STUDIES ON THE FAUNA OF CURAÇAO AND OTHER CARIBBEAN ISLANDS: No. 77.

COPEPODA ASSOCIATED WITH WEST INDIAN INVERTEBRATES - IV

The genera Octopicola, Pseudanthessius and Meomicola (Cyclopoida, Lichomolgidae)

by

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The material covered in this paper comprises:

Octopicola superbus Humes in Delamare Deboutteville, Humes & Paris, 1957,
ssp. *superbus* from France (p. 2–3, fig. 1), and
ssp. *antillensis* n. ssp., from the cephalopod *Octopus vulgaris* Lam. in Curaçao and Barbados (p. 5–9, figs. 1–2);
Pseudanthessius pectinifer n. sp., from the echinoid *Clypeaster rosaceus* L. in Bimini (Bahamas), Puerto Rico, and Jamaica (p. 15–23, figs. 3–5);
P.aestheticus n. sp., from amphinomid polychaetes in Jamaica (p. 23–34, figs. 6–8);
P.thorelli (Brady, 1880), from England (p. 32–34);
P.tortuosus n. sp., from amphinomid polychaetes in Puerto Rico, Jamaica, and Barbados (p. 34–44, figs. 9–12);
P.deficiens n. sp., from the ophiuroid *Ophioderma cinereum* Müller & Troschel in Curaçao, St. Martin, and Puerto Rico (p. 44–57, figs. 13–19);
Meomicola amplectans n.g., n. sp., from the echinoid *Meoma ventricosa* (Lam.) in Jamaica and Curaçao (p. 57–72, figs. 20–24).

All figures were drawn with the aid of a camera lucida.

Previous numbers in this series have appeared in these *Studies* *13*, no. 56, p. 1–20 (1962) – I; *14*, no. 66, p. 1–23 (1963) – II; *17*, no. 73, p. 1–37 (1963) – III.

Genus **Octopicola** Humes in Delamare Deboutteville, Humes & Paris, 1957

This genus exhibits a number of characters common in other lichomolgids, particularly *Pseudanthessius*. However, a complex of the following features appears particularly important in formulating a generic concept: the shape of the prosome and the 6-segmented female urosome, the second antenna, the mandible, the endopod of leg 4, leg 5, the female leg 6 with its widely separated elements, and association with octopods.

A single species has been described [1]: *O. superbus*, from *Octopus vulgaris* Lamarck at Banyuls, on the Mediterranean coast of France (Humes, 1957) and at Roscoff, on the Channel coast (Bocquet & Stock, 1960). When these two accounts are compared, several small differences become apparent: ratios of length, and of length to width, of the last two segments of the first antenna and of the length of the setae both on its segment 2 and subterminally on the last segment; the length to width ratio of the last segment of the second antenna; the relative length of the long seta in the female leg 6; the length to width ratio of the anal segment; and the length

[1] The description of a second species, from *Octopus* (*Tritaxeopus*) *cornutus* Owen in Madagascar, has recently been published (Humes, 1963).

of the caudal ramus. Since differences between populations seem of importance in evaluating our West Indian material, one of us (J.H.S.) has once again compared specimens from the Mediterranean and Atlantic coasts of France; he finds that most of the supposed differences are illusory.

The length to width ratio and the relative lengths of the terminal segments of the first antenna are rather variable and depend largely on the angle at which the structure is observed. In general, most specimens studied have slightly shorter terminal segments than the specimen illustrated by HUMES. The length of the setae, however, appears correctly in HUMES' figure and is too short in that of BOCQUET & STOCK.

The values for the length to width ratio of the last segment of the second antenna show considerable variation. In copepodids this segment is about twice as long as wide, as it is in some adult paratypes collected on May 3, 1955 near Banyuls. Adult, ovigerous females and males from the Roscoff area on the Atlantic coast of France, collected in September 1955 also showed this length to width ratio. This condition is illustrated in the figure given by BOCQUET & STOCK. In ovigerous females and males collected later in the year (September 2, 1954) near Banyuls, the length of the segment increased, and reaches dimensions similar to those shown in HUMES' paper. A range of intermediate values can be observed. So, the length and width of the 4th segment of A2 (length measured along inner edge, width taken at the middle) of paratypes collected in May (from Banyuls) vary between 40 × 24 μ to 70 × 21 μ for females (based on 5 specimens), and between 54 × 24 μ to 82 × 23 μ for males (based on 6 specimens). In September paratypes these dimensions are 94 × 21 μ to 101 × 21.5 μ for females (based on 3 specimens), and 93.5 × 22 μ to 101 × 22 μ for males (based on 3 specimens). The same dimensions are in September material from the Roscoff area 40 × 24 μ to 49 × 22 μ for females (based on 7 specimens), and 45 × 21.5 μ to 56.5 × 32 μ for males (based on 4 specimens). Summarizing, the situation seems similar to that discussed below for the caudal rami.

There may exist a slight difference in length of the long seta in the female leg 6, that of the Mediterranean specimens being slightly longer. This character shows some overlap, however, and is thus not very distinctive.

The measurements of the anal segments (Table 1) are identical for the two populations.

The caudal rami are variable in length (Table 1). As BOCQUET & STOCK (1959) have suggested for *Paranthessius* (*Herrmannella*) *rostratus* (Canu), the length of the ramus may increase with age in adult female specimens. The maximum value attained seems to be slightly higher for specimens from Banyuls than for those from Roscoff (Table 1).

The discovery in the West Indies of a form of *superbus* which shows somewhat more pronounced differences in structure from the European type but occurs on the same host is thus of some interest.

TABLE 1. A comparison of the length of the caudal ramus and of the anal segment in the two subspecies of *Octopicola superbus*

Subspecies	*O. s. superbus* Humus				*O. s. antillensis* n. ssp.			
Sex	Female		Male		Female		Male	
Locality	Roscoff	Banyuls	Roscoff	Banyuls	Curaçao	Barbados	Curaçao	Barbados
Number of specimens	6	10	6	7	3	8	6	10
Average length/width of anal segment (μ)	101/75	105/70	100/70	104/67	120/66	110/62	100/63	90/55
Range	88–109/ 68–82	88–127/ 68–88	95–109/ 68–75	91–109/ 52–73	109–136/ 61–68	88–117/ 49–68	92–116/ 54–68	65–104/ 44–62
Average length of caudal ramus (μ)	225	277	210	223	197	208	166	157
Range	197–245	231–315	204–224	208–239	156–231	164–226	143–184	120–172

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Octopicola superbus Humes in D.D., H. & P., 1957, **antillensis** n. ssp.

(Figs. 1–2)

Type material. – CURAÇAO: 1 ovigerous female (holotype), 1 male (allotype) from 1 host, November 6, 1958; 2 males from 2 hosts, November 10, 1958; 2 females from 1 host, December 9, 1958; 3 males from 1 host, December 14, 1958; 1 male from 1 host, January 24, 1959; all from Piscadera Bay (12°07'30" N, 68°59'00" W); collected by J.H.S.

Other material. – BARBADOS: 1 male, 2 juveniles from 3 hosts, Carlisle Bay, July 16, 1959. – 1 female, 1 male from 1 host, Bath Reef off Bayview, July 22, 1959. – 1 female, 1 male from 10 small hosts, Hastings Reef, July 23, 1959. – 1 female, 1 male from 1 host, on pier in front of Colony Club, near Bellairs Research Institute, July 25, 1959; collected by A.G.H. and R.U.G. – 11 females, 27 males, 15 juveniles from 14 hosts, Oistin's Bay, September, 1959; collected by R. Greenhill.

All specimens are from *Octopus vulgaris* Lamarck collected by skin-divers (by hand or spear) or by local fishermen (in baited traps – the "canasters" of the Leeward Islands) from shallow water (0–5 m).

Holotype, allotype, 5 paratypes and 17 specimens from Barbados in the Zoölogisch Museum, Amsterdam; 3 paratypes and 18 specimens from Barbados in the United States National Museum, Washington; and 17 specimens from Barbados in the British Museum (Natural History), London. The remainder is in the authors' collections.

Descriptive notes. – The West Indian *Octopicola* is very close to the typical form from Europe. No significant differences could be observed, even with oil immersion objectives and phase contrast microscopy, in the following structures: rostrum, first antenna[1]), labrum and oral area, mandible, first and second maxillae[1]), female maxilliped, postoral protuberance, and legs 1–4. On the other hand, in the adult the proportions of the urosomal segments and caudal rami, the armature of the genital segment, second antenna, male maxilliped, and leg 5 show small differences. The second of these, the armature of the genital segment, is possibly the best for quick diagnosis. All the differences are consistent throughout the rather limited range of specimens we have examined. Since the papers of HUMES (1957) and of BOCQUET & STOCK (1960) are fully

[1]) It may be noted, however, that the armature of the first antenna in both forms is: 4, 13, 6, 3, 4, 2, and 7 setae, with an aesthete on each of the last 3 segments; and that the small accessory seta on the second maxilla inserts on the distal rather than the basal segment.

illustrated, only structures which exhibit variation have been figured here.

The male and female of *s. superbus* are approximately the same length: 1.85 mm. The length of 2 females from Curaçao was 1.99 and 2.24 mm; 8 from Barbados averaged 1.89 mm (range, 1.47–2.09

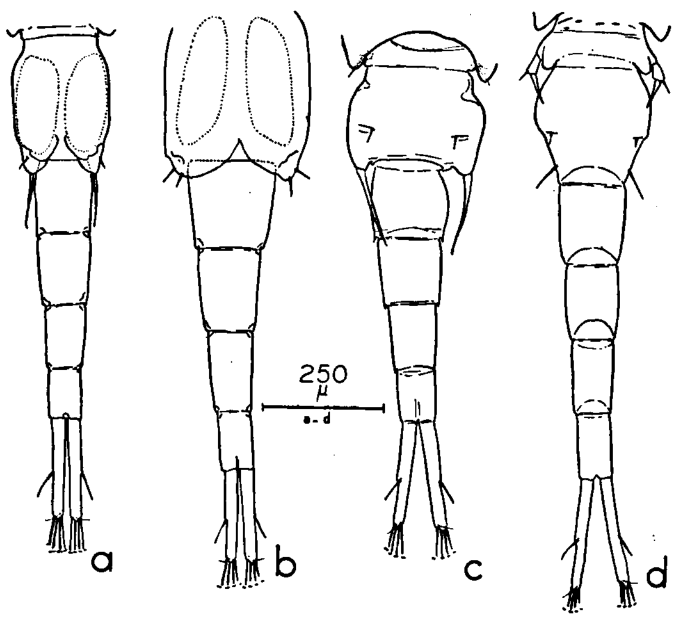


Fig. 1. ***Octopicola superbus antillensis*** **n. ssp., from Curaçao (*b, d*) and *O. s. superbus* Humes, from Roscoff (*a, c*). – Urosomes of males (*a, b*) and females (*c, d*); all to the same scale.**

mm). Five males from Curaçao measured 1.56, 1.60, 1.65, 1.69, and 1.69 mm; 10 from Barbados had an average length of 1.60 mm (range, 1.19–1.76 mm). From these values it is clear that the male of *s. antillensis* is somewhat smaller than the female, and the values for the male and female range respectively below and above those for their counterparts in *s. superbus*.

The fifth pedigerous segment of the female *s. antillensis* has small but distinct tergal plates (fig. 1*d*); these are lacking in *s. superbus*. Also, the free segment of leg 5 is almost invisible in dorsal view in the typical subspecies but clearly visible in *s. antillensis* (compare figs. 1*c* and 1*d*). This is partly the result of differing shape: the free segment of the leg is subquadrate in *s. superbus*, rectangular in *s. antillensis* (fig. 2*c*).

The female genital segment is quite differently shaped in the two subspecies (compare figs. 1*c* and 1*d*). Leg 6 in *s. superbus* is probably represented, in addition to the small seta near each oviducal opening, by a long seta on either side, reaching to the posterior end of the next urosomal segment or beyond. In *s. antillensis* this latter seta is much shorter, extending only slightly beyond the posterior joint of its own segment. Similarly, the 2 posterior setae on each genital flap of the male differ in relative length: in *s. superbus* (fig. 1*a*) one of the setae is very long, reaching nearly to the end of the next urosomal segment, while in *s. antillensis* (fig. 1*b*) both setae are short.

Although only one female (from Barbados) possessed intact ovisacs, it seems likely that the number of eggs is considerably reduced in the West Indian form but the size of each egg is larger. HUMES (1957, p. 4) gives 24 as the average number of eggs per ovisac in *s. superbus* (from Banyuls) with a range of 18–32; fig. 1*a* in BOCQUET & STOCK (1960) suggests a similar value for Breton specimens. The Barbados specimen had 10 eggs in each ovisac. From fig. 2*b* it is apparent that the ovisac of *s. antillensis* is almost the same size as that of *s. superbus* (0.648 × 0.229 mm: HUMES, 1957).

The urosome of the West Indian form is always more slender and often longer in both sexes than that of the European (compare figs. 1*a*, *c* and 1*b*, *d*). The caudal rami, on the contrary, are less elongate in *s. antillensis*. These differences can be demonstrated by measurements of the anal segment and the caudal rami in both sexes of the two subspecies (table 1). From the table it is evident that the caudal ramus is on the average more than twice as long as the anal segment in *s. superbus* but distinctly less than twice in *s. antillensis*, and that the anal segment is 1½ times as long as wide in *s. superbus* but over 1¾ times in *s. antillensis*.

A conspicuous structural difference between the two forms is to be found in the second antenna of both sexes. Apart from slight differences in the shape of the claws, the third segment bears a short, finely denticulated triangular process in *s. superbus*, whereas *s. antillensis* possesses a very prominent projection half as long as the accompanying claw and densely covered with long spinules (compare fig. 2*a* with fig. 3 in BOCQUET & STOCK, 1960. In the latter figure, however, it may be noted that there should be only 2 spines

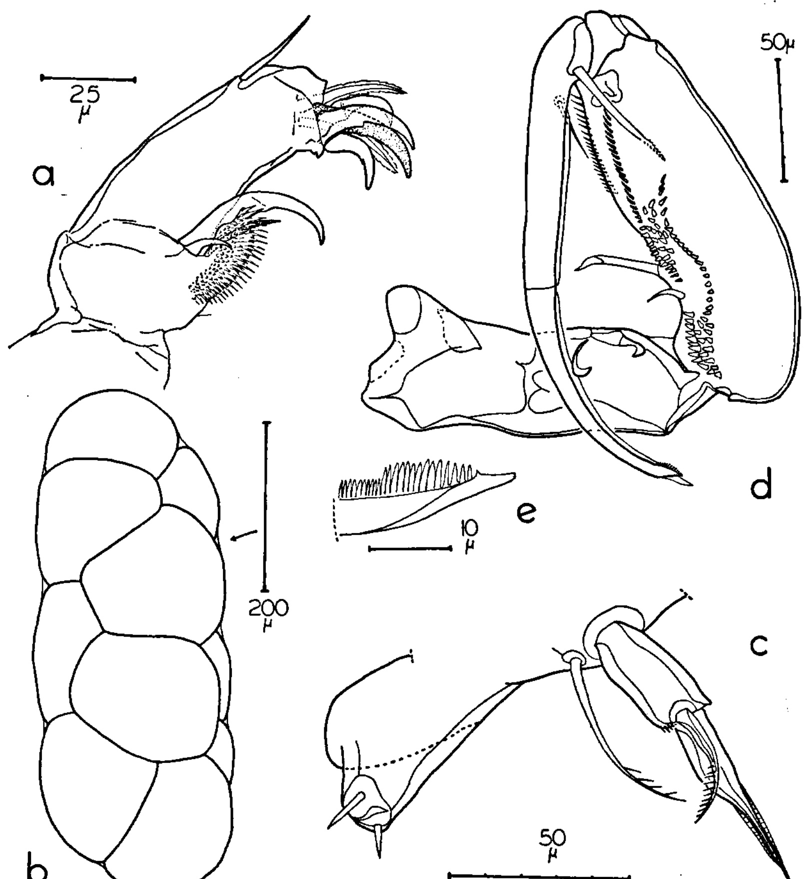


Fig. 2. *Octopicola superbus antillensis* n. ssp., female (*a* from Curaçao, *b–e* from Barbados): – *a*. Distal part of second antenna, dorsal. – *b*. Left ovisac, dorsal. – *c*. Right leg 5 and tergal plate, lateral. – Male (from Barbados): – *d*. Left maxilliped, medial. – *e*. Detail of tip of maxilliped dactylus.

– "épines denticulées" – terminally instead of the 3 shown; both of these are on the ventral (outer) side). The length/width ratio of the last segment of the second antenna in *s. antillensis* is about 2 : 1 (40 × 22 μ, the length measured along the inner margin and the width taken at the middle).

The male maxilliped (fig. 2*d*), which is armed with 2 rows of spinules on the inner surface of the second segment in *s. superbus*, bears additional groups of spinules connecting the 2 rows in *s. antillensis*. The spinules are also heavier in the latter subspecies. The tip of the dactylus is bluntly pointed and smooth in European specimens but prolonged into a small element, with a group of small spinules at its base, in the West Indian form.

Developmental stages. – In the juveniles available to us, there are differences in the anal segment (longer in *s. antillensis*), the second antenna (the inner of the third segment spinulose in *s. antillensis*), leg 5 (the terminal seta much longer in *s. superbus*), and leg 6 (the single seta, or one of the setae, much longer in *s. superbus*).

Remarks. – From the foregoing it is clear that two forms of *Octopicola* (European and West Indian), which differ in a few small but well-defined morphological characters, may now be recognized. Both are associated with *Octopus vulgaris* (according to Voss, *in litt.*, a circumtropical and temperate species). We have named the West Indian form at the subspecific rather than the specific level for the following reasons: 1) the two forms are allopatric but 2) associated with the same host; 3) the morphological differences which define them are less pronounced than those between the European and Madagascar forms of *Octopicola* [1]); 4) some of the differences show considerable overlap (see table 1). None of these points is conclusive, but, taken together, they seem to indicate a balance in favor of subspecific designation for the present.

1) The new Madagascar species (Humes, 1963) differs from *O. superbus* in several easily recognizable features: size, armature of the rostral area, length of the last segment of the second antenna, structure of the second maxilla, male maxilliped, leg 4 endopod, leg 5, leg 6 in both sexes, and proportions of the caudal ramus.

Genus **Pseudanthessius** Claus, 1889

In our opinion this genus should be limited to lichomolgids in which the second maxilla and female maxilliped are weakly armed; the endopod of leg 4 is unimerous and bears 2 elements only, both terminal; and leg 5 lacks a free segment. Biological criteria are less easy to erect, since species have been found associated with echinoids, flatworms, and a nemertean as well as in washings from unidentified invertebrates, in dredged material, in weed, and in the plankton. The new species described below extend the roster of hosts to include ophiuroids and annelids.

The most recent key to the genus (ILLG, 1950) lists 15 species: *assimilis* G. O. Sars, 1917, *concinnus* Thompson & A. Scott, 1903, *dubius* G. O. Sars, 1918, *gracilis* Claus, 1889 (the type, by subsequent designation in G. O. SARS, 1917), *graciloides* Sewell, 1949, *latus* Illg, 1950, *liber* (Brady, 1880) [1]), *mucronatus* Gurney, 1927, *nemertophilus* Gallien, 1935, *obscurus* A. Scott, 1909, *sauvagei* Canu, 1892, *spinifer* Lindberg, 1945, *tenuis* Nicholls, 1944, *thorelli* (Brady, 1880) [1]), and *weberi* A. Scott, 1909. Of these, SEWELL (1949) has suggested that *concinnus* is a synonym of *thorelli*, while GRAEFFE (1902) and LANG (1949) have equated *thorelli* with *gracilis*. We do not believe that either identification should be made on the evidence available at present (see p. 32–34 for discussion). There is good reason, however, to think that SEWELL's 1949 record of *liber* from the Nicobar Islands refers to a new species as yet unnamed (HUMES & CRESSEY, 1961).

Since ILLG's paper, 5 more species of *Pseudanthessius* have been described: *pacificus* C. B. Wilson, 1950, *minimus* Tanaka, 1960, *luculentus* Humes & Cressey, 1961, *notabilis* Humes & Cressey, 1961, and *agilis* Ummerkutty, 1962. In both *pacificus* and *minimus*, however, leg 5 has a free segment, and consequently we prefer to exclude these two from the genus. UMMERKUTTY (in litt., Feb. 3, 1963) has agreed that *agilis* should become a synonym of *luculentus*.

[1]) *Lichomolgus liber* Brady & Robertson, 1876, and *L. Thorellii* Brady & Robertson, 1876, must be considered *nomina nuda* since they were published without description, definition, or indication. Establishment of the names then dates from BRADY's accounts he Monograph of British Copepoda.

Our collections yielded 4 species, all new; *pectinifer, tortuosus, aestheticus,* and *deficiens*. No others have been reported from the West Indies or the east coast of North America; but HERBST (1955) has recorded an unnamed form from the Brazilian littoral.

The genus *Pseudanthessius* thus contains at present 22 species. Since the condition of the fourth endopod in *pectinifer, luculentus,* and apparently *spinifer* may lead to difficulties when one uses the key originated by NICHOLLS (1944), we suggest the following rearrangement. The key is necessarily based on published descriptions. Studies on *Paranthessius rostratus* and *Octopicola s. superbus* (p. 3) and on *Pseudanthessius deficiens* (p. 52) suggest that separations based on the length to width ratio of the caudal ramus should be used with particular caution.

