

NOTES ON A SMALL COLLECTION OF CALANOID
COPEPODS FROM THE NORTHEASTERN PACIFIC,
INCLUDING THE DESCRIPTION OF A NEW SPECIES OF
UNDINELLA (FAM. THARYBIDAE)

by

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The present paper deals with a sample of Copepoda collected by the crew of the Canadian weathership "P" in the northeastern Pacific, 50°N 145°W, on 22 September 1959 at 08.55 hours, depth 1200 m to the surface, the sample is labelled "V-3". All Copepoda Calanoida, with the exception of nauplii, have been removed from the sample and have been identified, many of the copepodids only as far as the genus.

Though many Copepoda have now been described from the Pacific Ocean and the number of samples studied has reached a considerable total, its copepod fauna, particularly that of the deeper strata, is still far from satisfactorily known. This pertains particularly to the northern Pacific, an area which, in comparison to the extensively studied northern Atlantic, has only been very poorly studied.

During my study of the above mentioned sample I have carefully compared the species of calanoid copepods present with the existing descriptions of Pacific species and, whenever possible, with descriptions of material from the North Atlantic. All noteworthy features that have been met with have been recorded and are presented below, along with additions to the distributional pattern of each species. The sample appears to contain a new species of the genus *Undinella*, which is described and illustrated here.

For a number of drawings (e.g., those of *Undinella acuta* nova species) I am indebted to Mr. H. Heijn.

List of species

<i>Calanus</i> species	<i>Eucalanus bungii bungii</i> Giesbrecht,
<i>Calanus pacificus</i> Brodskii, 1948	1892
<i>Calanus plumchrus</i> Marukawa, 1921	<i>Pseudocalanus minutus elongatus</i>
<i>Calanus cristatus</i> Krøyer, 1848	(Boeck, 1865)

<i>Clausocalanus arcuicornis</i> (Dana, 1849)	<i>Scolecithricella minor orientalis</i> Brodskii, 1950
<i>Spinocalanus stellatus</i> Brodskii, 1950	<i>Scolecithricella ovata</i> (Farran, 1905)
<i>Spinocalanus abyssalis</i> Giesbrecht, 1888	<i>Scolecithricella globulosa</i> Brodskii, 1950
<i>Spinocalanus longicornis</i> G. O. Sars, 1900	<i>Undinella acuta</i> nova species
<i>Mimocalanus distinctocephalus</i> Brodskii, 1950	<i>Metridia pacifica</i> Brodskii, 1950
<i>Aetideus armatus</i> (Boeck, 1873)	<i>Metridia curticauda</i> Giesbrecht, 1889
<i>Gaidius variabilis</i> Brodskii, 1950	<i>Metridia asymmetrica</i> Brodskii, 1950
<i>Gaetanus simplex</i> Brodskii, 1950	<i>Metridia brevicauda</i> Giesbrecht, 1889
<i>Gaetanus</i> species	<i>Metridia gurjanovae</i> Brodskii, 1950
<i>Pseudochirella polyspina</i> Brodskii, 1950	<i>Metridia princeps</i> Giesbrecht, 1892
<i>Pseudochirella spinifera</i> Brodskii, 1950	<i>Pleuromamma</i> species
<i>Paraeuchaeta japonica</i> (Marukawa, 1921)	<i>Pleuromamma abdominalis</i> (Lubbock, 1856)
<i>Paraeuchaeta rubra</i> Brodskii, 1950	<i>Pleuromamma scutullata</i> Brodskii, 1950
<i>Cornucalanus</i> species	<i>Lucicutia ovalis</i> (Giesbrecht, 1895)
<i>Scaphocalanus magnus</i> (T. Scott, 1894)	<i>Lucicutia</i> species
<i>Scaphocalanus medius</i> (G. O. Sars, 1907)	<i>Heterorhabdus</i> species
<i>Scaphocalanus subbrevicornis</i> (Wolfenden, 1911)	<i>Heterorhabdus spinifrons</i> (Claus, 1863)
<i>Amallothrix inornata</i> (Esterly, 1906)	<i>Heterorhabdus pacificus</i> Brodskii, 1950
<i>Amallothrix</i> species	<i>Heterorhabdus tanneri</i> (Giesbrecht, 1895)
<i>Racovitzanus antarcticus</i> Giesbrecht, 1902	<i>Augaptilus</i> species
	<i>Candacia columbiae</i> Campbell, 1929
	<i>Temorites brevis</i> G. O. Sars, 1900

Notes on the species observed

The length of the body is taken to be the distance between the front of the head and the end of the furca, measured along the mid-sagittal plane with the copepod in dorsal view. In those cases where marked differences with data from other authors are found, theirs are given also, for the purpose of comparison.

Data concerning the distributional area of the species are given only as far as the North Pacific is concerned.

CALANIDAE

Calanus species

Numerous unidentified copepodids of several species of this genus occur in the sample.

Calanus pacificus Brodskii, 1948 (fig. 1a)

Material. — 8 adult ♀♀; 1 adult ♂; 70 copepodids.

Remarks. — The adult specimens were compared with descriptions and figures published by Brodskii (1959, 1961). Brodskii's key (Brodskii, 1961:

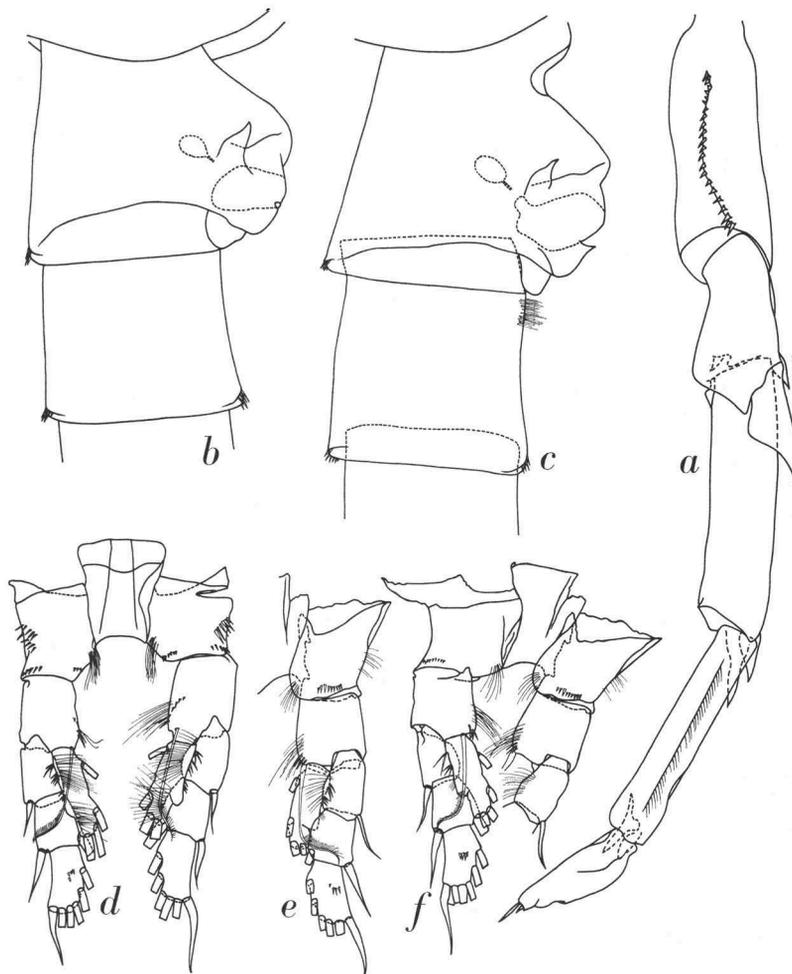


Fig. 1. a, *Calanus pacificus* Brodskii, ad. ♂, left fifth leg. b-f, *Spinocalanus stellatus* Brodskii, ad. ♀; b, c, lateral view from right side of genital somite; d-f, first legs of two specimens, anterior surface (fig. e represents the left first leg of the pair figured as fig. f). a-c, $\times 185$; d-f, $\times 135$.

19-20) for the identification of the various species of *Calanus* and their varieties left no doubt that all specimens examined here belong to *Calanus pacificus*. The following varieties are recognized by Brodskii in this species:

C. pacificus var. *oceanicus* Brodskii, 1959 and *C. pacificus* var. *japonicus* Brodskii, 1959. Not included in the key is a variety previously (Brodskii, 1959: 1545, fig. 1 nos. 7, 8, fig. 3 no. 10) referred to as *C. pacificus* var.?, probably because the identity of that variety was still doubtful to Brodskii himself. The characters used to differentiate between the varieties are summarized in Table I (data from Brodskii, 1961).

According to Brodskii (1959, 1961) the distribution of *C. pacificus* as a whole comprises the northern part of the Pacific, north of the Kuroshio current, the southern part of the Okhotsk Sea, the Sea of Japan with the exception of the northern part, the Yellow Sea and the China Sea. Also the species has recently been found by Park (1968) in the central part of the North Pacific.

C. pacificus var. *oceanicus* occupies the greatest area, viz., the northern part of the Pacific, the Yellow Sea and the Sea of Japan.

C. pacificus var. *japonicus* is found in the Tartar Strait along the coast of Sakhalin and is also found in Amur Bay, Sidimi Bay, Posjet Bay and Melkovodkaja Bay.

C. pacificus var.? is reported from Tzindao, Yellow Sea.

The last two varieties are limited to a relatively small area and are more or less separated geographically from each other as well as from *C. pacificus* var. *oceanicus* (fide Brodskii, 1961).

The characteristics observed in the specimens from the present sample are listed in Table II. The differentiating characters, used to discriminate between the varieties of *C. pacificus* and listed in Table I, in fact appear to show a greater variability than Brodskii suggested and distinctly appear not to be restricted to the respective varieties. A comparison of the data summarized in Tables I and II leads to the following conclusions.

Of two of the sets of characters used to differentiate between the three varieties, viz., "number of teeth along the basipodite of leg 5 in the female" and "length of antenna in relation to total body length in the female" both components occur in the individuals of one single population. The number of teeth of the basipodite is very variable; there is even a considerable variability between the left and right side of one pair of legs, while amongst the eight females examined the lowest (19) and the highest (35) number found covers all three varieties. Both above named characters therefore are unsuitable to discriminate between varieties of *C. pacificus*.

The possibility that a greater stability and constancy with regard to the above mentioned characters occurs in certain populations of *C. pacificus* in the North Pacific cannot be altogether ruled out, in fact Brodskii's papers seem to suggest that this has indeed been observed in the northwestern part of the

area. However, the present results clearly show the existence of populations with a greater amount of variability in the northeastern part of the Pacific; the separation of *C. pacificus* into three varieties in that area, based on the characters ascribed to them by Brodskii cannot be maintained.

The fifth leg of the present male specimen (fig. 1a) is of a slightly aberrant type as far as the ratio breadth/length of the first and second exopodal segments is concerned. In this respect the specimen approaches *C. pacificus* var. *japonicus* closest. Though no conclusion can be based upon one single individual, the similarity with the situation observed in the females is worth noticing. Here too a character ascribed to a distinct variety (var. *japonicus*) is observed in a specimen from a part of the Pacific far distant from the type locality of that variety.

The examination of larger numbers of *C. pacificus* from this and other North Pacific areas would enable us to obtain a clearer picture of the variability of these and other characters. Large numbers would also enable us to use statistical methods to differentiate between individual populations of this species.

***Calanus plumchrus* Marukawa, 1921**

Material. — About 60 adult ♀♀; about 60 adult ♂♂; about 120 copepodids.

Measurements. — Total length of adult females, 3.9-4.6 mm; of the adult males 3.9-4.7 mm. Brodskii (1950, as *Calanus tonsus*) gave the following measurements: adult ♀♀, 4.5-5.0 mm; adult ♂♂, 4.6 mm. Tanaka (1954, 1956): adult ♀♀, 4.16-4.40 mm; adult ♂♂, 4.40-4.82 mm.

