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HARPACTICID COPEPODS (CRUSTACEA) LIVING IN WOOD INFESTED BY LIMNORIA FROM NORTHWESTERN FRANCE

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ABSTRACT

In wood infested by Limnoria from northwestern France, 18 species of harpacticid copepods have been found. The published figures of Paradactylopodia brevicornis (Claus, 1866), Amphiascus minutus (Claus, 1863), Heterolaophonte stromi paraminuta Noodt, 1955, and Paralaophonte brevirostris (Claus, 1863) have been compared with the specimens at hand.

Heterolaophonte longisetigera Klie, 1950, is rised to specific rank, instead of being a subspecies of H. littoralis. Moreover, the genus Orthopsyllus is reviewed. Four valid species are distinguished: O. sarsi Klie, 1941, O. spinicaudatus Krishnaswamy, 1957, O. wallini Lang, 1934, and O. linearis Claus, 1866; the latter is subdivided into 4 groups, viz., the O. linearis-group, the O. major-group, the O. improportionalis - group and the O. illgi-group. An Orthopsyllus collected in Limnoria - wood is figured and described in detail. It is assigned to the O. linearis-group and named O. linearis f. setosus nov.

INTRODUCTION

During an investigation on the association of copepods and the gribble, Limnoria, Pinkster (1968) found 5 species of harpacticids: Tisbe parviseta Pinkster, 1968 and Harrietella simulans (T. Scott, 1894) on the Atlantic coast, Tisbe eurypleura Pinkster, 1968 and Amonardia normani (Brady, 1872) on the Mediterranean coast of France, and Donsiella limnoriae Stephensen, 1936, on both the Atlantic and Mediterranean coasts. On the French Atlantic coast around Wimereux (Pas-de-Calais) and in Brittany (Finistère) Pinkster collected some more harpacticids from wood infested by Limnoria. These collections, identified by the present author, form the subject of this paper.

The collection was found to contain 18 species of harpacticoids (table I). The most abundant species were Harpacticus obscurus, juv. Tisbidae, Parathalestris harpactoides, Harrietella simulans, and Donsiella limnoriae, whereas Dactylopodia vulgaris and Amphiascus minutus were less numerous.

All species were collected by rinsing the wood infested by Limnoria in sea-water containing 1% formaldehyde. This wood consisted of pieces from the poles marking the boundaries of commercial shellfish beds, situated on intertidal sand and mud flats. The composition of the harpacticid fauna was often found to differ greatly from one place to another.

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DISCUSSION OF THE SPECIES FOUND

ECTINOSOMATIDAE

Ectinosoma melaniceps Boeck, 1864
Was found in several samples collected around Wimereux.

HARPACTICIDAE

Harpacticus obscurus T. Scott, 1895
One of the most abundant species, especially in the Wimereux collections. From few to many specimens per sample.

Zaus aurelii Poppe, 1884
One adult specimen, and several juvenile specimens probably belonging to this species, from Wimereux.

TISBIDAE

In various Wimereux samples some dozens of specimens in various copepodid stages were found. However, with the taxonomic papers at our disposal it was not possible to identify them. Most specimens showed resemblance to *Tisbe compacta* (Sars, 1920).

Tisbe gurneyi (Lang, 1934)
2 specimens from Pointe aux Oies, Wimereux.

Tisbe furcata (Baird, 1837)
Some specimens from Penpoull, S. of Roscoff.

PELTIDIIDAE

Alteutha oblonga (Goodsir, 1845)
Found at Pointe aux Oies near Wimereux (3 specimens).

THALESTRIDAE

Thalestris longimana Claus, 1863
One ovigerous ♀ was found near Wimereux.

Parathalestris harpactoides (Claus, 1863)
Collected near Wimereux. Present in some few samples only, but in those samples very numerous.

Dactylopodia vulgaris (Sars, 1905)
Very numerous in the material collected near Wimereux.

Paradactylopodia brevicornis (Claus, 1866). Figs. 1, 2.
One specimen from Pointe aux Oies, near Wimereux. There are some differences between the figures given by Sars (1909) and this specimen. The antennule is certainly not completely drawn in Sars' figure. The second inner seta of the exopodite of leg 5 is 3 times as long as the exopodite,

instead of twice as long, as indicated by Sars. The exopodite of leg 5 is not twice as long as wide, as is stated by Sars, but only 1.3 times. The setae on the maxilliped are longer than illustrated by Sars.

DIOSACCIDAE

Amphiascus minutus (Claus, 1863)

About ten specimens from Wimereux and one from St. Thégonec, Brittany. The variability of this species is confirmed by many authors. Our samples too, show certain differences with the drawings by various authors. The inner side of the third segment of the exopodite of leg 4 has 3 instead of 2 well-developed setae (contrary to Lang's, 1965, observation) and the inner side of the first segment has setae with bristles instead of glabrous setae (Lang, 1965; Sars, 1911; Vervoort, 1964). Another specimen had one seta and one spine on the inner side of the third segment of this exopodite. The 3rd segment of the endopodite of leg 5 should, according to Lang (1965), be twice as long as the 2nd segment, instead of having the same length. The 2nd segment of the exopodite of leg 1 is usually 1.5 times the third segment instead of 3 times the third segment as in our specimens and in Sars' (1911) specimens. The outer side of the 2nd and 3rd segments of the endopodite of leg 1 has 2 and 3 strong spinules, respectively, instead of 2 and 5 spinules (Lang, 1965). The proximal seta of the 2nd segment of endopodite leg 3 was well-developed and ciliated instead of naked and small, as stated by Vervoort, 1964 and Lang, 1965.

