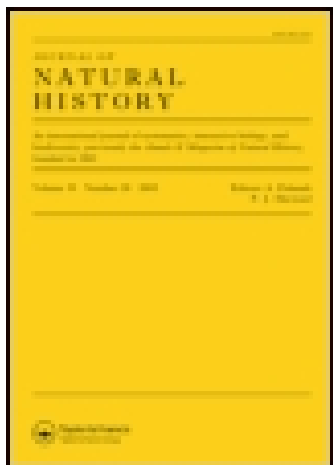


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XXXIV.—*On the Microscopic Fauna of elevated Alpine Lakes*  
(600–2780 metres above the Sea). By Dr. O. E. IMHOF\*.

THE geographical distribution of microscopic organisms presents a field in which persevering labour may still find a fruitful soil. As microscopic animals are for the most part inhabitants of the water, we must seek for our treasures especially in the larger and smaller water-basins. These we may group as temporary and permanent. The former are accumulations produced by great precipitations, which, however, again disappear in dry weather. The others consist of the persistent pools, ponds, lakes, and seas. Not only those of the latter group, but also those of the former harbour animal life during the time of their existence, and it is exactly in this direction that comprehensive investigations are most desirable, as these would show what animals survive the period of desiccation either in the developed state or as ova, what animals may be transported from one place to another by atmospheric currents, &c.

At present I leave out of consideration the geographical distribution of the microscopic fauna in the seas, and confine myself to the basins of fresh water. It may be mentioned in passing that the microscopic fauna of the sea also presents a fertile field of research, which has indeed only of late been again investigated with some energy. The improvement of the apparatus and of the methods of investigation are of especial importance. I have had the opportunity of collecting marine material by my improved methods, and always with good results. Thus in materials from the Baltic a number of microscopic organisms occurred the existence of which was previously unknown. (Among vegetable structures *Anabæna* and *Asterionella*.) Special value may be claimed for the proof that in the Baltic forms of animals and plants occur which are pretty generally distributed in our freshwater basins. As examples, I may mention two of my new species of Flagellata—*Dinobryon divergens* and *D. elongatum*. These two forms also occur in the lake of Zurich, where they sometimes occur in the spring and summer in quite enormous quantities, while their number in winter is very much reduced.

The permanent freshwater basins are of very different characters. Thus, for example, the peat-mosses display an abundant microscopic fauna. In Switzerland we find such

\* Abstract of an address delivered on November 22, 1886, before the Naturforschende Gesellschaft in Zurich ('Zoologischer Anzeiger,' 3rd and 17th January 1887, pp. 13 and 33).

peat-mosses in different places, *e. g.* in the neighbourhood of Zurich, near the Katzenssee; also near the Hüttwylerssee in the vicinity of the Untersee, the Bünzermoos in the Aargau, the peat-mosses near Einsiedeln, &c. A rich locality already indicated by me will be the extensive peat-mosses near the Lago di Varese in Upper Italy.

A peculiar character is possessed by the subterranean water-basins, such as are met with especially in Carniola, Dalmatia, and North Africa. In connexion with these we must also mention the fauna of the mineral springs. I have already commenced special investigations upon the fauna of the peat-mosses and mineral springs, and propose to report upon them next year.

For four years (since October 1882) I have chiefly occupied myself with the microscopic animals of the smaller and larger lakes belonging to the pelagic and deep-water fauna. The lakes hitherto visited by me amount in all to about 130.

In my present communication I propose to fill up a gap, namely as to the microscopic fauna of *greatly elevated* lakes. Upon this subject we find only isolated statements in literature. Probably the oldest publication in connexion with it is to be found in the 'Denkschriften der schweizerischen naturforschenden Gesellschaft,' in the year 1845:—Vogt, *Cyclopsine alpestris*, collected on the Aar glacier at an elevation of 8500 feet, = 2552 metres, above the level of the sea. Perty's work, 'Kleinste Lebensformen der Schweiz' (1852), contains the most extended observations upon microscopic organisms. Of Rotatoria, Perty names twenty-four species, which he met with principally upon the St. Gotthard, the Grimsel, the Gemmi, the Simplon, the Faulhorn, the Stockhorn, and the Sidelhorn. He also cites numerous Infusoria as inhabitants of the more elevated water-basins. In connexion with my present investigations the occurrence of *Dinobryon sertularia* upon the St. Gotthard and the Grimsel is particularly to be noted. In the celebrated 'Microgeologie' of Ehrenberg (1854) we find, on pl. xxxv. B, figures of animals of the high Alps, upon which Ehrenberg had in the previous year (1853) published a communication in the 'Monatsberichten' of the Berlin Academy. These organisms were obtained from the Weissthor Pass on Monte Rosa. There are six Tardigrada, three Rotatoria, and an Anguillulid from an elevation of 11,138 feet, = 3344 metres, above the sea-level.

