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REPORT

OF THE

CANADIAN ARCTIC EXPEDITION 1913-18

VOLUME VII: CRUSTACEA

PART N:

The Crustacean Life of some Arctic Lagoons, Lakes and Ponds

By

Frits Johansen

SOUTHERN PARTY—1913-16

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

Issued Dec. 30, 1922

Report of the Canadian Arctic Expedition, 1913-18.

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(Illustrated by seven plates.)

In this report some information is given about the bodies of fresh or brackish water examined during the period of the Canadian Arctic Expedition, principally in connection with their crustacean fauna (Amphipoda, Euphyllopoda, Cladocera, Copepoda and Ostracoda) treated in Parts E, G, H, I, J, in Volume VII.

I. *Teller, Alaska.*

The bodies of freshwater examined here were the large lake next to the town, a brackish pond between it and Port Clarence, various ponds on the higher tundra nearby, and a shallow artificial ditch just back of the now almost deserted town. The time I spent here was about a fortnight in the end of July and the beginning of August, 1913, at which time these bodies of water contained considerably less water than earlier in the season. Half a century or more ago[1] the large lake in question was a larger lagoon, with an outlet to Port Clarence, and at high tide in connection with Grantley harbour. In the course of time, however, sand and gravel filled in the outlet and the tidal zone at both ends, and by evaporation the lagoon became a more limited lake, still, however, retaining in its deeper water layers and in the organisms (diatoms, etc.) inhabiting it, traces of its marine origin. The Grantley harbour side is now represented by a swamp and gravelly or sandy tundra plains, the Port Clarence side by a considerably higher gravel ridge with sand-dune and tundra vegetation, merging into the present beach on one side, and on the other into the tundra swamp surrounding the lake. In this tundra swamp are situated a couple of ponds or deep waterholes, and the brackish pond examined is one of these. On two sides the large lake is surrounded by higher tundra falling off in "bluffs" to the lake itself or to the gravel and sandy mud along its margin. The depth of the lake is unknown, but from my observations I believe it does not exceed 3 fathoms and is probably nearer two. A rich vegetation of *Carex, Eriophorum, Hippuris,* mosses, etc., grows along the sides and out into the lake, and at such places the shallow water with its sandy mud or gravel bottom occupies a large part of the lake.

The examination of the plankton and bottom sample secured in this lake indicates that the deeper part of it, say below one fathom, is probably brackish and contains marine organisms, though the surface-water seemed quite fresh. The conditions in this lake are probably very similar to those of the one at Bernard harbour (see p. 16N), though both its elevation and depth are probably less; the distance from the beach is also less (about 300 feet). In addition to a number of insects, larvæ, etc., *Lepidurus arcticus* and other Entomostraca were secured in the marginal water of this lake.

The deepest of the ponds situated in the tundra swamp mentioned above was judged to be about one fathom deep, and it contained practically no shallow, marginal water, but an exceedingly rich vegetation of submerged *Myriophyllum,* etc., all around and in it. Its water was distinctly brackish to the taste, and

[1] See Plate IV., Commander Trollope's chart of 1854; Beechey's narrative, Part II., pp. 531–60, etc.

Mr. C. W. Lowe reports[1] that it contains many marine as well as freshwater diatoms. Its invertebrate animal life was unusually rich, both insects (hemiptera, diptera and coleoptera), worms (oligochaeta[2] and turbellaria), snails (*Aplexa hypnorum*), amphipods (*Synurella johanseni*) and a great number of copepods (*Eurytemora* sp.), ostracods,[3] and cladocera (*Daphnia pulex* f. *aestivalis*, *Chydorus sphaericus*, and *Eurycercus glacialis*). Being brown and numerous the last named large cladoceron was easily the most conspicuous invertebrate inhabiting the pond; it was noticed swimming freely in the water, "rowing" with its antennæ and foliaceous legs from one part of the mossy brink to another and occasionally hooking itself on to the vegetation by its large abdominal claw. In this pond male *Polyartemiella hazeni* were also secured.

The brackish character of the lake and pond may be explained thus:—

(1) The surrounding soil is a raised and augmented sea-beach still containing much saline matter; (2) the pond and lake are sufficiently deep to allow the more salty and heavier water to remain below all the year round; and (3) this bottom water does not freeze at all and later in the summer (middle or end of July) most of the melting water in the shallow places above evaporates or runs off through the swamp to Grantley harbour, and so has little influence in freshening the more salty water below. As the maximum thickness of lake-ice along this coast is about seven feet we may suppose that the deepest part of the lake in question (say more than nine feet) does not freeze to the bottom during the winter (though the ponds do); and thus the organisms found in this more salty bottom-water of the lake, can live there all year round, supposing the life-cycle of each species allows it. The reason the surface-water in the lake apparently is fresh, but that in the pond brackish is probably because of the very limited extent of the latter, its lack of outlet, and the strong influence of the saline soil surrounding it, therefore more briny character of its water.

The ponds on the higher tundra (see p. 3) had the usual character of more shallow tundra ponds with rich vegetation of mosses, *Carex*, *Eriophorum*, *Hippuris*, *Utricularia*, etc., about and in them. The invertebrate life was very rich and consisted in addition to insects, etc. (see above) of the following Crustacea: hundreds of dark brown, smaller amphipods (*Synurella johanseni*), the most typical and conspicuous invertebrate in them; cladocera (*Daphnia pulex*, and *D. longispina*), and branchipods (female *Polyartemiella hazeni*).

Regarding the influence of the seasonal weather at Port Clarence we know from the narratives by Captain Beechey of the "*Blossom*" and others[4] that the ponds and lakes at Port Clarence freeze over during September; from November on they are frozen to the bottom and the ground is covered with snow. The snow and ice then begin to melt away in May; and during the summer considerably more rain falls than on the coast north of Bering strait. The range of the average temperature during the year is from about 25° to 50° F.

II.—Coast East of Point Barrow.

The first snow in the fall comes between the middle and end of September, but on occasional mild days it may melt away in the sun at noon, so that it is often October and later before the land is well covered with snow. The ground is frozen from the surface down from the middle or end of September; new ice covers the ponds and lagoons (about one foot thick in

[1] Report Canad. Arct. Exped., 1913-18, Vol. IV, Part A.
[2] See Vol. IX. Part A, of this series of reports.
[3] The Ostracoda secured during the Canadian Arctic Expedition have not yet been identified.
[4] A. H. Brooks: Geography and Geology of Alaska, Washington, 1906 (Prof. Paper, No. 45, U.S.G.S.)

the middle of October)[1], and the sea generally freezes over rather suddenly about the middle or end of September, though open water lanes may be seen offshore here and there all winter.

The appearance of the ponds, lakes and lagoons upon the coastal plain of Arctic Alaska is practically the same everywhere all the way to the Mackenzie delta, and the accompanying photographs (Plate I) show them better than many words.[2] Nearest the beach the low, gravelly or tundra-coast often forms smaller or larger lagoons more or less connected with the sea. Where the water from the latter has access to the lagoon at high tide, it contains neither phyllopoda nor cladocera, though copepoda, fish fry and certain insect forms are found; but when it is really a beach-pond separated from the sea by drift-wood, sand, and gravel sometimes with vegetation it contains at least some of the other Crustacea too. In all cases the water is more or less brackish. The lagoons and beach ponds examined in June, 1914, at Martin point and in Camden bay (Konganevik and Collinson point), Alaska, are typical in regard to this.