The three outer setae of the baso-endopodite of leg 5 are 2 to 2.5 times as long as the inner seta, just as stated by Sars, 1911, and not of the same length (Lang, 1965).

Compared with the 7th segment, the respective lengths of the 2nd and 4th segment of A 1 are 2.5 and 2 times that length, instead of 3 (Lang, 1965) or 4 times (Sars, 1911).

The greatest variation is shown (1) by the middle segment of the exopodite of leg 1, its length being 1.5 to 2 times its width and 1 to 1.5 times the length of the first segment and (2) by the terminal seta on the inner side of the 3rd segment of the exopodite of leg 4 which varied from well-developed to almost rudimentary. On the third segment of endopodite of leg 4, the implantation of the inner seta varied as well.

CANTHOCAMPTIDAE

Orthopsyllus linearis (Claus, 1866) f. setosus nov. Figs. 3 - 12.
One ovigerous ♀ from Pointe aux Oies, Wimereux, August 10, 1968. This form is described at the end of this paper.

Mesochra cf. pygmaea (Claus, 1863)
One adult specimen and several copepodids from Pointe aux Oies, Wimereux.

LAOPHONTIDAE

Heterolaophonte longisetigera Klie, 1950 (new rank). Figs. 13 - 22.
H. littoralis longisetigera Klie, 1950: 121.

Seven specimens from Penpoull, S. of Roscoff. Lang (1965: 467) wondered already whether this form should not be considered a full species: "... it may therefore be questioned whether longisetigera is not a species by itself". Having new material at hand, I have taken the step to rise it to specific rank.

Leg 5 of this specimen corresponds completely with Klie's description and figure. Monard's (1935) specimens of H. littoralis T. & A. Scott, 1893, likewise from surroundings of Roscoff, may also belong to this species. Klie found his material in Heligoland, depth 6 to 8 m, in "Algendredschmaterial", and in intertidal "Rhodochortonrassen", both in October. The species thus is

known from Roscoff and Heligoland.

H. longisetigera differs from littoralis in the presence of an inner seta on the 3rd segment of the exopodite of leg 4 and in length of the setae on the exopodite of leg 5. In H. littoralis these are subequal to the length of the exopodite, while in longisetigera these are from equal to twice the length of the exopodite.

H. stromi paraminuta Noodt, 1955. Fig. 23.
Four specimens from Wimereux.

The material shows some slight differences compared with existing drawings. The 4th segment of the antennule is shorter than in Noodt's figure (1955) and the ciliation of the setae on the 1st segment of the exopodite of leg 1 is much longer. According to Lang (1965), the exopodite of leg 5 is 1.5 times as long as wide, in our specimens the length/width ratio is 2. In one of the specimens, the one exopodite of leg 5 has 7, the contralateral one 6 setae.

Paralaophonte brevirostris (Claus, 1863)
One specimen from Penpoull (= South of Roscoff).

The baso-endopodite of leg 5 in this specimen is covered with spinules. These are not represented in the drawings by Sars (1911). The 2nd segment of the antennule is just as long as the 3rd and 4th segment together, whereas according to Sars (1911), the 2nd and 3rd segments are equal in length.

Donsiella limnoriae Stephensen, 1936
In about half of the Wimereux samples with Limnoria, Donsiella was present and then always in fairly large numbers. It was not found, however, in Bretagne.

Pinkster (1968) clearly showed, that this species is a constant associate of Limnoria.

Harrietella simulans (T. Scott, 1894)
Harrietella was the most numerous harpacticid in practically all Wimereux samples.

It is not known whether the occurrence of this species in Limnoria samples depends on the presence of Limnoria (like Donsiella), on the presence of (a particular kind of) wood, or on the presence of holes bored by Limnoria, which may serve as a hiding place, as is possibly the case in Tisbe eurypleura Pinkster, 1968. It is, however, probable that the species is an associate of Limnoria, because it is morphologically similar to Donsiella, which attaches itself to Limnoria.

DISCUSSION OF THE GENUS ORTHOPSYLLUS

A meticulous study of all the figures of representatives of the genus Orthopsyllus known at present, reveals the difficulties connected with the various taxa as pointed out by many authors (e.g. Lang, 1965; Wells, 1968; Hamond, 1970).

In brief, these difficulties arise from the following points:

1. The description and illustrations of the type species, O. linearis Claus, are very incomplete.
2. Many figures of newly described species are rather sketchy (e.g., O. spinicaudatus and O. improportionalis).
3. For O. wallini, O. major, O. agnatus, and O. propinquus no figures of the exopodite of legs 2 to 4 are known.
4. No figure of leg 1 was given for O. wallini.
5. For O. spinicaudatus and O. linearis no figures of legs 3 and 4 exist.

6. Male specimens are described only in O. spec. Sewell and O. dubius.

7. The number of specimens on which descriptions of new species were based generally is one or two.

8. "Some species seem to have been founded upon the last copepodid stage" (Lang, 1965).

