European and 76% Indo-Malayan. The general distribution of the species has approximately been represented in the preceding table (+ present, — absent or not reported yet). Of the species recorded here only ten species have been reported from Assam by Dr. P. Brühl and the author. The rest are all new records of the province. I am indebted grateful to Dr. O. C. Schmidt for his kindly going through the paper and correcting the proof.

Systematic enumeration of species.

Myxophyceae.

Chroococcaceae.

Gloeocapsa.

1. **Gloeocapsa montana** Kütz. (plate I, fig. 1). — Plantmass not of definite form, pale yellow or brownish yellow, usually spherical or oval, finally forming an expanded mass of mucous layer; sheaths lamellose; cells 4—6 μ in diameter; cell contents granular blue-green.

Hab. On dripping rocks at Therria, the Khasia Hills at an elevation of 500 m.; collected by A. C. Joshi on the 6th March, 1932.

Oscillatoriaceae.

Oscillatoria.

2. **Oscillatoria princeps** Vauch. — The Khasia form of the species is characterised by its typical thickened or more or less capitate nature of the end cells. The specimen has been found mixed up with other algae. This cosmopolitan species is common everywhere in this country more frequently as "mesosaprob" alga floating in water near the edges of pools, puddles, ditches and sewage canals as densely crowded hair like black masses of filaments.

Hab. In a pool near Companygunj dakbungalow at the foot of the Khasia Hills; collected by A. C. Joshi on the 12th April, 1932.

3. **Oscillatoria pseudogeminata** G. Schmid. — Trichomes not tapering towards the apices, about 1,5 to 2,5 μ wide; cells more or

less as long as broad, 1,5 to 2,5 μ long, not constricted at the joints, cross-walls thick, pellucid; apical cell rotund, calyptra none.

Hab. In a pool mixed with other algae, near Companygunj dakbungalow; collected by A. C. Joshi on the 12th April, 1932.

4. **Oscillatoria terebriformis** (Ag.) Gom. (plate I, fig. 2). — Trichomes 4 μ in diameter, flexuous, straight towards the basal portion, somewhat loosely spirally curved and terebriform above, not constricted at the joints, very slightly attenuated towards the apex; apical cell rotund or somewhat truncate; cells 3—4 μ long; partition walls rather pellucid, not distinctly granulated; cell-contents finely granular, blue-green.

Hab. In a pool near Companygunj dakbungalow; collected by A. C. Joshi on the 12th April, 1932.

5. **Oscillatoria splendida** Grev. (plate I, fig. 3). — Trichomes characterised by their typical apices and end cells, about 2 μ wide; cells 3—5 μ long.

Hab. Mixed with other algae, in a ditch in Shillong; collected by P Mozumdar on the 3rd March, 1924.

The Khasia form is more like the variety attenuata than the typical form.

Spirulina.

6. **Spirulina major** Kütz. — Trichomes occurring in single filaments or in fragments, about 2 μ in diameter, distance between the turns 4 μ.

Hab. In a pool, mixed with other algae, near Companygunj dakbungalow; collected by A. C. Joshi on the 12th April, 1932.

Lyngbya.

7. **Lyngbya rivularianum** Gom. — Filaments single, tenuous, somewhat loosely tortuous, not attenuated towards the apices; sheath hyaline very thin and tenuous; trichomes 0,8 to 1,5 μ in width, not constricted at the joints; cells slightly longer than the diameter, about 1—2 μ long, partition walls pellucid, not granulated, apical cell rotund; cell contents homogenous, pale blue-green.

Hab. On dripping rocks at Therria mixed with other algae in the mucus layer of *Gloeocapsa montana*; collected by A. C. Joshi on the 6th April, 1932.

De Toni in his Sylloge Algarum, *Myxophyceae* p. 282, mentions that the trichomes are constricted at the joints "ad genicula constrictis" but Geitler in „Die Süßwasserflora Deutschlands, Österreichs und der Schweiz", Heft 12, *Cyanophyceae* (1925) 402,

while describing the species remarks that the cross walls are not constricted („Querwände nicht eingeschnürt und nicht granuliert"). The specimens examined by me confirms Geitler's statement.

8. **Lyngbya ochracea** (Kütz.) Gom. (plate I, fig. 4). — Plantmass occurring as red scum, trichomes thickly coated with iron-hydroxide.

Hab. Occurring as red mud on stones along the margin of Elephanta falls, Shillong, at an altitude of about 1850 m; collected by A. C. Joshi on the 11th April, 1932.

This iron-bacterium is frequently met with in various habitats in this country. In hilly and mountaneous parts this species occurs as rusty scums forming more or less pure association along the margins or stony, sandy or muddy beds of hill strems, ditches, waterfalls and cascades. *Lyngbya ochracea* has also been found as floculent minute deep rusty brown nodules in the plankton of some of the large rivers of this country. In freshwater tanks, jhils and pools its occurrence is pretty common. But its predominant growth has been observed in fresh and brackish water swamps and marshy areas in the plains. Its appearance sometimes in drinking water, especially during hot weather before the rains, in this country causes much annoyance.

9. **Lyngbya ceylanica** Wille (plate I, fig. 5). — Plantmass olive-green, spreading loosely on the substratum; filaments long, (10—14 μ) 10 μ in diameter; sheath at first thin and hyaline, later on thick and coloured reddish or brownish; Trichomes (8—12 μ) 8—9 μ in diameter, not constricted at the joint, not tapering towards the apices; partition walls not granulated; apical cells rounded, without any calyptra; cells broader than long, or nearly as long as broad, 6—8 μ in length; contents very coarsely granular, granules in old cells as large as 1 μ in diameter.

