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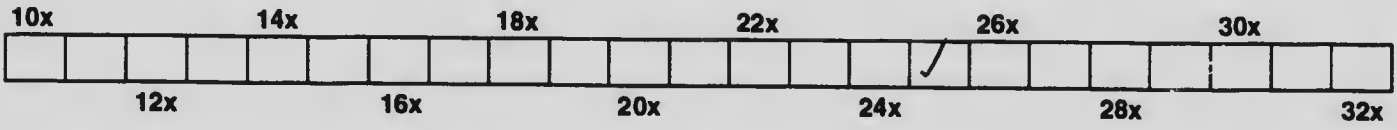

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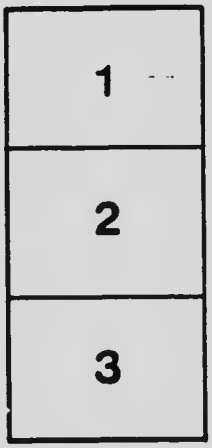

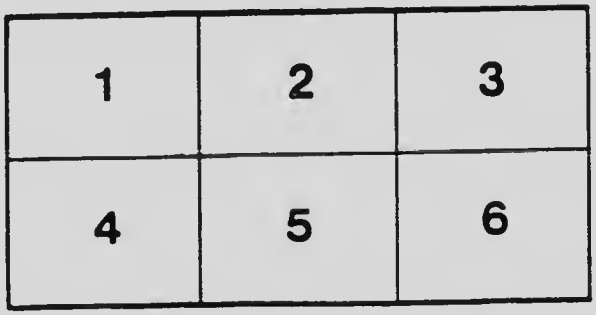

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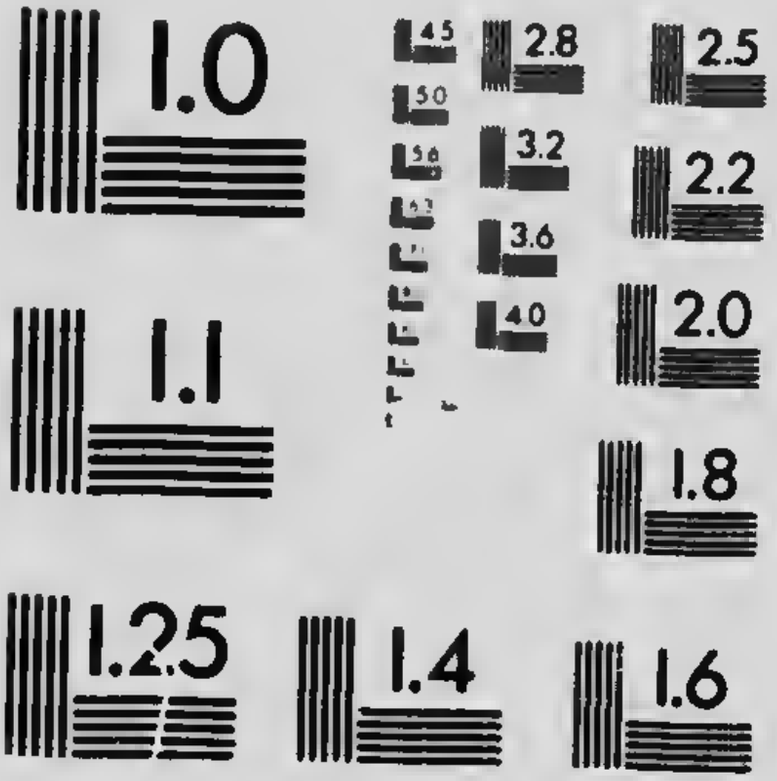

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REPORT

OF THE

CANADIAN ARCTIC EXPEDITION 1913-18

VOLUME VII: CRUSTACEA

PART G: EUPHYLLOPODA

By FRITS JOHANSEN

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OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1922

Issued May 19, 1922

Report of the Canadian Arctic Expedition, 1913-18.

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REPORT

OF THE

CANADIAN ARCTIC EXPEDITION 1913-18

VOLUME VII: CRUSTACEA

PART G: EUPHYLLOPODA

By FRITS JOHANSEN

OTTAWA
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PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1922

Issued May 10, 1922

Euphyllopod Crustacea of the American Arctic.

By Frits Johansen

With many text-figures.

INTRODUCTION.

The areas examined for freshwater crustacea during the Canadian Arctic Expedition in the years 1913-16, were the south side of Seward peninsula Alaska (Nome and Teller); the north coast of Alaska and Yukon Territory from Camden bay to Herschel island; Cape Bathurst; and the south side of Dolphin and Union strait, from Young point to Cape Krusenstern. At Cape Bathurst of the Entomostraca only Copepods, Cladocera and Ostracods were found.

Besides these Canadian Arctic Expedition specimens I have been able to examine many of the Euphyllopods formerly collected in the American Arctic (Point Barrow and Pribilof islands, Alaska; Fullerton, west side of Hudson bay; Labrador, Ungava, Ellesmere island), and to compare them with specimens from Greenland. Among the records of these older collections (some of which are here recorded for the first time), I include the additional data given by Baird, Packard, Sars, Daday de Dées, etc.

The present report thus aims to be a fairly complete account of the Euphyllopod Crustacea now known from the American Arctic (excluding Greenland). They comprise one[1] species of Notostraca, three of Anostraca, one of which is described as new; and one species of Conchostraca.

For a description of the various lagoons, lakes, and ponds, etc., examined during the Canadian Arctic Expedition I refer to Part N, in this volume.

I am indebted to the officials of the United States National Museum, Washington, D.C., for an examination of the arctic Euphyllopoda deposited there; to Prof. G. O. Sars of Christiana, Norway, for certain information about the specimens recorded by him; to Prof. A. S. Pearse of the University of Wisconsin, Madison, for assistance of various kinds, and to Dr. A. G. Huntsman of Toronto University, for many helpful suggestions on the manuscript of this report.[2]

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[1] Professor G. O. Sars advises me to omit from this report reference to specimens of *Lepidurus apus* (L.) secured by the Second Norwegian Arctic Exped. on Grinnell Island and recorded by him (1911). (See Canadian Field-Naturalist, Vol. 35, p. 47.)

[2] In the fall of 1921 the author had the opportunity to examine arctic Euphyllopoda in the collections in Scandinavia. The data secured of importance to this report have been inserted during the printing of it. Similar specimens in British Museum of Natural History, London, were also examined.

Order PHYLLOPODA.

Suborder NOTOSTRACA.

Family **APODIDAE** Burmeister.

Genus **Lepidurus** Leach.

Lepidurus arcticus (Pall.)[1]

Monoculus arcticus. PALLAS, 1793, App. (p. 679), p. 39.

Apus glacialis, KRÖYER, 1847, p. 431; GRUBE, 1853, p. 150; REINHARDT AND SCHIÖDTE, 1857, p. 35, 73; LILLJEBORG 1872, p. 843; VANHÖFFEN, 1897, p. 175; JOHANSEN, 1911, p. 333; STEPHENSEN, 1917, p. 284.

Lepidurus glacialis, BAIRD, 1852, p. 6, Tab. XXII, fig. 2; PACKARD, 1873, p. 619; and 1883, p. 316, Plates 16, 17, 21; LILLJEBORG, 1877, p. 11; MURDOCH, 1885, p. 149; SIMON, 1886, p. 429; GUERNE AND RICHARD, 1889, p. 631; WESENBERG-LUND, 1894, p. 87, and 1896, p 135; SARS, 1874, p. 88; 1886, p. 70; 1891, p. 27; and 1896, p. 68, Plates XI-XIII; RICHARD, 1897, p. 194, and 1898, p. 327-33; LINKO, 1901, p. 66; HABERBOSCH, 1916, p. 134.

Lepidurus arcticus, SARS, 1897, pp. 470-3; 1911, p. 15; LILLJEBORG, 1900, p. 3; ORTMAN, 1901, p. 145; EKMAN, 1905, p. 14; ZYKOFF, 1905, p. 342; BREHM, 1911, p. 306, Pl. 18; OLOFSSON, 1918, p. 383, fig. 18-19; JOHANSEN, 1921, p. 47, ("Can. Field-Nat.").

EXPEDITION RECORDS

Lake (lagoon) at Teller (Port Clarence), Alaska, July 25, 1913, 3 females.

Lagoon-pond at Martin point, Arctic Alaska, July 26, 1914, 40 females.

Lake inland at Bernard Harbour Northwest Territories, August 10, 1915, 11 females.

Pond on ridge at Bernard harbour, Northwest Territories, August 16, 1915, 42 females, 2 males.

Pond on ridge at Bernard harbour, Northwest Territories, October 6, 1915, 2 females.

Pond on ridge at Bernard harbour, Northwest Territories. July 3, 1916, 30 specimens (immature).

OTHER RECORDS.

Tundra pools at Point Barrow and Ooglamie, Alaska, July 10, 21, 1882. J. Murdoch coll. (Murdoch, 1885, p. 149), 65 females.

Ponds on coastal plain of Arctic ocean at lat. 69° 40′ N., long. 141° W., July 25, 1912, J. M. Jessup coll. 10 females, 6-15 mm. long.

Cape Kruscnstern, Northwest Territories, August 19, 1849, J. Rae coll. (Baird, 1852, p. 6). Four males (?) about 10 mm., 9 females 11 to 20 mm. long.[2]

Prof. G. O. Sars tells me in a recent letter (April, 1921), that this species was also secured by the "Gjöa"-Expedition (Amundsen), at Gjöa-Havn, south side of King William island, on the following dates: August 12, 23, 1904; August 6, 1905. The specimens are very many, and measure from 5 to 20 mm. in length.

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[1] Prof. G. O. Sars tells me in a recent letter that the proper specific name is *arcticus*, and not *glacialis*, because it is now definitely established that *Monoculus arcticus* Pallas (1793) is the same as *Apus glacialis* Krÿer (1847).

[2] The four smallest specimens are in poor condition; the 8 largest (15-20 mm.) females carry winter-eggs.

An unusually large ($3\frac{1}{2}$ cm. to cercopods) female from St. Paul island, Pribilof islands, Alaska. March 7, 1911. W. L. Halm coll.[1]

9 females ($1\frac{3}{4}$ to $2\frac{1}{2}$ cm. long) with eggs. Northumberland island, Northwest Greenland, 1899. Princeton Expedition (Ortman, 1901, p. 145).

16 specimens ($\frac{3}{4}$ to $2\frac{1}{4}$ cm. long; females with ripe eggs) Lake on Northumberland island, Northwest Greenland. August 7, 1901. R. Stein coll.

Beside these I have examined a great many specimens from Greenland, Iceland, Spitsbergen, Scandinavia, Baeren island, and arctic Eurasia in various museums (see footnote [2] on p. 9).

General Distribution

The species is already known from Cape Rutherford, Grinnell land (Sars, 1911), and a number of localities on the north, west and east coasts of Greenland (see Stephensen, 1917), Spitsbergen (Lilljeborg, 1877), Iceland (Kröyer, 1847), Baeren island (Lilljeborg, 1877), mountains of Norway (Sars, 1874, etc.), and Sweden (Lilljeborg, 1877), Archangelsk (Linko, 1901), Novaja Zemlya (Lilljeborg, 1877), and Arctic Siberia (between longitudes 120° and 150° E. (Sars, 1897). It is thus a truly circumpolar form, though in America it has so far not been recorded from between King William island and Labrador and from the westernmost of the islands composing the Canadian Arctic Archipelago. (I can find no definite records of it from Labrador.)

Biology

The species has been well described and figured, mainly by Sars (see above) who secured fairly young stages (2.2 mm. long) of it. Also Brehm (see bibliography) described still younger stages collected by myself in northeast Greenland, and similar young specimens were collected by Ólofsson on Spitzbergen (1918, p. 384.) Two larvae (metanauplii) of the same length (about 1·5 mm.) collected on Novaja Zemlya, June 23, 1875, are in the Riksmuseum, Stockholm. In a former paper (1911) I have recorded my observations made in Greenland on the biology of this species, and similar data were obtained during the Canadian Arctic Expedition, except that no stages between the ripe, deposited eggs and young individuals 3 mm. long were found. I have formerly (1911) stated that the nauplius stage seems to be suppressed, or of exceedingly short duration[2] in this species; so all the stages from the egg to the full-grown individuals of both sexes may therefore be considered known. It is a well-known fact, that the vast majority of the specimens observed of this species have been females (see also the records above); the males only attain half the size of the females and seem only to appear later in the summer (August), and in very small numbers (see bibliography, Sars, Brehm.). At least in Greenland the females reach a length of $3\frac{1}{2}$ cm., exclusive of the 3 cm. long cercopods (Lilljeborg, 1877).[3]

Field Notes and Description of Material

Of the 3 specimens from Teller, Alaska, the largest was only a fragment, but the two others were females, both 12 mm. long to end of telson (supra-anal plate), while the cercopods (caudal filaments) were 9 mm. long. I give here an outline (magnified about 50 times) of the shape of telson (dorsal view) of one of the 12 mm. long specimens; a comparison of this figure (text figure 1*a*) with the succeeding, similar ones mentioned below shows the great variation in this

[1] It seems as if the occurrence on islands tends towards increasing the size at which mature specimens of both this species and of *Branchinecta paludosa* (see p. 19) are generally found in the Arctic.

[2] The genus *Apus* has a well defined nauplius-stage (see Claus, Baird).

[3] In the Zoological Museum, Copenhagen, is a 34 mm. long specimen from Iceland, collected on August 28, 1906, and in Uppsala Museum a 36 mm. long specimen from Godhavn (Disco), West Greenland.

regard inside the same species and sex, and according to age (see Sars (1896), p. 71, Tab. XII).

