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(Cont.)
C.H. OSTENFELD and C. WESENBERG-LUND:

A Regular Fortnightly Exploration of the
Plankton of the two Icelandic Lakes,
Thingvallavatn and Myvatn.

(p. 1092 - 1167)
(+ Pl. 2-III)

COPEPODA.

Lepto. *Diaptomus minutus*, Lilljeb.

The *Diaptomus* species of the Thingvallavatn is the easily recognisable *D. minutus* (Lilljeborg). It is described by Lilljeborg from Greenland and Newfoundland; it is mentioned by Marsh (1893, p. 199) from Green lake, North America. In a subsequent paper (1897, p. 8) Marsh describes it as the commonest of all Diaptomidae appearing in samples collected in the great American lakes.

Richard and De Guerne (1889, p. 632) states that it has been found in Greenland near Tasersuaq. The species of the Thingvallavatn has already some time ago been determined as *D. minutus* by the same authors.

On 14th July *D. minutus* occurs in enormous numbers, but only as young ones. On 31st July I found many males with spermatophores within their bodies; the abdomen of the females is quite straight and the oviducts hardly noticeable; some females have 2 to 3 eggs. From 14th August till 15th September the sexual period is at its max. Males and females are nearly equal in number; the males all have spermatophores in their bodies, and the females often carry a cluster of 4 to 5. The egg-sacks never contain more than 4

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eggs and later in the period only 2 to 3. The oviducts are very conspicuous, and present dark tubes containing unripe eggs. The abdomen of the females is strongly curved and often, owing to pressure of the egg-sack, bent upwards at a right angle with the cephalosome. Very often I have found females with remnants of an earlier egg-sack attached to the abdomen, at the same time having oviducts filled with unripe eggs. By this we learn that a female may produce more than one brood. From 30th September to 16th November the species gradually disappears. On 16th October the oviducts contain no more unripe eggs, and females with egg-sacks are rare. The *vasa deferentia* of the males have no spermatophores; a few males were found on 10th November but no females with eggs. The last individuals are observed on 22nd January, when the species totally disappears, new individuals again appearing in spring 1904.

As far as I have been able to make out, *D. minutus* has only one kind of egg, and I have never seen any egg beyond the gastrula stage. With regard to the colour, we find two kinds of eggs, one being red and naked, the other gray and cleft to the gastrula stage. First I supposed the shell of the former, which is of a yellow colour, to be a little thicker than the hyaline shell of the gray eggs, but later I found intermediate stages between them. Furthermore, as I have never found nauplii in the time from 14th July 1903 to 16th April 1904, I suppose that all of the eggs are resting eggs.

Ekman (1904, p. 103) arrives at the same result with regard to the eggs of *D. laciniatus*, *lenticornis*, and *laticeps*.

Owing to the quality of the material it is impossible to give a correct conspectus of the life cycle of *D. minutus*; in this respect it is most unfortunate that the collections have not been carried on after 30th June 1903, when the nauplii had begun to appear.

I feel inclined to believe that the species has only one generation, which is hatched in April-May and dies out in January. This generation is derived from resting eggs which have hibernated in deep water either on the bottom or suspended in the water. My interpretation of the life cycle may perhaps be correct, inasmuch as Marsh, in 1897 as well as in 1903 (p. 22), after a rest

thorough exploration, has given a rather similar sketch of the life cycle of *D. minutus* in Green lake and in Lake Winebago. According to Marsh, *D. minutus* occurs there from July to December; the great max. occurs about the 1st of August, but it also has another but smaller max. in October; the species is rare in winter and spring.

Cyclops strenuus, Fischer.

The *Cyclops* species of the pelagic region of the Thingvallavatn is *C. strenuus* (Fischer), and not *C. scutifer* (G. O. Sars), to which result Richard (1892, p. 310) already has arrived. The species appears in the *forma vernalis*, Lilljeb. (1901, p. 47), which, according to Ekman (1904, p. 30), also is characteristic for the North Swedish alpine region. As far as my experience goes, it has no conspicuous seasonal variations in the Thingvallavatn.

On 14th July the species is rare, and only a few young unripe animals are found; on 31st July the number of animals is enormous, but all are quite young. In all the following samples till 30th September, its occurrence is rare, after that the species again becomes common; ripe males and a few females with eggs appear; the number increases steadily until 23rd January, when the species attains the main form and occurs in enormous numbers. All the females carry eggs, and males may be noticed in all the samples, but become rare in January. Then *C. strenuus* disappears entirely, and is not seen again until 16th April. In all the following samples till 30th June we find the number of individuals increasing. In May we only observe nauplii or very young animals; they become very numerous in June.

From the above statements it is impossible to arrive at any conclusion as to the propagation of *C. strenuus* in the Thingvallavatn. The very small number of individuals at 14th July, the enormous quantities at 31st July, and the almost total disappearance from 31st July to 30th September, clearly show that the samples by no means verify the existing facts. We are only able to note that from 14th July to 30th September 1902, as well as from 16th April to 30th June 1903, no ripe males or females with eggs appear. During this period we only find nauplii or half-grown

broods; the sexual period does not begin till the last days of September, and continues till January.

The number of eggs in every egg-sack at 30th September is about 4, in October-November 6-7, but in December-January it diminishes again (2-5).

I suppose that further explorations will show that the limnetic region of the Thingvallavatn contains several other plankton Crustacea than those mentioned in this paper. It must be kept in mind that all the samples are surface samples, and I consider it most probable that different species, especially *Bythotrephes*, may be found in deeper waters. Richard and De Guerne mention, as stated above, different bottom and shore species, among which we also find *Basmina arctica* (*B. obtusirostris*). This species may be considered a plankton as well as a shore organism. I only wish to emphasise that none of my numerous plankton samples ever contained a single *B. arctica*.

III. MYVATN. By C. WERNERUS-LUND.

1. General Remarks.

Myvatn is situated in the northern part of Iceland, in latitude 65° 33' N., 293 m. above sea-level, and is nearly 27 square kiloms. in extent. The lake has been formed in down-sunken parts of enormous lava torrents. The bottom consists almost entirely of lava, and is nearly everywhere surrounded by widely extending lava grounds. Along the shores, and forming islets in the lake itself, the lava is congealed in very peculiar and fantastic columns. The lake is situated in a volcanic area, which even now-a-days may be considered extremely active. Upon the east side of the lake very many solfatares occur. According to Thoroddsen, the ground is here actually seething with hot vapours, and it is dangerous to walk upon it; little hillocks of sulphur are very common and alternate with pools of mud, which incessantly boil and bubble, while ejecting bluish-black clay mud.

The surrounding country, especially the northern and eastern part, is extremely void of water, as all the rain is absorbed by the porous volcanic soil. It seems as if the water, partly through