Hab. On soil in Cherrapunji plateau forming surface layer of algal bed; collected by S. P. Agharkar in October, 1925.

Wille reported this alga from Ceylon.

10. **Lyngbya truncicola** Ghose var. **burmense** Ghose (plate I, fig. 6). — Plantmass spreading on soil; filaments flexuous, (13—15 μ) 14 μ in diameter; sheath 2 μ in thickness, at first hyaline, but in older filaments brownish red, not lamellose or very indistinctly lamellose; trichomes (11—12 μ) 10 μ in diameter, not constricted at the joints; not attenuated towards the apex; cross walls not granulated; apical cell obtusely rounded, not capitate; cells quadrate or slightly shorter than broad; contents coarsely uniformly granular, blue-green.

H a b. On soil of the flat meadow on the top of a hill at an altitude of 1000 m. in Shillong; collected by Dr. S. P. A g h a r k a r in October, 1925.

This terrestrial form is slightly smaller than the arborial form described by S. L. G h o s e. The altitude hardly affects its morphological characters as indicated in the above description.

11. **Lyngbya aureo-fulva** West et G. S. West (plate II, fig. 1). — Plantmass spongy, membranaceous, widely expanded, spreading more or less uniformly on the substratum, yellowish brown or pale pink in colour; filaments (13,5—4,5 μ) 10—15 μ in diameter, elongate, lying densely interwoven; sheath at first thin, hyaline, in old filaments thick, brown to pink in colour, lamellose, 1—2—3 μ in thickness, lamella 2—4 in number; trichomes (8,5—9,5 μ) 8—10 μ in diameter, rather fragile, slightly constricted, not attenuated towards the apex; apical cell broadly rounded, not capitate, crosswalls not marked by rows of granules; cells quadrate or slightly shorter than long 6—8 μ in length; contents granular, blue-green.

H a b. On soil, in Cherrapunji plateau mixed with other terrestrial algae; collected by Dr. S. P. A g h a r k a r in October 1925.

This is slightly larger than the African form of the species.

12. **Lyngbya aerugineo-coerulea** (Kütz.) Gom. — This is one of the most common algae found in various situations all over India as reported in the author's previous papers. The alga formed bottom layer on the substratum in Cherrapunji valley. In the culture its early growth was well marked superseding other species of the genus forming *Lyngbya*-association.

Porphyrosiphon.

13. **Porphyrosiphon Notarisii** (Menegh.) Kütz. — Filaments 24—30 μ in diameter; sheath purple densely lamellose, 4—5 μ in thickness, fibrillose at the apices, (8—9 μ) 16—20 μ in diameter; cells (4—5—12 μ) 10—16 μ in length; apical cell obtusely rounded; cellcontents uniformly coarsely granular, blue-green.

H a b. On a meadow at an altitude of about 1000 m. in a valley at Cherrapunji; collected by S. P. A g h a r k a r in October, 1925.

B e l a n g o r and K u r z recorded this species much earlier from India, and F e r g u s o n from Ceylon too. Recently B r ü h l and B i s w a s reported this species growing on the bark of trees and other subaerial habitats. This is one of the most common species of typical subaerial algae of India and other parts of the tropics. The terrestrial form growing on moist ground in a valley at Cherrapunji is fairly larger than the typical form of the species.

This alga has been observed to occur in abundance in comparatively drier climates on fairly harder granelly soil in the hilly areas of this country. The plant mass spreads as brownish pink, deep purple or chocolate coloured carpet like expansions on the substrata, frequently interlaced with the runners or halms of grasses and other trailing weeds forming a meadow or a grassland. Its predominant growth has been observed in the Santal parganas, Bihar and Orissa and upper gangetic plains on meadows and tablelands in different parts of this country. During the rains when the soil is flooded with water or the grounds are sufficiently wet, the colour of the sheath looses its intensity, and the hormogones ooze out of their sheaths to develop into adult plants. But during the hot months before the advent of the rains, when the soil becomes dry and almost parched, the membranes of this alga become coarser, thicker, more fibrillose and develop much deeper hues of pink, deep brown or purple colour protecting delicate resting hormogones inside them. The plantmass then breaks into small flakes or pustules and are blown away in different parts especially during the Northwesters, by gusts of wind, which are prevalent in this country from April to June before the advent of the rainy season which sets in the middle of June or beginning of July. Thus distributed the alga settles down with the showers of rain and in suitable moist habitats under favourable conditions grows again from its dormant homogones and thus repeats its life history year after year. In some parts thick stratified layers of the alga indicates its several years growth and suggests its habit of perennation.

Schizothrix.

14. **Schizothrix telephoroides** (Mont.) Gom. (plate II, fig. 2). — Plantmass pannose; filaments long, tenuous, 12—20 μ in diameter; sheath at first hyaline, later on reddish brown, firm, thick, sometimes inflated below the tapering apex, somewhat roughened on the surface; trichomes (4—9 μ) 6—8 μ in diameter, slightly constricted at the joints, usually solitary, sometimes two within the sheath, parallel, remote, slightly attenuated towards the apex; apical cell rounded; cells (6—14 μ) 4—6—8 μ in length quadrate or slightly longer or shorter than the width; contents coarsely granular, blue-green.

