OBSERVATIONS ON THE INVERTEBRATE FAUNA OF THE KUMAON LAKES.

III. The Freshwater Mollusca.

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The present paper on the Mollusca of the Kumaon Lakes is a continuation of the two papers published by Dr. N. Annandale and Dr. S. W Kemp in 1912 [1] on the Invertebrate Fauna of the Kumaon Lakes. It is based on a small collection of molluscs made by Dr. Kemp in 1911, and the large series of specimens obtained by Mr. S. L. Hora and myself from the various lakes and streams in August, 1920. The lakes visited were: Naini Tal, Sariya Tal, Khurpa Tal, Sukha Tal, Bhim Tal, Naukuchia Tal, Sat Tal, Damianti Tal and Malwa Tal. Collections were also made in the hill-streams running in the vicinity of these lakes. Notes on the situation, etc., of most of these will be found in the paper cited already, and I only include here a few general observations on the physical conditions of the lakes during August, 1920, with more detailed notes on the areas not visited by Dr. Kemp in 1911.

The water-level in all the lakes was much higher at the time of our visit than at that of his, owing to large quantities of water that had been brought during the rains from the extensive catchment-areas around each of them; the area of the lakes also was much larger. The shallower regions of the lakes, which in May, 1911, had been found to harbour rich growths of sponges and Polyzoa, had five to six feet of water, and sponges and Polyzoa were practically non-existent. The water in most of the lakes was clear and held very little mud in suspension.

All the lakes with the exception of Malwa Tal had, along the margins and up to a depth of about ten feet, thick growths of aquatic plants such as *Chara*, *Potamogeton*, *Hydrilla* and *Nelumbium* and large quantities of algae, such as *Spirogyra*. Sponges and Polyzoa were in a few cases found growing on the stems and leaves of these aquatic plants.

The fauna as a whole was very poor. The Peridiniid, which was found to be very common in 1871 [2] and rather scarce in 1911, was only found in very small numbers in Bhim Tal and in still smaller numbers in Naini Tal. Leeches were plentiful under

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[1] *Rec. Ind. Mus.* VII, p. 129 (1912).
[2] *Ann. Mag. Nat. Hist.* (4) VII, p. 229 (1871).

stones near the margins and a species of *Glossosiphonia* was found parasitic on *V bengalensis mandiensis*. Dragon-fly larvae, both Libellulids and Aeschnids, were fairly common, but the number of aquatic Hemiptera and Coleoptera was very small; in Malwa Tal the Hemiptera were a little more numerous. A special feature of Bhim Tal was the large numbers of Chironomid larvae which were living in tubes attached to submerged stones and tree-trunks. Molluscs of the genera *Limnaea, Gyraulus, Segmentina, Hippeutis* and *Sphaerium* were found in varying numbers in almost all the lakes, but *V bengalensis mandiensis* was only found in Naini Tal and Khurpa Tal. The conditions as to Crustacea were identical with what was found to be the case by Dr. Kemp in 1911. Fishes of the genera *Oreinus, Barilius, Barbus* and *Ophiocephalus* were common in all the lakes, and a species of the genus *Labeo* was also found in Malwa Tal.

SARIYA TAL.

This is a rather small lake, or rather a marsh in the course of a rapid hill-stream. It is situated at a distance of about three miles to the west of and at a slightly lower level than Naini Tal. It is a depression in the course of the hill-stream with about 3 to 8 feet of water; the area is not very large and the current in the lake is much slower than in the hill-stream. The entire area at the time of our visit supported a very thick vegetation consisting mainly of *Chara, Potamogeton* and large quantities of algae.

No Sponges or Polyzoa were seen. Dragon-fly larvae of *Sympetrum* sp.,[1] all too young to identify specifically, were fairly abundant. The Molluscan fauna was very poor; only a few *Limnaeae* and Planorbids were found after careful search.

KHURPA TAL.

