6. A 'species' of *Ceratium* occurs in abundance in the lakes and exhibits great variation. One form of this "species" predominates in each lake at a given date (at any rate in May) but the predominant form is not always the same in different lakes at the same date.

PART II.—SYSTEMATIC AND GEOGRAPHICAL NOTES ON THE SPONGES AND POLYZOA.

By N. ANNANDALE.

PORIFERA.

1. SPONGILLA (EUSPONGILLA) LACUSTRIS subsp. RETICULATA, Annand.

This sponge was only taken in the lowest of the lakes, Malwa Tal (alt. 3,600 feet), in which it was abundant and bore numerous well-developed statoblasts in May. The race is widely distributed in the plains of India, in which it flourishes chiefly in wet weather.

2. SPONGILLA (EUSPONGILLA) CINEREA, Carter.

Specimens were taken in Naukuchia Tal (alt. 4,000 feet) in May. They formed a layer never more than about 10 mm. thick on twigs and are (in a dry condition) of a pale yellow colour. The oscula were small and to some extent radiate, and the skeleton-spicules a little more coarsely spined than in the type, in which the oscula are much larger and non-radiate. The dark greyish colour of Carter's specimens was probably due to their having grown in muddy water. Specimens from the R. Godaveri at Nasik and the R. Bhima at Khed in the Poona district were of a bright green colour but resembled those from Kumaon in the structure of the skeleton-spicules and oscula. Except for the specimens from Naukuchia Tal the species is only known from the Bombay Presidency, the specimens recorded by Prof. Max Weber [1] from the Malay Archipelago as *S. cinerea* actually representing not this species but *S. proliferens*, mihi.

3. SPONGILLA (EUNAPIUS) CARTERI, Carter.

Sponges were taken in Bhim Tal (alt. 4,450 feet) and Sat Tal (alt. 4,500 feet) in May and gemmules were found floating on the former lake in October. This is perhaps the commonest of the Spongillidae in India. The specimens from Kumaon bore well-developed gemmules in May, a month in which these bodies are also fully formed in the plains. At lower altitudes, however, the sponge has usually disintegrated by this date, whereas in Kumaon it was evidently still in declining vegetative vigour.

[1] *Zool. Ergeb. Niederl. Ost-Ind.*, vol. i, pp. 35, 46 (1890).

4. SPONGILLA (STRATOSPONGILLA) BOMBAYENSIS, Carter.

Specimens from Naukuchia Tal (alt. 4,000 feet) differ sufficiently from the typical form as found in Bombay and Mysore to be regarded as the types of a new variety for which, in the *addenda* to my volume in the *Fauna of British India* (p. 241), I have proposed the name *pneumatica*. Their most striking feature is the thick but irregular pneumatic coat superimposed on the gemmule outside the gemmule-spicules. They are also remarkable for possessing short vertical branches, and one specimen takes the form of a delicate cup attached by its base to a twig.

EPHYDATIA FLUVIATILIS subsp. HIMALAYENSIS, nov.

Ephydatia fluviatilis, Annandale, *Faun. Brit. Ind.*, Freshwater Sponges, etc., p. 242 (1911).