Key to *Pseudanthessius* (adults)

1. Urosome of female 5-segmented, of male 6-segmented . . 2
   Urosome of female 4-segmented, of male (known only for *deficiens*) 5-segmented 17

2. At least one element on basal segment of first antenna almost as long as rest of appendage 3
   Elements on basal segment of first antenna less than half as long as rest of appendage 5

3. Two elements on basal segment of first antenna much better developed than the others 4
   A single element on basal segment of first antenna better developed than the others . . . . *luculentus*

4. Terminal spine on exopods of legs 2–4 strongly curved; distal segment of second antenna about 6× as long as wide . . . . *liber* sensu Sewell
   Terminal spine on exopods of legs 2–4 almost straight; distal segment of second antenna about 3× as long as wide . . . . *notabilis*

5. Caudal ramus about as long as wide . . . *pectinifer* (p. 15)
Caudal ramus about 2× as long as wide . . . . . *sauvagei*
Caudal ramus more than 2× but not more than 4× as long as wide 6
Caudal ramus more than 4× but not more than $7\frac{1}{2}$× as long as wide 12
Caudal ramus at least 10× as long as wide. 16

6. Lateral margins of female genital segment produced medially into conspicuous pointed expansions; 2 elements on third segment of second antenna modified as slender jointed claws (only the female known) . . . . *spinifer*
Lateral margins of female genital segment produced at most into small dorsal processes (*tenuis*), not conspicuously expanded; not more than one element on third segment of second antenna modified as a claw 7

7. Outer margin of fourth endopod smoothly convex. . . . 8
Outer margin of fourth endopod sinuate, broken by a swelling or indentation which may become a conspicuous knob or notch 10

8. Length of fourth endopod more than 4× width; no elements on second antenna ornamented with strong spinules 9
Length of fourth endopod less than 3× width; several terminal elements on second antenna ornamented with strong spinules *tortuosus* (p. 34)

9. Caudal rami little longer than anal segment; latter about as long as preceding segment . . . . *liber*
Caudal rami 25% longer than anal segment; latter nearly 2× as long as preceding segment . . . . *assimilis*

10. Fourth endopod with marked notch on outer edge at proximal third; segments of first antenna short and compact . *obscurus*
Fourth endopod with notch or constriction at center of outer edge; not all segments of first antenna short and compact 11

11. Segment of body behind cephalosome with posterior projections; fourth endopod no longer than basal segment of exopod, with proximal bulge on outer edge but no notch *mucronatus*
Segment of body behind cephalosome without posterior projections; fourth endopod longer than basal segment of exopod, with conspicuous notch. . . . . *tenuis*

12. Greatest width of fourth endopod over one-half length. *latus*
Greatest width of fourth endopod less than one-half length 13

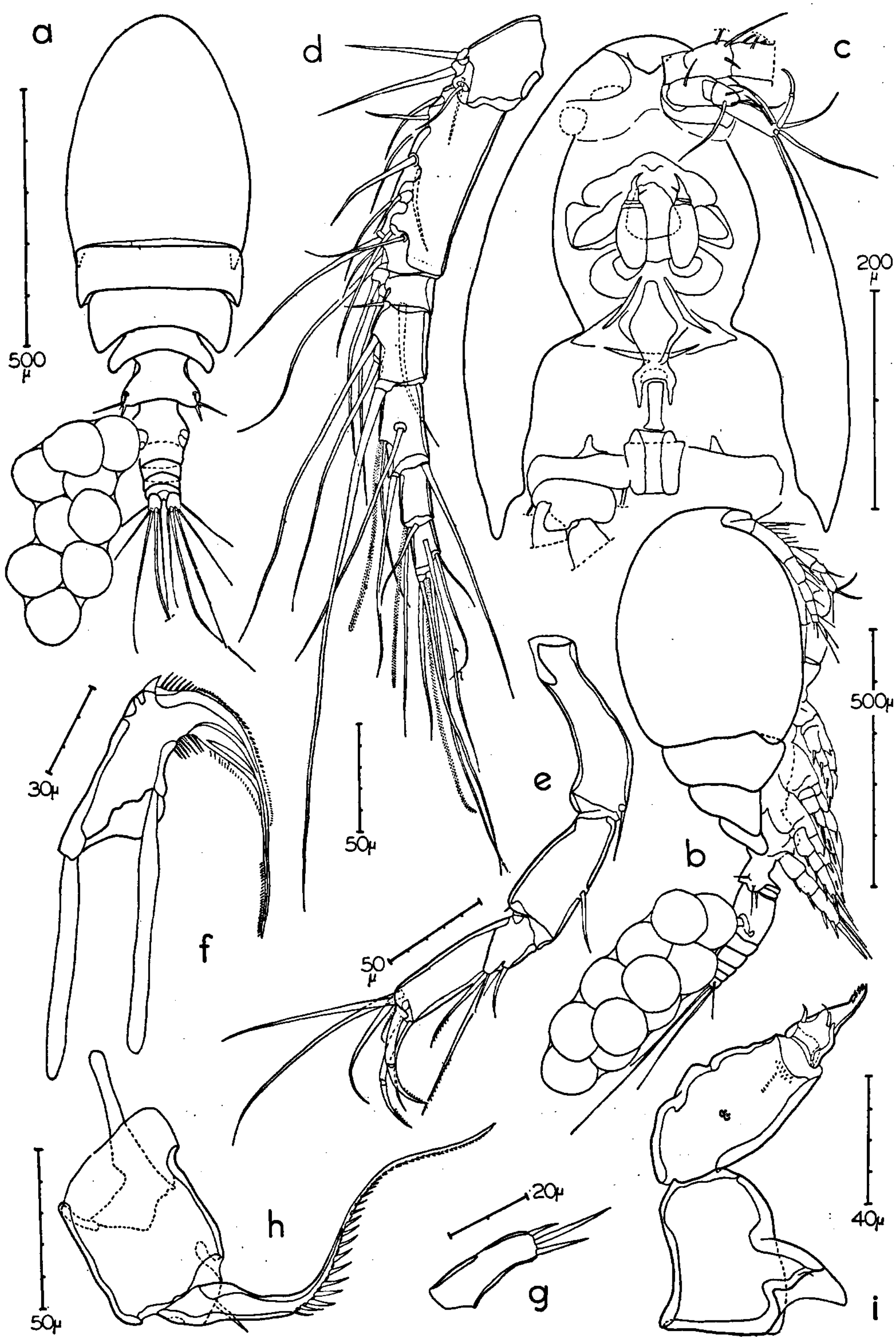
13. Fourth endopod with marked notch on outer edge and little proximal swelling 14
Fourth endopod with slight notch on outer edge and well-marked proximal swelling . . . . *weberi*
Fourth endopod without notch on outer edge but with some proximal swelling. 15

14. Fourth endopod less than 4× as long as wide; all caudal elements setae . . . . *gracilis*
Fourth endopod more than 5× as long as wide; 2 caudal elements flattened spines. . . . . *graciloides*

15. Caudal ramus 4–5× as long as wide; fourth endopod with little proximal swelling . . . . *nemertophilus*
Caudal ramus 6–7× as long as wide; proximal swelling on fourth endopod well-marked . . . . . . *aestheticus* (p. 23)

16. Last 2 segments of urosome subequal in length . . *concinnus*
Anal segment at least 2× as long as preanal *thorelli* (p. 32)

17. Each postgenital segment about 2× as long as wide; terminal segment of fourth exopod with 5 setae and 3 spines . . *dubius*
Each postgenital segment about as wide as long; terminal segment of fourth exopod with 5 setae and 4 spines. . . . . .
deficiens (p. 44)



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Pseudanthessius pectinifer n. sp.

(Figs. 3–5)

Type material. – BIMINI (Bahamas): 145 females, 234 males, 41 immature specimens from alcohol washings of 11 sea biscuits, *Clypeaster rosaceus* L. (Echinoidea), in shallow water, Bimini Lagoon off North Bimini Island (25°40′30″ N, 79°10′45″ W), May 30, 1959; collected by A.G.H. and R.U.G. – Holotype female, allotype male, and 121 paratypes (40 females, 60 males, 21 juveniles) deposited in the United States National Museum, Washington; the same number of paratypes in the Zoölogisch Museum, Amsterdam; 100 paratypes in the British Museum (Natural History), London; and the remainder in the collection of A. G. Humes.

Other specimens (all from *Clypeaster rosaceus*, collected by A.G.H. and R.U.G.). – BIMINI: 31 females, 48 males, 2 juveniles from 11 host specimens, June 4, 1959; 9 males from 3 specimens, June 9, 1959; both in about 1 m of water, southwest of Pigeon Cay, Bimini Lagoon. – PUERTO RICO: 35 females, 27 males, 1 juvenile from 32 hosts, in about 2 m of water, Caballo Ahogado Reef, south of Magüeyes Island, southwestern Puerto Rico, August 11, 1959. – JAMAICA: 3 females, 8 males, 3 juveniles from 16 hosts, August 31, 1959; 4 females, 6 males from 85 hosts, September 3, 1959; both in about 1 m of water, Rackham's Cay, off Kingston. – The specimens from Puerto Rico and Jamaica have been divided among the museums mentioned above.

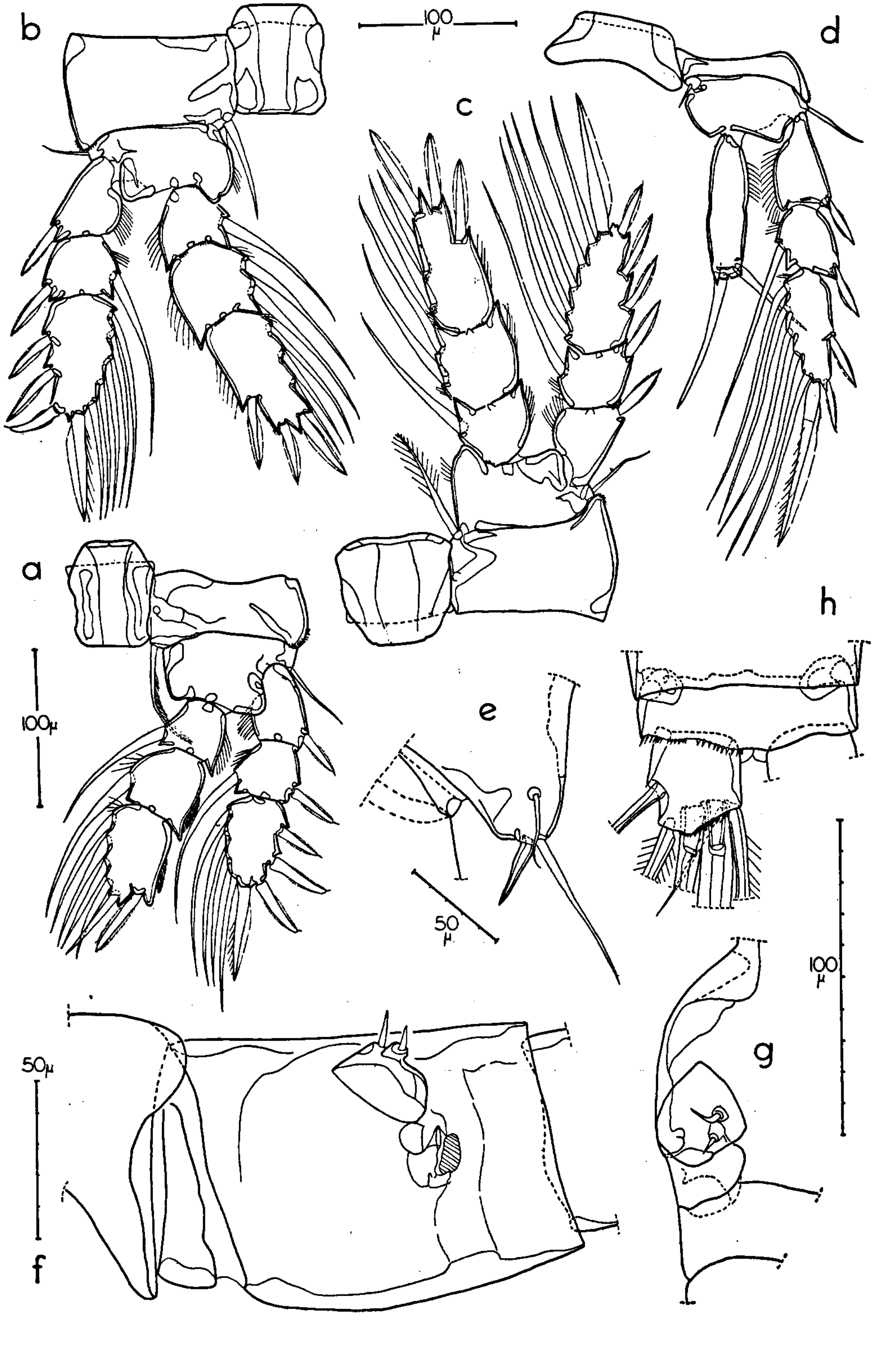
Illustrations have been made from a single paratype of each sex. One of the terminal hairs of A2 (dashed in fig. 3*e*), does not occur in the paratype, but is found in some other specimens. Measurements were made in lactic acid.

The specific name *pectinifer* (Latin, *pecten* = comb, *fero* = bear) refers to the modified spine on the endopod of leg 1 in the adult male.

Female. – The body (figs. 3*a*–*b*) is relatively robust, with a high vaulted prosome and a rather short urosome. The length of 10 paratypes, excluding the caudal setae, averaged 0.98 mm (measured in side view; range: 0.84–1.01 mm); the greatest width, 0.37 mm (0.35–0.39 mm); and the thickness (from the dorsal surface to the apex of the postoral protuberance), 0.42 mm (0.40–0.44 mm). Specimens from Jamaica and Puerto Rico were slightly larger, 10 averaging 1.06 mm in length (0.84–1.10 mm).

The sclerotization of body and appendages is strong, the surface of the exoskeleton being granular, striated, or covered with very

Fig. 3. *Pseudanthessius pectinifer* n. sp., female (Bimini): – *a*. Habitus, dorsal. – *b*. Habitus, lateral. – *c*. Cephalosome, ventral (right first and second antennae omitted, their areas of insertion being indicated by dashed circles; left leg 1 not shown). – *d*. Right first antenna, ventral. – *e*. Right second antenna, anterior (fine rugosities omitted). – *f*. Right mandible, dorsal. – *g*. Left first maxilla, ventral. – *h*. Right second maxilla, ventral. – *i*. Right maxilliped, medial.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g
f

fine hairlike processes. In addition, it may bear scale-like sculpturing, particularly on the urosome. Short hairs are scattered over the body.

In life, the color of specimens from Bimini was a light yellowish brown, with pink internal oily droplets and a dark red eye (in transmitted light); those from the other two islands were somewhat darker. The coloring matter is persistent in alcohol and lactic acid, and is apparently localized in the exoskeleton. Individuals presumed to be newly molted (those in which the cuticle was soft) were much paler. Large yellow-brown masses were often visible in the gut of these pale specimens.

The cephalosome (fig. 3*a*) includes the somite of leg 1 without any indication of the latter's anterior border, and forms much the largest tagma. There are 3 free metasomal segments. The tergum of the third (*i.e.*, the fourth pedigerous segment) is separated laterally from that of the second. The flexed urosome (fig. 3*b*) is characteristic of preserved specimens. There are 5 segments. The segment of leg 5 is incised ventrally and produced at the sides into the legs. An intersegmental area with a ventrolateral sclerite separates the fifth pedigerous and genital segments (fig. 4*f*). The genital segment is widest near the middle, being shaped like a somewhat globose spindle in dorsal or ventral view. The outline is smooth, without processes. The subdivision of the genital segment into its 2 constituent somites is well marked laterally and ventrally by a thickened band. The oviducal openings occur near the middle of each side, posterior and ventral to leg 6. The ovisacs are longer than the urosome and contain 9–11 rather large eggs, usually arranged in 2 irregular rows, and held together by a very thin membrane. The first postgenital segment is approximately the same size as the posterior genital somite and only slightly shorter than

Fig. 4. *Pseudanthessius pectinifer* n. sp., female (Bimini), continued: – *a*. Left leg 1 and intercoxal plate, ventral. – *b*. Right leg 2 and intercoxal plate, ventral (to same scale as *a*). – *c*. Right leg 3 and intercoxal plate, ventral (to same scale as *a*). – *d*. Left leg 4 and intercoxal plate, ventral (to same scale as *a*). – *e*. Right leg 5 *in situ*, dorsal. – *f*. Anterior part of urosome, left side, showing intersegmental sclerite, leg 6, and oviducal opening (leg 5 omitted; oviducal opening diagonally hatched). – *g*. Left leg 6 *in situ*, dorsal. – *h*. Anal segment and right caudal ramus *in situ*, ventral. (In *a–d* the ornamentation of the setae is omitted altogether.)

the succeeding 2 segments together. The latter of these bears the small, square anal area dorsally. A line of small spinules follows the lateral and ventral posterior edges of the anal segment.

A small, wide, shallow rostral fold extends ventrally at the extreme anterior end of the cephalosome.

The first antenna (fig. 3*d*) is 7-segmented, the segments decreasing in length in the order 2, 1, 5, 4, 6, 7, 3. Segment 7 appears to be subdivided terminally into 3 sections (possibly representing former segments). The setal armature is (from segments 1–7) 4, 13, 5, 3, 4, 2, 7. A narrow aesthete occurs on each of the last 3 segments. The elements on the last segment are disposed as follows: 4 setae on the basal portion, 2 setae and the aesthete on the second section, and a single terminal seta. Several setae are long, particularly the terminal one on the fourth segment.

The origin of the second antenna (fig. 3*e*) is lateral to and somewhat behind that of the first (fig. 3*c*). The appendage has 4 segments, the third and fourth partially fused. The segments routinely bear 1, 1, 4, and 6 elements respectively. Two of the terminal elements are modified as slender jointed claws. However, there may in addition be a very small termino-external seta (probably only a cuticular hair and not a true element) on the second segment and distally a short seta, inserted between the innermost terminal seta and the strongest terminal claw, in some specimens. Since this seta does not occur in all specimens, it is dashed in fig. 3*e*. The 2 terminal claws each have a short row of fine close-set denticles on the inner side of the curvature near the tip; the 4 long setae on the last 2 segments carry a row of rather widely spaced spinules along most of their length, but whether the shorter setae are similarly ornamented could not be resolved with certainty. The segments decrease in length in the order 1, 4, 2, 3, the last segment being about 3½ times as long as its width (maximum dimensions).

With the animal disposed ventral side uppermost, the oral complex is seen almost in a posterior view (fig. 3*c*). The shape of the labrum and the arrangement of the oral appendages is like that of Sars' (1917) pl. xcv, *Or. ar.* The labrum is not ornamented. There is a conspicuous square metastomal area delineated between the second maxillae; this is also smooth and slopes ventrally to the anterior end.

The mandible (fig. 3*f*) exhibits some of the features apparently basic for the genus. There is a small, spine-like element on the convex side and a row of spinules on the concave side, both at the base of the blade; the other ornamentation is shown in the figure. The blade is not set off from the proximal portion of the mandible; distally, it tapers into a long setiform process. Apodemes extend from each side of the base of the mandible.

The strap-shaped first maxilla (fig. 3*g*) bears 3 terminal setae only, although the cuticular thickening of the inner edge is interrupted at the point where a seta occurs in some species (*e.g., liber, assimilis*, and *deficiens*). The medial seta is the longest. In preserved specimens, the appendage extends almost ventrally between the mandible, second maxilla, and labral lobe on its side.

The second segment of the second maxilla (fig. 3*h*) is produced distally into a long lash, with a single row of spinules on its medial border. The lash is separated from the segment by a sclerotization at its base on the dorsal side. A short smooth seta occurs at this position. The ornamented element characteristic of most *Pseudanthessius* species is lacking. The lash of the appendage extends toward the mouth.

The maxilliped (fig. 3*i*) has 2 well marked segments and a terminal complex in which 2 further sections are recognizable. The first of the distal sections is smooth; the second bears 2 setae on the inner side, the distalmost with a minute denticle at its base, and extends into a short claw. The claw is spinulose on the inner side near the tip. There are 2 small elements and a patch of spinules on the medial side of the second segment. The 2 distal segments are oriented at right angles to the basal segment.

The oral area is quite widely separated from the origin of leg 1 (fig. 3*c*). The postoral protuberance appears particularly prominent in a side view of the body; ventrally, however, the posterior face of the protruding area is seen mainly to be represented by a tongueshaped sclerite which articulates posteriorly with the base of the first intercoxal plate. The postoral protuberance itself appears as a widely triangular area situated just behind the maxillipeds.

Legs 1–3 (figs. 4*a, b, c*) have trimerous rami. The exopod of leg 4 (fig. *4d*) is 3-segmented, the endopod unimerous. The armature of the legs may be expressed by the formula:

	protopod of legs 1–4	leg 1 exp	leg 1 end	leg 2 exp	leg 2 end	leg 3 exp	leg 3 end	leg 4 exp	leg 4 end
1st segment	0:1	I:0	0:1	I:0	0:1	I:0	0:1	I:0	II
2nd segment	1:0	I:1	0:1	I:1	0:2	I:1	0:2	I:1	
3rd segment		III I 4	I 5	III I 5	III 3	III I 5	III 2	II I 5	

The hairs on the setae are short and have a tendency to clump, so that the setae often appear to have lateral flanges. As in most species in the genus, there is little ornamentation on the legs. The intercoxal plates shorten and increase in width from front to rear. The endopod of leg 4 is of approximately the same width throughout, with the exception of a small sinuous constriction near the middle of each side.

Leg 5 (fig. *4e*) is represented by the 2 setae and spine characteristic for the genus. It seems probable that the terminal seta and spine are homologous with the armature of the free segment in other lichomolgids.

Leg 6 (figs. *4f–g*) forms a laterodorsal prominence on either side of the genital segment. The relatively large circular area with thin sclerotization around its base is particularly prominent. Two short elements and a spinous process occur at the tip. It is possible that this area, which may easily be confused with the more ventrally, placed oviducal opening, represents the opening to the spermatheca, but we saw no specimens with attached spermatophores.

The caudal ramus (fig. *4h*) is short, about as long as wide, and slightly longer than the anal segment. The 4 terminal setae are long, the next to the innermost rather lanceolate; all bear hairs.

M a l e. – The following sexual differences occur. The length of the body (figs. *5a–b*) is 0.82 mm (0.79–0.84 mm), based on 10 paratypes; greatest width and thickness 0.28 mm each (0.27–0.29 mm), so that the male is slightly smaller than the female.

The urosome is 6-segmented. The genital segment is formed of a single somite and appears subquadrate in dorsal or ventral view. Laterally, there is a slight ventral protrusion anteriorly. The spermatophores are relatively large, ovoid bodies with thick walls, and nearly fill the segment.

The appendages in general are smaller than those of the female. The aesthete on segment 5 of the first antenna is larger, however. The setae on segments 1 and 2 of the second antenna are borne on

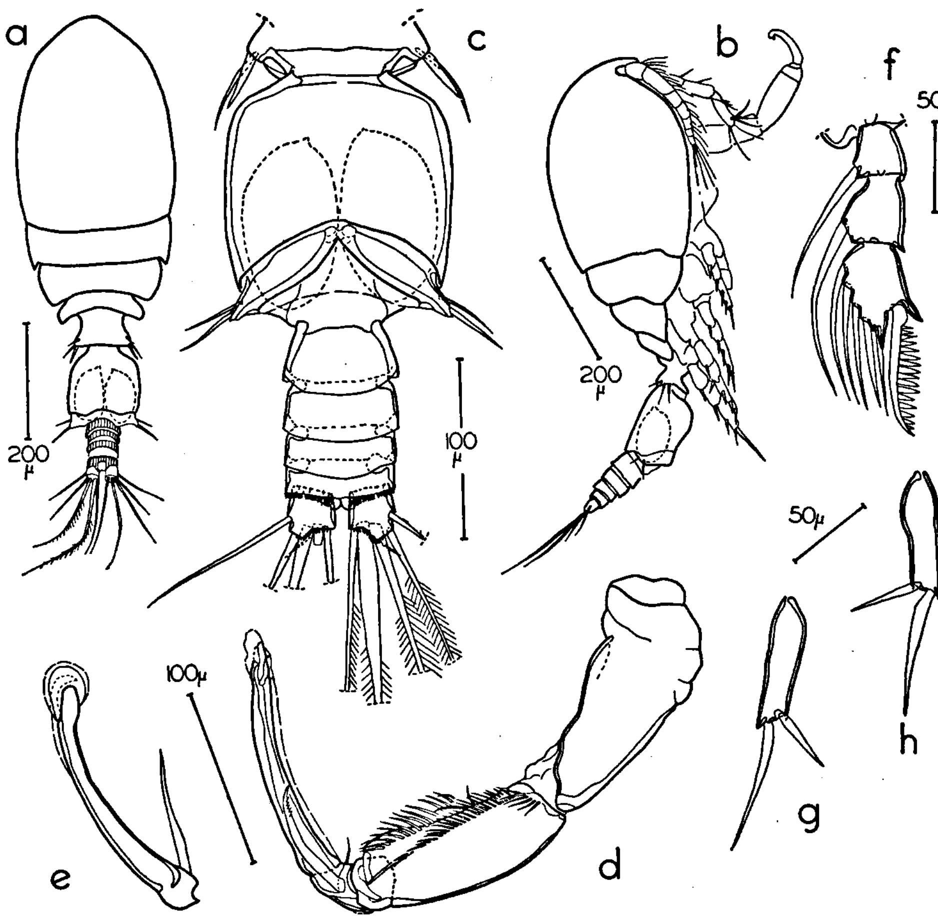


Fig. 5. *Pseudanthessius pectinifer* n. sp., male (Bimini): – *a*. Habitus, dorsal (sclerotized portion of the postgenital segments shaded). – *b*. Habitus, right side. – *c*. Urosome, ventral (dorsal setae of leg 5 omitted). – *d*. Right maxilliped, posteromedial. – *e*. Dactylus, anterior (to the same scale as *d*). – *f*. Endopod of left leg 1, ventral (ornamentation of the setae omitted). – *g*. Endopod of left leg 4, ventral. – *h*. Endopod of right leg 4, ventral (to same scale as *g*).

small protuberances. There is no sclerotization between the lash and segment 2 of the second maxilla.

