REPORT

OF THE

CANADIAN ARCTIC EXPEDITION 1913-18

VOLUME VII: CRUSTACEA

PART K: MARINE COPEPODA

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Report on the Marine Copepoda collected during the Canadian Arctic Expedition.

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The marine copepod crustacea, collected by Mr. Frits Johansen during the Canadian Arctic Expedition from 1913 to 1916, covers a wide extent of coastline from Vancouver island to Coronation gulf in the Northwest Territories of Canada, the whole embracing an area which has been only slightly explored in regard to its micro-crustacean fauna. The comparison of this fauna with that of the Atlantic coast of North America offers remarkable similarities mingled with dissimilarities, as indeed does every other division of the North Pacific fauna. The facts discovered justify the expectation that further data will throw light upon the relation of the pelagic copepods to the currents prevailing off the west coast. These insignificant arthropods form the basis of the food-supply for pelagic fishes, especially for young fishes, whilst the littoral and bottom-dwelling species have nutritive value for the flat-fishes, either directly or indirectly.

The copepod contents of Mr. Johansen's samples were generally scanty, so that it was not always possible to indicate their percentage composition. In the present report several species are identified for the first time from the west and northwest coasts, but perhaps the most memorable marine copepod record for the entire expedition is that of *Limnocalanus grimaldii* from Collinson point, Alaska. It will be found that the collection secured by Mr. Johansen under such arduous circumstances presents several other features of interest. A notable deficiency is the absence, from all the gatherings, of *Calanus cristatus* which, according to Giesbrecht, is the most characteristic species of the Behring sea and has not been found south of that area. The explanation of its absence is to be looked for in the comparatively small number of stations made by the expedition on the voyage to the Arctic Ocean where their main objective lay.[1]

The number of copepods of the subdivision Harpacticoida taken pelagically by horizontal towing of the plankton nets at or near the surface, in water lanes amid pack-ice, or by vertical hauls through holes in the ice, makes a rather striking commentary on this collection. Just as the pelagic Calanoids make daily excursions to and from the deeper strata of water, so the benthonic or bottom-dwelling Harpacticoids evidently rise toward the surface from time to time. Only one pelagic Harpacticoid was recorded from the east coast waters during the Canadian Fisheries Expedition, 1914-15, namely, *Halithalestris croni*. This species has not yet been found on the west coast. The clear-cut specific divergence of *Danielssenia stefanssoni,* in comparison with its Siberian congener, is another point worthy of special mention.

A. Calanoida.

1. **Calanus finmarchicus** (Gunnerus, 1765).

This prolific species is common to the North Pacific, North Atlantic, and Arctic oceans. According to the latitude, season, time, depth, and proximity to land or ice, in which it may be taken, it is found associated with very different companions.

[1] Note.—Most of the macroscopic forms in the Zooplankton (Fishes, Crustacea, Annelids, Medusæ, etc.), were picked out before the samples were sent to Prof. Willey.—Frits Johansen.

Stations 18*a, c, e, f*,: 62° N., 167° 30′ W., four gatherings with net No. 3[1], towing at surface for 5, 10, and 15 minutes, preserved in one vial, July 7, 1913. The quantity was small for the time employed in towing. It may be called an *Acartia*-plankton, since that genus was in the ascendant. There were also more than one hundred young Amphipods (Hyperidea), twenty-four crab larvæ (Zoeæ), and a few fish-larvæ.

The following century of copepods, exclusive of the Acartia, was made out:—

TABLE I (STA. 18, EXCL. ACARTIA).

Calanus finmarchicus ♂, 3·75 mm	1
Pseudocalanus elongatus	5
Centropages mcmurrichi ♀	1
Eurytemora herdmani (♂ and ♀)	40
Paralabidocera amphitrites (all young)	52
Tortanus discaudatus ♀	1
	100

Station 21*a, b, c*: 68°30′ N., 166° 32′ W., temperature 45.6° F., August 15, 1913. Three gatherings of five minutes each at surface, with net No. 2[2], yielded a fairly copious plankton of small Cladocera (*Evadne* and *Podon*), Molluscan larvæ, Annelid larvæ, Medusæ, 1 crab-larva (Megalopoda), young Amphipoda and some Copepods (table II). The station lies north of Bering strait, but south of the Arctic circle. The composition of the gathering indicates current action through the narrow strait.

TABLE II (STA. 21*a, b, c*).

Calanus finmarchicus, stages IV and V	2
Pseudocalanus elongatus (chiefly ♀)	25
Centropages mcmurrichi	2
Paralabidocera amphitrites (♂ and ♀)	15
Eurytemora herdmani (chiefly ♂)	25
Eurytemora johanseni (♂ and ♀)	9
Acartia longiremis	10
Acartia clausi	10
Oithona similis	2
	100

Station 25*b, c*: off Cooper island (point Barrow), Alaska, within the Arctic circle; depth two fathoms; August 27 and 28, 1913. Two gatherings of ten minutes each with net No. 3, at surface among ice, contained some very young *Calanus*.

TABLE III (STA. 25*b, c*).

Calanus finmarchicus I	3
Calanus finmarchicus II	3
Calanus finmarchicus III	2
Calanus finmarchicus IV	2
Pseudocalanus elongatus	24
Acartia (*clausi* and *longiremis*)	60
Oithona similis	3
Harpacticus (immature)	2
Danielssenia fusiformis	1
	100

Station 27*r*: Collinson point (Camden bay), Arctic Alaska; depth 1 to 2 fathoms; October 2, 1913. A short haul with catcher[3] from one fathom to the surface, under ice ten inches thick, captured a male of *Metridia longa* in company with *C. finmarchicus* V, and young *Pseudocalanus*.

[1] This plankton net was made of coarser silk, closed at the end, nine inches wide at the mouth, twenty inches long.

[2] Full-speed net of fine silk, two inches across mouth, two feet long, with bottle at end.

[3] See footnote p. 6 K.

Station 27*t*, *u*: same locality and depth as preceding, October 4 and 5, 1913. The following assemblage (table IV) was taken through a crack in the ice, one to two feet below the surface, with net No. 3:—

TABLE IV (STA. 27*t*, *u*).

Calanus finmarchicus IV, V and ♀	10
Calanus hyperboreus IV and V	4
Pseudocalanus elongatus	54
Limnocalanus grimaldii (♂ and ♀)	10
Oithona similis	20
Oncœa conifera	2
	100

In addition there was an *Ectinosoma*, a *Pseudobradya* and an *Acartia*. The presence at this station of *Limnocalanus* is of particular interest, as will be detailed more fully below. One *C. finmarchicus* ♀ measured 4.25 mm., another 4.5 mm.

Station 27*y*2: Entrance of lagoon at Collinson point; depth 1 to 2 feet inward current, no ice, net No. 3, fifteen minutes, October 8, 1913.

TABLE V (STA. 27*y2*).

Calanus finmarchicus IV	1
Calanus finmarchicus V	7
Calanus finmarchicus ♀	1
Calanus hyperboreus V	1
Pseudocalanus elongatus III	10
Pseudocalanus elongatus IV	20
Pseudocalanus elongatus V	30
Pseudocalanus elongatus ♀	10
Gaidius (immature)	10
Oithona similis	10
	100

Station 29*e*: 70° 3′ N., 141° W., depth 25 fathoms, April 2, 1914. Three vertical hauls with net No. 3, from 0–20 fathoms, through crack in ice, yielded one *C. finmarchicus* ♀ and two or three immature male *Pseudocalanus*.

Station 29*g*: 70° 20′ N., 140° 30′ W., depth 150 fathoms, April 6, 1914. Several vertical hauls were made, at various depths with plankton net number 5[1] through cracks in the ice. The captures comprised *C. finmarchicus*, young and adult, including a female of 5·5 mm., and a male of 4·5 mm., in company with *Calanus hyperboreus*, *Pseudocalanus elongatus*, *Euchaeta norvegica* (see below), *Metridia longa* and *Oithona similis*.

Station 41*s*: Bernard harbour (inner harbour), Dolphin and Union strait, temperature 35·3° F., net No. 3, ten minutes at surface, August 24, 1915.

TABLE VI (STA. 41s).

Calanus finmarchicus I–V	22
Calanus hyperboreus V	1
Pseudocalanus elongatus	60
Eurytemora herdmani	2
Oithona similis	12
Idyœa furcata	1
Danielssenia stefanssoni	2
	100

The absence of adult *Calanus* is to be noticed. One *Eurytemora* carried an ovisac. The *C. hyperboreus* V (the stage preceding maturity) measured 6 mm. in length and the fifth foot had 15 coxal teeth. One *C. finmarchicus* V of 4 mm., had 28 coxal teeth at the base of the fifth foot. At stage 1 there are

[1] Vertical net, 12 inches across mouth, end open 3 inches wide, with brass bucket and silk-net bottom; length $3\frac{1}{2}$ feet, the upper half made of canvas.

two pairs of swimming feet; at stage II, three pairs; at stage III, four pairs. One *C. finmarchicus* II was 1·52 mm. long; and one of stage IV measured 3·5 mm.

Station 43*e*: Dolphin and Union strait, off Stapylton bay, depth about 25 fathoms, net No. 3, ten minutes at surface, September 14, 1915. The material contained a quantity of phytoplankton and copepod pupæ, the latter dominating the zooplankton. *Fritillaria* and *Pluteus* were also present. The air temperature was 23° F., and the water temperature 30·8° F.

TABLE VII (STA. 43*e*).

Calanus finmarchicus I	12
Pseudocalanus elongatus ♀	12
Pseudocalanus elongatus ♀ juv	12
Pseudocalanus elongatus ♂ juv	20
Eurytemora herdmani ♀	1
Eurytemora herdmani ♂	5
Acartia longiremis ♀	1
Acartia longiremis ♂	16
Oithona similis	20
Amphiascus nasutus ♂	1
	100

Station 57*a*: Cape Smyth (point Barrow), Alaska, depth 3 fathoms, August 8, 1916; secured by the catcher[1]:—

Calanus finmarchicus IV	1
Calanus finmarchicus V	2
Calanus finmarchicus ♀	2

2. **Calanus hyperboreus** Kröyer, 1838.

Besides the occurrences of this species noted in Tables IV, V and VI, there are several other records to be mentioned.

Station 27*y*1: Lagoon at Collinson point Alaska, in 1-2 feet of water, no ice, October 8, 1913, catcher. One *C. hyperboreus* V, length 5·6 mm. The lateral lobes of the last thoracic segment were triangular and bluntly pointed, so that doubt might be entertained about its identification until the fifth legs, with 17 coxal teeth, were examined. The inner and outer branches of the fifth legs were 2-jointed; the remaining natatory legs had both rami 3-jointed. The anterior antennæ were 25-jointed, joints 8 and 9 being feebly separated.

Station 28*b*: Collinson point, Alaska, depth one fathom, ice 12 inches thick, 'October 14, 1913, catcher. One *C. hyperboreus* IV, length 4·7 mm. was taken The abdomen was three-jointed; p 5 Re and Ri, one-jointed; the remaining legs had two-jointed rami. The jointing of the antennæ and mouth-parts was the same as in the adult, joints 8 and 9 of the anterior antennæ being imperfectly divided.

Station 28*c*: Same locality, ice 16 inches thick, October 21, 1913. One female of 8 mm. was taken in the catcher.

Station 29*g*3: 70° 20′ N., 140° 30′ W., depth 150 fathoms; vertical haul with net number 5 from 50 to 150 fathoms, April 6, 1914. Two mature females measuring 7·5 and 8·5 mm. in length.

Station 30*a*: 69° 41′ N., 141° 11′ W., off Demarcation point, Alaska, about 300 yards offshore, depth 3 fathoms, May 4, 1914. Six vertical hauls with net number 3, from surface to bottom, through a hole in the ice which was six feet thick. The total number of copepods preserved was 74, distributed as under.

[1] The bag of the catcher was made of bobinette, having wider meshes than any of the plankton nets

TABLE VIII (STA. 30*a*).

Calanus hyperboreus IV	1
Pseudocalanus elongatus III	1
Pseudocalanus elongatus IV	7
Pseudocalanus elongatus V	42
Pseudocalanus elongatus ♀	11
Pseudocalanus elongatus ♂	5
Oithona similis	5
Oncæa conifera	1
Harpacticus superflexus	1
	74

Station 41*p*: Bernard harbour, Dolphin and Union Strait, Northwest Territories, beach water, in the catcher, August 14, 1915. One female 8·25 mm. long without the fan of caudal setæ, 10 mm. long including the caudal setae. A coloured drawing by Mr. Johansen shows the body nearly uniformly red, the anterior antennae deep red.

Station 41*u*: Bernard harbour, end of August, 1915. Four mature females were taken from the stomach of a Western Charr or Dolly Varden trout, *Salvelinus malma*, W. I wrote about this interesting find to Mr. Johansen who kindly informed me that practically all the specimens of the Dolly Varden trout which he obtained in the north were caught in salt water. A large lake east of Bernard harbour, contained individuals which had not succeeded in getting back to the sea before the creek froze up, so that they had to stay in the lake for the winter.

3. **Calanus tonsus** Brady.

G. S. Brady: Report on the Copepoda. Challenger Rep., vol. VIII, p. 34, 1883.

This is a normal-looking *Calanus*, like *C. finmarchicus*, but characterized by the absence of basal serratures on the fifth pair of legs. It was taken by the Challenger Expedition chiefly in the southern hemisphere but also, in company with *Calanus propinquus* Brady, in the surface tow-net at station 241, between Yokohama and Sandwich islands, over a depth of 2,300 fathoms in lat. 35° 41′ N., long. 157° 42′ E.

Three damaged specimens of *C. tonsus*, stage V, were contained in the gathering from C. A. E. station 13*a*, *b*, *c*, three surface tows of five minutes each, lat. 54° 30′ N., long. 159° 42′ W., July 1, 1913. The gathering was scanty but included *Acartia tumida* n. sp., *Acartia longiremis*, and *Harpacticus uniremis*.

C. tonsus was the species referred to without name in my report on an investigation into the Pacific Halibut Fisheries.[1] I saw numbers of them in an inlet to the south of Tassoo harbour, on the west coast of Moresby island, south of the San Christoval mountains, Queen Charlotte islands. In the evening of May 22, 1914, "they were rising to the surface amongst the kelp, one by one, then swimming round in spirals, clockwise, causing distinct widening ripples at the surface." These were also immature. From the peculiar distribution of this species it may be anticipated that future investigations will disclose a special connection with oceanic currents.

[1]Published in the Canadian Bluebook: Contributions to Canadian Biology (1914), Ottawa, 1916.

4. **Pseudocalanus elongatus** (Boeck, 1864).

This species shares with *Acartia* the quality of being the most abundantly represented in Mr. Johansen's gatherings. In addition to the stations tabulated above, the following have to be added.

Station 13*g*, *h*: 54° 30′ N., 159° 42′ W., two surface tows of 15 and 30 minutes, net number 3, July 1, 1913. The gathering was very scanty, a female *Pseudocalanus* being present, together with traces of *Metridia, Acartia, Harpacticus*, and *Cypris*-larvæ of Cirripedes.

Station 20*a*: Grantley harbour, Alaska; depth two fathoms, surface tow 5 minutes, net number 3, July 30, 1913. This was a Cladoceran plankton, numerous *Evadne* and *Podon*, with strong copepod infiltration, and some Molluscan and Annelid larvæ. *Acartia clausi* was almost as abundant as were the Cladocera.

TABLE IX (STA. 20*a*).

Pseudocalanus elongatus, scarce; ♂, ♀ and young.
Centropages mcmurrichi, abundant; ♀ and some ♂.
Eurytemora herdmani, two ovigerous females.
Eurytemora johanseni, males only noted.
Acartia clausi, very abundant.
Tortanus discaudatus, one female.
Idyæa furcata, one female.