9. As a rule, recent publications tend to contain more details than the older ones (e.g., the recent illustrations of O. illgi by Lang, 1965, as compared to the orginal ones of Chappuis, 1957). In part, this is certainly due to improvement of microscopical techniques. The more obvious differences between "old" and "recent" illustrations are manifest in:

    a. the configuration of the setae of leg 1.

    b. the number of setae on the terminal segment of the endopodite of legs 2 to 4 (Lang, 1965, noticed that the endopodite of leg 4 of a copepodid of O. illgi had 4 setae, whereas a full-grown specimen had 3).

    c. the armature of the furca, including the presence or absence of a lamella. For O. illgi, Lang (1965) demontrated a considerable variability in the furca, especially in the spinosity and/or sclerotization on both sides. This spinosity was considered, e.g. by Vervoort (1964), to be one of the identification characteristics.

10. The last difficulty, only recently discovered, is the variability within the species. Lang (1965) observed variability in the furca of O. illgi. Hamond (1970) did not find variability in the furca of his Orthopsyllus specimens, but he did find it in the seta-like projections on the first and third segments of legs 2 to 4, in the spinules on leg 1, and in the shape and armature of leg 5 of the male.

Through comparison of all published figures of Orthopsyllus-specimens, I arrived at the conclusion that O. spinicaudates, O. sarsi, and O. wallini are valid species. The remaining "species" are similar in so many respects that they might very well all belong to one species, O. linearis.

O. spinicaudatus Krishnaswamy, 1957 (from Madras) "... is, no doubt a distinct species, but Krishnaswamy's description of it is very incomplete" (Lang, 1965). The differences from the other species are: the 2nd segment of the endopodite of leg 1 bears two plumose setae instead of one; the outermost seta of the exopodite of leg 5 is of the same length as the seta next to it, instead of only a fraction of this length; on the 2nd segment of the exopodite of legs 2 to 4 an inner seta is present, lacking in other species; and the endopodites are said to have one segment instead of two. The inaccuracy displayed in the drawings of this species raises suspicion about the characteristics, such as the endopodites being one-segmented, and the endopodite of leg 1 having two plumose setae instead of one (see remarks on pectinicauda in the sequel).

O. wallini Lang, 1934 (from Tasmania) differs from all other species in having two instead of three outer spines on the exopodite of legs 2 to 4. It is probable that O. littoralis Nicholls, 1942 (from Australia) is synonymous with this species. I am not much impressed by the differences pointed out by Nicholls ("differs from that species in lacking an inner seta on the basal segment of the first (no doubt the second is meant) endopodite, in the seta formula and the shape of the fifth legs in the female"). Just as in O. rugosus cuticular cilia ("hairs") were taken for inner setae.

O. sarsi Klie, 1941 (from Norway) can be identified at once by the inner seta on the first segment of the exopodite of leg 1. This species was based upon the plate of O. linearis by Sars (1911). O. sarsi greatly resembles the O. major-group.

All the other species, described so far, have so many points in common that they may very well all belong to one single species, O. linearis (Claus, 1866). By comparing the relative length of segments and setae this species could be subdivided in 4 groups:

To the O. linearis-group we may ascribe the majority of the described specimens.

There is a great resemblance between the specimens from the Scilly Isles depicted by Brady (1880, probably a juvenile specimen) and Wells (1968) and from Norfolk by Hamond (1970).

It has long been suspected - e.g. by Kunz (1938), Klie (1941), and Lang (1965) - that O. propinquus Monard, 1926 might be identical with Claus' O. linearis, the more so as the type localities are not far apart (Cette and Nice). O. agnatus Klie, 1950 (from Heligoland) "steht linearis zumindest sehr nahe, und es entsteht der Eindruck, dass beide Formen letzten Endes synonym sind" (Noodt, 1955). Klie (1941) says: "schlage ich weiter vor linearis Claus als nicht ausreichend beschrieben zu den unsicheren Arten zu stellen.." and Vervoort (1964) states: "he failed to indicate differences between his new forms (agnatus, major, sarsi) and the type species".

Strictly speaking, the only difference between O. linearis f. bulbosus Noodt, 1955 (from Turkey) and the type species is the body length.

There is no doubt that O. spec. (Hamond, 1970) also belongs to this group. Lang (1965) and Hamond have given the best figures that are known for this genus. Comparing Hamond's figures with our specimen from Pointe aux Oies near Wimereux (figs. 3 - 12) the following differences have been found: the antennule of Hamond's specimen has fewer setae; the spinules on the endopodite of the antenna of our specimen are 2 to 3 times as long as those in Hamond's specimen; and the setae of the exopodite of the antenna are hirsute in our specimen versus naked in Hamond's.

Leg 1 resembles closely that depicted by Hamond, the only difference being the serrated seta on the endopodite, which is slightly longer in our specimen. As to leg 2, our specimen lacks the terminal inner seta on the first segment, otherwise Hamond's and our specimens are identical. The same holds true for leg 3, only the minute seta-like projection terminally on the inner side of the 3rd segment is absent in Hamond's specimen. Leg 4 is similar in both cases. In our specimen the outer seta of the baso-endopodite of leg 5 is much longer, and all the setae are densely ciliated. The shape of leg 5 is similar. The furca is almost exactly the same as in Hamond's material, but our specimen has got more outer setae near the lamellae. These minor differences can be explained by the variability within the species, as was demonstrated by Hamond (1970). But there are still the differences enumerated on page 14/15 in which our specimen differs from other described forms in the O. linearis-group.