Khurpa Tal is situated at a distance of about five miles from Naini Tal at an altitude of 5365 ft. It occupies a nearly circular depression surrounded on all sides by high hills. The area during the dry season is rather small, but the lake becomes much more extensive during the rains. The lake was stated to be over ten feet deep near the middle, though near the margins it is quite shallow. It is not fed by any streams and there is no regular outflow of water. At the time of our visit there was no real aquatic vegetation and the water was quite clear.

The fauna, which was very poor, consisted of the same species of fish as are found in the other lakes, a few dragon-fly larvae of the species *Anax parthenope* Selys, some *Limnaeae* and large numbers of *V bengalensis mandiensis* along the banks, feeding on algae growing on stones. No Planorbids were seen.

[1] I am indebted to Major F. C. Fraser, I.M.S., for the identifications of the dragon-fly larvae.

SUKHA TAL.

In May, 1911, this area was found to be quite dry, but a few Cladocera and Ostracoda were reared out of some earth brought back to Calcutta. In September, 1920, practically the whole of this area had 2 or 3 feet of water. The vegetation was very scanty, consisting only of a few stray plants of *Potamogeton*, but algae like *Hydrodictyon* and *Spirogyra* were very abundant.

A fair number of Cladocera and Ostracoda were collected and water-bugs were plentiful near the margins. Larvae of dragon-flies of the species *Anax parthenope* Selys, *Lestes cyanea* Selys and *Orthetrum triangulare* Selys were fairly abundant. No *Limnaea* was seen, but Planorbids of the genus *Gyraulus* were common amongst the algal filaments.

DAMIANTI TAL.

Situated at about the same level as the Sat Tal, but about a mile to the east of it, is a spring known as the Damianti Tal. A small stream, which has been greatly widened and deepened for irrigation purposes, leads down from the spring to the valley below. At the time of our visit both the spring and the mouth of the stream were full of cow-dung with many submerged grasses growing in them.

The only interesting animals collected here were a few *Limnaeae*, a few *Gyraulus* and some bivalves of the common Indian species, *Sphaerium indicum*.

The hill-streams were very uninteresting from the molluscan point of view. In the upper regions, where they are fairly rapid, no molluscs were found, but lower down they had a few Mollusca of the families Melaniidae, Planorbidae and Hydrobiidae. As these Molluscs were collected outside the limits of the Tal area and as they belong to common Gangetic species, I do not propose to include them in the present paper.

Family LIMNAEIDAE.

Genus **Limnaea** Lamarck.

Two species of this genus, *L. acuminata* and *L. luteola*, were collected in the Tal area. The former is the common species and is represented by a number of forms or phases, while the latter has a much restricted distribution and was found only once in a pond on the roadside near Naukuchia Tal.

Limnaea acuminata Lam.

1881. *Limnaea acuminata*, von Martens, *Conch. Mitth.* I, p. 75, pl. xiv.
1921. *Limnaea acuminata*, Annandale and Prashad, *Rec. Ind. Mus.* XXII, p. 568, pl. vii, figs. 1-3, text-fig. 12.

In the paper cited above Dr. Annandale and I have given reasons for considering most of the Indian species of the older

authors as being only forms, variations or phases of this highly plastic species. A few further remarks are necessary in view of the material now collected from the Tal Lakes.

Large series of specimens collected in Naini Tal, Sariya Tal, Khurpa Tal and Malwa Tal are like the typical *L. patula* Troschel figured by von Martens. Some of the shells from Naini Tal are referrable to the form *amygdalum* Troschel, while quite a large series of specimens are intermediate between the two forms. In view of these facts our conclusions as to the desirability of suppressing these names seem to be justified. We were, however, in doubt as to the form *chlamys* Benson. With a large series of specimens from a marshy area near Bhim Tal and from Naukuchia Tal, I believe this to be a well marked phase. Its elongate shape with a subcylindrical body-whorl, the comparatively short spire, rather narrow and elongate mouth with a nearly straight outer lip and the sulcate sculpture are quite characteristic of this phase.

The form referred to as Sowerby's *ventricularius* by Annandale[1] and *ventricularius* Kuster in the paper cited above was included on the authority of some Indian Museum specimens identified by Preston. The three shells, as I now find on comparison with the large series of shells from Naini Tal, are all young specimens of the form *amygdalum* Troschel and have nothing to do with the species *L. ventricularius* Parreiss, from " Ostindien."