At Martin point the investigations were made at the end of July[3] and all the lagoons and beach ponds seen there although extensive were very shallow (maximum depth of six inches). One lagoon pond had a water temperature of 52° F. at 3 p.m. (air 34° F.), on July 28. Its bottom was black, sandy mud, overlaid by a layer of light brown detritus mud and with loosely lying masses of green filamentous algae, etc. The macroscopic life consisted of a great many fry of the sculpin *Oncocottus quadricornis*, red *Chironomus* larvae[4] in their mud-tubes, and various copepods (*Eurytemora* sp., and *Canthocamptus* sp.,) besides collembola and small diptera on the surface. Even the lagoons that were connected with the sea at high tide had this same animal life. Another lagoon pond had more the character of a true beach pond. Its water temperature was 51° F. at 10 a.m. (air 32° F.) on July 26, and the bottom consisted of gravel, sand and, especially on the deeper places, fine light brown detritus mud, such as is usually formed by the *Chironomus* tubes and excrements. The insect life consisted of the usual collembola and small diptera upon the surface, and dytiscid beetles and larvæ besides small dipterous larvæ in the water. Far more conspicuous and interesting, however, were the freshwater crustaceans it contained. Besides the usual copepods (see above) I noticed and collected a great many *Daphnia pulex* of different sizes (see Report of Canadian Arctic Expedition, Vol. VII, Part H), besides the two characteristic arctic phyllopods, *Lepidurus arcticus* and *Branchinecta paludosa*. The former were making their familiar, winding tracks in the mud bottom, buried at the one end, or "browsing" immediately above it. In size they were from 8 to 18 mm. long (excluding the cercopods), thus probably representing both this and the preceding year's brood; all were females. Swimming around in the water were also fairy shrimps (*Branchinecta paludosa*) of both sexes from 1½ to 2 cm. in length; they were extremely active, swimming briskly around and trying to bury themselves in the mud, as I fished for them. The females carried ripe eggs and had much more brilliant colours than the paler males.

Similar shallow lagoons and beach ponds cut off from the stream-outlets by sandbars and partly dried up, and with stagnant and brackish water, were noticed at Konganevik in Camden bay in the end of June, 1914, but I found no Entomostraca in them, though they contained fish fry[5] and the usual insect life

[1] On September 20, 1913, this ice was six inches thick. (Observations at Collinson point.)

[2] See also Plate VI. in Brooks: Geography and Geology of Alaska (1906); Plate II. in Schrader and Peters: Reconnaissance in Northern Alaska, Washington, 1904, (Prof. Paper, No. 20, U.S.G.S.); Plates III.-V. in Leffingwell: Canning River Region Northern Alaska, Washington, 1919, (Prof. Paper, No. 109, U.S.G.S.); and the marine charts published by the British Admirality and the U.S. Hydrographic Office (also Alaska-Yukon Boundary Survey Map.)

[3] In this report "Beginning" of a month means 1st to 10th.
" " "Middle" " " 11th to 20th.
" " "End" " " 21st to 30th (31).

[4] For aquatic insects see Vol. III of this series of reports.

[5] *Oncocottus quadricornis*.

(collembola, dipterous larvæ, dytiscids, etc.). Interesting, however, was the occurrence of *Mesidothea entomon* in a deep pool in the outlet from the large lake here to the sea, as recorded in the report upon the Isopods collected during the expedition (Vol. VII, Part D, p. 21). Apparently these crustacea had reached the pool, which had fresh water, when it was connected temporarily with the sea at high tide. In this connection it is also of interest to observe, that the common marine littoral amphipod (*Gammarus locusta*) in the parts of the arctic coast investigated, as well as along the coasts of both the New and the Old World, at high tide often ascends to lagoons and outlets of rivers or brooks; and when left there by the sea receding, seems to thrive well, and thus may be termed a brackish water form, though not so typical a freshwater species as *Gammarus limnaeus* and *Synurella johanseni*.

There is an extensive salt water bight, separated from the harbour by two sandbars and a very shallow (1-2 feet) entrance, at Collinson point in Camden bay. The water in this lagoon is, however, deep enough to permit of the existence in it of true marine fishes and invertebrates, some at least belonging to littoral and planktonic forms; that is to say individuals which happen to get in through the entrance, which is almost dry at low tide. I have observed many times how effective is the renewal of marine life in this lagoon bight; even large *Mesidothea* being whirled out or more often in at the changing of the tides. The maximum depth of this lagoon bight does not reach one fathom, and it begins to freeze over considerably earlier (middle of September, 1913), than the bay or ocean outside. It freezes solidly to the bottom during the winter, and melts again next June. No freshwater streams, apart from melting snow in May-June, enter this lagoon bight, and it contained no freshwater life.[1]

No true lagoons are found at Collinson point proper, but several "beach ponds" occur. As is the case both east and west of this place a great amount of driftwood has been washed up on the beach (or former beaches), and together with the sand or gravel upon which it rests it bars the access of the sea or streams to these waterholes or ponds, which owe their origin mainly to snow accumulations and diffusion from the surrounding soil. Such a typical beach pond was investigated at Collinson point on June 22, 1914. The bottom was very uneven, owing to its being filled up with driftwood, which also surrounded it on all sides. Some parts of it were quite or nearly dried up; other parts were deeper, but I doubt if there is any water at all in it during the latter part of the summer (August). So it may perhaps better be termed a waterhole. The water in it was slightly brackish, and where exposed to the sun it had a temperature of 50° F. (air 41° F.), at 5.30 p.m. Vegetation (grass, mosses, etc.) was found in parts of the pond, but its sides and bottom were mostly made up of brown mud (organic detritus) and driftwood. On that day (June 22) this waterhole was swarming with thousands of young fairy-shrimps (*Branchinecta paludosa*) now in the metanauplii stages, and especially congregating in the muddy, sun baked parts of the pond. In addition a great number of *Chironomus* larvæ in their mud tubes were attached to the submerged driftwood or moved over the bottom; but otherwise the pond had little life. The same species of fairy-shrimps were also found to be numerous in a still smaller waterhole, the remnant of a dried up lagoon pond, near the beach and on the same level a little west of the beach pond described above, on July 11, when the temperature of the water in this small hole was 58° F. at 6 p.m.; This phyllopod was not found in other ponds or waterholes at Collinson point, and *Lepidurus arcticus* in none. Mr. Jenness brought me, however, a few specimens of both these species, *Lepidurus* collected on June 7, 1914, and *Branchinecta* July 17, 1914, in pools on Barter island, which may be said to form the eastern end of Camden bay, and is only a short distance from Martin point. In the middle of July the two waterholes at Collinson point mentioned

[1] See Plate V., on meridian of 144° 50′ W. longitude.

above were much diminished in size and would plainly contain no water at all at the end of the month. Unfortunately I did not ascertain this and what became of the fairy-shrimps they contained, because we sailed eastward shortly afterwards (July 24).

The typical tundra ponds or lakes are very much the same all along the arctic coast of northwest America, so it is not necessary to describe them, at any definite locality of the coast west of Mackenzie river, except on Herschel island (see later). In contrast to the beach ponds and lagoons they do not depend to any extent upon the configuration of the coastline of each particular place, because they are generally found only at a certain distance inland. There are, however, often ponds which represent a transition stage between the beach ponds or lagoons and the true tundra ponds; and such ponds are perhaps more likely than the freshwater bodies farther inland to contain Phyllopods. The photographs taken of the ponds along this coast during the expedition give a better idea of their appearance than many words of description.[1]

Those of the tundra ponds which contain water all the year round, are frozen to the bottom, unless they are more than one fathom deep, during the winter, and are generally covered with a deep layer of snow, except where the wind has removed this from spots on the ice surface. In the beginning of May (observations from Demarcation point, 1914), the power of the sun on clear, calm and warm days is so great that the ice in the very shallow ponds begins to melt, and the dark mud bottom to thaw, though the temperature of the strata (ice, mud bottom, dead leaves, etc.) on May 4 was only from 32° to 32.5° F. (air 29.5° F.), and the ground was still frozen solidly. Large hibernating, dipterous larvæ were then found in some of these ponds. The further melting of the shallow ponds at Demarcation point in 1914 was delayed until the middle of the month of May, owing to more wintry weather and cold nights, and none of the deeper ponds or lakes showed any signs of melting. On May 16 there was only a light snow layer on the tundra, and some of the shallow ponds were quite free of snow or ice, others only partly so, and often communicating with the melting water in the surrounding swamps. Their water had a temperature of 35° F. at 7.30 p.m. (air 29° F.). Then followed several days of colder weather, forming new ice on the melted ponds and snow upon the tundra, which, however, soon melted away.[2] Besides the dipterous larvæ mentioned above a number of other aquatic insects (other diptera, collembola, dytiscids, etc.), snails (*Aplexa hypnorum*),[3] etc., were now found in the ponds. My observations for the period from the end of May to the middle of July, 1914, are in Camden bay (Collinson point and Konganevik).