The O. major-group appears to be intermediate between O. linearis-group and O. sarsi. In practically every respect this group is similar to O. sarsi, the essential inner seta on the first segment of the exopodite of leg 1, however, is lacking. The O. major-group resembles O. sarsi in leg 1 (exopodite 0.7 - 0.8 times as long as endopodite; in other species 0.9 - 1.3 x, first segment endopodite 2.1 times as long as the 2nd segment, in other species 0.8 - 1.8 x) and many other characteristics. It must be assumed, however, that Klie's figures have been made from a dried specimen, as may be inferred from the structure of the knob on the 2nd segment of the antennule. Knobs on the antennule - in other genera as well - have a regular form, while the knob illustrated by Klie is irregular. Also the fact that the 3rd segment of the antennule appears to be unusually long, points in this direction.

The O. improportionalis-group differs from the O. linearis-group by the 1st segment of the endopodite of leg 1, being 1.6 - 1.8 times longer than the 2nd segment. In the O. linearis-group this ratio is 0.8 - 1.3, in the O. illgi-group 1.2 - 1.7, and in the O. major-group 2.1.

The type of this group, originally described by Jakobi, 1954, as Kataceletodes improportionalis, is said to have an antennule of 5 segments, instead of 4, with 5 instead of 4 setae on the 3rd segment of the exopodite of leg 1, and with an endopodite of leg 2 with one segment instead of two. Vervoort (1964) considers it very probable that this species is identical to O. linearis. O. "linearis" of Lang (1965) from South Georgia and the Falkland Islands, is ably described and illustrated. Also Scott's (1912) drawing of O. linearis from the South Orkneys strongly suggests

this group. Possibly the specimens illustrated by Scott (1893) from the Gulf of Guinea, and by Pesta (1916) from West Africa, likewise belong here.

The O. illgi-group differs from the other groups by the two longest setae of the baso-endopodite of leg 5 which are mutually of the same length, besides being clearly shorter than the longest seta of the exopodite. Characteristic as well is the shortness of the two most proximal setae of the baso-endopodite of leg 5.

These characteristics are found in O. rugosus Nicholls, 1941 (from Australia), O. similis Nicholls, 1942 (from Australia), O. pectinicauda Vervoort, 1964 (from the Caroline Islands), O. illgi (Chappius, 1957) from the eastern U.S.A., recorded by Lang, 1965, from the western U.S.A.). It is possible that O. dubius Vervoort, 1964 (from the Caroline Islands) and O. spec. Sewell, 1940 (from the Nicobar Islands, Indian Ocean) also belong to this group, since both are very similar to O. linearis and both are found within the distribution area of the O. illgi-group. O. rugosus is said to have an inner seta on the endopodite of leg 4 - for which reason it was split off - but the inner seta is depicted as a spinule or a cuticular hair. In the description of O. pectinicauda too much emphasis is laid on the furca which, especially in this species appears to be very variable. The alledged presence of 3 plumose setae on the exopodite of leg 1 might be due to wrong interpretation, the serrated tip being mistaken for a plumose tip.

DESCRIPTION OF ORTHOPSYLLUS LINEARIS F. SETOSUS NOV.

The specimen illustrated in figs. 3 - 12 particularly resembles O. agnatus (see Klie, 1950), O. linearis (see Wells, 1968) and O. spec. (see Hamond, 1970). The present specimen, however, differs slightly, because the longest setae of leg 5 are ramified, the proximal seta of the 3rd segment of the exopodite of leg 1 is short, and setae on the furca are very numerous. No other Orthopsyllus has this combination of characters. At first I held the ramifications of the setae for protozoans or algae, but on both sides of leg 5 exactly the same ramifications could be observed.

I do not feel justified creating a new species or subspecies on the basis of this single specimen. Provisionally, however, we might consider it a separate form, O. linearis f. setosus nov. Here follows the description of this specimen, an ovigerous ♀, collected at Pointe aux Oies, Wimereux.

Body about 6 times as long as wide.

Rostrum clearly visible, about as long as wide.

Antennule 4-segmented. The 2nd segment with a strong, somewhat crenulated, spine on its posterior margin. The 3rd segment is about twice as long as wide and bears an asthetasc. The 4th segment is slightly longer than wide and carries 8 thin setae, it has 2 spines on the front margin, which in the terminal part is provided with a double row of fine teeth.

The endopodite of the antenna has 2 or 3 segments, the exopodite 1 segment, the latter supporting pinnate setae, all of the same length.

The exopodites of legs 1 to 4 are 3-segmented, the endopodites always 2-segmented. The basal 2 segments of the exopodites of all legs have a well-developed outer spine, the first segment of all endopodites is devoid of setae. All exopodites lack inner setae.

Leg 1: the 1st and 2nd segments of the exopodite and the 1st segment of the endopodite are of about the same length. The total length of endopodite is about equal to that of the exopodite. The endopodite bears 2 distal setae on the 2nd segment, the innermost of which is the longer one, having a plumose tip, the other one having a serrated tip. The 3rd segment of the exopodite bears distally 2 setae, the innermost being again the longer one, having a plumose tip, the other having a serrated tip. In the middle of the outer side of this segment there is a spine.

