

XIV OBSERVATIONS ON THE INVERTE-
BRATE FAUNA OF THE KUMAON LAKES,
WITH SPECIAL REFERENCE TO
THE SPONGES AND
POLYZOA.

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[The following notes are, in the main, the results of a visit paid to the Kumaon lakes in May, 1911, by Mr. Kemp. We have, however, incorporated also observations made by myself in October, 1907.—*N. A.*]

PART I.—GENERAL.

By STANLEY KEMP and N. ANNANDALE.

The Kumaon lakes¹ are situated at altitudes of from 3,600 to 6,400 feet in the lower ranges of the Western Himalayas in the administrative district of Naini Tal. According to Theobald their origin "is due to the obstruction of local drainage caused by the debris of old moraines on the retrocession of the glaciers at the termination of the glacial epoch." None of them are of any great size, the largest, Naini Tal, covering an area of about 120 acres. The depth is as a rule considerable and in Naukuchia Tal may reach as much as 132 feet.

The principal lakes are five in number :—

	Altitude.	Maximum depth.
	Feet.	Feet.
Malwa Tal	3,600	127
Naukuchia Tal	4,000	132
Bhim Tal	.. 4,450	87
Sat Tal	4,500	61½
Naini Tal	6,400	93

The banks of the lakes are steep and in most cases composed of stones, at some points with a considerable amount of fine mud.

¹ For particulars of the geology and structure of these lakes see Theobald's paper "The Kumaon Lakes," *Rec. Geol. Surv. Ind.* XIII, p. 161 (1880), and Holland's Report on the geological structure and stability of the hill slopes around Naini Tal, *Mem. Geol. Surv. Ind.*, 1897.

Although water-plants occur in the lakes, they do not form the rank masses of vegetation that often choke small ponds in the vicinity. In the middle the bottom is composed, probably in all cases, of very fine mud; but little dredging has been undertaken. In Bhim Tal and Naini Tal a certain amount of fine silt is always held in suspension in the water; this is less conspicuously the case in Sat Tal and Malwa Tal, while the water of Naukuchia Tal is remarkable for its clearness.

MALWA TAL.

This lake, which was visited only in May, is situated in a narrow gorge some 3,000 feet in depth. The most striking feature of its fauna appears to be the great luxuriance of the Phylactolaematous Polyzoa.

The most abundant form was *Fredericella indica*, a species hitherto known, in an evidently depauperated phase, from lakes in the Western Ghats and in the plains of Travancore. In Malwa Tal the species formed a luxuriant growth consisting of numerous vertical branches, sometimes as much as 35 mm. long, closely pressed together and entangled. It exhibited, however, no tendency to the formation of solid bodies such as are composed by the zoaria of "*Alcyonella*." *F. indica* was found in greatest profusion at the east end of the lake, covering the under surfaces of stones in dense bushy masses; but it also occurred, though more sparingly, in other parts of the lake on the stems of water-plants. The polypides were for the most part (in May) in a state of activity and very few statoblasts could be found in the zoecia.

Plumatella diffusa was also abundant, but its polyparia were as a rule of small size. This species always forms recumbent colonies on flat horizontal or vertical surfaces but in some places the individual zoecia reach a greater length than is the case in Malwa Tal. The specimens were found most abundantly in this lake on the under surface of stones, in many cases together with *Fredericella*. *Plumatella emarginata* and *P. allmani* were both rare, the latter species being found on the stems of a rush.

One of the most interesting animals found in the lake was a new species of *Stolella*, a genus allied to *Plumatella* and recently described from the Indo-gangetic plain. The new species (*S. himalayana*) grew on the lower surface of stones together with *Fredericella* and *Plumatella*, but was very rare, only three specimens having been obtained. It formed a sparse and absolutely flat growth and seemed in danger of being overwhelmed by the more vigorous species associated with it. In all three specimens there were indications that active growth had not long been in progress and numerous minute colonies, in which it was evidently just starting, were found in the vicinity of the larger zoaria. In some cases the valves of a statoblast still adhered to the pair of polypides which as yet formed the whole polyparium. The typical form of *Lophopodella carteri* was found in abundance on the

lower surface of stones and less frequently on the stems of water plants. Many of the polyparia were undergoing division and the majority contained fully formed statoblasts. This polyzoon was also found in all the other lakes of Kumaon except Naukuchia Tal and nowhere in the district was it associated with any species of alga as was the case in Igatpuri lake in the Western Ghats.¹

The only sponge obtained in Malwa Tal was *Spongilla lacustris* subsp. *reticulata*, a form which is common in the plains of India and occurs in the W Ghats at an altitude of over 2,000 ft. The sponge formed a small basal mass with delicate branches and was of a green colour. It occurred, in no great abundance, on the stems of plants growing in the south-eastern corner of the lake.