***Calanus cristatus* Krøyer, 1848**

Material. — 5 adult ♀♀; 5 adult ♂♂; about 30 immature specimens.

Remarks. — The adult specimens generally resemble the descriptions and drawings given by Tanaka (1938) and Brodskii (1938, 1950).

Park (1968) found no adult specimens of this species.

Measurements. — Total length of the adult females, 7.0-7.8 mm; of the adult males, 6.8-7.3 mm. The following measurements are given in the literature: adult ♀♀, 8.6-10.4 mm; adult ♂♂, 9.0-9.6 mm (Brodskii, 1938, 1950), adult ♀♀, 8.4-9.3 mm; adult ♂♂, 7.4-8.6 mm (Tanaka, 1938), adult ♀♀, 8.4-9.3 mm; adult ♂♂, 6.7-8.6 mm (Davis, 1949).

EUCALANIDAE

***Eucalanus bungii bungii* Giesbrecht, 1892**

Material. — About 100 adult ♀♀; about 40 immature specimens, representing male and female copepodids, in the ratio 1 : 1, of the fourth and fifth stage.

Measurements. — Total length of the adult females, 6.5-6.6 mm. Johnson (1938) gave 6.8-8.0 mm as the length of the adult females. Brodskii (1950) gave the same measurements. Park (1968) found adult ♀♀ with 5.51-6.08 mm total body length.

PSEUDOCALANIDAE

Pseudocalanus minutus elongatus (Boeck, 1865)

Material. — About 60 adult ♀♀; about 30 immature specimens.

Measurements. — Total length of the adult females, 1.0-1.3 mm. Brodskii (1950) recorded: ♀♀, 1.2-2.0 mm; Farran (1951): ♀♀, 1.2-1.6 mm; Park (1968): ♀, 1.26 mm.

Clausocalanus arcuicornis (Dana, 1849)

Material. — 1 adult ♀; 1 immature ♂.

Measurements. — The adult female measures 1.9 mm. Brodskii (1950) gave 1.15-1.38 mm for adult females; Farran (1951) 1.0-1.6 mm. Park (1968) observed two size groups for both adult males and females in his material, the females ranging from 1.51-1.70 mm (large) and 1.12-1.58 mm (small), respectively.

SPINOCALANIDAE

Spinocalanus stellatus Brodskii, 1950 (fig. 1 b-f)

Material. — 7 adult ♀♀; 1 immature specimen.

Remarks. — When trying to identify the present specimens with the aid of Brodskii's key (1950: 121, 122) to the species of *Spinocalanus*, I encountered various difficulties. First of all the two distal segments of the exopodites of the second, third and fourth legs are broken off in all my specimens. The armament of the second exopodal segment of these legs, however, is a major characteristic in discriminating between the species *S. stellatus* Brodskii, 1950 and *S. spinipes* Brodskii, 1950.

Another characteristic important in distinguishing between these two species concerns the thorns on the distal segment of the exopodite of the first leg; it is, however, difficult to handle. The key differentiates between these two species in this respect as follows: *S. stellatus*, thorns on this segment long and placed on the distal part of the segment, and, *S. spinipes*, thorns on this segment short and placed on the proximal part of the segment. Brodskii's drawings of these appendages (1950, figs. 44, 45), however, give no certainty as to the exact meaning of these descriptions. Figure 44, showing the first leg, has the above mentioned thorns in the middle of the segment; fig. 45, of the first leg of *S. spinipes*, shows no thorns at all on that

particular segment. My specimens, inspected with regard to this particular character, show no constancy: in the majority of the specimens the spines are placed in the middle of the segment and in one specimen no spines at all have been observed. This has been illustrated in fig. 1 d-f.

Brodskii (1950) also attached importance to the occurrence of hairs along the inner margin of the exopodite of the first leg, as also appears from his key, viz., "first and second segments of the same exopodite [i.e., of the first leg] bearing long hairs on the inner margin" (for *S. stellatus*), and "hairs present on the inner margin of the first segment only" (for *S. spinipes*). My fig. 1 d-f shows the variability of this character in my specimens.

Another characteristic, not named by Brodskii in his description, but figured in his drawing of *S. spinipes* (Brodskii, 1950, fig. 45) is formed in that species by the raised border, which laterally limits the genital field. The free distal and the proximal edge of this border, the latter being the attachment of the border of the genital field to the genital segment proper, frontally make an acute angle. This particular structure, which is of a very characteristic appearance, is clearly visible in all my specimens (fig. 1 b, c) therefore, it seems to be a character shared by both species.

The brush of bristles on the ventral surface of the second abdominal somite in the female, figured by Brodskii (1950, fig. 45) for *S. spinipes* and mentioned for *S. stellatus* (Brodskii, 1950: 125) is present in five out of the seven specimens inspected.

I have brought my specimens to *S. stellatus* because of the following consideration. Brodskii (1950: 126) described *S. spinipes* with "basipodite of the first pair of legs without spines". All my specimens have distinct spines on the basipodite of leg 1, as are also present in *S. stellatus* (Brodskii, 1950, fig. 44). The variability in the position of these spines, shown by my specimens, is illustrated in fig. 1 d-f, showing the basipodites of the first leg in two of my specimens.

My specimens also have the caudal borders of the genital and second abdominal somites toothed dorsally, a character which, according to Brodskii's drawings, my specimens share with *S. stellatus*.

More material of *Spinocalanus stellatus* and *S. spinipes* will have to become available to establish distinctly the exact differences between these two, evidently closely allied, species.

Brodskii recorded *S. stellatus* from the northwestern Pacific and the Bering Sea only; I consequently assume, as no other authors seem to have met with this species, that it has not yet been found in the area now under investigation.

Measurements. — Total length of the adult females, 2.1-2.3 mm. Brodskii

(1950) gave as the total length of the adult female *S. stellatus*, 2.5-3.0 mm; for the adult female *S. spinipes* 2.3 mm.

Spinocalanus abyssalis Giesbrecht, 1888

Material. — 12 adult ♀♀; 4 immature specimens.

Measurements. — Total length of the adult females, 1.1-1.5 mm.

Spinocalanus longicornis G. O. Sars, 1900

Material. — 1 adult ♂.

Remarks. — The identification of this specimen is not wholly beyond doubt, since the exact length of the endopodites of the fifth legs could not satisfactorily be established. The length of the endopodites, in relation to that of the exopodites of the same legs, are, according to Brodskii's key (1950: 123) of major importance when identifying the males of *Spinocalanus*. After examination of the other characteristics of this male specimen and comparing these features (structure of leg 5, total body length, etc.) with those of the other known males of *Spinocalanus*, the conclusion was reached that the specimen most probably belongs to *S. longicornis*.

Brodskii (1950) mentioned *S. longicornis* from the central part of the Polar Basin only and Davis (1949) did not include this species in his list. Therefore it probably has not previously been observed in the area under consideration.

Measurements. — Total length of the adult male, 1.15 mm. Brodskii (1950) gave the length of the male as 1.2 mm.

Mimocalanus distinctocephalus Brodskii, 1950

Material. — A single female specimen of the fifth or fourth copepodid stage.

Remarks. — Though my specimen is immature it is easily identified on account of the very characteristic appearance.

Measurements. — Total length of the immature female, 2.25 mm. Brodskii (1950) gave the total length of the adult female as 2.6 mm.

AETIDEIDAE

Aetideus armatus (Boeck, 1873)

Material. — 2 adult ♀♀; 2 adult ♂♂; 1 immature specimen.

Remarks. — Brodskii (1950) listed two species of this genus that have been reported from the northern Pacific Ocean, viz., *Aetideus armatus* (Boeck, 1873) and *A. pacificus* Brodskii, 1950.

When comparing my female specimens with the characteristics Brodskii (1950: 142-144) listed for these species, they were found not to fit in every detail to either of these two descriptions. Though the specimens generally resemble *A. armatus* as described by various authors, the following differences were noticed.

The character of whether or not the spines of the last thoracic somite reach beyond the distal margin of the genital somite appeared to be less easy to handle than expected. Sars (1903, pl. 13) figured the female of *A. armatus* in dorsal view with these thoracic spines exactly reaching the distal margin of the genital somite (this figure is also reproduced by Brodskii, 1950, fig. 59). In lateral view the same spines are figured as reaching slightly beyond the distal margin. In Brodskii's (1950, fig. 60) drawing of *A. pacificus* the spines, in dorsal view, also reach the distal margin of the genital somite, but do not reach that margin in lateral view.

In all present specimens the spines of the last thoracic somite reach to the distal margin of the genital somite, in dorsal as well as in lateral view. I have had no opportunity, however, to compare specimens of the two species, so that I find this particular character hard to apply. Park (1968) on the contrary, who in the central North-Pacific found *A. pacificus* only, noted this character as very useful for distinguishing between the two species.

The chewing plate of the mandible, in both my female specimens, has eight teeth and a proximal, hairy seta, agreeing in the latter respect with Giesbracht's figure (1892, pl. 14 fig. 4). Sars (1903, pl. 14 fig. M) does not figure such a seta. With respect to the mandibles, the description given by Park (1968) for *A. pacificus* females, disagrees with Brodskii's (1950). Park (1968) found no differences in the mandibles of this species and those of *A. armatus*. This is in contradiction with Brodskii (1950) who described this particular mouthpart for *A. pacificus* with four (instead of eight) teeth.

The total body length of my specimens (vide infra) comes closer to Brodskii's data of *A. pacificus*, than to those he and other authors gave for *A. armatus*. Park (1968) considered the species to be clearly distinguishable by size.

Since the shape of the rostrum, the length of the first antennae, the number of mandibular teeth and the general shape of the body do not differ from existing descriptions of these features for *A. armatus*, my female specimens undoubtedly belong to the latter species. However, considering also the total body length, the present specimens occupy an intermediate position between the two species.

The same holds for the males, in which no differences with descriptions by various authors for *A. armatus* have been noticed. Again the size of the

specimens is much larger, than is reported in the available literature. The male of *A. pacificus* is unknown.

Now Brodskii (1950: 144) suggested, that the records of *A. armatus* from the northern Pacific Ocean by various authors may in fact concern *A. pacificus*, the more so, as he himself did not encounter *A. armatus* during extensive studies on the northern Pacific.

However, from the present observations it seems clear, that the latter species does occur in the area under consideration, although, considering the size of the organisms, we are probably dealing here with a geographical variant of the species. In that case, I would consider the form that Brodskii (1950) described as *A. pacificus*, and which he calls closely related to *A. armatus*, a subspecies of this latter species. This is the more convincing, as the fairly important character of the shape and the number of teeth on the chewing edge of the mandible in the female, appears to be variable in the Pacific form, and in fact may resemble that which is commonly found in *A. armatus* (vide Park, 1968). To reach a definitive answer as to the true status of *A. armatus* and its varieties, including the form described by Brodskii as *A. pacificus*, in the Pacific Ocean, more material is needed.

In the present state of our knowledge, specimens of *Aetideus* from the Pacific should be very carefully inspected for identification, as variability in various characters has been shown to occur.

Measurements. — Adult female, total length, 2.15-2.25 mm; adult male, total length, 2.0-2.1 mm. Brodskii (1950) gave the following measurements for *A. armatus*: adult ♀♀, 1.80-1.95 mm; adult ♂♂, 1.40-1.53 mm. Vervoort (1952): adult ♀♀, 1.80-1.95 mm; adult ♂♂, 1.40-1.55 mm.

Brodskii's (1950) measurements for *A. pacificus* are: adult ♀♀, 2.2-3.0 mm. Park (1968): adult ♀♀, 2.21-2.30 mm. The male of *A. pacificus* is unknown.

***Gaidius variabilis* Brodskii, 1950 (fig. 2)**

Material. — 1 adult ♀; 1 adult ♂; 15 immature specimens.

Remarks. — The adult specimens were found to fit Brodskii's (1950: 160, 161, fig. 74) description and figures very well. The maxilliped of the female, not figured or described by that author, was found to be of a characteristic structure. The lateral lappet on the external surface of the first segment is absent, though a relatively small, lappet-like structure occurs on the distal end of that segment. A serrate ridge is present on the second segment (fig. 2b).