Hab. On soil in a valley at Cherrapunji, collected by Dr. S. P. Agharkar in October, 1925.

The Assam form of the species is slightly broader and the cells somewhat shorter than Gomont's Ceylon form.

Microcoleus.

15. **Microcoleus chthonoplastes** (Flor. Dan.) Thur. — The Assam form of the species is characterised by having filaments 40—50 μ in width, sheath hyaline, sometimes wavy or roughened on the surface; trichomes 6—8 μ in diameter; apical cell pointed acutely or somewhat conical; cells 60—10 μ in length; contents granular blue-green.

Hab. On moist soil, Shillong; collected by S. P. Agharkar in October, 1925.

This is one of the most common alga growing everywhere on damp wet lands.

Scytonemataceae.

Scytonema.

16. **Scytonema crispum** (Ag.) Born. (plate I, fig. 7). — Plantmass in the form of lanose pustules of deep blue-green filaments becoming brownish or pale greenish with age; filaments (16—36 μ) 26 μ in diameter, long, crisp and branched; sheath firm, hyaline and brownish yellow in older filaments, when it is about 3 μ in thickness, membranous, hardly lamellose; trichomes in older filaments about (14—30 μ) 20 μ in diameter more or less constricted; apical cell rotund, much shorter than the diameter, sometimes about 2—4 μ in length; Cells 4—10 μ in length; heterocyst 20 μ in width and 10—14 μ in length, quadrate, depressed, sometimes many, sometimes rare; cell contents granular blue-green when young, yellowish brown when old.

Hab. On the filaments of *Spirogyra communis* and other green filamentous algae in a hill stream Mayphlong; collected by Dr. S. P. Agharkar in October, 1925.

The relation with this alga with the species of *Spirogyra* and others appears to be simply that of epiphytism. Not much symbiotic relation can be traced between the two. The filaments of green algae forming substratum for *S. crispum* to grow on them as more or less an epiphyte both obtaining food materials from the same medium. The growth of this alga, *S. crispum* is not uncommonly observed in bottles and beakers containing distilled water even when these vessels are kept inside the laboratory. This suggests the great variability of the hormogones and capacity of their growth under the most unfavourable conditions.

Petalonema.

17. **Petalonema crustaceum** (Ag.) Kirchn. (plate II, fig. 3). — Plantmass forming felt like or cushion shaped mass on the surface,

deep brown to almost black in colour; filaments (15—30 μ) 24 μ in diameter, more or less intricate, thick, somewhat decumbent, with more or less ascending false branches, coalesced at the base; sheaths thick 8—10 μ in thickness, lamellose with diverging layers, layers somewhat fibrillose, yellowish brown; trichomes (6—8 μ) 4—8 μ in diameter; in younger filaments the cells are as long as broad or slightly shorter or longer, generally shorter towards the apex and longer towards the older parts of the filaments, 4—10 μ long and 4—8 μ broad; the apical cells much shorter than broad, 2—4 μ in length and 6—8 μ in width, round; cells of trichomes in juvenile forms not constricted but with age they elongate, becoming inflated at the centre and irregularly moniliform in shape; contents coarsely granular in older cells, blue-green in younger; heterocysts 12 μ long and 6 μ wide, intercalary, oblong.

Hab. On damp soil at Cherrapunji, collected by Dr. S. P. Agharkar in October, 1925.

This species which is fairly widely distributed in Europe has been described by De Toni as *Scytonema crustaceum* Agardh, under the section *Petalonema*. This classification has been accepted also by Tilden and Fritsch. Kützing in his Tabulae Phycologicae II, p. 7, t. 25, fig. II, illustrates this species under the name of *Scytonema pachysiphon* Kütz. Geitler in Pascher's Süßwasserflora, prefers to accept Kirchner's combination namely *Petalonema crustaceum*. Owing to the distinctive characters of the sheath of this section of *Scytonema* I have thought it advisable to follow Geitler. De Toni, Tilden and Geitler all consider Kützing's illustrations as type. My drawing bearing general similarity to Kützing's figures illustrate variations in the characters of the Indian form of this alga in its different stages of growth as observed in the culture and in the field, mixed up as it is, with other members of the filamentous blue-green algae forming algal association on Cherrapunji plateau.

Stigonemataceae.

Stigonema.

18. **Stigonema aerugineum** Tilden (plate I, fig. 8). — Plantmass forming membranaceous expansions with densely interwoven layer of blue-green filaments; filaments (25 μ) 28—32 μ in diameter, elongate with pseudo-branches, pseudobranches sometimes slightly narrower than the parent filaments, 22—30 μ in width; sheats 4—6 μ in thickness, homogenous, colourless, not at all lamellose; trichomes

(14 μ) 16—20 μ in diameter, distinctly constricted at the joints; apical cell rotund; cells (6—8 μ) 10—14—20 μ in length, oval, quadrate or depressed, globose, somewhat crowded and irregularly arranged, usually forming a single row; heterocysts (8 μ) somewhat quadrate; cell contents uniformly granular bright blue-green.

Hab. One soil on the surface of a flat meadow at an altitude of 1000 m. at Cherrapunji; collected by Dr. S. P. Agharkar in October, 1925.

