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Contributions to the Non-Marine Fauna of Spitsbergen.
Part I. Preliminary Notes, and Reports on the Rhizopoda,
Tardigrada, Entomostraca, &c. By D. J. SCOURFIELD².

(Plate XLV.)

During the expedition to Spitsbergen under Sir W. Martin Conway in the summer of 1896, Dr. J. W. Gregory made several collections

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of Mosses in the neighbourhood of Advent Bay, Ice Fiord, which he very kindly allowed me to examine for microscopic organisms. Contrary to what might have been anticipated perhaps, it was found that these mosses harboured a very considerable fauna and flora, and as very little information has hitherto been available relating to the land-fauna of Spitsbergen, it has been thought desirable to bring together in the present paper the notes made during the examination, notwithstanding the fact that the different groups of organisms have been very unequally studied.

So far as concerns the essentially microscopic forms, we owe the earliest contribution on the subject to Dr. A. von Goes, who in 1862 published a short note ("Om Tardigrader, Anguillulæ m.m. från Spetsbergen," Öfver. K. Vet.-Akad. Förh. 1862, p. 18), in which he recorded the occurrence of 1 Tardigrade, 4 Nematoids, 2 Rotifers, and about 50 kinds of Diatoms, in mosses from Spitsbergen. But we are mainly indebted for the little already known to that indefatigable worker and prince of microscopists, C. G. Ehrenberg, who, in 1874, published a paper on "Das unsichtbar wirkende Leben der Nord-polarzone" (Die zweite deutsche Nord-polarfahrt in 1869-70, Band ii. Leipzig, pp. 437-467, 4 Plates), in which it is recorded that during the first German Polar Expedition in 1867 some mosses and moss-like plants were collected from Spitsbergen, and that these were found to contain, when examined in 1869, nearly a score of species of microscopic animals and plants, viz., 5 Diatoms, 2 (possibly 3) Rhizopods, 6 Infusorians, 2 Nematoids, 1 Rotifer (and the egg of another), and 1 Mite. Further allusion will be made to some of these under the different groups to which they belong. So far as I have been able to ascertain, nothing else has been published in connection with the smaller non-marine forms, but there exist papers or at least notes on Acaroids from Spitsbergen, by T. Thorell ("Om Arachnider från Spetsbergen och Beeren-Eiland," Öfversigt af Kongl. Vetenskaps-Akad. Förhandlingar 1871, Stockholm, pp. 683-701), and by E. Trouessart ("Note sur les Acariens recueillis au Spitzberg &c.," Nouvelles Archives des missions scientifiques, v., Paris 1893, p. 255); on Entomostraca (*Apus glacialis* only) by Lilljeborg; and on Insects by Malmgren, Holmgren, and many others.

The mosses brought home by Dr. Gregory represented fourteen different collections, thirteen of which were simply enclosed in tin boxes, whilst the remaining collection, which also contained algæ, was preserved in spirit. The mosses comprised many different species, and Mr. W. E. Nicholson of Lewes, who very kindly examined specimens of the commoner forms, was able to identify the following:—*Aulacomnium turgidum*, *Cynodontium wahlenbergii*, *Hypnum trifarium*, *H. stellatum*, *H. uncinatum*, *Polytrichum juniperinum* and *P. secangulare*. Strangely enough there was no Sphagnum, and in fact Dr. Gregory tells me that this moss is comparatively scarce and local in Spitsbergen. As regards condition, the mosses were very varied, some being wet and clean, others drier and loaded

with earth, so that the samples may probably be considered as fairly typical.

Before passing to the detailed notes upon the various groups of animals represented in the mosses, a few words on two of the more general results of the examination may not be out of place. First as regards the relative importance of the different groups from the point of view of their abundance. In this connection it may be remarked that although the micro-plants were not systematically looked for, one could not help being struck with the comparative abundance and variety of the Diatoms, whilst on the other hand the paucity of the Desmids was equally noticeable. The latter were in fact confined to a few individuals of one or two small species of *Cosmarium*. Of the animals, the dominant groups were undoubtedly the Rhizopoda and Nematoda, the former being, however, by far the most abundant. Next in order of importance came the Rotifera, Collembola, Infusoria, Chatopoda, and Tardigrada. The remaining groups, namely the Gastrotricha, Acarina, Entomostraca, and Insect larvæ, were only represented by a few solitary specimens here and there. The other result to be mentioned, and the one of most general significance, is that, so far as can be judged from the evidence now collected, the micro-fauna of Spitsbergen includes very few peculiar species. With but two or three exceptions, the most certain being, moreover, in a group (Tardigrada) which has been much neglected by naturalists, all the forms seen appear to have been previously found in Europe and North America. We have here, therefore, still further evidence of the enormous geographical range of many species of the lower forms of animal life, especially of the fresh-water forms, and of the really remarkable variations in external conditions under which they can not only exist but even thrive.