On May 26 the tundra was almost impassable owing to soft or melted snow, though the vegetation and invertebrate animal life had not yet progressed much in development, and the rivers were breaking up. On the last day of the month the tundra still looked wintry, and the vegetation was far behind. The deeper ponds were mostly melted, but had ice at their bottoms for long stretches or were partly covered with ice, the latter reaching to the bottom. The overflow from the melted snow assembled in temporary pools and streams, while the higher parts of the tundra still had much snow. There were, however, large, bare stretches, especially nearest the coast. I consider it very possible, that the cold and cloudy weather at the end of May and beginning of June, 1914, delayed the arrival of the spring (summer) that year beyond the normal. The vegetable and animal life of the freshwater ponds, even if these were only partly melted, however, progressed well, as proved by the number of dipterous larvæ and imagines, copepods, (*Cyclops magnus* and *C. vicinus*)

[1] See Plate IV in Vol. III, Part K of these reports.
[2] On May 21 the thermometer stuck into the mud of a shallow pond (water about one inch deep) showed 55.5° F. at 5 p.m. (Air about 35° F.), which indicates how warm the water in these ponds can become even so early in the spring.
[3] See Vol. VIII., Part A, this series of reports.

dytiscids, trichopterous larvæ, water mites, snails (*Aplexa hypnorum*), oligochaete worms (*Lumbriculus* sp.), protozoa, etc., which were secured in the beginning of June from them. From the middle of June most of the tundra ponds are free of ice, except where this is found in the bottom of the deepest ones, and contain a rich animal life. Thus a partly dried-up pond surrounded by swamp on the coastal tundra at Collinson point had a water temperature at 10 a.m. of 53° F. (air 40° F.), and contained a number of mosquito larvæ, hemiptera, water mites and dipterous imagines.

Another pond situated on the tundra at Konganevik also contained some bright red *Hydra* species[1] attached to the water plants, when examined at the end of June; its marginal water had a temperature of 54° F. at 2 a.m. on June 27 (air about 30° F.).

When I reached Konganevik (June 25) the smaller tundra ponds on the costal plain were already dried up or nearly so (steaming), while the large inland lakes were only partly melted and had ice in their middle and deeper water-layers. There are half a dozen of these large lakes, situated about a mile inland and surrounded by extensive swamps with many ponds through which an outlet[2] finds its way to the sea (see p. 6N), at their eastern end. Their general direction is east and west, paralleling the coast; and while tundra bluffs face them for longer stretches on their north and south sides, the low land surrounding and separating them from the sea at their east and west side indicates that they represent a former sound found here at a time when the coast had a lesser elevation. I could not then ascertain their depths; but it is possible they contain salt water in their deeper layers. Their general appearance is well shown by the photograph that is given (Plate I, fig. 1); it will be seen that a rich vegetation of Cyperaceae, etc., extended far out into them, thus indicating a broad belt of shallow, marginal water. In this latter I secured a great number of invertebrates, including many insects (perlids, trichoptera, diptera, dytiscids, etc.), water mites, copepods (*Cyclops capillatus*), "winter eggs" of *Daphnia pulex*, snails (*Aplexa*), oligochaete worms (*Lumbriculus*), etc.

In the beginning of July many of the ponds or brooks containing melting water are dried up completely or only have a small waterhole in the deeper part of the bed, while the deeper ponds are ice-free, and the melting of the ice in the large lakes progresses rapidly. The large creeks and rivers contain far less water than earlier in the summer. The animal life inhabiting the bodies of freshwater is much the same all the time, but at the beginning of July is supplemented by the young Cladocera (*Daphnia pulex*) which hatch several weeks after the nauplii of the fairy shrimps (*Branchinecta paludosa*) emerge from the eggs (see p. 6N).[3]

In the beginning of August I had the opportunity of examining a part of Icy reef, which stretches along the coast between Martin point and Demarcation point. The reef or sandspit is broader and longer than the spits forming Martin point and its gravelly places are larger and composed of bigger stone fragments, and the vegetation is far better developed. As is the case everywhere else along this coast much driftwood is scattered around, filling up smaller bays or bights on the south side, where also occur marshes, the latter often continued out into the shallow sound or lagoon separating the reef from the mainland. The sandspit also contained several closed-in lagoon ponds or beach ponds, mostly dried up, and containing so far as I observed not nearly so varied and rich a life as those at Martin point. No phyllopods were seen.

Herschel island reaches an elevation of 558 feet and represents a tundra island wholly made up of sand, mud, clay and a few boulders, while the ground-ice crops out here and there and may help supply some of the smaller creeks with

[1] See Vol. VIII., Part I, (Hydroids) in this series of reports.
[2] Shallow swamp in its upper course and deep tundra holes in its lower course.
[3] The less conspicuous and common nauplii of *Lepidurus arcticus* probably also hatch in the middle or end of June.

water. The island, according to O'Neill,[1] may perhaps be considered a raised delta formation, and is mostly well covered with a luxurious vegetation, except on the steep northern side and on the higher hills. Half a dozen ponds are scattered over the island from the beach to its highest elevation; they are sometimes deep, and mostly situated in the swamps which form the upper part of the creek-gullies, on the divide between the streams flowing north and south on the island.[2] They are therefore generally much filled with vegetation (grasses, *Carex, Hippuris*, etc.). I examined several of them in July-August, 1914 and 1916. The smaller ones had a teeming life of aquatic insects, water mites, snails (*Aplexa hypnorum*), cladocera (*Daphnia pulex* and *Eurycercus glacialis*), copepods (*Eurytemora, Diaptomus, Heterocope*), turbellaria, etc.; while the larger ponds contained the common phyllopods (*Branchinecta paludosa*), of both sexes and unusually large (over 2 inches long), and certain of the largest ponds a number of the arctic freshwater amphipods (*Gammarus limnaeus*). It was interesting to note the extremely rich and varied invertebrate[3] life in the various ponds upon this island; water birds visiting it from the mainland during the summer have perhaps something to do with this.

III. *Vicinity of Bernard harbour, N.W.T.*

It is fortunate that we have for this area a detailed topographical map (scale 2,000 feet to the inch) made by Messrs. Chipman and Cox of the southern party of the Canadian Arctic Expedition during 1914-16.[4] The map takes in the coast from the 2nd point (peninsula) northwest of our winter-quarters, to the coast and small island opposite the east end of Chantry island, including the latter. The map also shows the topography of the country inland for some miles, immediately east and south of the station, including the eastern parts of the two large lakes up the valley with the large creek (see below). The three largest lakes were sounded, also the sounds and bays between Chantry island and the mainland coast, from the inner harbour at the station to the bay in which the large "fishing creek" about four miles southeast of the station comes out.

The smaller pools and ponds, generally formed by the melting of the snow in the spring, are illustrated in Plate IX, Part K, Vol. III; Plate III, Part A, Vol. IV; Plate V, Part J, Vol. VII; and Plate IV, Part E, Vol. VIII of these reports; a few more are reproduced here. (Plate II).

When the warm weather comes in earnest (May-June) much melting water is formed from the snow and accumulates in the many depressions on the snow-free part of the tundra. Soon the overflow finds its way to the sea or helps to increase the size of the various ponds and lakes, as the ice of these melts from the margin out. The small, shallow ponds become free of ice about the middle of June, and in the first days of the next month the rivers and larger creeks have broken up, and the deeper ponds are free of ice.[5] By the middle of July the ice on the large lakes had been carried out to sea through their creek outlets, or had been dissolved in the lakes. As the land was now practically free of snow the heavy flow of water down the slopes had stopped, which fact, coupled with the lack of further overflow of the various ponds and lakes, makes these attain their maximum size at this time of the year, and decrease from now on, under the influence of the warm weather in the latter half of July and in August. The freezing of the ponds and lakes depends very much upon what time in the fall the winter weather sets in permanently; some times it takes place as early as the beginning or middle of September; in other

[1] Summary Report Geol. Surv. Canada, 1915, p. 236.
[2] See Plate I, fig. 2.
[3] Particularly crustacea.
[4] Plate VI.
[5] Except for a layer in their bottoms.

years not until a month later. During the winter the freshwater ice may attain a thickness of almost ten feet, from which it follows that all the ponds and lakes shallower than that freeze to the bottom. Owing to their size, currents and the influence of the winds the large deeper lakes do not freeze over permanently until a week or two after the ponds. As the large creeks forming the outlets are all shallow in this vicinity, they also quickly freeze to the bottom. It should be remembered however, that occasional low temperatures, generally at nights, both in the spring and the fall cause the surface of ponds and of the more quiet bights of the lakes to be covered with new ice which may, or may not, according to succeeding temperatures, melt away the same year.

To illustrate these general remarks about the influence of the weather upon the freshwater bodies the following field observations may be of interest.

