

2—MARINE COPEPODA FROM WESTERN AUSTRALIA

IV.—PSAMMOPHILOUS HARPACTICIDS.

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Sand inhabiting copepods are probably to be found in beaches all over the world but owing to their very specialized habitat it has been suggested that each species tends to have a very limited distribution, so that adjacent beaches might harbour entirely distinct species (Wilson, 1932, pp. 6-7 ; 1935). While this is true up to a point, later work has shown that not all such species are so restricted in their distribution. Kunz (1937, 1938) has recorded from Kiel Bay species which were originally described from Great Britain (*e.g.*, various species of *Paramesochra* and *Stenocaris minuta* Nicholls, 1935) and similarly *Remanea arenicola*, first described by Klie (1929) from Kiel Bay, has since been recorded from the Firth of Clyde (Nicholls, 1939).

The occurrence of such copepods in the sand beaches of Australia is not surprising, and in this paper three such copepods are described, each of them requiring a new genus for its reception. Samples were collected from two localities some 300 miles apart ; the first, in October, 1939, at Leighton Beach in the neighbourhood of Perth, and the second in March, 1940, at what is known locally as the " Back beach " at Dongarra. The first tentative search for sand-dwelling copepods in the local beaches failed, since previous experience had shown that they were most abundant within the top 10 cms. of sand. The coast line of Western Australia is, except in a few places, exposed to the force of westerly gales from the Indian Ocean, so that the upper layers are liable to be continuously turned over by wave action and disturbed. It was not until the top six inches of sand was thrown aside and sand from below that level washed for copepods that any were found, and even then not in any great abundance. It is of interest to note that the two species obtained in the region of Perth occurred also in the samples taken at Dongarra, 300 miles to the north.

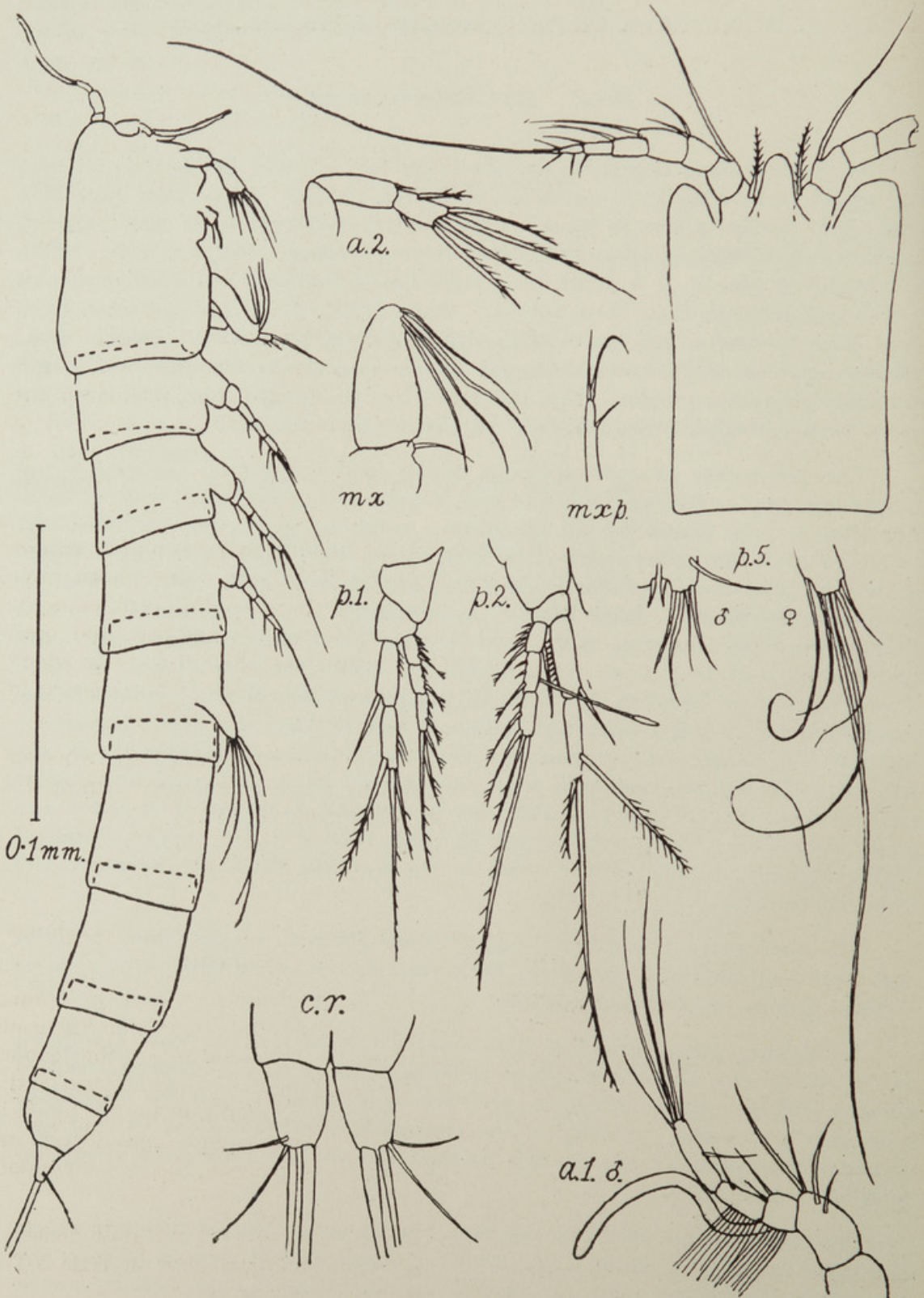
The species found here are related to those of similar habitat from European and American shores. One is an Ectinosomid, the other two are typical of certain groups of Canthocamptids.