RHIZOPODA.

Animals belonging to this class formed a very large proportion of the organisms found in the mosses. As will be seen from the detailed list, about twenty-one species in all were noted, and although some of these cannot be referred to named forms, it is almost certain that none of them are new to science. They are practically the same forms as one could find in damp mosses almost anywhere in England, on the Continent, or in North America. In fact, with the exception of abnormal specimens, almost every individual Rhizopod from these Spitsbergen mosses could be matched by a figure in Leidy's 'Fresh-water Rhizopods of North America' (Washington, 1879).

One point that deserves mention is the large number of specimens seen presenting abnormalities in the shape of the shell. This was especially noticeable with *Euglypha ciliata*, but also occurred in *Nebela collaris* and other species. It is tempting to refer this back to the influence of the severe climatic conditions under which the animals live in Spitsbergen, but with the exception of two

specimens of *Cyclops*, to be referred to later, none of the animals belonging to other groups presented any striking malformations.

Ehrenberg, in the paper already referred to, records the following species from Spitsbergen: *Arcella* —?, *Diffugia areolata* and possibly *Diffugia microstoma*, which could not, however, be found upon a second search. It is not quite certain which species are intended by these names, but it is at least very probable that the "*Arcella* —?" was not an *Arcella* in the modern restricted sense, but very likely a *Diffugia*, perhaps a variety of *D. constricta*. The *Diffugia areolata* was almost certainly *Euglypha alveolata*, and *D. microstoma* probably *Assulina seminulum*.

The following is a complete list of the species observed. The nomenclature adopted by Leidy has been adhered to as far as possible, and in the few cases where he differs from Blochmann ('*Mikroskopische Thierwelt des Süßwassers*,' Hamburg 1895), the names used by the latter have been added in brackets.

AMÆBA VERRUCOSA, Ehrbg.

This was the commonest of the three species of naked lobose Rhizopods seen, and occurred in both the adult and young stages (= *A. quadrilineata*, Carter).

AMÆBA RADIOSA, Ehrbg. (= *Dactylosphaerium vitreum*, H. & L.).

Only noticed in one collection. It was the "*vitreum*" form and not typical *A. radiosa*.

? *PELOMYXA VILLOSA*, Leidy (= ? *P. palustris*, Greeff).

The specimens seen, which were not very numerous, were all like the little form figured in the '*Fresh-water Rhizopods of N. America*,' pl. v. fig. 9, and they measured about $\frac{1}{250}$ of an inch in length.

DIFFLUGIA GLOBULOSA, Duj.

Not very common.

DIFFLUGIA PYRIFORMIS, Perty.

The larger and more typical forms of this species were decidedly rare. A very small variety measuring $\frac{1}{500}$ " — $\frac{1}{300}$ ", with the test often somewhat compressed and the sand grains but loosely joined, was, however, much more frequent, although not abundant.

DIFFLUGIA CONSTRICTA, Ehrbg.

On the whole the commonest of all the Rhizopods. It occurred in all the collections without exception, which was not the case with any other species.

NEBELA COLLARIS, Ehrbg.

A rather common species. Many specimens exhibited curious malformations, and a few had their shells pitted in the same way as *Hyalosphenia elegans* as shown by Leidy (*Rhiz. N. America*, pl. xx.). A few examples of the type figured by Leidy (*l. c.* pl. xxiv. fig. 12) were also observed.

NEBELA BARBATA, Leidy.

This was the form destitute of spines considered by Leidy to be a variety of *N. barbata* intermediate between the typical *N. barbata* and *N. collaris*. It is figured by him on plate xxiv. of the 'Rhiz. of N. America,' figs. 18 & 19. In the Spitsbergen mosses this species was not rare, but much less common than the foregoing.

? HELEOPERA PETRICOLA, Leidy.

In two of the collections specimens of a *Heleopera* were seen which were covered with flat but irregularly-shaped sand grains and were moreover slightly tinged with violet. I have found the same form in England, even the colour being the same; and I have regarded it as a variety of *H. petricola*, although it may possibly be a distinct species.