Station 40*d*: Bernard harbour, water depth 9 fathoms, six vertical hauls 0–5 fathoms with net number 3 through hole in ice, June 8, 1915. Female and immature male, the latter with four-jointed urosome but anterior antennæ 19-jointed as in adult male.

Station 42*p:* Bernard harbour (outer harbour), surface tow with net number 3 for 10 minutes, September 30, 1915. The scanty gathering included a few *Pseudocalanus*, mostly young. There were also present: *Eurytemora herdmani* ♂, *Oithona similis, Harpacticus uniremis, Idyæa furcata, Danielssenia stefanssoni*.

Station 42*y*: Dolphin and Union strait, off Bernard harbour, depth 17 feet, ice $2\frac{1}{2}$ feet thick, December 6, 1915, time noon. Six vertical hauls from surface to bottom were taken with net number 3 at low tide with an eastward current. There were upwards of 100 small copepods. The *Pseudocalanus* were of various ages, abdomen two to fourjointed, all immature.

TABLE X (STA. 42*y*).

Pseudocalanus elongatus	40
Metridia longa	8
Acartia longiremis	2
Oithona similis	38
Oncæa conifera	2
Idyæa furcata	10
	100

Station 42*z*: Same locality and depth as preceding; time midnight; three vertical hauls with net number 3 from bottom to surface through hole in ice; water temperature 29·2° F., December 12, 1915. Both males and females were taken, in company with *Idyæa furcata, Metridia longa, Acartia longiremis, Oncaea conifera* and *Thaumaleus bernardensis*.

A female *Pseudocalanus* from station 27*t*, *u*, (above table IV) had a two-chambered cyst attached to the right anterior antenna, with faint indication of radial arrangement of the brown granular contents (Fig. 1). Similar parasites, questionably assigned to the Infusoria, were observed and figured upon *Calanus* *finmarchicus* by T. Scott [15th Ann. Rep. Fishery Board, Scotland 1896 (1897) p. 172, pl. III, f. 22.] They are now believed to belong to the Peridinea and have been named *Ellobiopsis chattoni* by Professor Maurice Caullery.[1]

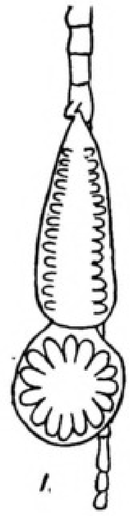

Fig. 1. Portion of right antenna of *Pseudocalanus* from Collinson point with *Ellobiopsis chattoni* Caullery attached to it.

According to Carl With (Copepoda I. Danish Ingolf Exped., vol. III, part 4, p. 57, Copenhagen 1915) this long established species should be known in future as *Pseudocalanus minutus* (Kröyer 1845-47).

5. **Gaidius** sp. juv.

Only immature examples of this form occurred in the gathering from station 27*y*2 (above, table V). They were mostly immature males. Front obtuse, rostrum obsolescent or absent; length of immature ♂, 1·92 mm.; fifth feet of immature male biramous (Fig. 2).

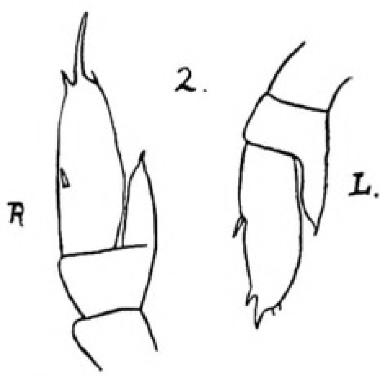

Fig. 2. *Gaidius* immature ♂, abdomen 4-jointed.
R. Right fifth leg.
L. Left fifth leg.

I had at first entered them in my list as *Chiridius obtusifrons* because of the absence of a rostrum and the presence of short lateral acuminations of the last thoracic segment. The male of *Aetideus armatus* is likewise devoid of a rostrum, but according to Sars this species has never been found anywhere in

[1] M. Caullery (Paris): Sur un parasite de *Calanus helgolandicus* Claus, appartenant probablement aux Peridiniens (*Ellobiopsis chattoni* n.g., n.sp.). Verh. VIII, Internat. Zool. Kongresses zu Graz 1910, Jena 1911, pp. 440–442. The complete description appeared in Bulletin scient. France, Belgique, t. 44, 1910, fasc. 3, 201–214, pl. V.

the Arctic ocean, and the adult male is only 1·45 mm. long. Aside from the presence or absence of a rostrum, the Canadian Arctic forms agree with *Gaidius tenuispinus* in having the inner branch (Ri) of the second legs (p.2) two-jointed and in lacking an outer seta (se) on the first joint of the outer branch (Re 1) of the first legs (p. 1). Sars observed that *G. tenuispinus* sometimes occurs in the same gatherings with *Ch. obtusifrons,* both species ranging through the Polar basin crossed by Nansen.

The inner ramus of the mandibular palp is not so "unusually small" as is required by the definition of *Chiridius;* the teeth of the mandible have simple points. The anterior antennae are 24-jointed, joints 8 and 9 being coalescent, the terminal joint distinct and short; the entire appendage is not longer than the forebody. The second basal joint (B2) of the second maxilliped (mp2) is hardly longer than the B1; the first inner seta (si) of B2 is inserted distad of the middle of the joint, the portions of the joint proximal and distal to the insertion of this seta being as 2: 1.

6. **Euchaeta norvegica** Boeck, 1872.

I noted only a single damaged immature female, with three-jointed abdomen, in the gathering from station 29*g*4, depth 150 fathoms; a vertical haul with net number 5 from 0 to 50 fathoms in an open water lane in pack-ice, 70° 20′ N., 140° 30′ W. There was a very small quantity of plankton for such a great column of water. In the same vial with the *Euchaeta* there was one *Metridia* longa ♀, and half a dozen *Oithona similis.*

Euchaeta norvegica is a characteristic North Atlantic and Arctic species. It occurred at numerous stations in Dr. Hjort's Canadian Fisheries Expedition 1914–15,[1] but not in Professor Herdman's traverses of the Atlantic to which reference will be made later. At Passamaquoddy Bay it forms part of the food of the Pollack.

7. **Centropages mcmurrichi,** n. sp.

This species occurred at several stations already mentioned: Tables I, II and IX. It was first obtained off the British Columbian coast by Professor J. Playfair McMurrich[2] in a patch of "brown water" off the entrance to Esperanza inlet , on the west coast of Vancouver island on September 11, 1912. He identified it as *Centropages hamatus* (Lilljeborg 1853), whilst noting differences in the armature of the genital segment of the female and in the structure of the fifth legs. It has the ventral recurved hook of C. *hamatus* ♀ in front of the genital pore but the remaining setulose armature of the genital segment is distinctive. The other principal specific character is afforded by the strong unguiform process on the inner side of the second joint of the outer ramus of the fifth foot (p5 Re2 ♀). In *C. hamatus* this process is smooth and less than half the length of the third joint (p5 Re3). In the present species the process is at least two-thirds the length of Re3 and is denticulated along its outer edge. The relative dimensions of anal segment and caudal furca in the female are: anal segment 6, furcal length 11, width of furcal ramus 3.

In addition to the stations named above, a single female, accompanied by numbers of *Paralabidocera,* was taken at station 21 *d, e, f,* with net number 3, 68° 41′ N., 165° 10′ W., temperature 45·5° F., surface, August 16, 1913. A female from station 20*a,* July 30, 1916 (Table IX) carried a spermatophore.

The spinules on the genital segment of the female include a pair of antero-ventral groups arranged in a comb-like row right and left of the swollen base

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[1] A. Willey: Report on the Copepoda obtained in the Gulf of St. Lawrence and adjacent waters 1915. Canad. Fish. Exped. 1914–1915. Department of the Naval Service Bluebook, pp. 173–220, Ottawa 1919.

[2] J. P. McMurrich: Notes on the Plankton of the British Columbia Coast. Trans. Roy. Soc. Canada (ser. III), vol. X, September, 1916, p. 77–8, f. 1–3.

of the hook; a right lateral comb-like group of strong spinules near the middle of the segment and a left postero-lateral group of much smaller spinules near the posterior end of the segment; also right and left dorso-lateral tufts in the anterior region. The segment itself and the groups of spinules are asymmetrical.

8. **Limnocalanus grimaldii** (J. de Guerne, 1886).

This noteworthy species occurred in one gathering only, at station 27 *t, u,* Collinson point, Alaska, October 4 and 5, 1913, forming 10 per cent of the copepod content (table IV). The lateral edges of the last thoracic segment (Th5) have an acute point set in the middle of the border and do not taper to the point; total length of female 2·85 mm. The caudal furca is long, two-fifths the total length of the urosome; the upper and lower surfaces of the caudal rami are beset with short spines, the inner and outer surfaces are setulose (or "ciliated"). Abdomen of female three-jointed; of male five-jointed, with spines on dorsal and ventral borders of Ab 2, 3, and 4. Right geniculate antenna of male with five joints beyond the bend, the first of which is long, the last very small.

It has perhaps the most remarkable distribution of any marine copepod. It was first taken in the Gulf of Finland and named in honour of Prince Albert of Monaco by J. de Guerne in 1886. Two years later it was declared by Nordquist[1] to be identical with *Limnocalanus macrurus* G. O. Sars 1862 from the Scandinavian lakes. Its validity as a species distinct from the freshwater form was proved by G. O. Sars who found it in material from the Caspian Sea, where it constitutes part of the relict glacial fauna of that basin.[2]

The same species (*L. grimaldii*) was recorded by Sars living pelagically in the estuary of the river Jana in Siberia. The length of female examples from Siberia was 3.30 mm., as against 2·80 mm. from the Caspian Sea. The largest individual observed by Nordquist in the Baltic was 3·15 mm. long. Sars regards it as a true Arctic form of marine origin and "its occurrence in the Baltic and in the Caspian sea must be explained by a direct connection in former times of these basins with the Glacial sea."[3]

There is a slight difference apparent between the figures of the falciform process at the end of the outer ramus of the right fifth foot of the male, given by Sars for *L. grimaldii* (1897 op. cit.) and for *L. macrurus* in his Crustacea of Norway, vol. IV Copepoda-Calanoida, Part VII and VIII, pl. 55, Bergen 1902. According to these figures the process is broader and shorter in *grimaldii* than in *macrurus*. The examples of *grimaldii* from Alaska agree in this respect with *macrurus*. There is a prominent ental cone on the first basal joint of the left p 5 ♂, corresponding with fair approximation to that indicated in the figure by Sars, 1897, op. cit., pl. 4, f. 18.

9. **Eurytemora gracilis** (Sars).

Temorella gracilis Sars (Jana Expedition, op. cit., 1898, p. 336).

This species was originally taken in the lower part of the river Jana, in the same locality as *Limnocalanus grimaldii*. A single damaged female, referred tentatively to *E. gracilis*, occurred in the gathering from station 21 *d, e, f,* lat. 68° 41′ N., 165° 10′ W., temperature 45·5° F., August 16, 1913, surface. The

[1] Oscar Nordquist: Die Calaniden Finlands. Bidrag till Kännedom af Finlands Natur och Folk, vol. 47, pp. 191-275, 10 pls. Helsingfors 1888.

[2] G. O. Sars. Pelagic Entomostraca of the Caspian Sea. Annuaire du Musée Zool. de l'Acad. Imp. des Sciences de St. Petersbourg 1897, pp. 38 to 49 of the reprint which I owe to the courtesy of the author.

[3] G. O. Sars: The Cladocera, Copepoda and Ostracoda of the Jana Expedition. Annuaire Mus. Zool. St. Petersbourg, III, 1898, p. 335.

terminal setæ of the natatory legs in the original description are cultriform, dilated in the middle. Owing to the state of preservation of the specimen at my disposal, I can say nothing on this point.

The length was 1·52 mm., the anterior antennæ were broken. Relative lengths of anal segment and caudal furca: anal segment 9, furcal length 15,

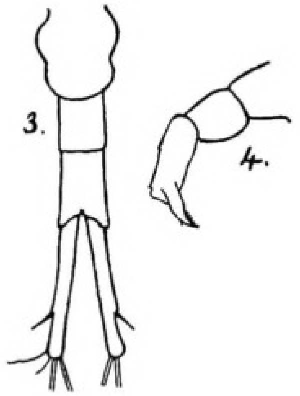


Fig. 3. *Eurytemora gracilis* ♀. Urosome from above.
Fig. 4. Same. Part of fifth leg.

width of caudal ramus 2; surface of caudal rami smooth (Fig. 3). In the last pair of legs (p. 5), the distal joint was lost; the unguiform process of the proximal joint of the Ramus (Re 1) projects nearly horizontally inwards, abruptly narrowing to a distal acuminate portion which is ciliated on the inner edge (Fig. 4). Genital segment with lateral convexities separated by a constriction (Fig. 3).

10. **Eurytemora herdmani** I. C. Thompson and A. Scott, 1898.

This is one of the most typical and abundant Copepods of the gulf of St. Lawrence. It was first obtained in 1897 by Prof. W. A. Herdman, who collected surface plankton through the ship's pump continuously day and night whilst the steamer was going at full speed across the Atlantic. Though not previously observed on the Pacific coast, it was taken at a number of stations by the Canadian Arctic Expedition: Tables I, II, VI, VII, IX, station 42p (under *Pseudocalanus*), and the following.

Station 17 *a, b, c*: 60° 9′ N., 167° 38′ W., three surface hauls, with net number 3, fifteen minutes each, preserved in one vial, July 6, 1913. Numerous small copepods, mostly adult ♂, some young forms, but not one female.

Table XI (Sta. 17*a, b, c*.)

Eurytemora herdmani ♂	45
Acartia ♂	45
Tortanus discaudatus ♂	10
	100

Probably both *Acartia longiremis* and *A. clausi* are present in subequal numbers, but as the metathoracic thorns of *longiremis* may be lost or worn down, it is not safe to differentiate these species by male characters. Another vial of the same date, labelled Sta. 17*e*, surface 30 minutes, same locality and net, contained a scanty gathering which included some Euphausiid eggs, one male *Eurytemora herdmani*, and a number of *Acartia longiremis*, both male and female. To begin to understand these relations it would be necessary to know approximately the time of day and the light conditions. In any case the assembling of males, as displayed in the table above, is not too commonly observed.

Station 19: See under *Acartia longiremis*.

Station 36: Off cape Lyon, Darnley bay, Northwest Territories, five minutes tow in surface, with net number 4,[1] from ship, water depth five fathoms, August 23, 1914. Only eight copepods preserved, all males: five *Acartia longiremis* and three *Eurytemora herdmani*. One of the latter was 1·20 mm. long; a male from station 21 (Table II) measured 1·36 mm.

Station 41*g*: Bernard harbour (outer harbour), surface net number 3, five minutes, August 1, 1915. One female in company with *Cyclopina schneideri*, *Harpacticus uniremis* and *Harpacticus superflexus*.

11. **Eurytemora johanseni,** n. sp.

This species was taken in company with *E. herdmani* (Table II and Table XII), from which it may be recognized externally by the length of the caudal furca. Whereas *E. herdmani* is longifurcate, the furca much exceeding the length of the anal segment, *E. johanseni* is brevifurcate, the furca and anal segment being subequal in length (Fig. 5).

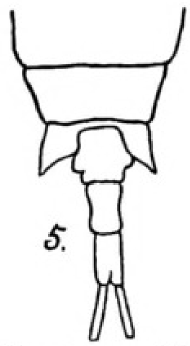


Fig. 5. *Eurytemora johanseni* ♀.
Dorsal view of hind-body.