In making preparations of such small copepods (all of these are under half a millimetre) there is a loss in definition owing to the clearing effect of Monk's (1938) medium, which is otherwise very suitable, and the appendage absorbs a very small quantity of the picro-indigo-carmin stain, so that permanent preparations made by this method are not the most satisfactory for detailed examination.

The procedure adopted here has been to remove and mount each appendage in a small quantity of stain for making the drawings and then to transfer the appendage to another slide for permanent mounting. Thus details can be obtained which might otherwise be overlooked. The mouth parts, of course,

are too small to be recovered after dissection and so the head is stained as a whole and dissected in Monk's medium, or may be examined from a second specimen by dissection and mounting in stain, or in formalin, and then discarded after drawing.

An explanation of the letters used in the figures has been given in Part III. of this series (this Journal, Vol. XXIX., p. 1).



Text fig. 1.—*Ectinosomoides longipes* gen. et sp. nov. ; whole animal $\times 360$, other figures $\times 600$.

It is a pleasure once more to acknowledge, with gratitude, the grant made by the Trustees of the Science and Industry Endowment Fund enabling me to purchase a dissecting microscope which made possible the study of these copepods.

Fam. **ECTINOSOMIDAE.**

Sars, 1911, p. 28.

This family is comprised of bottom living forms, usually inhabiting mud or sand, but includes also the free swimming *Microsetella*. It is one of the characteristics of the family, and more particularly of the genus *Ectinosoma*, that the body is "pronouncedly fusiform" and that the "cephalic segment is gradually attenuated in front" (Sars, 1911, p. 29). Furthermore, the fifth leg consists of "two well defined joints" and the distal joint is trilobate.

Now the sand-dwellers *Arenosetella* and *Hastigerella* depart noticeably from typical Ectinosomids in these features. In both genera the head is rectangular, without any anterior attenuation, and the fifth legs have both segments partially or completely fused while the trilobate condition of the distal segment has been lost.

It is for these reasons that I cannot agree with Kunz (1937, p. 100), who suggests that *Hastigerella* appears to be an aberrant *Ectinosoma*. It is much more closely related to *Arenosetella* than to *Ectinosoma* and but for the lack of the claw-like structure on the dorsal surface of the anal segment of the former could well be identified with that genus, in particular with *A. germanica* Kunz (1937, p. 95) which, in my opinion, is closer to *Hastigerella* than to Wilson's *Arenosetella*.