EXPLANATION OF TEXT-FIGURES

(All the figures, except 1*d*, *e*, are original, freehand drawings after alcoholic specimens, viewed under the microscope.)

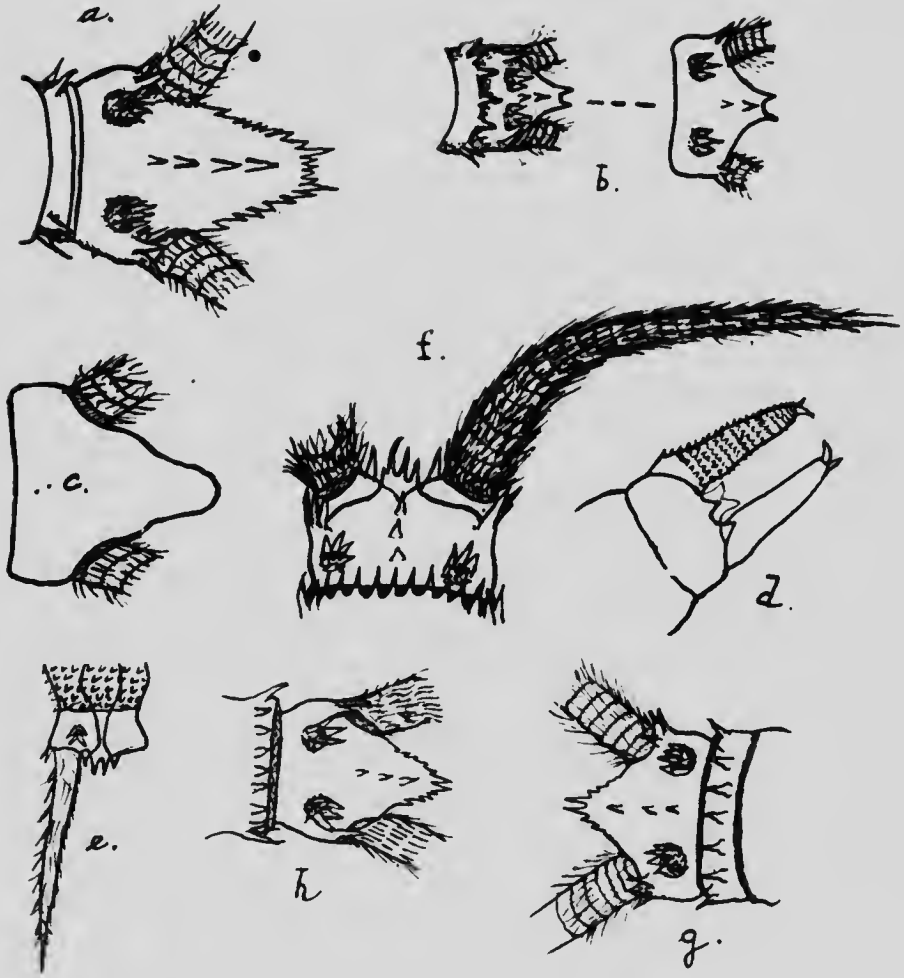

Fig. 1. Telson of *Lepidurus arcticus* Pall. (see also Olofsson, 1918, figs. 18–19.)

a. Dorsal view. About x 50. Animal (female) 12 mm. long. Teller, Alaska.
b. " " In natural position and spread out. About x 50. Animal (female) 8½ mm. long. Martin point, Alaska.
c. " " Outline of telson, without the spines. About x 50. Animal (female) 18 mm. long. Martin Point, Alaska.
d. " " Telson and cercopods of about 1½ mm. long, larva from N.E.-Greenland (after Brehm).
e. " " Telson and cercopod of about 2 mm. long larva from Filefjeld, Norway (after Sars).
f. " " Telson and cercopod of 3 mm. long larva from Bernard harbour, N.W.T., July 3, 1916. About x 100.
g. " " About x 50. Animal (female) 7 mm. long. Bernard harbour, N.W.T., August 16, 1915.
h. " " About x 50. Animal (female) 12 mm. long. Bernard harbour, N.W.T., October 6, 1915.

The specimens from the vicinity of Point Barrow, Alaska, collected by Murdoch in 1882 were all females and measured from 1 to $2\frac{1}{4}$ cm. to end of telson. The great majority of the 50 specimens from July 21, carried almost ripe eggs (except the youngest individuals), but none of the 15 specimens (1-$1\frac{3}{4}$ cm. long), from July 10 had any eggs. Murdoch (1885) notes, that in 1882 they were first observed on July 8, but the next year ten days later;[1] and these early specimens were probably less than 1 cm. long, and the brood of the year. Armature and shape of telson are as in the Canadian Arctic Expedition specimens of corresponding sizes.

The specimens from Martin point, Alaska, measured from $8\frac{1}{2}$ to 18 mm. to end of telson; I give here (text figures 1*b*, *c*) outlines of the shape of telson of the two extremes of size of these animals. The armature of spines on telson of the 18 mm. long specimen was as in the 12 mm. long specimen from Teller, Alaska (see above), while its cercopods were 10 mm. long. Only three of the 40 specimens were less than 11 mm. in length; the others had shape and armature of telson as in the 18 mm. long specimen or as in the two specimens from Teller. When seen in the water the carapace of the living animals was spotted light and dark brown (coloured like the mud-bottom of the lagoon-pond they occurred in), with the paired eyes blue, lined with purple. Head and tail coloured like carapace, but certain places ("snout" and underside of free tail end) with rose-purple. Cercopods brown. Inner side of carapace rose-brown. Foliaceous legs brown-green with pale appendages, the 11th pair of legs (female) darker green and with rose, big eggs. Telson pale greenish-blue, with base of cercopods dark. These *Lepidurus* were swimming around very actively in the shallow lagoon-pond, making by movements of the foliaceous legs their characteristic long, winding furrows in the mud surface; or burying themselves in the latter, so that their trails were more obscure, with an animal at one end of each. Their food consisted of the still smaller invertebrates (*Daphnia pulex*, Copepods, midge-larvae, etc.) present in great numbers here. As I collected practically all the *Lepidurus* I saw in this pond their size indicates that they all belong to the brood of the year (1914), and thus were almost two months old.

The specimens from Bernard harbour July 3, 1916, measured only from 3 to 10 mm. in length, with cercopods from $1\frac{1}{2}$ to 5 mm. long. As mentioned p. 5 these are the youngest individuals secured during the expedition, and I give here (text figure 1*f*) an outline (dorsal view) of telson and its armature of the smallest specimen. A comparison with text figures 1*b*, *g*, will show that the outline of telson is more rectangular than triangular, and runs out into *three* long spines and a very short one, while the older stages (more than $\frac{1}{2}$ cm. long) have only *two* larger spines here, between which (with specimens more than 1 cm. long) are found a few smaller spines. From the many American specimens I have examined this seems to be a constant and characteristic armature of the telson even in very big (up to 3 cm. long) individuals, while the row of tiny spines on the middle of the dorsal side of telson vary in numbers from two to four, as also the number of still smaller spines[2] between the terminal end of telson and the cercopods. In individuals less than 3 mm. long the shape of the telson is also more rectangular than triangular, and according to Sars (1896) and Brehm (1911)[3] ends in only two well-defined spines (points). From the text figures 1*a*, *b*, *c*, *g*, *h*, and Olofsson's account (1918, p. 384–86, figs. 18–19), it will also be seen how the outline of telson from rectangular becomes triangular, and in the older individuals almost spatulate, though they do not reach the maximum development in the latter direction (which seems to be accompanied by a reduction in length of the spines) shown by specimens from Norway (Sars, 1896, Tab. XII).[4] In color even the smallest

[1] From the narrative of the expedition, it appears that the summer came later in 1883 than in 1882.
[2] These spines seem to be absent with individuals less than about 4 mm. long.
[3] See text figures 1*d*, *e* (copies).
[4] Data about the growth of the cercopods are given by Olofsson (1918).

of the specimens from Bernard Harbour, July 3, 1916, had the greenish lustre typical of this species, the youngest ones being most transparent, but without the orange main colour characteristic of the still earlier stages (Sars, 1896, Johansen, 1911), except for the intestine. A photograph of a part of the pond in which they occurred is given on p. 7 in the report on Cladocera (Part H) in this volume; they were not found in the north-end of the large pond, perhaps because a stony shoal separates it from the deep part of the pond, where we may assume the animals take refuge when the new ice begins to form in the fall, nor in the other adjoining, large pond. I did not notice many individuals, and their place of occurrence was limited to the shallow bights filled with water mosses and detritus bottom along the grassy margin of this part of the pond. Their behaviour was quite as described on p 7 and it is fair to assume that they represent the brood of the year (1916), and thus are about one month old.

The specimens from a lake inland at the same locality, August 10, 1915, had a length of from 8 to 15 mm. (carapace 6 to 10½ mm.). Only the biggest one had a few almost ripe, rose-purple eggs in the pouch (11th leg pairs), while the others had unripe, whitish eggs. I kept them alive for a while, and noticed how they devoured the fairy shrimps (*Branchinecta paludosa*) found in the same lake. The latter was a typical large tundra pond or lake situated on the lowland, with a stony or muddy (detritus) bottom with many bights with *Carex*-vegetation. Its depth was not ascertained, but probably less than one fathom.

The specimens from August 16, 1915, were secured in the same pond as those from July 3, 1916 (see above), and measured from 7 to 15 mm., the largest specimens having the cercopods 9 mm. long. Two of the 15 mm. long (cercopods 7-8 mm.) specimens I consider to be males (after an examination of their 11th pair of legs), though Sars states (1896, p. 76), that the male attains a length of only 13 mm. They are the only males I observed with certainty during the expedition, though it is of course possible, that some of the younger individuals (say less than one centimeter in length) secured, are males. Their occurrence at Bernard harbour in the middle of August agrees with what is known from Norway (Sars, 1896) and Greenland (Brehm, 1911), as mentioned p. 5. I give here an outline (text figure 1*g*) of the shape and armature of telson in the youngest (7 mm. long) specimen, and refer to my remarks, pp. 5-7. Only a few of the 40 females secured (August 16, 1915) had a couple of eggs in the pouch (compare p. 7), so perhaps they had been largely deposited now, on water-plants, etc.

The pond in which these were found had on October 6, 1915, ice 7 inches thick over a water depth of 9 inches. Frozen into the ice I noticed many *Lepidurus arcticus* of all sizes, often found around air-bubbles enclosed in the ice at varying depth. By chopping them free and later thawing out I ascertained that all the animals were dead, but the full-grown females all had in each leg pouch (11th pair) at least one, dark-purple, ripe egg (1½ mm. in diameter). I placed these eggs to rearing, and collected more in the beginning of June next year, but though kept until next July they did not hatch. I also cut a hole through the ice about in the middle of this pond and secured two females *Lepidurus*, 10 and 12 cm. long,[1] which were swimming actively around under the ice, though there were only a few inches of water here (temperature 33° F., air 24° F., 1.30 p.m.). None of them had any eggs in the leg pouch, and the larger specimen was [illegible]edding its skin, the abdominal half of the animal having already grown a new [illegible]ula. I give here (text figure 1*h*) an outline of the shape and armature of t[illegible]ison of both individuals (see pp. 5-7).

The only *Lepidurus* I could find at Bernard harbour in June were a few, dead, full-grown females with ripe eggs in the leg-pouch collected on June 6, 1916, in the same pond[2] as where I had collected them before (see above).

[1] Cercopods half the body-length.
[2] Now already free of ice.

This seems to indicate that the hatching of the nauplius (metanauplius) does not take place in this vicinity much before the middle of June, even if the spring comes so early as was the case in 1916.

Hibernation

From the above, it will appear that this species, perhaps to a still greater degree than *Branchinecta paludosa* is exceedingly erratic in its occurrence, for I succeeded in finding it only in a few large ponds and lakes, though looking for it everywhere during three years. Nor is it known definitely whether any of the grown up animals hibernate in deeper lakes, or all die in the fall. According to Sars (1896, p. 82), however, it is found, in Norway, mainly in rather deep mountain-lakes; so we may perhaps suppose, that wherever the lake in which they occur is deep enough so as not to freeze to the bottom, some individuals hibernate there.[1] I have formerly (1911) expressed this opinion with reference to their occurrence in East-Greenland; and the large specimen from St. Paul Island, Alaska, secured in March, 1911, seems to point conclusively to this, if the collecting date is rightly given. On the arctic coast of this continent the species has not yet been found in deeper lakes, though the latter have been only little investigated; the occurrence, however, particularly at Point Barrow (see p. 7) in July, of specimens up to 23 mm. long, seems to make it impossible that the oldest (say above 10 mm. long) of these can have attained such a size during the little more than a month which has passed since the eggs hatched. It is a well known fact, illustrated also by the measurements of the specimens given on pp. 4-8, that there is often a great difference in size between the *Lepidurus* occurring together at a particular date in the same pond or lake. The specimens from Northumberland island, Northwest Greenland, August 7, 1901 (see p. 5); from Point Barrow, Alaska, July 21, 1882 (see p. 7), and from Martin point, Alaska, July 26, 1914 (p. 7), are cases in point. Even allowing (see above) for a certain number of those occurring during the summer being hibernating females, the fact that all intermediate sizes between the smallest and the largest individuals are found, seems to prove that the eggs do not all hatch simultaneously when the ice melts in the spring, and that the rate of growth of the members of the new brood is different, according to the amount of food each one is able to secure.[2]

According to Scharff (History of European Fauna, London, 1899, pp. 94, 167) and Wesenberg-Lund (1895) this species is known from arctic, pleistocene strata in Scotland and Denmark, as also in southern Sweden (Nathorst.)