Of the higher crustacea only a single species (*Potamon atkinsonianum*) was obtained. As Alcock² has shown, *P. atkinsonianum* is closely allied to *P. kooloense*. The latter form extends from the Nepal Terai to Afghanistan, while the former ranges from the Shan States to Simla. The species are characteristic respectively of the Eastern and Western Himalayas; but the two occur together over an area reaching from Nepal to Simla and both have been taken on the shores of the Kumaon lakes.

The entire absence of Palaemonidae and Atyidae is characteristic of all the lakes and of the streams in their immediate vicinity.

When Malwa Tal was visited in May the plankton was anything but rich. Small Copepods occurred, but not in large numbers, while Cladocera and Ostracoda were extremely scarce. A few specimens of a Rotifer belonging to the family Anuraeidae were obtained and also a few Hydrachnids. A minute Peridiniid was found in small numbers. It resembles *Ceratium longicorne*, Perty, in the length of its processes, but agrees with *C. kumaonense*, Carter,³ in having three processes instead of four: in some individuals, however, a rudiment of the fourth process can be detected, springing laterally from the anterior surface. The only adult aquatic insects which were observed were a Gerrid and a Corixid; small dragon-fly larvae were abundant and a few Ephemeridae were obtained.

NAUKUCHIA TAL.

This lake, also only visited in May, is, as is implied by its name ("the Lake of Nine Corners"), of irregular shape, not being situated in a narrow gorge.

The fauna is at once distinguished from that of Malwa Tal by the entire absence of polyzoa, so far as could be ascertained, and by the profuse growth of sponges.

The most abundant of the latter was a form of the widely distributed *Ephydatia fluviatilis*, a species not hitherto known to

¹ Annandale, *Fauna of British India*, Freshwater Sponges, etc., p. 234, pl. iii, fig. 4, and West, *Journ. As. Soc. Bengal*, 1911, p. 83.

² *Cat. Ind. Dec. Crustacea*, pt. I, fasc. II (Potamonidae), p. 26 (Calcutta, 1910).

³ *Ann. Mag. Nat. Hist.* (4), VII, p. 229 (1870).

occur in India, throughout the plains of which it is apparently represented by the allied "*Spongilla*" *meyeni* of Carter. In Naukuchia Tal the species was found in two phases the peculiarities of which were probably due solely to environment. When attached to water weeds it assumed the form of solid irregular masses often of considerable size and when attached to stones round the margin of the lake grew as thin films usually more or less circular in outline.

A new variety of *Spongilla bombavensis*, a species hitherto recorded from the Western Ghats, the Mysore plateau, the Island of Bombay and S. Africa, was distinguished from all forms previously found by the production of delicate vertical branches on a basal film. It grew on branches of trees at the edge of the lake. Specimens of *Spongilla cinerea* found in the same situation showed no tendency to the formation of branches, but coated the bark in an almost uniform layer about 1 cm. thick. This sponge has hitherto only been found in the island of Bombay and in the Western Ghats.

The only large crustacean which was obtained was a specimen of *Potamon atkinsonianum*.

The plankton resembled that of Malwa Tal, but Entomostracæ seemed less abundant, while Peridiniaceæ were more plentiful. In addition to *Ceratium longicorne*, which here appeared not infrequently in its typical development, a few specimens of *Peridinium apiculatum*, Ehrenburg, were observed. Insects again were exceedingly scarce, but a Rhynchoton belonging to the Naucorid genus *Heleocoris*, not seen in Malwa Tal, was found clinging to the under surfaces of stones on the margin of the lake.

Cladocera, aquatic insects and molluscs occurred in great abundance in a small pond lying above the level of the lake near its northern end.

BHIM TAL.

Owing to the fact that this lake has been dammed at its eastern corner and provided with sluices in connection with the water-supply, the level of the water and the area covered by it can be regulated artificially to a considerable extent. It was visited in October, 1907, and in May, 1911, and on both occasions the sluices were closed and the lake full.

Both sponges and polyzoa are fairly abundant in Bhim Tal; but the former grow less luxuriantly than in Naukuchia Tal, and the latter than in Malwa Tal. The following species were found:—*Ephydatia fluviatilis*, *Spongilla carteri*, *Plumatella diffusa*, *P. allmani*, *P. emarginata*, *P. tanganyikæ*, and *Lophopodella carteri*. *Fredericella indica* was not obtained.

Of the sponges in this list only gemmules¹ were found in October, 1907; but growing specimens were collected in May, 1911

¹ Annandale, *Journ. As. Soc. Bengal*, 1907, p. 24.