Similarly, I am inclined to think that *Ectinosoma leptoderma* and *E. tenuissima* Klie (1929) should not be identified with that genus since both have the rectangular head. One, however, has the fifth leg with both segments well-defined although the distal segment is not shown as trilobed, and both appear to lack the long inner modified setae on the endopods of the legs which were described for *H. palpilabra* and for *A. germanica* but were not present in *A. spinicauda* and *A. fissilis*.

Into which, if either, of these genera Klie's species should go or whether they constitute a new genus does not at present concern me, but I am of the opinion that they are not true *Ectinosoma* species.

Ectinosomoides longipes gen. et sp. nov.

Occurrence. Back beach, Dongarra, March, 1940, in sand washings from below six inches; both sexes taken but not abundantly.

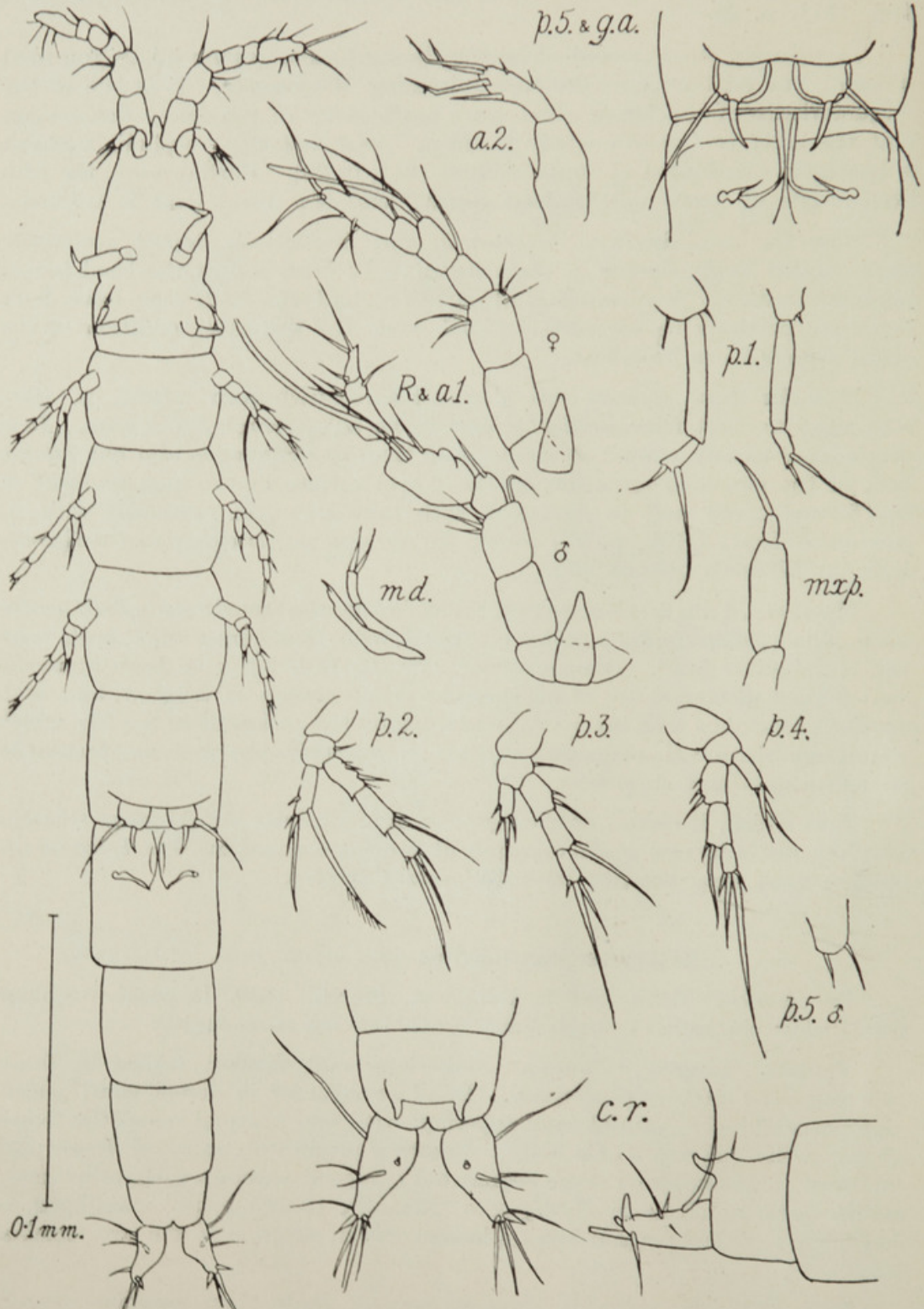
Female. Length 0.36 mm. Body long and slender, widest in front, tapering very slightly posteriorly. Head rectangular in dorsal view, genital segment undivided, caudal rami tapering, with two unequal setae, the longer almost as long as the whole body. Rostrum prominent, rounded, fused with the head; first antenna seven-segmented; second antenna without exopod; mouth parts much as in *Hastigerella* (Nicholls, 1935) except maxilliped, in which the terminal portion bears a lateral seta in addition to the two terminal setae.