May 22, 1915, was clear and unusually warm (from 24° to 62° F.). The melting snow formed temporary, stagnant, small pools, both on the sea ice, where there were accumulations of sand, and upon land. The largest of these pools was found in a depression on top of a ridge; it had free water six by two feet wide. The two big lakes inland west of the station had the snow upon their ice melted away at many places, but no water was to be seen. The different ponds at the harbour were all covered by snow.

About the same date next year the spring was more advanced. Thus on May 21 the weather was clear and warm (max. temp. 59° F.). Thermometer lying in a water accumulation (melted snow, dark bottom) on the tundra showed 54° F., while the air was only 43° F. (noon). Even on the lowland (tundra or swamp) the snow was disappearing fast; there were many and extensive melting ponds on top of the lake ice, and the latter was soft and wet. Much melting water was coming down in the big creek, and also in smaller, temporary streams.

May 24, 1915, was clear or cloudy, with temperatures from 20° to 45° F. Where there were, on land or on the sea ice, accumulations on top of the snow, the snow had melted, forming a hole with the sand in the bottom; the snow protruding as an icy brim over the north side of the hole, while the south side was open, and gently sloping outwards. At the bottom of such a hole upon the land the thermometer showed, when sheltered from the wind, 33·5° F., at noon, while the air was 27·3° F. Another stretch close by had the snow melted away to a considerable extent, so that the bare tundra was exposed, showing stagnant melting water pools in the depressions. This melting water had at noon a temperature of 48·8° F. (thermometer lying in the bottom), while the bare ground around it (thermometer lying on the ground) was 50° F.

On the last day of May, 1916, the land was all free of snow, except for patches upon the slopes. All the ponds at the harbour were also free of ice (apart from new ice formed at night) and snow, and had their maximum extension. The big lake in the valley west of the station was still covered with ice in its southern part, while the north part was open, with the water streaming to the outlet, along which cakes of ice were carried down to the sea.

On June 16, 1915, one of the ridges at the harbour was largely free of snow even upon its north side; and about half way to the top a broad terrace showed melting water in the depressions in the form of temporary smaller ponds or water-holes with gravel bottom. On the swamp below, south of the ridge, a few of the true tundra ponds with detritus mud bottoms were open, and there was stagnant water in the other depressions. The swamp itself was now mostly free of snow, but the mud flats through which it merges into the sandy beach, only partly so. The ponds now drained off through several small temporary streams to the bay. Two days later the snow was melting rapidly, and the small streams coming down the slopes formed temporary pools here and there, and merged into lakes or creeks. The thermometer lying upon the bottom of such a pool showed 56° F., in flowing melting water close by 37·7° F., and on melting snow here 33·8° F., at 3 p.m. In the larger, more stationary pond upon the swamp west of the house the snow had not yet melted from its higher north side. Thermometer lying in the shallow (about one inch deep) water here showed 48·8° F., while the air was 35° F. (5 p.m.). This pond has no greater depth than one half foot, and its bottom consists of brown organic detritus mud and algae.

Walking inland from the station five days later it was somewhat difficult to get past the many water holes, ponds and streams upon the low, swampy tundra. The ground was now practically free of snow, only a little still remaining upon the slopes of higher hills (ridges), and on the larger lakes, which were only partly melted. The whole lower country was one vast swamp, with an immense amount of streaming or stationary melting water, connecting and extending the lakes and ponds, often running under the snow, or digging canals through it. The smaller ponds were all free of ice, but the larger ones had often patches of ice in their bottoms, or the ice still covered their surface at one end. The larger lakes showed no open water, apart from certain places where streams of melting water came down; so that a belt of free marginal water, corresponding in size to that of the brook, was formed. Apart from these places, over the rest of the lake, the ice was still thick, but had many cracks; and (where it was not covered by soft and wet snow) was honeycombed (ruffled), and had many melting pools upon the surface.

In the middle of July, 1915, the big lake west of the station was free of ice, apart from a little in its west end. Only the bigger creeks had water, the temporary streams on slopes and tundra and also the swamps having dried up. Lakes and ponds were much diminished in size, by their having dried up along the margin, and apart from the big lakes (especially inland) which still had quite a little ice in their middle, were quite ice-free.

It will be seen that the spring came earlier in 1916 than in 1915. Thus while the big lake southwest of the station a week into June, 1916, had open water only along its shore, at the east end, all the three big lakes at the harbour were free of ice 3-4 weeks later the same year, a fortnight earlier than in 1915.

In the first week of August, 1915, many of the shallower ponds at the harbour had dried up, and the smaller lakes also were much reduced in size, by evaporation. The large creek at the harbour only contained water in the form of pools here and there, at the deeper places, or as streams intersecting the gravel bed and swamps.

While no Notostraca (Apodidae) were observed in the ponds I examined on Chantry island, fairy shrimps were found there (June 17, 1916), in the shape of nauplii and metanauplii of the common, circumpolar form, *Branchinecta paludosa.* They occurred in several ponds on the lower parts of the west end of the island (probably also in the other ponds) and in sufficient numbers to warrant the belief, that their presence upon this island was not accidental. As none of the islands between Chantry island and the mainland contain any ponds, no Entomostraca were found on them.

On the mainland here Notostraca (*Lepidurus arcticus*) was only observed in certain large ponds or lakes, but two species of Anostraca were found. One of these (*Artemiposis stefanssoni*) I observed at only one place, namely the three large ponds[1] on top of the ridge southwest of the station. The metanauplii were found here on July 3, 1916, while copulating males and females were observed and collected in the same ponds on October 6 in the preceding year. The other branchipod was *Branchinecta paludosa.* It was observed to be common, also, in certain of the large ponds or smaller lakes inland, particularly in shallow ponds in the valley of the large creek and on the adjoining slopes. Some of these ponds dried up completely during the summer, others almost completely; it is therefore perhaps small wonder that this species of fairy shrimps

[1] Elevation about 100 feet, one foot deep; became free of ice in the end of June.

was not observed in the locality in question from September to May inclusive. The growth of *Branchinecta paludosa* from the nauplius to the mature male or female is sufficiently rapid (about a month) to allow the species to deposit the fertilized eggs before the complete drying up of the pond in which it is found, and long before its freezing up later in the fall.

While the shallow ponds at Bernard harbour are very similar to the others occurring all along the arctic coast the small, brackish pond on the south side of the outlet of the large creek just west of the station presents some peculiar and interesting features. The pond is situated on gravel and sand flats at only a few feet elevation and surrounded by vegetation composed almost exclusively of a minute *Carex* (*C. subspathacea*). When the snow is melting rapidly it receives some additional freshwater from the slopes behind, and the overflow has excavated a fairly deep and wide channel between the pond and the beach nearby. During the summer and until the snow falls the outline of the pond is however well defined (see Plate II). The pond consists of a deeper (up to one fathom) hole in the middle, bottomed with a thick layer of black, stinking mud, and very shallow (a few inches deep) marginal water, extensive in the early summer, but rapidly drying up under the influence of the sun later. It contains a rich animal life, composed of Entomostraca (*Branchinecta paludosa, Daphnia pulex* and copepods), aquatic insects, etc., more or less restricted to the masses of green filamentous algae found in the water. The bottom of the marginal water area of the pond is covered with light brown detritus mud.[1]

It has been mentioned above, that the brackish nature of the water in this pond had little influence upon its content of invertebrates; this is further emphasized by my finding the same Entomostraca, etc. (except *Daphnia pulex*), in a much smaller, shallow, brackish pool near the coast a little further west and north in the middle of July, 1916. The saline nature of the water in this latter pool was shown by its taste and the presence of certain marine algae (Fam. Ulvaceae), besides the common green filamentous algae, typical of freshwater. In this case the distance from the beach was so insignificant, and the pool so small and shallow, that its formation is to be attributed to a slight, and fairly recent, raising of the sea shore.