Legs 2 to 4 are clearly larger than leg 1 and possess 1 smaller and 4 larger spines on the 3rd

segment of the exopodite, of which 3 on the outer side, 1 terminal, and 1 on the inner side; inserted near the latter there is a small cuticular hair. The exopodites are 2.5, 2.5, and 4 times as long as the endopodites, respectively. The chaetotaxis formula of the endopodites in legs 2 to 4 is: 0, 1, 1; 1, 1, 1, and 1, 1, 1, respectively; near the middle setae, a small cuticular hair arises.

Leg 5: the contralateral rami of the baso - endopodites are separated, just as the exopodites. The baso - endopodite bears 5, the exopodite 6 setae, all, except for the innermost seta on the exopodite, strongly pinnate. The 4th and 6th seta on the exopodite (starting from the outside) are relatively very short. The longest seta on the exopodite and that of the endopodite are plumose. The baso - endopodite reaches almost to the distal end of the exopodite. The exopodite is 1.5 times as long as broad.

The furca is 1.5 times as long as wide. The inner margin is terminally armed with 6 spines, the outer side is proximally provided with a denticulate lamella. Along the inner margin there are 7 setae and another one in the middle, along the terminal margin there are 3 setae, of which the central one is long and stiff, the innermost small and thin, and the outermost greatly broadened at the base and larger than the inner one.

Table I. List of species of harpacticids found in wood infested by Limnoria in western France.

\+ = present; ++ = common; +++ = abundant; - = absent.

species observed	locality and date	
	dép. Pas - de - Calais: Audresselles, 7 Aug. 1968; Pointe aux Oies, 10 Aug. 1968; Wimereux, 22 Apr. 1967 and 13 to 28 July 1967	dép. Finistère: Penpoull, 26 June to 9 July 1965; Penpoull and St. Thégonec, 23 Sep. to 6 Oct. 1966
Ectinosoma melaniceps	++	-
Harpacticus obscurus	++	+
Zaus aurelii	+	-
Tisbe gurneyi	+	-
Tisbe furcata	-	+
Alteutha oblonga	+	-
Thalestris longimana	+	-
Parathalestris harpactoides	++	-
Dactylopodia vulgaris	++	-
Paradactylopodia brevicornis	+	-
Amphiascus minutus	++	+
Orthopsyllus linearis f. setosus nov.	+	-
Mesochra cf. pygmaea	-	+
Heterolaophonte longisetigera	-	+
Heterolaophonte stromi paraminuta	+	-
Paralaophonte brevirostris	-	+
Harrietella simulans	+++	++
Donsiella limnoriae	+++	-

APPENDIX

The following species of the genus Orthopsyllus have been described:

O. linearis Claus, 1866: 22, pl. 2 ; Brady 1880: 95 - 97, pl. 80 figs. 1 - 14 ; Scott, 1893: 98, pl. 12 figs. 29 - 32; Scott, 1913: 567 - 568, pl. 9 figs. 10 - 22; Pesta, 1916: 9 - 10, fig. 4; Lang, 1965: 400 - 401, figs. 220 - 221; Wells, 1968: 415 - 416, figs. 11 - 12.
O. propinquus Monard, 1926: 44, 54, figs. 64 - 73.
O. wallini Lang, 1934: 52 - 54, figs. 144 - 153.
O. major Klie, 1939: 225; Klie, 1941: 30 - 34, figs. 24 - 32.
O. spec. Sewell, 1940: 341, 360, fig. 84.
O. sarsi Klie, 1941: 29; Klie, 1950: 111; Sars, 1909: 289 - 290, pl. 199.
O. rugosus Nicholls, 1941: 420 - 422, fig. 21
O. littoralis Nicholls, 1942: 136, fig. 3.
O. similis Nicholls, 1942: 137, fig. 4.
O. agnatus Klie, 1950: 108 - 112. figs. 129 - 135.
O. improportionalis Jakobi, 1954: 194 - 195, pl. 4.
O. spinicaudatus Krishnaswamy, 1957: 74 - 77, fig. 16.
O. illgi Chappuis, 1957: 417 - 419, figs. 12 - 22; Lang, 1965: 400 - 411, figs. 222 - 227.
O. dubius Vervoort, 1964: 291 - 294, fig. 115.
O. pectinicauda Vervoort, 1964: 294 - 300, figs. 116 - 118.
O. spec. Hamond, 1970: 209 - 217, figs. 1 - 26.