This alga differs from the typical form in its distinctly larger dimensions and its more pronounced subaerial habit, than the typical form described by Tilden. The alga was first collected from Hawaii and was found growing at the bottom of a pool. The rapid and predominant growth in the culture of this alga explains tis dominance in the algal association of the table-land of Cherrapunji on the top of the hill ranges at a height of about 1000 m. The culture indicated its subaerial and amphibious habit of growth.

Rivulariaceae.

Gloeotrichia.

19. **Gloeotrichia atra** (Roth) Biswas n. comb. (plate I, fig. 9). — Thallus somewhat spherical embedded in the mucus of *Gloeocapsa montana*; filaments not very long, attenuated towards the apices, fragile, widened towards the base ending in broader cells, globose spore and distinct, hemispherical basal heterocyst; sheaths close, yellowish ampliated above more or less like that of *Gloeotrichia natans*; trichomes compressed, held up in the mucus, varies in dimensions, 2—6 μ in width towards the base; heterocysts basal, contiguous to the spore, hemispherical rather compressed due to pressure, 2—4 μ in diameter; lower cells adjacent to the spore shorter than broad about 4—6 μ in thickness; upper cells as long as broad or longer than broad; resting spores globose, elliptic or oblong, 12—28 $\mu \times 8$—10 μ, wall of the spores smooth; contents granular, pale blue-green.

Hab. On dripping rocks scattered in the slimy mass of *Gloeocapsa montana*, at Therria; collected by A. C. Joshi on the 6th April, 1932.

Roth the author of this species names this alga as *Rivularia atra*. De Toni accepting this nomenclature described it in his Sylloge Algarum, *Myxophyceae*, pp. 664—666, as *R. atra* and puts it under the section *Eurivularia* Kirchner. Tilden in her Minnesota Algae vol. I, pp. 289—290, adopts De Toni's description and figures Wille's illustration. The form described here agrees in

general with the descriptions of De Toni and others. Wille's and Kützing's figures also bear close similarity to those of mine. The figures of the previous writers indicate at the base of the trichome inflated cells like those of resting spores. But these figures do not clearly show the detailed characters of the plant. The specimens examined by me clearly exhibit the presence of the resting spores nearly in all the trichomes. I therefore prefer to put the species under the section and the genus *Gloeotrichia* J. Agardh, instead of *Rivularia* and adopt the new combination *Gloeotrichia atra* (Roth) Biswas.

Chlorophyceae.

Chlorococcaceae.

Chlorococcum.

20. **Chlorococcum** (cf.) **humiculum** (Naeg.) Rabh. (plate II, fig. 4). — Plantmass mucilaginous, somewhat spherical in the early stages, developing as small globules of 1 to 2 mm. in diameter, later on diffluent spreading on the substratum; cells spherical (6—12 μ) 8—10—14 μ in diameter.

Hab. On soil in a valley in Shillong growing among grasses, *Eriocaulon* and *Utricularia* species; collected by Dr. S. P. Agharkar in October, 1925.

The systematic position of this widely distributed alga has been dealt with in detail by Fritsch in his splendid account of the genus *Chlorococcum*, in the British Freshwater Algae. It is quite evident that, *Chlorococcum humicolum* includes *Cystococcus humicola* Naeg. as discussed by Fritsch. Some of the earlier authors, as noted by De Toni in his Sylloge Algarum, *Chlorophyceae*, reduced both the above species to different forms of *Protococcus viridis* Ag. Pascher and his colleagues in Süßwasserflora Heft 5 (1915), as also H. Printz in Engler's Natürl. Pflanzenfamilien (1927), consider them as two distinct species and hence describe them under two different genera *Chlorococcum* and *Cystococcus*. This alga developed in the culture of the soil of the Shillong valley with other algae, but was soon replaced by the stronger filamentous members of the blue-green algae. The dimensions of the alga agree with the African form of the species.

Hydrodictyaceae.

Pediastrum.

21. **Pediastrum duplex** Meyen var. **gracillimum** West et G. S. West (plate II, fig. 5; plate III, fig. 1). — Colony 8—16 celled; marginal

cells 20 × 12 μ, central cells 16 × 16 μ; arms 4 in number; gaps 4—16 μ in diameter; the arms of the marginal cells narrow and widely bifurcated, distance between the arms 8—16 μ; cell contents granular.

Hab. In a pool near Companygunj dakbungalow, collected by A. C. Joshi on the 12th April, 1932.

22. **Pediastrum tetras** (Ehrenb.) Ralfs — This species belonging to the same habitat is one of the constituents of the algae of the freshwater pool at Companygunj dakbungalow.

Oocystaceae.

Oocystis.

23. **Oocystis elliptica** W. West (plate III, fig. 2). — Colonies surrounded by a mucous envelope; sheath hyaline; cells elliptic, elongate, 2 times as long as broad, 24 μ long, 12 μ wide; ends rounded.

Hab. Embedded in the mucus mass of *Gloeocapsa montana*, on dripping rocks at Therria at an altitude of 200 m.; collected by A. C. Joshi on the 6th March, 1932.

24. **Oocystis solitaria** Wittr. — Cells enveloped in an elliptic sheath, somewhat thickened and pointed at both the poles, elliptic elongate, 24—28 μ long and 12 μ broad.

Hab. Embedded in the mucus of *Gloeocapsa montana* on dripping rocks at Therria at an altitude of 200 m., collected by A. C. Joshi on the 6th October, 1932.

Coelastraceae.

Tetrastrum.