Here also a figure of the fused fourth and fifth thoracic somites and of the abdomen of the male, (fig. 2a) is given, as this has not been published before.

Brodiskii (1950) records this species from the northwestern Pacific and the Bering Sea; it is now also recorded from the northeastern Pacific.

Measurements. — Total length of the adult female, 3.3 mm; of the adult male, 3.35 mm.

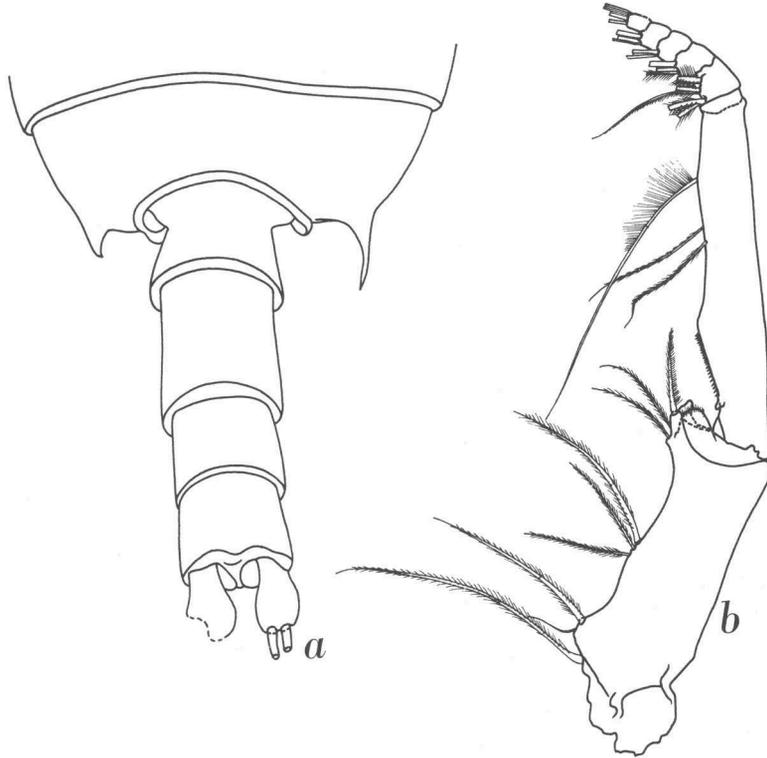


Fig. 2. *Gaidius variabilis* Brodiskii, ad. ♂. a, dorsal view of the last thoracic somite and abdomen; ad. ♀. b, maxilliped. a, $\times 70$; b, $\times 100$.

Gaetanus simplex Brodiskii, 1950 (figs. 3, 4a-e)

Material. — 3 adult ♀♀; 2 adult ♂♂; about 25 immature specimens.

Remarks. — With the exception of the features listed below the specimens were found to fit Brodiskii's (1950: 163, 164, fig. 77) description and figures.

Two of my females have the brush of spinules on the first basipodal segment of the right fourth leg only; in the third specimen both left and right fourth legs have such a brush of spinules.

Brodiskii (1950: 164) stated, that "the cephalic spine as well as the thoracic spines are shorter in the male than they are in the female". This applies to my material only as far as the thoracic spines are concerned.

As far as the cephalic spines are concerned, however, the opposite situation is met with (figs. 3, 4 a, b, d, e).

The caudal margins of the abdominal somites in the male, with the exception of the genital somite, are minutely serrated (fig. 4 c). In the female the caudal margins of the genital, as well as of the second and third abdominal somites, are serrated, but much less distinctly so than in the male. The fine, irregular teeth in the female occur more laterally and are not visible in the medial portion of the caudal margin.

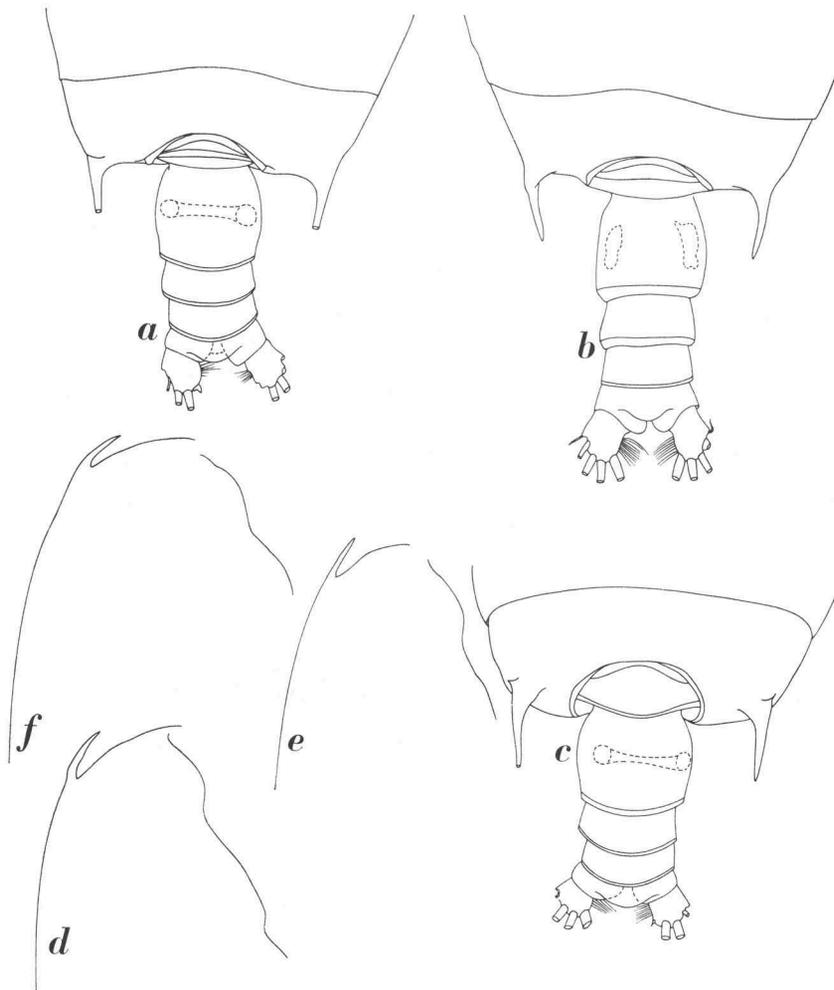


Fig. 3. *Gaetanus simplex* Brodskii, ad. ♀. a-c, dorsal view of the last thoracic somite and abdomen of specimen no. 1, 2, and 3, respectively; d-f, right lateral view of the frontal part of the head of specimen no. 1, 2, and 3, respectively. $\times 50$.

G. simplex is recorded by Brodskii (1950) from the northwestern part of the Pacific and from the Bering Sea; the present record evidently is the first from the northeastern Pacific.

Measurements. — Total length of the adult female, 3.5 mm; of the adult male, 3.4 mm. Brodskii (1950) gave the following measurements: adult ♀♀, 3.2 mm; adult ♂♂, 3.1 mm.

Gaetanus species

Material. — 2 immature specimens.

Remarks. — The two specimens are of an early copepodid stage. Two features are worth mentioning, viz., the smooth caudal border of the last thoracic somite (in both specimens), and the relatively long first antenna, measuring 1.25 times the total body length in the larger specimen.

Measurements. — Total lengths, 2.5 and 1.7 mm.

Pseudochirella polyspina Brodskii, 1950 (fig. 4 f)

Material. — 1 adult ♀.

Remarks. — This specimen generally resembles Brodskii's (1950: 185, fig. 102) description and figures but for the first pair of legs. As can also be seen from fig. 4 f, the external marginal spines of the first and second exopodal segment of that leg are serrate. The terminal spine of leg 1 has a serrated outer edge, while the inner edge has long hairs. This condition is similar to that figured for the male of *P. spinifera* by Brodskii (1950, fig. 104). Furthermore the endopodite of leg 1 in *P. polyspina* bears a row of fine spinules not figured by Brodskii, but also occurring in the other species of this genus.

Brodskii (1950) recorded *P. polyspina* from the northwestern Pacific and the Bering Sea; the present record apparently represents the first from the northeastern Pacific.

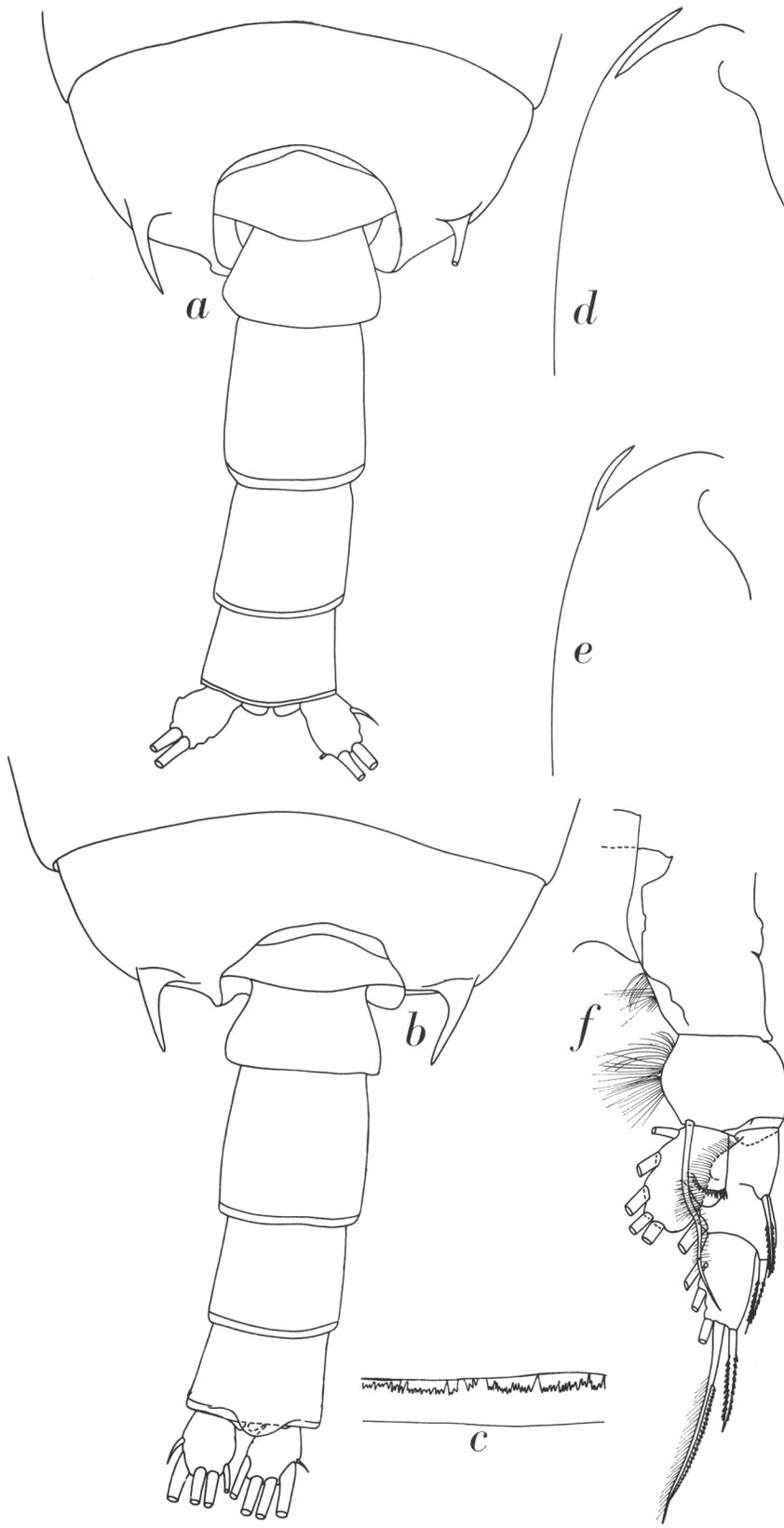
Measurements. — Total length of the adult female, 6.15 mm. Brodskii (1950) gave the total length for this sex as 5.8 mm.