Description of female: total length 1·28 mm., anterior antennæ as long as forebody; length of caudal furca 0·112 mm., of anal segment 0·104 mm., wings of genital segment small; mouth-parts as in *E. velox*. The fifth legs (p. 5♀) are four-jointed as in the type species; the unguiform process of the penultimate joint (Re 1), not exceeding Re 2 in length, is coarsely denticulated on its outer side; the right Re 2 (distal joint of the appendage) is larger than the left and crenulated on its inner border (Fig. 6).

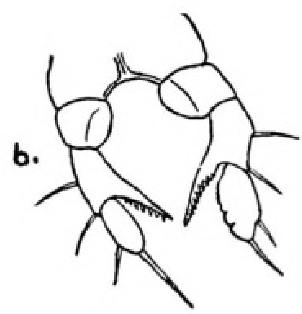
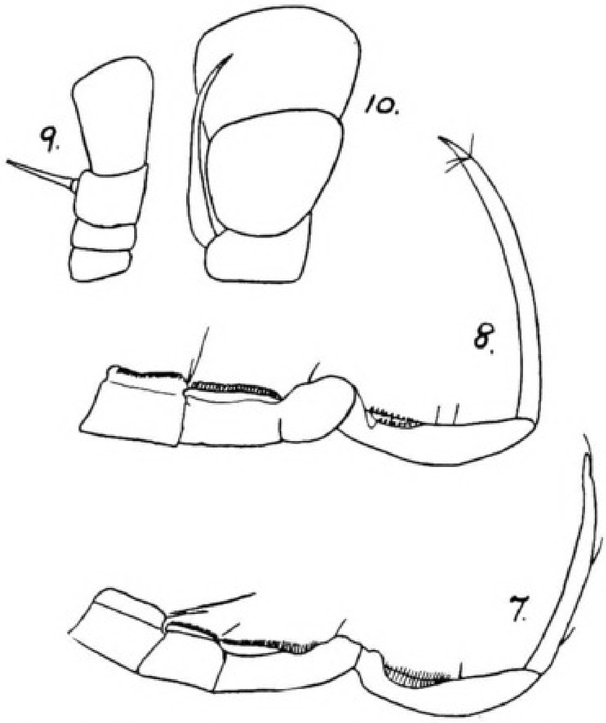


Fig. 6. Same. Fifth legs.

Description of the male: total length 1·12 mm. The anterior antennæ are to be distinguished from those of *E. herdmani* on close inspection (Figs. 7-10). In both species, the intumescence in the middle section of the right antenna is formed by joints 13-18 inclusive. Of the two distal joints beyond the bend, the penultimate joint is to the terminal joint as 5: 8 in *herdmani* and as 4: 5 in *johanseni*. In other words, the penultimate joint of the right antenna of *E.*

[1] Net as net No. 3 (see note p. 4K), but made of fine silk.

johanseni is subequal to that of *E. herdmani*, but the terminal joint is shorter than in *herdmani*. Again, in *E. herdmani*, joint 12 carries a long curved unguiform spine commonly applied to the face of the antenna, though capable of being extended forwards. In *E. johanseni*, joint 12 carries a spine standing out at right angles to the face of the antenna, less than half the length of that of



Figs. 7–10. Details of right antenna of male.
7. *E. johanseni*, distal joints.
8. *E. herdmani*, same.
9. *E. johanseni*, spine on joint 12.
10. *E. herdmani*, same.

herdmani, slightly curved and minutely bifid or flaring at the tip. Other spines occur on the proximal joints but only the spine on joint 12 has specific value. In both species the right antenna presents a proximal as well as a distal swelling with short narrow joints intervening.

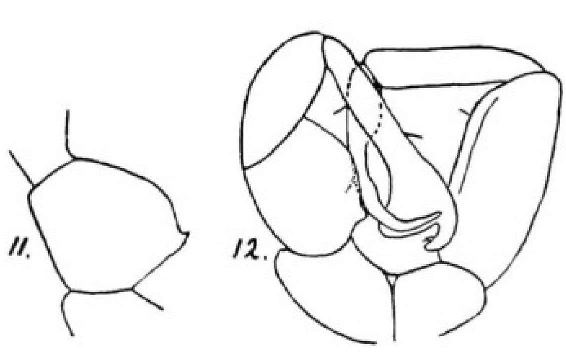


Fig. 11. *E. johanseni* ♂. Left p. 5 B2
Fig. 12. Same. Fifth legs from behind.

Fifth legs (p 5 ♂): the left B2 shows a strong ental protuberance (Fig. 11); the inner margin of the right B2 is entire; the terminal joint of the left foot with subdistal spoonshaped expansion (Fig. 12). In *E. herdmani* there is a prominent cylindrical ental tubercle at the proximal end of the right B2.

In one specimen the caudal furca was asymmetrical, suggesting a mingling of characters, as shown in Fig. 13.

The arrangement of the setæ on the natatory legs agrees with that of *E. velox*, except that the third joint of the outer branch of the first foot (p. 1 Re 3)

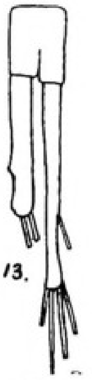


Fig. 13. *E. johanseni* ♂.
Abnormal caudal furca.

is furnished, as in *E. herdmani*, with seven setæ (2 se, 1 st, 4 si); in *E. velox* this joint has six setæ (1 se, 1 st, 4 si).

12. **Metridia longa** (Lubbock, 1854).

Station 27*r*. Collinson Point, Alaska, October 2, 1913: one male, with the left anterior antenna geniculate; length 3·88 mm.

Station 29*g*. 70° 20′ N., 140° 30′ W., depth 150 fathoms: several vertical hauls with net number 5, from 0 to 150 fathoms, April 6, 1914. The gathering, amongst others (see under *Calanus finmarchicus*), contained females and young; one female was 4·88 mm. in length.

Station 42*y*. See Table X. Young individuals.

Station 42*z*. See under *Pseudocalanus*. A young *Metridia longa* of 1·67 mm. was taken.

From these scanty records it is evident that this representative Arctic species was only present in traces. Its abundance at suitable places in the north is shown in the following extract, which I have not seen quoted before, from A. E. Nordenskiold: The Voyage of the Vega round Asia and Europe, translated by A. Leslie, London (Macmillan) 1881, vol. II, pp. 54–56: "The common idea that all animal life ceases when the interior animal heat sinks under the freezing point of water, is not quite correct. This is proved by the remarkable observation made . . . during the wintering at Mussel Bay in 1872–73, that small crustacea can live by millions in water-drenched snow at a temperature of from —2° to —10°·2 C. If during winter one walks along the beach on the snow which at ebb is dry, but at flood tide is more or less drenched through by sea-water, there rises at every step one takes, an exceedingly intense, beautiful, bluish-white flash of light, which in the spectroscope gives a one-coloured labrador-blue spectrum. It produces indeed a peculiar impression on a dark and stormy winter day (the temperature of the air was sometimes in the neighbourhood of the freezing-point of mercury) to walk along in this mixture of snow and flame. On a closer examination, it appeared that this light-phenomenon proceeded from a minute crustacean, which, according to the determination of Prof. W. Lilljeborg, belongs to the species *Metridia armata* A. Boeck (= *M. longa*). When the temperature [of the snow-sludge] sinks below —10° C., the power of this small animal to emit light appears to cease."

13. **Metridia lucens** Boeck, 1864.

I have only one record of this species in the collection: one male, 2 mm. long, at station 13*g*, *h*, 54° 30′ N., 159° 42′ W., July 1, 1913, at the surface. It has been reported very common, summer and winter, in the San Diego region.[1]

14. **Paralabidocera amphitrites** McMurrich, 1916.

Station 14. 54° 23′ N., 164° 45′ W., surface, 15 minutes, net number 3. July 2, 1913. Two males in company with an ovigerous *Harpacticus uniremis*.

Station 18. Table I; many young, but no adults, were taken here, and again at station 19 (see under *Acartia longiremis*).

Station 21*a*, *b*, *c*. Table II, young and adults of both sexes.

Station 21*d*, *e*, *f*. 68° 48′ N., 165° 10′ W., net number 3, three surface hauls of 15 minutes each, temperature 45·5° F., August 16, 1913.

TABLE XII (STA. 21*d*, *e*, *f*).

Centropages mcmurrichi ♀	1
Eurytemora gracilis ♀	1
Eurytemora herdmani ♂	4
Eurytemora herdmani ♀	3
Eurytemora johanseni ♂	36
Eurytemora johanseni ♀	6
Eurytemora johanseni ♀ stage V	4
Paralabidocera amphitrites ♀	4
Paralabidocera amphitrites ♀ stage V	14
Paralabidocera amphitrites ♀ stage IV	3
Paralabidocera amphitrites ♂	5
Paralabidocera amphitrites ♂ stage V	6
Paralabidocera amphitrites stage III	4
Acartia (clausi–longiremis) ♂	9
	100

Professor McMurrich's material consisted of two females and one male, collected by himself in September, 1912, from a patch of "brown water," about 3½ miles off Amphitrite point, Vancouver island.[2] They were sub-mature specimens, not having achieved the final ecdysis, and whilst they exhibited certain generic features, the specific characters were in part lacking. The missing characters relate chiefly to the right anterior antenna of the male, the fifth pair of legs of the male, and to the genital segment of both sexes. In the male, the fifth feet undergo a remarkable transformation on the passage to maturity.

The lateral cephalic hooks and the rostral processes are like those of *Pontella* and some species of *Labidocera*. *Paralabidocera* further agrees with the definition of *Labidocera* in the absence of a rostral lens, in having the dorsal eyes contiguous in the male, and in having less than seven teeth on the mandible. It differs from *Labidocera* and agrees with *Pontella* in having 24 joints in the anterior antennæ of the female, seven joints in the second maxilliped, and three joints in the inner branch of the first feet. The abdomen is three-jointed in the female, five-jointed in the adult male. The last segment of the thorax is distinct in the female, but in the male its median part is suppressed in dorsal view, only the lateral lobes having a joint-line, as in *Labidocera kroyeri* ♂ Giesbrecht.

[1]C. O. Esterly: The Pelagic Copepoda of the San Diego Region. Univ. of California Publications, Zoology, Vol. 2, No. 4, October 14, 1905, p. 177.

[2]J. P. McMurrich: op. cit. 1916, pp. 82-87, f. 8-14.

Length of female 3·6 mm., of male 3·09 mm. The rostral processes are long and acute in both sexes, in the young as well as in the adult (Fig. 14). Sometimes, as seen specially in the male, the left rostral hook is smaller than the right.

Fig. 14. *Paralabidocera.*
Front with right eye and rostral hooks of female.

The lateral lobes of the last thoracic segment are symmetrical in the female; they are broadly rounded, with a small protuberance at the middle of the lateral border, or this may be worn down so that the lateral lobe appears evenly rounded (Fig. 15).

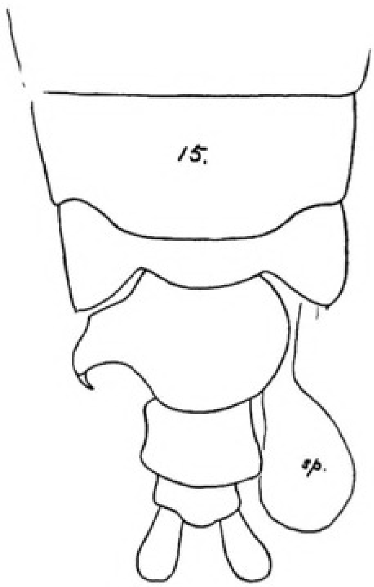


Fig. 15. *Paralabidocera.*
Hind-body of female from above; sp. Spermatophore.

In the male, the lateral lobes are very unequal, that on the left side resembling the female, though less broadly rounded in side view, sometimes triangular

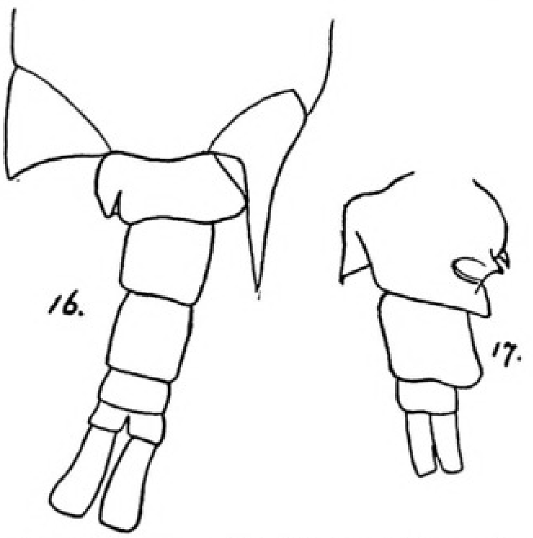


Fig. 16. *Paralabidocera.* Hind-body of the male from above.
Fig. 17. *Paralabidocera.* Urosome of female in side view.

and pointed. The right lateral lobe is drawn out into a long spike nearly or quite reaching to the end of the second segment of the urosome (Fig. 16).

The genital segment of the male (Fig. 16) exhibits a small lobe and notch on the left side. The genital segment of the female (Fig. 15) carries a large wing-like lobe on the left side, terminating in a recurved hook; this hook is easily lost, so that the lobe then appears to end bluntly. In side view the segment presents a ventral convexity and two small curved hooks, right and left of the genital opening (Fig. 17).

The anterior antennæ of the female reach to the end of the forebody. Of the 24 segments of which they are composed, numbers 3 to 8 are short and subequal; the antenna breaks readily between the 8th and 9th joints. The right grasping antenna of the male, with the geniculation between the 18th and 19th joints, is more like that of *Pontella* than that of *Labidocera* (Fig. 18).

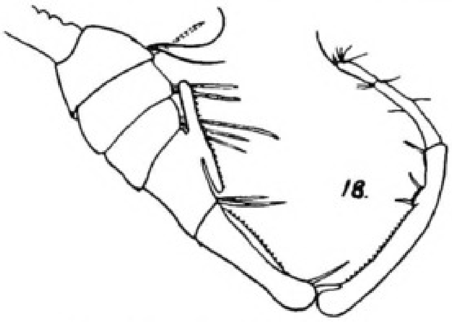


Fig. 18. *Paralabidocera.*
Terminal portion of right antenna of male.

There is a serrated upraised flange upon joint 17, a serrated border upon joint 18, and two toothed edges upon the compound joint 19–21, namely, a long proximal and a short distal comb. The terminal part of the appendage, beyond the bend, consists of three distinct segments, corresponding respectively to joints 19–21, 22–23 and 24–25. This is a generic character, inasmuch as the right anterior antenna of the male *Labidocera* has four terminal segments, hat of *Pontella* two.

In the second or posterior antennae, B2 is fused with Ri 1, the zone of fusion being indicated by a shallow impression at the level of the insertion of a group of two si; measuring Ri from this point, the two rami are subequal in length.

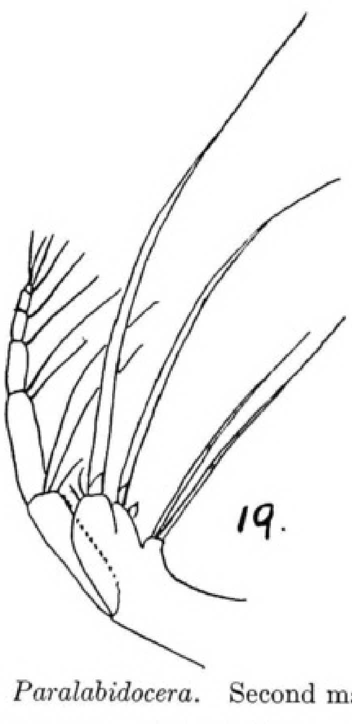


Fig. 19. *Paralabidocera.* Second maxilliped.