Legs 1-4 with exopods three-segmented, their outer margins densely spinous; middle segment bearing a long inner modified seta in legs 2-4; endopods two-segmented and longer than the exopods.

Seta formula.

		endopod	exopod
p. 1	1. 120	0. 0. 022.
p. 2-4	1. 120	1. 1. 022.

Fifth legs composed of simple elongate lamellae, adjacent in mid-line of body, each bearing six unequal setae.



Text fig. 2.—*Psammopsyllus operculatus* gen. et sp. nov.; whole animal $\times 360$, other figures $\times 600$.

Male. Length 0.34 mm. Body and most appendages similar to those of the female. Urosome five-segmented; first antennae probably seven-segmented, but the segmentation was not distinct in my preparation; the fourth segment bears a long stout sensory filament and there is probably a more slender one terminally. Fifth legs smaller than those of the female and the setae much shorter, the innermost being altered into a small spine.

Like *Pseudectinosoma* (Kunz, 1935), this copepod differs from other members of the family in the possession of two-segmented endopods in all the swimming legs. This condition in the first legs is known for two genera, *Halophytophilus* Brian (1918) and *Bradyellopsis* Brian (1924) (*vide* Lang, 1935, p. 335). It further differs from *Ectinosoma* in the shape of the body and structure of the fifth legs, and from *Arenosetella* in the absence of the anal appendages. It differs from *Hastigerella* most noticeably in the condition of the endopods, and absence of exopod on the second antenna, while the mouth parts appear to be more reduced. *Pseudectinosoma* has the typical fusiform body and shows a number of differences in the proportions and armature of the swimming legs. The second antenna and fifth legs are less reduced.

Fam. **STENOCARIDAE** sens. str.

Lang, 1936.

Psammopsyllus operculatus gen. et sp. nov.

Occurrence. Leighton Beach, and Back Beach, Dongarra; washed from sand below six inches from surface; both sexes, moderately abundant.