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[1] Prof. Sars tells me in a recent letter that he thinks this is not improbable. He also informs me that besides the lakes given in "Fauna Norvegica" it has later been found at many other places in southern Norway, but only in mountain lakes situated at high elevation (about 2000 to 4000 feet; see also Sars, 1891, p. 27.) Olofsson's statements (1918) about its biology in Spitsbergen, outside the summer months, are not founded upon actual observations.

[2] To make these points more clear I have recently taken the trouble to measure the approximate lengths (to end of telson) of all the specimens from Greenland and Eurasia (found in the museums in London, Copenhagen, Christiania, Uppsala, Stockholm and Gothenburg) which have delinite dates of collecting given upon their labels. The following is a summary of the results of this, to which should be added the (very little) information given by various authors.

West Greenland. Beginning of July: 5-15 mm. Middle and End of July: 10-23 mm.

West Greenland. Beginning and Middle of August: 15-30 mm.

North Greenland. Beginning of July: 10 mm.; Middle and End of July: 10-20 mm.; Beginning of August: 8-23 mm.

East Greenland. Middle of June: 1 mm.; End of June: 1½ and 5-10 mm.; Beginning of July: 10-15 mm.; Middle of July: 5-15 mm.; End of July: 3-25 mm.; Beginning of August: 10-25 mm.; Middle of August 10-25 mm.; End of August and Beginning of September: 10-30 mm.

Iceland. [illegible]ing of August: 5-15 mm.; End of August: 25-35 mm.

Spitsbergen. Beginning of August: 5-15 mm.; Middle of August: 7-23 mm.; End of August: 8-20 mm.

Bæren island. Middle of July: 10 mm.; End of July: 10-20 mm.; Middle of August: 8-14 mm.

Norway and Sweden. Middle of July: 15 mm.; End of July: 5-20 mm.; Beginning of August: 10-20 mm.; End of August: 25 mm.

Novaja Zembla. End of June: 1½ mm.; Middle of July: 7-10 mm.

Siberia. End of August: 15 mm.; Beginning of September: 30 mm.

Suborder ANOSTRACA.

FAMILY **POLYARTEMIIDAE** Simon.

Genus **Polyartemiella** Daday de Dées.

Polyartemiella hazeni (Murdoch).

Polyartemia hazeni MURDOCH, 1884, p. 522; 1885, p. 150, pl. II; EKMAN, 1902, p. 5, figs. 1–5.

Polyartemiella hanseni DADAY DE DÉES., 1910, p. 106, fig. 2; PEARSE, 1913, p. 2; 1918, p. 666.

Polyartemiella hazeni JOHANSEN, 1921 p. 25. ("Can. Field-Nat.")

This species was first described and named by the collector, John Murdoch. Ekman and Daday de Dees later amplified Murdoch's description, giving some far better figures of both sexes but Daday apparently misread the specific name as *hanseni*, a mistake later followed by Pearse.

While the southern party of the Canadian Arctic Expedition stayed at Teller (Port Clarence), near Bering strait, Alaska, in 1913, I found specimens of both sexes of this species in two different tundra-ponds here.[1]

Two males were secured in the brackish pond, between the large lagoon lake and Port Clarence bay, on August 3, 1913.

I give here (text figure 2) an outline of the head and tail-ends (dorsal and ventral views) of one of these males. The total length (from tip of A2 to end of cercopods) is 12 mm., A2 being 3 mm. and tail 2 mm. long ineluding the short ($\frac{1}{2}$ mm.) cercopods. Murdoch states, that with his specimens the body (probably exclusive of A2) is double the length of the abdomen (tail); but from an examination of my specimens this applies more to the female (see below) than to the male where its body length is three or four times that of the abdomen. The colour of the living animal is, according to Murdoch, a pale iridescent green; in addition to this I find, however, that the accessory claspers (see below), the mouth parts and the protruding genitalia are more brownish (cuticula), and the contents of the intestine dark green, as also the paired eyes have a brilliant purplish-black colour, bordered with red. The number of foliaceous legs are 18, while the females from August 6, 1913, have only 17 pairs, a sexual difference already noted by Murdoch.

As seen on text figure 2c the front-end of the head runs out anteriorly into a broad, coniform and thorny "lamellar process"[2] behind which the small, black nauplius-eye is situated. The first pair of antennae are more obscure, being more or less hidden by the enormously developed second pair of antennae (A2). The latter are, with my two males much swollen and antler-like, being divided into three branches, of which the lower one is the longest (and biggest) with three joints; the next shorter and with two joints; and the terminal one a stumpy, single joint. The whole of the inner (under) side of these claspers (A2), from their base to the tips of the branches is covered with small spines, particularly extensive on the middle part of the clasper. At the base of each clasper is inserted, *ventrally*, a much shorter, truncate appendage tapering off at the free end, and also with small spine-hooks on the inner side, from the base to the terminal point. I propose to call these the "accessory claspers." They are only about one-third the lengths of the large claspers (A2), but distinctly set off from

[1] A comparison of the description and figures of *P. hazeni*, from Teller, Alaska, given in this report, with Murdoch's and Ekman's (the latter copied by Daday, 1910) descriptions and figures, shows certain differences in the male claspers and in the genital region of both sexes. Prof. A. S. Pearse, of Madison, Wisconsin, however prononnces the specimens from Teller, sent to him for examination, to be *P. hanseni*, (*P. hazeni*) Murdoch.

[2] Daday's "appendage."

the latter as an almost worm-like, apparently very contractile and movable paired appendage. Murdoch does not mention nor figure these "accessory claspers," but records the longest of the three branches of the large claspers (A2) as a large, curved process (armed on the tip and inner surface with numerous fine teeth)

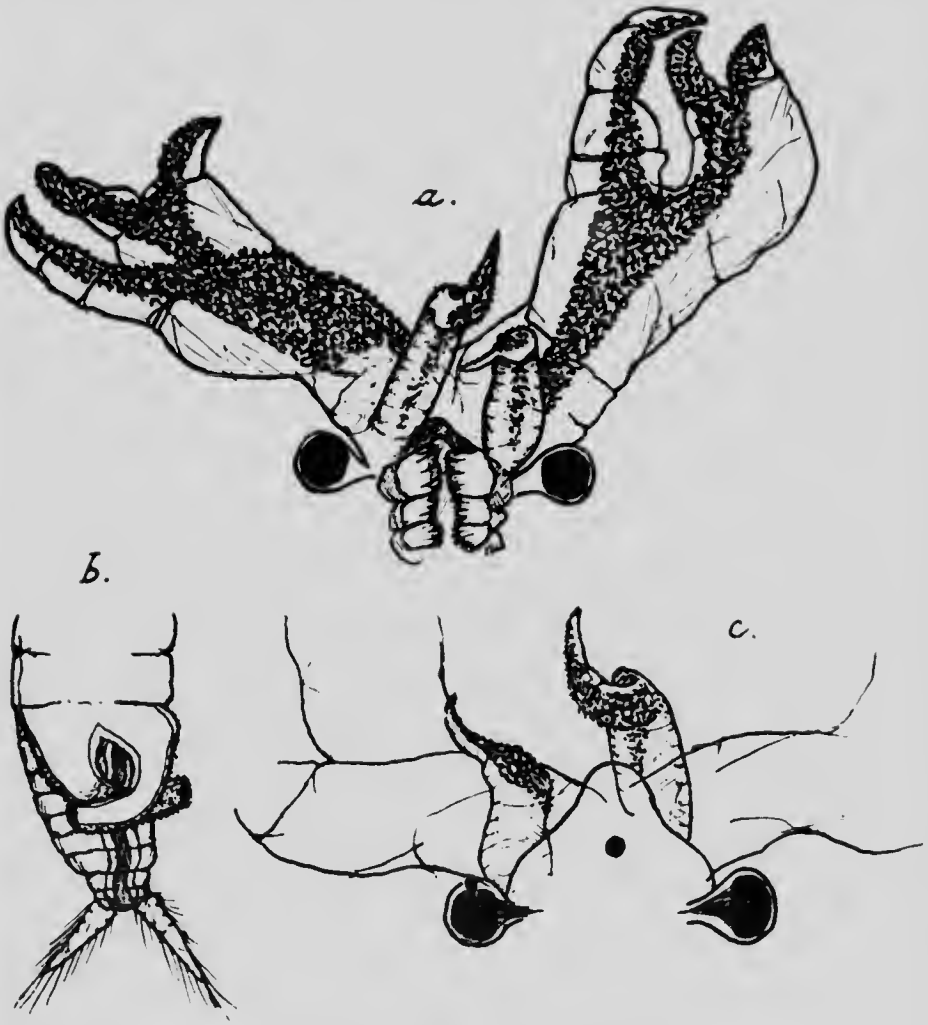

Fig. 2. *Polyartemiella hazeni* (Murdoch). Male. Teller, Alaska, August 3, 1913.
a. Ventral view of head. About x 50.
b. " " genitalia and abdomen. About x 50.
c. Dorsal view of head (claspers only indicated). About x 50.

projecting from the middle of the lower surface of A2. He also mentions that the extremity of the large claspers is bifurcated into two short, blunt branches, also armed on the inner side with fine teeth, which correspond with my specimens (see above).

Ekman (1902), Daday (1910) and Pearse (1918) in describing the large claspers as quadriramose, apparently include the "accessory claspers" as one of the branches of the large claspers (A2), which is perhaps correct, considering that the "acces-

sory claspers" are also armed with "teeth" (spine-hooks), and there may be some seasonal and local variation as to their fusion with the rest of the antennae. It is, therefor, perhaps not so surprising, that they were overlooked in Murdoch's more superficial description of the male. His figure (4*a*) is also very poor. The foliaceous legs of this species are described by Murdoch as short and broad, and are very similar to the foliaceous legs of the other known species (*P. judayi*) figured and described by Daday (fig. 3*d*, *e*, *f*,; p. 110, 1910); so I can pass right on to the abdomen of the male (text figure 2*b*). The ventrally protruding genitalia of my specimens are plump and sack-like,[1] their free ends (penis) being almost horse-shoe shaped, and armed with small spines along their edges and on the more bluntly cut off end. There seems to be a great number of segments in the tail (abdomen), but probably it is somewhat contracted, the (eight?) joints being telescopically compressed at the distal end, so there seems to be ten segments. The cercopods are a little smaller than with the females.

Three days later (August 6, 1913) I collected six females of this same species in another pond situated on the tundraplateau nearby, at Telle Alaska. I give here (text figure 3) an outline of the head and tail-end of the biggest of these six females. It will be seen, that the frontal, lamellar process is less conspicuous than in the male, though the nauplius-eye is as distinct; on the other hand, the first pair of antennae are more prominent, as is also the brain and adhesive organ behind the nauplius eye. The second pair of antennae are only developed as two conical protruberances, slender and finger-like at their tips. The labrum seems to be larger than with the male, and has very much the same outline as the frontal process of the other sex. The abdomen is less tapering, but more swollen and longer than with the male, owing to the development of the large ovum-sack, which has obliterated several of the segmental distinctions, so there are only half so many (but longer) joints here than with the male. The dorsal view shows how the ovisac is "protected" dorsally by 2 broad flaps (folds) apparently continuations from the last body-segment and the first ones of the abdominal segments; and the ventral view shows 2 finger-like processes one on each side of the uterine opening, the latter being large and lanceolate in shape supported inside by a broad, circular "rim."[2] From the ventral view the ovarium is also seen to be enclosing the intestine as an almost solid mass, only separated in two at the middle. Half a dozen ripe eggs appear on each side of the ovarium. Murdoch did not notice the two abdominal, dorsal flaps, though he records the two slender ("tooth-like") processes beside the ovarial opening, and the voluminous ovisac, rounded at the end. In my specimens the egg-sac is about two-thirds the length of the abdomen, and of a swollen-conical shape. The cercopods seem to be somewhat longer and broader than with the male; and there are 17 pairs of foliaceous legs. Length of head 1 mm.; of body 7 mm.; tail 4 mm. (including cercopods).

The five other females are a little smaller, about 10 mm. long, to end of the cercopods, but otherwise as developed.

The sexual differences in this species are thus very distinct, and comprise, in addition to the different development of claspers and genitalia, a more plump shape of the male, owing to its smaller size[3] and shorter but more jointed abdomen, characters which are also found in the other species (*P. judayi*) of this genus, and in the Eurasian species *Polyartemia forcipata* Fisch., belonging to the same family (see Sars, 1896, p. 60-62).

The females of *Polyartemialla judayi* are very similar to those of *P. hazeni*; but the males are immediately recognized, their claspers being more in the

[1] Daday figures (2d) and mentions (p. 106) a fingerlike short process protruding from the middle of the ventral surface (Copied from Ekman).

[2] On one of Daday's (Ekman's) figures (2 b) is also seen a "wing-flap" on each side of the egg-sack, in front, and there is only *one*, broad fold upon the dorsal side.

[3] Daday (1910) gives the total length of the males as 9-11 mm., and of the females as 10-12 mm.

shape of broad fish-hooks than of antlers, and triramose, thus resembling *Polyartemia*, though there is no frontal process. The species (*P. judayi*) has hitherto only been found on the Pribilof Islands, Alaska (Daday, 1910).

