

NOTES ON SOME COPEPOD PARASITES IN THE COLLECTION  
OF THE BRITISH MUSEUM (N.H.), LONDON

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DURING the course of a review of the work on the copepods parasitising Indian marine fishes (Pillai, 1965b) it was found that the correct recognition of some of the species recorded by Bassett-Smith (1898) from Indian waters is difficult because of the absence of information on details. When it is remembered that Bassett-Smith's papers were published nearly seventy years back this defect is quite understandable. But unfortunately no one seems to have taken any interest in redescribing them. During the tenure of a Royal Society and Nuffield Foundation Commonwealth Bursary I utilised part of my time to examine Bassett-Smith's collection in the British Museum (N.H.). To my regret I was able to locate only a few of them and even those present were represented by only one or two specimens each. As it was considered inadvisable to destroy these specimens, they were examined after clearing them in lactic acid. All the illustrations accompanying this paper were prepared without dissection. It is hoped that the present report will add to the usefulness of Bassett-Smith's pioneer work.

I take this opportunity to express my gratitude to the Royal Society for enabling me to go over to London and study the material. My thanks are also due to Dr. A. L. Rice and Dr. K. G. McKenzie for providing me excellent facilities for work in their Laboratories.

Suborder CYCLOPOIDA

Family BOMOLOCHIDAE CLAUS

Genus *Nothobomolochus* Vervoort

Genus *Bomolochus* Von Nordmann contained a very large number of species some of them totally different from others. After a detailed study of the species Vervoort divided the genus into four genera namely *Bomolochus* Von Nordmann, *Bomolochoides* Vervoort, *Parabomolochus* Vervoort and *Nothobomolochus* Vervoort. The last which alone concerns us here can be distinguished by the presence of a chitinous plate bearing three processes on the basal part of the antennules.

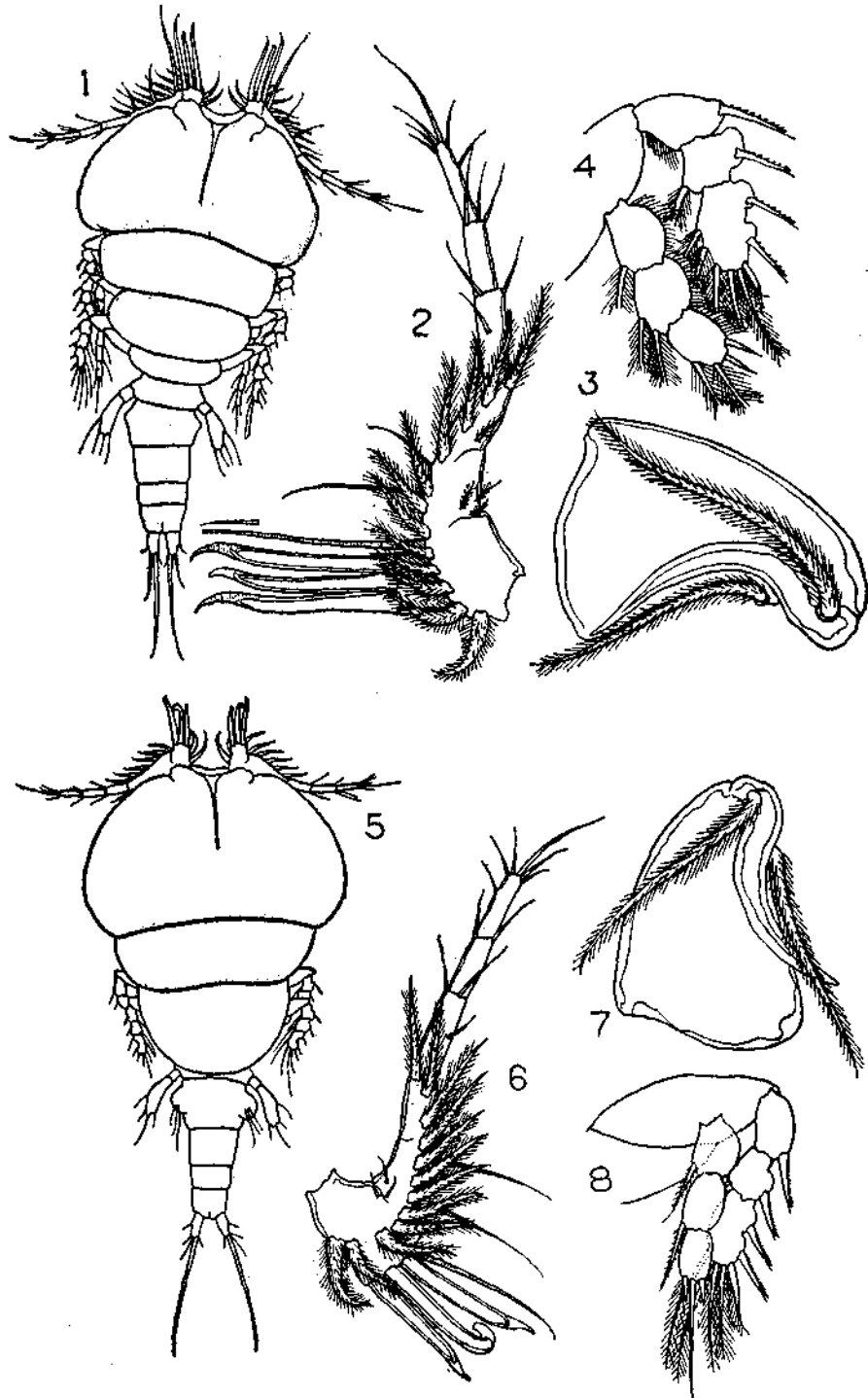
*Nothobomolochus tricerus* Bassett-Smith