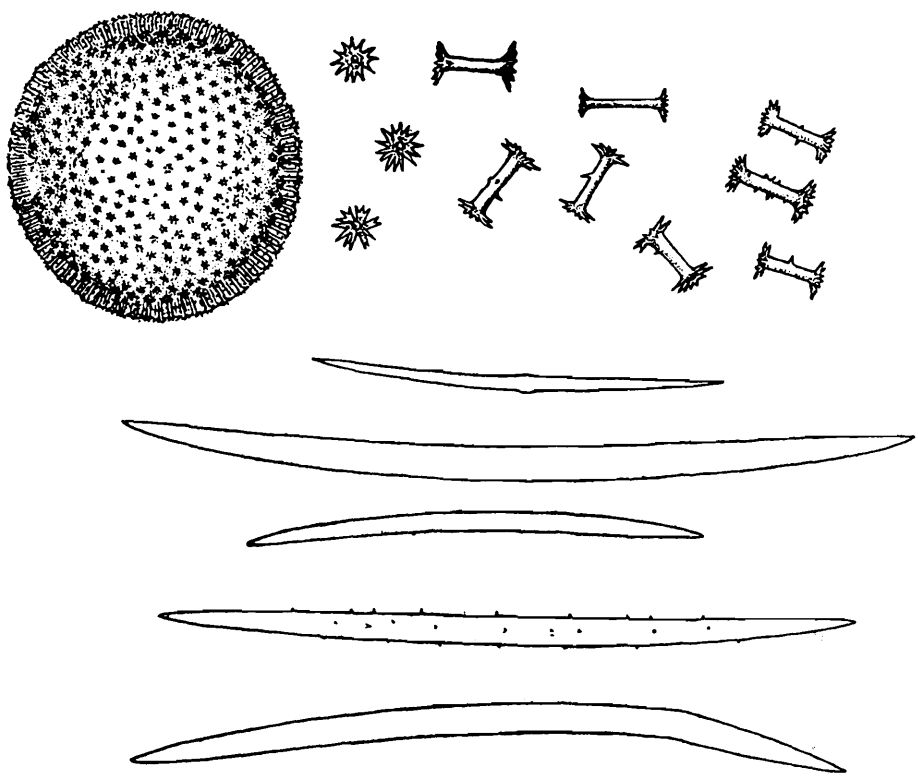

Fig. 1.—Gemmule (×75) and Spicules (×240) of *Ephydatia fluviatilis* subsp. *himalayensis*.

Specimens belonging to this common and widely distributed species were taken in May in several of the lakes, in which it appears to replace *E. meyeni*, Carter, the form common in the plains of India. In Naukuchia Tal, the water of which is remarkably clear, Mr. Kemp was able to see that they did not occur at depths much greater than 10 feet. Gemmules were also taken on the surface of Bhim Tal in October and were attributed to *E. robusta*[1] (Potts), which is probably only a variety of *E. fluviatilis*. The sponge from the lakes of Kumaon, however, although very

[1] Annandale, *Journ. As. Soc. Bengal*, 1907, p. 24, fig. 7.

near to *E. robusta*, exhibits certain peculiarities which seem to entitle it to be regarded as a distinct local race. For this new subspecies the name *himalayensis* is proposed. Many of the specimens are well preserved but I can detect no trace of "bubble-cells" in their parenchyma.

E. fluviatilis subsp. *himalayensis*, may be distinguished from the typical form of the species by the following characters:—

(i) The skeleton-spicules are very variable in length and usually rather slender. The majority are long.

(ii) Scattered amongst the smooth skeleton-spicules of the ordinary type there are a few particularly slender ones which have, widely and sparsely scattered over the middle region, a comparatively small number of very minute spines, the tips being always smooth.

(iii) The gemmule-spicules are somewhat variable in proportions but as a rule rather shorter than is ordinarily the case in the species. Their rotulae are narrow and often almost regularly, although always deeply indented round the margin. The shafts are slender and either smooth or provided with a few comparatively short spines.

The external form of the sponge is very variable and seems to depend to a large extent on the nature of the object to which it is attached. Specimens growing on slender twigs at the surface form a compressed crest like a cockscomb, those attached to stones at the bottom spread out in a flat film of little depth, and those fixed to delicate water-weeds form irregular nodules. No large specimens were obtained, none having a superficial area of more than a few square centimetres. The specimens (dry and in spirit) have a faint yellowish colour. They contained (in May) numerous well-formed gemmules.

Habitat.—Kumaon, W Himalayas: Naukuchia Tal (4,000 feet), Bhim Tal (4,450 feet), Sat Tal (4,500 feet) and Naini Tal (6,400 feet) (*Kemp*, May, 1911).

In the possession of spined skeleton-spicules *E. fluviatilis* subsp. *himalayensis*, resembles a form of the species which Weltner [1] has recently described from Issyk-Kul in Turkestan. It does not possess, however, the monstrous amphistrongyli of the latter and appears to have less spongin in its skeleton. The external surface is also smoother and the canals are less capacious.

POLYZOA.

The following is a list of the polyzoa taken in the Kumaon lakes; the species have been described in my volume on the Fresh-

[1] "Beiträge zur Kenntniss der Fauna Turkestans—viii. Spongillidae des Issyk-Kul-Sees und des Baches bei Dschety-Ogus." *Travaux de la Société Imp. des Naturalistes de St. Pétersburg*, xlii. p. 63, text figures 8-39, and pl. I, figs. 1-7 (1911).

water Sponges, Hydroids and Polyzoa in the "Fauna of British India," but it now seems necessary to regard one (*Plumatella tanganyikae*) as the type of a new subgenus.

1. FREDERICELLA INDICA, Annandale.

Taken by Mr. Kemp in Malwa Tal, Sat Tal and Naini Tal (3,600—6,400 feet) in May. The specimens from the Himalayas differ from those on which the original description of the species was based (from lakes in the W Ghats near Bombay and in Travancore) in their much more luxuriant growth. They form dense bushy masses, in some cases with vertical branches as much as 3·5 cm. long. The type specimens were, however, taken in November and were evidently just re-assuming active growth after a period of quiescence.