Both sponges and polyzoa were found in greater abundance than elsewhere on branches of trees growing towards the north end of the lake, in an area left entirely dry when the sluices are opened. *Lophopodella carteri* appeared to be equally abundant on the two occasions on which the lake was visited; but *Plumatella allmani* was only taken in October, 1907, and *P. diffusa*, *P. emarginata* and *P. tanganyikae* in May, 1911.

Most of the specimens of *Ephydatia fluviatilis* exhibited a peculiar external modification; growing on narrow twigs, their base necessarily covered a narrow but elongated surface; in consequence their growth was mainly in a vertical plane, the best developed having the form of a large cockscomb.

Here, as in Naukuchia Tal and Malwa Tal, a small leech belonging to the genus *Glossosiphonia*¹ was found in considerable numbers. In May it was noticed that in small pools in the partly dried river bed at the north end of Bhim Tal, individuals of this leech were in the habit of attaching themselves to large water beetles belonging to the genera *Hydrophilus* and *Cybister*: as a rule to the former. The position chosen was invariably the apex of the dorsal surface of the elytra, where in some cases as many as four specimens were found. Leeches could not be discovered beneath the wing-cases and it is difficult to suggest any reason for the association of the two forms, except that leeches attached to water-beetles must have a considerable chance of escape from pools that are drying up, owing to the fact that the beetles have the power of flight. The species of the genus *Glossosiphonia* are known to feed chiefly, if not entirely, on soft-bodied animals, and in the present case it was clear that they were unable to penetrate the hard integument of the insects. Mollusca were abundant in these pools, but only to one specimen, belonging to the genus *Limnaea*, was a leech attached.

In Bhim Tal itself no large water-beetles appeared to exist. *Glossosiphonia* was found under stones round the margin of the lake, frequently with young ones of a pale green colour attached to the ventral surfaces. At least three other Hirudinea were found together with this form, one of them probably representing the genus *Limnatis*. In addition a small dark grey planarian was not uncommon.

As regards the plankton the most notable feature on both occasions was the enormous abundance of a *Ceratium*; but whereas in 1907 the form that occurred could be identified with *C. longicorne*, Perty, in May, 1911, the majority of the specimens agreed closely with Carter's original figure of *C. kumaonense*. It is obvious that much research on the Peridiniaceae of the Indian lakes is necessary before any statement can be made as regards the limits of the "species"—even of those already recorded.

¹ Mr W. A. Harding has kindly informed us that this species is closely allied to the British *G. heterodita* but probably represents a form hitherto undescribed. It is perhaps specifically identical with a species occurring in Calcutta but not as yet found in association with beetles in that locality.

Although there appears to be some evidence that these two forms are merely phases of one species, it is noteworthy that *C. kumaonense*, to use the name without prejudice, is the common form in Bhim Tal at a time of year at which *C. longicorne* predominates in other lakes situated in the same district and at approximately the same altitude.

SAT TAL.

This lake is situated about two miles west of Bhim Tal at a slightly greater elevation. Originally, as is implied by the name, seven lakes existed, but only two sheets of water of any considerable size now remain. The larger, Sat Tal proper, is U-shaped and in former times comprised two separate lakes; but a neck of shallow water now connects the large eastern part with the smaller, but much deeper western part.

The fauna of Sat Tal is in some respects similar to that of Bhim Tal, but the plankton is poor and the *Ceratium*, found in such abundance in the latter lake, was (in May) almost entirely absent. Two species of sponge were found, *Ephydatia fluviatilis* and *Spongilla carteri*, the latter being very common. Of polyzoa, *Lophopodella carteri* was plentiful on the branches of trees growing in the eastern part of the lake and *Fredericella indica* was found in the same situation along with a few colonies of *Plumatella tanganyikae*. The water bug *Heleocoris*, noticed in Naukuchia Tal, was not uncommon; but other aquatic insects were, as usual, extremely scarce. Small leeches similar to those obtained in Bhim Tal occurred under stones on the margin of the lake.

The plankton was very scanty; a few copepods were found and *Peridinium apiculatum* was comparatively plentiful. The few examples of *Ceratium* that were obtained had the same form as those observed in Malwa Tal.

In May a small pool of water existed at the bottom of a deep ravine situated close to the weir at the north-west corner of the lake. This, as was found to be the case with the ponds in the vicinity of Bhim Tal and Naukuchia Tal, sustained an abundance of insect and molluscan life.

Gurud Tal, a small lake situated close to Sat Tal but at a slightly greater elevation, could not be examined systematically owing to the absence of a boat. Judging, however, from an inspection of the bank, its fauna did not appear to differ in any notable way from that of the larger lake.

NAINI TAL.