In the seven-jointed second maxilliped (Fig. 19), the inner margin of B2 is denticulated as in *Labidocera;* distally this joint carries two long setae and one additional shorter seta; Ri 1 has two setæ, Ri 2 has one, Ri 3 has one, Ri 4 has one, and Ri 5 has three apical setae. The distal lobe of B1 has one long seta and two very small anterior setae at its base, one of which was distinctly plumose. In the example figured, one of the two setae of the middle lobe of B1 is lost, its place being indicated by a small mamelon.

The distribution of the setae on the swimming legs agrees with *Labidocera*, the external setae being set in deep notches. In the fifth legs of the female (Fig. 20), it is to be noted that the right and left B1 are confluent across the middle line; B2 has two setæ on its hinder surface, one of which is minute.

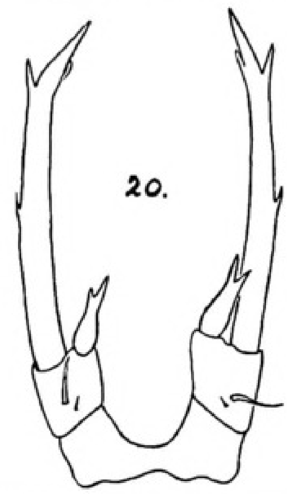


Fig. 20. *Paralabidocera*.
Fifth legs of female from behind.

In the adult male the right foot ends in a rounded chela (Figs. 21 and 22); in one case it was observed that the chela was firmly grasping the right anterior

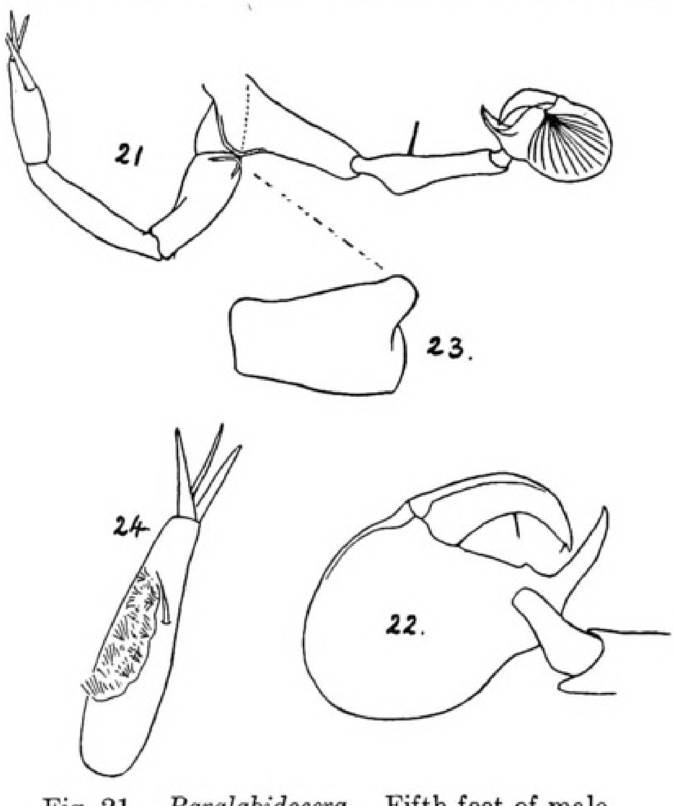


Fig. 21. *Paralabidocera*. Fifth feet of male.
Fig. 22. *Paralabidocera*. Chela of right leg.
Fig. 23. *Paralabidocera*. Left B2.
Fig. 24. *Paralabidocera*. Left end-joint.

antenna of the same individual, which it had presumably caught hold of in he death-struggle. A lobe on the left B2 (Fig. 21) is directed towards a corresponding tuberosity on the right B1; when the left B2 is disarticulated and viewed from the side, the lobe appears as the proximal end of an elevated border (Fig. 23). On the anterior surface of the terminal joint of the left foot there is an elongate depression beset with groups of very fine hairs, with a small se beside it (Fig. 24).

The mandible has five teeth followed by a group of small setæ; the first (ventral) tooth is large. The rostral eye has no lens.

15. **Acartia clausi** Giesbrecht.

Station 17 (Table XI), station 18 (Table I), station 20a (Table IX), station 21 (Table II), station 25 (Table III). Station 20*h*: Port Clarence bay, Alaska, water depth three fathoms, net number 3, surface-tow five minutes, amongst seaweed, August 4, 1913. A small vial contained a number of Cladocera (*Podon leuckarti* and *Evadne nordmanni*), a young *Caprella*, and several *Acartia clausi*, male and female. The arrangement of the setæ on the swimming legs agrees with the description given by Giesbrecht, and the first basal joint (B1) of the second to the fourth feet has an emarginate outer border and an incised inner border as in the type.

Station 25, off Cooper Island, near Point Barrow, is the only station within the Arctic Circle where this species was taken, although station 21 lies north of Bering strait. Port Clarence lies to the south of the strait, about 65° north latitude. Sars (1903) has never met with *A. clausi* in any samples of plankton from the Arctic Ocean. On the south and west coasts of Norway it is as common as *A. longiremis* with which it is often found.

This species is more of an estuarine and inshore form than is *A. longiremis*.

16. **Acartia longiremis** (Lilljeborg, 1853).

This is an Arctic species with a wide southern extension.

Station 6*b*. 56° 26′N., 133° 00′W., just below the surface, 15 minutes, net No. 4, June 24, 1913. This was a thin Acartia plankton, numbers of *A. longiremis* being noted and, in addition, two male Cumaceans and several Ostracods.

Station 12*b*, *c*. 54° 38′N., 157° 45′W., two surface tows of five minutes each, net number 3, June 30, 1913. A few *A. longiremis* ♂ and ♀ were taken, together with a trace of *Oithona* and a number of young Amphipoda-Hyperidea.

Station 13 *a*, *b*, *c*. 54° 30′N., 159° 42′W., three surface tows of five minutes each, net number 3, July 1, 1913. The catch was very scanty but there was a male *longiremis*, 1·12 mm. in length; the number of setæ on the inner border of the two-jointed inner branch of the fourth foot (p. 4 Ri Si) is 3, 5, the same as in *A. clausi;* Sars figures 2, 5.

Station 17 *a*, *b*, *c*. Table XI. Whereas most Calanoids are largely differentiated by male characters, *Acartia* is an exception, and the males of *A. clausi* and *longiremis* are hard to distinguish, if the thorns are lost from the last thoracic segment.

Station 18: See under *Calanus finmarchicus* and remarks on table I.

Station 19 *a-e*. 63° 43′N., 165° 24′W., surface, July 8, 1913, net number 3, five tows of fifteen minutes each. Nearly fifty *Acartia* identified in part as *longiremis*, about half as many young *Paralabidocera*, and a single male *Eurytemora herdmani*.

Station 21 *a*, *b*, *c*, and *d*, *e*, *f*. Tables II and XII.

Station 25 *b*, *c*. Table III.

Station 36. Off cape Lyon, Darnley bay, Northwest Territories, net number 4, surface tow of five minutes, August 23, 1914. Five males in company with *Eurytemora herdmani* (q. v.). Phytoplankton was represented by *Ceratium*, *Chaetoceras* and *Coscinodiscus*.

Station 40*r*. Bernard harbour (outer harbour), Northwest Territories, water depth 10 fathoms, three vertical hauls 0 to 5 fathoms through hole in ice, net number 3, temperature −0·8°C., July 1, 1915. *Coscinodiscus* and *Balanus* nauplii were abundant. The copepods present were: *Acartia longiremis* ♀, *Oithona similis* ♀, *Ectinosoma neglectum* and *Idyæa furcata* ♀.

Station 42*y*. Table X.

Station 42*z*. See under *Pseudocalanus*.

Station 43*e*. Table VII. A female carried two spermatophores.

17. **Acartia tumida,** n. sp.

Three examples of a third species of *Acartia* were taken in surface, at stations 13 *a*, *b*, *c*, in company with *Calanus tonsus* (q. v.) and *Acartia longiremis* (q. v.). The position was 54° 30′ N., 159° 42′ W., July 1, 1913, net number 3.

Length of female, 2·00 mm.; anterior antennæ not exceeding length of forebody, reaching as far as the front part of the genital segment when laid back, having about the same relative length as in *A. bifilosa*. Rostral filaments are present, widely separated in ventral view; labrum large trilobate with ciliate edges, as figured by Sars for *A. longiremis*. Lateral borders of last thoracic segment smooth (Fig. 25); urosome smooth, some minute points dorsally near the posterior edge of the genital segment and at posterior edge of the pre-anal segment; anterior antennæ without thorns.

The caudal setæ (Fig. 26) were broken, some of their swollen basal parts remaining attached to the short and broad rami.

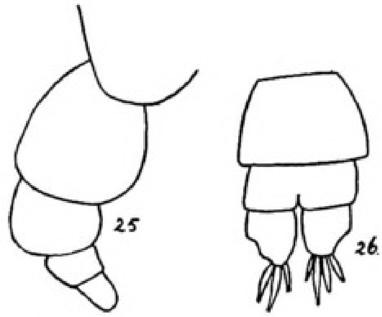


Fig. 25. *Acartia tumida:* end of thorax and the urosome in side view.
Fig. 26. Same. Urosome from below.

In the swimming feet, the terminal seta (st) of the outer ramus is much longer than Re 3, longer in fact than the whole Re, with a strongly serrated outer edge; the arrangement of the setæ is the same as in *A. clausi*.

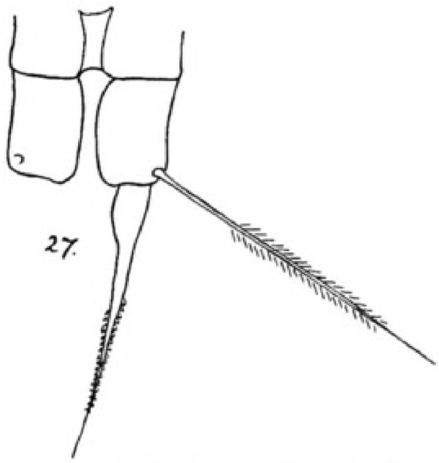


Fig. 27. *Acartia tumida.* Fifth legs of female, shown complete on one side, the basal joints parallel.

Fifth legs (p 5 ♀): the basal joints, right and left, are parallel; the terminal joint, representing the Re, has a swollen proximal portion followed by a narrow neck, upon the distal part of which there commence two rows of small denticulations pointing distally. These denticulations are evenly disposed, increasing slightly and then diminishing in size, to be continued upon the proximal half of the attenuating setiform process (Fig. 27). This delicate and regular serrulation is quite different from the coarse denticulation figured for *Acartia tonsa*, where the teeth are few in number, the proximal largest.

18. **Tortanus discaudatus** (I. C. Thompson and A. Scott, 1898).

In Professor Herdman's traverses of the Atlantic, which have been referred to under *Eurytemora herdmani*, he obtained another leading component of the Gulf of St. Lawrence copepod plankton, namely, the present species. Whilst in America he paid a visit to Puget Sound, where he carried out some dredging and tow-netting. Amongst the more abundant forms in the Puget Sound gatherings was this same species, new for the Atlantic and new for the Pacific.[1] It composes 50–75 per cent of the summer copepod plankton off Souris, Prince Edward Island, and is very abundant off the Biological Station at St. Andrews, N.B.

Station 17 *a, b, c*. See Table XI.
Station 18. See Table I.
Station 20*a*. See Table IX.

B. Cyclopoida, Etc.

19. **Oithona similis** Claus, 1866.

This small and slender species is apt to escape through the meshes of ordinary tow-nets, but none the less it appears frequently in Mr. Johansen's gatherings. Like *Acartia longiremis*, it is an Arctic form with a southern extension.

Station 12 *b, c*. See under *Acartia longiremis*.

Station 12 *d*. Same position, surface, 15 minutes, net number 4, June 30, 1913. Phytoplankton (*Coscinodiscus, Peridinium, Rhizosolenia*, chain algæ), Tintinnoids and *Oithona*.

Station 21 *a, b, c*. Table II.
Station 25 *b, c*. Table III.
Station 27*y* 2. Table V.
Station 29*g* 4. See under *Euchaeta norvegica*.
Station 30 *a*. Table VIII.

Station 40 *c*. Bernard harbour, Dolphin and Union strait, water depth 9 fathoms, three vertical hauls, 0 to 3 fathoms, through hole in ice; net number 3, June 7, 1915.

Table XIII (Sta. 40*c*).

Pseudocalanus elongatus, immature ♀.
Oithona similis ♂.
Cyclopina schneideri.
Harpacticus superflexus ♂.
Dactylopusia signata ♀.

Station 40 *d*. Same locality, depth, and net, six vertical hauls through hole in ice, 0 to 5 fathoms, June 8, 1915.

[1] W. A. Herdman, I. C. Thompson, Andrew Scott: On the plankton collected continuously during two traverses of the North Atlantic in the summer of 1897; with descriptions of new species of Copepoda; and an Appendix on dredging in Puget Sound. Trans. Liverpool Biol. Soc. XII, pp. 33-90, pls. V-VIII, Liverpool 1898.

TABLE XIV (STA. 40*d*).

Pseudocalanus elongatus ♀.
Pseudocalanus elongatus ♂ stage V.
Eurytemora herdmani ♀ (1·4 mm.).
Oithona similis.
Cyclopina schneideri.
Ectinosoma neglectum.
Harpacticus superflexus ♂ (1·05 mm.).
Dactylopusia signata.

Station 40*e*. Same locality, depth, and net, three vertical hauls, 5–0 fathoms, June 10, 1915. Several *Oithona similis* with *Dactylopusia* and *Ectinosoma neglectum.*

Station 40*r*. See under *Acartia longiremis*. A female *Oithona* measured 0·86 mm., a male 0·78 mm. The relative lengths of the last thoracic segment, the abdominal segments and the furca were:—

	Th5.	Ab1.	Ab2.	Ab3.	Ab4.	Ab5.	Furca.
Male....	7	10	8	7	7	7	7
Female..	8	19		9	8	9	7

Station 41*s*. See Table VI.
Station 42*p*. See under *Pseudocalanus.*
Station 42*y*. Table X.
Station 43*e*. Table VII.
Station 46*b*. Bernard harbour, depth 6 fathoms, ice 5 feet thick, vertical haul with net number 3, from bottom to surface, temperature 29·2° F., February 5, 1916. About half a dozen Copepods in all, including: *Oithona similis, Oncaea conifera, Idyæa furcata,* and *Dactylopusia signata.*

Station 46*h*. Dolphin and Union strait, off Chantry island, depth about 50 feet, ice 4 feet thick, three vertical hauls, with net number 3, from 33 feet to surface, June 10, 1916. Several *Oithona,* with several immature *Idyæa furcata* and one *Cyclopina schneideri* ♀.

20. **Cyclopina schneideri** T. Scott, 1903.

Thomas Scott: Notes on some Copepoda from the Arctic Seas collected in 1890 by the Rev. Canon A. M. Norman, F.R.S., Ann. Nat. Hist. (7) XI, 1903, p. 6.

Station 40*c*. See Table XIII.
Station 40*d*. Table XIV.
Station 41*g*. Bernard harbour (outer harbour), depth 0–2 fathoms, surface 5 minutes, net number 3, August 1, 1915.

TABLE XV (STA. 41*g*).

Eurytemora herdmani, one female.
Cyclopina schneideri, one male, one female.
Harpacticus uniremis, one (injured).
Harpacticus superflexus, 48 examples, including several males and one female with ovisac.

Station 46*h*. See under *Oithona*. A female from this station measured 0·84 mm., caudal rami shorter than anal segment as 5 : 6; length of caudal ramus to breadth as 5: 3; interrelations of caudal setæ as in *C. litoralis* Brady.[1] Anterior antennæ 12-jointed, with six terminal subequal small joints; of the proximal joints the fourth is the shortest, the sixth the longest, agreeing with Scott's figures and thus establishing the constancy of these proportions. The mandible, also figured by Scott, has a large B2 (the basal joint of the palp), shaped like an ascidian, carrying at the summit an outwardly curved two-jointed Ri, which is separated by a wide concave interval from the four-jointed Re.