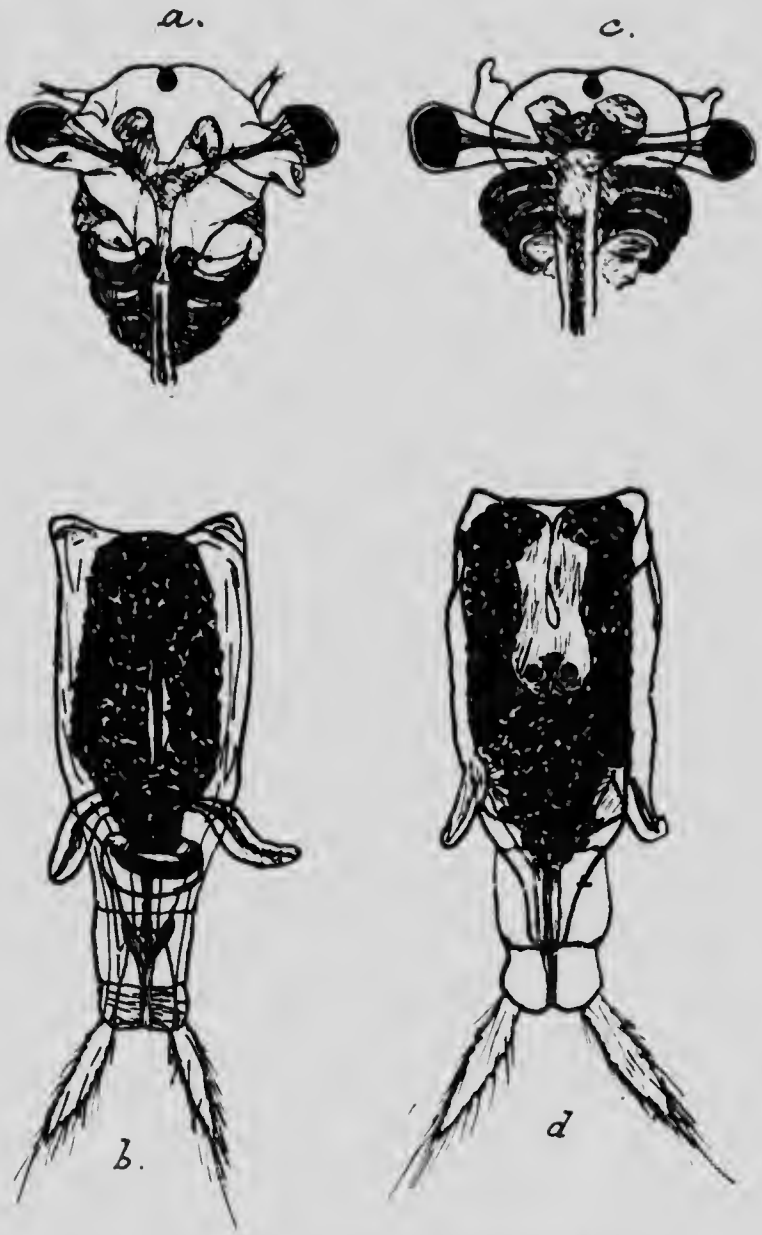

Fig. 5. *Polyartemella hazeni* (Murdoch). Female. Teller, Alaska, August 6, 1913.
a. Ventral view of head. About x 50.
b. " " ovisac and abdomen. About x 50.
c. Dorsal view of head. About x 50.
d. " " ovisac and abdomen. About x 50.

Murdoch's specimens of *Polyartemia hazeni* all came from the vicinity of Point Barrow, Alaska, and apparently these were the only ones Daday de Dées had for basing his description and figures on. Through the kindness of Prof. Paul Bartsch, of Washington, D.C., the Murdoch specimens of this species now in the United States National Museum were sent for examination in 1920, and as the collecting data in Murdoch's report are somewhat indefinite, I here quote the specimen-labels: 2 specimens (male, female with eggs), cotypes, from tundra-pools at Ooglaamie (Point Barrow), Alaska. July 24, 1882. J. Murdoch coll. 2 specimens (male, female with eggs), cotypes, from tundra-pools at Cape Smyth (Point Barrow), Alaska. July 10, 1883. J. Murdoch coll. 3 specimens (one male, 2 females with eggs), from tundra pools at Cape Smyth (Point Barrow), Alaska. July 16, 1883. J. Murdoch coll.[1]

As to their habits Murdoch states, that "they swim swiftly and are very hard to catch," but from my observations of a great many fairy-shrimps of different species, including this one, this characteristic is only relative, depending upon the season, age and sex. While the younger stages and the males, and both sexes at the end of the season are fairly easy to catch, are the full grown females in high summer very swift and agile and somewhat difficult to catch. This holds good for all the fairy-shrimps I have observed.

The farthest eastward this species (*P. hazeni*) has hitherto been observed are represented by those collected by J. M. Jessup on the coast, on right on the boundary line between Alaska and Yukon Territory (about 69½° N., long 141° W.). They have been recorded by Pearse (1913), and collected in a muskeg lake at lat. 69° 40′ N., on July 25. 1912 (where current together with *Branchinecta paludosa*) and in muskeg pools on plain Firth River (lat. 69° 20′ N.) on June 23, 1912. The latter date interesting being so very early in the summer; but it must be recalled that locality is about two degrees of latitude south of Point Barrow.

There is little likelihood of this species occurring along the arctic coast east of the Mackenzie delta, otherwise I think it would have been observed during the Canadian Arctic Expedition, considering that a number of the two American Arctic Phyllopods (*Lepidurus arcticus* and *Branchinecta paludosa*) were secured along that part of the coast. The new records of *P. hazeni* from Teller, Alaska, probably represent almost its southern limit, so that the species must be termed a typical representative of the arctic fauna in Alaska, perhaps very similar to the freshwater Amphipod *Synurella johansenæ* (see Part I, p. 21, in this volume). Daday (1910) has already called attention to this strongly limited (high arctic) occurrence of *P. hazeni*, and opines that it will be found much south of the isotherm of 14° C., a proposition which the later records towards the south and east have now, however, modified somewhat. I do support Daday's opinion, that *Polyartemia hazeni* is the most typical American Arctic Phyllopod known so far, replacing *Polyartemia forcipata* upon this continent, though its distribution seems to be far more limited than is the case of *P. forcipata*.

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[1] The specimens examined and described by Ekman (1902) are in the zoological institution, Upsala, Sweden, and comprise six males and fourteen females. Only half of them are in a fair condition. As to the collecting data are only given as: "Point Barrow, Alaska. Internat. "Polar Expedition 1882-84. Murdoch." Except for the first branch of the male claspers being more in the shape of "accessory claspers" these specimens agree with Ekman's description and figures. There are also two males and four females of this species collected at Cape Smyth (Point Barrow), Alaska, in 1883, by the same expedition, in British Museum of Natural History, London (Norman Collection).

FAMILY **BRACHINECTIDAE** Daday de Dées.

Genus **Branchinecta** Verrill.

Branchinecta paludosa (O. F. Müller).

Cancer paludosus Müller, 1788, p. 10, pl. 48, figs. 1-8.

Cancer stagnalis Fabricius, 1780, p. 247 (*non* Linnaeus).

Cancer paludosus Herbst, 1790-1804, p. 118, pl. 35, figs. 3-5;

Branchipus paludosus Kröyer, 1838, p. 319, No. 41; Grube, 1853, p. 137; Reinhardt, 1857, p. 73; Dybowski, 1860, p. 200, Pl. X, figs. 7-8; Packard, 1867, p. 295; Lilljeborg, 1872, p. 842; Sahlberg, 1875, p. 320; Daday de Dées, 1890, p. 35, figs. 1-3.

Branchipus middendorfianus Fischer, 1851, p. 153, pl. VII, figs. 17-23; Grube, 1853, p. 136.

Genus *Branchipus* (?) Baird, 1852, p. 29.

Branchipus groenlandicus, Verrill, 1869, p. 253; and 1870, p. 244-6, figs. 7-10.

Branchinecta arctica and *groenlandica* Verrill, l.c.; and Packard, 1873, p. 621.

Branchipus (*Branchinecta*) *arcticus* and *Verilli* Miers, 1877, p. 105, pl. IV, fig. 1.

Branchinecta paludosa Verrill, l.c.; Sars, 1874, p. 89; 1897, p. 487 , pl. 30 fig. 1-2; 1896, p. 41, pl. VI-VIII; Lilljeborg, 1877, p. 4; 1888, p. 154; Packard, 1883, p. 336, pl. IX, X; Wierzejki, 1883 (1882); Wesenberg-Lund, 1894, p. 89; Vanhöffen, 1897, p. 159-75; Ekman, 1905, p. 14; Daday de Dées, 1910, p. 160; Stephensen, 1917, p. 285; Haberbosch, 1920, p. 52; Johansen, 1921, p. 25. ("Can. Field-Nat.")

The above bibliography shows clearly how the species finally (Packard) got its scientific name, and it became recognized, that all the other species of the same genus in the Arctic are only synonyms of *B. paludosa*. Only the most important works published since the seventies are given above. The specimens follow:

Expedition Records

About 30 nauplii and metanauplii from beach-pond at Collinson point, Arctic Alaska, June 22, 1914.

10 metanauplii and immature ones from same pond as preceding ones, July 16, 1914.

3 males, one female, from pool on Barter island, Arctic Alaska, July 17, 1914. D. Jenness coll.

Many males and females from lagoon-pond at Martin point, Arctic Alaska, July 26, 1914.

5 males, 5 females, from ponds on Herschel island, Yukon Territory, August 13-14, 1914.

5 males and 3 females from tundra-pond at Young point, Northwest Territories, July 18, 1916.

About 40 nauplii and metanauplii from ponds on Chantry island (Bernard harbour), Northwest Territories, June 17, 1916.

One metanauplius, hatched from hibernating eggs, middle of June, 1916, lake inland at Bernard harbour.

4 males and 6 females from shallow pond on sandflats at Bernard harbour June 30, 1916. Also immature specimens from brackish pond here, same date.

7 males and 9 females from same shallow pond as preceding ones July 6, 1916.

5 males and 13 females from brackish pond at Bernard harbour, July 10, 1916.

17 males and 9 females from waterhole on beach west of Bernard harbour, July 14, 1916.

32 immature ones from brackish pond at Bernard harbour, July 15, 1915.

3 males and 8 females from same pond as preceding ones, July 19, 1915.

One young male and 30 females from same pond as preceding ones, August 4, 1915.

5 males and 9 females from lake inland at Bernard harbour, August 10, 1915.

12 males and 8 females from pond on ridge slope at Bernard harbour, August 23, 1915.

Other American Records (excluding Greenland)

Puddle at White Horse, Yukon Territory, June 7, 1912, J. M. Jessup coll. (Pearse, 1913, p. 2).

About 55 males and 50 females from tundra pools at Point Barrow, Arctic Alaska, July 10, 1882; J. Murdoch coll.[1] (Murdoch, 1885, p. 149).

About 70 males and 125 females from tundra pools at Cape Smyth (Point Barrow) Arctic Alaska, July 16, 1883, and other dates; J Murdoch coll.[1] (Murdoch, 1885, p. 149).

Muskeg lake, coastal plain of Arctic ocean (Lat. 69° 40′ N., Long. 141° W.), July 25, 1912; J. M. Jessup coll. (sex and numbers not given by Pearse, 1913, p. 2).

Fragments of 2 males and 2 females from (pond at?) Cape Krusenstern, Northwest Territories, August. 1849; J. Rae coll.[1] (Baird, 1852, p. 29).

Gjöa-Havn, on the south side of King William island, at the following dates:

A few specimens on August 12, 1904. (2 about 10 mm. long females.)[1]

5 males and 7 females, 13-15 mm. long, on August 23, 1904, and August 6, 1905.[1] It occurred here together with *Lepidurus arcticus* (Pall.) (Gjöa-expedition,).[2]

About 1 dozen specimens from Fullerton, west side of Hudson bay, "Neptune" Expedition, 1903-04, A. Halkett coll.[1] (Halkett, 1906, p. 368).

2 males and 4 females from a pond at Point St. Charles (Montreal), Que., May-June, about 1890; E. Ardley coll.[1] (Johansen, 1921, p. 27, "Can. Field-Nat.").

28 males and 4 females (1½ to 2 cm. long) from freshwater-pools on rocks, mouth of Koksoak river, Fort Chimo, Ungava, L. M. Turner coll. (no date) [1]

2 males and 1 female (about 2 cm. long) from Indian harbour, Hamilton inlet, Labrador, August 12, 1908; O Bryant coll.[1]

Specimens from pools on rocks at Indian Tickle and Tub island, Hamilton Inlet, Labrador, August 7, 10, 1864; A. S. Packard coll. (Packard, 1883, p. 337).

Vicinity of the winter-quarters upon Johan peninsula, east side of Ellesmere island (Lat. 78° 45′ N., Long. 75° W.), as follows:

3 males ... bay near Rice strait, August 18, 1898.

Many specimens from a freshwater pond, August 22, 1898, (about 1½ cm. long.)[1]

Young specimens from brackish water, Winter-quarters, June 17, 1899.

Young specimens from brackish water, Winter-quarters, June 29, 1899.

(Second Norwegian Arctic Expedition in the "Fram".)[2]

23 males and 7 females (1 to 1½ cm. long) from freshwater pond at Payer harbour, Cape Sabine, east side of Ellesmere island, Princeton Expedition, 1899, (Ortmann, 1901, p. 145) [1]

[1] Specimens examined by me (F. J.).
[2] Letter of April, 1921, from Prof. G. O. Sars to me.

3 males and 4 females from a small freshwater lake, and in a stream under the ice at Discovery bay, east side of Ellesmere island (Lat. 81° 41′ N., Long. 64° 45′ W.), Hart, Esq., coll. (Miers, 1877, p. 105).