The first naturalist who particularly investigated the pelagic fauna of the Swiss lakes, and among these the elevated St. Moriz lake, was P. E. Müller, from Denmark, who was

occupied with the Entomostracan group of the Cladocera. In this lake of the Engadine he found only a single species, *Bosmina longispina*. This group of the Cladocera was investigated in 1877, as regards its Swiss representatives, by Lutz of Berne. The basins examined lie in the environs of Berne (500–600 metres above the sea-level); but Lutz also gives some particulars as to forms which he obtained at greater elevations. In lakes of the St. Gotthard Pass, at 1800 metres, *Sida crystallina*, *Bosmina longispina* and *B. laevis*, Leydig, and *Chydorus sphaericus*; on the Giacomo Pass, at 2400 metres, *Alona lineata* and *Chydorus sphaericus*.

From thirty-two, chiefly Italian, lakes, Pavesi has brought together remarkably abundant materials upon the pelagic fauna. Of these thirty-two lakes, three are more than 600 metres above the level of the sea:—Lago di Ledro (669), *Ceratium longicorne*, *Bosmina longispina*, and *Cyclops brevicornis*; Lago di Alleghe (976), *Simocephalus vetulus*, *Daphnia pulex*, *D. longispina*, *Cyclops brevicornis*, *C. serrulatus*, and *C. gigas*, Lago di Ritom, *Vorticella* sp., *Simocephalus vetulus*, *Daphnia pulex*, *Cyclops brevicornis*, *C. serrulatus*, and *Diaptomus castor*.

Lastly, Asper, in his publications on the pelagic and deep-water fauna, has given some statements as to microscopic forms of animals. Thus, in the Klönthal lake (804 metres) he found a *Daphnia* and a Calanid, in the Silsersee a *Daphnia* and a Cyclopid, and in the lakes near the hospice of St. Gotthard (2114 metres) a *Daphnia* and some Calanids.

Of similar investigations beyond the borders of Switzerland we have to note the following:—

By Brandt, in the Alpine lakes of Armenia—Goktschai (1904 metres), several species of *Cyclops*; Tschaldyr (1958 metres), *Daphnia hyalina*, *Bythotrephes longimanus*, *Leptodora hyalina*; by Wierzejski, in the lakes of the Tatra; and by Zacharias, in the two Koppenteichen (1168 and 1218 metres).

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*Methods of investigation.*—As there are generally no boats on the more elevated lakes, and it would be too expensive to carry a boat about with one to a great number of lakes unless it were very light and divisible, we must avail ourselves of other methods. The simplest method is to throw out the net, which, with some practice, may be done to a distance of 10 metres or more; but in this case one always runs the risk that the net, when allowed to sink, may become entangled. The loss of the net may be avoided by screwing it on to a divisible rod. I employ my alpenstock, to which two some-

what thinner rods of the same length can be attached. Another method is that which I have already described\*, by means of a float to which the net is attached by a cord of any desired length, and with this one is able to fish a lake throughout its whole extent. Upon this method is founded another kind of investigation, by which we are enabled, *without a boat*, to bring up from the middle of the lake, and *from exactly measurable depths*, samples of mud with their inhabitants. Thus a small float is drawn out upon the cord stretched over the surface of the water, either to its middle or to any spot that may be selected for examination. The cord is then drawn tightly to both shores and fixed. The float has in the middle an aperture somewhat larger than the transverse measurement of my mud-scoop, which has already been described†. Over the aperture a pulley is attached to an upright bar, and over this runs a cord to which the apparatus is attached. When the mud-scoop, which is lowered from the shore, has touched the bottom it is drawn up again, and then the float with the apparatus is pulled to one shore, a sufficient quantity of line being let out at the opposite side.