The three larger lakes situated west and south of our winter quarters at Bernard harbour have already been referred to. The two most westerly ones of these are the biggest, though only their east ends are shown on the detail map. The most northerly is situated about 35 feet above sea level some distance inland, and has an outlet to the sea through the large creek already mentioned. Another creek flows into the south side of the lake, carrying the overflow from the lakes and ponds situated inland there, and probably also from the west end of the large lake described just below. The large lake in question may be considered merely a widening of the creek coming into and out from it, and is almost entirely surrounded by swampy tundra, thus resting in an extensive valley, bounded here and there by low ridges. In the beginning of October, 1915, I took a number of soundings from the 9-10 inches thick fall ice across the middle of the lake, from the big boulder near its south shore to a grassy point opposite, on the north shore. The result is given in the following table (maximum depth in italics):—

(1)	$13\frac{1}{2}$ inches water....................	Bottom brown sand
(2)	$20\frac{1}{2}$ " "	" "
(3)	24 " "	" "
(4)	21 " "	" "
(5)	20 " "	" "
(6)	18 " "	" "
(7)	19 " "	" "

[1]See Part A, Vol. IV of these reports.

(8)	17 inches water	Bottom brown sand
(9)	19 " "	" "
(10)	20 " "	" "
(11)	*30* " "	Bottom black mud, covered by brown sand.
(12)	28 " "	

Hole (1) was 25 paces from the boulder, and (12) 100 paces from the other shore; holes (1) to (9) were 25 paces apart and (9) to (12) 100 paces apart. It will thus be seen, that the maximum depth of the lake is less than three feet; and by walking along the middle of it for its whole length and being able to see the bottom through the ice all the way I definitely proved this. In spite of this there were more open water and recently frozen over lanes in the middle of the lake and near its north shore[1] on this date than in the two other large lakes mentioned below. This is probably because there is a certain amount of circulation in the large, shallow lake, until the deep part of its outlet, right at the lake, freezes to the bottom, while the two other lakes have no flowing water in their outlets in the fall. No trouts were observed in it, but sticklebacks (*Pygosteus pungitius*), snails (*Aplexa, Lymnaea, Valvata*), aquatic insects, etc., were common in this large, shallow lake.

The east end of the second big lake is also partly shown on the detail map of Bernard harbour. It lies about 65 feet above sea level, in close proximity to the large, shallow lake (at only half that elevation) mentioned above and only separated from it by a gravel ridge about 125 feet high, and in the spring emptying some of its overflow into it, through the creek mentioned before. Towards the east there is an old, forked creek bed, which in the spring carries melting water from the slopes to the sea, passing through the small brackish pond at the mouth of the large creek already described. This large lake is bounded on its west and north sides by the steep slopes of the gravel ridge just referred to, and on its south and east sides by lower tundra slopes which form a sandy beach with or without aquatic vegetation (*Carex, Juncus,* etc.) here and there (see Plate III, fig. 1). While the two other large lakes at Bernard harbour are more or less rounded-oval in outline, this one is bottle-shaped, having a long, almost cylindrical, eastern part connected with the wide, rounded, western part by a narrow sound, about 175 paces wide, about midway down the lake.

On September 23, 1915, I took a line of soundings from the ice across this narrow place with the following result (maximum depth in italics):—

(1)	45 inches water	Bottom stones and sand.
(2)	76 inches water	Bottom sandy mud.
(3)	*80* " "	Bottom as (2).
(4)	41 " "	Bottom as (1).

The ice was 7 to 9 inches thick. Hole (1) was 25 paces from the south shore hole (4) 45 paces from north shore; soundings 25 paces apart. The next day I took another line of soundings across the eastern part of the same lake, about half way between the soundings of the preceding day and the shore at the east end of the lake. The result follows (maximum depth in italics):—

(1)	63 inches water	Bottom brown sandy mud
(2)	87 " "	" "
(3)	150 " "	Bottom brown (3) or dark-green (4), (5), sandy mud with thin ice-layer and green algae. [(3)–(8)]
(4)	*160* " "	
(5)	157 " "	
(6)	151 " "	
(7)	148 " "	
(8)	100 " "	
(9)	60 " "	Stones and sand.

[1]Where the lake is deepest.

Hole (1) was 25 paces from south shore; hole (9) the same distance from north shore; holes (1) to (3) 25 paces apart; holes (3) to (7) were $12\frac{1}{2}$ paces apart; and (7) to (9) were 25 paces apart. The distance from this line of soundings to the east shore of the lake was 475 paces. The ice was 7 to 8 inches thick, but only 3 to 4 inches near the north shore.

Two days later I took a third line of soundings across the wide western part referred to above, so far as I could judge, at the place where the lake was widest hereabout, about halfway between the soundings of September 23, 1915, and the west end of the lake. I found the following depths (maximum depth in italics). The ice was $6\frac{1}{2}$ to $8\frac{1}{2}$ inches thick, at certain places only 4 inches.

(1)	44	inches water	Bottom stones and sand.
(2)	58	" "	" "
(3)	68	" "	and mud.
(4)	82	" "	Bottom brown, sandy mud.
(5)	92	" "	Bottom black, sandy mud.
(6)	95	" "	Bottom as (5).
(7)	97	" "	Bottom as (5).
(8)	100	" "	Bottom as (5).
(9)	107	" "	Bottom as (5).
(10)	120	" "	Bottom as (5).
(11)	*120*	" "	Bottom as (5).
(12)	120	" "	Bottom as (5).
(13)	113	" "	Bottom as (5).
(14)	113	" "	Bottom as (5).
(15)	109	" "	Bottom as (5).
(16)	107	" "	Bottom as (5).
(17)	106	" "	Bottom as (5).
(18)	105	" "	Bottom as (5).
(19)	99	" "	Bottom as (5).
(20)	90	" "	Bottom as (5).
(21)	77	" "	Bottom as (2).
(22)	62	" "	Bottom as (2).
(23)	40	" "	Bottom as (2).

Soundings 25 paces apart; hole (1) 25 paces from south shore; hole (23) 20 paces from north shore.

It will be seen from these three lines of soundings, that the 10 feet deep western part of the lake is separated from the (15 feet) deepest eastern part by a shoal (until $6\frac{1}{2}$ feet deep) at the narrows. Some microscopic entomostraca (cladocera, copepoda, and ostracoda), etc., were obtained by vertical hauls with a plankton net in this lake on September 26, 1915. The usual life of aquatic insects, sticklebacks, etc., was of course also found. No trout were observed or secured in this lake, though fishnets were set under the ice in the fall of 1915.

We now come to the third of the big lakes at Bernard harbour. It is situated at 16 feet elevation about 700 feet south of the bay in which the large creek, formerly referred to, comes out. Its somewhat oval shape is well shown on the detail map, and it is about $\frac{1}{2}$ mile long with a maximum width of less than half of that. A view of it is reproduced on p. 6, in Vol. VII, Part H, of these reports, from which it will be seen, that it lies in an extensive valley-plain surrounded by swamps or low tundra elevations. Only at the time of maximum snow melting does it have an outlet to the sea to the north of it; this outlet is not nearly so well defined as that from the other two large lakes mentioned, and has more the character of depressions in the swamp between the middle of the north shore of the lake and the sea, than of a creek bed. From July on it is practically dried up.

On September 28, 1915, I took two lines of soundings across this lake from the 7-8 inch thick ice. One line was laid from the north to the south shore of its western part, about 500 paces from its western shore. The depths were (maximum depth in italics):

(1)	42 inches water	Bottom few stones and light brown mud.
(2)	70 " "	(as above)
(3)	100 " "	
(4)	116 " "	Bottom a thinner layer of light brown mud above a thick layer of black mud.
(5)	144 " "	
(6)	161 " "	
(7)	193 " "	
(8)	205 " "	
(9)	218 " "	
(10)	225 " "	
(11)	228 " "	
(12)	228 " "	
(13)	228 " "	
(14)	213 " "	
(15)	177 " "	
(16)	82 " "	
(17)	58 " "	Bottom as (1)-(2).

Note.—In February, 1916, I found the water depth a little east of (12) to be *240* inches (20 feet), the maximum depth found in this lake.

Hole (1) was 25 paces from the north shore and hole (17) was 30 paces from the low stony point on the south shore. Holes (1) to (9) were 25 paces apart (9) to (17) were 12½ paces apart.

The other line of soundings was laid from the south to the north shore across the east part of the same lake, about 400 paces east of the soundings given above. The result follows (maximum depth in italics):—

(1)	33 inches water	Bottom brown sandy mud, with a few stones.
(2)	50 " "	
(3)	72 " "	
(4)	85 " "	
(5)	92 " "	
(6)	166 " "	Bottom black mud.
(7)	207 " "	
(8)	222 " "	
(9)	*223* " "	
(10)	113 " "	
(11)	69 " "	Bottom as (1)-(5).
(12)	66 " "	
(13)	64 " "	
(14)	57 " "	
(15)	50 " "	
(16)	36 " "	

Hole (1) was 25 paces from south shore; hole (16) was 20 paces from north shore; holes (1) to (4) and (12) to (16) were 25 paces apart, the rest 12½ paces apart

It will be seen from these two lines of soundings, that the maximum depth is 20 feet, and that the "deep" (say below two fathoms) lies much nearer the south than the north shore of the lake.