25. **Tetrastrum tetracanthum** (G. S. West) Brunnth. var **khasianum** nov. var. (plate III, fig. 3). — Coenobiis 4-cellularibus, 8 μ diametro metientibus; cellulis indivisis, anguste ovatis vel irregulariter quadratis, 4 μ crassis; in apicem aculeiformen productis; aculis 12 μ longis, hyalinis, divergentibus. — Coenobia without mucous envelope 4 celled, about 8 μ in diameter, without the spines; cells about 4 μ in diameter, ovate more or less four cornered by mutual pressure, spines somewhat twisted or bent sideways about 12 μ in length, hyaline.

This new variety differs from the typical form which bears a close similarity to the 4 celled colony of *Pediastrum simplex*. The Khasia form is easily distinguished by its reduced dimensions — almost half of the size of the typical species — and by the spines

either bent or developing sideways slightly irregularly from the dorsal side of each of the irregularly four conered cells.

H a b. Rather rare, in a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th October, 1932.

This species was recorded as a constitutent of the plankton Algae of Africa and reported here for the first time from India. The variety established is a peculiar minute form quite characteristic of its habit in a small pool.

Scenedesmus.

26. **Scenedesmus obliquus** (Turp.) Kütz. — 4 celled colony pretty common; cells 8 μ in width, 24 μ in length without the spines, spines hyaline, 4—8 μ in length.

H a b. In a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th April, 1932.

27. **Scenedesmus acuminatus** (Lagerh.) Chod.

H a b. In a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th April, 1932.

28. **Scenedesmus spinulatus** n. spec. (plate III, fig. 4). — Coenobiis 4-cellularibus, 28 μ longis, 20 μ latis; cellulis uniseriatis, oblongo-cylindricis, 20 μ longis, 6—8 μ latis, cellulis omnibus utroque polo obtusis, spinulatis; spinulis trinis 2—5 μ longis, in cellulis intermidiis plus minusve erectis, in cellulis extimis utroque apice saepius elongatis furcatis vel divergentibus; membrana cellularum in periphaeris extimis cellulis aculeis erectis parvis numerosis dense vestita. — Colonies 4 celled, 28 $\times$ 20 μ; cells in one row, oblong and cylindrical, 20 μ long, 6—8 μ broad, poles obtuse, all the cells furnished with three spinules at both ends; spinules three in number, in the intermediate cells more or less erect, in the marginal cells often furcate, the lateral spinules divergent more or less at right angle to the axis; cell membranes of the peripheral cells full of short straight hairs; cell contents packed with coarse granules, top view rotund, about 6—8 μ in diameter.

This species is quite distinct from the rest by its characteristic three furcate spines at both ends. It is allied to three species namely *S. serratus* (Corda) Bohlin, *S. Hystrix* Lagerh. and *S. brasiliensis* Bohlin. The new species differs from these three species in the nature of its having three peculiar furcate and divergent apical spines, arrangement of the cells and membranes of the marginal cells being covered with fine erect short hairs unlike *S. serratus* and *S. Hystrix*. This is much larger than the African form of *S. armatus* (Chod.) G. M. Smith var. *spinosus* Fritsch et Rich, and the nature

and arrangement of the spines in this new species distinguishes it from the rest.

H a b. In a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th April, 1932.

29. **Scenedesmus brasiliensis** Bohlin (plate III, fig. 5). — Colony 8 celled; cells all in one row, 12—16 μ long, 6 μ broad, median ribs prominent.

H a b. In a pool near Companygunj dakbungalow, collected by A. C. J o s h i on the 12th April, 1932.

The Khasia form of this species differs from the typical form by its having larger number of dentations along the peripheral walls of the marginal cells.

30. **Scenedesmus quadricauda** (Turp.) Bréb. (plate I, fig. 10). — Colony 2—4 celled, cells 12 μ long, 4 μ wide; the two median cells sometimes with one central rib in each cell, the ribs projecting out as small teeth at both the poles.

H a b. In a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th April, 1932.

The typical form of this species is quite common in the pool of the Companygunj dakbungalow. But sometimes the two celled form with two curved spines on one end only at opposite poles is not very rare. — Some of the four celled Khasia forms of this species are, as noted above, characterised by the two ribs running along the centre of the median cells and produced as small teeth like structure at both ends.

31. **Scenedesmus bijugatus** (Turp.) Kütz.

H a b. In a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th April, 1932.

The Khasia form of this species is 8 celled in two series one above the other, the upper row of cells attached at their lower ends to the upper ends of the lower cells in alternating succession. This arrangement of the cells suggests its being an intermediate form between the extreme forms of a) *seriatus* Chod. and b) *alternans* (Reinsch) Hansg.

Coelastrum.

32. **Coelastrum sphaericum** Naeg. (plate I, fig. 12). — Coenobium globose or oval about 28 μ in diameter; marginal cells with obtuse conical projections about 6—8 μ in diameter, central cells about 8 μ in diameter.

H a b. In a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th April, 1932.

The Khasia form of this species figured appears to be a young daughter colony.

33. **Coelastrum proboscideum** Bohlin (plate I, fig. II). — Coenobium globose, about 20—24 μ in diameter; cells more or less hexagonal, about 8 μ in diameter, marginal cells with thickened poles.

Hab. In a pool near Companygunj dakbungalow; collected by A. C. Joshi on the 12th April, 1932.

The Khasia form of the species is somewhat irregularly shaped due evidently to mutual pressure during the development of the daughter colonies.