I now pass to a selection from the results obtained in seventy-three freshwater basins elevated more than 600 metres above the sea-level, commencing in the east of my field of investigation. I have already reported upon the following elevated lakes in *Austria*:—The Offensee (646 metres), Fuschlsee (661), Krotensee (?), Vorderer Langbathsee (675), Grundlsee (700), Altaussee (709), Schwarzsee (720), Zellersee (754), Vorderer Gosausee (909), and Plansee (977).

In Upper Bavaria I investigated sixteen elevated lakes in August and September 1884 and August 1885. Hitherto only Leydig and Weismann have published contributions to the knowledge of the vertical distribution of microscopic organisms in this region, which is so rich in lakes, and these relate to the Cladocera. My results as to the pelagic fauna are as follows:—

1. STAFFELSEE, 601 metres.—(Protozoa:) *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rotatoria:) *Anuraea intermedia*, Imh. (Cladocera:) *Daphnella brachyura*, Liév.; *Daphnia*, 2 sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Copepoda:) *Cyclops*, sp.; *Diaptomus*, sp.
2. KÖNIGSEE, 603 metres.—(Prot.) *Dinobryon divergens*, Imh.; *Ceratium hirundinella*, O. F. Müll.; *Epistylis lacustris*,

\* Zool. Anzeiger, no. 224.

† Sitzungsber. Akad. Wiss. Wien, 1885 (April).

- Imh. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kellicott; *A. aculeata*, var. *regalis*, Imh.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnia*, 2 sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
3. OBERSEE, 603 metres.—(Clad.) *Daphnia*, sp.
4. NIEDER-SONTHOFERSEE.—(Prot.) *Ceratium hirundinella*, O. F. Müll.; *Vorticella*, sp. (Rot.) *Polyarthra platyptera*, Ehr.; *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, 2 sp.; *Diaptomus*, sp.
5. ALPSEE (near Immenstadt), 664 metres.—(Prot.) *Dinobryon divergens*, Imh.; *D. elongatum*, Imh.; *Peridinium pri-vum*, Imh.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia hyalina*, Leyd.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp. (Insecta) *Corethra* (larvæ).
6. TEGERNSEE, 726 metres.—(Prot.) *Dinobryon sociale*, Ehr.; *D. divergens*, Imh.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *A. aculeata*, var. *regalis*, Imh. (Clad.) *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
7. BANNWALDSEE, 732 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
8. HOPFENSEE, 734 metres.—(Prot.) *Dinobryon divergens*, Imh.; *D. elongatum*, Imh.; *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll.; *Vorticella*, sp. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Euchlanis*, sp.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia kahlbergensis*, Schöd.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
9. WEISSENSEE, 735 metres.—(Prot.) *Dinobryon divergens*, Imh.; *D. elongatum*, Imh.; *D. petiolatum*, Duj.; *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, sp.; *Leptodora hyalina*, Lillj. (Insecta) *Corethra* (larvæ).
10. SCHLIERSEE, 768 metres.—(Prot.) *Dinobryon sociale*, E r.; *D. divergens*, Imh.; *Ceratium hirundinella*, O. F. Müll.; *Peridinium tabulatum*, Ehr. (Rot.) *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella*

*brachyura*, Liév.; *Daphnia hyalina*, Leyd.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