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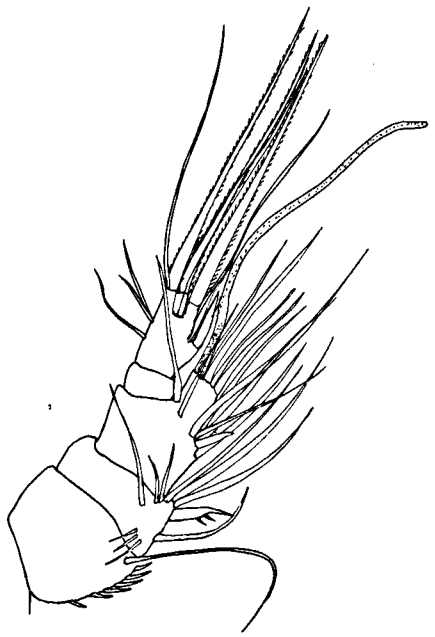

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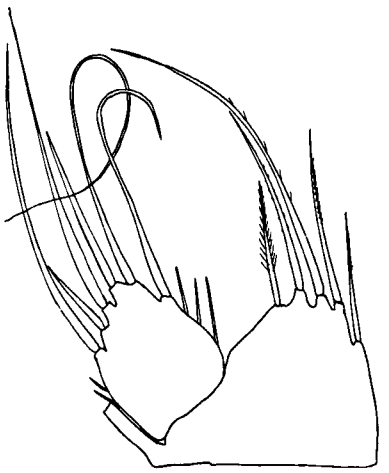

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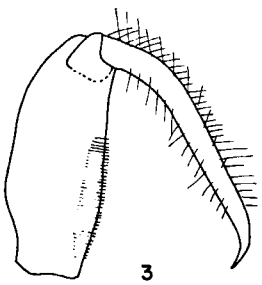

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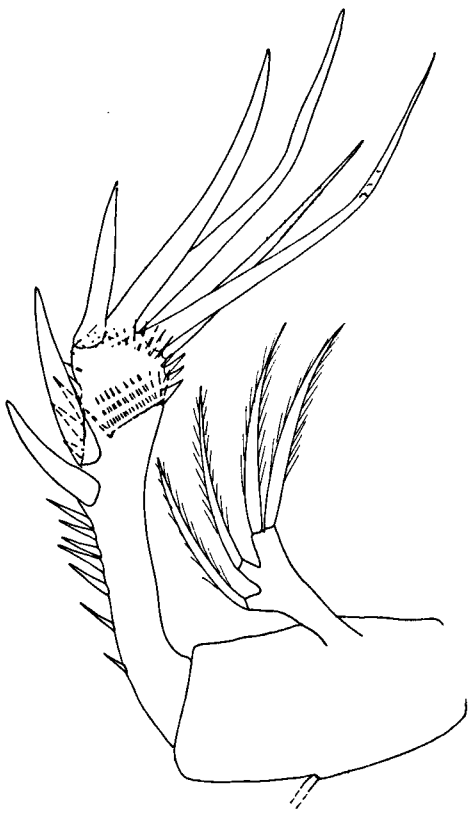

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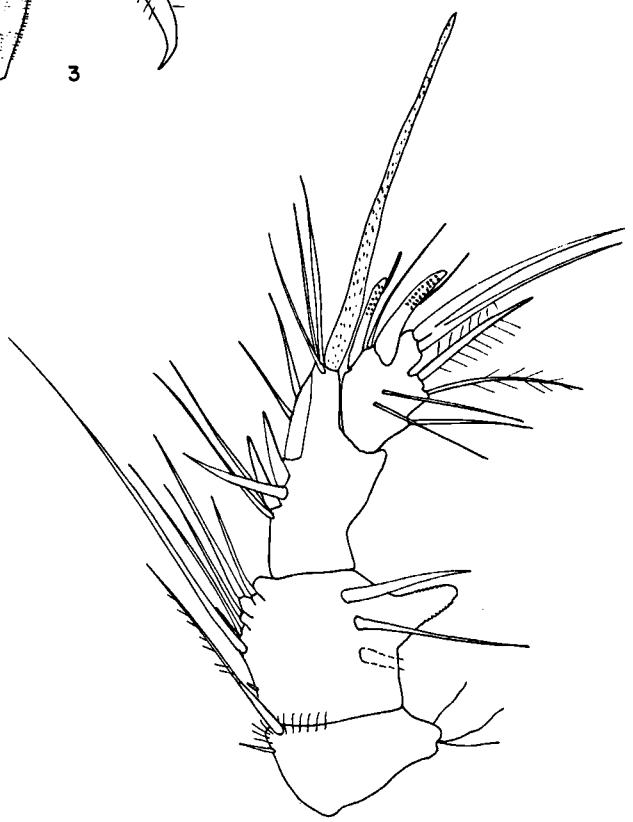

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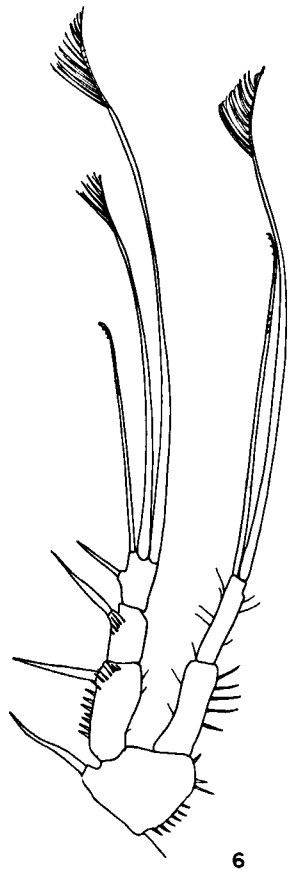