Pseudochirella spinifera Brodskii, 1950

Material. — 1 adult ♂.

Remarks. — The caudal margins of the abdominal somites, with the exception of the genital somite, were found to be minutely and irregularly serrated, the serration being of the same type as that found in *Gaetanus simplex* males. No further noteworthy features have been observed.

Since the species is so far only known from the northwestern Pacific, this



seems to be the first record from the northeastern part of that Ocean.

Measurements. — Total length of the adult male, 5.15 mm.

EUCHAETIDAE

Paraeuchaeta japonica (Marukawa, 1921)

Material. — 2 adult ♀♀; 3 adult ♂♂.

Remarks. — The only slightly aberrant feature concerns the left fifth leg of the male. The teeth on the curved, lateral, teeth-bearing plate of the distal segment of that leg were found to be very sharp and distinct. In Brodskii's (1950, fig. 123) drawing of this appendage, the row of teeth looks like a crenate ridge with fairly obtuse teeth. The teeth, in fact, resemble those of *P. rubra* very much.

Measurements. — Total length of the adult female, 7.0 mm; of the adult male, 6.1 mm. Brodskii (1950) gave the following measurements: adult ♀♀, 6.3-6.5 mm; adult ♂♂, 5.5-6.3 mm.

Paraeuchaeta rubra Brodskii, 1950 (figs. 5, 13a)

Material. — 1 adult ♂.

Remarks. — The distal segment of the left first leg differs from Brodskii's (1950: 214, 215, fig. 128) description and figure. The lateral teeth-bearing plate, as in the preceding species, is armed with sharp, distinct teeth. As this particular detail is not very distinct in Brodskii's figure, a new figure is presented here (fig. 5 c). A relatively short, thorn-like projection occurs near the base of the serrated plate, a situation similar to that in *P. brevirostris* Brodskii, 1950 (Brodskii, 1950, fig. 129). A short spine also occurs on the proximal part of this segment, a situation which is also found in several related species of *Paraeuchaeta*. I have availed myself of the opportunity to figure the frontal part of the head in lateral view (fig. 13a) and the abdomen (fig. 5 a, b). The caudal edges of the abdominal somites of my male specimen have distinct, triangular teeth, which cover a greater area, than these apparently do in the female, figured by Brodskii. The mouthparts of the male are of the same type as those of the male of *Paraeuchaeta norvegica* (Boeck, 1873) (vide G. O. Sars, 1903, pl. 26).

No previous records from the northeastern Pacific are available; Brodskii

Fig. 4. a-e, *Gaetanus simplex* Brodskii, ad. ♂; a, last thoracic somite and abdomen of specimen no. 1, dorsal view; b, last thoracic somite and abdomen of specimen no. 2, dorsal view; c, serrated caudal margin of the second thoracic somite; d, frontal part of the head of specimen no. 1, right lateral view; e, frontal part of the head of specimen no. 2, right lateral view. f, *Pseudochirella polyspina* Brodskii, left first leg, anterior surface. a, b, d, e, × 90; c, × 345; f, × 170.

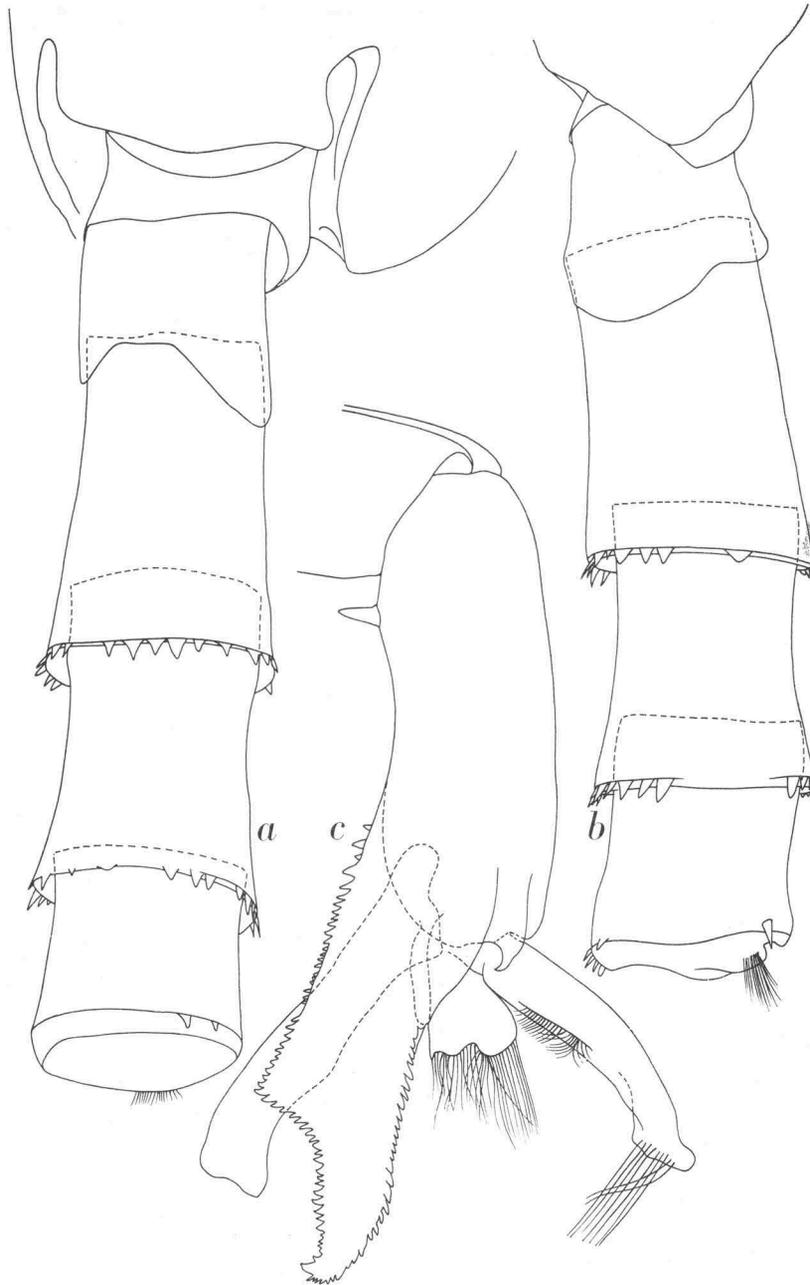


Fig. 5. *Paraeuchaeta rubra* Brodskii, ad. ♂. a, last thoracic somite and abdomen, dorsal view; b, last thoracic somite and abdomen, lateral view; c, terminal part of the left fifth leg. a, b, $\times 70$; c, $\times 250$.

(1950) recorded the species from the northwestern Pacific, the Sea of Okhotsk and from the Bering Sea.

Measurements. — The male specimen has a total length of 6.0 mm, but the anal somite and the furca are missing. Brodskii (1950) gave the total length of the male as 6.1 mm.

PHAENNIDAE

Cornucalanus species

Material. — 1 immature specimen.

Remarks. — This early copepodid cannot properly be identified. Brodskii (1950: 235) only recorded *C. indicus* Sewell, 1929, from the northern Pacific. Publications from other authors state that various other species of *Cornucalanus* do occur in adjacent areas.

Measurements. — Total length of the specimen, 3.4 mm.

SCOLECITHRICIDAE

Scaphocalanus magnus (T. Scott, 1894)

Material. — 2 adult ♀♀; 3 immature specimens.

Measurements. — Adult females: total length 5.2 mm.

Scaphocalanus medius (G. O. Sars, 1907)

Material. — 3 adult ♀♀; 2 immature specimens.

Remarks. — In the adult females the line separating the cephalon and the first thoracic somite, as well as that separating the fourth and fifth thoracic somites, are still faintly visible; no complete fusion consequently has occurred. The caudal margins of the abdominal somites, including the genital somite, are serrated and have small, distinct teeth. This detail was not mentioned by Sars (1925) nor by Brodskii (1950).

Measurements. — Total length of the adult females, 2.9-3.1 mm.

Scaphocalanus subbrevicornis (Wolfenden, 1911)

Material. — 2 adult ♀♀.

Remarks. — Brodskii (1950) only mentioned this species from the northwestern part of the Pacific, whilst Davis (1949) did not report it from the northeastern Pacific. This seems to be the first record from the area under consideration.

Measurements. — Total length of the adult females, 2.0-2.2 mm. Brodskii (1950) gave 1.75-2.1 mm as the total length of this sex.

Amallothrix inornata (Esterly, 1906)

Material. — 1 adult ♀.

Measurements. — Total length of the specimen, 3.9 mm.

Amallothrix species

Material. — 1 immature specimen, 2.45 mm long.

Racovitzanus antarcticus Giesbrecht, 1902

Material. — 5 adult ♀♀; 6 immature specimens.

Remarks. — The species is mentioned from the northwestern Pacific, the Bering Sea and also from Antarctic waters by Brodskii (1950); it is not mentioned by Davis (1949) and is probably here first recorded from the northeastern part of the Pacific.

Measurements. — Total length of the adult females, 2.25 mm.

Scolecithricella minor (Brady, 1883) var. **orientalis** Brodskii, 1950

Material. — 25 adult ♀♀; 5 adult ♂♂; 17 immature specimens.

Remarks. — All adult specimens could easily be identified as belonging to this variety. This is in accordance with the distribution of this variety as recorded by Brodskii (1950: 269). No aberrant features have been found, nor were transitions between this variety and *S. minor* var. *occidentalis* Brodskii, 1950, observed.

Measurements. — Adult females, total length, 1.3 mm; adult males, total length, 1.3 mm.

Scolecithricella ovata (Farran, 1905)

Material. — 2 adult ♀♀.

Remarks. — This species was recorded by Brodskii (1950) from the northwestern Pacific and the Bering Sea. It is not included in Davis' (1949) list of copepods from the northeastern Pacific, so that the present record seems to be the first from that area. Park (1968) recently recorded *S. ovata* from the central North Pacific.

Measurements. — Adult females, total length, 1.75-1.85 mm. Brodskii (1950) and Rose (1933) gave the length of this sex as 2.2 mm. Park's (1968) specimens measured 1.88-1.98 mm.

Scolecithricella globulosa Brodskii, 1950

Material. — 1 adult ♀.

Remarks. — The present specimen fits Brodskii's (1950: 270, fig. 180) description and drawings perfectly, but for one character of the abdomen.

In my specimen the caudal margins of the abdominal somites bear serrated ridges, composed of distinct teeth; this feature is not mentioned by Brodskii. This seems to be the first record of the species from the northeastern Pacific, as it has only been recorded so far from the northwestern Pacific Ocean (Brodskii, 1950).

Measurements. — Total length of the adult female, 2.0 mm. Brodskii (1950) recorded 1.8 mm as the length of adult females.

THARYBIDAE

Undinella acuta nova species (figs. 6-12)

Material. — 3 adult ♀♀; in addition I have seen one more female collected in 1958 from Canadian Weathership "P" at 50°N 145°W, in the Pacific.