11. ALPSEE (near Füssen), 774 metres.—(Prot.) *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
12. SCHWANSEE, 780 metres.—(Prot.) *Dinobryon elongatum*, Imh.; *Peridinium*, sp.; *Peridinium tabulatum*, Ehr. (Rot.) *Anuræa cochlearis*, Gosse; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, 2 sp.; *Bosmina*, sp.
13. WALCHENSEE, 790 metres.—(Prot.) *Dinobryon divergens*, Imh.; *D. elongatum*, Imh.; *Peridinium primum*, Imh.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell. (Clad.) *Daphnia*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
14. BADERSEE, 830 metres.—No representatives.
15. EISEE, 959 metres.—(Rot.) *Anuræa cochlearis*, Gosse; *A. tuberosa*, Imh.; *Asplanchna helvetica*, Imh. (Clad.) *Leptodora hyalina*, Lillj.
16. SPITZINGSEE, 1075 metres.—(Prot.) *Dinobryon sociale*, Ehr.; *D. divergens*, Imh.; *D. petiolatum*, Duj., var.; *Peridinium tabulatum*, Ehr.; *Ceratium hirundinella*, O. F. Müll.; *Epistylis lacustris*, Imh. (Rot.) *Synchaeta pectinata*, Ehr.; *Polyarthra platyptera*, Ehr.; *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Sida crystallina*, Müll.; *Daphnia*, sp.; *Scapholeberis mucronata*; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

Upon the deep-water fauna of a number of these lakes, and upon Bavarian lakes at a lower elevation, I will report hereafter.

On the microscopic animals from high Alpine lakes of Switzerland I have already published some statements with regard to the following:—Engstlensee, Seealpsee, Cavloccio, Lungino, and Sgrischus. The total number of lakes situated in Switzerland above 600 metres and hitherto investigated amounts to fifty-two. I give here in abstract the results obtained in some of them. The greater part (forty-five) belong to the Canton of the Grisons. Commencing with the



lakes occurring in other cantons, the following results may be indicated :—

1. TURLERSEE (Zurich; not belonging to the region of the Alps), 647 metres.—(Prot.) *Dinobryon sertularia*, Ehr.; *D. divergens*, Imh.; *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Sida crystallina*, Müll.; *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
2. LUNGERNSEE (Unterwalden), 659 metres.—(Prot.) *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Sida crystallina*, Müll.; *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
3. EGERISEE (Zug), 727 metres.—(Rot.) *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
4. SEELISBERGERSEE (Uri), 753 metres.—(Prot.) *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Triarthra longiseta*, Ehr.; *Anuræa cochlearis*, Gosse; *Asplanchna helvetica*, Imh. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.
5. KLÖNTHALERSEE (Glarus), 804 metres.—(Clad.) *Daphnia*, sp.; (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
6. SEEALPSEE (Appenzell), 1142 metres.—In this lake the material was collected for me on July 24, 1885, by M. Heuscher with my apparatus. (Rot.) *Conochilus volvox*, Ehr.; *Anuræa aculeata*, Ehr.; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Bosmina*, sp. (Cop.) *Cyclops*, sp. *Asplanchna helvetica* especially occurred in enormous numbers of individuals.
7. ENGSTLENSEE (Berne), 1852 metres.—(Rot.) *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.

Lakes situated in the Canton Graubünden :—

1. CRESTA (near Flims), 830 metres.—(Clad.) *Lynceus truncatus* (captured in the region of the pelagic fauna). (Cop.) *Diaptomus*, sp.
2. LAAXERSEE (near Flims), 1020 metres.—(Clad.) *Daphnia*, sp.; *Bosmina*, sp.; *Lynceus*, sp. (Cop.) *Cyclops*, sp.
3. DAVOSERSEE, 1561 metres.—(Prot.) *Peridinium*, sp.; *Ceratium*