[1] W. Giesbrecht: Die litoralen Cyclopiden des Golfes von Neapel. Mitth. zool. Stat. Neapel 14, 1901 ,pp. 40–46.

The fifth legs (Fig. 28) are two-jointed, the second joint carrying three setæ at the end, a slender one in the middle, a stout vaned (bilimbate) se and a similar but smaller si; the proximal joint carries a simple se, like the apical seta.

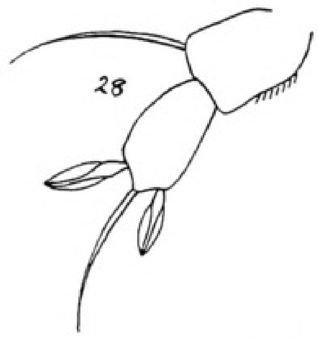


Fig. 28. *Cyclopina schneideri.*
Fifth leg of female.

The male, from station 41*g*, was nearly 0·74 mm. long. Anterior antennæ two-thirds the length of the forebody, with 16 joints; joints 4 to 9 inclusive are telescoped, 10 to 14 inclusive form the intumescence; the 10th joint carries two spiniform processes applied to the anterior face of the 11th; the remaining segments of the enlarged part with pectiniform setæ.

21. **Oncaea conifera** Giesbrecht, 1891.

For reference see Nordisches Plankton, Bd. IV, Lief. VIII, Copepoden by Dr. van Breemen, p. 188–9, Kiel und Leipzig, 1908.

Station 30*a*. See Table VIII.
Station 42*y*. Table X.
Station 42*z*. See under *Pseudocalanus*. A single female preserved from this station measured 0·65 mm. in length.
Station 46*b*. See under *Oithona*. This is an Arctic species with an exceedingly wide southerly range even reaching to the Antarctic ocean. Or it might perhaps be described as a Mediterranean species, ranging north, south, east and west from its centre of distribution. It cannot be stated positively whether it is an Arctic emigrant to the south or a Mediterranean migrant to the north. The evidence from the present collection bearing upon this point is not very cogent, but, so far as it goes, it points to the north as the home of this species. What is true of the distribution of *Oncaea conifera* applies also to *Oithona similis*, except that the latter, like *Acartia longiremis*, penetrates into the Baltic, from which sea *Oncæa conifera* appears to be excluded.

C. Harpacticoida.

22. **Ectinosoma neglectum** Sars, 1904.

G. O. Sars: Crustacea of Norway. Copepoda-Harpacticoida, Bergen, 1904, p. 31.

Station 40*d*. See Table XIV.
Station 40*e*. See under *Oithona*.
Station 40*r*. See under *Acartia longiremis*.
An immature female from station 40*r* was 1·07 mm. long; the distal joints of the fifth legs were not separated from the rest of the lamelliform appendage, but the marginal setæ were present and elongated. The inner and

outer branches of the fourth legs were 3-jointed and equal. Anterior antennæ with five joints; in the figure of the antenna most of the setæ are omitted; on the terminal joint one of the setæ has a swollen base (Fig. 29).

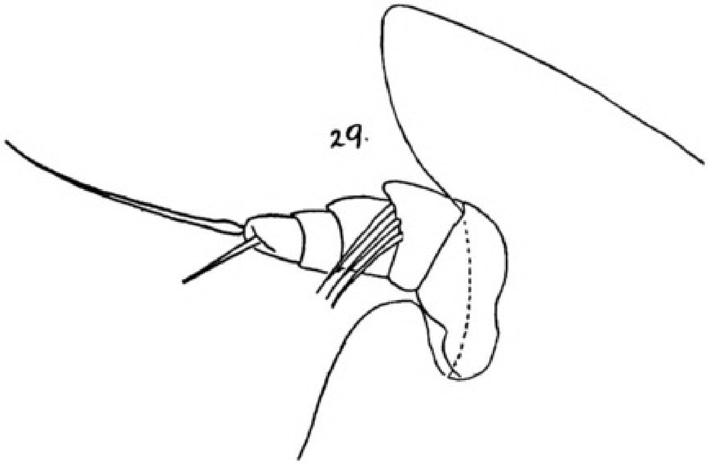


Fig. 29. *Ectinosoma neglectum* ♀ juv.
Front and anterior antenna.

The anterior lip (labrum) projects in front of the mouth-parts as an acute recurved hook in both sexes. Two males, from station 40*e*, measured 0·77 and 0·86 mm. respectively. On the ventral side, the posterior borders of the abdominal segments are fringed with delicate spinules, including the pre-anal and anal segments, on which the spinules are smaller. On the dorsal aspect, the posterior borders of Ab 1, Ab 2, Ab 3, and Ab 4 are conspicuously fringed. The urosome of the male consists of six segments: Th 5 and Ab 1-5.

The anterior antennæ of the male (Fig. 30) are thick and short, with a double protuberance at the back of the third joint. This protuberance is shown as a single tubercle in the figure by Sars.

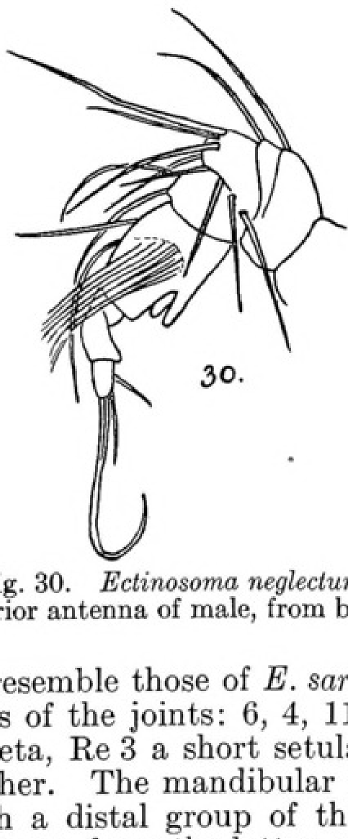


Fig. 30. *Ectinosoma neglectum*.
Anterior antenna of male, from below.

The posterior antennæ resemble those of *E. sarsi;* the Re is 3-jointed with the following relative lengths of the joints: 6, 4, 11; Re 1 carries a distal seta, Re 2 a stronger and longer seta, Re 3 a short setula and two terminal plumose setæ, one longer than the other. The mandibular palp likewise resembles that of *E. sarsi:* a long B2, with a distal group of three setæ, carries a terminal one-jointed Re and, at a distance from the latter, a shorter tri-setose Ri.

The caudal furca is as long as the anal segment (Fig. 31): there is a short strong spine on the outer margin of each ramus and, more distally, a group of two slender auxiliary setæ.

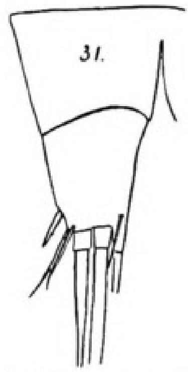


Fig. 31. *Ectinosoma neglectum* ♂.
Left ramus of caudal furca from above.

Fifth feet (p. 5 ♂) have the marginal spines not exactly with the same interrelative lengths as figured for the type by Sars, but the anterior or appendicular seta arises from the distal joint near the base as in the original (Fig. 32).

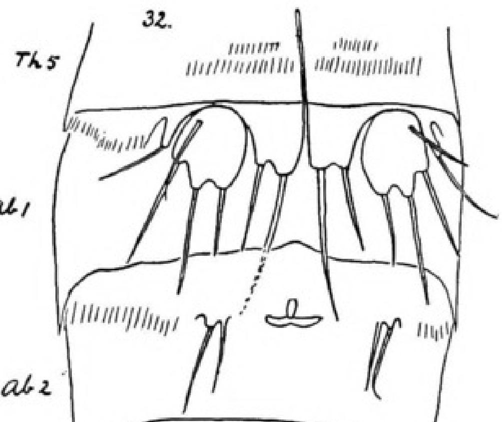


Fig. 32. *Ectinosoma neglectum*.
Fifth feet with part of urosome.

Swimming feet (p1-p4) show some variation in arrangement of setæ in different individuals and even on the two sides of one. All the Ri 3 have five setæ (1 se 4 si); p 1 Re 3 has six setæ, as in *E. sarsi* (3 se, 1 st, 2 si); p 2 Re 3 has seven setæ (3 se, 1 st, 3 si) instead of eight in *E. sarsi;* p 3 Re 3 has eight setæ (3 se, 1 st, 4 si); in two specimens the proximal se of p 3 Re 3 was absent on one side, in another the full number occurred on both sides; p 4 Re 3 has seven setæ (2 se, 1 st, 4 si).

23. **Ectinosoma finmarchicum** (T. Scott, 1903.)

Station 27 *t*, *u*. See Table IV.

Female of 1·07 mm., carrying a yellow ovisac in the preserved state. Anterior antennæ 6-jointed; p 2 Re 3 with seven setæ as in *E. neglectum*. Upper lip bluntly rounded. The fifth legs have the inner seta of the lamellar process and the middle seta of the distal lobe equal and longer than the rest (Fig. 33). The appendicular seta arises from the distal lobe near the base, whereas in

Scott's figure (op. cit. pl. 1, f. 13), it is shown arising from the basal joint. The inner lamellar process and the distal lobe of p 5 are elongate and subequal. The caudal setæ reached a length of 0·64 mm.

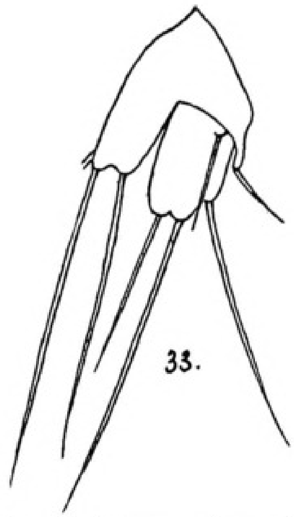


Fig. 33. *Ectinosoma finmarchicum.* Fifth foot of female.

Sars cites *E. finmarchicum* as a doubtful synonym of *E. elongatum*, adding that the latter is of smaller size, 0·88 mm. He figures the appendicular seta of the distal lobe of p 5 in *E. elongatum* as arising not far from the distal margin of the lobe.

24. **Pseudobradya minor** (T. and A. Scott, 1896).

Station 41*n*. Bernard harbour (inner harbour), depth 0–2 fathoms, surface 5 minutes, net number 3, August 9, 1915. Associated with *Harpacticus superflexus* (see below).

Length of female 0·664 mm., caudal setæ 0·178 mm. Anal segment and caudal ramus form a simple cone in side view, the ramus appearing slightly

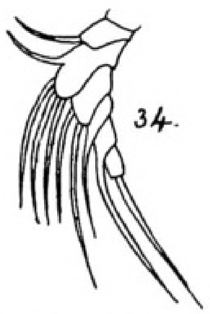


Fig. 34. *Pseudobradya minor.* Anterior antenna of female.

shorter than the anal segment as 5: 6. Anterior antennæ (Fig. 34) 6-jointed, proximal parts expanded. Posterior antennæ with 3-jointed Re, the proportional lengths of the joints being 2, 1, 9.

First and second maxillipeds are shown in their relative positions in Fig. 35. The first maxilliped (mp 1) is stout and curved, the two proximal joints subequal in length. The second maxilliped (mp 2) is short and straight, with very long plumose basal seta, about twice the length of the appendage.

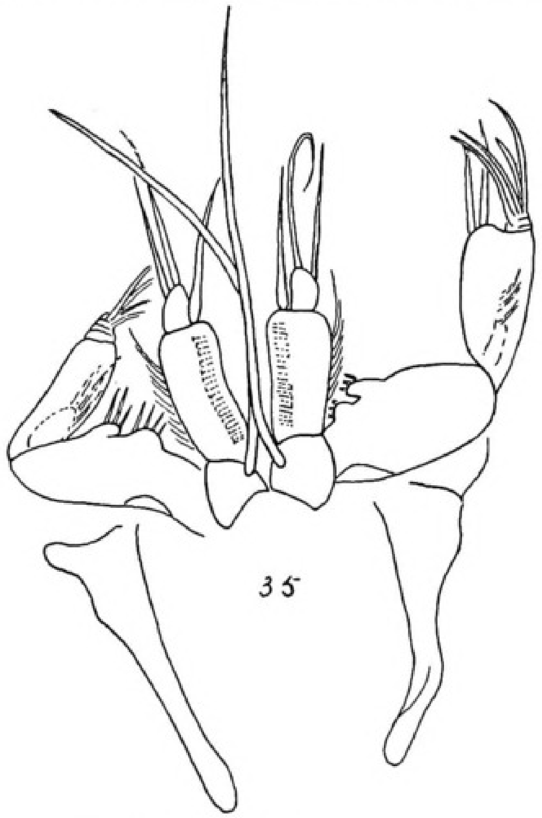


Fig. 35. *Pseudobradya minor.*
First and second maxillipeds.

The arrangement of setæ on the thoracic legs is the same as that indicated for the two before-named species of *Ectinosoma;* in particular p 2 Re 3 has seven setæ (Fig. 36).

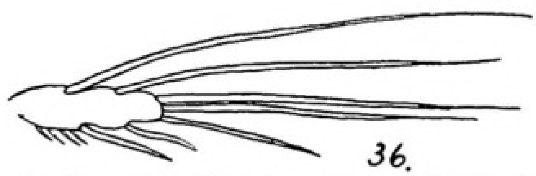


Fig. 36. *Pseudobradya minor.* P 2 Re 3.
The outer margin is below.

In the third foot (p 3) the basal joints (B1 and B2) are broad, and the rami are inserted upon the outer half of B2, so that the right and left Ri are

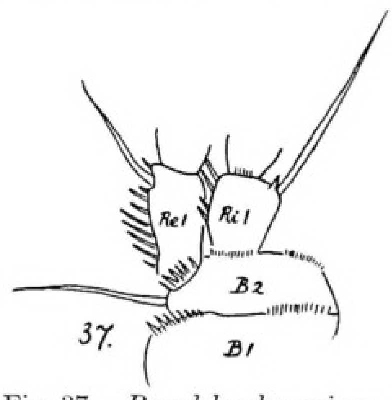


Fig. 37. *Pseudobradya minor.*
Part of third foot, anterior surface.

widely separated; B2 has an se, and rows of spinules at the bases of the rami and around the inner angle; B1 has a distal marginal anterior row of spinules interrupted in the middle of the series (Fig. 37).

The fifth foot resembles that of the type, but the marginal setæ are uniformly longer than in the figure by Sars (Fig. 38).

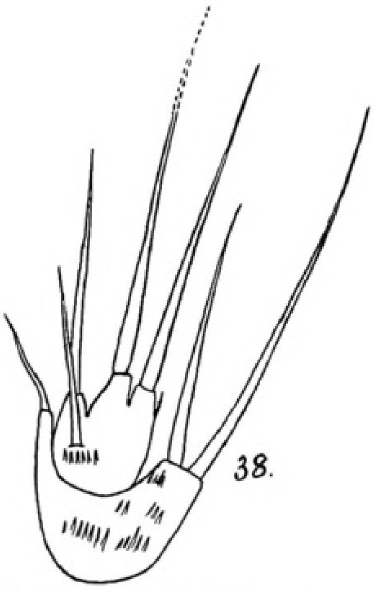


Fig. 38. *Pseudobradya minor.*
Fifth foot of female.