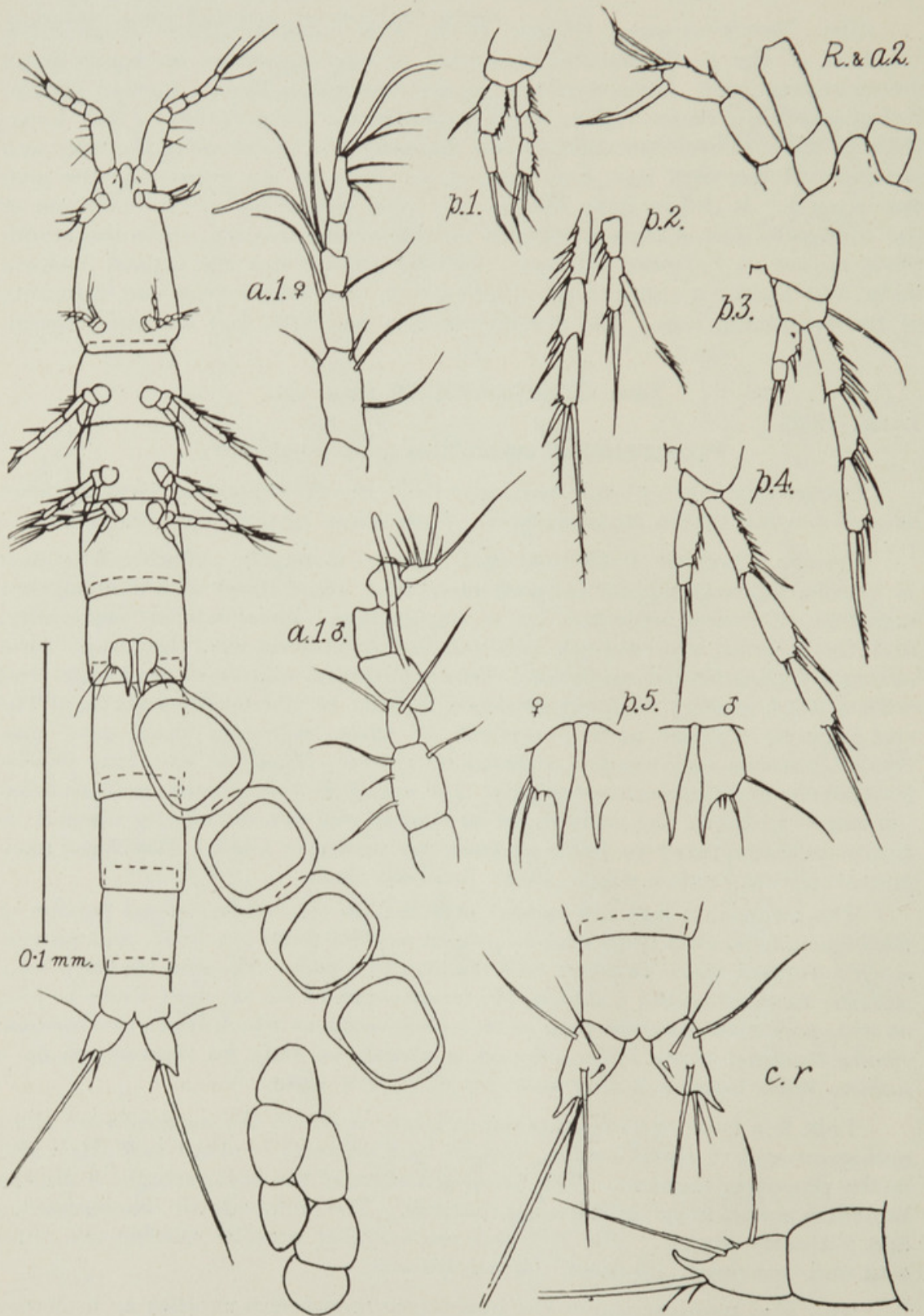
Female. Length 0.39–0.45 mm. Body elongate, cylindrical, widest in middle, tapering slightly towards each end. Head fused with first segment and line of fusion indicated by a constriction. Head widens posteriorly, and the rostrum is prominent, pointed, and articulated with the head. First antenna six-segmented, geniculate between second and third segments, and with a short sensory filament attached distally to the fourth segment. The end segment appears to be composed of three segments fused into one. Second antenna with exopod replaced by a seta. Mandible with long slender gnathobase and two-segmented palp. The maxillule was not seen and the maxilla was overlain by the maxilliped so that it was not sufficiently distinct to figure, but it appears to have at least two accessory lobes. Maxilliped moderately strong, with a single, short, terminal claw.