- hirundinella*, O. F. Müll. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
4. LOWER AROSASEE, 1700 metres.—(Prot.) *Ceratum hirundinella*, O. F. Müll. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
  5. UPPER AROSASEE, 1740 metres.—(Prot.) *Dinobryon divergens*, Imh.; *Ceratum hirundinella*, O. F. Müll. (Rot.) *Polyarthra platyptera*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.
  6. ST. MORIZERSEE, 1767 metres.—(Prot.) *Ceratum hirundinella*, O. F. Müll. (Rot.) *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
  7. CAMPFERSEE, 1793 metres.—(Prot.) *Salpingœca convallaria*, Stein; *Ceratum hirundinella*, O. F. Müll.; *Stentor*, sp.; *Epistylis lacustris*, Imh. (Rot.) *Synchaeta pectinata*, Ehr.; *Triarthra longiseta*, Ehr.; *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
  8. SILVAPLANA, 1794 metres.—(Prot.) *Ceratum hirundinella*, O. F. Müll. (Rot.) *Conochilus volvox*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Daphnia*, 2 sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
  9. SILSERSEE, 1796 metres.—(Prot.) *Ceratum hirundinella*, O. F. Müll. (Rot.) *Conochilus volvox*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Sida crystallina*, Müll.; *Daphnia sima*; *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
  10. MARSCH, 1810 metres.—(Prot.) *Ceratum cornutum*, Ehr. (Rot.) *Anuræa longispina*, Kell.; *Euchlanis lynceus*, Ehr.; *Floscularia ornata*; the last two on the bottom. (Clad.) *Daphnia sima*. (Cop.) *Diaptomus*, sp.; *Heterocope robusta*, Sars.
  11. NAIR, 1860 metres.—(Rot.) *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp.; *D. sima*; *Lynceus*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.; *Heterocope robusta*, Sars.
  12. GOD SURLEJ, 1890 metres.—(Prot.) *Ceratum hirundinella*, O. F. Müll. (Rot.) *Euchlanis*, sp. (Clad.) *Daphnia*, sp.; *D. mucronata*; *Lynceus*, sp. (Cop.) *Diaptomus alpinus*, Imh.
  13. WEISSENSTEIN (north side of the Albula Pass), 2030 metres.—(Rot.) *Anuræa longispina*, Kell.; *A. aculeata*, var. *regalis*, Imh. (Clad.) *Daphnia*, sp.; *Lynceus*, sp. (Cop.) *Diaptomus alpinus*, Imh.
  14. VIOLA, 2163 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*,

- Imh. (Rot.) *Polyarthra platyptera*, Ehr.; *Euchlanis*, sp. (Clad.) *Daphnia*, sp.; *Macrothrix*, sp.; *Lynceus*, sp. (Cop.) *Cyclops*, sp.
15. NERO (Bernina Pass), 2222 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*, Imh.; *Peridinium*, sp. (Rot.) *Anurea longispina*, Kell. (Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.
16. BIANCO (Bernina Pass), 2230 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*, Imh. (Rot.) *Polyarthra platyptera*, Ehr.; *Syncheta pectinata*, Ehr.; *Anurea longispina*, Kell. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.
17. CROCETTA (Bernina hospice), 2307 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*, Imh. (Rot.) *Polyarthra platyptera*, Ehr.; *Syncheta pectinata*, Ehr.; *Anurea longispina*, Kell. (Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.
18. GRAVASALVAS (between Piz Lagreo and the crown of the pass of the Julier), 2378 metres.—(Rot.) *Anurea longispina*, Kell. (Clad.) *Lynceus*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.
19. NAIR (to the north of the Silsersee), 2456 metres.—(Rot.) *Anurea longispina*, Kell. (Cop.) *Diaptomus alpinus*, Imh.
20. MOTTA ROTONDA (south of the Piz Gravasalvas), 2470 metres.—(Clad.) *Macrothrix hirsuticornis*; *Lynceus*, sp. (Cop.) *Diaptomus alpinus*, Imh.
21. MARGUM (above Sils-Maria), 2490 metres.—(Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.
22. MATERDELL, 2500 metres.—(Rot.) *Polyarthra platyptera*, Ehr. (Cop.) *Diaptomus alpinus*, Imh.
23. LOWER RAVEISCHGSEE (on the Sertig Pass, Bergün-Davos), 2500 metres.—(Clad.) *Daphnia*, sp.
24. TSCHEPPE (between Piz Lagreo and Piz Polaschin), 2624 metres.—(Rot.) *Anurea longispina*, Kell. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.
25. SGRISCHUS (on the Piz Corvatsch), 2640 metres.—(Rot.) *Anurea longispina*, Kell. (Cop.) *Cyclops*, sp.
26. FURTSCHELLAS (on the Piz Corvatsch), 2680 metres.—(Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.; *Heterocope robusta*, Sars.
27. PRÜNAS (south of the Piz Languard), 2780 metres.—(Cop.) *Cyclops*, sp. (in the upper lake); *Diaptomus alpinus*, Imh. (in the lower lake; these two lakes were formerly a connected water-basin).