The 2 basal segments of the maxilliped (fig. 5*d*) are long, the second with 2 rows of spinules longitudinally on the inner face and a shorter line (not shown in the figure) transversely on the anterior face near the distal end. This third line may be quite prominent when the appendage is viewed *in situ* with the animal lying on its side. In addition, the second segment bears 2 small setae near the middle of the inner face; these cannot easily be differentiated from the spinules in the longitudinal rows except in a medial view, when they can be seen to originate between the two rows. The third segment is small and incompletely sclerotized; it is closely associated but clearly articulated with the second, and unarmed. The fourth segment is about the same size as the third, bears 2 setae on the inner face, the posterior one rather large; and is produced into a long dactylus. There is some indication at the base of the latter of an original articulation. There is a membranous flange on the concave side of the dactylus, and this continues into the thin, spoon-shaped tip (fig. 5*e*) whose "bowl" faces forwards.

The first segment of the endopod of leg 1 (fig. 5*f*) lacks the process present on the outer side in the female, but those on segment 3 are longer and more sharply pointed. The spine on the third segment is modified into a long, curved, heavily ornamented element. The endopod of leg 4 (figs. 5*g–h*) lacks the medial constriction of the female appendage but may be somewhat more swollen at its base on the outer side.

Leg 6 (fig. 5*c*) is represented by the usual ventral flange bearing 2 subterminal setae. It is probable that the short terminal process is homologous with the spine of leg 5.

Developmental stages. – The developmental stages in our collections are similar to those designated Copepodid III–V in other copepods. Three specimens of "Copepodid III", 6 "IV", 20 female "V", and 18 male "V" occurred. In "Copepodid III" the body has 7 segments, the first antenna 6; legs 1–3 are biramous, with 2-segmented rami; both rami of leg 4 are 1-segmented; and leg 5 is represented by a single seta. At "Copepodid IV" the body and the exopod of leg 4 each have an additional segment; leg 5 shows the adult armature; and leg 6 is represented by a pointed process bearing a subterminal seta. In "Copepodid V" the body is 9-segmented; the first antenna has 7 segments; both rami of legs 1–3 and the exopod of leg 4 are 3-segmented; and leg 6 is similar to that of the adult male.

Although it is possible that statistical analysis of a large enough sample might reveal a sexual difference in length at "Copepodid IV", "Copepodid V" is the first in which male and female forms could be recognized in our material. The main criteria for differentiation are the size of the body (the female being larger), the size and shape of the maxilliped (that of the male being larger, with the end shaped like the nib of a pen), and the spine on the endopod segment 3 of leg 1 (lamelliform in the male).

The "Copepodid V" stages are helpful for interpreting the adult condition. They suggest that, at the molt to the adult, the anal segment divides into two, and that the segment immediately behind the one bearing leg 6 is incorporated into the genital segment of the adult female. Also, it appears that the third and fourth segments of the male maxilliped (including the dactylus) are completely homologous with the 2 sections of the third segment (and armature) in the female. The changes in shape of the spine on the third endopod segment of leg 1 in the male are also of interest.

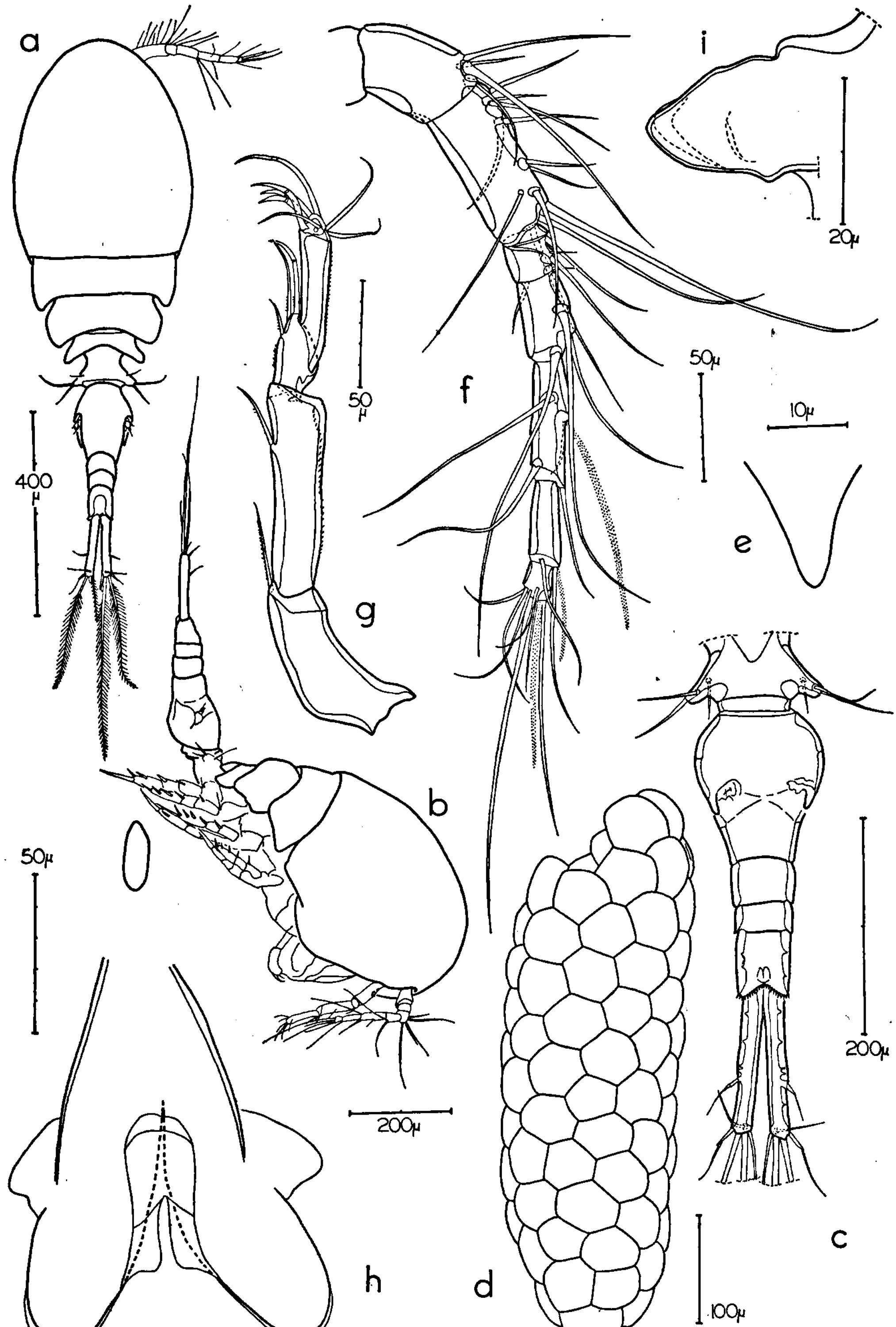
Remarks. – *P. pectinifer* does not seem particularly close to any of the other species of *Pseudanthessius*. Perhaps the greatest correspondence is to *P. weberi* A. Scott (known only from the female, a single specimen of which was obtained from invertebrates dredged at nearly 1600 m in the East Indies): in the general shape of the body, particularly the anterior segments of the urosome; the small number of relatively large eggs; the general structure of the second antenna, mandible, and second maxilla; and a similarity in size and in the form of the other appendages. The genital segment of *P. weberi* is more elongate, however, as are the succeeding segments and the caudal rami; and the fourth endopod is swollen at the base of the outer side.

Pseudanthessius aestheticus n. sp.

(Figs. 6–8)

Type material. – JAMAICA: 13 females, 22 males from alcohol washings of 14 amphinomid polychaetes (probably a mixture of *Hermodice carunculata* (Pallas) and *Eurythoe complanata* (Pallas), the familiar "stinging worms" of the West Indies), Lime Cay (17°55′00″ N, 76°49′21″ W), off Kingston, under rocks in about 1 m of water, August 30, 1959; collected by A.G.H. and R.U.G. – Holotype female, allotype male, and 10 paratypes (3 females) in the United States National Museum, Washington; 11 paratypes (4 females) in the Zoölogisch Museum, Amsterdam; 9 paratypes in the British Museum (Natural History), London; and the remainder in the collection of A. G. Humes.

Other specimens (all from *Hermodice carunculata* in Jamaica, collected by the staff of the UCWI Marine Laboratory). – 4 males from 1 host, Drunken Man's Cay,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off Kingston, in about 1 m of water, August 28, 1959. One copepodid from 1 host, 1 male and 1 copepodid from another, Gun Cay, off Kingston, September 27, 1961. – These specimens in the collections of A.G.H. and R.U.G.

Specimens of *Pseudanthessius tortuosus* and of 2 undescribed lichomolgids occurred in the same collection with the type material. The Drunken Man's Cay sample also contained one of these lichomolgid species; the second Gun Cay sample, the other.

Drawings have been made from the holotype (figs. *6a–b*), allotype (fig. *8e*) and a dissected paratype of each sex. Fig. *6d* was drawn from a third paratype. Measurements were made in lactic acid from paratype material.

The name *aestheticus* (Greek, αἰσθητικός = perceptive) refers to the well developed aesthete complement of the male.

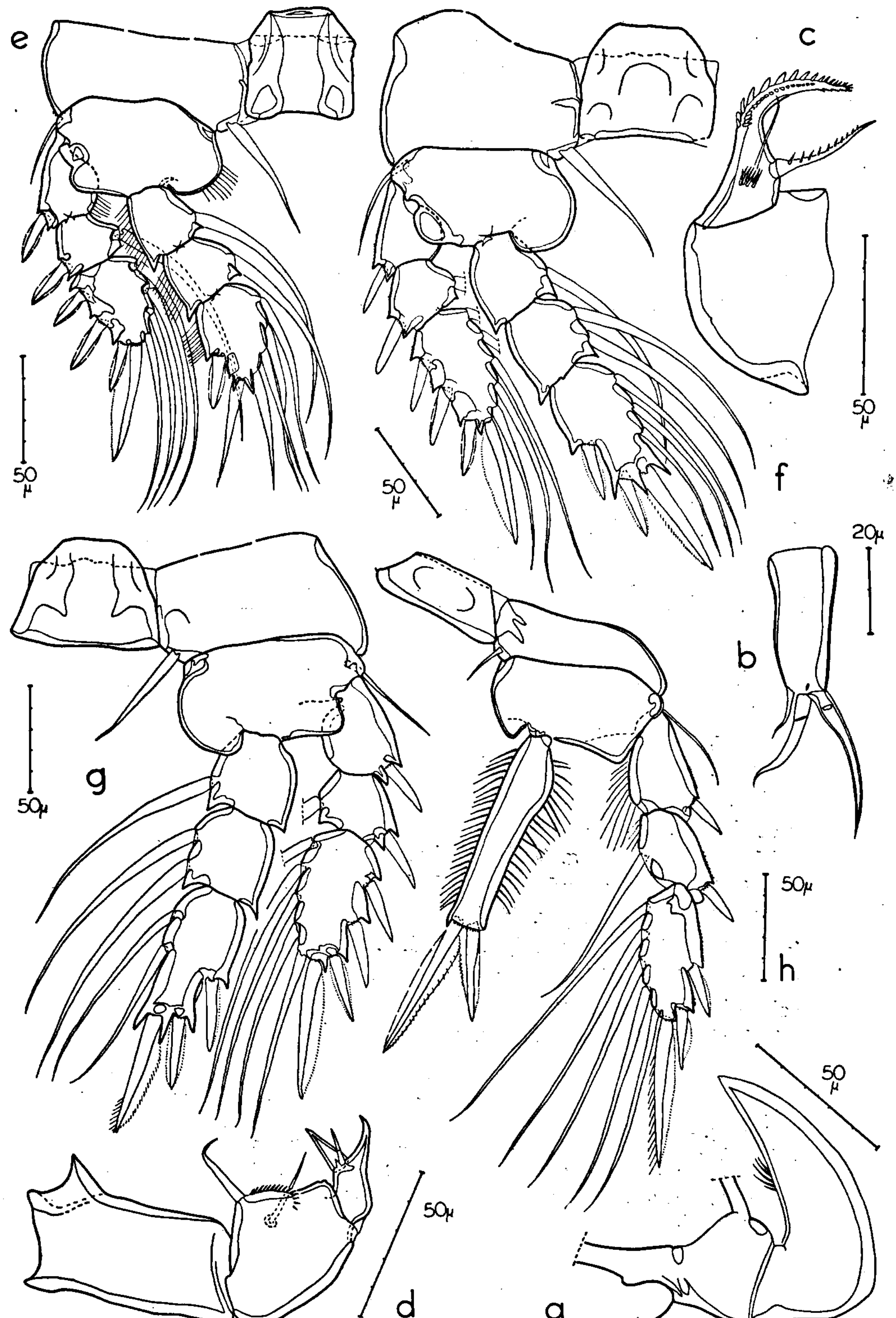
Female. – The average length of the body (figs. *6a–b*) is 1.02 mm (range, 0.99–1.09 mm), based on 10 specimens; the maximum width of 5 specimens, 0.37 mm (0.35–0.37 mm); and the height of 5 others, 0.33 mm (0.31–0.37 mm). The urosome is relatively larger than in *P. pectinifer*.

A short ventrolateral sclerite occurs between the fifth pedigerous and genital segments (fig. *6c*) as in *P. pectinifer*. The genital segment itself is relatively less wide than that of *P. pectinifer* but of similar shape. The lateral expansions, however, run posteriorly to terminate each in a small, bluntly pointed process, lying lateroventrally over the respective genital opening. There is good evidence, particularly laterally, of a division between the 2 somites making up the genital segment. The ovisac (fig. *6d*) is large and contains about 70 closely packed eggs. The anal segment is almost exactly twice as long as that preceding it.

The rostral fold (fig. *6e*) is relatively long but bent posteriorly so that it does not protrude in lateral view (fig. *6b*).

The first antenna (fig. *6f*) has 7 segments, decreasing in length in the following order: 2, 5, 1, 4, 6, 3, 7. The boundary between the second and the third segments is not clear and the pattern of sclerotization on the ventral side suggests a complex of 3 sections within the third segment. The armature (proximal to distal segments)

Fig. 6. *Pseudanthessius aestheticus*, n. sp., female (Jamaica): – *a*. Habitus, dorsal (holotype). – *b*. Habitus, right side (holotype). – *c*. Urosome, ventral. – *d*. Right ovisac (incomplete near anterior end), lateral (from a third female). – *e*. Rostral outline, anterior. – *f*. Left first antenna, ventral (inner). – *g*. Right second antenna, ventral (inner). – *h*. Labrum, ventral and slightly from left. – *i*. Left "paragnath", posterodorsal.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is: 4, 12, 5, 3, 4, 2, and 7 setae, with an aesthete on each of the last 3 segments. The distalmost seta on the anterior side of the third segment appears to be borne on a small knob. The aesthetes are narrow and not very prominent.

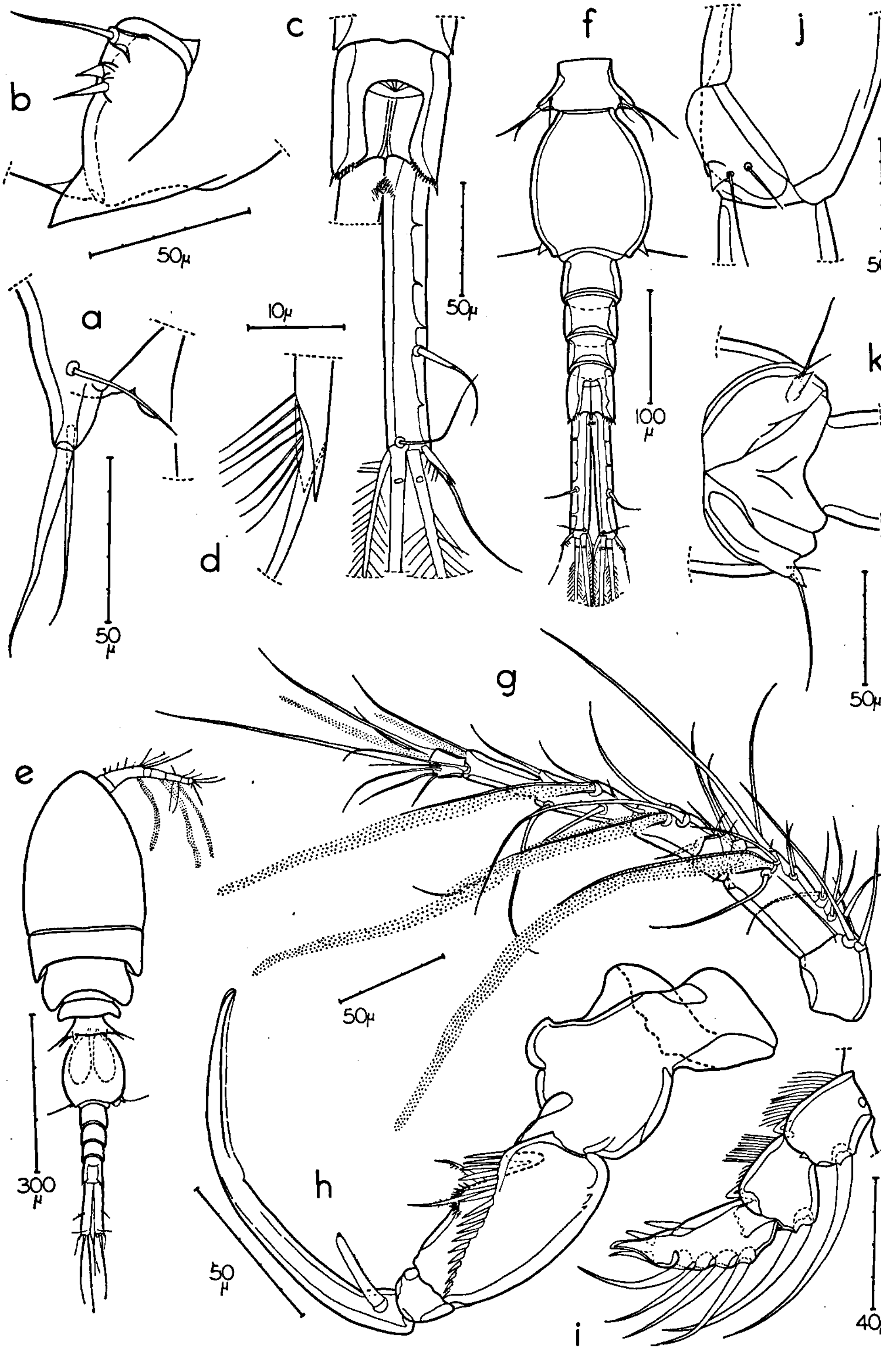
The second antenna (fig. 6*g*) is similar to that of *P. pectinifer* but the second segment is the longest. The length of the last segment is about 5½ times its width. There are 3 setae on the inner distal corner of the third segment. None of the terminal elements is particularly strong but their size and breaks in the sclerotization of the inner 4 delimit them from the posterior 3 setae. One of these 4 inner claws is larger than the others.

A small raised area occurs between the rostrum and the poorly defined anterior limit of the labrum (fig. 6*h*). A pair of right-angled membranous flaps interrupt the smooth sweep of the incision in the latter's posteroventral border. There is no well defined metastomal area, but a pair of small lobes (rudimentary paragnaths?) occurs just behind the insertion of the first maxillae. These lobes (fig. 6*i*) appear bifurcate near the tip and are unornamented. They usually remain attached to the mandible-first maxilla complex during dissection. The oral mass protrudes markedly in a side view of the whole animal.

The mandible (fig. 7*a*) is rather different from that of *P. pectinifer*. The fairly wide, blunt-tipped blade is clearly set off from the base, but apparently by the pattern of sclerotization rather than by a functional articulation. A group of spinules on the outer edge forms its only ornamentation and there are no accessory elements. A single strong apodeme extends inward from the posterolateral corner of the mandibular base.

The first maxilla (fig. 7*b*) is relatively longer that of *P. pectinifer*. The 3 terminal setae decrease in size toward the midline. The 2 inner setae seem to show the same type of articulation which

Fig. 7. *Pseudanthessius aestheticus*, n. sp., female (Jamaica), continued: – *a*. Right mandible, ventral. – *b*. Right first maxilla, dorsal. – *c*. Right second maxilla, dorsal (spinous element restored from another specimen). – *d*. Right maxilliped, lateral. – *e*. Right leg 1 and intercoxal plate, ventral. – *f*. Right leg 2 and intercoxal plate, ventral. – *g*. Left leg 3 and intercoxal plate, ventral. – *h*. Left leg 4 and intercoxal plate, ventral. (In figs. *f* and *g* the finer ornamentation is omitted; in *e* and *h* from the setae only).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characterizes the medial setae on the end of each caudal ramus in many copepods, *i.e.*, to possess a basal peg over which the end of the seta fits.

The lash of the 2-segmented second maxilla (fig. 7*c*) is rather short and carries 2 rows of denticles, on the inner and ventral surfaces. It does not appear to articulate with the distal segment. There is a spine about as long as the lash, with a single line of strong spinules on the inner side. A rather long seta, forming the third part of the armament, arises from a circlet of spinules on the dorsal side of the second segment.

The trimerous maxilliped (fig. 7*d*) carries 2 setae, one rather strong, on the second segment. This segment is expanded medially and carries a line of small spinules on its dorsomedial face. A seta with a denticle at its base and a stout spine occur on the last segment in addition to the terminal claw-like process; all these elements are smooth.