I have recently (March 2nd, 1912) found this species growing with fair luxuriance on the leaves of *Vallisneria spiralis* in a canal at Cuttack in Orissa. Some of the zoaria contained statoblasts; in others they were absent. The ectocyst was paler in colour than in Mr. Kemp's Kumaon specimens.

2. PLUMATELLA EMARGINATA, Allman.

Bushy masses of this common and universally distributed species were taken in May in Malwa Tal and Bhim Tal.

3. PLUMATELLA DIFFUSA, Leidy.

Common in Malwa Tal and Bhim Tal in May: one of the few species as yet taken in the plains of North-Western India.

4. PLUMATELLA ALLMANI, Hancock.

Taken in Malwa Tal in May by Mr. Kemp and in Bhim Tal in October by myself. Specimens from these lakes show every gradation between the form originally described by Hancock and Allman's *P. elegans*; they possess, however, an apparent peculiarity in coloration in that the older zooecia are invariably surrounded by a band of dark pigment near the middle.

AFRINDELLA, subgen. nov.

This subgenus is distinguished from *Plumatella* (*s.s.*) by the manner in which the orifice is closed when the polypide retracts its lophophore. The stiffened ectocyst of the zooecium, instead of merging gradually into the much softer and more flexible tentacle-sheath, terminates abruptly and the tip of the zooecium therefore becomes truncate—as a rule obliquely truncate, because the stiffened ectocyst is produced at the dorsal end of the periphery, which is oval in outline, further than at the ventral. Immediately following the sharply defined orificial margin thus produced and in direct

continuity with it, the dorsal end gives rise in some zooecia to a small semicircular projection or hood even darker than itself but somewhat more flexible. At each side of the periphery a projecting valve, which is colourless, softer and still more flexible, is formed in continuation of the stiffened wall, and the two valves are joined together round the ventral end by a narrow fringe of integument similar to that of which they are themselves formed. The terminal wall of the zooecium may therefore be said to be surrounded for the greater part of its extent by a projecting fringe or border the surface of which has the roughened appearance characteristic of the external ectocyst, although the colour and stiffness of the latter are absent. Although I talk of this structure as a projecting border, its distal margin is, as a matter of fact, in direct continuity with what becomes the proximal end of the tentacle-sheath when the polypide is fully extended, just as its proximal margin is in continuity with the wall of the zooecium.

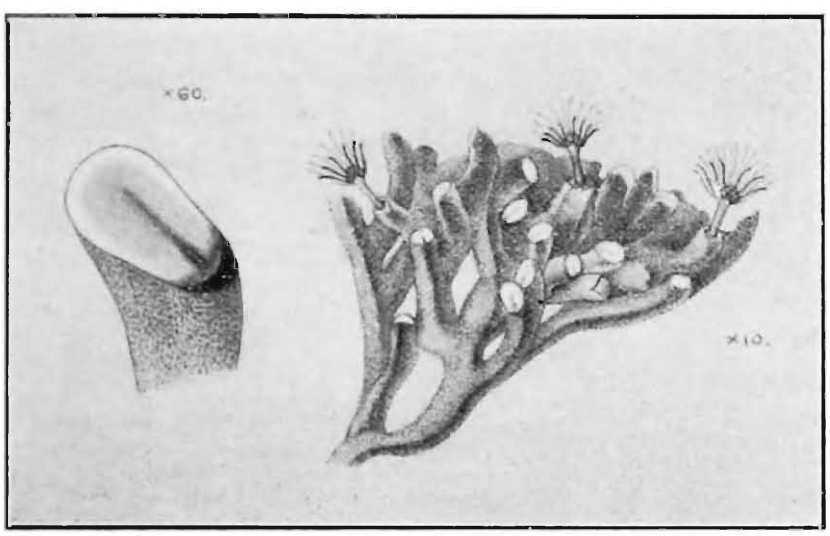

Fig. 2.—Part of zoarium of *P. tanganyikae* from Cuttack, × 10, with the tip of a single zooecium, × 60.

When the polypide retracts its lophophore, the hood (when it is present) is drawn downwards to a slight extent, owing to the fact that it is attached distally to the tentacle-sheath, and bends over the orifice. For the same reason the lateral valves close together tightly, completely covering the orifice. If retraction of the lophophore is spasmodic or unusually violent the valves are dragged into the zooecium so far that a kind of antechamber is formed above them, of course open at the tip. When the lophophore is extended, the valves are thrust apart and the hood is forced into line with the end of the orificial wall. Before the tentacles emerge, however, a bulbous transparent mass appears between the valves and forces them asunder. It is the still partially-invaginated tentacle-sheath.