The form here described differs slightly from the typical *Ps. minor* in certain proportions, somewhat as *Ectinosoma neglectum* differs from *E. sarsi.* In the gathering from station 27 t, u, (see remarks under Table IV) there was another *Pseudobradya,* of 0·86 mm., caudal setæ 0·51 mm., which may be the *Ps. acuta* of Sars. It comes very near to *Ps. acuta* by its rostrum, p 5, and furca; but in p 5 the appendicular seta arises near the base of the distal joint, whereas in *acuta* Sars describes and figures it as issuing from the basal joint.

In *Ps. minor* Sars mentions the caudal setæ "not much elongated". In *Ps. acuta* the caudal setæ are "slender and elongated". Sars obtained only two examples of *Ps. acuta,* in company with *Ps. minor,* at Selven, Trondhjem Fiord. A similar origin of the appendicular seta from the basal joint was figured by T. Scott for *Ectinosoma finmarchicum,* wherein this species would differ from *E. elongatum* Sars, which was also found only at Selven in 3-6 fathoms, on muddy sand. The value of the appendicular seta as a diagnostic feature seems not to be fully established.

25. **Harpacticus superflexus,** n. sp.

This species resembles *H. flexus* Brady in all but size and the shape of the finger of the posterior maxilliped.

Station 25*b*, *c*. See Table III. Immature.
Station 30*a*. Table VIII. Immature ♂.
Station 40*c*. Table XIII ♂
Station 40*d*. Table XIV. ♂ 1·05 mm.
Station 41*g*. Table XV. 48 examples.
Station 41*n*. See under *Pseudobradya.*

Length of female, 1·20 to 1·26 mm., of male, 1·04 to 1·12 mm.; caudal furca a little longer than anal segment, caudal setæ, 0·65 to 0·69 mm., sometimes shorter in the male. Urosome stout, barrel-shaped; caudal rami parallel, as broad as long, spinose distally. The body in the preserved state is often transparent. The cephalosome has a polished convex dorsal surface; the remaining segments of the thorax are smooth, with a metallic lustre, and groups of small dark spots on the pleuræ.

Anterior antennæ 9-jointed, seven-tenths the length of the cephalosome measured in the middle line. Posterior antennæ with Re two-jointed (Fig. 39); the number and arrangement of setæ is subject to variation, as is the relative length of the two joints.

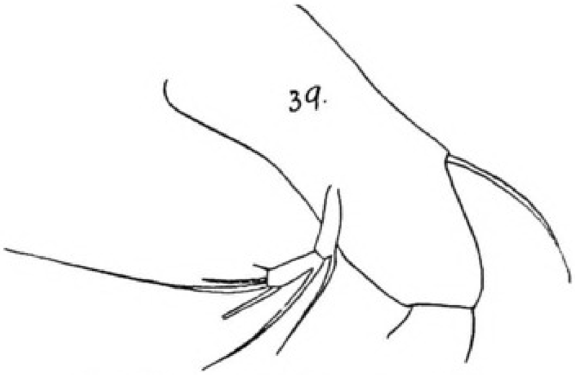


Fig. 39. *Harpacticus superflexus.*
Base of posterior antenna showing the two-jointed Re.

The mandible has the structure shown in Fig. 40, both rami of the palp being one-jointed; the outer ramus is the smaller; on the other mandible of this individual instead of the two si of Ri shown in the figure, there was a group of three setæ as in *Tigriopus* (Sars).

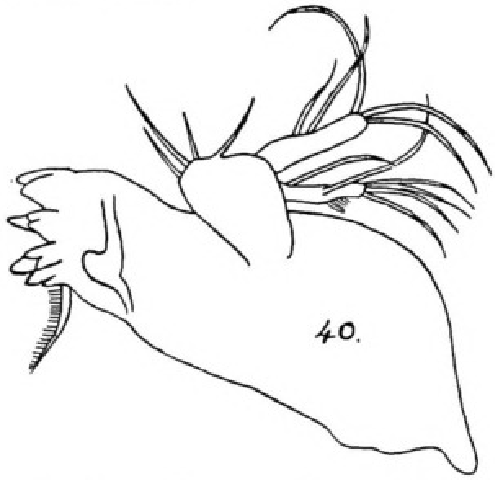


Fig. 40. *Harpacticus superflexus.* Mandible.

The maxilla was like that of *H. chelifer,* with two long plumose setæ behind the masticatory claws on B 1, as figured by Sars; below the claws (observed in the male) were two subequal setæ with distended proximal portions and long-plumed attenuated distal portions; B2 bifid, the proximal inner smaller lobe carrying two equal plumose setæ, the upper larger lobe, a group of setæ; Ri and Re both tri-setose.

First maxilliped (mp 1): B 1 with three setigerous digitiform inner lobes (Li); B 2 is the distal digitiform segment of the appendage, carrying a sub-

Fig. 41. *Harpacticus superflexus.* Terminal portion of first maxilliped.

distal group of four setæ and terminating in the claw or dactylus of the appendage; above the claw, and parallel with it, there is a plumose seta, and another smaller seta below it (Fig. 41).

Second maxilliped (mp 2): like that of H. flexus, with simple fusiform hand, but the dactylus is shorter than the hand as 2: 3 (fig. 42).

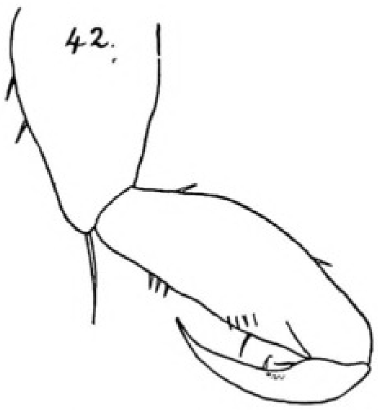


Fig. 42. *Harpacticus superflexus.* Second maxilliped.

The first thoracic foot (p 1) is like that of *H. flexus*, both rami two-jointed, Ri about as long as the proximal joint of Re; Ri 2 with a claw-like spine and two setæ at the end, Ri 1 with distally placed si (Fig. 43); Re 2 ending with three curved claws and a slender seta. In the second thoracic foot (p 2 ♀) it is to be noted that the middle joint of the inner ramus (Ri 2) has two si, against one si figured for *H. chelifer*; this duplication of the si was found in two successive preparations on both sides. The third and fourth legs agree with *H. chelifer*.

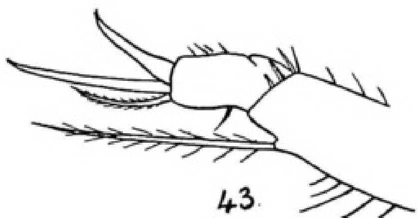


Fig. 43. *Harpacticus superflexus.*
Terminal portion of inner ramus of p 1.

In the male, the second foot (p 2 ♂) has the mucronate process of Ri 2 only a little exceeding the length of Ri 3 (Fig. 44).

Fig. 44. *Harpacticus superflexus.* P 2 Ri of male.

In the third foot of the male (p 3 ♂), Re 1 is two-thirds the length of Re 2 and Re 3 together, the relative lengths of these joints being 26, 19, 20; the enlarged outer spines of Re 3 are graded as 10, 17, 27; thus Re 3 se 3 is to Re 3 as 27 : 20, the se 3 has usurped the position of the terminal seta (st), so much so that the latter appears to belong to the series of si, of which there are four (in addition to the st); the st has about twice the bulk of the fourth si, but it is flexible, longer and much slenderer than the se 3. In *H. chelifer* ♂ the p 3 Re 3 st is rudimentary; in *H. uniremis* ♂ it makes a fourth spine. In *H. gracilis* ♂ the st is like that of H. *uniremis*, but the Se 3 is the shortest of the series. The male of *H. flexus* is undescribed.

Fifth legs of female (p 5 ♀): inner lamellar process low, broad, evenly arched, with four marginal spines; distal joint with five marginal spines (Fig. 45).

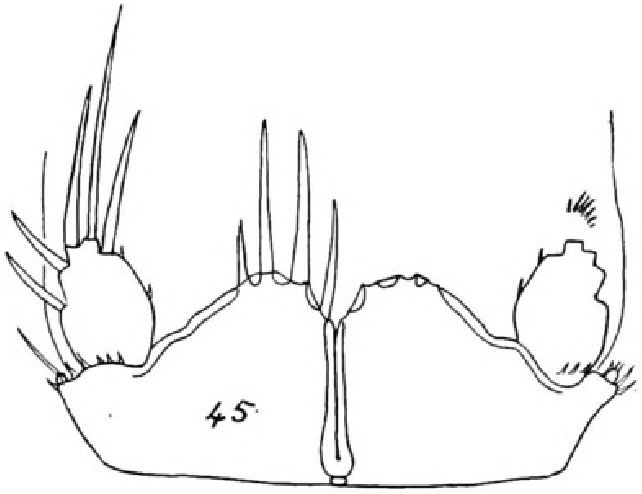


Fig. 45. *Harpacticus superflexus.* Fifth legs of female.

Fifth legs of male (p 5 ♂): inner lamellar process absent as in *H. uniremis;* an arcuate row of spinules occurs on the segment (Th 5) to the outer side of p 5; in front of this arc there is a transverse row of points, and a corresponding oblique row occurs on the genital segment (Fig. 46).

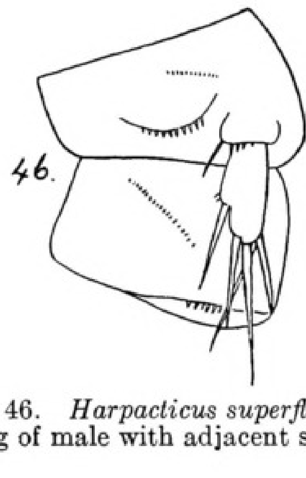


Fig. 46. *Harpacticus superflexus.*
Fifth leg of male with adjacent segments.

With reference to the pelagic occurrence of this species, it may be mentioned that Brady (Brit. Cop. 1880, II, p. 152) records that *H. flexus* had been taken by the surface net in Westport Bay, Ireland; elsewhere at the bottom in depths of 1 to 20 fathoms.

The anterior antennæ of the male present the distal expansion found in other species of *Harpacticus;* when viewed from the outer aspect the dactylus is seen to possess a lateral spur and tubercle.

26. **Harpacticus uniremis** Kröyer.

Station 7*a*. 55° 42′ N., 136° 20′ W., surface 5 minutes, net number 3, June 25, 1913. Seventeen examples. One female measured 1·4 mm., one male 1·28 mm., another male 0·80 mm. In addition, there were young Gammaridea and an Ostracod (*Conchoecia*).

Station 13. 54° 30′ N., 159° 42′ W. Several surface gatherings, with net number 3, July 1, 1913. There were some *Cypris* larvæ of Cirripedes.

TABLE XVI (STA. 13).

Calanus tonsus. Three, immature.
Pseudocalanus elongatus ♀. One.
Metridia lucens ♂. One.
Acartia longiremis ♂ and ♀. Five.
Acartia tumida ♀. Three.
Harpacticus uniremis ♂ and ♀. Eleven.

One female bearing ovisac was 1·20 mm. long, caudal setæ 0·80 mm.; anterior antennæ 9-jointed; p 1 with four biserrulate claws at end of Re and one such claw at end of Ri. The terminal claw on p 1 Ri is accompanied by a falciform seta, which is often broken quite regularly at one spot. appearing as if jointed (Fig. 47).

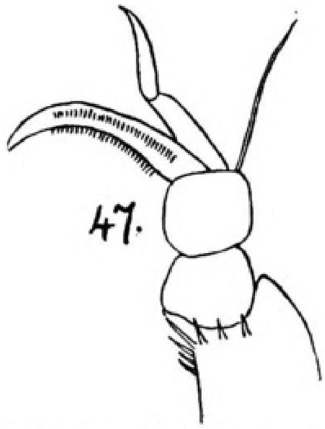


Fig. 47. *H. uniremis* ♂.
Terminal portion of p 1 Ri; from station 13.

The maxilla is like that of *H. chelifer;* B2 bifid, the rami one-jointed, Ri trisetose, Re quadrisetose, the masticatory setæ vaned (Fig. 48).

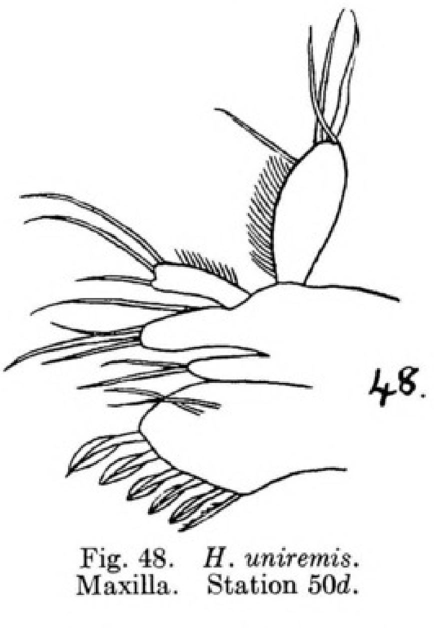


Fig. 48. *H. uniremis.*
Maxilla. Station 50*d*.

Second maxilliped: B 2 with a proximal comb of spinules on its anterior face (Fig. 49) and two combs on its posterior face, one proximal and one central, as figured by Sars.

Station 14. See under *Paralabidocera.* One ovigerous female, length 0·96 mm.

Station 41*g*. Table XV. One example of 1·36 mm.

Station 42*p*. See under *Pseudocalanus*. Several examples comprising males and females. Length of one male 1·2 mm. When the body is viewed from the side, without further preparation, it can be observed that the ectal spinules or spinules on the outer surface of Re 1 in p2–p4 are arranged in three oblique rows:

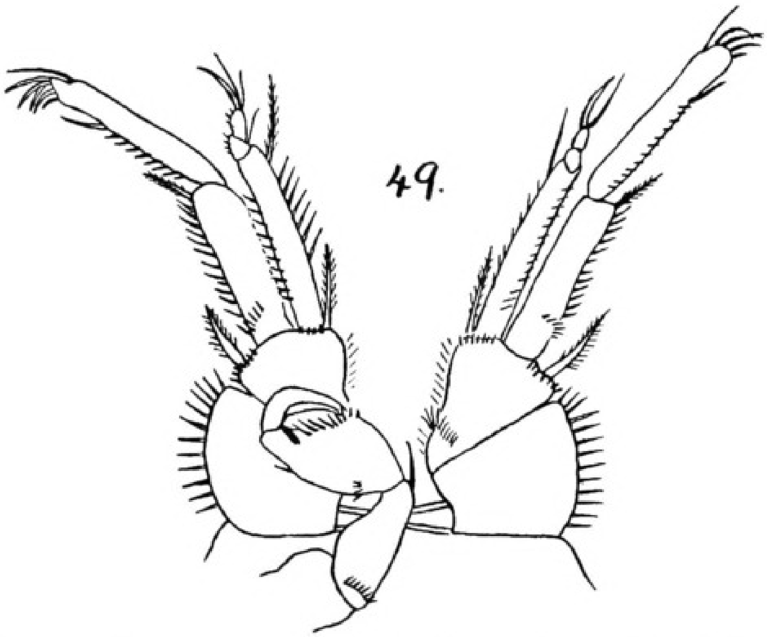


Fig. 49. *H. uniremis*. First pair of legs and second maxilliped (of right side) in position. Station 50*d*.

this is indicated in a figure by Sars. The anterior antennæ of the male present a distal expansion followed by a movable finger (dactylus) which is furnished with a smooth spur projecting forwards, as described and figured by Sars; in certain aspects the spur looks like the main body of the joint.

Station 50*d*. Young point, Dolphin and Union strait, Northwest Territories, in beach water amongst algæ, July 21, 1916. There were three Harpacticoids in the vial, one *Idyœa furcata*, and two *H. uniremis* ♀. One female carried an ovisac, and there was a loose ovisac in addition; length of ♀, 1·3 mm. In the thoracic legs, p 2 Ri 2 has two si; p 5 with 4 marginal spines on the inner expansion and 5 on the distal lobe.