The ice in this lake was used for drinking purposes (see Plate III, fig. 2) and attained during the winter a thickness of almost ten feet. It was the only one of the three large lakes which contained any fish,[1] namely a number of the Red Canadian trout (*Salvelinus marstoni* Garm.) not elsewhere observed during the expedition. The fishing for them was carried on during the months of October to December, 1915, with good results, by nets set under the ice, but at Christmas the nets were taken up, because there seemed to be no more fish in the lake. A number of different invertebrates were secured by examining the stomachs of these fishes, and by vertical hauls with a plankton net through a hole in the ice at the deepest place of the lake, during the autumn, winter and spring. Temperatures of the water layers were also taken with a reversing thermometer occasionally in the same hole, and samples of the bottom kept. Besides a number of aquatic insects and water mites the waters contained of crustacea many copepods (*Eurytemora* sp., and *Cyclops strenuus*), freshwater amphipods (*Gammarus limnaeus*), and ostracods, besides cladocera. The last named order was represented by two pelagic forms, *Bosmina longirostris* and the interesting new form (*arctica*) of *Daphnia longispina* var. *hyalina* described and figured by Dr. Juday on p. 5 of Part H in this volume. Oligochaete worms (*Lumbriculus*), and still more primitive invertebrates were also secured, but the latter have not yet been worked up, except the diatoms, among which were found a number of marine "*relict*" forms, recorded by Prof. L. W. Bailey in Part B of Vol. X in this series. There is thus also definite biological evidence for the view that this lake was formerly a part of the sea. The elevation of the lake is so slight, that a rise of the sea only 16 feet would give the latter access to the lake and thoroughly mix its water layers. Though I made no analysis of the salinity of the deeper (say below two fathoms) water layers of the lake, there can be no doubt that they are saline or brackish, for the temperatures I took of the different water layers from the hole I kept open in the ice, from the fall to the spring, at the deepest part of the lake showed that while the surface layers always, during this time, had a temperature of from 32° to 33° F. the water layers at the bottom (covered by ice 6 feet thick on February 18, 1916, had temperatures of from $30\frac{1}{2}$ to $31\frac{1}{2}$ F. ($-0\cdot7°$ to $-0\cdot2°$ C.). At the latter temperature the bottom water would, if it were fresh, of course be in the form of ice.

It is an interesting fact that neither this lake nor the one at Teller (described p. 3) have any permanent outlet to the sea, and thus perhaps are better able to conserve the saline nature of their deeper water layers. In both cases their marine origin is well established by geological and biological evidence, and they are deep enough not to freeze to the bottom during the winter, and to prevent a mixing of their fresh and saline water layers, by currents and the wind. While the deep layers of the lake at Bernard harbour have their typical, pelagic life (*Daphnia longispina* var. *hyalina* and *Bosmina longirostris*), the freshwater layers of both lakes were teeming with all the varieties of invertebrates usually found in true lakes.

In June, 1915, I found the depth of a lake inland, covered by 6-7 feet of ice, to be about 15 feet. The lake was situated several miles inland southwest of our house and separated by a narrow neck of land from a similar lake, both stretching in an east to west direction (see Plate VI.). I cut holes in the ice of one of these lakes, and found it to contain, besides aquatic insects, a number of the freshwater amphipod *Gammarus limnaeus*, as well as masses of immature copepods (*Cyclops* sp.), pelagic rotifers,[2] diatoms, etc. Fish hooks were set under the ice, but no trout secured. Trout were however found in the large inland lake, from which the fishing creek east of Bernard harbour comes, and in certain other lakes some distance back from the coast. In the stomachs of the fishes (*Cristivomer namaycush*) secured from the Eskimos I found however,

[1] Apart from Sticklebacks (*Pygosteus pungitius* L.) common in all three lakes.

[2] See Part E, Vol. VIII, of these reports.

besides the common amphipods (*Gammarus limnaeus*), the two interesting marine "relicts" *Mesidothea entomon*, (end of June, 1915), and *Mysis relicta* (October 1915), proving that these crustaceans are also to be found in certain of the inland lakes. In the case of *Mysis relicta* its occurrence in these lakes is probably a case (see p. 3, Part B, in this volume) of a true "relict," from the time the lake in question was a part of the sea; in the case of *Mesidothea entomon* however I have personally observed (see p. 21-22, Part D, in this volume), that it ascends certain suitable creeks to reach a lake, though in other lakes it may be a true "relict" form. It is therefore quite possible that several others of the large lakes inland at Bernard harbour have a similar origin and under investigation will show the same character (deeper parts saline, marine elements in its fauna, etc.), as the one described on p. 14-16N.

About the lakes at Bernard harbour which have a size between the large ones described above, and the true ponds, little need to be said beyond what is given in my description of the insect life.[1] Most of them are merely enlarged ponds in their nature, and few exceed one fathom in depth. On the detail map of the harbour several of such lakes will be noticed inland, south of our winter quarters.

Perhaps the best criterion for what may be considered a lake and what a pond in this vicinity, there being all grades between them, is the presence or absence of the typical and common freshwater amphipod (*Gammarus limnaeus*), which is not found in ponds, but only in lakes and their tributaries. Here they feed upon the still smaller animals occurring pelagically (copepods and cladocera) or in the vegetation, and upon the latter itself. Their occurrence is thus an interesting contrast to the other large freshwater crustaceans (Euphyllopoda), which principally occur in ponds, lagoons or smaller lakes along the arctic coast. Thus I did not observe any fairy shrimps in the large lake described on p. 12N, but there were a great number of them in a large pond situated in the swamp surrounding this lake (July, 1915). Nor was *Lepidurus arcticus* observed in, or collected from any of the three large lakes investigated at Bernard harbour. The cold water form of fairy shrimps (*Artemiopsis stefanssoni*) may of course occur in other elevated ponds in this vicinity than the three given on p. 11N.

References.

Besides the information about certain lagoons, lakes and ponds given in this report, descriptions of other bodies of freshwater along the arctic coast of America west of longitude 110° West, with occasional references to their crustacean life, are to be found in the following accounts of earlier expeditions and reports in this series:

(1) Coast beetween Bering strait and latitude 71° North: See "Narrative of a voyage to the Pacific and Bering strait 1825-28," by Capt. F. W. Beechey, London, 1831, Part I, pp. 247-333; also Schrader and Peters, "A Reconnaissance in Northern Alaska across the Rocky Mountains, along Koyukuk, John, Anaktuvuk and Colville Rivers, and the Arctic coast to Cape Lisburne in 1901." Professional Paper 20, U.S. Geological Survey, Washington, 1904, pp. 49-50.

(2) Vicinity of Point Barrow: See "Report of the International Expedition to Point Barrow, Alaska, 1881-83," Washington, 1885, pp. 149-51.

(3) Coast between Point Barrow and International Boundary: See "The Canning River Region, Northern Alaska," by Ernest de K. Leffingwell, Professional Paper 109, U.S. Geological Survey, Washington, 1919; for rivers, ground-ice, etc.

(4) East side of Mackenzie river delta: See "Arctic Searching Expedition," 1848-49, by Sir John Richardson, London, 1852, pp. 152-54.

(5) Cape Bathurst and Young point, Northwest Territories: See Volume III, Part K, pp. 17-18, of this series.

(6) Stapylton bay to Coronation gulf and Wollaston land (Victoria island): See Volume XII, pp. 14-26, of this series.

[1]See Part K. Vol. III, of these reports.

NOTE—The six photographs reproduced in the report were all taken by the author.

PLATE I.

FIG. 1—Large freshwater lakes near Konganevik, Camden bay, Alaska. July 4, 1914.

FIG. 2—Tundra pond overgrown with *Hippuris*, *Carex*, and *Eriophorum* on Herschel island, Yukon Territory, July 29, 1916.

PLATE II.