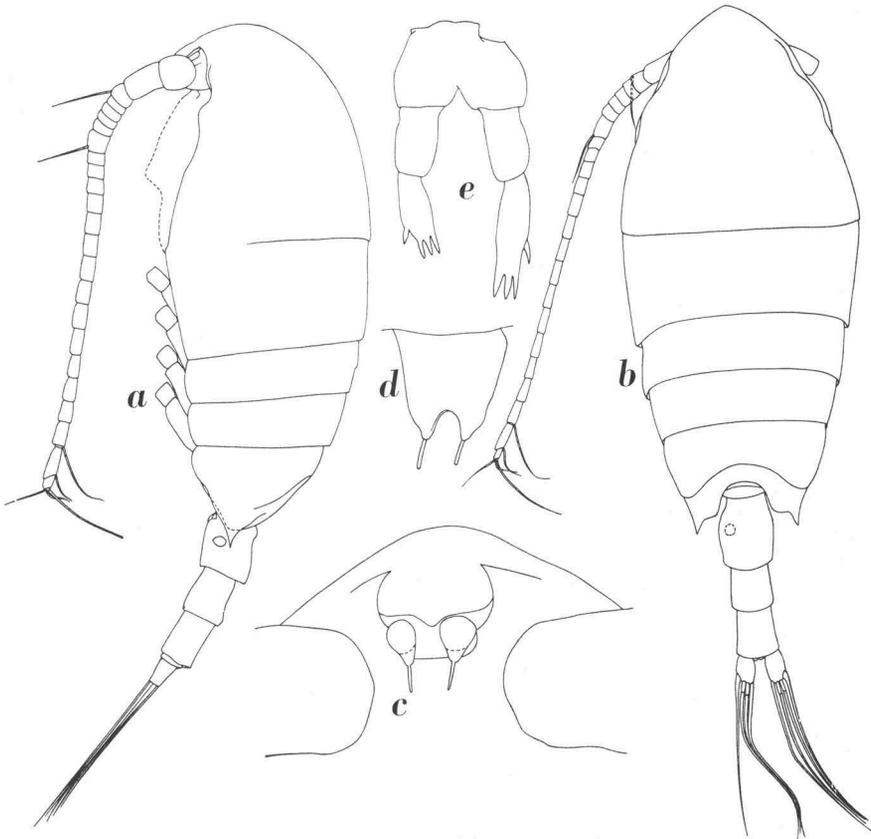


Fig. 6. *Undinella acuta* n. sp., ad. ♀, holotype, a, whole animal, lateral view from left side; b, whole animal, dorsal view; c, frontal part of the head and rostrum, ventral view; d, rostrum, ventral view; e, fifth pair of legs. a, b, $\times 50$; c, d, $\times 200$; e, $\times 240$.

Types. — A female, 1.89 mm long, has been selected the holotype. This specimen has been dissected and mounted. The two other specimens, 1.87 and 1.77 mm long, are the paratypes. All these specimens are preserved in the Rijksmuseum van Natuurlijke Historie, Leiden. The registration nos. are: holotype, Crust. F. 789; paratypes, Crust. F. 790.

Description. — The total length of the body, measured in the mid-sagittal plane, is 1.89 mm. The greatest width of the body is 0.50 mm; the greatest depth is 0.54 mm. The length of the abdomen is contained 3.06 times in that of the cephalothorax. The length of the cephalothorax has been measured from the anteriormost point of the head to the intersegmental membrane between the fifth thoracic and the genital somite.

The general shape of the cephalothorax (fig. 6 b) is oval, with the greatest width and depth at the line separating the cephalon and the first thoracic somite. Rostrally from this line the sides of the body (i.e., the ventral margin of the tergites) are curved into two smooth swellings, on either side of the body. The very front of the head is smooth as no projections are present; in lateral view it appears to be smoothly rounded. In dorsal aspect the cephalon ends frontally into an obtuse point. The cephalothorax narrows gradually in a caudal direction.

The cephalon and the first thoracic somite are partially fused. However, the line separating the two portions is still distinctly visible. In dorsal view this line extends along the whole width of the body; in lateral view it occupies about three-fifth of the body height. The fourth and fifth thoracic somites are fused to a greater extent, the dividing line being more faintly visible than that between cephalon and thoracic somite 1, although still distinctly discernable. In dorsal view this line is seen over the whole width of the body, curving rostrally in the mid-dorsal line. In lateral view it occupies about half the height of the body.

The caudal edge of the fifth thoracic somite has a strong, rostrally directed curve in the mid-dorsal line, much stronger than the corresponding curve of the rostral margin of this somite. The latero-caudal margin of the fifth thoracic somite is produced into a very sharp point, one on each side of the abdomen, which reaches the middle of the genital somite. In dorsal view these points dilate very slightly; in lateral view they are directed caudally and very slightly upwards (fig. 6 a, b).

The abdomen has three visible somites; the anal (fifth) somite is completely telescoped into the fourth. The visible somites have the following proportional lengths:

$$\text{somite} \frac{1+2}{37} \quad \frac{3}{23} \quad \frac{4+5}{25} \quad \frac{\text{furca}}{15} = 100.$$

The genital somite, in dorsal view, has smoothly rounded lateral swellings (fig. 7 a). The somite is slightly asymmetrical in shape as only one seminal receptacle, that on the left side, is present. This receptacle is round in dorsal view and oval in lateral view, the narrowed part ending in the tubule (fig. 7 c). A genital protuberance on the ventral surface is scarcely developed (fig. 7 b).

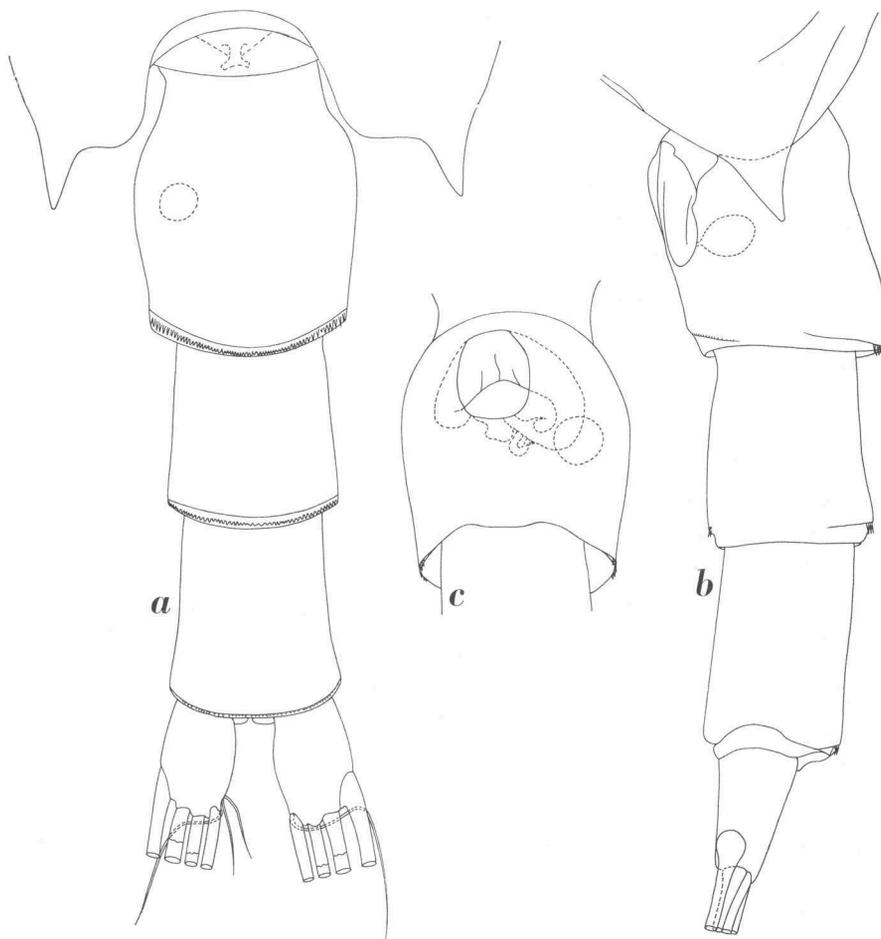


Fig. 7. *Undinella acuta* n. sp., ad. ♀, holotype. a, last thoracic somite and abdomen, dorsal view; b, last thoracic somite and abdomen, lateral view from left side; c, genital complex, ventral view. $\times 200$.

The anal somite, usually minute in representatives of this genus, is practically invisible here.

The furcal rami (fig. 7 a) are about 1.5 times long as wide, they diverge slightly. Each ramus has four strong setae, three at the caudal border, one

placed caudo-laterally and all projecting backward. These setae are of sub-equal length, i.e., about the length of the abdomen. There is at least one curved seta on each ramus, attached to the medial side.

The caudal edges of the abdominal somites have serrated margins. On the genital and last abdominal somites the serrated margins are only visible dorsally, but along the caudal border of the intermediate somite they are visible dorsally as well as ventrally. The teeth of which the serrated edges are composed are sharp and distinct laterally, and more obtuse and irregular in the median portion.

The rostrum consists of a more or less triangular, downward pointing plate, the distal third or fourth of which is bifid. Each portion bears a slender filament (fig. 6 c, d).

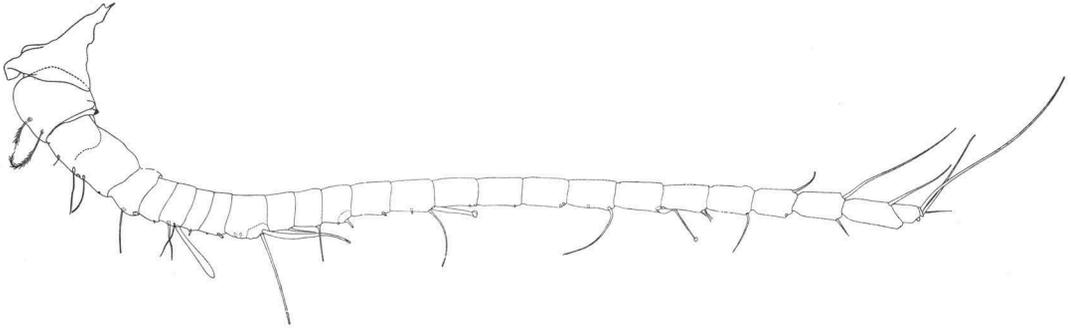


Fig. 8. *Undinella acuta* n. sp., ad. ♀, holotype, left first antenna. $\times 120$.

The first antennae (fig. 8) are composed of 24 free segments; when fully extended backward they reach the middle of the fourth thoracic somite. Aesthetascs are present on segments 2, 3, 5, 7, 8, 11, 13, 18 and 24. Large setae occur on segments 3, 7, 8, 13, 17, 20, 22, 23, and 24; on the 24th segment there are even two setae. The first segment has two moderately long, hairy setae frontally and a row of distally directed spinules near the distal margin, caudally. Segments 1, 2 and 8 are the largest segments. As the aesthetascs are broken in many cases, the observations recorded above have been composed from several specimens. The type specimen has aesthetascs on segments 5, 8, 13, and 18 of the left first antenna; in the other specimens the distribution is as follows: no. 1, left side, segments 3, 5 and 7, rest of antenna broken off; no. 2, left side, segments 2, 11, 18 and 24; right side, segments 11, 13 and 24.

The exopodite of the second antenna (figs. 9 a, 10 a) is longer than the endopodite. The second basal segment has a serrated seta. The remaining setae on the second antenna are not hairy.

The gnathal lobe of the mandible (figs. 9 b, 10 b) has one setiform tooth dorsally, one multicuspidate molariform tooth and three (left mandible) or six (right mandible) monocuspidate molariform teeth. The whole cutting edge of the mandible is strongly hairy; the hairs equal or eventually exceed, the teeth in length. Except for the number of teeth, the mandibles are symmetrical.

The first maxillae (figs. 9 c, 10 c) are of the type ordinarily met with in *Undinella*.

The second maxilla (fig. 9 d, 10 d) has five lobes; all lobes bearing three setae. Those of the most proximal lobe are of equal length; on the other lobes there are two equally long setae and one shorter seta. One of the long setae on the lobe of the second basal segment is fairly heavy. On the rostral surface of that lobe the two-segmented endopodite is present, the distal segment of which bears four slender, thin-walled setae, that are slightly sensoriform in appearance. Except for these four setae all remaining setae are to a greater or lesser extent hairy.

The first basal segment of the maxilliped (figs. 10 e, 11 c-e) has four setae; the second basal segment has two setae at the distal end and one seta on the proximal portion. The setae of the maxilliped are easily damaged.

The exopodites of all swimming legs are three-segmented. The endopodite of the first pair is one-, that of the second pair two-, and those of the third and fourth pairs three-segmented.