Extralimital Distribution

In Greenland it has been recorded from a number of localities (see Stephensen, 1917) on the north and west coasts, from Polaris bay (about lat. 82° N.) in north to Frederikshaab (about lat. 62° 30′ N.) in south. It has not yet been found on the east coast of Greenland, nor on Iceland and Spitsbergen. It is otherwise known from Lapland and Kola peninsula, Finmark., Kjölen and the Dovre mountains, etc., in Scandinavia (Sars, 1896, Lundblad, 1914-15); Kolgujew island (Zykoff, 1905); Novaja Zemlia (Lilljeborg, 1877); and in Arctic Siberia between longitude 100° and 150° E. (Sars, 1897; Fischer, 1851); Bering island (Lilljeborg, 1887), Awatscha bay (about lat. 60° N.), Kamchatka (Daday de Dées, 1910); and Pribilof islands, collected on both St. George and St. Paul islands from 1872 to 1916 (specimens in U.S.N.M.); and in lakes on Hohen Tatras (Carpathians) at an elevation of about 1,650 metres (Daday de Dées, 1890; a male and a female (about 1½ cm. long) are in Brit. Mus. Nat. Hist., London (Norman Collection).

Its occurrence on the Dovre and Kjöien Mountains (at about 2,500 feet elevation) and Carpathians, and perhaps also at White Horse[1] must be explained as glacial, "relict-forms" continuing their existence in lakes at an elevation of not less than about 2,000 feet. The other records (excepting the one from Montreal) prove its complete circumpolar distribution and indicate its southern limit on the lowlands.

Field Notes and Description of Material

Murdoch's specimens from the vicinity of Point Barrow measured from 1 to 2 cm. (exclusive of the cercopods), and were thus all mature males and females, which one would expect judging from the month (July) in which they were secured.

The specimens from Collinson point, June 22, 1914, measure from one to six mm., and include one nauplius (or rather transition stage between the nauplius and metanauplius stage), 1¼ mm. long. It quite corresponds with the "metanauplius" described by Sars (1896, p. 53, Tab. VIII, fig. 15). It is thus a little older than the nauplii (stage I) I secured on June 17, 1916, at Chantry island (see p. 20). It is characterized by the lack of lateral eyes, by the foliaceous legs (half a dozen pairs) and tail (abdomen) being only little developed,[2] and by the enormous second pair of antennae, labrum and mandibular-palp, the principal locomotory-organs. We may suppose it to be about a week old (stage II).

Then there were half a dozen metanauplii (stage III) from 1½ to 2 mm. long, and corresponding to Sars' fig. 16 on Tab. VIII, and described by him, p. 54. Lateral, composite eyes are now present, the foliaceous legs are better developed, showing 8-9 distinct pairs well developed anteriorly, and decreasing behind while the three last pairs can be seen in a rudimentary state under the cuticula. The tail (abdomen) is less clumsy, and more elongate than in the preceding stage, and ends in two small, three-jointed, hairy cercopods. The labrum is still very large, but the second pair of antennae and the mandibular-palp are not nearly so large in proportion to the rest of the body as in the preceding stage.

Various features of the youngest of the larvae show, however, that it is a little older than the one figured by Sars (1896), and thus represent a stage between his figs. 16 and 17, on Tab. VIII. Thus my specimen has the lateral, composite eyes better developed (set off); the second pair of antennae is not so long and

[1] Elevation 2,000 to 3,000 feet.

[2] Abdomen cleft at tip, each part ending in a spine, but no cercopods to be seen yet.

broad, and less branched; the mandibular-palp is smaller, but the maxillae better developed, as also the foliaceous legs. The latter end in a long, temporary swimming branch while the broader, respiratory part is as yet only developed as a short lobe. There is also a distinct swelling of the last body-segments, heralding the development of the genitalia; and the abdomen shows about ten, indistinct segments, of which the next to the last is the narrowest, while in the preceding stages the tip of abdomen is the narrowest, another adult feature. The cercopods are also better "set off" from the last abdominal segment than in Sars' specimen. The general shape of the abdomen is cylindrical, it is longer in proportion and more distinct from the body than in the larvae from Norway.

The oldest ones of these (stage III) metanauplii from Collinson point showed transition forms to the next stage (IV), of which I secured a dozen specimens from 2 to 4 mm. long. These have practically the same appearance as Sars' fig. 17, and are described by him, p. 55. The composite eyes, foliaceous legs and abdomen are better developed, the head more set off from the body, but the second pair of antennae and the mandibular-palp still more reduced. Labrum is still large. The oldest of them were transition-forms to the next stage (V) of which I secured a dozen specimens from 4 to 6 mm. long. They correspond fairly well with the 5 mm. long specimens figured by Sars on Tab. VI, figs. 5, 6, and described by him p. 55, some of my specimens belonging to this stage (V) being a little younger, some of the same age, and some a little older than the Norwegian specimens.

In the oldest larvae the eleven pairs of foliaceous legs [1] are well developed and distinct, though none of them reach the length of the second pair of antennae. The latter are now a little more than one fourth of the total length of the larva, while with my stage III they are about one-third the total length. Labrum is greatly reduced (less than the length of the head, while on stage II it is double the length of the head) but even the 2nd maxillae well developed. The tail (abdomen) is now long (about half the total length), and slender cylindrical with the cercopods [2] almost lanceolate in shape, as with the adults. With other words, except for the 2nd pair of antennae and the less development of the genitalia these oldest larvae (stage V) are practically as the adults, and probably two weeks old. In colour all these Collinson point larvae had orange-red head and body (until genitalia); intestine yellow-brown with dark faeces; conspicuous red-orange brown granules [3] in labrum, black-metallic eyes and the cuticula white-yellow with darker mouth-parts.

The pond in which these *Branchinecta* larvae occurred was a beach pond at Collinson point. The larvae were not found in such parts of the pond where the vegetation (grass, mosses, etc.) was prominent; but places where the side and bottom of the pool was composed of mud-detritus and decaying pieces of driftwood were swarming with them. Here the larvae led a true pelagic life, unlike the adults (see later), keeping away both from the surface and the bottom of the pond. The youngest larvae (nauplii-metanauplii) especially were very active, being propelled quickly by violent strokes of the enormous second pair of antennae, while the older larvae would remain more "suspended" in the water, though "rowing" with their appendages. There is less than one second between two succeeding strokes of the locomotory organs of the larvae, and in the water they turn easily around in all directions. Particularly the youngest larvae seem to be in movement all the time, the few foliaceous legs developed assisting the large antennae in rowing and balancing the movements, taking the larvae off in "jumps" continually. Especially is this the case when the larvae get entangled in the vegetation (green algae) of the pond; they then try frantically all kinds of violent motions to get free again. This also holds for the older larvae from this date, only with the difference, that the swimming

[1] Swimming-branch and respiratory branch equally developed (see above).
[2] The (middle) spines in which these end are longer than with the younger stages.
[3] Excretory organs.

with these is mainly produced by the foliaceous legs and less by the second pair of antennae, while the development of the long tail (abdomen) enables them to make sudden twists and jerks, like the adults.

The above notes on the habits of the larvae were made partly by observing them in the pond, and partly by keeping them alive in a glass with water. I kept them for a month, but during that period they did not attain the size of those left in the pond, probably because they did not have the same food supply as in their natural surroundings. Thus more larvae were collected in the same pond on July 10-11, 1914; they now measured from about 5 to 10 mm. in length, and there were none younger than my stage V, described on p. 53. I kept ten of them, and it could now be decided, that the three largest of these were females and the rest males. The former had a short ovisac, the latter small claspers (second pair of antennae). There were still a great number of larvae in the pond; and they seemed to be thriving well, in spite of the fact that parts of the pond were completely dried up; even places with only a gallon of water were teeming with them.

A smaller waterhole (remnant of a dried up lagoon-pond) nearby and on the same level (old beach) had a water temperature of 58° F. at 6 p.m. on July 11. It contained, in spite of its small size, hundreds of *Branchinecta paludosa* larvae of the same size (5-10 mm.) as the ones mentioned above.

The four *Branchinecta paludosa* collected by Mr. D. Jenness in a pond on Barter island, Alaska were from 15 to 20 mm. long, and represented three males and one female, all mature and of the same appearance as those next to be described.

The specimens from Martin point, Alaska, July 26, 1914, measured from 15 to 20 mm., the full grown males being a little bigger than the corresponding females. The movements of the animals were very swift, twistings of the body, somersaults and jerking jumps abounding, particularly with the females when I tried to catch them. I give here an outline (text figure 4*a*-*c*) of the head and genitalia of one of the mature males, and of the second antennae of one of the females, all side-views. The row of hooked spines or teeth on the inner side of the basal segment of second antennae, the long, distal part of the latter, and the terminal spines and short filament on the genitalia of the male are easily seen; also the contractile nature of the second antennae of the female. In colour the males were when alive, transparent, pale white-green, with the three eyes black, while the foliaceous legs, brain-part and front-edge of the large claspers (2nd pair of antennae) were dark green, the intestinal canal pink (copepod-content?), and the ripe semen-thread white. 20 males were kept.

The females were much more brightly coloured, a fact also known from other fairy-shrimps (for instance *Eubranchipus gelidus*). They had a transparent, whitish-pink main colour with black eyes. Front part of head (from between the eyes) with its appendages, the back (dorsal side) and sides (from above the beginning of the foliaceous legs to the last abdominal segment and the base of the foliaceous legs dark purple. The tail (abdomen) behind the ovisac of a dark blue-violet colour, with a white stripe (unripe eggs?) on each side underlying the violet colour of the tail and the purple colour of the back, stretching from behind the base of the ovisac to the middle of the series of foliaceous legs. Eggs in uterus ripe, 1-5 mm. in diameter of a red-brown colour. Ovisac and intestine paler; unripe eggs in ovisac as a rose streak on both sides of the ripe ones. There was some variation in the distribution and intensity of these purple and violet colours among the 21 females I secured here, but the dark-purple, streak on the dorsal side of the intestine is particularly constant and very characteristic of the mature female of this species (see p. 23).

In several of the ponds on Herschel island I secured on August 13-14, 1914, four mature males (2¾ cm.) and three mature females (2½ cm.) of *Branchinecta paludosa*, the biggest specimens of this species I saw during the expedition.

These animals were very shy and alert when I tried to catch them, and the ponds they occurred in were pretty deep in places, though the fairy-shrimps seemed to prefer the shallower marginal water of the ponds, where the vegetation was most luxurious. The males were bigger, but less agile than the females, which of course had ripe eggs in the ovisac; in colour both sexes were as those described above from Martin point. In text figure 4*d* is shown an outline of the male genitalia; seen from the side.

The *Branchinecta paludosa* collected at Young point on July 18, 1916, measured from 10 to 13 mm. in length. Five of these were male and three females. The latter ones were the smallest, but had a few ripe eggs in the ovisac, while the males had big elaspers. In colour, etc. they were the same as the many specimens of corresponding sizes (age) secured at Bernard harbour, farther east, in 1915 and 1916 (see below).

At Bernard harbour, on June 17, 1916, just hatched nauplii and metanauplii of *Branchinecta paludosa* occurred in one pond near the beach on the west side of Chantry island, and in another at somewhat higher elevation on the south side of the same island. Both were typical shallow tundra ponds and particularly the one most easterly situated had a luxuriant vegetation of mosses, green algae, and detritus-mud bottom. The larval fairy-shrimps were present in great numbers, but somewhat difficult to observe, owing to their minute size, transparency and habit of hiding among the stones (gravel) and vegetation; I caught them in a similar way as I secured the larval *Lepidurus arcticus* in Greenland (1911, p. 336), by stirring up the water along the margin of the pond. I secured about 3 dozen of them altogether; and as the earliest larval stage of *Branchinecta paludosa* was hitherto unknown I give a sketch (text figure 4*e*, *f*) and short description of them (stage I).

It will be seen from these two figures (side view and abdominal dorsal view), that the nauplius eye and first pair of antennae are well developed, and that the head part of the larva comprises about half the total length, and is of rounded ovate shape. The second pair of antennae are enormously developed, and divided into a shorter, more basal, and a longer, distal, plump branch with long swimming hairs, among which are half a dozen situated at the base of the biggest branch of the antennae. At the base of each antenna project two [1] long stylet-spines [2] with a "brush" of small hairs at their ends, proportionately longer (hairs) and more one-sided than on the larva figured by Sars (1896, pl. VIII, fig. 15); we may perhaps suppose these stylets help in keeping the equilibrum when the nauplius swims, and in the gathering of food in the succeeding stages of the larva (Sars, p. 54). The largest branch of the antennae particularly shows evidence of its contractile nature (joints). There is no sign of the composite eyes yet. Behind these antennae are seen the large mandibular palp, with half a dozen long hairs (Sars figures eight). Then follows the somewhat pear-shaped abdomen, showing indistinct segmentation (3 joints?) and by being serrated, with short hairs on the ventral side indicating the foliaceous legs. It is possible, that the end of the abdomen has been damaged (missing) in my specimens, because it is more bluntly cut off, and does not end tapering and in two short spines as in Sars' larva. There is no question, however, as to my larvae being, as indicated by the length of their first pair of antennae, the rounded body form, etc., nearer the just-emerged nauplius stage than is that of Sars. The youngest of these larvae, which had apparently been hatched a day or two previously and of which two were secured, were $\frac{1}{2}$ mm. long, while that of Sars was perhaps 1 mm. long. I further secured half a dozen metanauplii (stage II) about 1 mm. long, similar to Sars' figure 15 (Plate VIII), the oldest of these showing transitions (both in size and development) to a half dozen metanauplii ($1\frac{1}{2}$ mm. long) corresponding to Sars' figure 16. The oldest of these latter in the same way

[1] The inner one of these, which Sars (1896) says ends in a divided "brush," is very indistinct in my specimens.