The structure of the postoral protuberance is very much like that of *P. pectinifer*.

The segmentation, armature, and appearance of legs 1–4 (figs. 7*e–h*) are like *P. pectinifer*. The endopod of leg 4 (fig. 7*h*) is 96 μ in length (exclusive of the terminal spines) and 23 μ in greatest width, which occurs within the bulge near the base on the outer side. There is no outer notch. The ramus carries a row of rather strong hairs on either side.

The terminal element of leg 5 (fig. 8*a*) may be considered a stout seta rather than a spine. Leg 6 (fig. 8*b*) is represented by a seta and 2 shorter elements above each oviducal opening.

The caudal ramus presents a number of interesting features. The first is their size: about 131 × 18 μ, being thus about 7¼ times

Fig. 8. ***Pseudanthessius aestheticus***, **n. sp.; figs. *a–d*, female, continued, figs. *e–k*, male (both from Jamaica): – *a*. Left leg 5, dorsal *in situ*. – *b*. Left leg 6 and ventral spine on genital segment, right side. – *c*. Anal segment and right caudal ramus, dorsal. – *d*. Detail of proximal part of outer terminal seta on this caudal ramus. – *e*. Habitus, dorsal. – *f*. Urosome, dorsal. – *g*. Right first antenna, ventral (inner). – *h*. Right maxilliped, ventral. – *i*. Endopod of right leg 1, ventral (ornamentation of setae omitted). – *j*. Left leg 6 *in situ*, lateral. – *k*. Posterior part of genital segment *in situ*, showing legs 6, ventral and slightly from right.**

as long as wide. A patch of fine spinules on the dorsomedial surface near the base has not been recorded in other species of *Pseudanthessius;* nor has the most outstanding character: the structure of the outer subterminal and distal outermost setae. As in some species of *Hemicyclops* Boeck (Clausidiidae) (compare fig. 8*d* with HUMES, CRESSEY & GOODING, 1959, fig. 4) and *Anthessius* Della Valle (Myicolidae) (BOCQUET & STOCK, 1958, fig. 1*b*, detail), these setae consist of a basal shaft terminating in 2 long pointed processes between which the terminal lash arises. Here, only the basal portion of the terminal lash carries hairs. All the other terminal setae are hirsute as in *P. pectinifer*. The seta on the outer edge also has a shaft and lash, but the end of the former appears entire (*i.e.*, not divided into terminal processes) and there are no hairs.

Male. – The male (fig. 8*e*) is smaller than the female. The length of 10 specimens averages 0.81 mm (range, 0.72–0.90 mm); the maximum width, 0.25 mm (0.22–0.27 mm); and the height, 0.23 mm (0.21–0.24 mm). Although there is a decrease in absolute size, some of the difference is due to the larger cephalosome of the female.

The urosome (fig. 8*f*) is, as usual, 6-segmented, the genital segment being a unit, slightly flattened dorsoventrally, and subovate in dorsal outline. The spermatophores are relatively less wide than those of *P. pectinifer*. The ratios of the lengths of the 4 posterior urosomal segments are approximately 3 : 3 : 2 : 5.

The rostrum, second antenna, oral region, mandible, first and second maxilla, postoral protuberance, and legs 2–5 are, in general, like those of the female but proportionately smaller. Some of the processes on the segments of legs 2–4 may be more sharply pointed than in the female.

The first antenna (fig. 8*g*) is a most distinctive appendage since it has 2 extra aesthetes (on the second and fourth segments) and these, like the one on the third segment, are very large. As in *Anthessius* (BOCQUET & STOCK, 1958; ILLG, 1960), extra aesthetes in *Pseudanthessius* appear not to be derived from setae present on the female appendage (compare also figs. 9*e* and 12*d* in the following species). The setal armature is thus the same as in the female. The 3 long aesthetes each seem to have a thickened support along the basal part of their anterior surface. The other aesthetes and the proportions of the segments are as in the female.

The maxilliped (fig. 8*h*) is tetramerous, the fourth segment produced without a break into the dactylus. The first segment has a rounded process on its inner face; the second a line of much stronger spinules than in *P. pectinifer* ventromedially. The dorsal side of the second segment is incised by a conspicuously cuticularized depression near the base. The main element on the fourth segment is stouter than in *P. pectinifer* and has a subterminal notch. In its distal third the posterior (outer) face of the dactylus becomes membranous but, although there is also a minute flange on the other side of the tip, no spoon-shaped modification like that in *P. pectinifer* occurs.

The endopod of leg 1 (fig. 8*i*) is more modified than in *P. pectinifer*. The processes on the outer distal corners of the first 2 segments are rather more bluntly pointed than in the female and set dorsal to the edge. The lines of hairs on the outer side of the segments are restricted to the first segment and part of the second. Segment 3 is somewhat elongate. Only 4 setae are normally developed on this segment, and these insert on the dorsal side. Their hairs (not shown in the figure) are heavier and more profuse than in the female. A small element, which may represent the fifth seta of the female leg, also inserts dorsally on the inner side of a terminal curved process. In a corresponding position on the outer side there is a small spine-like element. A second spine occurs further proximally. An alternative interpretation might homologize the terminal process with the most distal seta on the female leg and the elements on either side with the pointed processes which flank this seta in the female. However, this would require the complete reversal of these elements and processes between the sexes. The 2 elements (small seta and spine) subterminally on either side in the male can be seen very clearly to articulate if the leg is viewed from the dorsal side, and the spine is almost identical with the one which inserts nearer the base of the segment. The terminal process shows no trace of an articulation. The situation in the female is just as clear-cut. It must be admitted, however, that the first explanation does not allow as exact an accounting as its alternative, since the terminal curved process in the male cannot definitely be equated with any structure on the female leg (unless it represents one or other of the 2 pointed processes or the result of a fusion of both) and the second spine has to be considered a new development.

Leg 6 (fig. 8*k*) forms the usual pair of flaps, bearing 2 setae and a spinous process, over the genital openings.

The caudal ramus is not quite as long (107 μ) in relation to its width (17 μ) as in the female. The ratio is thus only 6.3 : 1 instead of slightly over 7.

Remarks. – *P. aestheticus* most nearly resembles *P. thorelli* (Brady) and *P. concinnus* Thompson & A. Scott. Through the good offices of Dr. J. P. Harding, A.G.H. and R.U.G. have been able to examine, as a lactic acid whole mount, one of the 2 males of *P. thorelli* from the Norman Collection in the British Museum (Natural History); Cat. No. 1911.11.1.47588–589. (This specimen was labeled from Salcombe and Plymouth, and is thus probably one of those referred to in Norman & T. Scott, 1906, p. 198). Brady's figures (1880, pl. lxxxviii, figs. 1–9) are sufficiently good to establish that the specimen represents his species, but as Sars (1917) noted, the form needs redescribing. Since material of the female will be necessary for this, we have not attempted a redescription here. The following notes, however, will supplement some points in Brady's account. Except where stated, comparison is with the male of *P. aestheticus*.

The length is about the same as that of *P. aestheticus*: 0.87 mm (measured in lateral view).

The difference from *P. aestheticus* in the shape of the genital segment in dorsal or ventral view (subquadrate in *P. thorelli*), in the proportions of the succeeding urosomal segments (6 : 5 : 2 : 6 in *P. thorelli*, measured from the side), and in the length: width ratio of the caudal rami (an accurate value could not be obtained for the specimen of *P. thorelli* since the urosome is bent upon the prosome, but it is in excess of 10 : 1) are well marked. The spermatophores are like those of *P. aestheticus*. *P. thorelli* also has large spinulose flanges dorsally and laterally on the distal edges of the second (genital), third, and fourth urosomal segments as well as on the anal segment, where the flange is continuous ventrally. It is interesting that the same modification of the outer subterminal and distal outermost setae on the caudal rami as in *P. aestheticus* occurs.

The rostral fold is longer than that of *P. aestheticus.*

Aesthetes occur in the same positions on the first antenna, but the proximal 3 are not enlarged.

It is probable that BRADY's figure 4, of the second maxilla, lacks only a short spinulose spine, corresponding to the slender seta in *P. aestheticus.* The line of spinules he shows, possibly at its base, could not be seen. The proximal armature of the apical lash comprises 2–3 large spinules, and the lash itself is slender and attenuated distally, thus furnishing a conspicuous difference from *P. aestheticus.*

The maxilliped is very similar to that of *P. aestheticus.* The tip of the dactylus, however, is more modified and had the shape of an elongate truncated cone in the aspect from which the specimen was examined. Whether a spoon-like flattening of the tip (like that in *P. pectinifer*) occurs could not be determined.

There is probably little or no modification of the last endopod segment of leg 1 from the female condition. The armature comprises 4 setae and 2 well developed spines. The innermost spine is set off by spinous processes at the base in the same fashion as the corresponding seta in the female of *P. aestheticus.*

The endopod of leg 4 is very similar to that of *P. aestheticus.* The terminal element on leg 5 is a flanged spine. Leg 6 is somewhat larger and placed more ventrally on the genital segment.

By comparison of BRADY's account, as supplemented above, with the figures in CLAUS (1889) and SARS (1917), there can clearly be no question of synonymy between *P. gracilis* Claus and *P. thorelli* at present. Separation of *P. thorelli* from *P. concinnus* must depend on the accuracy of the descriptions of the respective females in BRADY (1880) and THOMPSON & A. SCOTT (1903, p. 277, 303, pl. XIV figs. 24–30), since *P. concinnus* is known only from this sex. The shape of the genital segment, the proportions of the succeeding urosomal segments, the possible addition of an element on the second segment of the maxilliped in *P. concinnus,* the replacement of the spine (?) by a seta on the leg 1 endopod segment 3 of *P.*

thorelli, and the well developed leg 6 of *P. concinnus* would seem to be the important features. Meanwhile, until comparisons of new specimens can be made, it seems preferable to retain the 2 as separate species, while recognizing their strong similarity.

P. aestheticus can best be separated from *P. concinnus* at present by the shape of the female genital segment, the shorter caudal rami, and the structure of the second maxillar tip. It may be that, when more is known about the 3 forms, *P. concinnus* and *P. aestheticus* will prove to be subspecies of *P. thorelli*, or all to form a superspecific complex.

Pseudanthessius tortuosus n. sp.

(Figs. 9–12)

Type material. – PUERTO RICO: 70 females, 180 males, numerous juveniles from alcohol washings of 4 amphinomid polychaetes (probably *Hermodice carunculata* (Pallas)), Corona del Diablo Reef (17°58′0″ N, 67°03′0″ W), off Magüeyes Island, La Parguera, among *Porites* coral, in about 1 m of water, August 24, 1959; collected by A.G.H. and R.U.G. – Holotype female, allotype male, and 75 paratypes (all in alcohol) deposited in the United States National Museum, Washington; the same number of paratypes in the Zoölogisch Museum, Amsterdam, and in the British Museum (Natural History), London; and the remainder in the collection of A. G. Humes.

Other specimens. – PUERTO RICO: 7 females, 5 males, 1 juvenile from 2 amphinomids, 69 females, 49 males, 61 juveniles from 6 amphinomids, both from Mata Cagada (a small reef between Magüeyes Island and Cayo Majimo, La Parguera), among *Porites* in about 1 m, August 20 and 23, 1959, respectively; collected by A.G.H. and R.U.G. – JAMAICA: 14 females, 35 males, some juveniles from 14 amphinomids, Lime Cay, off Kingston, under rocks in about 1 m of water, August 30, 1959. – 111 females, 114 males, 51 juveniles from 2 amphinomids; 45 females, 224 males, 81 juveniles from 3 amphinomids; both on rocks near tide-gauge at Port Royal, in about 1 m, September 1 and 2, 1959, respectively; collected by A.G.H. and R.U.G. – 12 females, 26 males, 10 juveniles from 1 *Hermodice carunculata*, 1 male from another (small); 13 females, 39 males, 10 juveniles from 1 *Eurythoe complanata* (Pallas) (Polychaeta: Amphinomidae), 2 females, 9 males from another, 1 female, 3 males from a third (small); all from Gun Cay, off Kingston, September 27, 1961; collected by the staff of the UCWI Marine Laboratory. – BARBADOS (all from *H. carunculata*, collected by R.U.G.): 1 female from 1 host, 2 males from another, both on reef off Holetown, St. James, in about 1 m, December 28, 1961. – 3 females from 1 host, 3 females, 1 male from another, both under rocks, Oistin's Bay, Christ Church, in 2–3 m, January 3, 1962. – 20 females, 37 males, 12 juveniles from 1 host, 1 male from another, both from reefs off Coral Reef Club, St. James, in 1–2 m, January 13 and 14, 1962. – Material of these other specimens has been divided among the three institutions and the author's collections.

The amphinomids from Puerto Rico are probably *H. carunculata*; those from Jamaica, except where otherwise stated, possibly a mixture of this species with *E. complanata.*

Specimens of *P. aestheticus* and of 2 undescribed lichomolgids occurred in the first Jamaica collection, and a female of one of these lichomolgids in the first Gun Cay (Jamaica) collection.

Figures are based on specimens from the first Jamaica collection. Several of the original pencil drawings were made by Mr. ROGER F. CRESSEY, to whom we wish to express our thanks. Measurements were made in lactic acid on specimens from this Jamaican collection.

The specific name *tortuosus* (Latin = winding) refers to the form of the second antenna.

Female. – The length of the body (figs. 9*a*–*b*) is 0.89 mm (range, 0.79–0.93 mm), based on 10 specimens; the maximum width, 0.40 mm (0.36–0.44 mm), and thickness 0.28 mm (0.23–0.30 mm). Thus the cephalosome is relatively more expanded than, but not as inflated as, in *P. pectinifer* and *P. aestheticus.* The anterior limit of the somite bearing leg 1 is indicated by a slight furrow on the back and sides. The tergal plate of the third pedigerous segment is somewhat separate from that of the second; the one on the fourth pedigerous segment is not very well defined.

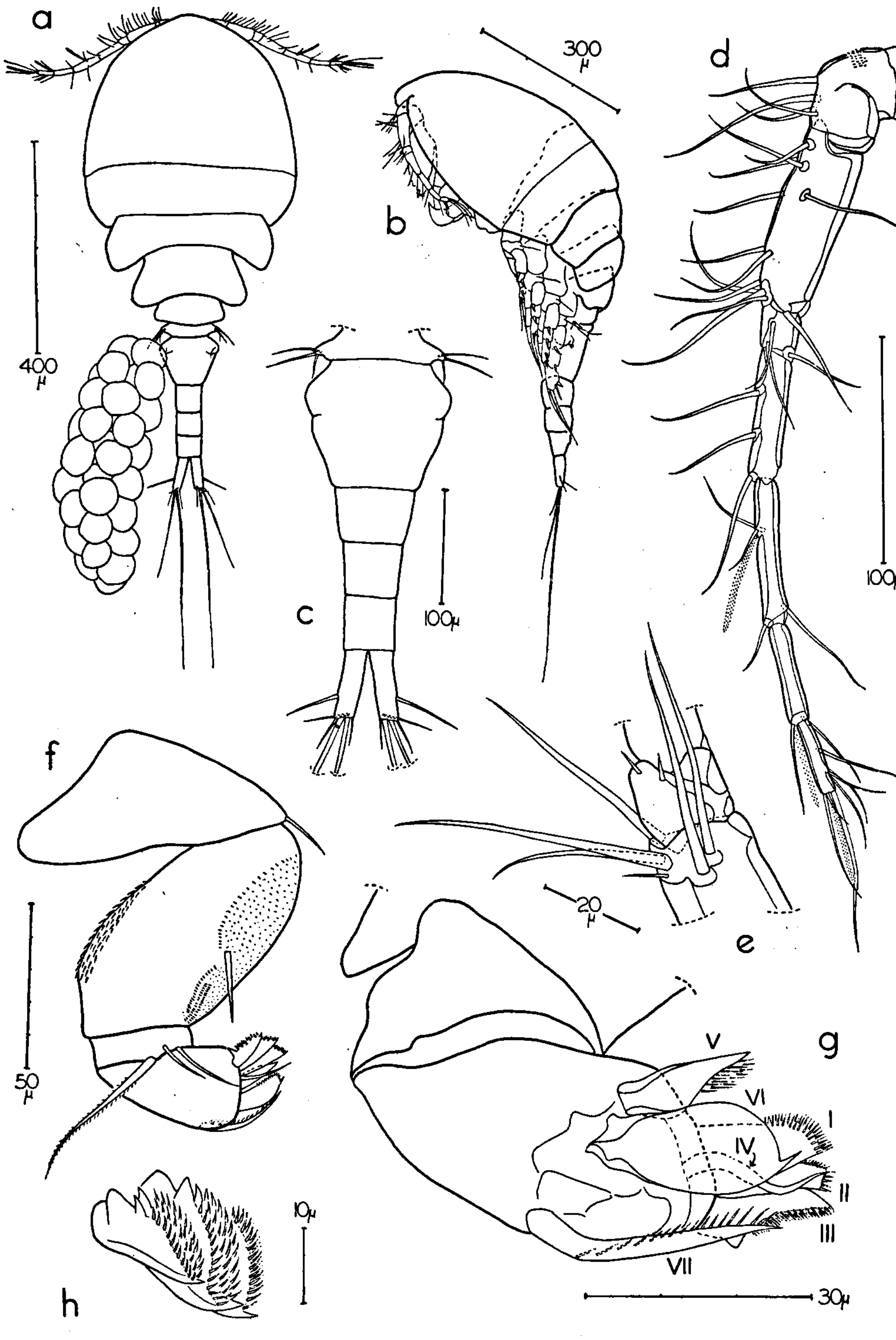
The segment bearing leg 5 is much smaller than in the preceding 2 species. There is no intersegmental sclerite. The genital segment is wider proximally, with lateral genital openings in the anterior half. Ovisacs (fig. 9*a*) are larger than the urosome and contain some 30–40 closely packed eggs. The 3 postgenital segments appear similar in size but actually decrease very slightly posteriorly.

In life by reflected light the color of the body is brownish, the eye red, and the ovisacs reddish tan.

The rostrum is scarcely differentiated, even in ventral view.

The segments of the first antenna (fig. 9*d*) decrease in length in the order 2, 5, 4, 6, 1, 7, 3. Segments 4–7 are longer and narrower than in the 2 preceding species. The armature is numerically the same as that of *P. pectinifer*, but the setae are much shorter and more widely spaced and the aesthetes are relatively smaller.

The 4 segments of the second antenna (fig. 9*f*) form a spiral, the terminal elements of this pair of appendages meeting medially. The second segment is the largest, the others, particularly the third, being short and stout. The last segment is about 2 times as long as


a
400 μ
300 μ
b
d
c
100μ
100μ
f
50 μ
20 μ
e
g
V
VI
I
IV
II
III
VII
h
10μ
30μ

wide. There are 3 setae on the dorsomedial edge of the third segment; the longest, which is spinulose, often extends posteriorly under (*i.e.*, ventral to) the mouthparts. The terminal armature (fig. 9*g*) is distinctive: there are 2 spinulose, thickened lamelliform elements (V and VI) on the anteroventral edge, a long ornamented seta (VII) posteroventrally and, on the dorsal side, 3 spines (I–III) thickly set with spinules. Basally on each of these spines there is a heavy denticle (fig. 9*h*). Between the spines and the largest, most posterior lamella there is a further small seta (IV). Thus, the customary 7 elements are present. Although their homologies with the 4, 2, 1 pattern into which this armature usually falls are not entirely clear, it seems likely that seta IV by its position should be grouped with the 3 spines.

The posterior edge of the labrum (fig. 10*a*) extends into 2 long lobes with subacute tips which curve outwards. These lobes reach to the level of the second maxillae. There is a raised metastomal area, which has a well defined subtriangular basal outline, between the second maxillae. Paragnath-like projections were not seen.

The mandible (fig. 10*b*) is similar to that of *P. aestheticus*, but the ornamentation consists of a row of fine striations on the ventral side and a lateral spinulose flange near the tip. A peculiar lacuna in the sclerotization occurs posterolaterally at the position of the accessory structure in *P. pectinifer* and *P. deficiens*.

The first maxilla (fig. 10*c*) bears 3 terminal seta-like elements, as in *P. aestheticus*.

The anterior face of the basal segment of the second maxilla (fig. 10*d*) is covered with fine spinules. As in *P. aestheticus*, the armature of the second segment is tripartite: a terminal lash whose medial surface is spinulose, a long seta with a spinulose flange, and a shorter smooth seta. The last 2 elements arise respectively on the dorsal and posterior surfaces of the segment.

Fig. 9. *Pseudanthessius tortuosus* n. sp., female (Jamaica): – *a*. Habitus, dorsal. – *b*. Habitus, left side. – *c*. Urosome, ventral – *d*. Left first antenna, dorsal (anterior). – *e*. End of second segment of left first antenna *in situ*, posteroventral (most elements on third segment omitted). – *f*. Left second antenna, dorsal (outer). – *g*. End of right second antenna, ventral (ornamentation of large lamelliform element omitted). – *h*. Three innermost spines of this antenna in a different view.

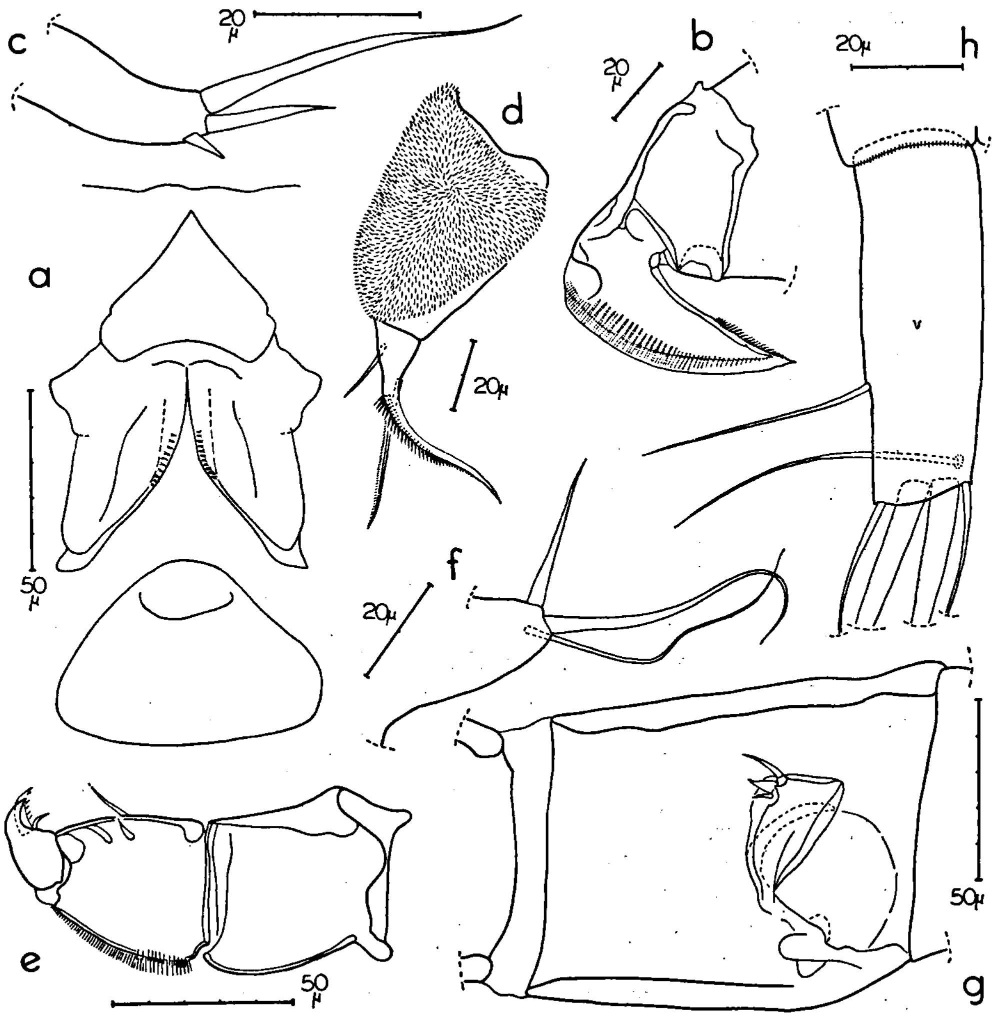


Fig. 10. *Pseudanthessius tortuosus* n. sp., female (Jamaica), continued: – ***a***. Oral area, ventral. – ***b***. Right mandible, ventral. – ***c***. Left first maxilla, ventral. – ***d***. Right second maxilla, ventral. – ***e***. Left maxilliped, anterior. – ***f***. Right leg 5, ventral ***in situ***. – ***g***. Genital segment ***in situ***, showing right leg 6 (anterior side toward the scale). – ***h***. Right caudal ramus, ventral.

