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ALGAE OF THE LOKTAK LAKE.

By PAUL BRÜHL AND KALIPADA BISWAS.

INDEX OF SPECIES.

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CORRECTION SLIP.

Page 258,	line 5	from top	*read* Annandale	*for* Annandle.
,, 259	,, 16	,, ,,	,, 122	,, 121.
,, 263	,, 5	,, bottom	,, Vaucher	,, Vancher.
,, 283	,, 14	,, ,,	,, mahabaleshwarensis	,, mahabaleshwarensio.
,, 288	,, 16	,, ,,	,, lateralibus	,, ateralibus.
,, 301	,, 12	,, ,,	,, ambitu	,, ambito.
,, 302	,, 17	,, ,,	,, inferiores	,, inferioribus.
,, 302	,, 17	,, ,,	,, superiores	,, superioribus.
,, 304	,, 5	,, top	,, oblongis	,, oblonga.
,, 304	,, 7	,, bottom	,, cellula	,, cellulis.
,, 304	,, 7	,, ,,	,, visa	,, visis.
,, 304	,, 5	,, ,,	,, utraque	,, utraqne.
,, 313	,, 11	,, top	*insert* 120	*before* Desmidium.
,, 314	,, 1	,, ,,	*read* 121	*for* 120.
,, 314	,, 4	,, bottom	,, 122	,, 121.

ALGAE OF THE LOKTAK LAKE.

A memoir dedicated to the memory of the late Dr. N. Annandale, who was ever ready to encourage and assist those engaged in genuine research work.

By PAUL BRÜHL AND KALIPADA BISWAS.

The following is an account of the Algae forming the greater part of specimens collected by DR. HORA and the late DR. ANNANDALE in Manipur during a zoological expedition undertaken in 1920 for the main purpose of investigating the Fauna of the Loktak Lake. DR. ANNANDALE, in 1923, made over to us ten phials containing algae preserved in spirits of wine. The present memoir is the result of our study of the collection. A paper on "The aquatic and amphibious mollusca of Manipur" by Dr. Annandale, Dr. Baini Prasad and Mr. Amin-ud-Din has been published in vol. XXII, Pt. IV, No. 28 of the Records of the Indian Museum. The Introduction to this paper by the late Dr. Annandale deals with the geographical and physiographical features of the Loktak Lake and its surroundings. It further discusses the origin of the Loktak Lake, the general characters of its fauna and flora and the chemical composition of the water of the lake.

The following statements are based on Dr. Annandale's introduction to his account of the aquatic and amphibious mollusca of Manipur already referred to:

The State of Manipur covers an area of more than 87,000 square miles and is situated between 28°50′ and 25°41′ North latitude and 93°2′ and 94°47′ East longitude. The Manipur valley lies at an elevation of about 2,600 feet and forms a flat swampy plain about 50 miles long and 25 miles broad; it is surrounded by mountains apparently consisting of hard shale associated with sandstone of probably pretertiary age. The Loktak Lake occupies a variable area in the southern part of the valley and is fed by hill streams with a scanty aquatic vegetation; most of these streams arise in the Naga Hills. The lake itself occupies one of the several depressions met with in the Manipur valley, most of which dry up more or less during the colder season, the Loktak Lake being the only one of the lakes formed during the monsoon which contains some water all the year round. At no time is it little more than a large, deep swamp, though in places the depth reaches ten feet. It is largely filled with submerged vegetation; a considerable part is covered with floating islands formed of living and decayed plants. The bottom of the Lake is composed of evil-smelling mud containing much rotten vegetation.

"Towards the eastern side of the Loktak Lake a chain of small rocky islands, the chief of which is called Thanga, rise from the surface to a height of several hundred feet. In February, 1920, these islands were separated from a broad peaty area, occupying the eastern part of the valley, only by a stream of running water."

"At no point has the lake definite shores, and even the rocky islands are surrounded in winter by flat mud-banks, which slope down under the water very gradually. On the northern and western sides the floating islands become, as it were, gradually stranded and changed into grass-land."

Dr. Annandle draws attention to the luxuriance of the vegetation of the lake, which gives the latter the character of a large swamp. Specially notable among the phanerogamic plants are *Trapa bispinosa* and species of *Potamogeton* and *Hydrilla*. *Pistia, Lemna* and *Azolla* are seen in the open channels among the floating islands. The bulk of the vegetation of the islands are grasses and sedges. The leaves and stems of the "submerged plants are as a rule densely covered with small algae."

The algae collected by Dr. Annandale and Dr. Hora were contained in ten phials and were gathered at "stations" 13, 14 and 19.

Numbering the phials from 1 to 10, the contents were obtained at the following places:—

(1) A small channel south of Thanga Island; contents: some diatoms and a few desmids.
(2) The small muddy bathing-post at Thanga Island; contents: a few diatoms.
(3) A narrow open channel; 5–8 feet deep, joining the stream draining the lake, south of Thanga Island; contents: a few species of *Spirogyra* and *Mougeotia*.
(4) From the same locality; contents: some diatoms and a few desmids.
(5) From the same locality; contents: a *Spirogyra*.
(6) Open channel; scrapings from a shell: fragments of a filamentous alga.
(7) Open space in Loktak Lake; contents: *Spirogyra varians*.
(8) Open space surrounded by floating islands; contents: *Spirogyra varians*.
(9) From the same locality; contents: *Desmidium Swartzii* and a few species of *Spirogyra* and *Mougeotia*, none of them in copulation.
(10) From the same locality; this gathering consisted of practically all the species described in the following account.