PSEUDOCHELAMYS PATELLA, C. & L.

Considerable numbers of the empty tests of this minute Arcella-like Rhizopod were seen, but very few living animals.

ARCELLA ARTOCREA, Leidy.

The absence of Arcellas from the collections was a very striking characteristic, and it was not until the examination was nearly finished that a single empty shell of an undoubted *Arcella* was found. It agreed very well with *A. artocrea* in most respects, but the ring of minute tubercles round the mouth could not be made out, and its diameter was barely $\frac{1}{250}$ ".

EUGLYPHA ALVEOLATA, Duj.

A few specimens of the spineless form of this species were obtained from three of the collections.

EUGLYPHA CILATA, Ehrbg. (= ? *E. ampullacea*, H. & L., and *E. compressa*, Carter).

In point of numbers this species was as common as *Diffugia constricta*, but it was not quite so constant, being apparently absent from three of the fourteen collections. The great majority of the specimens were destitute of "cils," only a small number being of the typical ciliated form. The amount of variation in size, outline, shell-structure, and amount of compression was very great indeed, and in addition to this many examples presented curious malformations, such as an oblique mouth, notched fundus, &c.

EUGLYPHA CRISTATA, Leidy.

A rare species, only detected in three of the collections.

ASSULINA SEMINULUM, Ehrbg.

Another rare species, only seen in two collections. In one of these the animals were quite characteristic, even possessing the peculiar brown colour so well shown by Leidy. The specimen

from the other collection, however, was colourless and appeared like fig. 26, on plate 37, of Leidy's 'Rhizopods of N. America.'

TRINEMA ENCHELYS, Ehrbg.

About as common as *Euglypha ciliata* and found in the same number of collections, namely eleven. The specimens exhibited a very considerable amount of variation. In a few collections a form was seen which was larger than any of the ordinary specimens, being $\frac{1}{400}$ " , and characterized by the great development of the shell around the oral aperture. Leidy gives figures of forms probably identical with this (*l. c.* plate 39. figs. 41, 61, & 63 inferior views, and fig. 54 lateral view). It is probably also the same as *Arcella disphæra*, Ehrbg.

ACTINOPHRYS SOL, Ehrbg.

Specimens of this well-known Heliozoan occurred sparingly in three of the collections.

ACANTHOCYSTIS sp.

This was a very small species, $\frac{1}{200}$ " , with numerous delicate simple spines and a few long pseudopods. It was very similar to the drawing of an unnamed species given by Leidy (*l. c.* plate 43. f. 10), but was destitute of the envelope of granular protoplasm shown in that figure. According to the key given by F. Schaudinn (Heliozoa in 'Das Tierreich,' Berlin 1896), it comes nearest to *A. spinifera*, Greeff. This form was represented in three collections by a few specimens.

CLATHRULINA ELEGANS, Cienk.

Only a single detached capsule of this beautiful species was found. It was of a deep yellow colour, $\frac{1}{500}$ " in diameter, not quite spherical and with slightly irregular openings. It contained two encysted individuals.

GROMIA sp.

A specimen of a species of *Gromia* was seen by Mr. Bryce whilst searching for Rotifers, but no further specimens could be obtained, and the species remains uncertain.

In addition to the foregoing, a minute testaceous Rhizopod was seen in two or three of the collections which may possibly have been *Chlamydoptyrys stercorea*, Cienk. In outline, size ($\frac{1}{700}$ "), and absence of evident shell-structure it was about the same as the species named, but no pseudopods were seen, and it is therefore impossible to be sure even of the group to which it belonged.

INFUSORIA.

A fair number of Infusorians were noticed, but the group was not specially studied and no detailed account of it can be given. It may be noted, however, that the commonest form was either identical with or very similar to *Uroleptus piscis*, Müll. Ehrenberg,

in the paper previously quoted, records the following species from Spitsbergen:—

Kolpoda cucullus (= ? *Oxytricha pellationella*); *Stylonichia pustulata*; *Trichodina tentaculata* (= ? *Gyrocoris oxyura*); *Vorticella microstoma*; and *Monas*.

GASTROTRICHA.

The few examples seen belonging to this group were all representatives of the genus *Chetonotus*, but the species was not determined in any case.

ROTIFFERA.