The maxilliped (fig. 10*e*) is also similar to that of *P. aestheticus*. The terminal segment continues into a short hook-like process. A finely spinulose hooked spine parallels the posterior (medial) side of this process (and is thus very difficult to resolve except in certain views), and a small element (with no proximal denticle) is borne dorsally between their bases. Two short setae on the medial surface of the second segment complete the armature. The outer and posterior faces of the second segment are clothed with fine spinules.

The postoral protuberance is not particularly prominent and is not differentiated laterally in ventral view.

The segments of legs 1–4 (figs. 11*a, e, h, j*) are more rounded than in the 2 preceding species. The endopod of leg 4 has an entire or slightly sinuate outer margin. The inner margin has a prominent dip near the base. The greatest width of the endopod is near the middle, where it becomes about 2/5 of the length. The base is very narrow, so that the outer margin appears expanded proximally.

The only differences from the armature of *P. pectinifer* (p. 20) are the absence of a spine on the third exopod segments of legs 2 and 3, so that the formula for these segments becomes II I 5. Peculiarities in the ornamentation are: the shorter, heavier hairs along the 2 spine-like setae on the third endopod segment of leg 1 (figs. 11 a, d); the flanged spines (fig. 11*b*) only on the last 2 exopod segments of leg 1 and in the middle of the group on the last exopod segment of leg 2; the ventrally inset position of the spine on the first exopod segment of each leg, and the small area edged with spinules on the ventral side of this exopod segment (fig. 11*i*); the covering of fine spinules on the outer side of all the exopod segments (except the last of leg 1) and of the leg 4 endopod. There are also hairs on the inner side of the basis of legs 1–3, on the outer side of the leg 1 endopod, on both sides of the endopods of legs 2–4, and (a particularly strong group) on the inner side of the first exopod segment of all the legs. Scattered hairs may also occur on the inner sides of the second and third endopod segments. With the sharply decreasing width of the pedigerous segments, the legs come to insert more and more laterally, even though the trend for widening intercoxal plates is not as strong as in the preceding 2 species.

Leg 5 (fig. 10*f*) is represented by 3 setae on either side of the

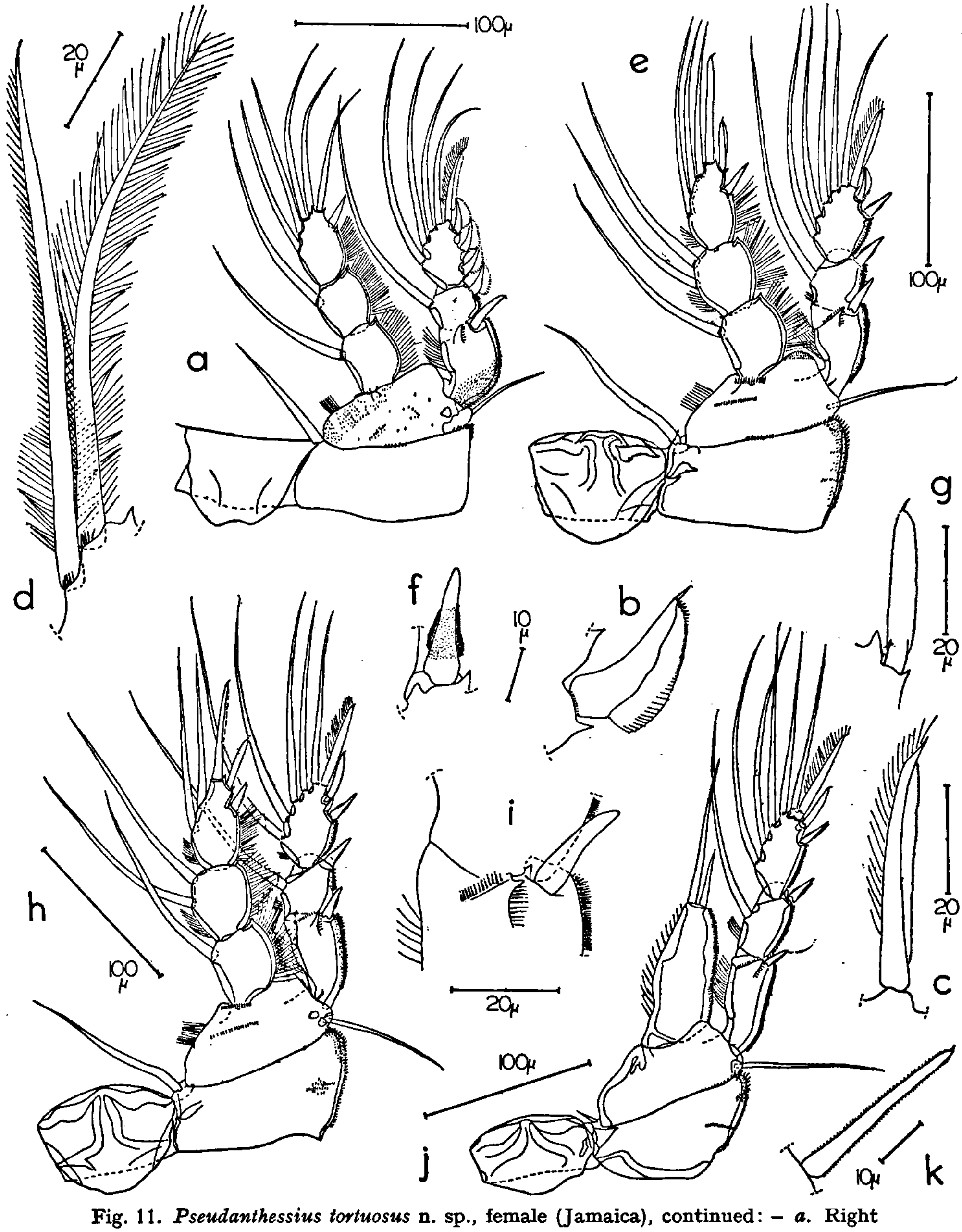


Fig. 11. *Pseudanthessius tortuosus* n. sp., female (Jamaica), continued: – *a*. Right leg 1, ventral. – *b*. Enlargement of middle spine on outer side of third exopod segment of this leg. – *c*. Enlargement of terminal spine on the same exopod segment. – *d*. Enlargement of second and third setae from base on third endopod segment of this leg 1. – *e*. Right leg 2, ventral. – *f*. Enlargement of spine on second exopod segment of this leg 2. – *g*. Enlargement of middle spine on third endopod segment of this leg 2. – *h*. Right leg 3, ventral. – *i*. Enlargement of junction between first and second exopod segments of this leg 3. – *j*. Right leg 4, ventral. – *k*. Enlargement of outermost spine on endopod of this leg 4. (In figs. 11*a*, *e*, *h* and *j* the ornamentation of the setae is omitted).

urosomal segment; leg 6 (fig. 10*g*), by the lobe bearing 2 setules flanking a spinous process, just above the genital openings.

The length of each caudal ramus (fig. 10*h*) is slightly more than 3 times its greatest width, and about 1¼ times the length of the anal segment. All the caudal setae are smooth.

Male. – The body (fig. 12*a*) is smaller than that of the female, and the cephalosome proportionately even less inflated than in *P. pectinifer* and *P. aestheticus*, the length being 0.64 mm (range, 0.60–0.66 mm), the maximum width 0.26 mm (0.25–0.27 mm), and the height 0.13 mm (0.12–0.15 mm), all based on 10 specimens. The tergal plates are all close-set. The urosome comprises 6 segments. The genital segment is intermediate in shape between those of *P. pectinifer* and *P. aestheticus*. Spermatophores (fig. 12*c*) are like those of *P. aestheticus*.

The rostrum, mandible, first and second maxillae, postoral protuberance, legs 2–5, and caudal rami are very similar to those of the female but are proportionately smaller. On the first antenna there is a small aesthete at the distal end of the second segment (fig. 12*d*). Comparison of this figure with fig. 9*e* indicates that this aesthete is not a modified seta. The first antenna is otherwise like that of the female but, as usual, slightly smaller. The segments of the second antenna (fig. 12*e*) are somewhat narrower in relation to their length than those in the female, and the ornamentation of the second and third segments is stronger. The armature is the same in number and type of elements.

The labral lobes (fig. 12*f*) have smoothly rounded tips which extend posteriorly. The base of the metastomal area is obcordate.

The second segment of the tetramerous maxilliped (fig. 12*h*) is slightly inflated and strongly expanded on the medial side, in relation to those of *P. pectinifer* and *P. aestheticus*. This segment bears 2 small setae mediodorsally. In addition, there is an extensive patch of strong spinules along the medial surface, a smaller patch of spinules on the anterodorsal surface, and a sheet of minute spinules ventrally. The dactylus carries a strong acuminately-tipped seta proximally on the ventral side and a minute element posteriorly above it. The tip of the dactylus is not modified.

The second and third segments of the leg 1 endopod (fig. 12*i*) are

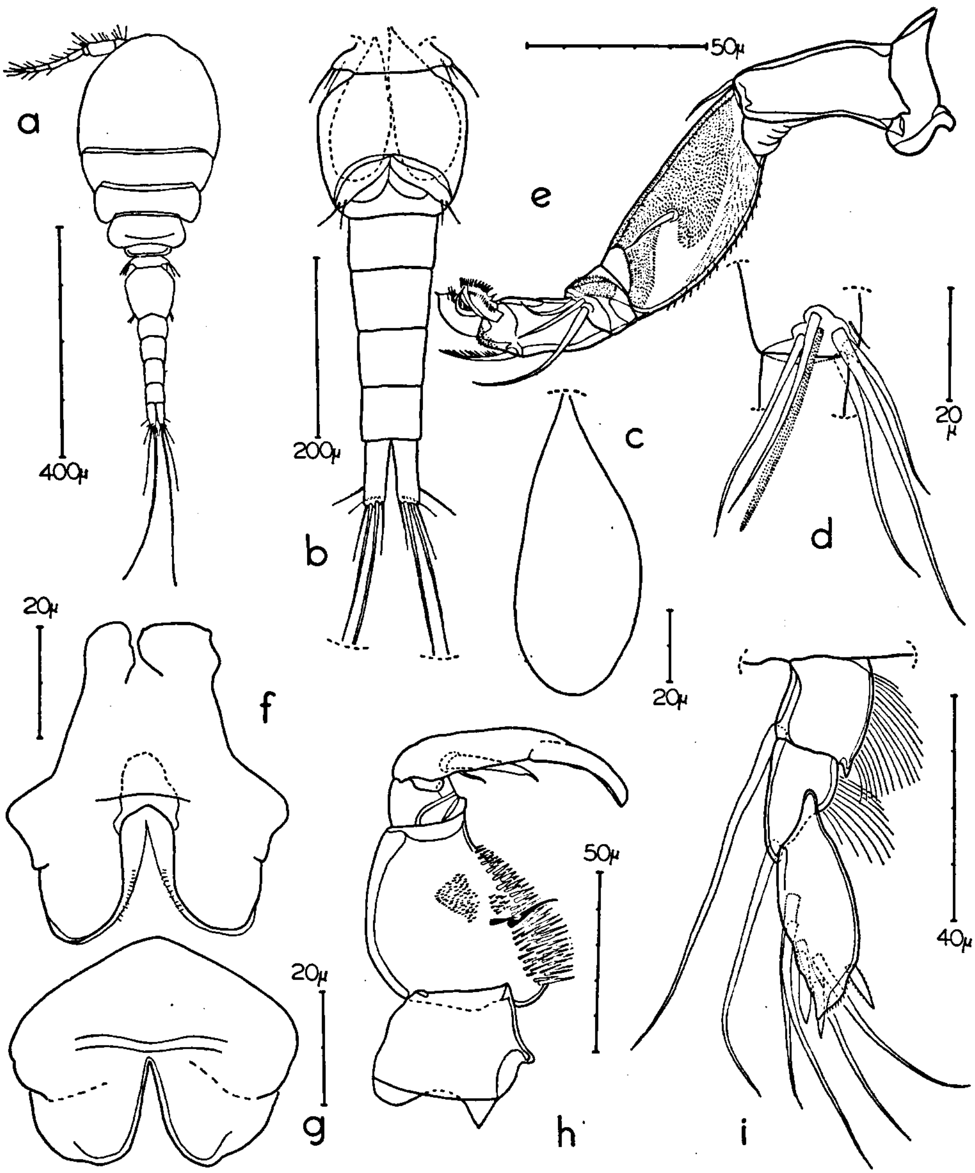


Fig. 12. *Pseudanthessius tortuosus* n. sp., male (Jamaica): – *a*. Habitus, dorsal. – *b*. Urosome, ventral. – *c*. Spermatophore from left side of genital segment, ventral. – *d*. End of second segment of left first antenna, posteroventral. – *e*. Right second antenna, ventral (some terminal elements omitted). – *f*. Labrum, anteroventral. – *g*. Metastome, ventral (from a different specimen). – *h*. Left maxilliped, anterodorsal. – *i*. Endopod of left leg 1, ventral.

elongate and slightly twisted so that the elements originate on the dorsal (posterior) side. The armature of the third segment is III 4 instead of I 5 but, as in *P. aestheticus*, the homologies of the distal elements with those of the female are not clear. The outer side of the third endopod segment lacks a row of hairs.

Leg 6 (fig. 12*b*) is similar to that of the preceding species but lacks a spinous process thus comprising only the 2 subterminal setae.

Developmental stages. – Copepodids between the first (*i.e.*, a stage carrying 2 pairs of legs and a rudimentary third) and the adult occured in some of our collections. Their anatomy will not be analyzed here.

Biology. – Some adult males (about 8% of the preserved specimens) were found grasping copepodids of stages III–V. The posture was the same in all cases; the 2 animals were oriented in the same direction, the cephalosome of the male lying over the copepodid's urosome. The copepodid was grasped around the fifth pedigerous segment by the male's maxillipeds, the tips of the dactyli crossing so that each lay on a different side of the copepodid's body and was buttressed posteriorly against the swelling of leg 5. The second antennae of the male curved around ventrally and appeared to hold the body of the copepodid in place.

It is not unusual to find some adult male lichomolgids (and other copepods) grasping copepodids as well as adult females. So far as we know, however, this is the first time a species of *Pseudanthessius* has been reported to show amplexus at a time other than that immediately preceding the transfer of spermatophores. Such behavior may be of interest in relation to the persistent association of adults of the 2 sexes in *Meomicola amplectans* (see p. 69), but in *P. tortuosus* only copepodids are grasped.

Many females from each collection were ovigerous.

The main discussion of host relations in *P. tortuosus* and *P. aestheticus* is deferred to a later paper in which 2 other lichomolgids associated with amphinomid polychaetes will be described. Further morphological points will also be considered at that time. It may be said here that *P. tortuosus* appears to be associated with *Hermodice carunculata* throughout the West Indies and may also

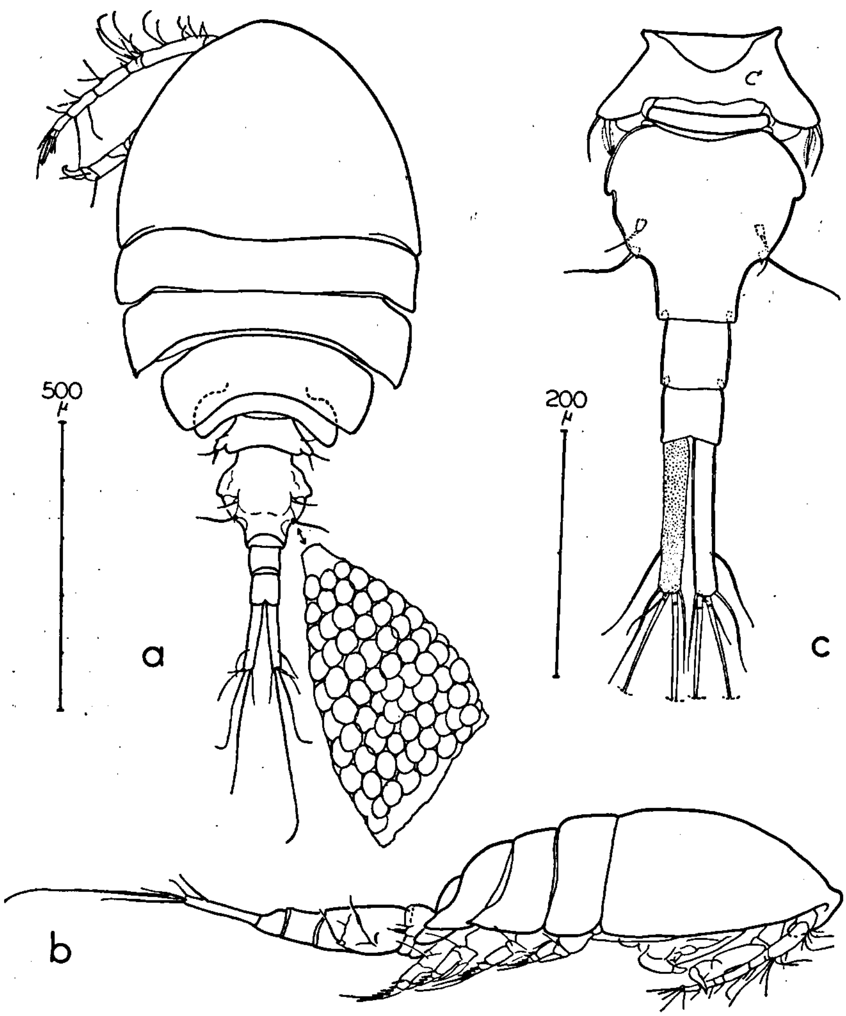


Fig. 13. *Pseudanthessius deficiens* n. sp., female (Curaçao): – *a*. Habitus, dorsal. – *b*. Habitus, right side (to same scale as *a*). – *c*. Urosome (isolated), ventral (dorsal seta of leg 5 omitted).

utilize *Eurythoe complanata* as a host even where the 2 polychaetes coexist.

Remarks. – *P. tortuosus* appears to be an even more distinctive species than *P. pectinifer*. To some extent, it shares characters with *P. nemertophilus* Gallien and *P. latus* Illg, notably in the structure of the fourth endopod and, to a lesser degree, of the second antenna, but it appears probable (from evidence which will be discussed in a later paper) that these are adaptive. In fact, it is the detailed structure of the second antenna, particularly the modified terminal elements, which constitutes the easiest character for distinguishing this from other species of *Pseudanthessius*. Other characters are the shape of the first antenna, the ornamentation of the second maxilla, the female maxilliped, and legs 1–4, and the structure of many elements on these legs, of the male metastome, and of the maxilliped.

Pseudanthessius deficiens n. sp.

(Figs. 13–19)

Type material. – CURAÇAO: (1) 30 copepods from 3 specimens of the brittlestar *Ophioderma cinereum* Müller & Troschel (Ophiuroidea, Ophiodermatidae), western extremity of Fuikbay (12°03′00″ N, 68°51′00″ W), in sand under stones at about 1 m depth of water, December 3, 1958; (2) 3 females, 1 male, 1 copepodid from 1 specimen of the same host in the same locality, in about ½ m of water, January 27, 1959; both collected by J.H.S. – Holotype female chosen from the second collection and deposited in the Zoölogisch Museum, Amsterdam (ZMA Co. 100.636*a*), together with specimens from both collections (ZMA Co. 100.637*a–b* and -636 respectively). Eight paratypes (4 females) from the first sample placed in the United States National Museum, Washington; 2 in the collection of A. G. Humes.

Other specimens. – From *Ophioderma cinereum*, CURAÇAO: 2 males, 1 copepodid from 1 host, in about 3 m, October 21, 1958 (ZMA Co. 100.638); 1 male from 1 host, in about 2 m, November 20, 1958 (ZMA Co. 100.639); 1 male from 1 host, in about 3 m, January 8, 1959 (ZMA Co. 100.640); all at Piscadera Bay. – 4 males from 1 host, Awa di Oostpunt, in about 2 m, November 2, 1958 (ZMA Co. 100.641). Collected by J.H.S. – ST. MARTIN: 1 female from 9 hosts, Pointe Bluff, under stones in 0.1–0.3 m, February 7, 1959 (ZMA Co. 100.642), collected by J.H.S. – PUERTO RICO: 1 female from 4 hosts, off Magüeyes Island, reef between Caballo Ahogado and shore to the north, August 23, 1959; collected by A.G.H. and R.U.G. – From *Ludwigothuria mexicana* (Ludwig) (Holothurioidea, Holothuriidae), CURAÇAO: 3 females, 2 males, 3 copepodids from several specimens of the host, Fuikbay, in about 3 m, December 3, 1958 (ZMA Co. 100.643); collected by J.H.S. This single collection from a holothurian probably represents contamination.

Drawings, with the exception of fig. 14*a* are of specimens from Curaçao.

The specific name *deficiens* (Latin = lacking) refers to the reduced number of urosomal segments.