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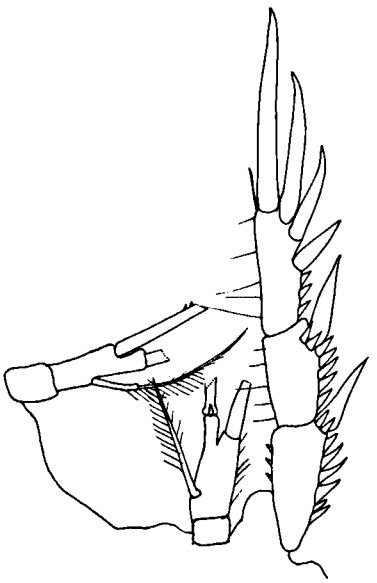

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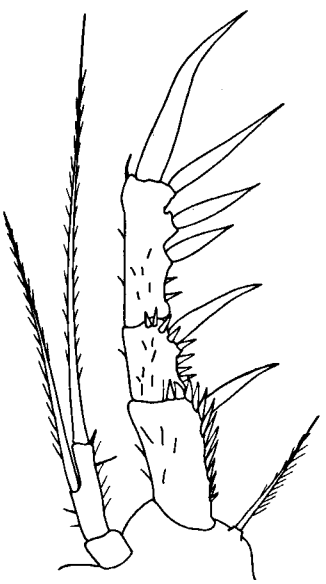

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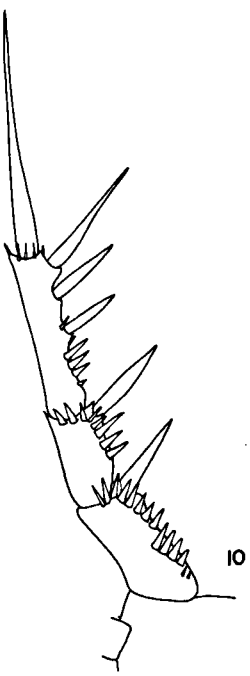

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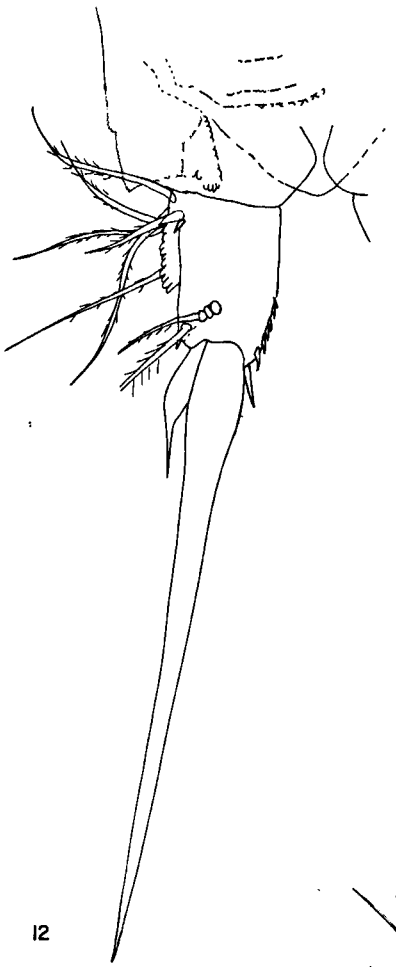

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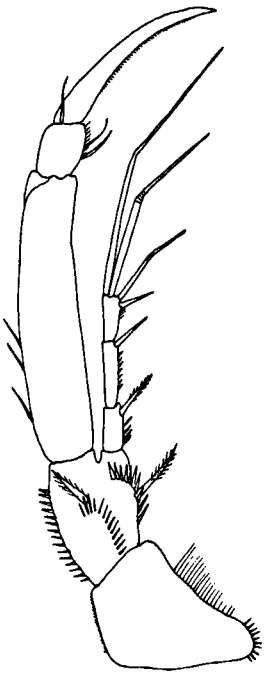

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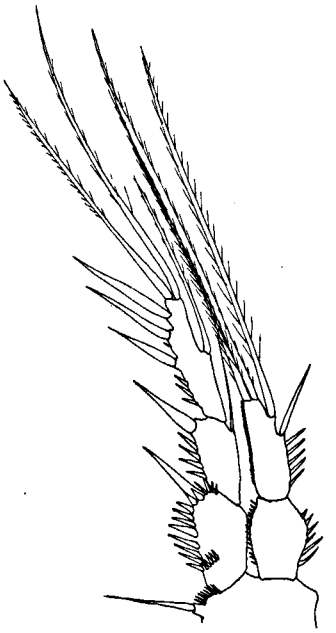

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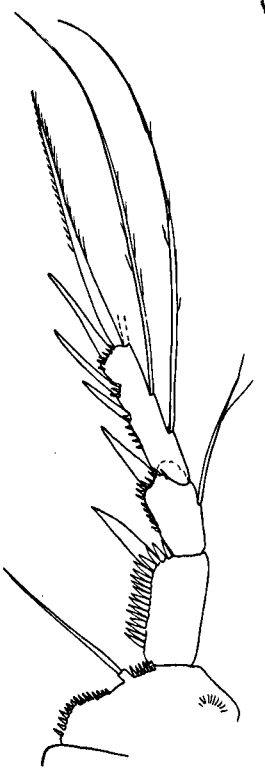