Sars finds that the *H. chelifer* var. *arcticus* described from Bering Sea on floating kelp by S. A. Poppe (Arch. f. Naturgesch. 50, 1884) belongs to *H. uniremis*. According to the same author, it is found along the whole Norwegian coast, but only in depths of 20 to 100 fathoms. L. W. Williams found it in Narragansett Bay abundant in tow-nettings in shallow water,[1] and I have found it amongst the stomach contents of the winter flounder at St. Andrews, N.B. It has not been taken at Woods Hole.[2]

27. **Idyæa furcata** (Baird).

Station 20*a*. See Table IX. One female.

Station 40*r*. See under *Acartia longiremis*. Several females, one with ovisac, 1·03 mm., another 1·00 mm., another 0·80 mm., and a fourth 1·05mm.; relative lengths of Th 5, Ab 1–4, and furca: 10, 15, 10, 9, 8, 6. The first and second maxillipeds when seen in situ appear much alike, uncinate; the anterior with larger claw, biarticulate; the posterior, three jointed, the claw itself having an intercalary joint at its base.

Station 41*s*. See Table VI.

[1] L. W. Williams: Notes on marine Copepoda of Rhode Island. Amer. Nat. 40, p. 653–4, 1906.
[2] R. W. Sharpe: Copepoda of Woods Hole. Proc. U.S. Nat. Mus. 38, pp. 405–436, 1910.

Station 42*p*. See under *Pseuducalanus* for position.

TABLE XVII (STA. 42*p*).

Pseudocalanus elongatus. One ♀.
Eurytemora herdmani. One ♂.
Oithona similis. Four.
Harpacticus uniremis. Seven (♂ and ♀).
Idyœa furcata. Two ♀.
Danielssenia stefanssoni. Five females.

Length of one ♀, 1·2 mm., anterior antenna 8-jointed; setæ with penicillate tips on p 1 Re 3, p 1 Re 2, and p 1 Ri 3.

Station 42*y*. See Table X.

Station 42*z*. Dolphin and Union strait, off Bernard harbour, depth 17 feet, ice $2\frac{1}{2}$ feet thick, midnight, water temperature 29·2° F., three vertical hauls bottom to surface, December 12, 1915.

TABLE XVIII (STA. 42*z*).

Pseudocalanus elongatus, males and females.
Metridia longa, young (2-jointed urosome).
Acartia longiremis.
Oncœa conifera, one female.
Idyœa furcata, many young and adult.

There was a female with ovisac containing eggs in the first nauplius stage. One male measure 0·88 mm. In immature *Idyœa furcata* both the apical claws of p 1 Ri 3 were observed to be penicillate; in the adult only the longer of the two is penicillate.

Station 46*b*. See under *Oithona*.

Station 46*h*. See under *Oithona*. Several immature examples.

Station 50*d*. See under *Harpacticus uniremis*. A single female with ovisac; length 1·13 mm.

I have also found this species very abundant in the stomach contents of the winter flounder at St. Andrews, N.B., associated with *Harpacticus uniremis*.

28. **Dactylopusia signata**, n. sp.

Station 40 *c*, *d*, *e*. See under *Oithona*.

Station 41*n*. Bernard Harbour, Northwest Territories, depth 0–2 fathoms, August 9, 1915; associated with *Harpacticus superflexus*, *Amphiascus nasutus*, and *Danielssenia stefanssoni*.

Length of one female 0·8 mm., of another 0·63 mm. None was found with ovisac and no male was observed. Rostrum blunt, conspicuous in side view. Caudal rami very small, shorter than the anal segment, the innermost

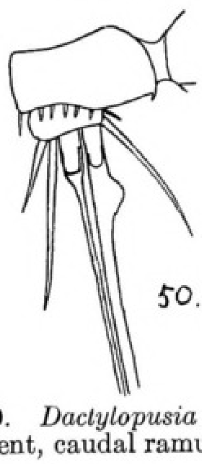


Fig. 50. *Dactylopusia signata*.
Anal segment, caudal ramus and setæ.

but one of the terminal setæ on each ramus with a characteristic rounded protuberance near the base on the inner side. This ental protuberance of the caudal seta is the chief distinctive mark, to which the specific name refers (Fig. 50).

Anterior antennæ 9-jointed, the 8th joint very small and a constant characteristic (Fig. 51). Mouth-parts normal; the first maxilliped is clawed like the second, its claw being longer and more powerful than that of mp 2; the basal joint of mp 1 has three inner setigerous lobes of which the proximal was observed with a single long thick soft seta, the other two having more than one seta at their apices.

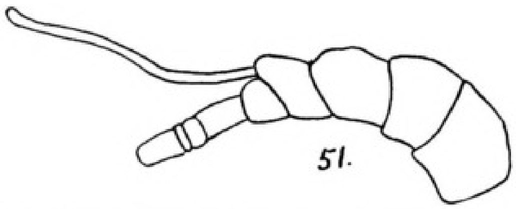


Fig. 51. *Dactylopusia signata.* Anterior antenna.

The first thoracic legs are like those of *D. thisboides* and *D. neglecta;* Ri 1 with a plumose si at the centre of the joint. The outer distal angles of Re 1 and 2 of the natatory legs are not conspicuously produced, as they are in *D. thisboides.* Second legs with setæ as in *D. thisboides;* the ectal spinules of Re are coarser than those of Ri; B2 with slender se and triangular acute ental spur, a feature also found in *D. thisboides;* in p 2 Ri 2 the slender proximal si arises distad of the centre of the joint. Third legs: B2 with still slenderer se and very small ental spur. In the fourth legs the Ri 2 has only one si and this appears to be distinctive.

In the natatory legs p 2 to p 4 the terminal seta of the outer ramus is longer than the entire ramus, in p 4 much longer. The se 3 has the same length as the Re 3 in p 2 and p 4, a little shorter than the Re 3 in p 3.

The fifth legs appear to differ from *D. thisboides* in the interrelative lengths of the marginal spines, but the general correspondence is remarkably close (Fig. 52).

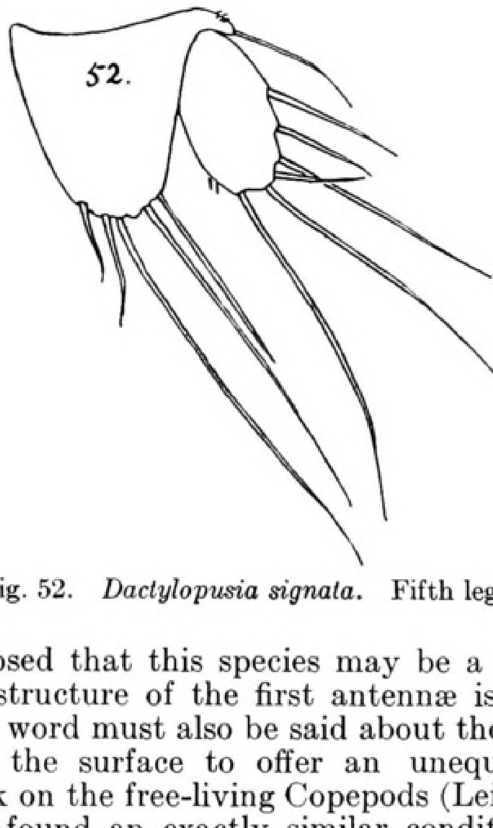


Fig. 52. *Dactylopusia signata.* Fifth leg.

It might be supposed that this species may be a submature " instar " of *D. thisboides,* but the structure of the first antennæ is hard to reconcile with such a supposition. A word must also be said about the character of the caudal seta, which seems at the surface to offer an unequivocal distinction. On consulting Claus's work on the free-living Copepods (Leipzig, 1863) at a distance from my material, I found an exactly similar condition of the setæ figured for *Thalestris forficula* Claus. This species is now placed by Sars in a new genus, *Microthalestris,* and nothing is said about the " kolbig angeschwollen " bases of the caudal setæ, although a figure by Sars shows them slightly enlarged. A similar condition, again, still more pronounced, is figured by Sars for *Amphiascus giesbrechti*, but here the protuberance is directed outwards.

Whatever may be the significance of this small tubercle on the caudal setæ, it is of some interest to find it occurring in three different genera.

29. **Amphiascus nasutus** (Boeck).

Station 41*n*. See under *Dactylopusia signata*.
Station 43*e*. See Table VII.

This is, for its size, a stout harpacticoid with heavily built cylindrical urosome. Length of female, 1·22 mm., of male, 0·72 mm. Caudal ramus truncate, shorter than anal segment (Fig. 53).

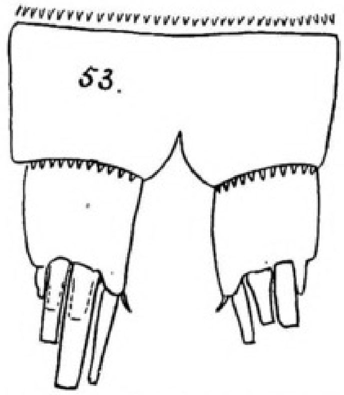


Fig. 53. *Amphiascus nasutus.*
Anal segment and furca from below.

Anterior antennæ distinctly 9-jointed, the proportional lengths of the joints being: 7, 5, 5, 7, 2, 3, 1·5, 2, 4. Posterior antennæ with Re three-jointed, the middle joint short; Re 1 with one seta, Re 2 achætous, Re 3 with one proximal and two strong apical setæ with several setules around their bases. Second maxilliped with the si of the hand arising towards the distal end of the joint.

Thoracic legs: p 1 with both rami three-jointed as in Dactylopusia, but the si of Ri 1 is inserted near the distal end of the joint (Fig. 54).

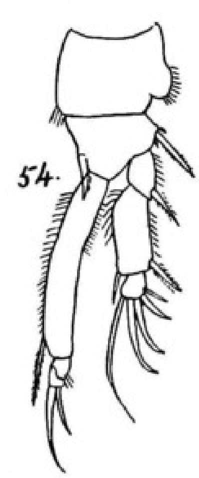


Fig. 54. *Amphiascus nasutus.* P 1.

In the second leg (p 2), Ri 2 has two setæ, Ri 3 has only four (1 se, 3si), in place of the five in *Dactylopusia* (Fig. 55); B2 has a slender se and a short thorn-like process in place of an si; outer distal angles of Re 1 and Re 2 are produced into two thick-based, somewhat blunt acuminations, that of Re 2 larger than that of Re 1 (Fig. 56). In the fourth leg Ri 2 has only one si (Fig. 57); Re 3 only seven setæ (3 se, 1 st, 3 si).

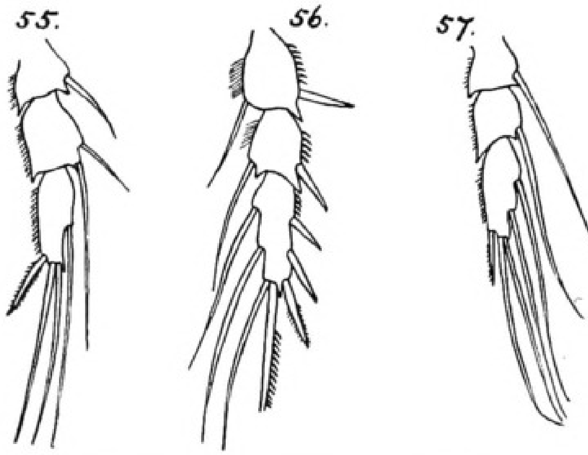


Fig. 55. *A. nasutus* ♀. p 2 Ri.
Fig. 56. Same. p 2 Re.
Fig. 57. Same. p 4 Ri.

The fifth legs (p 5 ♀) are highly characteristic, with a long and steep declivity occupied by a few spinules, stretching between the two outermost spines of the distal lobe (Fig. 58). Behind the innermost setæ of the inner lobes there is seen a chitinous thickening proceeding backwards from the genital opening.

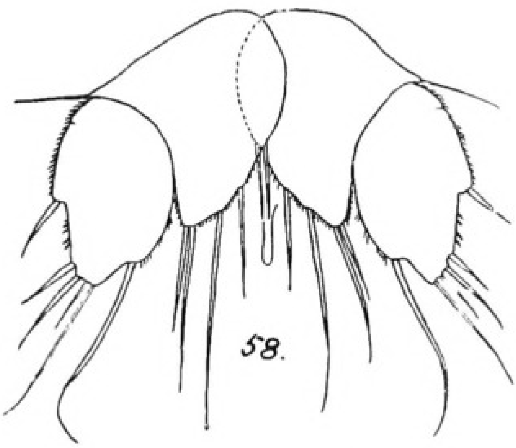


Fig. 58. *Amphiascus nasutus.* p 5 ♀.

In the male, the inner ramus of the second foot is transformed in an extraordinary manner, as in the type figured by Sars.

30. **Tachidius brevicornis** Lilljeborg, 1853.

Station 40*v*. Creek mouth at Bernard harbour, Northwest Territories, 0–1 fathom, July 8, 1915.

The gathering consisted of seventeen small Harpacticoids, all of this species, all females, and all, with one exception carrying an ovisac.

Length 0·76 mm.; eggs counted in five ovisacs: 39, 43, 44, 44, 53. Arrangement of the setæ on the rami of the natatory legs p 1 to p 4 and dorsal crescentic spinulose anal valve as figured by Sars. In the first leg B2 has an ental spine set upon a prominent rounded boss and an equal ectal spine on the anterior surface (Fig. 59).

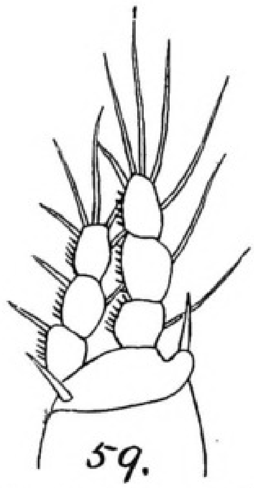


Fig. 59. *Tachidius brevicornis.* First leg, anterior surface.

31. **Danielssenia fusiformis** (Brady).

I have identified a single individual of this species from Station 25 *b*, *c*, taken at the surface close to ice, north of Cooper island, Alaska, August 27 and 28, 1913.[1] The length was about 0·85 mm. As a *Danielssenia*, its distinguishing feature is the 5-jointed antenna, but in the specimen this is not so decisive as could be desired. The terminal part of the antenna seems at a certain focus to consist of two joints. The antennæ carry a number of conspicuous thorny bristles, three of which are especially prominent upon the basal half of the terminal portion and one of them is inserted at the level where the articulation should occur. This bristle was lost on one antenna and its sharply defined broad base of insertion simulated an interarticular junction. The basal seta of the posterior maxilliped was damaged accidentally in the manipulation. The fifth foot accords with the figure by Sars.

Neither Brady nor Sars seems to be entirely satisfied as to the distinctness of *D. typica* and *D. fusiformis*, and the differential characters advanced by Brady are not those upon which Sars relies.

32. **Danielssenia stefanssoni,** n. sp.

Station 41*n*. See under *Dactylopusia*.

Station 41*s*. See Table VI.

Station 42*p*. Dolphin and Union strait, surface-tow, with net number 3, 10 minutes, Bernard harbour (outer harbour), water depth three fathoms, September 30, 1915.

TABLE XIX (STA. 42*p*).

Pseudocalanus elongatus	12 (young and adult).
Eurytemora herdmani	3 (males).
Oithona similis	4.
Harpacticus uniremis	11 (males and females).
Idyæa furcata	2 (females).
Danielssenia stefanssoni	5 (females).

Length of female, 1·226 mm. Rostrum prominent, defined behind. Caudal rami slightly exceed anal segment as 10 : 9. Anterior antennæ 6-jointed with following relative lengths of joints: 13, 10, 7, 4, 5, 5. Posterior antennæ with

[1] See Table III.