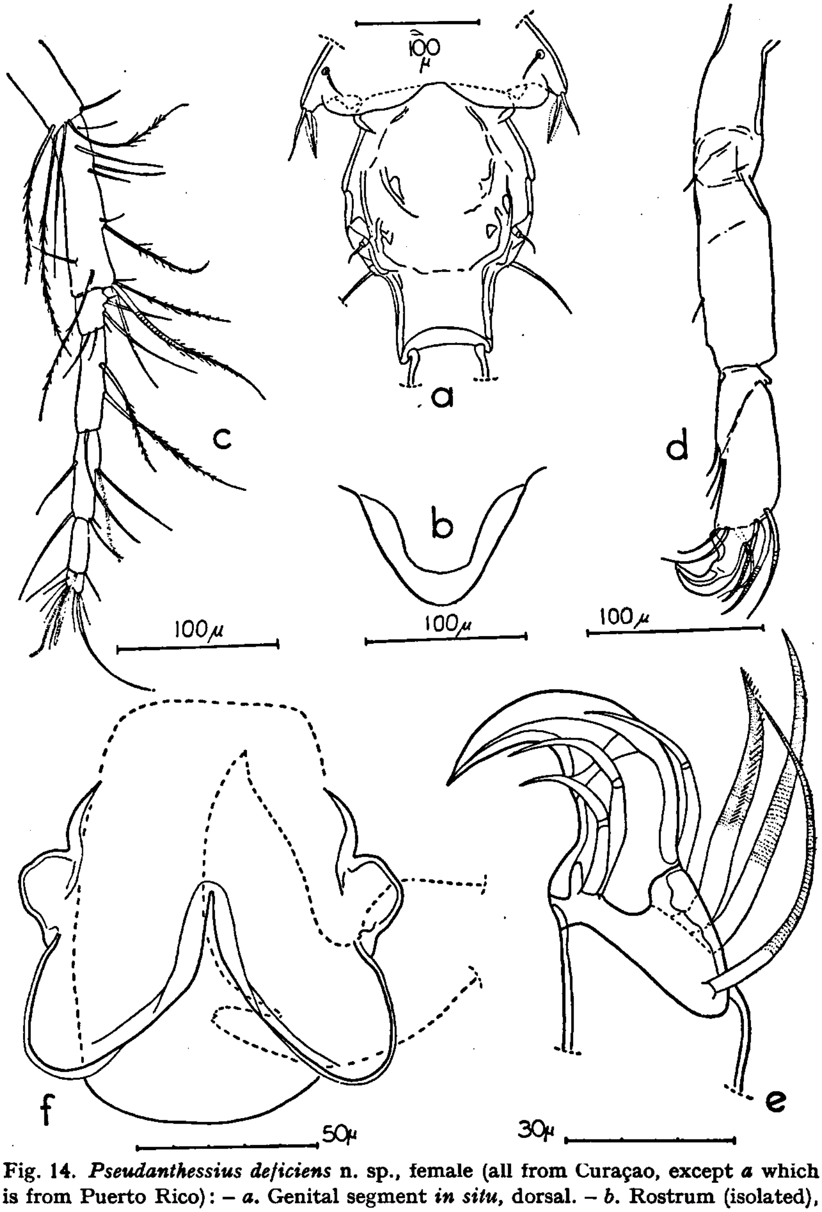


Fig. 14. *Pseudanthessius deficiens* n. sp., female (all from Curaçao, except *a* which is from Puerto Rico): – *a*. Genital segment *in situ*, dorsal. – *b*. Rostrum (isolated), ventral. – *c*. First antenna. – *d*. Second antenna, medial (dorsal.) – *e*. Distal end of left second antenna, medial (dorsal). – *f*. Labrum and metasomal area, ventral *in situ* on isolated cephalosome (dashed outline continuing metasomal area on left side and top of figure also indicates limits of supralabral cavity; partial outline of left mandible dashed on right).

F e m a l e. – The body length (without caudal setae) of specimens from Curaçao and St. Martin varied between 0.975–1.30 mm; the width, at the level of the first pedigerous segment, averaged 0.53 mm ($\pm$ 0.01 mm), and the height, 0.24 mm (0.20–0.26 mm), both in 5 specimens. These measurements for the specimen from Puerto Rico, however, were 1.5, 0.72, and 0.30 mm respectively.

A difference also occurs in the thickness of the exoskeleton; this is very thin in all but the Puerto Rican female (*cp.* fig. 13*c* with 14*a*). A feature of the cuticle in all specimens is the presence of numerous fine spots; this condition is particularly noticeable on the caudal rami (figs. 13*c*), where the spots are largest, but, depending on the clarity of the specimen, can be seen to extend to the rest of the urosome and even to parts of the prosome (dorsum, ventral side of the cephalosome, and tergal plates), the spots becoming increasingly minute anteriorly. Whether these spots represent gland openings or a particular pattern of cuticular deposition could not be determined, but the latter explanation seems more likely. An elongate patch of small tubercles follows each ventrolateral margin of the cephalosome to the first pedigerous somite.

Color in life: the small eye has a faint reddish tint; body transparent and colorless; intestine whitish; ovaries and ovisacs cream-colored.

The prosome is somewhat expanded (fig. 13*a*), being less than $1\frac{1}{2}$ times as long as wide, and dorsoventrally flattened (fig. 13*b*). The somite of leg 1 is more distinctly separated from the head than in the other West Indian species, but still does not form a functional unit. The rounded margins of the tergal plates on the second and third pedigerous segments are indistinctly crenulated, and their free corners each produced to a point. The last tergal plate is largely concealed by the one preceding it.

The urosome (fig. 13*c*) is interesting in having only 4 segments. Its length, relative to that of the prosome, is about 1 : 1.7. The fifth pedigerous segment bears a pair of small dorsal posterior flanges. A ventrolateral sclerite separates the fifth pedigerous and genital segments. The lower part of the sides of the genital segment is expanded laterally at the anterior end, the middle of each expansion being produced into a small rounded posterior process (fig. 13*c*).

In the Puerto Rican specimen, the degree of expansion, particularly proximally, is much less, so that the mediolateral processes are hardly noticeable (*cp.* fig. 13*c* with 14*a*). There are 2 setae at either posterior corner of the expanded portion, each at the head of a depression (fig. 17*b*): the anterior depression probably being the one into which spermatophores are inserted, the posterior one containing the opening of the oviduct. Ovisacs were broken in all available specimens; they probably are of fairly large size, sausage-shaped, and contain numerous rather small eggs (fig. 13*a*). The posterior part of the genital segment is tubular and much narrower than the anterior part. The third urosomal segment is slightly larger than the anal segment. As in all the preceding species, a ventrolateral line of minute spinules extends along the posterior border of the anal segment.

The rostrum (fig. 14*b*) is similar to that of *P. aestheticus*, but is set off from the anterior end of the cephalosome by a slight indentation dorsally (fig. 13*b*). In a more posterior view than that of fig. 14*b*, the tip appears bilobed.

The segments of the first antenna (fig. 14*c*) decrease in length in the order 2, 1, 4, 5, 6, 3, 7. The armature (proximal to distal segments) is: 4, 13, 6, 3, 4 setae and 1 aesthete, 2 setae and 1 aesthete, 7 setae and 1 aesthete. The extra small element on segment 3 inserts near the basal seta. As in the other West Indian species, the third segment is partially subdivided, the basal portion carrying the 2 proximal elements; and some elements on the distal portion of the second segment and on the third segment are very small. The aesthetes are inconspicuous.

The maximum length of the fourth segment of the second antenna (fig. 14*d*) is slightly more than 3 times its greatest diameter. The setae on the first and second segments are rather small. The structure of the 7 terminal elements (fig. 14*e*) is as follows: 3 of the 4 claws are very small, the fourth enlarged into a powerful hook, all jointed; 2 stout setae, one with a row of spinules, occur just behind the end on the outer (anterior) face dorsally; and a single seta is somewhat more proximally placed on the inner face.

The labrum and metastomal area (fig. 14*f*) are similar to those of the other species. A small unornamented lobe (paragnath?) lies medial to the base of each first maxilla.

The mandible (fig. 15*a*) resembles that of *P. aestheticus*, being represented mainly by the short, wide, acutely pointed blade, which shows some signs of a division from the base. On its medial side, however, the blade has a wide, rather foliaceous and terminally bilobed process which extends somewhat dorsally. The processes from the pair of mandibles meet in the midline (*cf*. fig. 14*f*). On the outer side the blade carries the usual row of spinules, here borne on a slight flange.

The first maxilla (fig. 15*b*) is rather wider than in the other West Indian species, and bears an inner as well as the 3 terminal setae. The medial terminal seta is the longest.

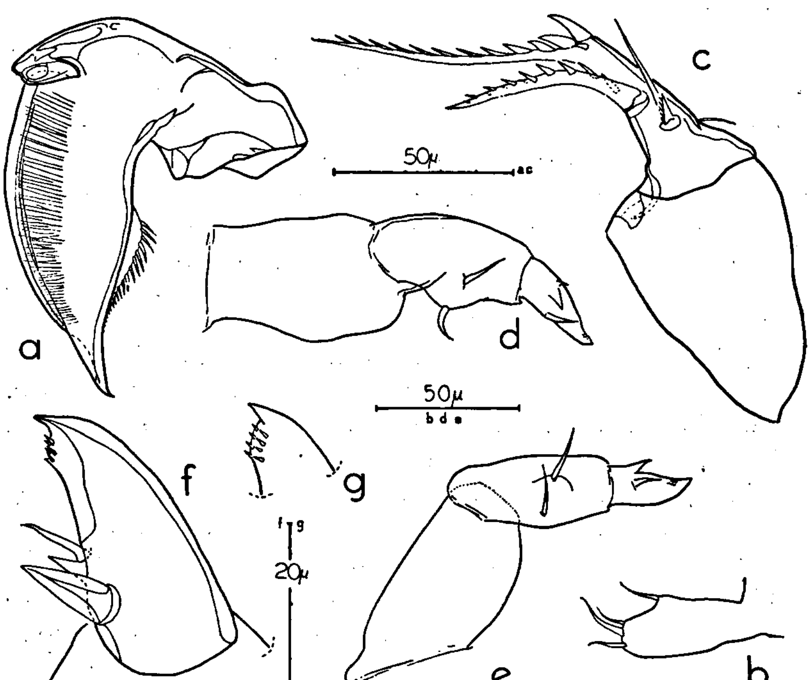


Fig. 15. *Pseudanthessius deficiens* n. sp., female (Curaçao): – *a*. Left mandible, dorsal. – *b*. Left first maxilla. – *c*. Left second maxilla, dorsal. – *d*, *e*. Maxilliped of 2 different specimens, in different positions. – *f*. Distal segment of left maxilliped, ventral and slightly anterior. – *g*. End of same, more medial.

The distal segment of the second maxilla (fig. 15*c*) is prolonged into an apical lash and bears 3 additional elements. The first 2 teeth of the medioventral row on the apical lash are somewhat enlarged; a small dorsal tooth lies near their bases. The lash-like element on the dorsal segmental surface is much shorter and slightly stouter than the apical lash, with a medioventral row of spinules along its length and a shorter outer row near the tip. A relatively long seta arises in very close association with a short spinulose scale (*cf.* the flange of spinules in *P. aestheticus*) lying more proximally on the posterior surface; this seta does not appear to be ornamented. Still nearer the base of the second segment and more ventral there is a slender inconspicuous seta, apparently lacking in all other species of *Pseudanthessius.*

The setae on the inner and dorsal surfaces of the second segment of the maxilliped (figs. 15*d–e*) are approximately equal in size. The last segment does not extend into the hook-like process which characterizes the other West Indian species but ends in a small point; a medial flange, which carries a row of spinules on either side, lies subterminally. Nearer the base a stout spine ventral to, and a small seta inserted on a denticular process dorsal to, the inner side of the last segment complete the armature (fig. 15*f*).

The postoral protuberance and the sclerites between the legs are similar to those of the other West Indian species.

Legs 1–4 are illustrated in figs. 16*a–d*. The armature is the same as that of *P. pectinifer* (p. 20); there is little ornamentation. Noteworthy features are: the size of the spine on endopod segment 3 of leg 1, the small but prominent process on the inner side of the basis in legs 2–4, and the shape of the endopods. The endopod of leg 4 (fig. 17*a*) is usually slightly less than 5 times as long as wide; the inner edge is relatively straight, with a small pointed process at the distal end; the outer edge is divided into 2 nearly equal portions by a small, acutely pointed process (actually situated at about 41% of the distance along the inner length of the leg). These portions of the outer edge may have almost straight or slightly convex borders; their ornamentation is heavier than that along the inner edge. In some specimens there is a pointed process at the distal end of the outer edge.

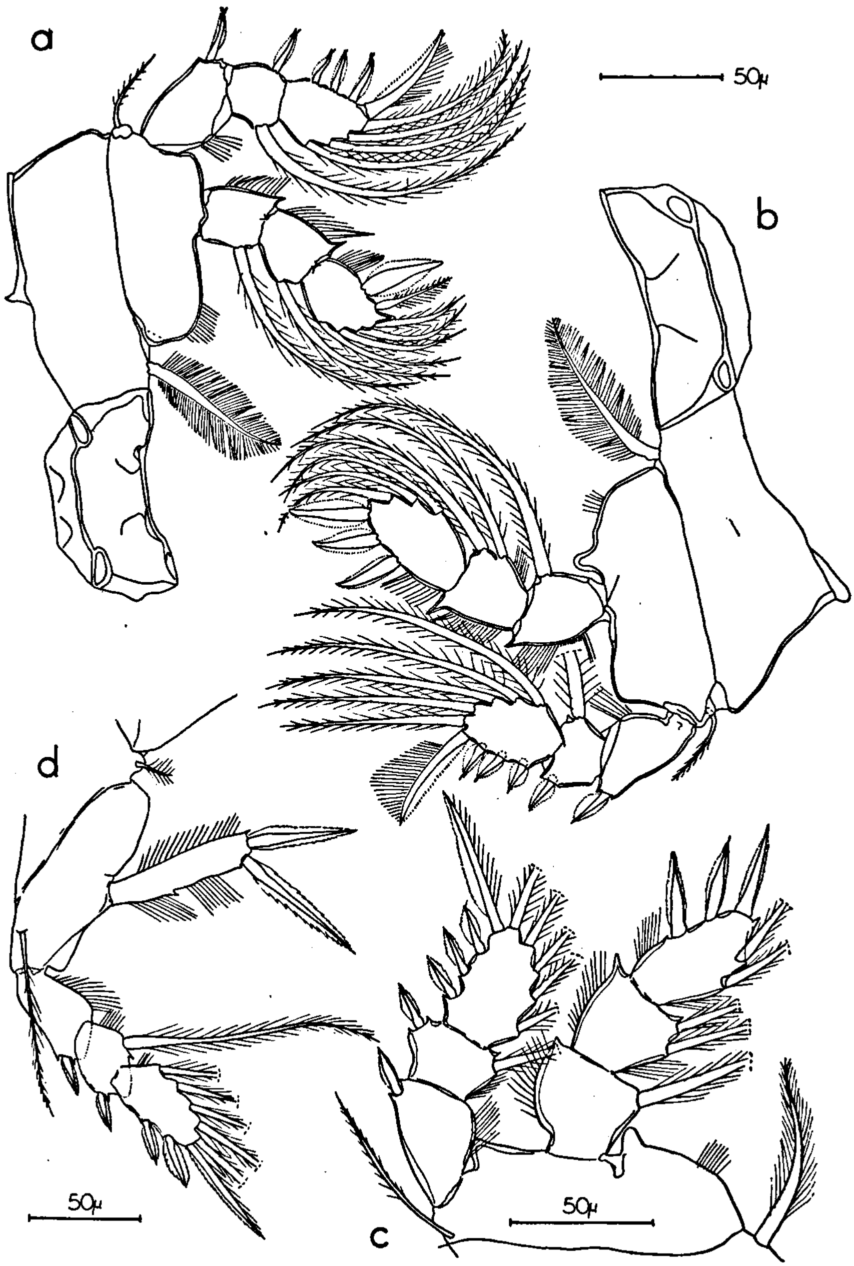


Fig. 16. *Pseudanthessius deficiens* n. sp., female (Curaçao): – *a*. Left leg 1 and intercoxal plate, ventral. – *b*. Left leg 2 and intercoxal plate, ventral (to same scale as *a*). – *c*. Left leg 3, ventral. – *d*. Right leg 4, ventral.

Leg 5 (fig. 17*b*) is armed with 2 rather short setae and a spine. The 2 setae of leg 6 are each borne on a small papilla. The anterior seta is hirsute. Associated with the base of the posterior seta there is a small denticular process; the latter is reduced in the Puerto Rican specimen. This separation of the 2 elements of leg 6 is reminiscent of the condition in *Octopicola.*

The caudal ramus (fig. 17*c*) varies from about 6.66 times as long as wide to nearly 8.5 times (in the Puerto Rican specimen) and is 2.5 times the length of the anal segment. Besides the spotted cuticle, the ornamentation of the ramus includes a line of minute spinules along the ventral posterior border and sometimes a few scattered hairs along the inner surface. All but the more distal of the outer setae are inserted dorsally and the 4 innermost setae are hirsute. The proximal outer seta is inserted at about 72% of the distance along the ramus.

Male. – The body (fig. 17*d*) is smaller than that of the female. The length varies between 0.7 and 0.8 mm, the width 0.35 mm ($\pm$ 0.01 mm; 3 specimens) and height 0.13 mm ($\pm$ 0.01 mm; 3 specimens). The cuticular spotting is less pronounced. The tubercles on the ventrolateral border of the cephalosome are absent, but the sides of this tagma are crenulate. The body sometimes exhibits a slight orange hue.

The urosome (fig. 17*e*) is 5-segmented. The genital segment is similar in shape to that of *P. tortuosus*. The spermatophores are large, filling the genital and most of the fifth pedigerous segments. The first 2 postgenital segments are nearly the same size.

The rostrum is somewhat more obviously bilobed apically than in the female.

As in *P. tortuosus*, the first antenna (fig. 18*a*) carries a single additional aesthete distally on the ventral side of segment 2. The aesthetes on segments 5 and 6 are relatively rather longer than in the female. The setae on the first and second segments of the second antenna (fig. 18*b*) and the 3 reduced terminal claws are similarly larger. The terminal seta on the third segment is much larger and jointed like the terminal claws.

The mandibular blade (fig. 17*f*) is relatively narrower, as is the process at its base. The latter is not terminally bilobed. The spinules

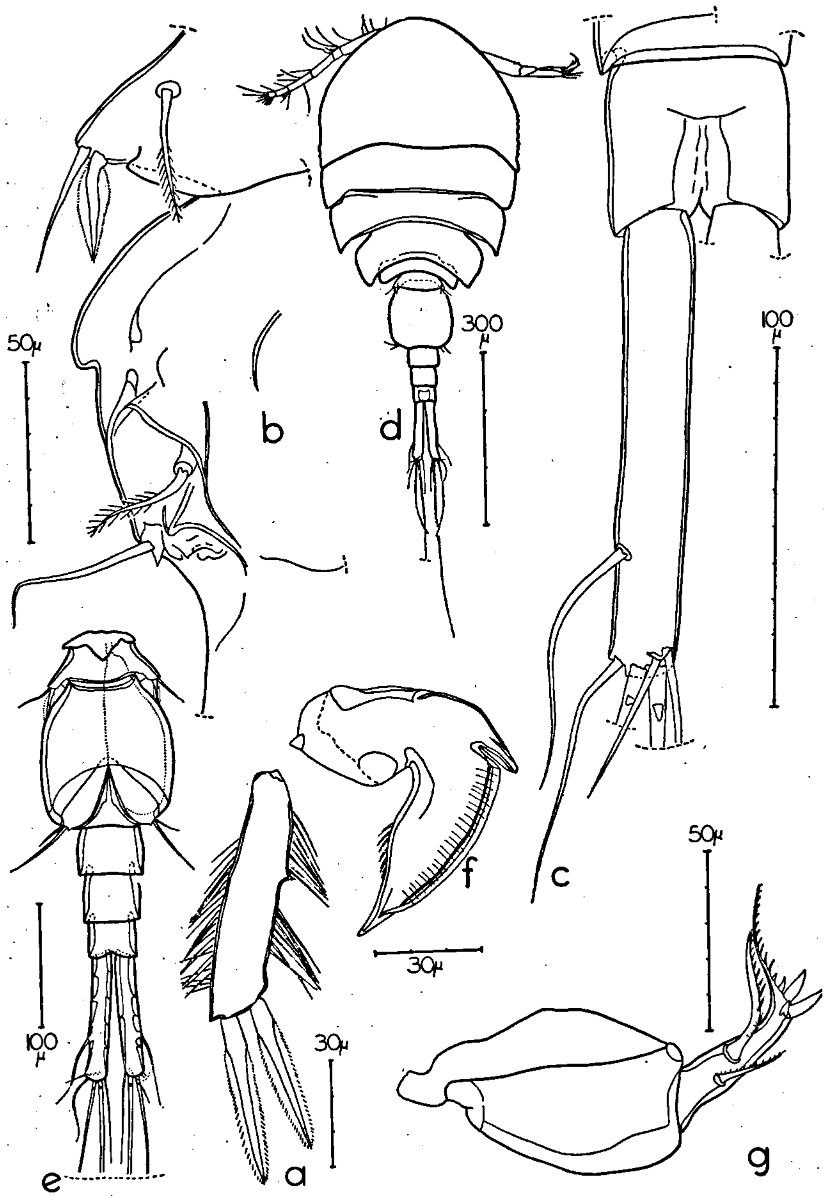


Fig. 17. *Pseudanthessius deficiens* n. sp., *a–c*, female; *d–g*, male (Curaçao): – *a*. Endopod of left leg 4, ventral. – *b*. Left legs 5 and 6 *in situ*, dorsal. – *c*. Anal segment and left caudal ramus, dorsal. – *d*. Habitus, dorsal. – *e*. Urosome (isolated from body), ventral (dorsal seta on leg 5 omitted; spermatophore indicated by dotted line on right side of figure). – *f*. Left mandible, ventral. – *g*. Left second maxilla, dorsal.

on the outer side are much fewer than in the female and not borne on a flange. The proximal 2 teeth and the dorsal tooth on the apical lash of the second maxilla (fig. 17*g*) are relatively larger. The scale at the base of the long seta is absent and this element bears strong hairs. The fourth element on this segment of the second maxilla does not appear to be present.

The maxilliped (figs. 18*c–d*) is somewhat similar to that of *P. pectinifer*, but the dactylus is much longer, occasionally reaching to the insertion of leg 4. Segments 2 and 3 are reflexed on segment 1 as in the female. There are 3 groups of spinules on the medial side of segment 2, one strong. The 2 setae on this segment are, as usual, rather inconspicuous and placed on either side of the most dorsal patch of spinules. A small seta lies on the dorsal side at the base of the fourth segment (almost on the articular membrane) and a large spine somewhat more distally on the ventral side. A narrow membranous flange follows the inner curvature of the dactylus, expanding slightly at the tip.

Although legs 1–4 are generally smaller than those of the female, the first 3 endopods are of approximately the same length (*cp.* fig. 18*e* with 16*b*) and their armature is slightly modified. The last 2 segments of the leg 1 endopod (fig. 19*a*) are virtually fused; the outermost element on segment 3 is smaller; the element next to it has been transformed into a spine; and the succeeding 2 elements are spiniform setae. In legs 2 (fig. 18*e*) and 3 (fig. 19*b*) the terminal endopod setae show signs of modification into spines and the spines are stouter. The setae on the coxa and basis of leg 4 are relatively smaller than in the female. The endopod of this leg is shorter as well as narrower, but, since the 2 portions of the outer side are somewhat more convex, the length: width ratio is only about 3.33 : 1. The proximal process on the outer side of the ramus is smaller.