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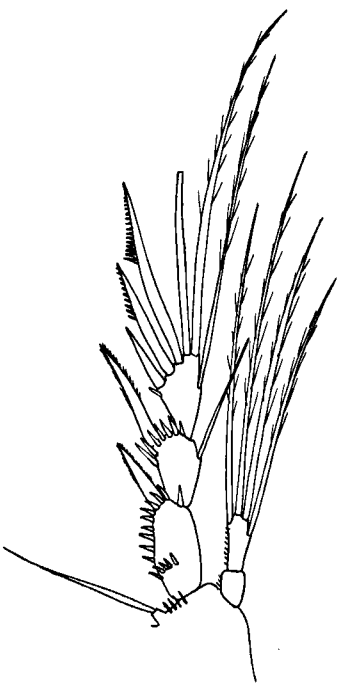

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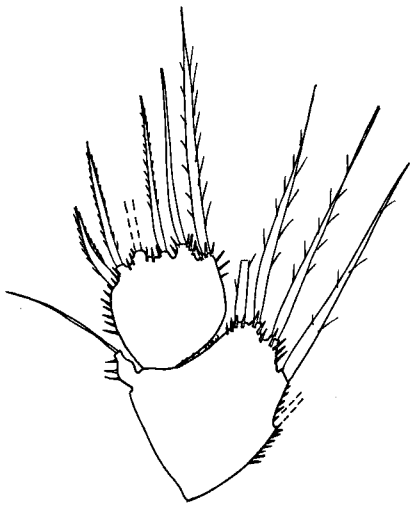

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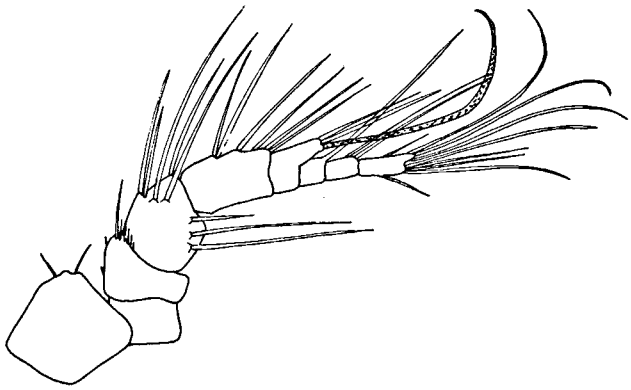

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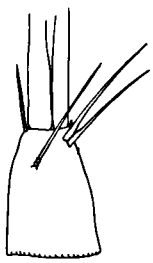

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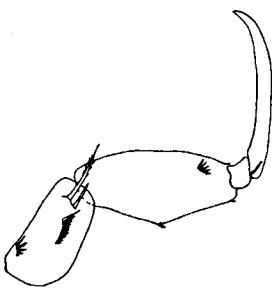

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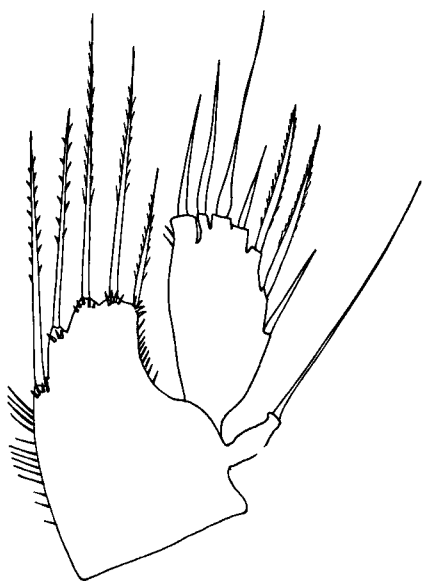

23

LEGEND TO THE FIGURES

Figs. 1-5. 1-2, Paradactylopodia brevicornis (Claus, 1866), ♀, from Pointe aux Oies (Pas-de-Calais, France). 1, antennule (scale A); 2, leg 5 (scale A).
3-5, Orthopsyllus linearis (Claus, 1866) f. setosus nov., from Pointe aux Oies (Pas-de-Calais, France). 3, maxilliped (scale B); 4, antenna (scale A); 5, antennule (scale B).

Figs. 6-11. Orthopsyllus linearis (Claus, 1866) f. setosus nov. 6, leg 1 (scale A); 7, leg 2 (scale A); 8, leg 3 (scale A); 9, endopodite of leg 4 (scale A); 10, exopodite of leg 4 (scale A); 11, leg 5 (scale C).

Figs. 12-17. 12, Orthopsyllus linearis (Claus, 1866) f. setosus nov., left furcal ramus (scale A).
13-17, Heterolaophonte longisetigera (Klie, 1950), new rank, ♀, from Penpoull (Finistère, France). 13, leg 1 (scale C); 14, leg 2 (scale C); 15, endopodite of leg 3 (scale C); 16, exopodite of leg 3 (scale C); 17, leg 4 (scale C).

Figs. 18-23. 18-22, Heterolaophonte longisetigera (Klie, 1950), new rank, ♀, 18, leg 5 (scale C); 19, rostrum and antennule (scale C); 20, antenna (scale C); 21, left furcal ramus (scale C).
23, Heterolaophonte stromi paraminuta Noodt, 1955, ♀, from Wimereux (Pas-de-Calais, France), leg 5 (scale A).