[2] Sars' "spike-bristles."

showed transition to the biggest metanauplii (2-2½ mm.), of which I secured that day about two dozen specimens, and which had nine to eleven pairs of foliaceous legs, thus being practically the same stage as Sars' fig. 17 (Tab. VIII).

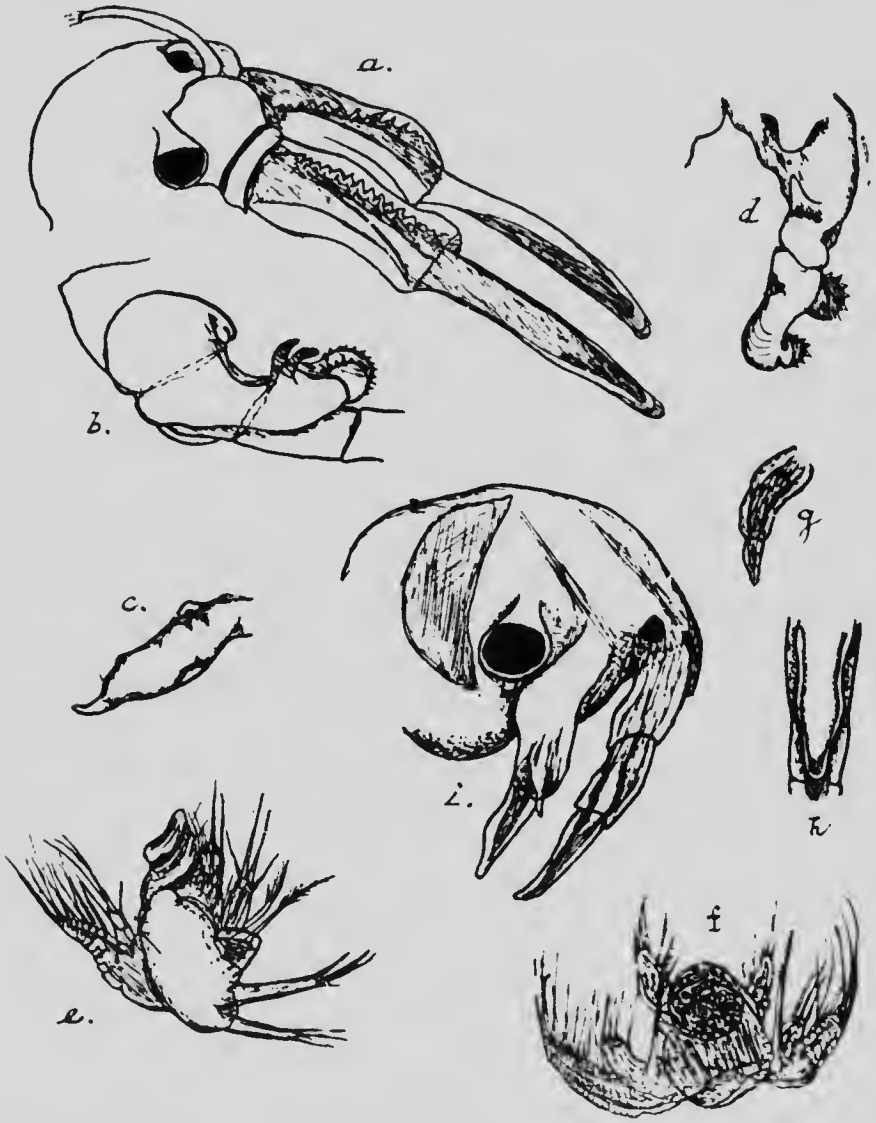

Fig. 4. *Branchinecta paludosa* (O. F. Mueller). All about x 50, except *e-f* (about x 100).
a. Side-view of head of male, 20 mm. long. Martin point, Alaska, July, 1914.
b. " " " genitalia, male, 20 mm. long. Martin point, Alaska, July, 1914.
c. Second antenna of female, 19 mm. long. Martin point, Alaska, July, 1914.
d. Genitalia (half) of male, 28 mm. long. Herschel island, Y.T., August, 1914.
e. Side-view of nauplius, ½ mm. long. Chantry island, N.W.T., June 17, 1916.
f. Abdominal-dorsal view of same larva as *e*.
g. 2nd antennn of male, 7 mm. long. Bernard harbour, N.W.T., July 10, 1916.
h. Ovisac of female, 9 mm. long (ventral view). Place, etc. as *g*.
k. Ovisac of female, 9 mm. long (ventral view). Bernard harbour, N.W.T., July 10, 1916.
i. Front-view of male, 15 mm. long. Bernard harbour, N.W.T., August 4, 1915.

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These larvae from Chantry island were orange (the labrum "kidney" above the mouth parts being most strongly coloured), with black eyes, darker intestine (food-particles) and pale appendages. I kept them alive for about a month (Rearing No. 120) and on June 20, three days after being collected, they were all in the metanauplius stage, and the smallest of them of the same size as the biggest ones (see above) collected on June 17. Three days later their average length was 5 mm.; and two weeks later they were from 4 to 9 mm. long; the largest one could now be identified as an immature female, with an ovisac 1½ mm. long. These observations show the rate of growth of the younger stages of this species, even in captivity, without food. They also show the unequal lengths of the larvae, according to their date of hatching, a point already emphasized under *Lepidurus arcticus* (p. 9).

On this place it is interesting to record the hatching of one of the *Branchinecta paludosa* eggs collected (female animals) in a lake-pond at Bernard harbour on August 10, 1915 (see p. 24). The eggs were kept in my laboratory tent until the following spring (1916), in a bottle of water (Rearing No. 94). The water with the eggs was of course frozen solid for nine months (September to May inclusive); nevertheless when it thawed out in the beginning of June, 1916, three of the eggs hatched and the nauplii emerged. Unfortunately I did not observe them until the middle of the same month, when the larvae were 2 mm. long, and thus corresponding to those collected at the same time on Chantry island (see above). I consider it very probable that the hatching of these eggs took place one or two days before it happened that year in the ponds where the ice would not melt as quickly as in a bottle. The experiment shows definitely the hardiness of the eggs of this species, and that they form the means of hibernating and propagating.

On June 20, 1916, I collected in the brackish pond at Bernard harbour six immature *Branchinecta paludosa* as representatives of the sizes found there that date. [illegible] ured from 3 to 9 mm. in length, two of them (7, 8½ mm.) could be iden[illegible] males (claspers small), and two (8, 9 mm.) as females with short ovisae wit[illegible]ut any eggs. The same day I also secured in the shallow pond on the sandflats (see Plate V, in Part J. of this volume) a few immature individuals (5-10 mm. long), and ten older ones (9-14 mm.). The latter ones were present in great numbers and of my specimens four are males, with big claspers, and of a more pale orange colour than the females, and without the dark purple-violet colour streak dorsally (see p. 19); while the females had olive-green eggs in the ovisae. The main reason for the difference in size between the specimens (from the same date) from the brackish pond, and those from the shallow pond, probably is that the latter, owing to its position and character melts earlier in the summer than the brackish pond, and more completely.

On July 6, 1916, the *Branchinecta paludosa* in this shallow pond had attained a size of around 15 mm. and fifteen of them were kept. Seven of these were mature males and had big claspers, etc., while the rest were females with many ripe eggs in the ovisac.

Four days later I collected eighteen more specimens in the same brackish pond; they measured from 7 to 15 mm., and five were males, the rest females. Of the former one (7 mm.) had the second pair of antennae little developed (see text figure 4*g*), and no signs of external genitalia; another (13 mm.) both of these sexual characters better developed (as text figure 4*i*); while the three other males (14-15 mm.) had the second pair of antennae and the genitalia fully developed. Of the females the eight smallest (9-12 mm.) had the second pair of antennae shorter than in the male of 7 mm. and a short ovisac without any eggs (see text figure 4*h*). The five other females (13-15 mm.) had the larger antennae (2nd pair), and the ovisac well developed, the latter with ripe eggs inside.

The water hole with brackish water near the beach west of Bernard harbour examined July 14, 1916, contained besides many bright red Copepods (*Eury-*

temora sp.) a number of *Branchinecta paludosa* feeding upon them, twenty-six of which were secured, including seventeen males.

The three smalles males (12 mm.) had shorter claspers and less developed genitalia than the the larger ones (14-16 mm.), in which the antennae sometimes reached a length of 4 mm. Of the females the five smallest ones (8-12 mm.) had small ovisaes without eggs, while the four others (14-15 mm.) had big ovisaes with ripe eggs.

Spring came considerably earlier in 1916 than in 1915 at Bernard harbour, and this had an important influence on the first appearance of insects on the ground and in freshwater, as well as upon the fairy-shrimps; though it has already been emphasized (p. 22), that all the ponds in one definite locality do not melt at the same time or rate; and thus the average size of fairy-shrimps in one pond may be smaller or larger than that of those in another pond. It is therefore perhaps not so surprising, that though I looked for them both at the end of June and the beginning of July, 1915, I did not find any before the middle of the last month, when I secured 32 immature specimens in the brackish pond repeatedly referred to, on July 15. They measured from 6 to 9 mm., and half a dozen of them were males (claspers very small), the rest females, with short ovisae without any eggs. The youngest of them (5-6 mm.) might even be called metanauplii, still having the second pair of antennae large. They were either swimming around in their typical way with the aid of their foliaceous legs, letting themselves drift, with the ventral side upwards, in the wind-current near the surface, or "browsing" in the mud bottom and algae in the pond. It will be seen from above, that at about this time the succeeding year the fairy-shrimps were considerably larger, even in the same pond. Other immature individuals of the same size were observed to be common in other, larger, ponds inland at Bernard harbour the same day (July 15, 1915).

Four days later the fairy-shrimps in the same brackish pond had attained a length of 7-11 mm., and I kept eleven of them. Three of these were males (10-11 mm.) with small claspers, the rest females (7-10 mm.) with short ovisae without any eggs.

On August 4, 1915, I again examined the same brackish pond. It still contained a number of fairy-shrimps, now about 15 mm. long. I secured 30 of these which all proved to be mature females, except one young male of the same length. The latter had only short claspers (see text figure 4*i*) and the genitalia little developed, thus considerably less advanced than the males from July 14, 1916 (see above), not to speak of the males secured on August 10, 1915 (see p. 24). We may, therefore, suppose that the egg from which it came hatched unusually late, though its size does not indicate it. It seemed as if all the other male fairy-shrimps in the pond now (August 4) had died off; and even the females were found less in the water itself than along the margin of the pond, often washed up here, wriggling around in the mud; and when placed in the water they seemed very sluggish. The rapid evaporation of the shallow part of the pond at this time of the year has probably "stranded" them on land; and from their (females) present development and habits I suppose it is about time for them to die out, in this pond at least, after having deposited their eggs, most of the males apparently having died already. Perhaps the brackish nature of the water in this pond has something to do with the fact that their life thus seems to be shorter than in other ponds (see below); I tried to keep some of them alive, but they died very soon after. Their brilliant colours have already been described for specimens secured at Martin point the preceding year (p. 19). These from Bernard harbour differed somewhat from the Alaskan specimens, having the dark purple colour only as the characteristic, broad, dorsal stripe. On the other hand the main colour is more blue, particularly the outer half of the foliaceous legs and the top of the head, though not the tail (abdomen). The mouth parts including labrum were red-brown, and the part of the ovarium at the base of the ovisac red-purple; intestine yellow-green. The mature males from Bernard

harbour were uniformly pale orange, without any of the blue or purple colours of the other sex.

Four days later, August 10, 1915, I examined a very large pond or small lake inland at Bernard harbour. It has already been described (p. 8), under *Lepidurus arcticus*, which also occurred in the same lake, and it has been mentioned there how much the fairy-shrimps were appreciated as food by the other Phyllopods. The former were particularly found in the sheltered, plant-filled, shallow bights of the lake, where they were swimming briskly around, dodging away with great alertness, when I tried to catch them. Fourteen were secured (11-15 mm.), five of which were males. The former had very big claspers, well-developed genitalia, and were of a uniform pale *brown* colour, with intestine (food particles) orange, and the head bluish dorsally. Their colours were thus more like the males from August 4, 1915 (see above) than like the males from Martin point (p. 19). The females all had ripe light brown eggs in the ovisac and unripe, white eggs in the ovarium. In colour they had the same brilliant coloration as given above (August 4, 1915); but there was quite a variety in its intensity in the various females. Thus some of them had even the second pair of antennae, the dorsal side of the foliaceous legs and the back between these, besides the dorsal side of the body-trunk violet-brown (thus with similar colours to those of the females from Martin point (p. 19); while other females had the colours of those from August 4, 1915. The variation in colour of these females from August 10, 1915, is mainly given by the different extension and intensity of the purple (violet-brown) and deep blue pigmentation. The decided difference in colour between the males and females of this species has probably something to do with the lesser size, but greater numbers of the latter compared with the former ones; and perhaps also with the fact that the males seem to die off earlier in the fall than the females; and therefore it is of importance to the latter ones to attract the attention of the males in time to get their eggs fertilized. I kept several of these fairy-shrimps from August 10, 1915, alive, but in the course of a week they all died. I kept, however, some of the eggs all during the winter and three of them hatched next June (see p. 22).