This important group was carefully studied by Mr. D. Bryce, who has given so much attention to the subject of the moss-dwelling Rotifers. It will be seen from his report following this paper that twenty-six species were observed, half of them belonging to the genus *Callidina*. One species is described for the first time, although it is not peculiar to Spitsbergen, having been previously found in England.

NEMATODA.

The Spitsbergen mosses appear to offer very favourable conditions for the existence of Nematoids, as specimens of these animals were found, usually abundantly, in nearly all the mosses examined. No attempt was made, however, to determine the species. Of the four species seen by Dr. Goes, as previously mentioned, one was thought by him to be new, whilst the others came nearest to *Anguillula mucronata*, *A. ecauda*, and *Amblyura serpentulus* respectively. Ehrenberg's two species were *Anguillula longicauda* and *A. brevicauda*.

CHÆTOPODA.

Several of the collections contained numbers of Chaetopod worms, but no special attention was given to them.

TARDIGRADA.

When first examined the Spitsbergen mosses contained a moderate number of Water-bears, but afterwards they almost entirely disappeared. Unfortunately proper attention was not given to these animals when they were most abundant, and the notes about two or three of the species are therefore very imperfect. The following is a list of the forms seen.

MACROBIOTUS HUFELANDII, C. Schultze.

This well-known species was by far the most abundant, occurring in nearly all the mosses examined. Examples in all stages of development were seen ($\frac{1}{100}$ "— $\frac{1}{40}$ "), and occasionally eggs. The latter were covered with little conical projections (sharp-pointed, not blunt as figured by L. Plate, "Beiträge zur Naturgeschichte der Tardigraden," Zool. Jahrbücher, Bd. iii. Morph. Abt. Taf. xxii.

fig. 28), and were always free, never within the cast skin of the mother.

MACROBIOTUS TUBERCULATUS, L. Plate.

Only two specimens of this form were seen. They agreed very well with the original description ("Beiträge," &c. l. c. p. 536) in most particulars, but they were very small, being only $\frac{1}{140}$ ".

ECHINISCUS ARCTOMYS, Ehrbg.

Specimens of this pretty little species were seen in several of the collections. It may be interesting to note that Ehrenberg first found this species in moss from Monte Rosa, collected at a height of over 11,000 ft. (Weissthor Pass), where the conditions of existence would be not unlike those prevailing in Spitsbergen.

ECHINISCUS SPITSBERGENSIS, n. sp. (Plate XLV.)

This new species was only seen in one collection, and unfortunately only empty skins were obtained, so that the following description is somewhat incomplete.

The back is covered with a series of nine hardened plates, the arrangement of which is in general the same as in other species of *Echiniscus*. The details of arrangement can best be seen by reference to the accompanying drawing (Pl. XLV. fig. 1). All the plates are strongly tuberculated, the tubercles being largest in the central portions of each plate, but becoming smaller towards the margins. There are four pairs of lateral filaments originating from the posterior angles of head, first, second, and third body-segments respectively. In addition to these there are two long filaments springing from the posterior margin of the second body-segment, each of which is situated about halfway between the lateral filament and the mid-dorsal line. The posterior margin of the third body-segment is provided with four broad spines—two large, rather closely approximated to the median line, and two very minute, one just above each lateral filament. The two middle claws of the four on each foot are each provided with a little hook near the base (figs. 2 & 3), as occurs also in *E. spinulosus*, Doy, and *E. granulatus*, Doy. Length of specimens seen, nearly $\frac{1}{100}$ ". Living animals would undoubtedly be somewhat longer, and would therefore appear more elongated than might be supposed from the drawing.

Two further species of Tardigrades were also seen during the early part of the examination of the mosses, but the notes taken were not sufficient for specific determination and the animals were not found a second time. Both were probably species of *Macrobotus*. One of them was a form somewhat similar to *M. tuberculatus*, but each of the little tubercles on the back was furnished with two minute prickles. The length was only $\frac{1}{150}$ ". The other was a moderately large form, being $\frac{1}{60}$ ", and possessed the striking peculiarity of having a pharynx nearly three times as long as broad.

The Water-bear found by Dr. Goes in 1862 was considered by him to be most closely allied to *Macrobotus dujardini*, Doy.

ACARINA.

A few very much damaged specimens of Oribatidæ were found and submitted to Mr. A. D. Michael, who very kindly examined them. He says that although, owing to the imperfect preservation, he cannot be absolutely certain about the species, he feels pretty sure that they belong to *Scutovertex bilineatus* and *Nothrus invenustus*. If these determinations are correct, both of these forms are new to the known fauna of Spitsbergen.