The swimming legs are carried attached to the ventro-lateral portion of the segments so that they tend to project oar-like from the body, and provide a wide ventral space between each member of a pair. The first leg has a long, slender, two-segmented endopod, the basal segment six to eight times as long as wide and three times as long as the distal segment which bears two unequal strong terminal claws. The exopod is absent or may be represented by a minute knob bearing a tiny seta, or by a seta alone.

Legs 2–4 have three-segmented exopods in which the segments are short and stout and of equal length, but the end segment is about half the width of the preceding segment. The usual armature of the outer margin is present but there are no setae on the inner margins. The endopods are one-segmented and variously armed. The fifth legs are rounded lamellae bearing one outer seta and one short, terminal, curved spine.

The anal segment shows the operculum modified somewhat as in *Arenosetella*, the lateral margin is produced into upwardly curved claws which are immobile. The caudal rami show a similar tendency to the development of spurs both terminally and dorsally.

Male. Length 0·39–0·45 mm. Body as in female, but genital segment divided, giving a five-segmented urosome. First antennae seven-segmented and twice geniculate; other head appendages and swimming legs as in female. Fifth legs somewhat reduced, having only two short setae.



Text fig. 3.—*Neoleptastacus spinicaudatus* gen. et sp. nov.; whole animal $\times 360$, separate egg-sac $\times 216$, other figures $\times 600$.

This copepod resembles other members of this family in several respects. The rostrum is well developed and clearly articulated. In spite of the reduced first exopod, in which it approaches *Psammastacus* (Nicholls, 1935), it is perhaps more closely related to *Leptopontia* (T. Scott, 1902). This is shown by the structure of the mandible, the first endopod, and the anal operculum. The swimming legs are, however, in all cases more stoutly constructed and the endopods are only one-segmented.

Fam. CANTHOCAMPTIDAE.

Neoleptastacus spinicaudatus gen. et sp. nov.

Occurrence. Leighton Beach, and Back Beach, Dongarra : washed from sand below six inches from surface ; both sexes, common.

Female. Length 0.28–0.30 mm. Body elongate, cylindrical, with a very slight taper towards each end. Rostrum small, rounded, fused with head ; first antenna six-segmented, the second the largest and the fourth bearing a short, slender, sensory filament. Second antenna with the exopod reduced to a short seta ; mandible palp two-segmented, the end segment with three setae ; the maxillule was not seen ; maxilla with two inner lobes ; maxilliped short and stout.

The swimming legs have three-segmented exopods and two-segmented endopods ; the rami are subequal in the first leg but the endopod shortens progressively posteriorly ; the segments of the first and second endopods are subequal but in the other legs the end segment is very short. The exopods are without inner marginal armature of any description. The fifth legs consist of rectangular lamellae, in which the inner distal corner is produced into a spur-like process, outside of which are two very short and two longer setae.

The caudal rami are divergent, slightly shorter than the anal segment and a little longer than wide. Each bears terminally one large spine, and dorsally a smaller one ; there are several setae.

One egg-sac is carried with, normally, two to four large eggs, but occasionally six eggs may be borne in which case they overlap instead of forming a linear egg-sac.

Male. Length 0.28–0.30 mm. Differs from the female only in having a five-segmented urosome and in the usual modification of the first antenna. The fifth legs do not differ appreciably from those of the female.

This copepod is related to *Paraleptastacus* by virtue of its small rostrum, fused with the head, but it differs in the structure and armature of the legs. The first legs show little difference except that the middle segment of the exopod is without a spine, but in legs 2–4 the endopod is much shorter than the exopod, and the end segment of this ramus is much reduced in the third and fourth legs. The exopods lack the inner modified setae found in *Paraleptastacus*, but one such, though not of the spatulate type, occurs on the second endopod.

The fifth legs are only one-segmented, the distal segment being obsolete, while the inner part of the basal segment is prolonged into a spine. This leg resembles the corresponding leg in *Leptastacus* in appearance, but here all the setae are external to the spine. The maxilliped shows a reduction from the condition found in *Paraleptastacus* (Wilson, 1932 : Nicholls, 1935, 1939).

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