This, the largest of the Kumaon lakes, is situated at an elevation of about 6,400 ft., nearly 2,000 ft. higher than Bhim Tal; but notwithstanding its greater altitude the fauna did not present any considerable difference from that found in the lower lakes, though, on the whole, it appeared to be less rich.

In May almost all the margin was occupied by a dense belt of water-weeds, many of which possessed very long stems and grew from considerable depths. These weeds afforded support to large colonies of *Lophopodella carteri* and *Fredericella indica* and it was noticed that *L. carteri* invariably lived on the upper parts of the stems, extending to within a foot or so of the surface, while *F. indica* always occupied a lower position. Together with these polyzoa large colonies of Vorticellids were conspicuous, more particularly near the surface of the water. The only sponge observed was *Ephydatia fluviatilis*, which grew both on the stems of water-plants and on the under surface of stones on the western bank.

The scarcity of aquatic insects was again a very noticeable feature; but a leech of the predaceous family Herpobdellidae which seemed to be rare in the other lakes was not uncommon under stones.

In May the plankton was decidedly richer than in Sat Tal. Copepods were comparatively abundant and Rotifers of the family Anuraeidae were by no means uncommon. *Ceratium* was exceedingly scarce; the few specimens observed had the same form as those found in Malwa Tal.

At the northern end of Naini Tal, situated at an elevation of about 7,000 ft., there is a small temporary sheet of water bearing the name of Suka Tal. In May, 1911, this was completely dried up, but from earth brought back to Calcutta and placed in an aquarium a few Cladocera and Ostracoda were reared. It was in Suka Tal in October, 1906, and May, 1909, that specimens of an interesting Anostracous crustacean, *Pristicephalus priscus*, were obtained. This species, which has recently been described by Prof. von Daday,¹ seems to be restricted to the Western Himalayas. It has been found in two localities in the Simla Hills and, in addition to Suka Tal, at Bhowali, a village on the road between Bhim Tal and Naini Tal. In May, 1911, the species seemed to be entirely absent from small pools in the vicinity of the Kumaon lakes, although it was abundant in 1907 in the same months near Simla. The erratic appearance and disappearance of the species of Branchiopoda is well known.

The table on the next page illustrates the distribution of Porifera and Polyzoa in the five principal lakes of the district. None of our specimens are from deep water, none having been procured from a greater depth than about 6 feet.

¹ "Mon. Syst. Phyllopo des anostracés" (Ann. Sc. Nat. Zool. (Paris), 9e série, XI, p. 224, fig. 29; 1910).

	Malwa Tal, 3,600 ft.	Naukuchia Tal, 4,000 ft.	Bhim Tal, 4,450 ft.	Sat Tal, 4,500 ft.	Naini Tal, 6,470 ft.
PORIFERA—					
<i>Epydatia fluviatilis</i>		C	++	C+	+
<i>Spongilla carteri</i>	::	+	+	C+	
<i>Spongilla cinerea</i>	+	C			
<i>Spongilla lacustris</i> subsp. <i>reticulata</i> ..					
<i>Stratospongilla bombayensis</i> var. <i>pneumatica</i>					
POLYZOA—					
<i>Lophopodella carteri</i>	+	::	C	C	C
<i>Fredericella indica</i>	C	::	+	+	
<i>Plumatella diffusa</i>	+		+		
<i>Plumatella allmani</i>	+		R		
<i>Plumatella emarginata</i>	R		R		
<i>Plumatella tanganyikae</i>	::	..	+	R	
<i>Stolella himalayana</i>	R				

[C = common; + = present; R = rare.]

Imperfect as the above observations are, the following general conclusions as regards the fauna of the Kumaon lakes may be stated with some confidence:—

1. The zoo-plankton (more particularly the smaller crustacea) is, at any rate in the month of May, much more abundant in the small pools in the neighbourhood of the lakes than in the lakes themselves; this is also the case as regards aquatic insects.
2. Sponges and polyzoa are remarkably abundant in most of the lakes, but no specimens of the latter group were taken in Naukuchia Tal.
3. Both sponges and polyzoa, with a few exceptions (*e.g.* *Stolella himalayana*), contain numerous resting reproductive bodies in May. This agrees with what occurs in the plains of India, except that the production of these bodies is usually completed and the vegetative part of the organism has decayed about a month or six weeks earlier. It is very different from what occurs in European lakes, in which the resting reproductive bodies are usually found at the approach of winter.
4. Mollusca such as *Limnaea* and *Planorbis* reach a larger size in the small pools in the vicinity of the lakes than in the lakes themselves.
5. No species of Caridea occurs in the lakes. Decapoda are represented solely by two species of *Potamon* (*s. s.*).

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 Weber¹ 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).