On August 23, 1915, I secured 20 more fairy-shrimps of this species in a shallow pond situated on the north facing slope of a ridge at Bernard harbour, thus a place where the power of the sun to dry up the pond was somewhat curtailed. Five of these were males and had big claspers, and the rest were females with ripe eggs in the ovisac. In all the length was from 12 to 15 mm. I did not observe this species at Bernard harbour later in that year; and as the winter set in early (middle of September) it is possible they did not last long. Nor did I observe them at Bernard harbour in the fall of 1914, and at that time in 1916 we had left the Arctic.

Other Material

Rae's specimens from Cape Krusenstern, east of Bernard harbour[1] (see p. 16), recorded by Baird (1852), almost certainly belong to this species, as believed by Packard (1883, p. 337). It is extremely improbable that they could belong to the new species of *Artemiopsis*, seeing that it is very rare, found only in one pond at Bernard harbour during two years' stay, and does not seem to occur in ponds on the coastal lowland where Rae travelled, but only in certain elevated ponds inland.

The fairy-shrimps secured by the "Neptune" Expedition (see p. 16), were collected "in freshwater ponds, formed of melted snow, in the barrens at Fullerton," on the west side of Hudson bay (about lat. 63° N.). They were identified as *Branchinecta paludosa* by Prof. G. O. Sars and have been mentioned by Halkett (1905, p. 107).

[1] Not Cape Krusenstern, Alaska, as given by Murdoch (1885).

Specimens from this collection in the old Fisheries Museum in Ottawa were dried up when I found them, but they show the characteristics of the species. There are about a dozen of them, and both sexes are represented; they seem to have been about one centimeter long, when collected.

The slender terminal joint of the claspers (second antennae) of the males is much longer, more curved, but less tapering (more like *B. coloradensis*) than given in figures by authors. The serration ("teeth") on the basal joint of the claspers is distinct. A study of the specimens collected during the period of the Canadian Arctic Expedition makes me think, that as the males increase in size, the basal joint of the claspers becomes considerably longer, and gets the "telescopic" appearance as figured by Sars (Plates VI-VIII), and also shown on the largest (most mature) males I secured during the expedition. The terminal joint thus seems shorter in proportion, than with the younger males.

It is interesting to see, from Halkett's field notes, that fairy-shrimps were observed much later at Fullerton (in the fall of 1903), than I noticed during the Canadian Arctic Expedition. Females were thus collected on October 26 through a hole in the ice of a pond about 7 feet deep, and more also on the succeeding days up to the beginning of November. On October 30, the thickness of the ice was measured to be 12-14 inches, the air temperature being about zero, Fahrenheit, and that of the water at the freezing point. The male Phyllopods had apparently died out then, but even so late as November 2, a female was obtained. Cladocera and copepods, of course, occurred all through the winter. "By testing the water in these ponds, containing Entomostraca, with nitrate of silver, it manifested the slighest bluish tinge. This means a very slight saline element in the water, but an element in some way or other introduced, for the ponds were certainly formed of fresh water, through the melting of the snow, and the water was that used for drinking and cooking purposes" (A. Halkett). It is probably a case of lagoons or brackish ponds similar to those observed during the Canadian Arctic Expedition.

The record of six fairy-shrimps of this species (identification verified by Prof. A. S. Pearse) from a pond at Point St. Charles, near Montreal, P.Q., given on p. 16, is certainly most extraordinary. Prof. A. Willey, who sent the specimens, informs me that the species has not been observed there since. They are mature individuals, about 2 c.m. long, the two females having ripe eggs in the ovisac. They were collected in a pond cut off from the river, in May-June, about 20 years ago, by E. Ardley. Perhaps the (dried) eggs were brought with a ship returning from Labrador, and then hatched with the advent of spring (April) around Montreal, thus two months before it takes place on the arctic coast. I did not observe the species, nor any other Euphyllopoda, during my recent (1920) trip along the east side of James and Hudson bays, to beyond lat. 56° N., so the only other records of it on the Labrador peninsula are those given on page 16 (Hamilton inlet and Fort Chimo). The only other southern record of it on this continent is White Horse, Yukon Territory (see p. 16), while in Europe it has been found in the Scandinavian peninsula and Carpathian Mountains (p. 17).

Life History in Greenland

Wesenberg-Lund gives (1894) some data concerning the species as it occurs on the southern part of the west coast of Greenland, saying that they become mature in July, at a size of 14 mm.; and that the same animals have double this size in November.[1] Vanhöffen (1897) says that the eggs develop there in May under the ice and secured young individuals at the end of May 1883. Wesenberg-Lund also says, that the ovisac appears at the same time as the

[1] I have seen as large specimens of *B. paludosa* from West Greenland as those I collected upon Herschel island (see p. 19).

mandibular palp is thrown off, and the use of the second pair of antennae as swimming instrument is discarded. Apparently both sexes occur there in equal numbers, the males attaining the largest size. As the summer passes their numbers decrease, and their size seems to depend upon the length of time the ponds they occur in carry any water.

I have examined a great number of specimens of this species from Greenland and arctic Eurasia, found in the museums in London and Scandinavia.

Genus **ARTEMIOPSIS** Sars.

Artemiopsis stefanssoni.

Artemiopsis Stefanssoni Johansen, (Preliminary diagnosis in *Canadian Field-Naturalist*, vol. xxxv, No. 2, p. 29, issued June 22, 1921).

This species was secured in one of the three large tundra ponds situated at about 100 feet elevation on one of the gravel ridges near the coast of Bernard harbour, south of our winter house. I collected a number of mature males and females here, on October 6, 1915, by cutting a hole in the ice of the pond.

Immature Stages

On July 3, 1916, I secured, in the same pond, fourteen larvae presumably of the same species, measuring from two to three mm. in length. They were in the metanauplius and post-mentanauplius stage, the youngest of them having large second pair of antennae, and the abdomen (tail) not fully developed, though both the paired eyes, and 10 to 11 pairs of foliaceous legs were present. In the largest specimens the second pair of antennae were comparatively shorter, and all the nine joints of the tail (abdomen) to be seen. As even the mature specimens of the genus can hardly be distinguished from the genus *Branchinecta*, except in the sexual characters, it follows, that the larvae are practically of the same appearance as *B. paludosa* of corresponding age, so I do not find it necessary to figure them. From *B. paludosa* of the same size they are distinguished by having more of the adult characters (foliaceous legs developed, second pair of antennae shorter, etc.). The tail (abdomen) even when it has all its nine segments, is shorter and more solid-clumsy than tapering, with the cercopods (each of which ends in a long spine) less differentiated, as described under the adults.

They were found in numbers among the stones covered by detritus-mud and vegetation in the shallow bights of the pond, showing up by their pink or pale rose colour. They were rather sluggish in behaviour and fairly easy to catch by stirring up the water, which later that day (3.30 p.m.) had a temperature of 55° F. (Air 50° F., clear and warm).

Branchinecta paludosa was not observed in these three ponds (though both *Lepidurus arcticus* and other Entomostraca were common there (see p. 8), during our stay at Bernard harbour. At this time of the year *B. paludosa* at this locality had already reached such a size (1-1½ cm.) that the two sexes could be easily separated, thus five times the length of the *Artemiopsis* larvae. When it is further remembered (see above and below), that the full grown *Artemiopsis* were secured the preceding fall in this same pond, there can be little doubt but that these larvae belong to the genus *Artemiopsis*, and not to *Branchinecta*.

Description of Adults

I give some illustrations (text figures 5-6) of the adults of this new and interesting species, which shows certain differences from the only other species hitherto known, *A. bungei* Sars, from eastern Siberia, sufficiently characteristic to support a new specific name. The males (text-figure 5) measured from 7 to 10 mm., and in spite of their small size they were fully mature, and continually copulating with the females. They had the eleven pairs of foliaceous legs, and

the nine joints of the tail (abdomen) very similar to those of *A. bungei;* the cercopods are with both sexes less slender at their base than in other species of fairy-shrimps and more in the shape of continuations of the two "halves" of the last abdominal segment (see figs. 5*b*, *c*, 6*d*). The head of the male (fig. 5*a*, *c*) is

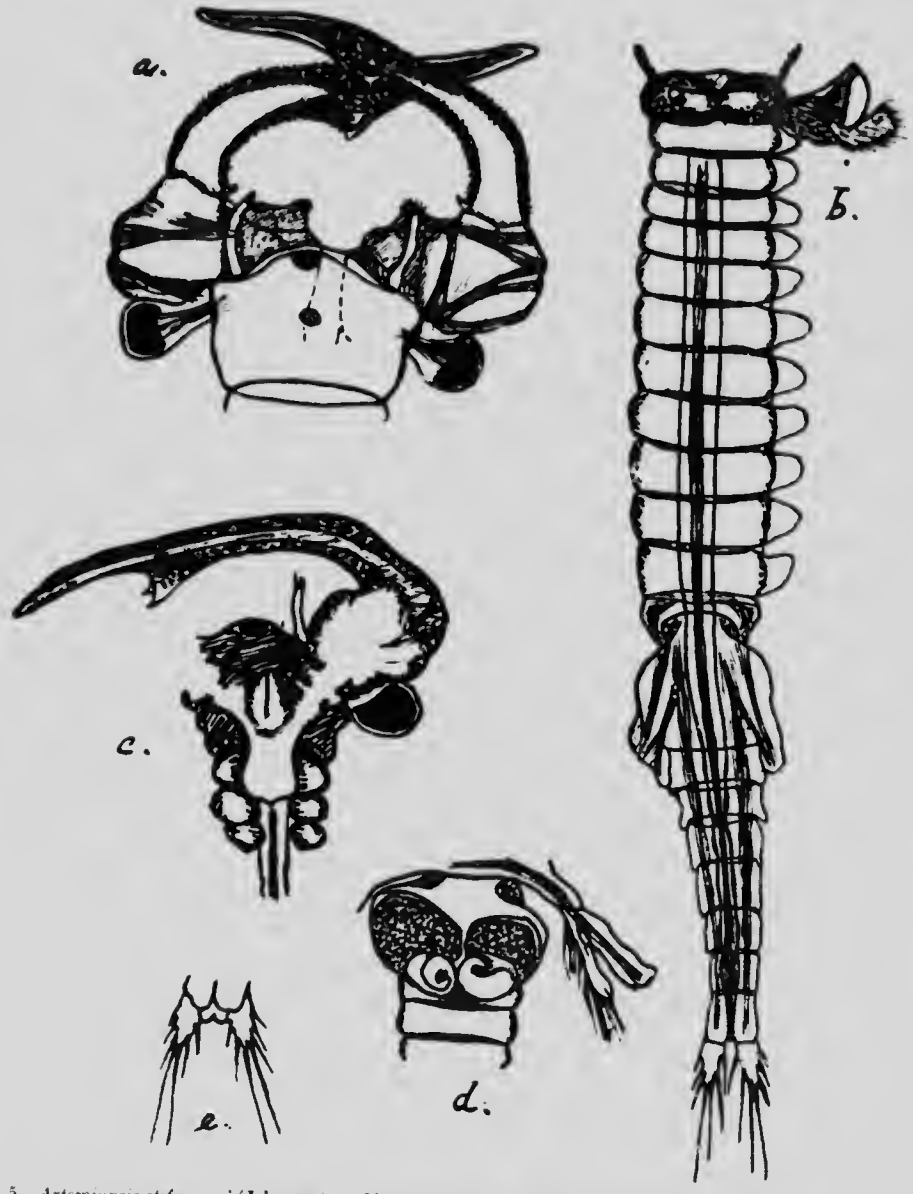

Fig. 5. *Artemiopsis stefanssoni* (Johansen). Male, 7–10 mm. long, Cotypes. Bernard harbour, N.W.T., October 6, 1915. About x 50.

a. Dorsal view of head. Claspers crossed.
b. " " body and abdomen. First pair of foliaceous legs and mandibles indicated.
c. Ventral " head (part).
d. " " genitalia. Last pair of foliaceous legs indicated.
e. " " tip of tail (abdomen)

somewhat square in shape, and convex in front, in the middle of which the fairly large nauplius-eye is seen, and with the adjesive organ occupying almost the centre of the dorsal surface of the head. The composite paired eyes are large, with movable, more slender peduncules and of the usual, iridescent, blackish colour. Their length is about that of the first pair of antennae situated next to them. The second antennae are developed as large sickle-shaped claspers, reminding one strongly of the mandibles of certain insect-larvae (Dytiscidae). Their bases are confluent, uniting into the labrum (see below) and more slender than at the level of the composite eyes, where the basal joint is enormously swollen (to give room for the powerful muscles) and ends inwardly in a broad and flat part, somewhat triangular in shape and ending in a blunt point, well shown in the dorsal view. The terminal joint of the claspers resembles a broad and flat fish hook, running out into a blunt and slightly curved terminus, and with a widening occupied by two hooks a little more than half way down. Each clasper is roughly spinose on the whole of the terminal joint, except for the proximal half of the central thickest part. At the base of the terminal joint of each clasper is a small hooked spine, on the inner side. The head is without frontal process unless a small, heart-shaped appendix, made up of two halves, situated between the bases of the two claspers, ventrally, can be considered as such[1] (fig. 5*c*). The labrum is broadly spatulate, rounded at its free posterior end. Behind it are seen the mandibles and two pairs of maxillae. The two first abdominal segments of both sexes are fused together and much swollen, owing to the development of the genitalia. The ventrally protruding part of the latter has in the male somewhat the shape of the "sac" of the Cirriped, *Sacculina*, parasitic upon the tail of crabs. With the fairy-shrimp this "sac" is somewhat slender at its base, and occupied by the two coiled penes, their swollen bases showing a granulated spiny chitinous and yellow surface (fig. 5*d*). The free ends of the two penes each form a coil somewhat resembling a snail-shell with a few loose turns; the spine in which each one ends (see *A. bungei*) is apparently only protruded occasionally, in the actual moment of copulation. The length of the abdomen is a little less than that of the body (excluding the head), and has no dorsal processes above the genitalia.