Limnaea luteola Lam.

1920. *Limnaea luteola*, Annandale, *Ind. Journ. Med. Res.* VIII, p. 109.

This species, as was stated by Annandale in the paper cited above, is identical with Deshayes' *L. succinea*, but as Lamarck's name has priority, it should be known as *L. luteola*. It is not very abundant in the Gangetic Valley, but is the common species of Peninsular India. The occurrence of large numbers of specimens in a muddy pool near Naukuchia Tal at an altitude of over 4000 ft. is, therefore, of special interest. In this pool the specimens were found attached to the stems of *Potamogeton* and to a grass which were growing abundantly in the muddy waters of the pool.

All the specimens are quite typical and are fully grown.

Genus Gyraulus Agassiz.

1919. *Gyraulus*, Annandale and Prashad, *Rec. Ind. Mus.* XVIII, p. 52.
1921. *Gyraulus*. *id.*, *ib.*, XXII, p 582.

This genus is represented in the Tal Area by three species *G. convexiusculus* (Hutton), *G barrackporensis* (Clessin) and what appears to be an undescribed species. I do not, however, propose to describe it till the collection of the Indian Museum Planorbidae,

[1] *Ind. Journ. Med. Res.* VIII, p. 110 (1920).

now with Monsieur L. Germain of the Paris Museum, is returned to India.

Gyraulus convexiusculus (Hutton).

1921. *Gyraulus convexiusculus*, Annandale and Prashad, *op. cit.*, p. 582

Large numbers of specimens of this species were collected in Naini Tal, Sariya Tal and a hill-stream opening into the north-western corner of Bhim Tal, attached to the stems of *Potamogeton* and entangled in the filaments of algae like *Spirogyra*.

Gyraulus barrackporensis (Clessin).

1886. *Planorbis Barrackporensis*, Clessin, *Limnaeiden* in Mart. Chemn. *Conch. Cab.*, p. 125, pl. xviii, fig. 7.
1886. *Planorbis Huttoni, id., ib.*, p. 139, pl. xviii, fig. 4.
1909. *Planorbis barrackporensis*, Germain, *Rec. Ind. Mus.* III, p. 120.
1915. *Planorbis (G.) barrackporensis* and *P. (G.) huttoni*, Preston, *Faun. Brit. Ind. Freshw.-Moll.* pp. 121, 120.

I agree with Germain in considering *P. barrackporensis* and *P. huttoni* as being the same species. The species is known to occur in such widely separated localities as Barrackpore, Calcutta, Benares and Tibet.

In the Tal area we collected specimens of this species in Naukuchia Tal along with those of *Hippeutis caenosus* (Benson).

Genus Hippeutis Agassiz.

1921. ? *Hippeutis*, Annandale and Prashad, *op. cit.*, p. 584.

In the paper cited above Dr. Annandale and I recently suggested that Benson's *Planorbis caenosus*, which had hitherto been assigned to the genus or sub-genus *Segmentina*, agrees with his other species *P. umbilicalis* in shell-characters and is probably congeneric with it. We further questioned their being included in the genus *Segmentina* and suggested that they should probably be placed in the genus *Hippeutis*. An examination of the soft parts and radula of the European *H fontanus* confirms this opinion.

Hippeutis caenosus (Benson).

1850. *Planorbis caenosus*, Benson, *Ann. Mag. Nat. Hist.* (2) V, p. 349.
1876. *Planorbis caenosus*, Hanley and Theobald, *Conch. Ind.* pp. xviii and 18, pl. xxxix, figs. 7–9.
1878. *Planorbis caenosus*, Sowerby, *Conch, Icon.* XX, pl. x, figs. 78, *a, b.*
1878. *Planorbis caenosus*, Nevill, *Hand List Moll. Ind. Mus*, I, p. 246.
1886. *Planorbis caenosus*, Clessin, *op. cit.*, p. 165, pl. xxiv, fig. 4.
1915. *Planorbis (Segmentina) caenosus*, Preston, *op. cit.*, p. 127.
1918. *Planorbis caenosus*, Annandale, *Rec. Ind. Mus.* XIV, p. 113.