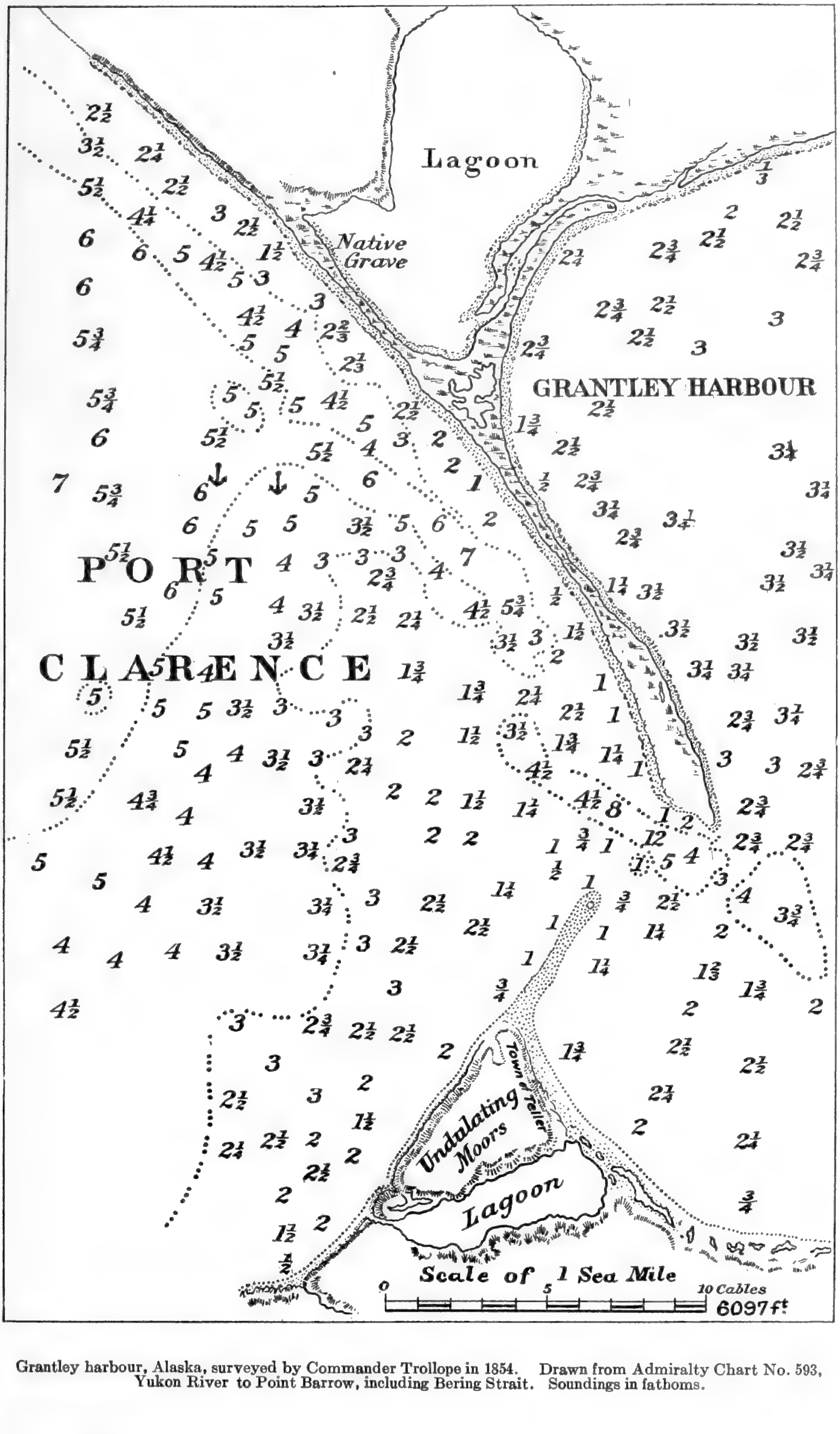
FIG 1—Tundra pond with *Carex* and *Eriophorum*, at Bernard harbour, Dolphin and Union strait, Northwest Territories August 4, 1915.

FIG 2—Brackish pond at outlet of creek at Bernard harbour. July 15, 1915.

PLATE III.

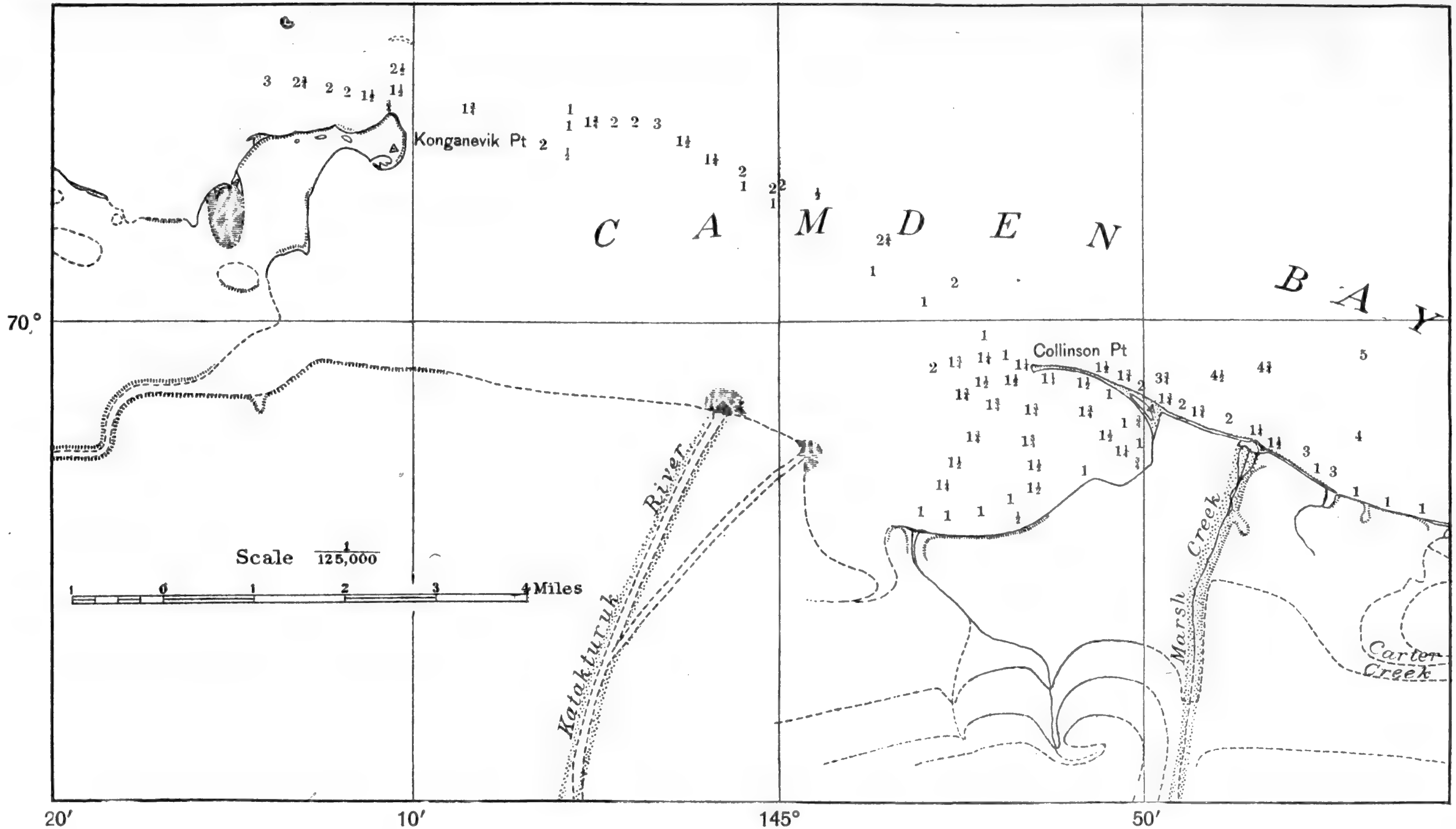
FIG. 1—East end of long, narrow, inland lake southwest of Bernard harbour, July 15, 1915.