Lastly, I have to add the results from two elevated *Upper Italian* lakes, both situated near the Swiss borders :—

1. PALU (in the Val Malenco, south of the Muretto Pass), 1993 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Rot.) *Conochilus volvox*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Lynceus*, sp. (Cop.) *Cyclops*, sp.
2. TEMPESTA (in the Val Brutto in passing towards Poschiavo, on the Piz Scalino), 2500 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*, Imh. (Rot.) *Anuræa longispina*, Kell. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

### General Results.

The great majority of the freshwater basins investigated up to 2000 metres elevation harbour a pelagic fauna very rich in individuals. In some of the lakes situated at a still higher level I also met with an enormous number of microscopic animals, as, for example, in the lakes of the Bernina Pass :—Nero, Bianco, Crocetta (2307 metres). Still higher up the result in this respect was surprising in the smaller water-basins of the Upper Engadine :—Margum, Tscheppa, Sgrischus, and Furtschellas (2680 metres). In some of them a *Daphnia* was particularly numerous, in others *Diaptomus alpinus* was represented in remarkable numbers.

From the tabular summaries drawn up we get the following remarkable results :—

Up to a height of 1796 metres (Silsersee) from seven to sixteen species appear usually in each lake. The higher we go up the smaller becomes the number of species inhabiting the open water.

As the most widely and generally distributed we find representatives of the genera *Daphnia*, *Cyclops*, and *Diaptomus*. The genus *Bosmina* occurred up to a height of 1908 metres (Cavlocchio). *Bythotrephes longimanus* is wanting in the lakes above 709 metres (Altaussee). *Leptodora hyalina* occurs in almost all lakes up to 1075 metres (Spitzingsee). *Daphnella brachyura* is ascertained only up to a level of 780 metres (Schwansee).

Among the Rotatoria the general distribution of *Anuræa longispina*, which has already been noted, is to be mentioned (highest lake, Sgrischus, 2640 metres). *Polyarthra platyptera* and *Syncheta pectinata* are met with here and there up to considerable elevations, the former in the Materdell, 2500 metres, the latter in Crocetta, 2307 metres. *Asplanchna helvetica* in nearly all lakes up to 774 metres (Alpsee,

Füssen), and here and there still higher—Spitzingsee, Seealpsee, Campfer (1793 metres).

Among the Protozoa *Ceratium hirundinella* is widely and very generally distributed up to 1993 metres (Palü), *Peridinium* up to 2222 (Nero). Species of the genus *Dinobryon* (especially *D. divergens*) exist in very many lakes up to an elevation of 1740 metres (Upper Arosa lake). From still more elevated lakes within a limited geographical region we have to note a variety, *alpinum*, of *D. sertularia* ([Poschiavo, 962], Viola, Nero, Bianco, Crocetta, and Tempesta, 2500 metres), colonies of which were captured in the above-mentioned lakes, sometimes in considerable numbers.

Finally, we have to note among the Copepoda the remarkable occurrence of *Heterocope robusta* in the lakes Marsch, Nair, and Furtshellas (2680 metres), all three in the Upper Engadine.

XXXV.—*Description of Chondrosia spurca, n. sp., from the South Coast of Australia.* By H. J. CARTER, F.R.S. &c.

*Chondrosia spurca, n. sp.*

Specimen massive, irregularly cuboidal and nodular; broadly sessile where it appears to have been cut off by the dredge; nodules or round projecting parts of the surface covered with a smooth skin, followed inwardly by more or less fleshy substance, which, on becoming attenuated, traverses in all directions a mass of coarse detritus composed of fragments of shells, corals, gravel, sand, &c., that give it general solidity. Texture fleshy and homogeneous where devoid of foreign bodies; gritty in the rest of its composition. Colour yellowish drab. Surface sleek, smooth, slippery, uneven, more or less puckered in growth here and there; apparently without any opening at all in some parts, poriferous in others, pierced by vents here and there. Pores in tracts here and there, simple, or in the interstices of a well-pronounced fibro-reticulation. Vents of different sizes, on a level with the surface, scattered irregularly more or less in groups. Structure, commencing from without inwards, consisting of fine fibrillous tissue, so homogeneous in appearance throughout as to present no distinction in colour or composition between the surface and the interior beyond increasing compactness, which