It was not until I had had an opportunity of examining at leisure with a binocular microscope healthy living colonies of

Plumatella tanganyikae that I realized the complexity of the opercular apparatus in this species, but once this had been realized, it was not impossible to trace the same structures in preserved specimens from both Africa and India, although the much paler colour of the ectocyst in the former made the observation more difficult than it was in the case of Indian examples of the species. The peculiarities described in the preceding paragraphs would fully justify the recognition of *P. tanganyikae* as the type-species of a distinct genus, were it not for the fact that the different species of *Plumatella* (*s. s.*) exhibit considerable variation in respect to the manner in which the orifice is closed. In those species (*e.g.*, *P. repens* and *P. fruticosa*) in which the zooecial wall is fairly flexible and there is no furrow along its dorsal surface, the polypide is merely withdrawn by the retractor muscles, in the same way as the tip of the finger of a glove might be withdrawn by pulling strings attached to its internal surface. The walls of the zooecium collapse together and the result is a rounded tip with a minute round aperture in the middle. In those species, however, (e.g., *P. emarginata* and *P. diffusa*) in which the external ectocyst is somewhat inflexible, a furrow (that is to say, a narrow longitudinal area on which the ectocyst is thinner and softer) extends from the orifice along the dorsal surface of the zooecium and forms at one end the dividing line between valves not dissimilar to those which close together over the tentacle-sheath in *P. tanganyikae*. The lophophore emerges between them just as it does in that species. In *P. tanganyikae* there is usually no furrow on the distal end of the zooecium proper, although there often is one on the proximal part; but occasional zooecia may be found in which, in the absence of a dorsal hood, the soft integument of the valves and the separation between them extend for a short distance along the dorsal surface of the zooecium. Even in such zooecia, however, the separation between the stiff zooecial wall and the soft opercular part of the ectocyst is much more clearly defined than it ever is in such species as *P. emarginata*.

P. tanganyikae must be recognized as the type-species of the new subgenus *Afrindella*, for it is not certain, though highly probable, that a similar method of closing the zooecium occurs in Kraepelin's *P. philippinensis*, which in other respects appears to be closely related.

5. PLUMATELLA (AFRINDELLA) TANGANYIKAE, Rousselet.

P. tanganyikae, Rousselet, *P.Z.S.*, 1907 (1), p. 252, pl. XIV, figs. 1-4

P. bombayensis, Annandale, *Rec. Ind. Mus.*, II, p. 169, figs. 1, 2.

P. tanganyikae, *id. Faun. Brit. Ind.*, Freshwater Sponges, etc., p. 225.

I do not think that the form I described as *P. bombayensis* can be distinguished specifically from Rousselet's African species,

as intermediate specimens occur; but Indian specimens represent a distinct race for which the name *bombayensis* must stand. Mr. Kemp found this species somewhat sparingly in Bhim Tal and Sat Tal in May. His specimens have a peculiar reddish colour and their zooecia are longer and slightly less recumbent than those from the W Ghats. They were attached to small stones.

I have recently (March 2nd, 1912) found several colonies of this species growing, together with *Fredericella indica*, on the leaves of *Vallisneria spiralis* in a canal at Cuttack in Orissa. They resembled those found on the lower side of stones from Igatpuri but were evidently young.

It is curious that no species of *Plumatella* with broad statoblasts (except the aberrant *P. punctata*, Hancock) has as yet been found in India. Braem[1] has recently described (together with a new species of *Victorella*) a form allied to, if not identical with, *P. fungosa* (Pallas) from Issyk-Kul in Turkestan, but I know of no similar form in this country.

6. STOLELLA HIMALAYANA, Annandale.

Annandale, *Faun. Brit. Ind.*, Freshwater Sponges, etc., p. 246, fig. 49.

This species is described and figured in the *addenda* to my volume in the "Fauna" (p. 246, fig. 49) from specimens taken by Mr. Kemp in Malwa Tal in May. At that season the species was evidently scarce, but the zooecia contained few statoblasts (only free ones) and numerous young colonies were being formed by the budding of old statoblasts on the stones to which the adult zoaria were attached.

S. himalayana differs from *S. indica*,[2] the type species of the genus, in the following characters:—(i) the zooecia are entirely recumbent; (ii) each zooecium is separated from all others by the stolon-like prolongation of their bases; and (iii) the zoarium produces lateral branches almost in a cruciform manner.