ENTOMOSTRACA.

Two species of Copepoda were found, representing the two families Harpacticidæ and Cyclopidaæ. Of the former, unluckily, only a single damaged specimen was seen. It was very minute, measuring in its shrunken state $\frac{1}{30}$ "", and was probably a male, but this could not be definitely determined as the first pair of antennæ had been torn off. Although apparently a new species, a proper account of it cannot be given, owing to the imperfect condition of the specimen.

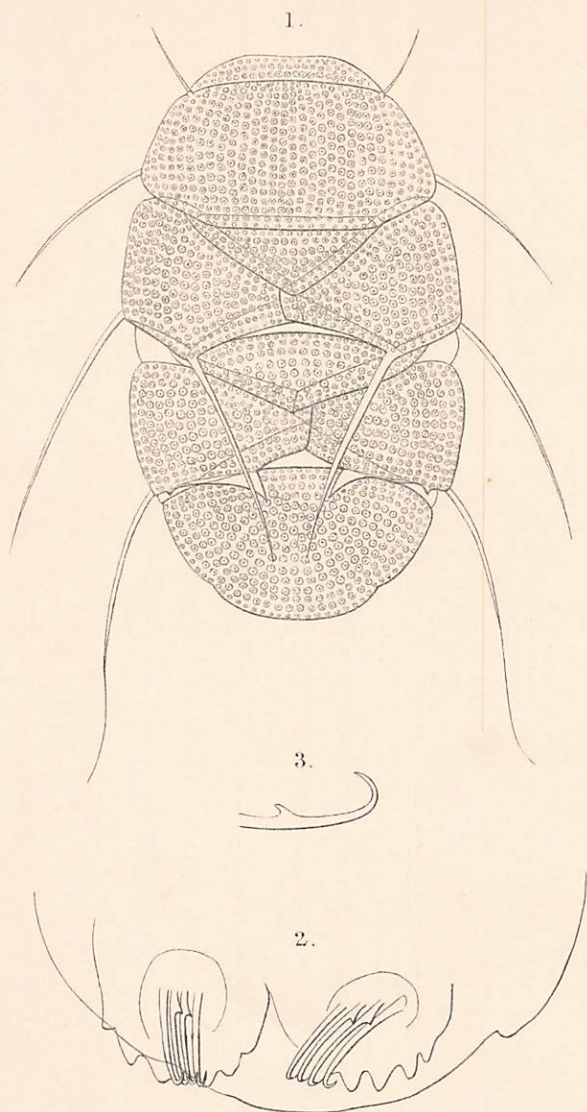
The other Copepods belonged to the genus *Cyclops*. Four individuals in all were observed, from as many different collections, three by myself and one by Mr. Bryce. Of the former, two were adult males of *Cyclops bisetosus*, Rehberg (as defined by Schmeil, "Deutschlands freilebende Süßwasser Copepoden," Theil i. 1892), and the other a young individual with 10-jointed antennæ, and without much doubt also a male of the same species. The most peculiar feature in connection with the two adult specimens was, that although undoubtedly *C. bisetosus*, both of them exhibited malformations. Thus in one example both of the fifth pair of feet were abnormal, and also differed considerably from one another. In the other specimen the feet of the fifth pair were quite normal, but the two largest tail setæ were unusually thickened near the base, and at a point on the protopodites of the fourth pair of feet, where there should be one thick spine, there were two on the right foot and none on the left. It may be useful to note that *C. bisetosus* is usually found in this country in little temporary pools with a thick growth of amphibious grasses and other vegetation, but I have also found it occasionally by washing damp mosses.

INSECTA.

The only adult Insects found were Collembola or Spring-tails. Numerous specimens of a perfectly white species were present in some of the collections, and also a few examples of a black species, but they have not yet been determined. In addition to these, two or three Dipterous larvæ were obtained.

EXPLANATION OF PLATE XLV. (p. 791).

- Fig. 1. *Echiniscus spitsbergensis*, n. sp. Dorsal view of an empty skin. $\times 300$.
 Fig. 2. " " Ventral view of posterior body-segment, showing fourth pair of feet. $\times 600$.
 Fig. 3. " " One of the two median claws, showing small accessory hook. $\times 800$.



D.J. Scurfield del.

Mintern Bros. lith.

ECHINISCUS SPITSBERGENSIS.