Zygnemaceae.

Spirogyra.

34. **Spirogyra** (cf.) **communis** (Hass.) Kütz. — Vegetative cells (18—26 μ) 24 μ about five times longer than broad, 130 μ in length; chloroplast one with 2—3 turns in each cell.

Hab. In a hill stream Mayphlong; collected by Dr. S. P. Agharkar in October, 1925.

The fruiting specimen of this species was not available. But the vegetative characters present are sufficient to consider this alga provisionally as a form of *Spirogyra communis*. The alga is the host of *Scytonema crispum* as mentioned on previous pages.

Desmidiaceae.

Penium.

35. **Penium Navicula** Bréb. var. **inflatum** West et G. S. West (plate III, fig. 6). — Cells 90 μ long, 21 μ broad; ends 8—10 μ wide; cell wall smooth, colourless.

Hab. In a ditch in Shillong at an elevation of 100—200 m.; collected by P. Mozumdar on the 3rd March, 1924.

The Khasia form is comparatively larger than West et G. S. West's typical form of the variety *inflatum*, otherwise it agrees in all other respects with this variety.

Closterium.

36. **Closterium intermedium** Ehrenb. (plate III, fig. 9). — Cells 300—364 μ to 510 μ long, 20—36 μ wide; 12—15 μ broad at the apices; cell membrane striated, striations 4 in number in the, with 3—5 transverse sutures, ochere coloured when mature; — var. *hibernicum* 307—367—510 × 21—30 μ, 9 striae in each 10 μ, cell wall yellow brown.

H a b. In a ditch in Shillong at an elevation of 1000—2000 m.; collected by P. M o z u m d a r on the 3rd March, 1924.

The Khasia specimens of *Cl. intermedium* agrees with the Bohemian variety *sculptum* Racib., in dimensions and nature of the apical granules and striations on the membrane.

37. **Closterium Jenneri** Ralfs (plate III, fig. 7). — Cells 84 μ long, 12 μ wide; ends 4 μ broad; cell wall smooth, becoming golden yellow with age.

H a b. In a ditch in Shillong at an elevation of 100—200 m.; collected by P. M o z u m d a r on the 3rd March, 1924.

W. W e s t and G. S. W e s t in their British Desmidiaceae I, p. 135, remarks that the cell wall is colourless. The specimen at my disposal indicates that the alga is colourless to golden yellow colour when mature, the younger daughter half having smooth colourless membrane where as the older mother half having golden yellow or straw coloured membrane.

38. **Closterium Leibleinii** Ralfs. — This alga is fairly common too in the ditch at Shillong; collected by P. M o z u m d a r on the 3rd of March, 1924.

39. **Closterium peracerosum** Gay (plate III, fig. 8). — Cells moderately large about 220 μ long, 12 μ broad, slightly curved, inner margin nearly straight; cell wall smooth, pale straw coloured.

H a b. In a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th April, 1932.

The Khasia form of this species differs from the typical form in its pale straw coloured cell membrane due evidently to age.

40. **Closterium rostratum** Ehrenb. — Cells 228 μ long, 16 μ wide; 4 μ broad at the apices.

H a b. In a ditch in Shillong at an elevation of 1000 to 2000 m.; collected by P. M o z u m d a r on the 3rd March, 1924.

Cosmarium.

41. **Cosmarium tenue** Archer (plate III, fig. 11). — Cells about 1—$^1/_3$ times longer than broad, 16 μ long and 12 μ broad; Isthmus 4 μ in width; top view elliptic, thickness 8 μ.

H a b. In a pool near Companygunj dakbungalow; collected by A. C. J o s h i on the 12th April, 1932.

This species is rather rare in this collection, although it is a common Indian and Malayan species.

42. **Cosmarium granatum** Bréb.

H a b. On dripping rocks scattered in the mucus of other algae, at Therria at an elevation of 500 m.; collected by A. C. J o s h i on the 6th April, 1932.

This cosmopolitan alga was also observed to find its access into the mucus of *Gloeocapsa montana*, but unlike the Malayan form the cell membrane of this Khasia form is smooth resembling more with the Loktak form.

43. **Cosmarium connatum** Bréb. (plate III, fig. 10). — Cells surrounded by a hyaline mucus envelope about 1—$^1/_3$ times longer than broad, 70—80 μ long, 45—60 μ broad, moderately constricted; sinus widely open, apex obtuse; isthmus 44—50 μ in width, semicell elliptic with a broad base; apex broadly rounded or sometimes flattened; top view orbicular, about 40—50 μ in diameter; cell membrane minutely punctate between the scrobiculations.

H a b. Embedded in the slimy mass of *Gloeocapsa montana* growing on dripping rocks at Therria at an elevation of 500 m.; collected by A. C. J o s h i on the 6th April, 1932.

The Khasia form of the species bears very close similarity in all its characters to that of the Malayan form described and figured by K r i e g e r in his monograph entitled „Die Desmidiaceen der Deutschen Limnologischen Sunda-Epedition" This species is a subaerial form and the presence of this and *C. granatum* in the mucus mass of *Gloeocapsa montana* may be ascribed to the reason advanced by R o l f G r ö n b l a d in his paper on "A contribution to the knowledge of subaerial desmids"

Staurastrum.