This species has been recorded from Jamalpur, Bengal; Manbhum, Orissa; Bhim Tal, United Provinces; and Yawnghwe Province, Burma. A fair series of specimens was collected by us in

Naukuchia Tal. Unfortunately most of them were dead shells and are not, therefore, available for anatomical study.

Genus **Segmentina** Fleming.

1921. *Segmentina*, Annandale and Prashad, *op. cit.*, p. 585.

In the Tal area we found specimens of *S. calathus* (Benson), the only Indian species which Dr. Annandale and I were able to assign definitely to this genus.

Segmentina calathus (Benson).

1821. *Segmentina calathus*, Annandale and Prashad, *op. cit.*, p. 585.

We found only a few specimens of this widely distributed species amongst the algae in Naini Tal. The specimens were found only near the shores.

Family HYDROBIIDAE.

In spite of careful search no representatives of this family were discovered by us in the Tal Lakes and I am very doubtful as to whether any of them are really endemic in the lakes. While making this rather bold statement I am aware of the record of some specimens of *Tricula montana* and *Bythinia pulchella* from Naini Tal by Nevill in his Hand-List,[1] but that does not necessarily mean that the specimens referred to were collected in the lake itself. Benson's type-series of the former species was collected in a small stream flowing into Bhim Tal and probably Stoliczka's specimens referred to by Nevill were also obtained from some stream around Naini Tal. The only specimen of *B. pulchella* (also from Stoliczka's collection, but not now to be traced in the Indian Museum) must also have been collected outside the lake, as the species is not known to inhabit large areas of clear water.

Genus **Tricula** Benson.

1921. *Tricula*, Prashad, *Rec. Ind. Mus.* XXII, p. 67.

I have nothing further to add to my recent account of the genus and of the species, *T. montana*, of the Tal area.

Genus **Digoniostoma** Annandale.

1920. *Digoniostoma*, Annandale, *Ind. Journ. Med. Res.* VIII, p. 104.
1921. *Digoniostoma*, Annandale, *Rec. Ind. Mus.* XXII, p. 4.

The only species which we actually found in the Tal area was Benson's *Paludina pulchella*. It has, on shell-characters alone, been recently assigned to the genus *Digoniostoma*, but the radula and soft parts are certainly different from those of *D. cerameopoma*, the type-species of the genus. I do not, however,

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[1] *Hand-List Moll. Ind. Mus.* II, pp. 35 and 62 (1884).

discuss the generic position here, as, in view of Robson's [1] recent remarks, I propose revising all the Indian Hydrobiidae when more material is available.

Digoniostoma (?) **pulchella** (Benson).

1836. *Paludina pulchella*, Benson, *Journ. As. Soc. Bengal* V p. 476.

Large series of specimens of this species were collected by us in a pond along the roadside near Naukuchia Tal at an altitude of over 4000 ft., together with specimens of *L. luteola*.

Family VIVIPARIDAE.

Genus **Vivipara** Lam.

In the Tal area this genus is represented by a race of the common Indo-Gangetic species *V bengalensis*. Even this race was found to have a restricted distribution, as specimens were found only in Naini Tal and Khurpa Tal.

Vivipara bengalensis race **mandiensis** Kobelt.

1921. *Vivipara bengalensis* race *mandiensis*, Annandale, *Rec. Ind. Mus.* XXII, p. 271.

I have nothing to add to Annandale's detailed account of this and the allied races, beyond recording the occurrence of this race at such high altitudes as that of Naini Tal and Khurpa Tal.

Family CYRENIDAE.

Genus **Sphaerium** Scopoli.

1921. *Sphaerium*, Prashad, *Rec. Ind. Mus.* XXII, p. 614.

I have nothing to add to my recent account of this genus and of the widely distributed Indian species, *S. indicum* Desh., specimens of which were found by us in Damianti Tal.

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[1] *Ann. Mag. Nat. Hist.* (9) VIII, pp. 401–413 (1921).