FIG. 2—Cutting ice on the large, deep lake south of Bernard harbour, September 28, 1915



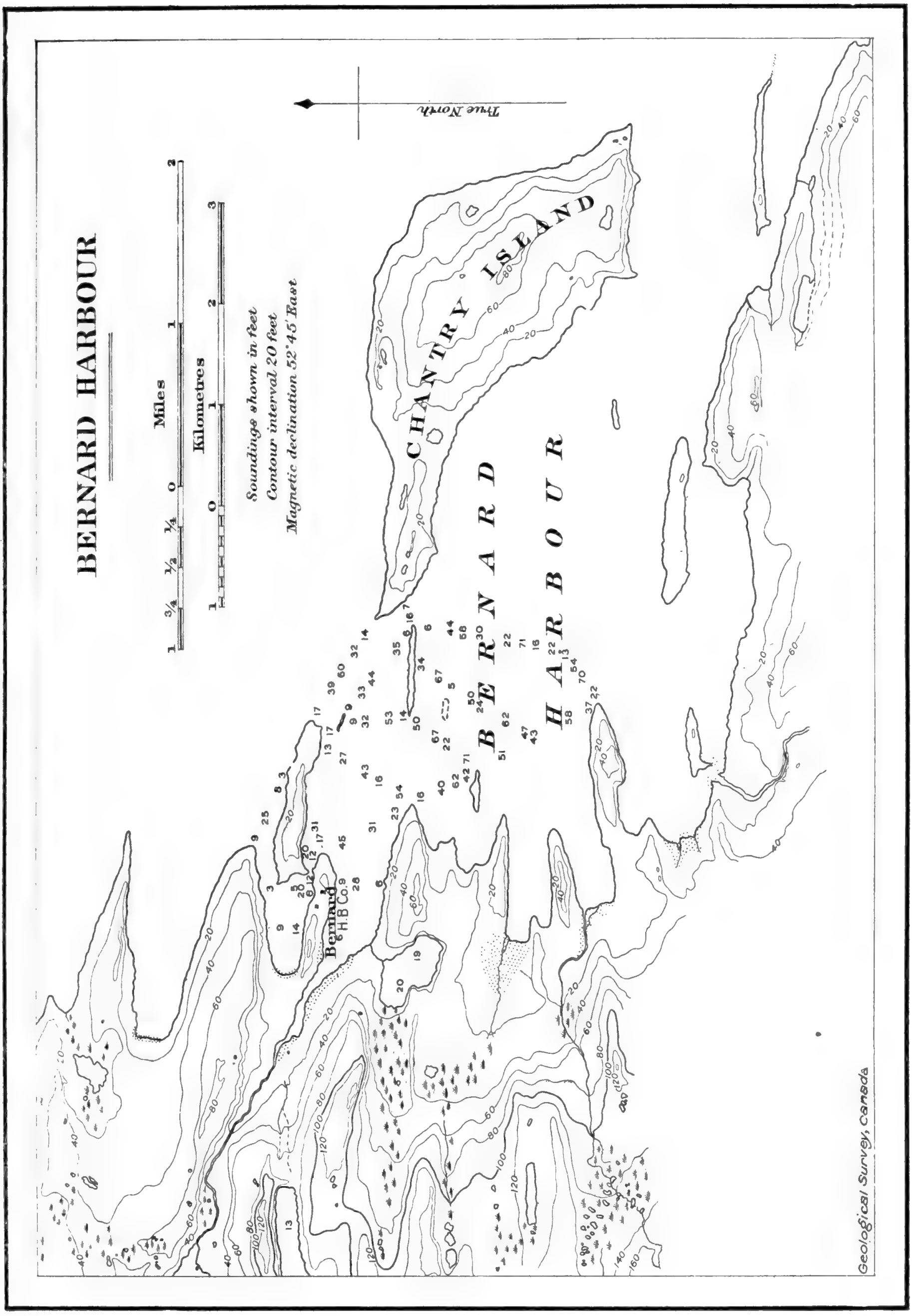
Grantley harbour, Alaska, surveyed by Commander Trollope in 1854. Drawn from Admiralty Chart No. 593, Yukon River to Point Barrow, including Bering Strait. Soundings in fathoms.

PLATE V.



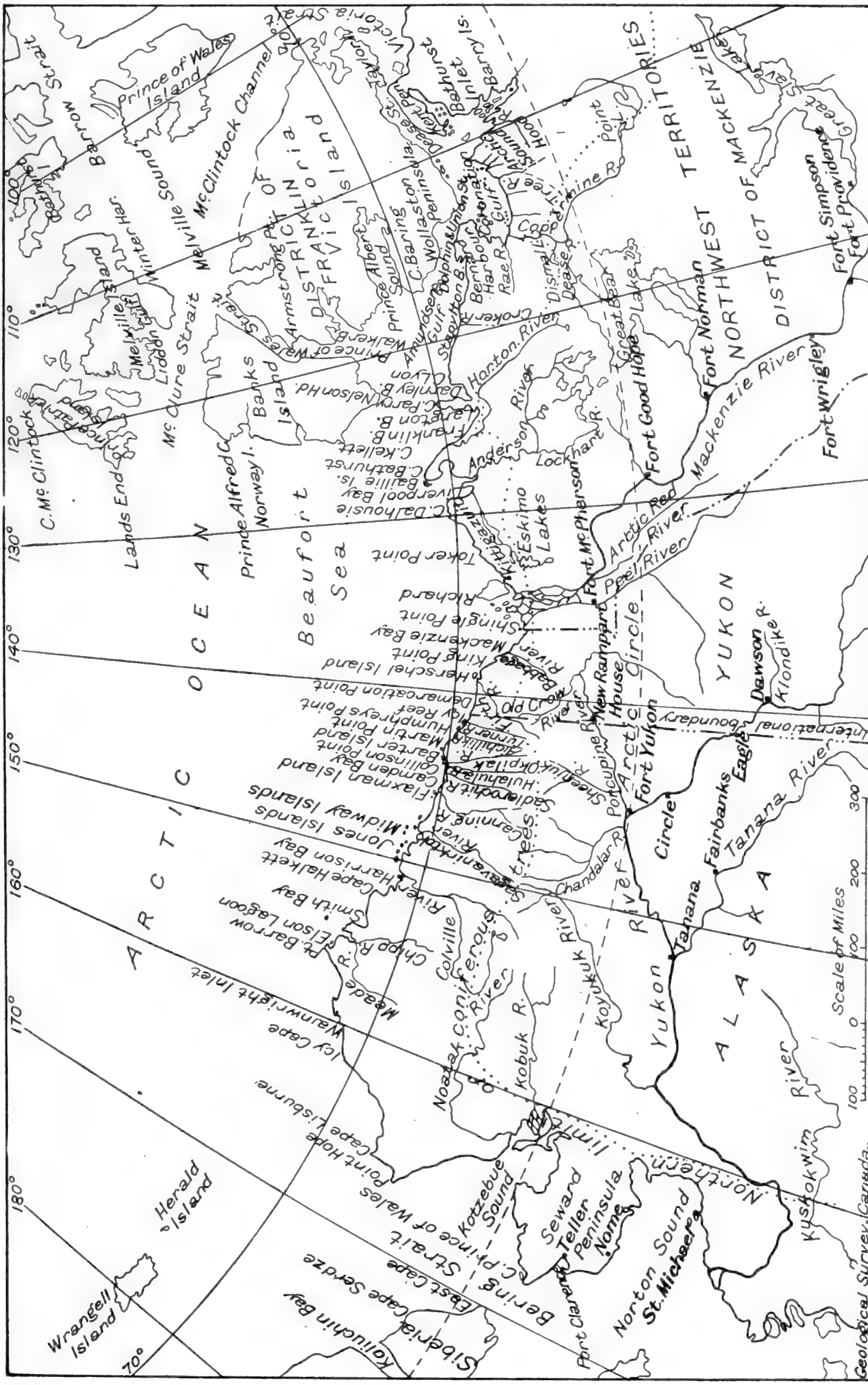
Camden bay, Arctic coast of Alaska. From Plate V, the Canning River Region, Northern Alaska, by Ernest de K. Leffingwell, Professional Paper 109, U.S. Geological Survey, Washington, 1919. Soundings shown in fathoms.

PLATE VI.



Bernard harbour, Dolphin and Union strait, Northwest Territories. Surveys by K. G. Chipman and J. R. Cox. Soundings by F. Johansen.

PLATE VII.



Western Arctic Coast of America; Canadian Arctic Expedition, 1913-1918.

Report of the Canadian Arctic Expedition, 1913-18.

VOLUME VIII: MOLLUSKS, ECHINODERMS, COELENTERATES, ETC

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Pteropoda. By W. F. Clapp.................................(*In preparation*).
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