The first and second segments of the basipodite of the first pair of legs (fig. 11 a) have a brush of hairs at the internal margin, in some cases reduced to a considerable extent. The second segment of the basipodite has a curved seta placed near the internal end of the insertion of the endopodite. This endopodite has a row of sharp denticles just below the distal edge of the external lobiform process. All three segments of the exopodite have an external marginal spine, reaching just beyond the middle of the following segment. The terminal exopodal spine is hairy along the inner edge and serrate along the outer edge.

The second to fourth legs (figs. 11 b, 12 a, b) have a brush of hairs on the internal surface of the first segment of the basipodite. This brush of hairs may be strongly reduced or even absent, as is the case in the type specimen. The first and second exopodal segments all have an outer edge spine, which is comparatively short and does not reach the middle of the external margin of the next segment. Both outer and inner edges of these spines are smooth. Along the external margin of the third exopodal segment there are three of such spines, that are also quite smooth along both edges. The terminal spines



Fig. 9. *Undinella acuta* n. sp., ad. ♀, holotype. a, second antenna; b, mandible; c, first maxilla; d, second maxilla. All appendages are figured from the outside. X 200.

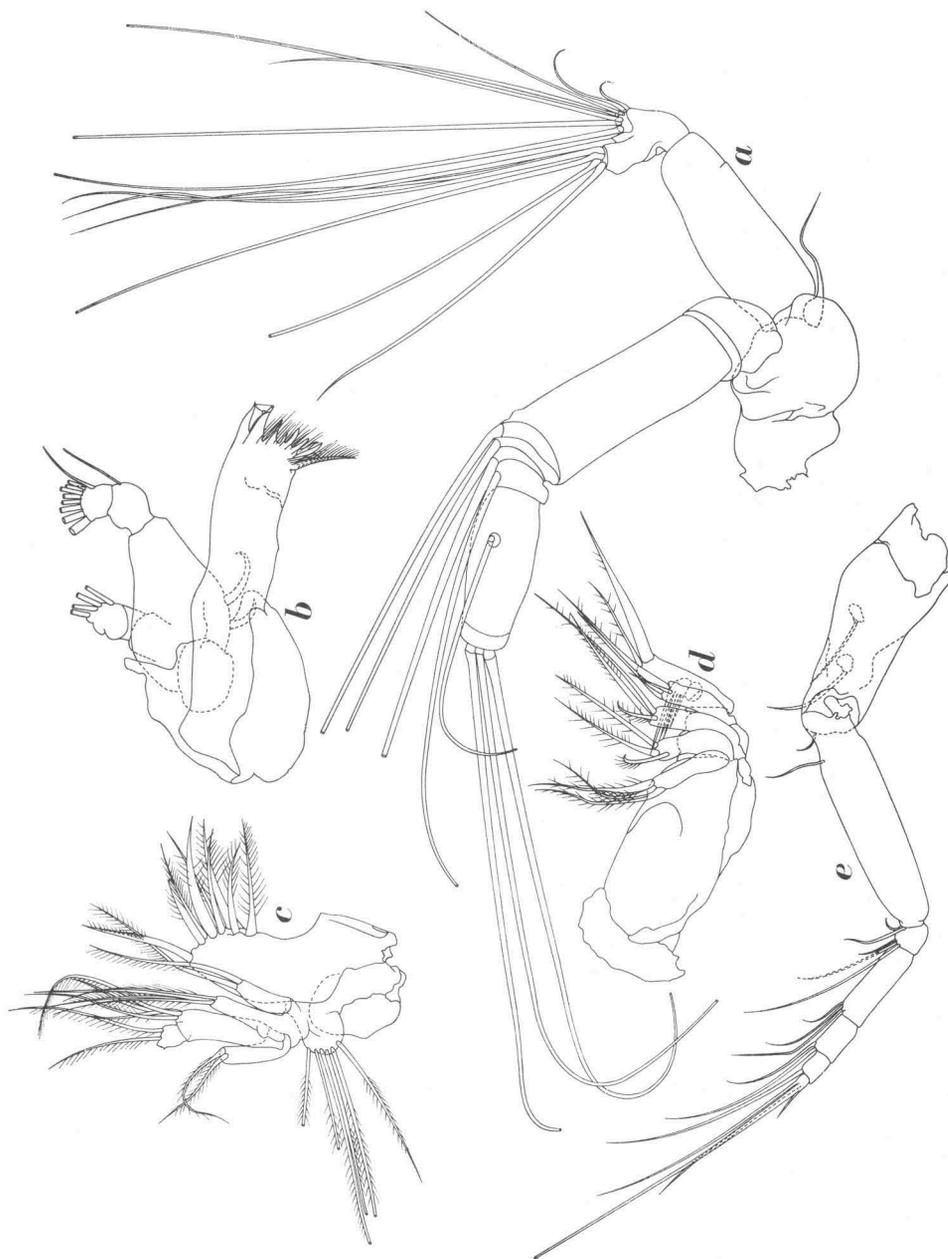


Fig. 10. *Undinella acuta* n. sp., ad. ♀. a-d, holotype; a, second antenna; b, mandible; c, first maxilla; d, second maxilla, all figured from the inside. e, paratype, left maxilliped. X 200.

of the exopodites are heavy and flattened; the outer edge is serrate; the inner edge may be hairy.

The fifth legs (fig. 6 e) are minute and uniramous; the left and right leg share the basal segment. The two-segmented left and right legs are slightly unequal, mainly due to the fact that the second segments are of different

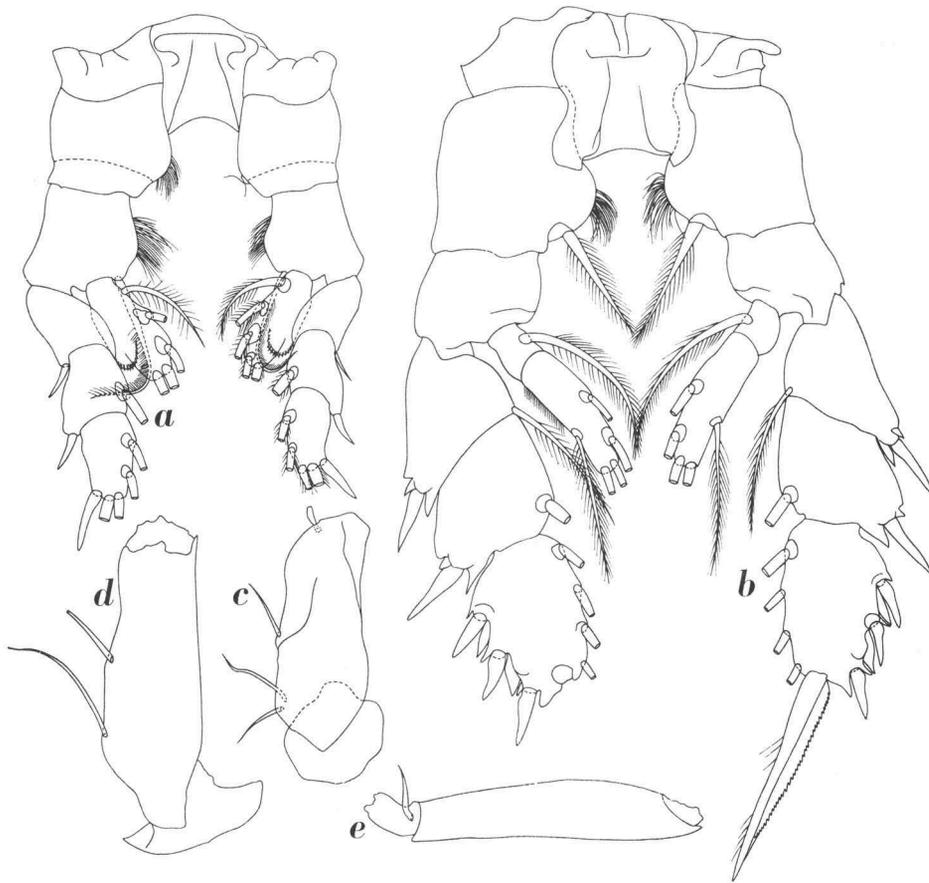


Fig. 11. *Undinella acuta* n. sp. ad. ♀, holotype. a, first pair of legs, posterior surface; b, second pair of legs, anterior surface; c-e, maxilliped. $\times 200$.

lengths. The second (distal) segment ends into three apical, spiniform, smooth points, that are of equal length. In addition each leg bears a slightly smaller smooth point on the external surface of the segment, at a distance of about half to one-third the length of the segment measured from the distal end. This lateral spine, in contrast to the apical spines, may be set off distinctly at its base.

The male is unknown.

Remarks. — This is a relatively small calanoid, with a comparatively long abdomen and with the fifth thoracic somite ending in sharp points, projecting caudally. The regularly oval cephalothorax, the shape of the rostrum and the details of the legs make the species easily recognizable as a species of

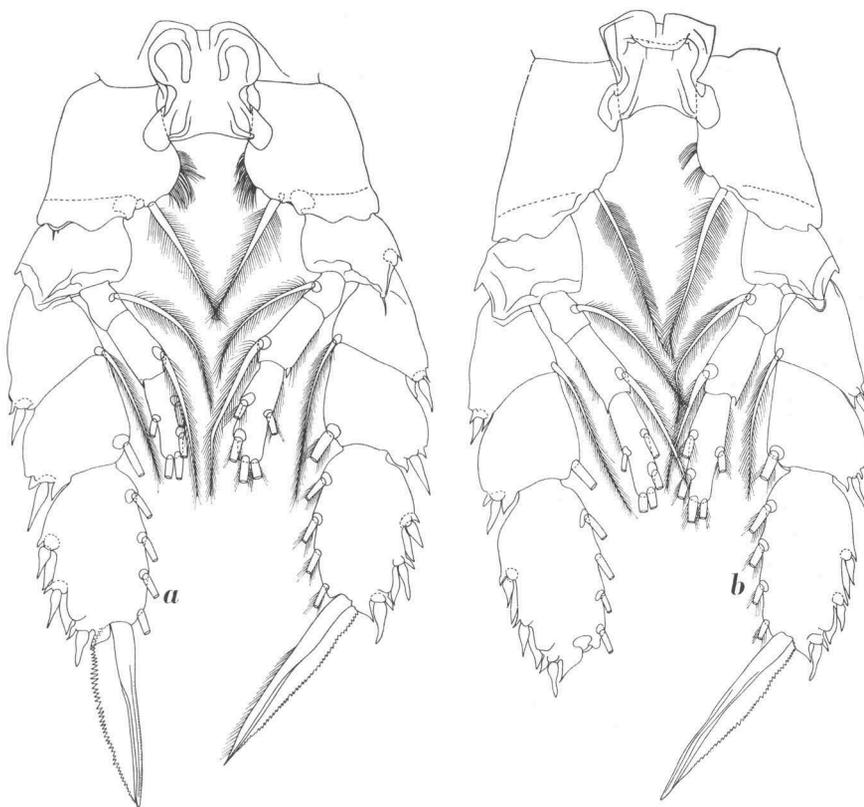


Fig. 12. *Undinella acuta* n. sp., ad. ♀, holotype. a, third pair of legs, anterior surface; b, fourth pair of legs, anterior surface. × 160.

Undinella (Fleminger, 1957). Amongst the other species of *Undinella* it is remarkable by the very sharp latero-caudal points of the fifth thoracic somite, that, beginning from a narrow base, end sharply. The fifth legs too are very characteristic, as is also the rostrum, with the apically attached filaments. The first antenna has a row of distally directed spinules near the distal margin of segment 1.