44. **Staurastrum punctulatum** Bréb. (plate III, fig. 12). — Cells nearly as long as broad, 28 μ long and 28 μ broad, deeply constricted, slightly twisted at the isthmus; sinus open, apex acute, isthmus 12 μ in width; semicells sub-rhomboid elliptic, dorsal and margin convex, angles acute, vertical view triangular, 28 μ in width; cell membranes uniformly granulate.

H a b. In a ditch in Shillong, collected by P. M o z u m d a r on the 3rd March, 1924.

The Khasia form of the species resembles the typical form more than any of the varieties mentioned by W. W e s t et G. S. W e s t and K r i e g e r.

Hyalotheca.

45. **Hyalotheca dissiliens** (Smith) Bréb. — Cells 16—20 μ long and 20—28 μ broad.

Hab. In a ditch in Shillong; collected by P. Mozumdar on the 3rd March, 1924.

This alga formed the dominant species of the algal association in the ditch referred to. The Khasia form bears closer resemblance to the Malayan form than the Loktak form which is slightly smaller in dimensions, less constricted at the middle of the cells and less crenate at the angles.

Herbarium, Royal Botanic Garden, Calcutta, the 16th August 1933.

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Explanation of figures.

Plate I.

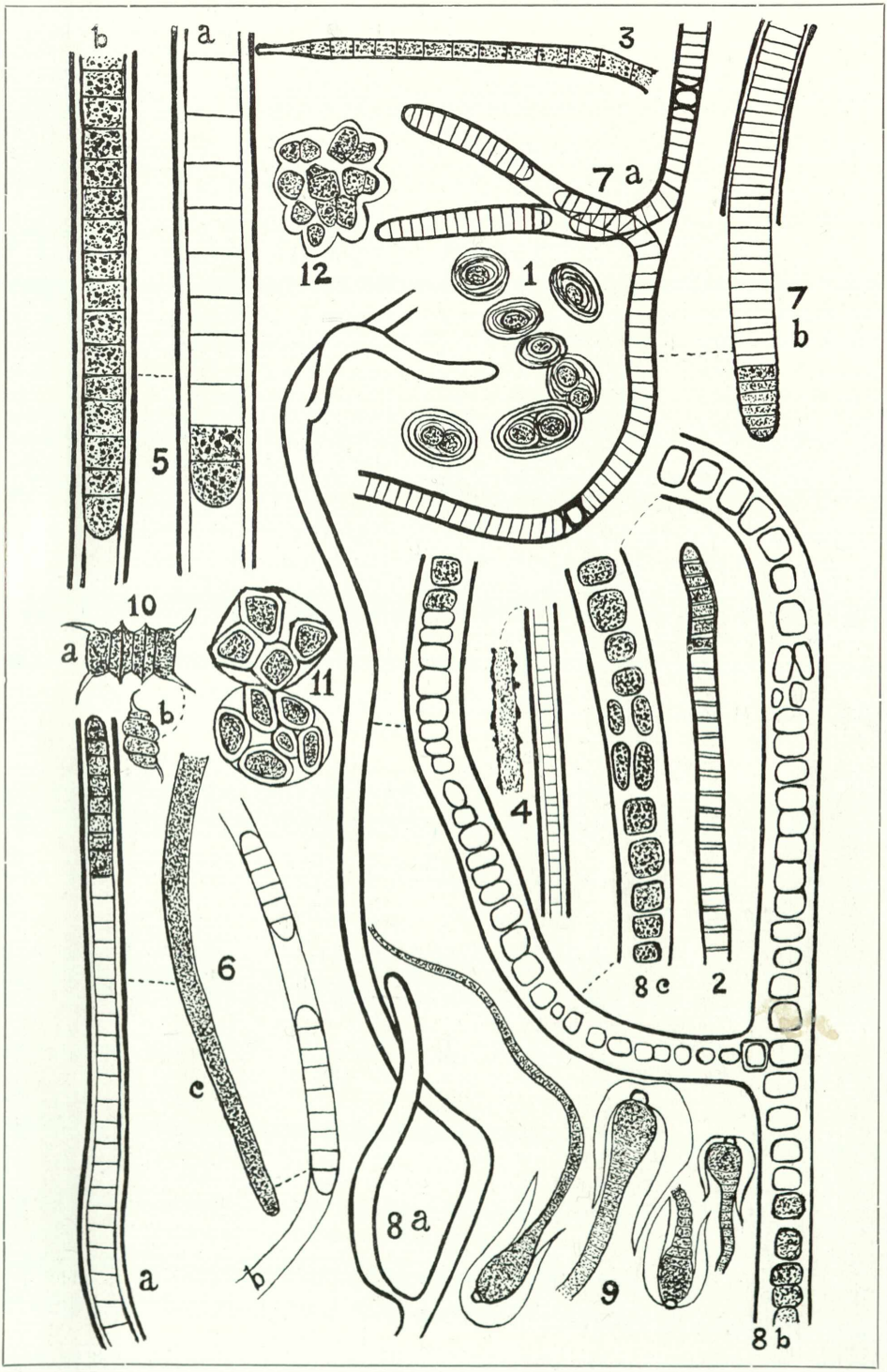
Fig. 1. *Gloeocapsa montana* — × 500.
2. *Oscillatoria terebriformis* — × 1000.
3. *O. splendida* — × 1500.
4. *Lyngbya ochracea* — highly magnified.
5. *L. ceylanica* — × 750.
6. *L. truncicola* — var. *burmense* — × 300.
7. *Scytonema crispum* — a = × 20, b = × 300.
8. *Stigonema aerugineum* — a = × 100, b, c, = × 200.
9. *Gloeotrichia atra* — × 500.
10. *Scenedesmus quadricauda* — × 500.
11. *Coelastrum proboscideum* — × 700.
12. *C. sphaericum* — × 600.