Leg 6 (fig. 17*e*) consists of the usual ventrolateral flaps at the posterior end of the genital segment, each bearing 2 setae and a minute spinous process.

The length: width ratio of the caudal ramus is about 6.5 : 1.

Developmental stages. – The major point of interest furnished by the developmental stages available is the fact that elongation of the caudal rami occurs at the molt between what we presume to be the Copepodid V and the adult. In the former

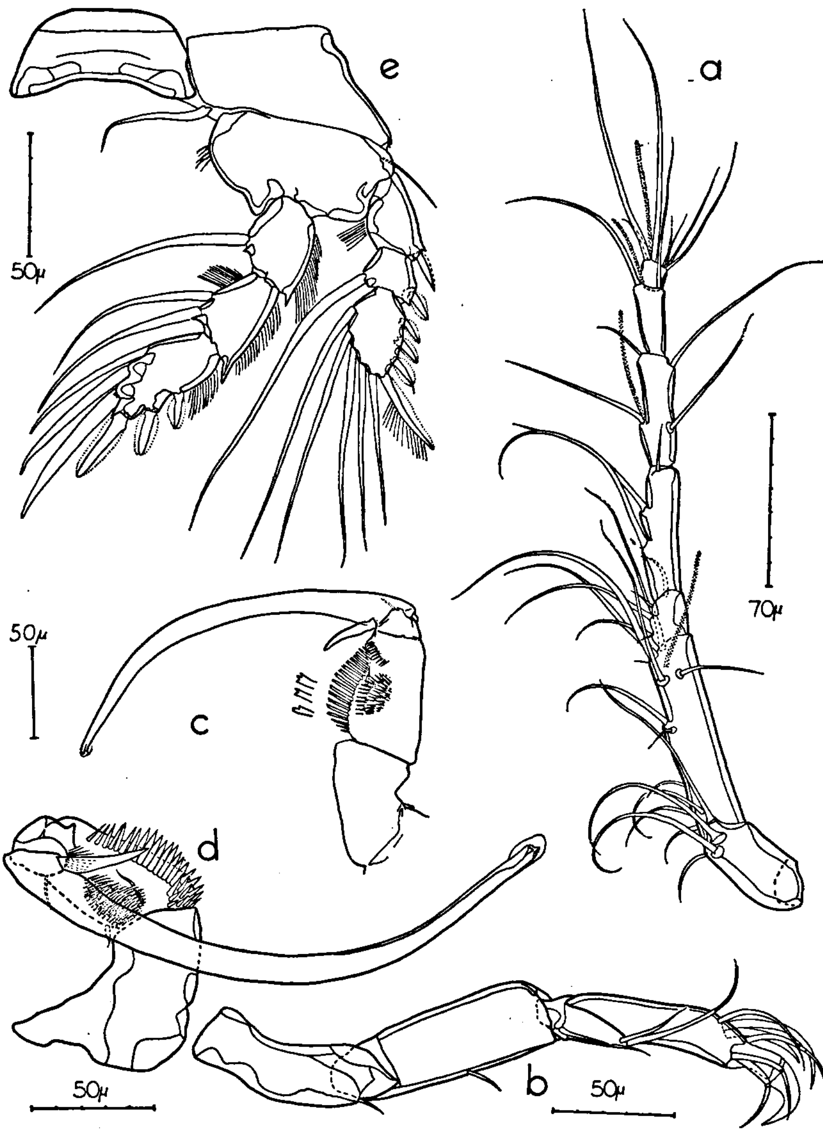


Fig. 18. *Pseudanthessius deficiens* n. sp., male (Curaçao): – *a*. Left first antenna, dorsal (lateral). – *b*. Right second antenna, medial (dorsal). – *c*. Maxilliped, flattened under cover glass. – *d*. Left maxilliped, medial (exoskeletal thickening of second segment and dactylus omitted). – *e*. Left leg 2 and intercoxal plate, ventral (ornamentation of all setae omitted).

stage the ramus is about 3.5 times as long as wide (fig. 19*d*). Since the proximal outer seta inserts in almost the same relative position in the Copepodid V, the Curaçao and Puerto Rican adults, despite considerable differences in relative length of the ramus, it is clear that the major elongation must take place over the whole length.

Biology. – This species seems to be a specific and relatively constant associate of *Ophioderma cinereum*. It was not found on any other of the 15 ophiuroid species examined in the West Indies. The single collection from the holothurian *Ludwigothuria mexicana* probably represents contamination, since the copepod occurred abundantly on *O. cinereum* from the same locality, collected on the same day.

Remarks. – As indicated in the key, only one other species of the genus agrees with *P. deficiens* in the reduction of the number of urosomal segments, *viz.*, *P. dubius*. This is a most unusual phenomenon in the family Lichomolgidae, where the number of body

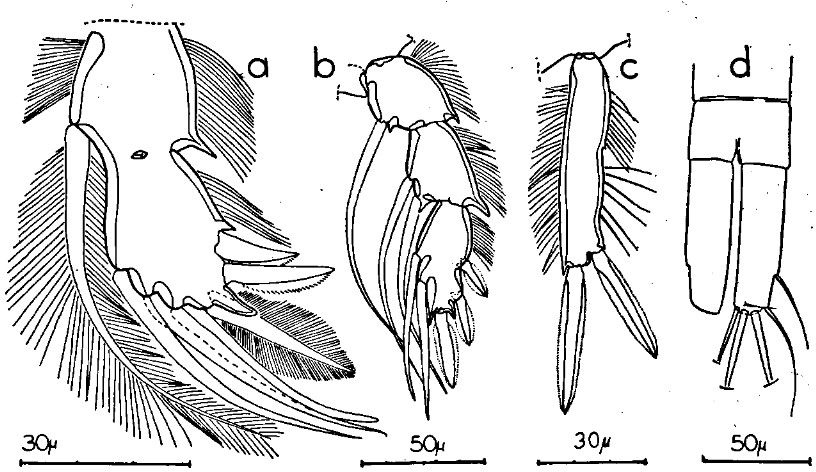


Fig. 19. *Pseudanthessius deficiens* n. sp., *a–c*, male; *d*, 5th copepodid (Curaçao): – *a*. Last two endopod segments of left leg 1, ventral (ornamentation of three proximal setae on segment 3 omitted). – *b*. Endopod of left leg 3, ventral (ornamentation of all setae omitted). – *c*. Endopod of left leg 4, ventral. – *d*. Anal segment and caudal rami, dorsal (furcal setae omitted on left side).

segments is generally constant. What may be a transitional stage is exhibited by *P. thorelli*, where the preanal segment is very small (see p. 32). The character is of particular interest in reference to the new genus *Meomicola* described below. Since, however, as SARS (1918) has already remarked for *P. dubius*, the remaining characters agree so completely with the other species of *Pseudanthessius*, there is no reason to attribute these 2 forms to another genus.

P. deficiens appears more similar to its Norwegian "relative" than to any other species in several further morphological characters, but differs in a number of characters. (Since *P. dubius* is known from a single female [1]), caught off the west coast of Norway, only characters of this sex can be compared.) In the West Indian species, the prosome is more expanded, with differently shaped segments; the shape of the genital segment (whose subdivision is less well marked) differs, as do the proportions of the other urosomal segments; the largest claw on the second antenna is stronger; the elements on the second maxilla and maxilliped may be more numerous; processes are present on the inner sides of the bases of legs 2 and 3; the setae on the outer sides of the bases of legs 3 and 4 are longer; leg 6 is stronger; and the proximal seta on the outer edge of the caudal ramus is inserted nearer the tip. Nothing is known of the biology of *P. dubius* [1]).

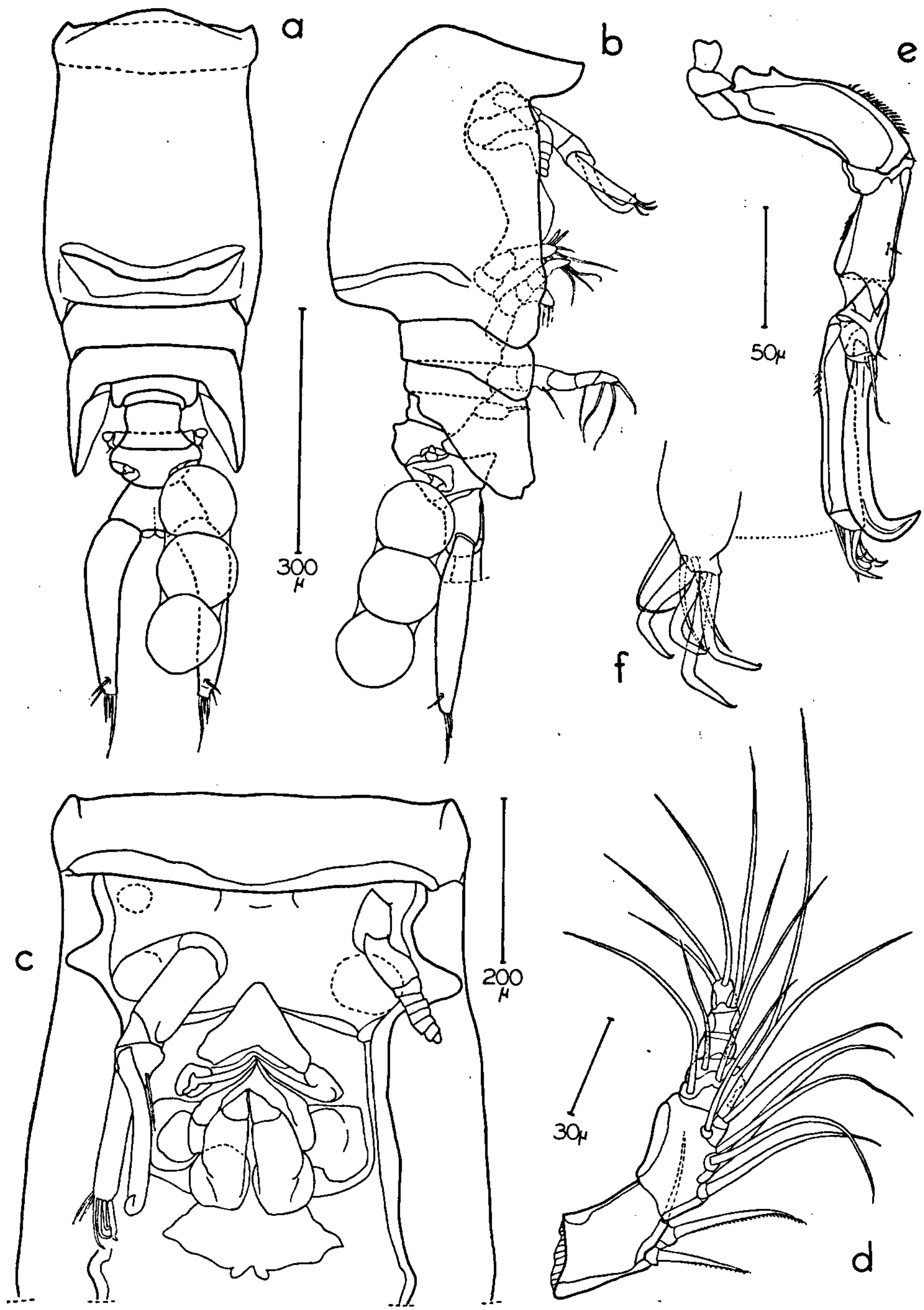
Meomicola amplectans n. g., n. sp.

(Figs. 20–24)

Type material. – JAMAICA: 85 females (4 large type[2]), 227 males (5 large), 1 juvenile from alcohol washings of a single cake urchin, *Meoma ventricosa* (Lamarck), north side of Lime Cay (17°55′0″ N, 76°49′21″ W), off Kingston, in sand at about 5 m depth of water, August 30, 1959; collected by A.G.H. and R.U.G. – Holotype female, allotype male (both small forms), 20 female, 60 male small paratypes and 1 female, 1 male large paratypes (all in alcohol) deposited in the United States National Museum, Washington; 80 small and 2 large paratypes in the Zoölogisch Museum, Amsterdam; the same number of paratypes in the British Museum (Natural History), London; and the remainder in the collection of A. G. Humes.

[1]) BRESCIANI & LÜTZEN (1962, p. 402), in a tabular synopsis "List of Invertebrate hosts and their Copepod parasites at the Swedish West coast", mention *Asterias rubens* as the host for *P. dubius*. This is probably a lapsus, since in their main text (p. 378) they call the species *P. thorelli*.

[2]) Adults of this species are divisible into large and small morphs (see p. 67–68).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Other specimens (all from *Meoma ventricosa*). – JAMAICA: 131 females (2 large), 181 males (1 large), 2 juveniles from 3 hosts, 191 females (3 large), 297 males (4 large), 1 juvenile from 5 hosts, west side of Rackham's Cay, off Kingston, in sand, August 31, 1959; collected by A.G.H. and R.U.G. – CURAÇAO: 19 females (16 large), 10 males (7 large), from 1 host, Santa Marta Bay, in sand at about 4 m depth of water, December 7, 1958; collected by J.H.S. – Large type specimens have been divided between the three institutions mentioned above and the authors' collections.

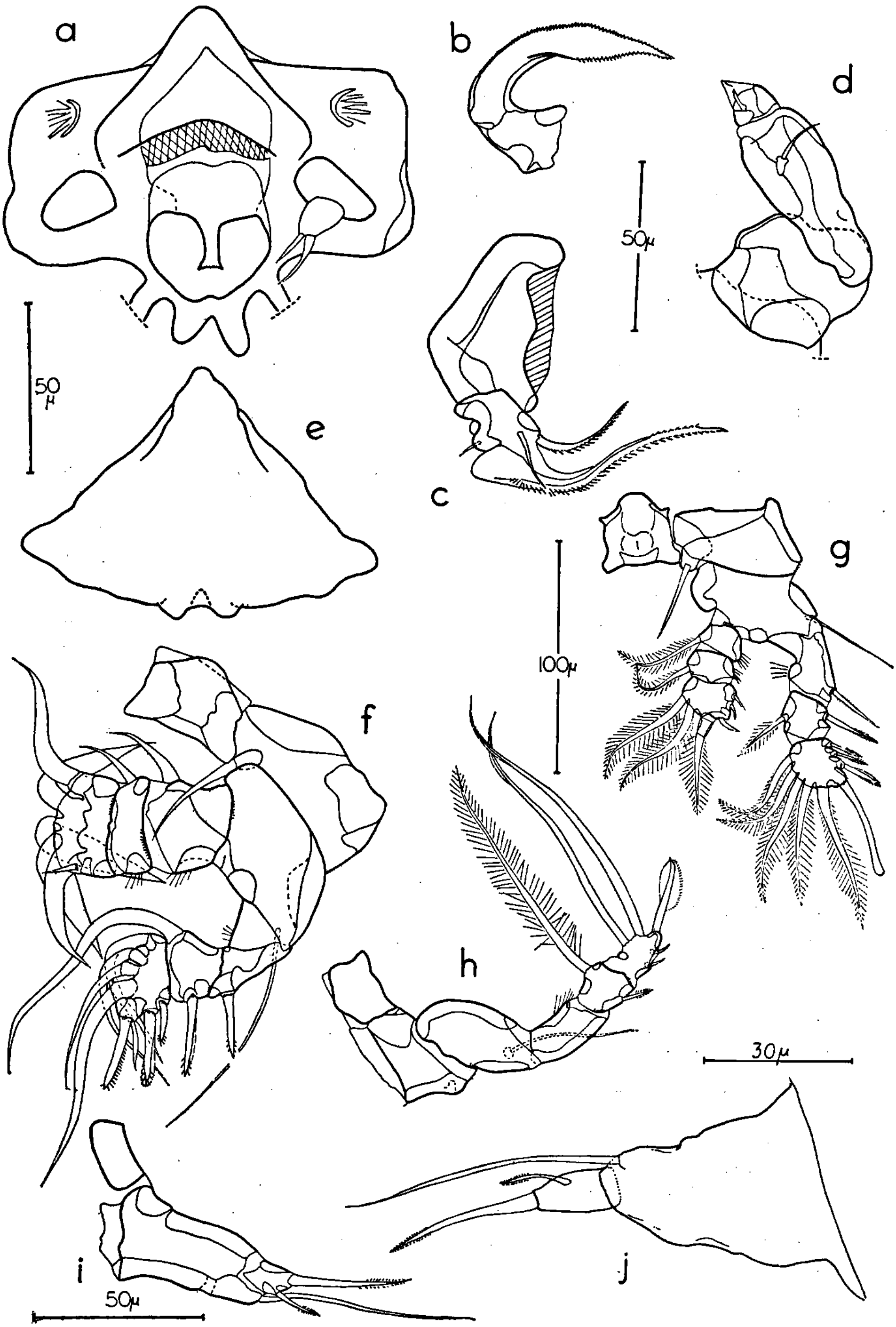
Figs. 20*a–e*, 21, 22*a–b*, 22*d–h*, 23*a–d* have been made from a single paratype of each sex, figs. 23*e–h* from another pair, figs 20*f* and 22*c* from still other specimens. Measurements are from specimens in lactic acid.

The specific name *amplectans* (Latin = clasping) alludes both to the occurrence of many specimens in amplexus and to the numerous prehensile modifications in each sex.

Female. – The body (figs. 20*a–b*), while retaining the basic cyclopoid structure, is somewhat modified. Several characters combine to produce the characteristic habitus. The prosome exhibits the common arrangement of cephalosome (including the first pedigerous somite) and 3 free metasomal segments. The anterior end of the prosome is rather protuberant dorsally but produced ventrolaterally into a pair of "horns" so that in dorsal or ventral (fig. 20*a*) view the anterior edge appears almost flat. Seen anteriorly, the depression between the "horns" is semicircular. Inflation of the cephalosome but not the metasomal segments produces a sharp decrease in height at the posterior end of this tagma. The tergal plates on the first 3 body segments extend ventrally on either side so as to cover the greater part of the appendages in side view. In addition the tergum of the third pedigerous segment is produced posteriorly into a pair of well marked "wings". There is no tergal plate on the fourth pedigerous segment.

The urosome is reduced to 3 segments: fifth pedigerous, genital, and anal. Two sharp bends occur (within the fifth pedigerous segment and at the posterior end of the genital segment) so that, in

Fig. 20. *Meomicola amplectans*, n. g., n. sp., female small form (Jamaica): – *a*. Habitus, dorsal. – *b*. Habitus, right side. – *c*. Anterior part of cephalosome, ventral (semidiagrammatic; right first antenna and left second antenna omitted but their areas of insertion indicated by dashed circles; armature of left first antenna not shown). – *d*. Left first antenna, lateral (anterior); several elements omitted. – *e*. Left second antenna, medial. – *f*. Detail of terminal part of fourth segment of second antenna.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side view, the urosome appears Z-shaped. The fifth pedigerous segment is produced laterally into the sessile leg 5 and closely associated with the genital segment (figs. 20*a–b*). The pattern of sclerotization provides the only indication at this stage that the rather short genital segment comprises 2 somites. The segment extends into a very obvious ventral process. The genital openings are laterodorsal. Ovisacs contain 2–3 large eggs, arranged in a longitudinal row and held together by a very thin membrane. A thinly sclerotized region separates the genital from the anal segment. The latter is subtriangular in dorsal view (fig. 22*d*). The anus is terminal. The strong, curving caudal rami complete the habitus characters.

The average length of 10 small paratypes (measured with the body in side view) was 0.82 mm (range: 0.76–0.85 mm); the maximum height (of the tergum near the posterior end of the cephalosome and thus not including the anterior "horns") and width were 0.27 mm (0.25–0.30 mm) and 0.25 mm (0.24–0.27 mm) respectively. The lengths and heights of three small measured females from Curaçao were 0.73 × 0.28, 0.77 × 0.27 and 0.73 × 0.27 mm.

The body and appendages have a thick exoskeleton. Gaps in this for short hairs and canals produce a somewhat irregular cuticular surface.

It is possible that the anterior "horns" and the region between them (together termed here the frontal plate) constitute an extrarostral modification of the cephalosome and that the true rostrum is represented only by a slight median protuberance where the frontal plate grades dorsally into the ventral body surface.

Both pairs of antennae are borne in a rectangular depression bounded by the frontal plate, oral area, and the ventrally produced

Fig. 21. *Meomicola amplectans* n.g., n. sp.; figs. *a–i*, female small form (Jamaica), continued; fig. *j*, female large form (Curaçao): – *a*. Oral plate, also showing left first maxilla *in situ*, ventral. – *b*. Left mandible, ventral. – *c*. Left second maxilla, medial (with second segment adjusted on first; to same scale as *b*). – *d*. Left maxilliped, medial (to same scale as *b*). – *e*. Postoral protuberance, ventral (to same scale as *a*). – *f*. Left leg 1, ventral (flattened, with basis adjusted on coxa). – *g*. Left leg 2, ventral. – *h*. Right leg 3, ventral (to same scale as *g*). – *i*. Right leg 4, ventrolateral (to same scale as *f*). – *j*. Left leg 4, dorsal.

sides of the cephalosomal tergum (*cp.* figs. 20*b* and *c*). The first antenna (fig. 20*d*) is very short and scarcely extends beyond this depression. Of its 7 segments, the third and fourth appear partially fused in lateral view but are clearly distinguishable medially. Segments 1 and 2 are large, the remainder of approximately the same length. The appendage is clothed in long flexible elements, distributed by segments (proximal to distal) as follows: 3, 11, 3, 4, 4, 3, 8 (many of these have been omitted in the figure). It was impossible to determine whether any – and, if so, how many of these elements – are aesthetes.

The most obvious characteristics of the 4-segmented second antenna (fig. 20*e*) are the elongate, somewhat offset last segment and the long, strong claw which forms the main armature of the third segment. The single element on each of the first 2 segments is minute; there are a seta and a setule in addition to the claw on the third segment; and the terminal armature consists of 4 small claw-like elements and 3 short setae (fig. 20*f*). The ornamentation is sparse.

The general arrangement of the oral area and its appendages is shown in fig. 20*c*. The labrum is fused, together with a protuberant metastomal area between the second maxillae, into a heavily sclerotized oral plate (fig. 21*a*). There are only 3 gaps in this: a pair (one on each side) for the insertion of mandibles and first maxillae, and the central mouth aperture. Posteriorly, a single pair of brachia extends between the bases of second maxillae and maxillipeds, and a median V-shaped process articulates with the anterior end of the postoral protuberance. The labrum protrudes both anteriorly, ventral to the edge of the oral plate, and ventrally. Its postero-ventral border is smooth and incised medially in the usual lichomolgid fashion. On either side of the labrum there is a fan-shaped area in the sclerotization of the oral plate. There is no other ornamentation. On its dorsal side, the metastomal area becomes somewhat cordiform in outline and more strongly sclerotized.