The species differs from *U. oblonga* (G. O. Sars, 1900) by the presence of serrated edges along the caudal margins of the abdominal somites. The

second antenna, in *U. acuta*, has one seta on the second basal segment and none on the first basal segment of that appendage; in *U. oblonga* there are two setae and one seta, respectively. The masticatory part of the first maxilla in *U. acuta* extends more distally than it does in *U. oblonga*. The endopodites of leg 2 are two-segmented in *U. acuta* and one-segmented in *U. oblonga*; those of the third and fourth pairs are three-segmented in *U. acuta* and two-

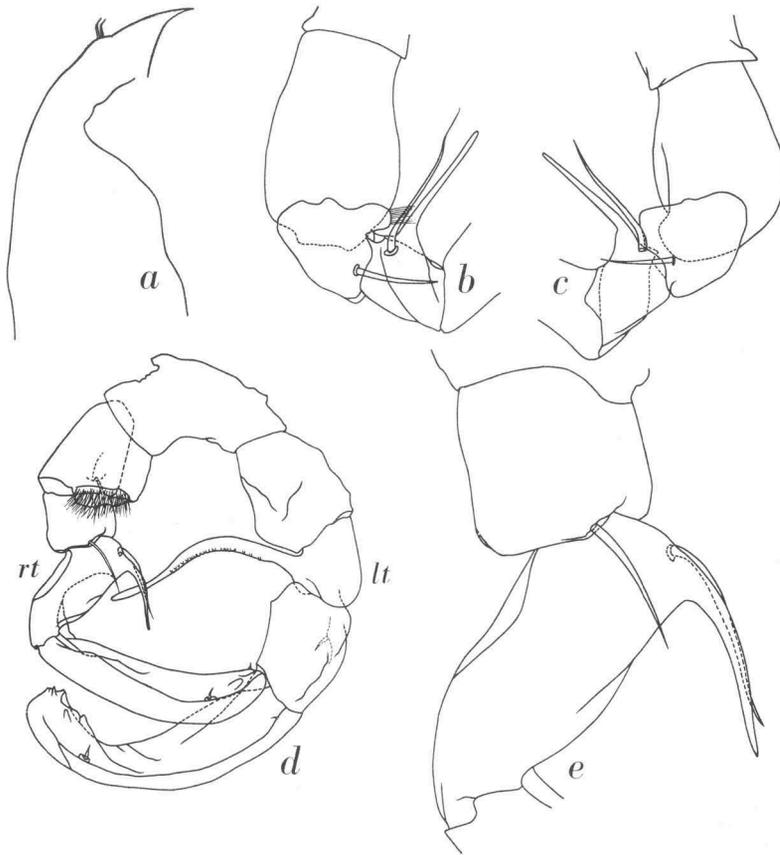


Fig. 13. a, *Paraeuchaeta rubra* Brodskii, ad. ♂, lateral view of the frontal part of the head. b, c, *Metridia pacifica* Brodskii, ad. ♂, part of the right fifth leg of two different specimens, viewed from different angles. d, e, *Metridia gurjanovae* Brodskii, ad. ♂; d, fifth pair of leg; e, part of the right fifth leg. a, $\times 65$; b, c, e, $\times 320$; d, $\times 135$.

segmented in *U. oblonga*. The two species are of a different size too, as Sars gives 3 mm as the total length of the female of *U. oblonga*.

The adult female of *U. simplex* Wolfenden, 1906, measures 1.45 mm according to that author; Rose (1933) gives the length as 1.45-1.60 mm.

Moreover, this species differs from *U. acuta* in the general shape of the body, the shape of the rostrum, etc.

U. frontalis (Tanaka, 1937) has rows of hairs on the first and second segments of the maxilliped; in *U. acuta* such rows are not present. The fifth

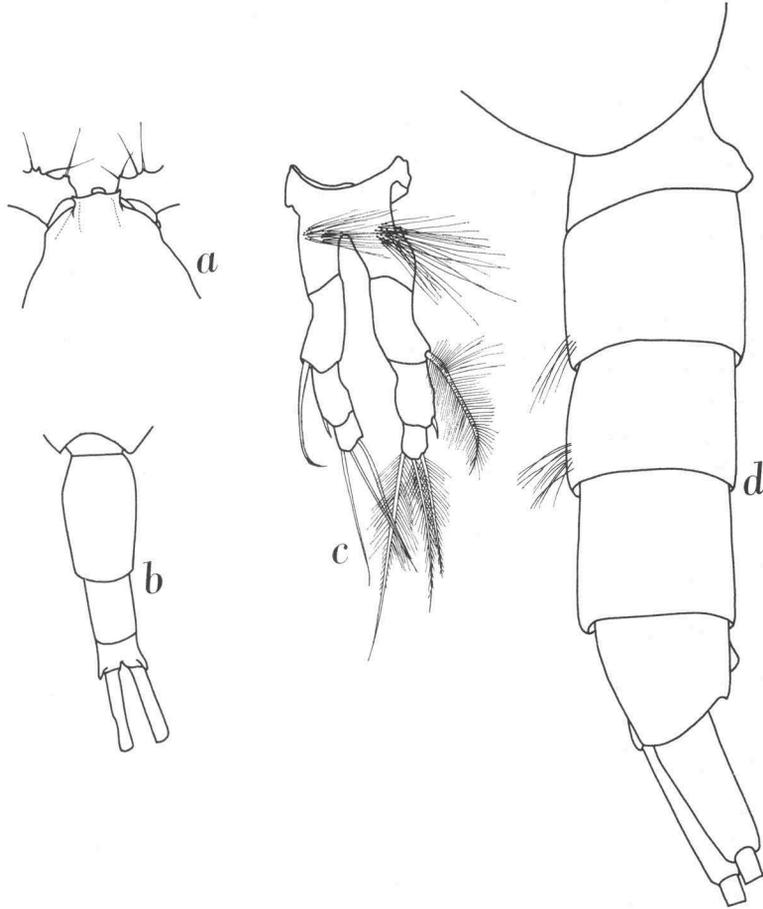


Fig. 14. a-c, *Metridia princeps* Giesbrecht, ad. ♀; a, frontal part of the head in dorsal view; b, abdomen, dorsal view; c, fifth pair of legs; d, *Pleuromamma scutullata* Brodskii, ad. ♂, lateral view of the abdomen from the left side. a, b, $\times 25$; c, $\times 35$; d, $\times 100$.

legs of both species are much alike, although those of *U. frontalis* are generally longer.

In *U. spinifer* Tanaka, 1960, the thoracic somites four and five are completely fused and the endopodites of the second and third pairs of legs are spinulose.

METRIDIIDAE

Metridia pacifica Brodskii, 1950 (fig. 13 b, c)

Material. — About 60 adult ♀♀; about 60 adult ♂♂; numerous immature specimens of all copepodite stages.



Fig. 15. a-c, *Heterorhabdus pacificus* Brodskii, ad. ♀; a, genital complex, lateral view from right side; b, chewing plate of the left mandible; c, chewing plate of the right mandible. d, *Heterorhabdus tanneri* Giesbrecht, ad. ♀, lateral view of the genital complex from left side. a, d, $\times 90$; b, c, $\times 160$.

Remarks. — In general I found my specimens in good agreement with Brodskii's (1950: 295, fig. 201) description and figures of *M. pacifica*. The following remarks, however, must be made.

1. The prehensile first antenna of the male is found on the left or the right side, without a distinct preference for either of these sides.

2. The middle of the right fifth leg of the male, according to Brodskii's figure, has two moderately long, internally directed spines. Brodskii's drawing suggests that the two spines originate from a different segment. This is emphasized by Brodskii's description: "not only the fourth but also the third segment (of the right fifth leg) bears a spine". The drawing also suggests that both spines are of the same nature. A close observation of the appendage convinced me that the situation is in reality quite different. There are in fact two inwardly directed spines on the fourth segment of the right fifth leg, one being a true spine, projecting from the segment, the other being a spiniform projection of the segment. The third segment of this leg also has a spine, but this spine is short and has a different direction (fig. 13 b, c). Evidently this last spine has not been meant by Brodskii. See also *M. asymmetrica* and *M. gurjanovae*.

3. Brodskii (1950, fig. 201) obviously erroneously placed the indication "female first pair of legs" besides a drawing on a larger scale of the female fifth pair of legs.

4. Park (1968) reported *M. lucens* from the Pacific Ocean, stating that Damkaer (1964) found no morphological differences between Pacific and Atlantic specimens, to justify two distinct species.

Unfortunately, I have had no opportunity to compare the present material with either Park's nor Damkaer's, nor have I seen Atlantic males. However, literature data (e.g., figures published by G. O. Sars, 1903, pl. 57; Giesbrecht, 1892, pl. 33 fig. 22), convinced me, that with respect to the right fifth leg in the male the situation differs quite a lot in both species. I would not consider the additional spine on the fourth segment of this particular leg a minor anatomical detail, since the structure is very characteristic: we are not dealing here with just another spine, it is, on the contrary, placed and shaped in a very special way, acting as a counterpart of the spiniform projection of the same segment.

Moreover, this structure is also undoubtedly found in *M. gurjanovae*, and, in my opinion, distinctly places this species and *M. pacifica* (and perhaps also *M. asymmetrica*) apart from all other species of the genus *Metridia*.

Measurements. — Total length of the adult females, 2.9-3.3 mm, of the adult males, 1.65-2.05 mm.

***Metridia curticauda* Giesbrecht, 1889**

Material. — 13 adult ♀♀; 15 immature specimens.

Remarks. — Brodskii (1950) recorded this species from the northwestern part of the Pacific and the southern part of the Bering Sea; it was not men-

tioned by Davis (1949). This apparently is the first record from the north-eastern Pacific.

Measurements. — Total length of the adult females, 3.1-3.55 mm.

***Metridia asymmetrica* Brodskii, 1950**

Material. — 1 adult ♂.

Remarks. — The structure of the right fifth leg in the male is comparable to that found in *M. pacifica*. Brodskii's (1950, fig. 205) figure gives no certainty as to the position of the inwardly projecting spines on the right fifth leg; in the description he states "proximal joint of right (fifth) leg swollen on the inner side and hairy, next joint armed with two short spines". Unfortunately in my specimen the distal parts of the fifth legs were broken off, so that I could not examine the situation more closely myself.

M. asymmetrica was reported by Brodskii (1950) from the northwestern part of the Pacific; I have been unable to trace previous records from the northeastern part.

Measurements. — The adult male is 3.45 mm long. Brodskii (1950) gave as the length of this sex 3.6-3.9 mm.

***Metridia brevicauda* Giesbrecht, 1889**

Material. — 1 adult ♀.

Remarks. — The distribution of this species in the Pacific, according to Brodskii (1950) is from 16°N to 3°S, but he also states: "This species was recently found in the Bering Sea (the 1932 Expedition of the State Hydrological Institute)". The present record from the northeastern part of the Pacific indicates that the species has a greater distributional area in the North Pacific than previous records suggest.

Measurements. — Length of the adult ♀, 1.9 mm.

***Metridia gurjanovae* Brodskii, 1950 (fig. 13 d, e)**

Material. — 1 adult ♂.

Remarks. — Brodskii (1950: 301) gave Epstein (1949) as the author of this species. Dr. Brodskii kindly informed me (in litt.) that Epstein had not published the description of this species at the time of publication of Brodskii's monograph. As Brodskii (1950) was the first to give both a description and a figure of this species he consequently has to be cited as the author.

Attention should be drawn to the structure of the right fifth leg (fig. 13 d) of the male. The nature of the spines on the middle portion of that leg is not quite distinct in Brodskii's figure (1950, fig. 207). I had the opportunity

to study the right fifth leg in a more favourable position (fig. 13 e). The fourth segment of this leg has a spine and a spiniform projection, both pointing medially; the third segment also has a spine, pointing in another direction.

The structure of the fifth legs of the males of the species *Metridia pacifica*, *M. gurjanovae* and probably also *M. asymmetrica* is very similar and might be an indication of a closer relationship between these three species within the genus *Metridia*.

Brodskii (1950) recorded *M. gurjanovae* from the southern part of the Bering Sea only; it has not yet been recorded from the northeastern part of the Pacific.

Measurements. — Total length of the adult male, 3.0 mm.

Metridia princeps Giesbrecht, 1892 (fig. 14 a-c)

Material. — 1 adult ♀.