7. LOPHOPODELLA CARTERI (Hyatt).

I found this species fairly common in Bhim Tal in October and Mr. Kemp took it in great profusion in the same lake and in Malwa Tal and Sat Tal in May. At both seasons statoblasts were being produced in large numbers, but in my specimens a large proportion of these were more or less ill-formed, the hooked processes being deficient or obsolete. These specimens were made the types of my variety *himalayana*. Mr. Kemp's were, however, quite normal. *L. carteri* was originally found in the island of Bombay and is abundant in November in Igatpuri lake in the

[1] "Beitrage zur Kenntniss der Fauna Turkestans—viii. Bryozoen und deren Parasiten," *Trav. Soc. Imp. Naturalistes St. Petersburg*, vol. xlii, p. 5, figs. (1191).

[2] *Rec. Ind. Mus.*, iii, p. 279, fig. (1909). Professor K. Ramunni Menon of Madras has recently sent me specimens of *S. indica* from that city.

W Ghats. A record of "*Lophopus*" from Madras may actually refer to this species, statoblasts of which have been found in German East Africa. A race (*davenporti*, Oka) occurs in Japan and is distinguished by the stronger development of the hooked processes at the ends of the statoblasts.

GEOGRAPHICAL DISTRIBUTION OF THE SPECIES.

The following list shows practically all that is known of the distribution of the sponges and polyzoa that have been found in the Kumaon lakes, at any rate so far as India is concerned. It would seem to provide evidence that the aquatic fauna of the Malabar Zone [1] is less restricted than it at one time appeared to me. Recent investigations, however, undertaken in different parts of India, prove that the African element which is so marked a feature of that fauna is more widely distributed in India than was at first realized. In particular, a species (a somewhat peculiar species, it is true) of *Corvospongilla* has been found in the Ganges valley,[2] while both *Fredericella indica* and *Plumatella tanganyikae* have been discovered in the main Peninsular Area of India. It is noteworthy that the Gangetic *Corvospongilla* differs from its congeners in having free statoblasts provided with a well-developed pneumatic layer, but a species of the genus more typical in this respect (*C. ultima*)[3] has also been found at Tanjore far to the east of the Western Ghats.

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[1] See Alcock, *Cat. Ind. Dec. Crustacea Ind. Mus.*, part i, fasc. ii (Potamonidae), 1910; also the general introduction to my volume on the Freshwater Sponges, etc., in the *Fauna of British India*, p. 10.

[2] Annandale, *op. cit.*, p. 243.

[3] This species is wrongly attributed to *Spongilla* in the "Fauna" (p. 105).

Geographical Distribution of the Sponges and Polyzoa of the Kumaon Lakes.

[Forms of which the names are marked with an asterisk are apparently peculiar to the lakes of Kumaon.]

Name of Species.	Malabar Tract.	Peninsular India (Main Area).	Indo-Gangetic Plain.	Distribution outside India.
SPONGES.				
Spongilla lacustris subsp. *reticulata.*	Igatpuri, W. Ghats ..	Madras, etc. ..	Gangetic delta ..	Typical form of the species widely distributed in Europe, N. Asia and America.
Spongilla cinerea ..	Bombay (island); Igatpuri; Poona district.	....	....	....
Spongilla carteri ..	Many localities ..	Many localities ..	Many localities ..	Mauritius; Malay Archipelago; E. Europe; ? Central Africa.
Spongilla bombayensis var. *pneumatica* *	Bombay (island); Igatpuri (*typical form*).	Bangalore (*typical form*) ..	....	Natal, S Africa (*typical form*).
Ephydatia fluviatilis subsp. *himalayensis.**	....	....	....	Europe; America; N. Asia (*typical form*) Turkestan (? *var.*); S. Africa (*var*).
POLYZOA.				
Fredericella indica ..	Igatpuri, W. Ghats; Travancore (plains).	Cuttack, Orissa	....	A specimen from N. Assam may belong to this species, but it is doubtful even whether it is *Fredericella.*
Plumatella emarginata .	....	....	Gangetic delta ..	Europe, N. America, etc.
Plumatella diffusa ..	..	....	Gangetic delta, etc. ..	Europe, N. America.
Plumatella allmani	....	..	....	England.
Plumatella (*Afrindella*) *tanganyikae.*	Igatpuri, W. Ghats ..	Cuttack, Orissa	..	Central Africa (L. Tanganyika).
*Stolella himalayana** ..	...	....	....	..
Lophopodella carteri ..	Bombay (island); Igatpuri.	? Madras	..	E. Africa (*typical form*); Japan (*subspecies*).