The mandible (fig. 21*b*) is represented by a rather narrow elongate blade curving anterodorsally toward the mouth. The blade is set off from the base of the mandible, and is ornamented with fine spinules on either margin. The first maxilla (*cf.* fig. 21*a*), a small lobe which is very difficult to see until the mandible is removed, extends posteroventrally and bears 2 terminal setae.

The first segment of the second maxilla (fig. 21*c*) is large and smooth. The second segment bears 4 elements: a spinulose lash with a crest-like basal flange, a shorter lash ventral to it, a seta on the medial side, and a setule dorsally. Like the mandible, the terminal part of the second maxilla extends towards the mouth.

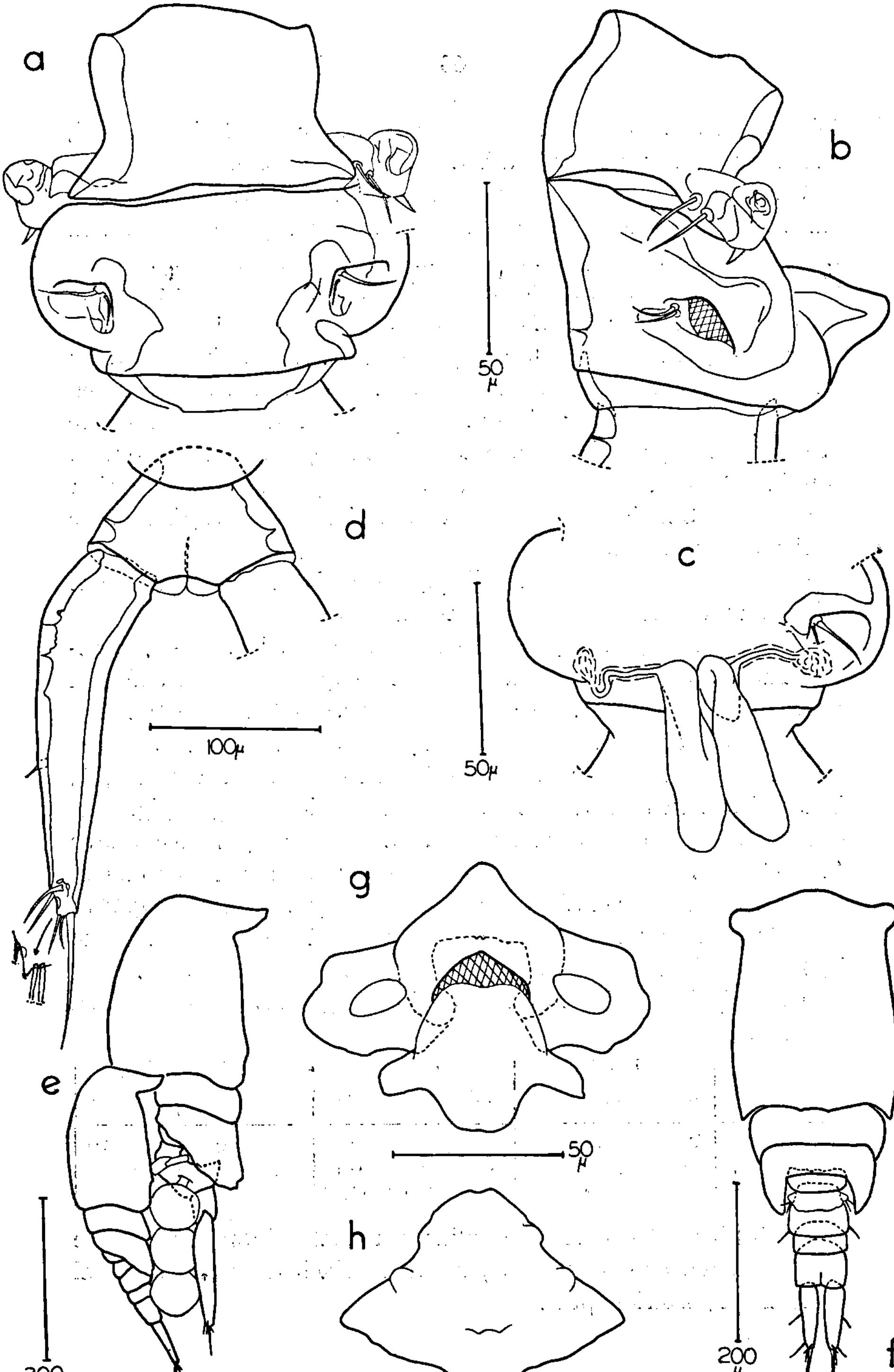
The 3-segmented maxilliped (fig. 21*d*) carries a short seta on each of the last 2 segments and ends in a blunt, thinly cuticularized process. The condition in the male suggests that the element on the last segment represents the armature of an original fourth segment. The last 2 segments are bent anteriorly at right angles to the first segment so that their medial surfaces are juxtaposed against those of the other maxilliped.

The postoral "protuberance" (fig. 21*e*) forms an almost flat triangular sclerite between the oral plate and leg 1.

Legs 1 and 2 (figs. 21*f–g*) have bimerous protopods and 3-segmented rami. In preserved specimens the last segment of each endopod curves posteriorly; that of leg 1 also curves outward so that the original ventral surface is pressed against the last segment of the opposite leg. These terminal endopod segments, particularly of leg 1, bear thick, lamelliform setae and reduced spines. Leg 3 (fig. 21*h*) consists of a bimerous protopod and a single 3-segmented ramus (almost certainly the exopod). In preserved specimens this pair of legs usually extends straight out from the body as shown in fig. 20*b*; the setae are long and interlace. The protopod and single ramus of leg 4 (fig. 21*i*) are both unimerous. The seta on the basis of each leg is relatively long. The armature of the 4 legs may be represented as follows:

	leg 1			leg 2			leg 3		leg 4	
	prot.	exp.	end.	prot.	exp.	end.	prot.	exp.	prot.	exp.
1st segment	0:1	I:0	0:1	0:1	I:0	0:1	0:0	0:0	0:0	1:I
2nd segment	1:0	I:1	0:1	1:0	I:1	0:1	1:0	I:1	1:0	
3rd segment		III I 4	I 5		III I 5	III 3		II I 2		

Leg 5 (figs. 22*a–b*) forms peculiar ventrolateral swellings at the extreme distal end of the body segment. Each leg bears 2 dorsal setae and a posterior spine.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A seta and a small curved element near the oviducal openings probably represent leg 6 (figs. 22*a–c*).

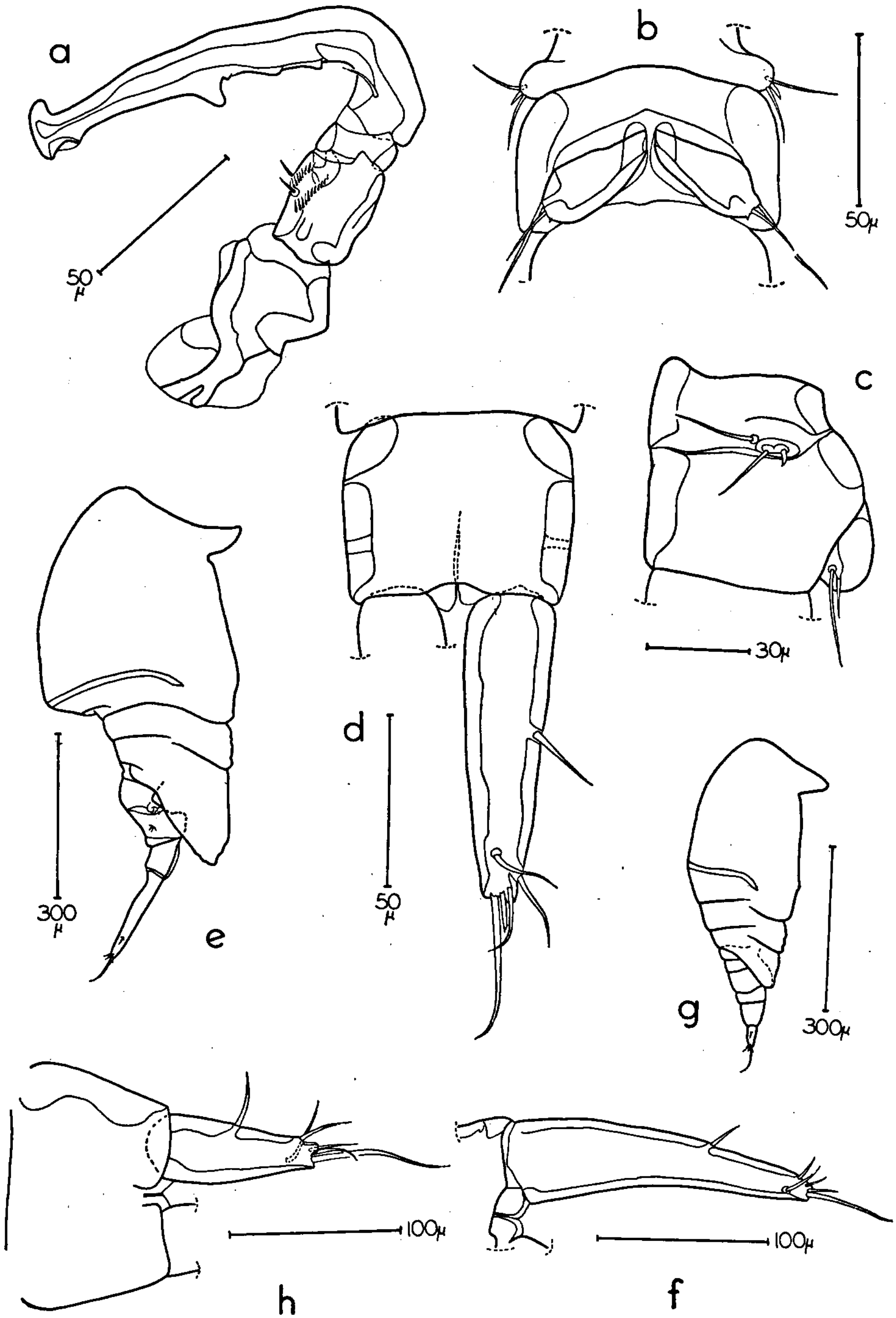
Each caudal ramus (fig. 22*d*) forms a large curved cylinder bearing 3 terminal setae, a dorsal seta and 2 setae on the outer edge. It is probable that the innermost terminal seta of the basic cyclopoid pattern has been lost, since the present innermost seta is the largest. All the setae are rather short, however.

Male. – The body (figs. 22*e–f*) is smaller than that of the female: an average length for 10 small paratypes was 0.57 mm (range: 0.54–0.59 mm); width, 0.16 mm (0.15–0.18 mm); and height, 0.20 mm (with negligible variation). Three small Curaçao males measured 0.56 × 0.15, 0.54 × 0.16 and 0.55 × 0.18 mm. The cephalosome is thus relatively less thick; there is no sharp difference between its thickness and that of the rest of the body. The third tergal plate is less extensive.

The urosomal segments are arranged in linear fashion and are relatively larger than those of the female. The genital segment does not have a ventral process but the flaps of leg 6 are quite protuberant. There is a segment between the genital and anal segments. The sclerotization of the anal segment (fig. 23*d*) indicates the partial expression of 2 somites (see under Developmental stages for further discussion).

Spermatophores were very rare in our samples. A few females (apparently the younger ones) carried empty cases (fig. 22*c*) and in 2 cases males were observed with what appeared to be an undischarged spermatophore pendant from the genital segment. From these examples the spermatophore would seem to be a twisted cylinder with a thin wall, about the size of the male caudal ramus when full but shrinking considerably after discharge.

Fig. 22. *Meomicola amplectans* n. g., n. sp., small form (Jamaica); figs. *a–d*, female, continued, fig. *e*, both sexes, figs. *f–h*, male: – *a*. Legs 5 and 6 *in situ*, dorsal (dashed lines in middle of left side indicate where part of outline of genital segment has been omitted to show setae of right leg 5; these elements omitted from left side). – *b*. The same from the right (to the same scale). – *c*. Part of genital segment of a different female showing attached spermatophores, dorsal. – *d*. Anal segment and left caudal ramus, *in situ* on body, dorsal. – *e*. Amplexus, from the right side. – *f*. Habitus, dorsal. – *g*. Oral plate, ventral. – *h*. Postoral protuberance, ventral (to the same scale as *g*).


a
50 μ
b
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c
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g
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h
100μ
f
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The frontal plate and rostrum, first and second antennae, labrum, mandible, first and second maxillae, and legs 1–4 are like those of the female.

The metastomal area between the maxillae (fig. 22*g*) is longer than in the female, and evenly sclerotized throughout. It appears to form the posterior part of the oral plate and the postmaxillary brachia depend from it without any break. The posterior edge is smoothly rounded. The postoral "protuberance" (fig. 22*h*), which, as in the female, articulates with this posterior edge, is wider and somewhat bifid anteriorly.

The maxilliped (fig. 23*a*) has 4 segments, the last being prolonged without break in the sclerotization into the dactylus. The second segment carries 2 inner setae. The third segment is bare, but an element is carried near the base of the dactylus. The long dactylus, sharply curved on its segment, has a very characteristic pattern of processes.

Leg 5 (fig. 23*b*) is somewhat less protuberant and structurally more like the *Pseudanthessius* pattern than that of the female; the armature, however, is the same in both sexes.

Leg 6 (figs. 23*b*, *c*) forms the usual paired flaps, which occupy much of the ventral surface of the genital segment. The armature is similar to that of leg 5 but the spine is represented only by a minute denticle.

The caudal rami (fig. 23*d*) are straight cylinders, tapering slightly toward the distal end and rather shorter than those of the female. The more distal seta on the outer edge of each is distinctly larger.

Variation in the adults. – Both sexes exist as large and small forms. As the numbers of specimens given above indicate, the small form is much more numerous in the Jamaica collections, but

Fig. 23. *Meomicola amplectans* n. g., n. sp.; figs. *a–d*, male small form, continued, figs. *e–f*, female large form, figs. *g–h*, male large form (all from Jamaica): – *a*. Left maxilliped, medial. – *b*. Legs 5 and 6, *in situ* on isolated urosome, ventral. – *c*. The same, from right side. – *d*. Anal segment and right caudal ramus, dorsal (from isolated urosome). – *e*. Habitus, from right side. – *f*. Right caudal ramus, *in situ* on isolated urosome, dorsal. – *g*. Habitus, from right side. – *h*. Left caudal ramus, *in situ*, ventral.

in the Curaçao sample the large form is more abundant. The preceding descriptions have thus been based mainly on this small form. The large form differs in having a larger prosome, the cephalosome being higher, with a more protuberant anterior end, and shorter caudal rami (figs. 23*e*, *g*). The female is also longer, her third tergal plate more extensive posteriorly, the urosome bent more strongly between the genital and anal segments, the genital process less protuberant, and the caudal rami almost straight. Figs. 23*e–h* will illustrate many of these differences.

Measurements of the 3 large female paratypes (from Jamaica) were as follows: length, 0.88 mm; width, 0.29 mm; and height, 0.37 mm; of 3 large male paratypes: length, 0.57 mm; width and height each 0.22 mm. There was practically no variation in these values. The lengths and heights of 3 large females from Curaçao were 0.79 × 0.37, 0.81 × 0.35 and 0.73 × 0.32 mm; of 3 large males from Curaçao 0.50 × 0.19, 0.52 × 0.19 and 0.53 × 0.21 mm.

No intermediates occurred in our collections between the large and small forms. This is indicated particularly well by the measurements of the height of the cephalosome in the female and the length of the caudal ramus in the male (fig. 24).

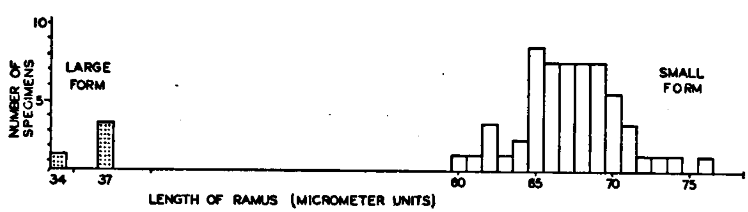

Fig. 24. *Meomicola amplectans* n.g., n. sp., male (Jamaica). – Length frequency histogram of the caudal ramus.

When males and females occurred in pairs (see below), large females carried only large males and small females, small males.

We do not think the differences mentioned above sufficient to justify distinguishing the large and small forms taxonomically.

Developmental stages. – The 4 immature specimens available seem to represent a stage corresponding to the generalized Copepodid V, since legs 1–6 are present and the rami of legs 1–3 are 3-segmented. The specimen from the type lot may tentatively be identified as a female because of its larger size (0.52 mm against

0.43 mm for the other specimens) and proportionately larger caudal rami (length, 0.09 mm against 0.06 mm).

Of greatest interest in these immature forms is the presence of a differentiated preanal somite which is separated from the true anal somite by a thickened band but does not articulate with it. The urosome is thus partially pentamerous.

Functional morphology and biology. – Approximately two-thirds of the females were still carrying males when they were finally examined; the proportion in life is thus probably rather higher. Fig. 22*e* shows the characteristic posture.

There are a number of morphological adaptations which aid amplexus. The anterior end of the male is stopped against the female cephalosome, his frontal plate resting on the thickened strip at the front of her second pedigerous segment and fitting around the dorsal part of this segment. The maxilliped is the major prehensile organ, although the large hook on the second antenna may apparently be employed occasionally in conjunction with it. The terminal part of each dactylus spans the ventral side of the female fifth pedigerous segment so that the process on the middle of the dactylar dorsal surface lies on one side of the female segment and the tip on the other. The dactyli cross so that the process on the tip of each dactylus interlocks with that in the middle of the dorsal side of the other and lies behind it. The maxillipeds are also retained in this position by the projecting leg 5 of the female posteriorly (and, to a lesser extent, by the process on the female genital segment) and anteriorly by the greater width of the fourth pedigerous segment (together with the pressure of the anterior end of the male against the female cephalosome). The caudal rami of the female appear to support the ovisacs but their outward curvature also allows the hind part of the male body to fit between them when no eggs are present.

It is not clear how transfer of the spermatophores can be carried out in this amplectiform posture, and probably copulation involves a change in position.

A few males were found still grasping a spine of the host spatangoid. Only the hooks of the second antennae were used for prehension, the dactyli of the maxillipeds being folded up out of the way. The frontal plate fitted around one surface of the spine. It is likely that the female hangs on in a similar fashion.

The greater number of males in our collections (nearly twice that of females) is interesting. It may be a valid expression of the need for every female in the population to possess a consort or simply due to males being more easily dislodged from the host than females.

Remarks. – *Meomicola amplectans* extends the trend which exists in the Lichomolgidae for reduction of legs 1–4 to a stage considerably beyond that shown by *Heteranthessius* T. Scott, 1904. In the latter genus (hitherto the most modified lichomolgid known with respect to the structure of its legs) the endopod of leg 4 is virtually absent (BOCQUET, STOCK & BÉNARD, 1959) but the exopod and both rami of the preceding legs are 3-segmented. Thus *Meomicola* is unique in this family in the loss of the leg 3 endopod and the reduction of leg 4 to protopod and a single unimerous ramus. In a key, such as that to the Lichomolginae in SEWELL (1949, p. 96), *Meomicola* may be traced with *Pseudanthessius* and then distinguished by the condition of legs 3 and 4.

Another unusual character is the extent to which reduction of segments in the urosome has proceeded: the minimum hitherto known is 4 for the female and 5 for the male (see the account of *Pseudanthessius deficiens* above). The occurrence of males in amplexus is also a situation not previously reported in lichomolgids.

Meomicola seems to resemble *Pseudanthessius* closely in its morphology. The sessile leg 5, hitherto considered one of the main characters diagnosing *Pseudanthessius* in any lichomolgine assemblage [1]), is perhaps the most strikingly similar structure. Others, such as the first antenna, the mouthparts, and leg 6, show a generic resemblance. The common sexual dimorphism of the leg 1 endopod in *Pseudanthessius* may be an expression of the same tendency which gives rise to the unusual structure of this ramus and, to a lesser degree, that of leg 2 in *Meomicola*. Similarly, the fact may be of significance that, among lichomolgids, only in some species of *Pseudanthessius* does reduction in the number of urosomal

[1]) From ROSOLL's fig. 7 (Taf. II), *Astericola clausi* Rosoll, 1888, appears to share this character; however, BOCQUET & STOCK (1962) have shown, that the fifth leg of *A. clausi* includes a small discrete segment. They synonymize *Astericola* with *Stellicola* and consider *Lichomolgus asterinae* Bocquet, 1952, identical with *Stellicola clausi* (Rosoll, 1888).

segments occur. The position at which the male grasps the female is the same as that assumed by males of *P. tortuosus* (p. 43).

In its choice of host, *M. amplectans* recalls the echinophile species of *Pseudanthessius*. One of these, *P. sauvagei*, is also known from several species of spatangoids (CANU, 1892; STOCK, 1960; BRESCIANI & LÜTZEN, 1962).

Besides the condition of the body and legs 1–4, *Meomicola* differs from *Pseudanthessius* in the second antenna. Only on the terminal segment of this appendage are elements ever modified for a prehensile function in *Pseudanthessius*, whereas in *Meomicola* it is the penultimate segment which carries the large hook. The situation in other lichomolgids is not yet sufficiently clear to indicate whether this difference may be of generic importance. Otherwise, the second antenna is very similar to the *Pseudanthessius* pattern. Possibly specific also are the constant association of male with female and of both with the host (together with the concomitant morphological modifications) but, for the present, we prefer to consider these of greater significance.

The following diagnosis is suggested for the genus *Meomicola*.

Meomicola n. g.

Lichomolgid copepods in which the urosome is reduced to 3 segments in the adult female, 4 in the adult male. Eggs few. Spermatophores seasonal or transitory. Caudal ramus sexually dimorphic.

First antenna of 7 compact segments. A large hook borne on third segment of second antenna; fourth segment elongate, with 7 small elements.

Labrum and metastome fused into an oral plate complex with which postoral protuberance articulates. Mandibular blade partially differentiated from base; no accessory elements. Only 2 setae on first maxilla, both terminal. Second maxilla with main and accessory elements, and a setule in addition to the usual seta, so that there are 4 elements in all. Female maxilliped 3-segmented, a seta on each of the last 2 segments; appendage 4-segmented in male, with 2 setae on second segment and 1 on fourth at base of dactylus.

Legs 1 and 2 biramous, rami 3-segmented. Last segment of each endopod curving posteriorly, with enlarged setae and small spines. Exopod of leg 3 trimerous, armature reduced; endopod absent. No exopod spines with accessory elements. Leg 4 of 2 segments; the first protopodal, the second presumably a remnant of the exopod. Leg 5 sessile, with 3 elements. Setae of leg 6 present.

Both sexes close external associates of spatangoids. Male usually occurring in amplexus, grasping female around base of urosome.

Type and only known species: *M. amplectans* n. sp.

Gender of genus masculine. The name is derived from that of its host (*Meoma*) plus *-cola* (from Latin, *colere* = to inhabit): thus, "associate of *Meoma*".

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