Remarks. — Fig. 14 c shows the fifth legs of my specimen; the structure of this pair of legs agrees well with the description of *M. princeps* according to Brodskii's (1950: 289-290) key, as the setae are placed at the apex of the distal segment. In one, perhaps minor, detail my specimen resembles *M. ornata* Brodskii, 1950, viz., in the brush of long hairs on the first segment of the basipodite of leg 5. In *M. princeps* there is one such brush present on the first basipodal segment of both sides (cf. G. O. Sars, 1925, pl. 53 and Brodskii, 1950, fig. 208, figure copied from Sars). In *M. ornata* there are two separate rows of hairs on the first basipodal segment of both sides (Brodskii, 1950, fig. 210). In my specimen the basipodite of one side has a single brush of hairs, while on the other side two rows of hairs are present.

The frontal part of the head, moreover, is not as smooth in my specimen as, judging by various accounts, seems to be the case in *M. princeps*, nor is it as indented as is described for *M. ornata* (cf. Brodskii, 1950: 303, 304, fig. 210). As can be seen from fig. 14 a the extreme frontal part of the head is cut into one ornate figure on both sides. In this particular character my specimen occupies a position intermediate between the two species.

In order to reach a satisfactory solution concerning the taxonomic position of my specimen I have also checked other characters which could possibly be used to discriminate between the two species.

The ratios of the lengths of the abdominal somites differ markedly in the two species, as can be seen from Brodskii's (1950, fig. 208, 210) drawings. The lengths of the abdominal somites have been taken from drawings in Brodskii (1950, fig. 208, 210), Giesbrecht (1892, pl. 33 figs 35, 40) and Sars (1925, pl. 54), viz., the length of the genital somite,

the length of the intermediate abdominal somite and the length of the anal somite and furca. The same has been done in a drawing of the present specimen. I have invariably used the length of the intermediate somite as standard reference with which the other segments have been compared, as this segment seemed to be the more stable portion of the abdomen, the major differences occurring in the genital somite and the anal somite and furca.

In Table III the ratios are given, as are also the actual lengths of the various abdominal sections as measured in the above mentioned drawings.

Although only very few specimens have been measured and we must take into account intraspecific variation, the table shows that only comparatively small differences exist between the two sets of ratios of *M. princeps*. Major differences exist between the individual species.

Examination of Table III again shows that the specimen from sample V-3 takes an intermediate position between *M. princeps* and *M. ornata*. In my opinion the resemblance with *M. princeps* is slightly stronger, so that it can best be attributed to that species. My material, unfortunately, is too small to allow speculations concerning the nature of the differences that have been observed. The study of intraspecific variation in both *M. princeps* and *M. ornata* is still imperative.

The distribution of the two species discussed can be summarized as follows (Brodskii, 1950; Davis, 1949; Rose, 1933; Farran, 1948):

Metridia princeps: northern and temperate Atlantic Ocean, Bay of Biscay, Malay Archipelago, Antarctic, Pacific Ocean at 3°S 99°W, and the south-eastern Pacific.

Metridia ornata: northwestern part of the Pacific Ocean, about 35°N 125°W.

Although, through the lack of material, no definite conclusion can be reached at the present stage, it is my personal opinion that the present specimen belongs to a geographical variety of *M. princeps* and that *M. ornata* as described by Brodskii (1950: 303, fig. 210) must also be regarded as a variety or a subspecies of *M. princeps*. Brodskii (1950: 305) already noticed the close relationship between *M. princeps*, *M. ornata*, *M. macrura* G. O. Sars, 1925, and *M. ignota* Esterly, 1906.

Measurements. — Total length of the adult female, 7.5 mm. Brodskii (1950) gave as the length of adult females of *M. princeps*, 8.1-8.5 mm, of *M. ornata*, 8.0-8.5 mm.

Pleuromamma species

Nine immature specimens, representing early copepodids of various species of this genus occur in the sample.

Pleuromamma abdominalis (Lubbock, 1856)

Material. — 1 adult ♀.

Measurements. — Total length 4.1 mm.

Pleuromamma scutullata Brodskii, 1950 (fig. 14d)

Material. — 1 adult ♀; 4 adult ♂♂.

Remarks. — A brush of hairs occurs on the ventral side of both the second and third abdominal somites of the male (fig. 14 d); that on the third being the only one mentioned by Brodskii (1950).

This species is recorded by Brodskii (1950) from the northwestern part of the Pacific and from the Bering Sea. The present record from the northeastern Pacific shows that its occurrence in the northern Pacific is extensive.

Measurements. — Total length of the adult female, 3.9 mm; of the adult male, 3.25 mm.

LUCICUTIIDAE

Lucicutia ovalis (Giesbrecht, 1889)

Material. — 15 adult ♀♀; 6 adult ♂♂; 2 immature specimens.

Measurements. — Total length of the adult female, 1.8 mm; of the adult male, 1.5 mm.

Lucicutia species

Material. — 1 immature specimen.

Measurements. — Total length 4.1 mm.

HETERORHABDIDAE

Heterorhabdus species

Numerous copepodids of all stages, belonging to various species of this genus, were met with in the sample.

Heterorhabdus spinifrons (Claus, 1863)

Material. — 2 adult ♂♂.

Remarks. — Brodskii (1950: 353) records the species from the northern Pacific, its distributional area ranging from 41°N to 14°N (cited from Giesbrecht, 1898) with a doubtful extension as far as 56°N. It has now been demonstrated that the species occurs at least as far north as 50°N.

Measurements. — Total length of the adult males, 3.2-3.4 mm.

Heterorhabdus pacificus Brodskii, 1950 (figs. 15 a-c)

Material. — 2 adult ♀♀; 2 immature specimens.

Remarks. — The adult females generally agree with Brodskii's description and figures (1950: 355, fig. 250), but I found differences in the structure of the mandibles. Brodskii described the mandibles of the females as "symmetrical, except for the number of teeth". In his drawing the right mandible is figured, bearing two teeth. My specimens were found to have two teeth on the chewing plate of the left mandible and three on that of the right mandible (fig. 15 b, c). A similar situation is found in females of *H. norvegicus* (Boeck, 1873) (cf. G. O. Sars, 1903, pl. 81), but nothing is known concerning the constancy of this feature. Some variability in this respect in both *H. pacificus* and *H. norvegicus* can reasonably be expected.

The caudal margins of the abdominal somites have serrated edges in my specimens; these are not mentioned or figured by Brodskii (1950).

H. pacificus is only mentioned from the northwestern part of the Pacific (Brodskii, 1950); the present record proves that its distribution extends farther eastward.

Measurements. — Total length of the adult females, 3.25-3.75 mm.

Heterorhabdus tanneri (Giesbrecht, 1895) (fig. 15 d)

Material. — 2 adult ♀♀; 1 adult ♂; 1 immature ♀.

Remarks. — The caudal borders of the abdominal somites in the female were found to have toothed edges dorsally and dorso-laterally. This detail is not mentioned by Brodskii (1950) who described the female.

This species is mentioned by Brodskii (1950) from the Bering Sea and the northwestern Pacific. Its occurrence in the northeastern Pacific has now been established.

Measurements. — Total length of the adult females, 4.0-4.9 mm; of the adult male, 3.85 mm. Brodskii (1950) gave the following measurements: adult ♀♀, 4.0-4.1 mm; adult ♂♂, 3.6-3.9 mm.

AUGAPTILIDAE

Augaptilus species

Material. — 1 immature specimen of an early copepodid stage.

Measurements. — Total length of the specimen, 4.0 mm.

CANDACIIDAE

Candacia columbiae Campbell, 1929

Material. — 1 adult ♂.

Measurements. — Total length of the specimen, 3.8 mm.

BATHYPONTIIDAE

Temorites brevis G. O. Sars, 1900

Material. — 4 adult ♂♂; 1 immature specimen.

Remarks. — Brodskii (1950) recorded this species from the central part of the Polar Basin, from the northwestern part of the Pacific Ocean and also from Antarctic waters. It is not mentioned in Davis' list (1949), so that the present record seems to be the first from the northeastern Pacific.

Measurements. — Total length of the adult males, 1.75-1.9 mm.

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TABLE I
 Characteristics of the varieties of *Calanus pacificus* Brodskii

Variety	Total length in mm	Presence of distinct lateral swellings	Females		Number of teeth on basipodite of leg 5
			Drop-like shape of the body in dorsal view	Length of first antenna in relation to total length	
<i>oceanicus</i>	2.8-3.2 (3.06)	+	—	longer	31-39*
<i>japonicus</i>	2.7-3.1 (2.76)	—	+	longer	22-29**
var.?	2.4-3.2 (2.67)	+	—	shorter or equal	18-21

Variety	Total length in mm	Type of fifth legs	Males		Endopodite of 5th leg reaching distal margin of 1st exopodal segment
			Ratio breadth-length of 1st and 2nd exopodal segment of leg 5	Ratio breadth-length of 1st and 2nd exopodal segment of leg 5	
<i>oceanicus</i>	2.8-3.1 (2.93)	thin	1 : 3.5	1 : 3.5	almost
<i>japonicus</i>	2.6-2.8 (2.67)	thin	1 : 4.5	1 : 4.5	not
var.?	2.6-2.7 (2.65)		as in var. <i>oceanicus</i>		

* The number which Brodskii (1961) gave in his key is 31-39; in the descriptions he mentioned 32-39. Obviously the number 31 has not been observed by Brodskii himself but has been included in case it would be encountered.

** The number given by Brodskii (1961) in the description is 22-29; in the key he stated "less than 30". As *C. pacificus* var. ? does not figure in the key a further limitation of this number in *C. pacificus* var. *japonicus* was not necessary then.

TABLE II
 Characteristics of specimens of *Calanus pacificus* Brodskii from sample V-3

Number of specimen	Sex	Length in mm	Presence of distinct lateral swellings	Drop-like shape of the body in dorsal view	Length of first antenna in relation to total length	Number of teeth on basipodite of leg 5 *	Type according to Brodskii
1	♀		+	—	shorter	29 31	<i>oc/jap</i>
2	♀	2.60	+	—	shorter	20 23	<i>jap/var.?</i>
3	♀	2.85	+	—	shorter	29 25	<i>jap</i>
4	♀	2.65	+	—	shorter	23 21	<i>jap/var.?</i>
5	♀	2.50	+	—	shorter	27 24	<i>jap</i>
6	♀	2.80	+	—	longer	19 21	<i>var.?</i>
7	♀	2.80	+	—	shorter	23 23	<i>jap</i>
8	♀	2.90	+	—	shorter	35 35	<i>oc</i>
1	♂	2.60					

Type of 5th leg
thin

Ratio breadth: length of left 5th leg
1st exopodal segment 1:4.1
2nd exopodal segment 1:5.6

* The number of teeth at the basipodite of both sides is given.
 An additional character used by Brodskii to differentiate between the males, viz., the length of the endopodite of the left fifth leg in relation to the first exopodal segment of the same leg, could not be studied here as the endopodite was broken off.

TABLE III

Comparison of ratios of the lengths of the abdominal somites in some species of *Metridia*

	Genital somite	Median abdominal somite	Anal somite and furca
Specimen from sample	33	20	28
V-3	<i>1.65</i>	<i>1</i>	<i>1.40</i>
<i>M. princeps</i> (after Brodskii, 1950, from G. O. Sars, 1925)	12	9	12
	<i>1.33</i>	<i>1</i>	<i>1.33</i>
<i>M. princeps</i> (after Giesbrecht, 1892)	28	20	25
	<i>1.40</i>	<i>1</i>	<i>1.25</i>
<i>M. ornata</i> (after Brodskii, 1950)	20	11	18
	<i>1.82</i>	<i>1</i>	<i>1.63</i>
<i>M. macrura</i> (after G. O. Sars, 1925)	14	9	19
	<i>1.55</i>	<i>1</i>	<i>2.11</i>

Note. The actual measurements are given in mm (in arabic numerals). The ratios are given in italics. The data of *M. macrura* have been added for comparison with another large species of *Metridia*.