Plate II.

Fig. 1. *Lyngbya aureo-fulva* — × 750.
2. *Schizothrix telephoroides* — a, b = × 300, c, d = × 500.
3. *Petalonema crustaceum* — a = × 800, b = × 1000.
4. *Chlorococcum humiculum* — × 1000.
5. *Pediastrum duplex* var. *gracillimum* — × 600.

Plate III.

Fig. 1. *Pediastrum duplex* var. *gracillimum* — × 600.
2. *Oocystis elliptica* — × 650.
3. *Tetrastrum tetracanthum* var. *khasianum* — × 500.
4. *Scenedesmus spinulatus* — × 750.
5. *S. brasiliensis* — × 650.
6. *Penium Navicula* var. *inflatum* — × 250.
7. *Closterium Jenneri* — × 600.
8. *C. peracerosum* — × 500.
9. *C. intermedium* — a = × 250; var. *hibernicum*, b, c = × 400.
10. *Cosmarium connatum* — a, b = × 300, c, d = highly magnified.
11. *C. tenue* — × 600.
12. *Staurastrum punctulatum* — × 650.



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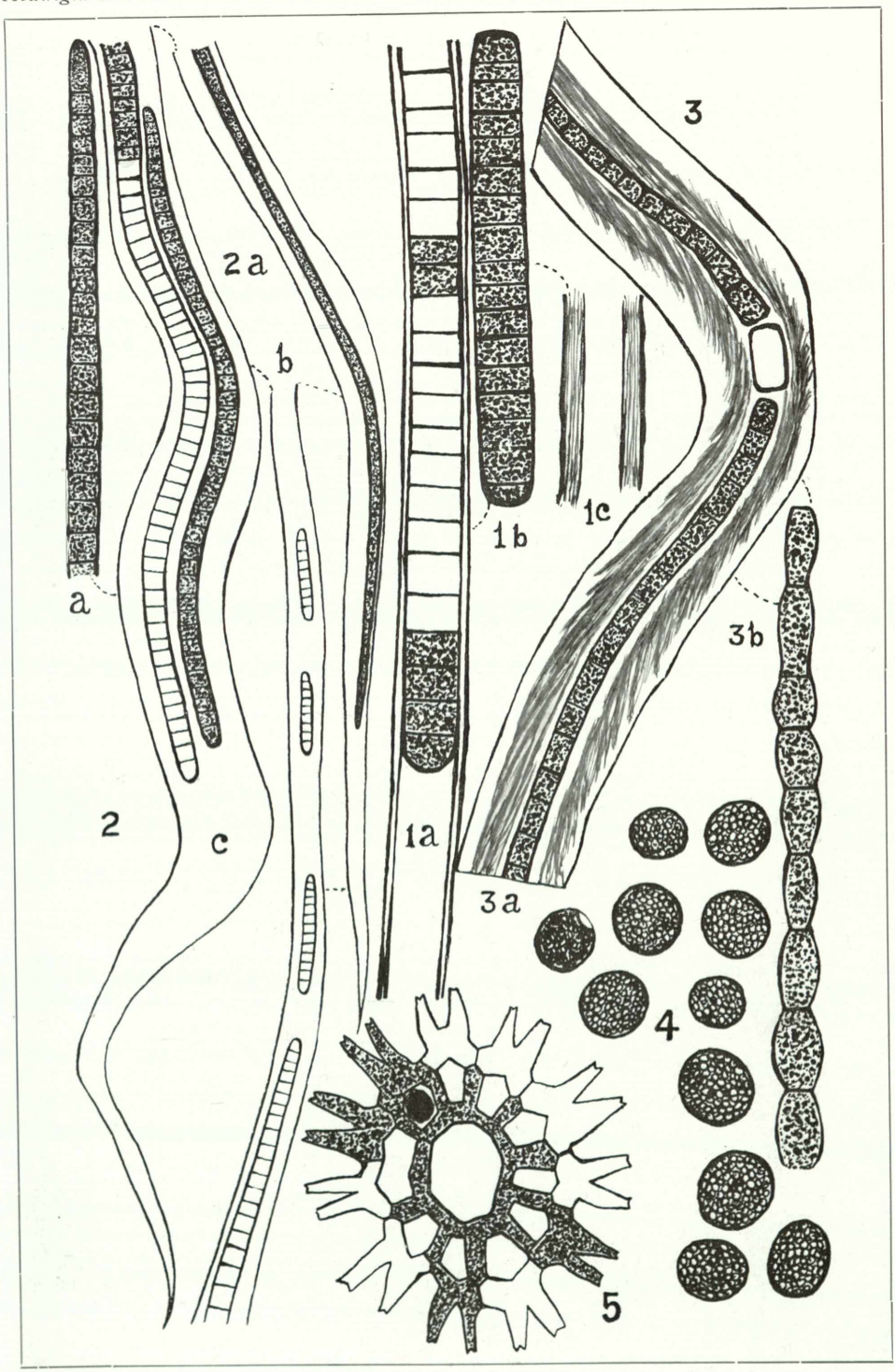

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