The preceding statement indicates clearly that the harvest gathered in cases like the present one depends very much on accident as to its plentifulness or otherwise.

We do not consider it improbable that the Loktak Lake and similar accumulations of water within the Manipur State would yield at least five hundred species of Algae, if collections are made all the year round. It so happens that in what may be called "chance" collections Desmids and Diatoms take the lion share, filamentous algae being often deliberately left aside. Wallich's collections described by Prof. Turner contained 22 species of Myxophyceae, 542 species of Desmids and 60 species of Green Algae not Desmids. Burkill's collection of Algae chiefly from Burma, identified by W. West and G. S. West, is composed of 58 species of Diatoms, 148 species of Desmids and 53 species of other Green Algae. Freeman's collection of Ceylon fresh-water Algae, worked out by W. West and G. S. West, contained 7 species of Rhodophyceae, 49 species of Diatoms, 33 species of Myxophyceae,

246 species of Desmids and only 84 species of Chlorophyceae exclusive of Desmids; W. West and G. S. West note that "Very few Algae were observed belonging to the families Confervaceae and Ulotrichaceae; this we are unable to account for, as many of the collections were from suitable localities for these plants." That one should expect a larger proportion of non-Desmid Chlorophyceae follows from a census of the number of species of Chlorophyceae described or referred to by De Toni in his Sylloge Algarum. It is true that a certain number of species are doubtful; but considering that since the appearance of the volume containing the Chlorophyceae of the Sylloge a considerable number of newly discovered species have been described, the relative proportions may not have been greatly changed. It is thus found that the species of Chlorophyceae enumerated in the Sylloge are 2,826, of which 1,011 are Desmids; that is to say that of the whole of the Chlorophyceae 35·8 per cent are Desmids and 64·2 per cent are non-Desmids. Among the latter most frequently gathered by collectors are members of the families Pleurococcaceae, Protococcaceae, Botrydiaceae, Hydrodictyaceae and Coelastraceae.

Of the 121 species described and figured in the present memoir 41 appear to be new. In our investigations into the algal flora of North-Eastern India we have often realised the correctness of Prof. Turner's dictum that "the value of gatherings is often in inverse ratio to the extent of country traversed." What may be called "botanical raids" lead rarely to results of appreciable value. It is always desirable to continue the investigation, at least at regular intervals, during the whole at least of one year. The sudden appearance and disappearance of algal species is often very startling.

Only in a few cases have we come across any zygospores. Our descriptions are therefore incomplete, as far as this matter is concerned; but we have made it a point only to describe what we have actually seen. With reference to the dimensions stated it may be noted that the numbers outside brackets are based on our own measurements, which have been taken by means of a Metz echelon eye-piece micrometer; the numbers within brackets are quoted from literature. The drawings have been made by using a Leitz No. 164 Drawing Ocular.

The literature quoted is that which we have had opportunity of referring to and of which we subjoin a list. We have not considered it to serve any useful purpose to refer to literature not available in Calcutta and probably not in the whole of India. Those who are interested in the latter will find information in De Toni's Sylloge Algarum, which for many years to come will be an indispensible work of reference; further in Nordstedt's Index Desmidiacearum and in West's invaluable volumes on British Desmidiaceae.

List of Literature consulted :—

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(5) Rabenhorst, Flora Europaea Algarum.

(6) Delponte, Specimen Desmidiacearum Subalpinum. Le Desmidiacee del Lago di Candia, in Memorie della Reale Academia delle Scienze di Torino, Serie Seconda, Tomo XXVIII (1876).
(7) Continuation of (6) in Tomo XXX (1878).
(8) Cooke, British Fresh-water Algae (1882—1884).
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(12) Nordstedt, Fresh-Water Algae collected by Dr. Berggren in New Zealand and Australia, in vol. XXII of the Kongliga Svenska Vetenskaps—Akademiens Handlingar (1888).
(13) Hansgirg, Prodromus zur Algenflora von Böhmen (1888).
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(20) Oltmanns, Morphologie and Biologie der Algen. 2. Auflage. 3. Bände (1922—1923).
(21) Revue Algologique, edited by P. Allorge and G. Hamel (since March, 1924).

Besides these we have consulted papers by various authors in La Nuova Notarisia, Hedwigia, the Annals of Botany, the Botanical Gazette, The New Phytologist, the Journal of the Linnean Society, Berichte der deutschen botanischen Gesellschaft, Die Oesterreichische Botanische Zeitschrift, the Annales du Jardin Botanique de Buitenzorg, Beihefte zum Botanischen Centralblatt.

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[1] I desire to record my appreciation of the painstaking care with which my collaborator, Mr. Kalipada Biswas, M.A., Government of Bengal Research Scholar, has isolated the various specimens, written out detailed preliminary notes, taken accurate measurements, and executed the drawings. I am personally responsible for the text.

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