The females (see text fig. 6) are a little larger (8-11 mm.) than the males, mainly caused by an elongation of the abdomen. The head (fig. 6*a*, *c*) is more rounded oblong than in the male, and of course smaller, owing to the little development of the second pair of antennae. The first pair of antennae seems comparatively shorter than in the male, while the second pair is only a little longer than the composite eyes, and of the shape usual with female fairy-shrimps. The nauplius-eye, adhesive organ and mouth parts[2] are of course as with the male, as also the body with its foliaceous legs. The first and the last pairs of the latter are shown in fig. 5*b* and *d*. They are similar to those of *A. bungei* (Daday de Dées, 1910, fig. 17).

In the female *A. stefanssoni* the last body segment and the two succeeding abdominal segments are each produced laterally (fig. 6*b*) into a flap-process (important for copulation-purpose), very similar to the two similar ones found on the same part of the body in the female *Eubranchipus gelidus* (Hay). They are, however, not lanceolate-triangular as in *E. gelidus*, but more spoon-shaped. The ovisac (fig. 6*d*) is very large and oval, its transversal diameter being longer than the longitudinal. On its ventral side are seen two broad folds in the wall of the ovisac probably supporting the latter in its movements. These females, secured on October 6, 1915, had a great number of ripe, red-brown eggs filling the whole middle part of the ovisae, the unripe part of the ovarium showing up as two smaller masses above the ripe egggs. The abdomen is about the same length as the body, owing to the great development of the ovisac.

[1] It is probably a remnant of the "kidney-labrum," so largely developed in the nauplius and metanauplius stages of fairy-shrimps (see p. 17).

[2] There seems to be no "appendix" to the labrum ("kidney remnant") as with the male; that the latter has it is the only case among fairy-shrimps I know of.

It will thus be seen, that the female is not unlike that of *Eubranchipus gelidus*, having, however, one more abdominal segment and three dorsal processes; but the male is easily distinguished from that of the latter by the lack of frontal organ (process), and the quite different claspers, etc. From *A. bungei* the female *A. stefanssoni* is distinguished by the greater transverse diameter

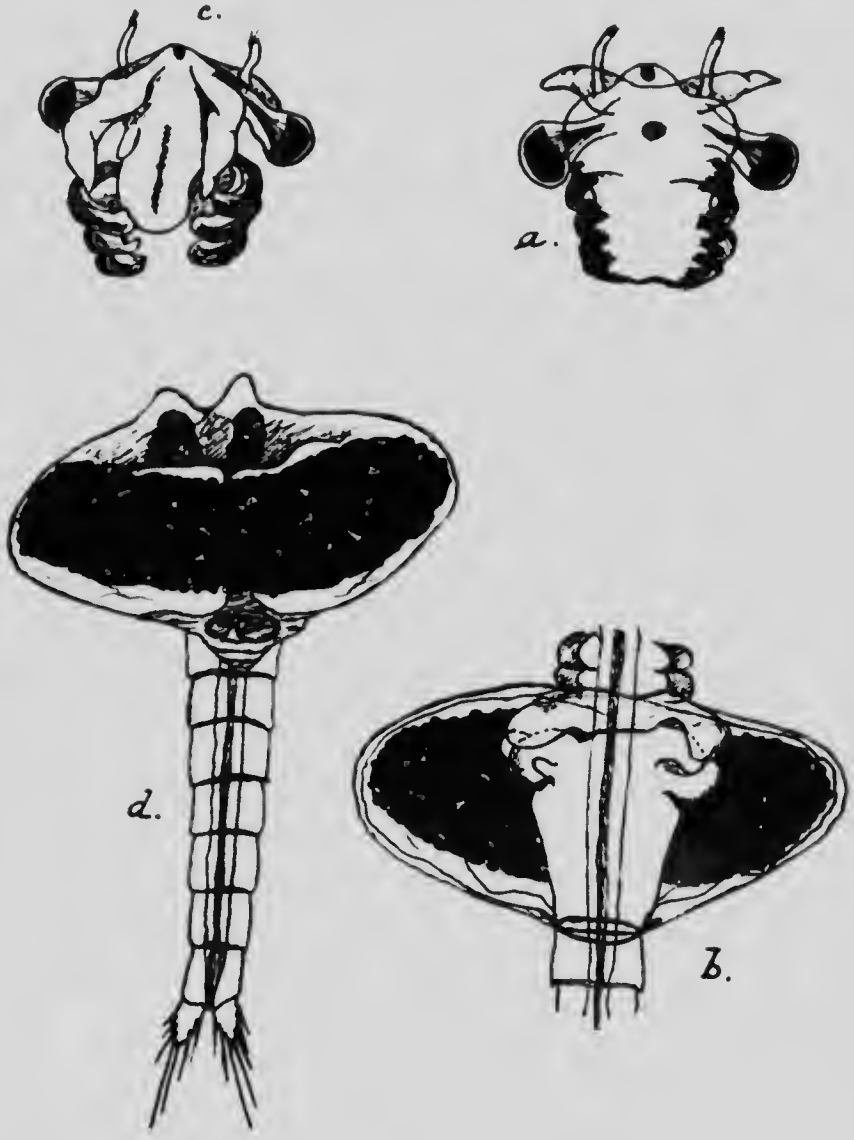

Fig. 6. *Artemiopsis stefanssoni* (Johansen). Female, 8–11 mm. long, Cotypes. Bernard harbour, N.W.T. October 6, 1915. About x 50.

a. Dorsal view of head. Mouth-parts indicated.
b. " " ovisac-region. Note the three flaps.
c. Ventral " head. Mouth-parts indicated.
d. " " ovisac and abdomen. Note the opening and wall-supports of the former.

(about the length of the seven last abdominal segments); while the claspers of the male *A. bungei* are more antler than sickle-shaped, and have only one hook (branch) about halfway down the terminal joint, while the small hook-spine on the innerside of ther terminal joint is situated about half way between the large hook mentioned above and the proximal end of the terminal joint, and not at the base of the latter, as in *A. stefanssoni*. The blunt point on the innerside of the swollen first joint of the claspers also seems to be more in the shape of a spiny protuberance in *A. bungei* than in *A. stefanssoni*.[1]

The length of *A. bungei* is given for the male, 8-12 mm., and for the female, 7-8½ mm., but from Daday's figure (fig. 17) it would appear that the ovisac of the females secured has not reached its full development, so this sex probably reaches at least the same size as the male, judging from *A. stefanssoni* (see p. 26, 28).

I have not been able to consult Sars' (1897, p. 478) original description of *A. bungei*; so all my references to it here are based upon Daday's description and figures (1910, p. 172-75).

I am indebted to Prof. A. S. Pearse, of Wisconsin University, for telling me that these mature fairy-shrimps from Bernard-harbour represent a new species of *Artemiopsis*, after he had examined a sample of the specimens sent him.

My detailed measurements of the size extremes of both sexes follow (alcohol-specimens). Male, 7 mm.; claspers, 2 mm.; head (without A2), 1 mm.; genitalia, ½ mm. broad and 1 mm. long; abdomen (including genitalia and cercopods), 2 mm. The same measurements for male 10 mm. long: 2½ mm.; 1¼ mm.; ¾ by 1½ mm.; 2½ mm. Female, 8 mm.: Head, 1 mm.; second pair of antennae, ¾ mm.; ovisac, 1¼ mm. long by 2¼ mm. broad; abdomen, 2½ mm. The same measurements for female, 11 mm. long, were: 1½ mm.; 1 mm.; 2 by 3 mm.; 3 mm.

The shortness of the abdomen (tail) is thus a characteristic feature for both sexes, compared with other fairy-shrimps.

In colour the males were paler than the females, the former being whitish-yellow with darker (yellow-brown) claspers and foliaceous legs, head, etc. The females had much brighter colours, being orange-red-brown, especially the head, foliaceous legs and the dorsal side; while the tail and ovisac (uterus) is pale transparent, with the eggs coloured olive-brown. Both sexes have the labrum of a strong orange-rose colour.

Biology

When found they were, as mentioned above, in lively copulation though there were only a couple of inches of water under the seven inches of thick ice. The females seemed to be a little more numerous than the males, so the latter had a busy time attaching themselves by the aid of their claspers to the dorsal lateral processes of the females (above the ovisac), thus resting on the back of the females. When in copula, the males assist in swimming, though the chief movement is effected by the female. By keeping some of them in a glass of water, I observed that the males would not swim around alone for any length of time, but would quickly "attach" one of the "idle" females in the way just described. During the swimming the females turn the ovisac from side to side, so as to bathe its eggs in the water, in the same way as I have observed in *Eubranhipus gelidus* (*Canadian Field-Naturalist*, February, 1921, p. 28); there being, about one second between the turning of the ovisac from left to right, and vice versa. The animals lived in captivity for a few days only and then died; though I kept their eggs until next summer they did not hatch (Rearing No. 98).

[1] The peduncles of the composite eyes also seem to be more slender in *A. bungei* than in *A. stefanssoni*.

This new species may also occur in certain other ponds at Bernard harbour; where the hatching of the eggs takes place a couple of weeks later, but then both sexes occur later in the fall than is the case with *Branchinecta paludosa* in this locality (p. 24).

As to the life conditions of *Artemiopsis* it is interesting to note that Daday says (p. 175) that *A. bungei* seems to be an inhabitant of very frigid regions in eastern Siberia. The water of the lake in which it was collected, along the river Bolschaja Baranicha, had a temperature of only 1.1° Reamur. The temperature of the water at the other places where it was found (New Siberian islands, mouth of Lena river, etc.) are not given, but some of the specimens were collected on October 10, 1886, thus corresponding remarkably well with the records for *A. stefanssoni* given in this report. We may therefore, perhaps, consider Bernard harbour as the approximate southern limit for this latter species, and look for it to be found upon the islands composing the Canadian Arctic Archipelago. The temperature of the water in the pond less than one foot deep where I collected it, on October 6, 1915, at Bernard harbour, was 33° F. (hole cut in ice), while the air temperature was 24° F. (1.30 p.m.; clear and calm.) [1]

The species is named in honour of the commander of the Canadian Arctic Expedition, Mr. V. Stefansson. Type-locality; Pond at Bernard harbour, Northwest Territories, October 6, 1915 (males and females); July 3, 1916 (metanauplii). Many specimens, F. Johansen coll. Catalogue Nos. 1660, 1661, 1662, Victoria Memorial Museum, Ottawa, Canada.

Suborder Conchostraca.

I did not observe any Phyllopods of this suborder during the Canadian Arctic Expedition; nor have they hitherto been recorded from the American Arctic or Greenland. As, however, I got a number of the species belonging to the two other suborders, besides Cladocera, I have hitherto attributed the absence of Conchostraca in the regions in question to their well known exceedingly sporadic occurrence where they are found; and even conjectured (*Canadian Field-Naturalist*, 1921, p. 88), that this suborder seems to be absent from these regions.[2]

In June, 1921, I received, however, a letter from Dr. Chancey Juday, of the University of Wisconsin, telling me that *Linmadia lenticularis* L. was collected by J. M. Jessup in May-July, 1911-1912, in lakes on the coastal plain of the Arctic ocean (about lat. 69° 40′ N, 141° W.), according to specimens now in the United States National Museum. The species was also collected in the same year at Old Crow river, Alaska; and *Lynceus (Limnetis) brachyurus* in the same locality (north of New Rampart House), and at White Horse, Yukon Territory. These latter records from the subarctic parts of this continent are given in my semi-popular article quoted above. They represent the first records of Conchostraca in the arctic and subarctic regions of this continent; and it is interesting, that both of the species are Eurasian forms, hitherto not found in America; unless (as Sars thinks) *L. lenticularis* is the same species as *L. americana*, found in New England, and *L. brachyurus* the same as *L. gouldii* found in Canada and northern United States.

It thus seems as if *L. lenticularis* just enters the American Arctic, perhaps only west of Mackenzie Delta, where the lines of isotherms, as well known, run much farther north than is the case in eastern Canada. The species was originally described by Linnæus from Finland; and is, according to Sars, found at a number of places in Scandinavia and central Europe.

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[1] The stenothermal, cold water form of Copepods (*Diaptomus baciliger* Koelb.), was also collected the same date in this pond (see Part J, p. 6-7 in this volume).

[2] The Bibliography given below is therefore limited to Notostraca and Anostraca

Conclusion

There is, perhaps, no other group of freshwater invertebrates which yields so easily new facts and interesting biological features as the Crustacea; not only in the Arctic, but generally. Their seemingly erratic and sporadic occurrence; the influence of the various seasons of the year upon their life-cycles; the sudden "blooming forth" of certain forms in tremendous numbers in the spring and early summer, and their disappearance as suddenly in the fall; these and other points have long made these freshwater-invertebrates particularly fascinating for study.

It will be seen from the preceding pages, that the Phyllopods occurring in the Arctic present as interesting, biological features as these from farther south, though for certain species our information is as yet incomplete. For anybody who spends a whole year in the Arctic there should also be something inspiring in the fact, so easily ascertained, that the rich life in bodies of fresh water, not to speak of the sea, continues all the year round, in spite of a low temperature and of many feet of ice covering them; and that each spring and summer invariably brings there also that exuberant vigor and fullness of life which is the characteristic of all living beings under favourable natural conditions.

Ottawa, Canada, April, 1922.

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