Re three-jointed; Re 1 carries a small proximal si inserted near the middle of the joint, in addition to its distal plumose si; the distal joint of the Ri carries a long spicate seta followed by three geniculate setæ, then, near the inner distal margin three strong spines; between the two subdistal spines of this group there is a long curved claw, not described in other species (Fig. 60).

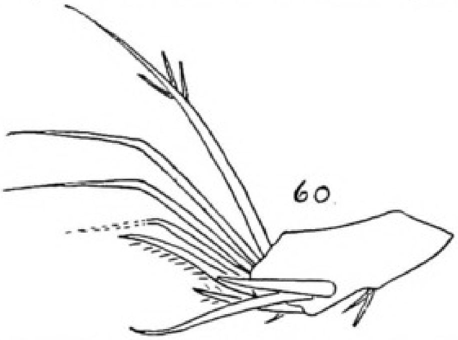


Fig. 60. *D. stefanssoni* ♂. Distal joint of inner branch of posterior antenna, viewed from the mesial surface.

In the mandible, arising from a point near the middle of the Ri, there is a group of three si instead of two si figured by Sars for *D. fusiformis;* observed in both sexes. In the maxilla, the small club-shaped Re carries three long plumose setæ flaring apart as figured by G. S. Brady for *D. fusiformis.* The armature of mp 2 differs from that of *D. fusiformis,* the two plumose setæ of the basal joint being inserted at the same transverse level instead of one behind the other (Fig. 61).

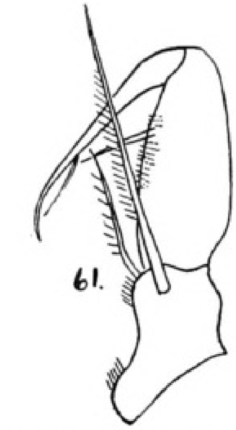


Fig. 61. Posterior maxilliped. *D. stefanssoni.*

The thoracic legs of the female offer few distinguishing characters: p 3 Re 3 has eight setæ (3 se, 1 st, 4 si); p 3 Ri 3 has six setæ (1 se, 5 si); p 4 Re 3

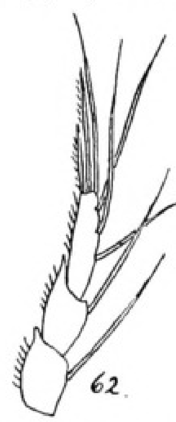


Fig. 62. *D. stefanssoni* ♀. P 3 Ri.

has eight setæ; p 4 Ri 3 has five (1se, 4 si). In the third foot (p 3) the outer distal angle of Ri 2 is produced into a simple cone in place of the mucronate process of the male (Fig. 62).

In *D. typica*, as figured by Sars, and in *D. fusiformis*, as figured by Brady, the Ri 3 of p 4 has four setæ, there being only one seta arising from the centre of the inner margin of the joint. In both sexes of *D. stefanssoni* there are three setæ at the apex of p 4 Ri 3, namely a short se and two longer si; on the inner margin of the joint there are two more si, a proximal one arising from the middle of the inner margin, and a distal one inserted between this and the apex of the joint. In *D. sibirica* Sars, p 4 Ri 3 has six setæ in the female, five in the male.

Fifth legs (p 5 ♀): hardly to be distinguished from *D. sibirica*, unless it is by the interspacing of the marginal spines on the inner lamellar expansion; differing from *D. fusiformis* in the more proximal origin of the innermost marginal spine of the inner lamella (Fig. 63).

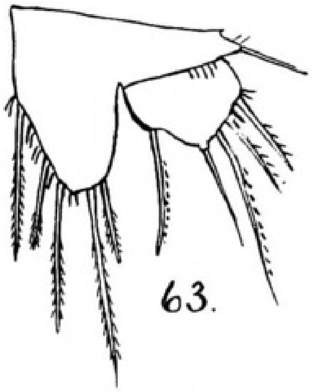


Fig. 63. *D. stefanssoni*. Fifth leg of female.

In one case the distal joint of one side showed an aberration in the presence of a long supernumerary spine at the inner side of the lobe, making a total of six marginal spines instead of the normal number, five (Fig. 64).

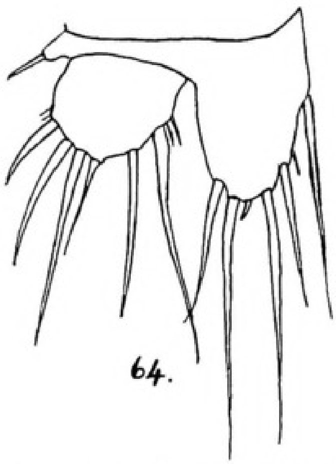


Fig. 64. *D. stefanssoni*. Aberrant fifth foot of female.

In the male, the fifth legs are small, the rounded distal joint with five setæ, the reduced inner lobe with two unequal setæ, as in *D. typica*.

Description of male; length 1·01 mm.; anterior antennæ subcheliform, as in *D. typica*, figured by Sars. The second thoracic leg (p 2) offers distinctive characters in the presence of a powerful hamate process on the inner side of

Ri 1, and of a serrulate rostriform process of the reduced Ri 3; the subulate process of Ri 2 is a generic character (Fig. 65 and 66).

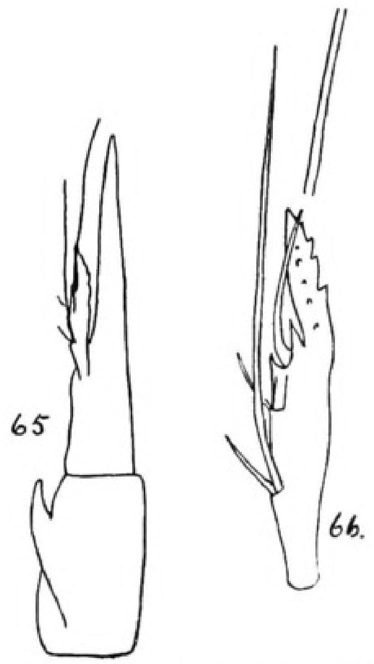


Fig. 65. *D. stefanssoni* ♂. P 2 Ri.
Fig. 66. Same. P 2 Ri 3 enlarged.

In the third leg of the male, Ri 2 is produced at its outer distal angle into a strong mucronate process of rather complex form (Fig. 67). In the fourth foot the distal angle of Ri 2 is produced into a slightly curved acuminate process.

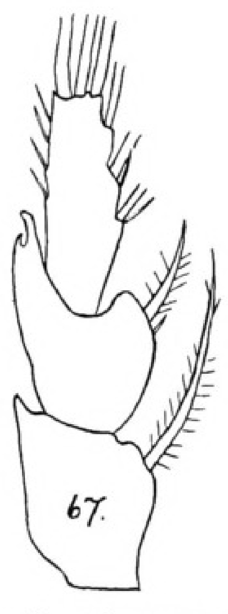


Fig. 67. *D. stefanssoni* ♂. P 3 Ri.

The only other species with which the characters of the male *D. stefanssoni* can be compared is *D. sibirica* G. O Sars (1898, Jana Expedition op. cit. p. 343). The hamate process on p 2 Ri is common to both. On the other hand, in *D. sibirica* the reduced Ri 3 of the second foot of the male is without a rostriform process. This is the cardinal distinction, the presence in the one and the absence in the other of a sharply defined character. The anterior antennæ in the female of *D. sibirica* are five-jointed.

D. Monstrillidae.

33. **Thaumaleus bernardensis,** n. sp.

Two males were taken at Station 42*z*, December 12, 1915 (see under *Pseudocalanus*). Length of one male 1·9 mm., of the other 2·4 mm. The description relates to the larger.

The head and first thoracic segment are fused together to form a cephalothoracic segment which only slightly exceeds the next three segments (Th 2–4). The lengths of the antennæ, of the cephalothorax, and of the three free pedigerous thoracic segments combined, are subequal, the proportions in the order named being: 55 : 56 ; 53. The hind-body, comprising the apodous fifth segment (Th. 5), the genital segment, two following segments and the furca, has the relative length represented by the number 35. Thus the forebody is approximately three times the length of the hind-body. The anal or last abdominal segment shows superficial indication of an imperfect division into two segments, the same appearance being presented by both individuals. Counting it as one segment, the caudal furca is a little shorter, in the ratio of 7 to nearly 8. There is a very small papilla on the ventral side of Th. 5, representing a rudiment of the fifth legs (Fig. 68).

The ventral lobes of the genital segment have the proportions shown in the figure. Each caudal ramus carries four setæ, the most ventral one being much shorter than the others (Fig. 68).

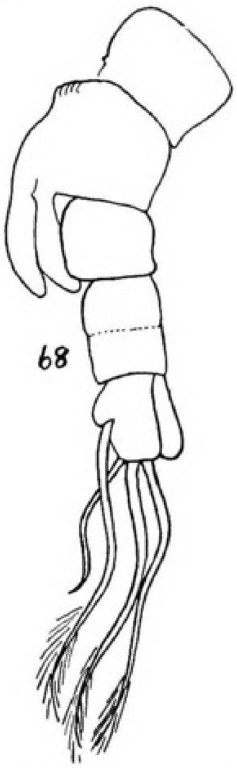


Fig. 68. *Thaumaleus bernardensis.*
Hind-body of male.

The distance between the frontal margin and the mouth cone is less than one-third of the distance of the latter from the hinder margin of the cephalothoracic segment. On the ventral side of the head there are several chitinous structures intervening between the anterior antennæ and the rudimentary mouth-cone. In front of the latter the cuticle is wrinkled, as mentioned by Giesbrecht for *Th. longispinosus,* and the wrinkles terminate in a small papilla.

which may represent a rudimentary (i.e., vestigial) labrum. In front of this there is another median papilla of uncertain significance, and before this again a pair of clear oval areas. At the base of each anterior antenna there is a small transversely elongate chitinous thickening. Finally, on either side of the supposed labrum there is a wrinkled papilla showing a small central cavity; these are the possible vestiges of posterior antennæ (Fig. 69).

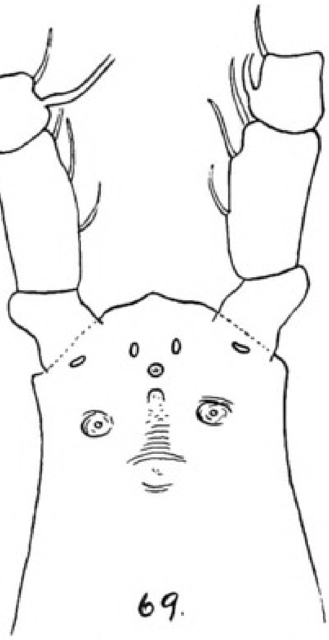


Fig. 69. *T. bernardensis.* Ventral side of head.

The five antennary joints have the numerical proportions 8, 10, 5, 15, 16. The fifth joint carries a strong, terminal claw-like seta, which can be held forwards or bent at a right angle to the joint. The following setæ are to be found at different points on the antennæ:—

First joint: a subulate seta with short plumes.

Second joint: five shortly plumose subulate setæ, of which three are to be seen at the margin (Fig. 69), and in addition a long plumose seta arising dorsally at the distal margin, whose long plumes occur on the slender distal portion of it.

Third joint: two long plumose setæ and a shorter subulate seta beset with fine points.

Fourth joint: sever. setæ, including a slender æsthetask or sensory filament and one long plumose seta: proximad of the long plumose seta are two marginal subulate setæ of which the proximal one is the longer; removed from the margin a little in front of the proximal subulate seta and proximad of the base of the long seta is the æsthetask. In *Th. longispinosus*, Giesbrecht figures the æsthetask alongside of the long seta. Distal to the base of the long seta is a marginal subulate seta like the proximal one. Exactly opposite the base of the long seta is a short subulate seta, and in front of this a precisely similar one. In Giesbrecht's figure of *Th. longispinosus*, in place of the single marginal proximal subulate seta, there are two equal setæ side by side.

Fifth joint (Fig. 70): there are three branched setæ, a long plumose seta, four soft slender setæ which look like æsthetasks, a marginal and a subterminal subulate seta and the terminal claw, making eleven altogether, as in *Th. longispinosus.*

The swimming feet are all alike, both rami three-jointed, the Re with 1. 0, 1 se; 1, 1, 4 si; and one st. The st is plumose, like the others. The Ri has 1, 1, 5 setæ. The se of B2 is quite small and slender, longer on the third feet, as is the case in other species. In the males of *Th. longispinosus* and *thompsoni*, there are only three si on the Re 3 of p 1, in addition to the st, according to Giesbrecht.

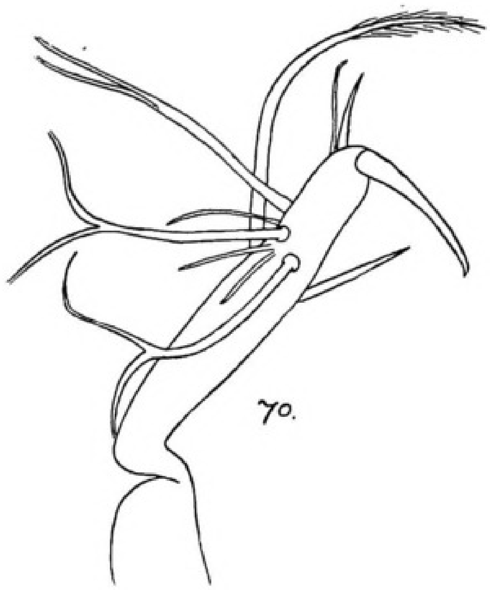


Fig. 70. *Th. bernardensis*. Terminal portion of left antenna; only the primary bifurcation of the branched setæ is shown.

The material obtained by the Canadian Arctic Expedition constitutes an imperfect index to the wealth of elemental life in the northern waters of Canada. The Copepods, as a class, provide fish food for food fish. There is an inexhaustible supply of this fish food in the Arctic ocean, whence it filters down into the northern seas, where commercial fisheries are carried on. By tracing out the southern extension of arctic and sub-arctic forms, a great deal has been accomplished in giving precision to problems which await solution in the North Atlantic. Similar exploratory and experimental work is required for the North Pacific. In this way materials would be forthcoming which would enable the age-composition of the different colonies of organisms on the sea-floor to be made out. Equipped with such data we should be able to foretell the probable incidence of lean years in the fisheries. With this information at their disposal the capitalist corporations would be able to curb their tonnage so as to maintain an economic equilibrium between the market and the deep sea. This is what biological work can do for the deep sea and other fishery interests. Leaving out of consideration the salmon family and some other anadromous fishes, science cannot effectively replenish the stock of fishes in the sea, but it can claim to predict the periodicity of fluctuations when the necessary data have been accumulated after many years.

No epidemics affect the plankton, but we know that higher animals are liable to various disorders and derangements whereby their numbers are reduced. The presence of an abundant food-supply does not unfailingly attract a multitude of feeders, and this fact, well-known to marine biologists and other naturalists, but not so well known to those who have had no actual experience in the matter of the interdependence of organisms, indicates that while there is no limit to the supply of primary food-stuffs in the sea, there are limits, in some cases very narrow, in others very wide, but always very definite, to the valuable species which subsist directly or indirectly upon this food.

Whilst investigating the distribution and periodicity of the food-organisms, the biologist is brought into contact with the feeders, and though his methods of extracting secrets from the sea may be slow, yet they are sure. Not sensational discoveries, but dogged perseverance, such as that exhibited to good purpose by the members of the Canadian Arctic Expedition, should be encouraged with a free hand, for the glory of Canadian science and the protection of Canadian maritime industry.

MONTREAL, June 30, 1919.