(Figs. 1-4)

*Bomolochus tricerus* Bassett-Smith, 1898a, p. 3, pl. 1, fig. 1; 1899, p. 443; Gnana-mathu, 1949, p. 318; Sewell, 1949, p. 169; Pillai, 1965a, p. 39, f. 15.

*Bomolochus managatuwo* Yamaguti, 1939, pl. 3, figs. 28-29; pl. 4, figs. 30-37.

*Nothobomolochus tricerus* Vervoort, 1962, p. 64; Pillai, 1965b, p. 1567, fig. 17.



FIGS. 1-4. *Nothobomolochus tricerus* Bassett-Smith  
 (1) Female, dorsal view; (2) first antenna; (3) maxilliped; (4) third leg.  
 FIGS. 5-8. *Nothobomolochus denticulatus* (Bassett-Smith)  
 (5) Female, dorsal view; (6) first antenna; (7) maxilliped; (8) fourth leg.

## REMARKS

The original description of this species by Bassett-Smith was based on collections made at Bombay from the gill cavity of *Pampus argenteus* (Euphrasen). Bassett-Smith has not designated any type. The British Museum Natural History, London, possesses a single female with Reg. No. 98-4-20-10 which therefore becomes the holotype.

In his review of the family Bomolochidae Vervoort observed that this is a very insufficiently known species. Since then I made a large collection of specimens from the type host *Pampus argenteus* at Trivandrum and described the species in detail. The present study based on the only specimen available of the original collection shows that Bassett-Smith's description as observed by Vervoort is very inadequate and my description is clearly applicable to the type specimen.

*N. tricerus* can be easily distinguished by the nature of its antennule. The three basal segments are partially fused, with a stout chitinous plate carrying three long slender chitinised processes. The outer processes are apically drawn out whereas the median is apically blunt and shorter than the former. In addition to these the antennule carries on its basal part twelve stout strongly hirsute setae and three modified setae; the one nearest the chitinous plate is long.

The cephalothorax is much broader than long. The second thoracic segment is transversely rectangular and the third transversely oblong. The fourth segment is partially overlapped by the third. Abdomen is four-segmented and its first segment is slightly broader than the fifth thoracic segment.

***Nothobomolochus denticulatus* (Bassett-Smith)**

(Figs. 5-8)

*Bomolochus denticulatus* Bassett-Smith, 1898b, p. 78, pl. 3, fig. 1; 1899, p. 433; Gnanamuthu, 1949, p. 318; Sewell, 1949, p. 169; Pillai, 1965, p. 41, fig. 16.

*Nothobomolochus denticulatus* Vervoort, 1962, p. 65; Pillai, 1965b, p. 1567, f. 18.

## REMARKS

Three females of this species collected by Bassett-Smith are in the British Museum, Natural History. They were collected from *Sphyræna jello* and *Hemirhamphus far* at Trincomalee, Ceylon.

The original description of this species like that of *N. tricerus* is very inadequate. Based on a rich collection made at Trivandrum I gave a detailed description of both male and female which is clearly applicable to the type material in the British Museum.

*N. denticulatus* can be easily distinguished by the comparatively large third thoracic segment which completely overlaps the fourth and partially overlaps the fifth thoracic segment. The antennule carries, as is usual in the genus, twelve strongly hirsute setae and three chitinous processes borne on a chitinised plate,

In addition to that there are three long slender modified setae. A peculiar feature which has to be mentioned is that the chitinised processes on the antennule have been described differently by different authors. These processes generally remain recurved so that they appear as 'obtuse ended bristles of about equal length', (Bassett-Smith, 1898). But as illustrated here the median process is 'obtuse ended' and the others are apically drawn out and acute.

Suborder CALIGOIDA

Family CALIGIDAE

Genus *Caligus* Muller

*Caligus platytarsis* Bassett-Smith

(Figs. 9-23)

*Caligus platytarsis* Bassett-Smith, 1898b, p. 83, pl. 4, fig. 2 ; Pillai, 1965b, p. 1594, fig. 79.

*Caligus bombayensis* Rangnekar, 1955, p. 55.

*Material examined*

A single female collected by Bassett-Smith from the gills of *Mugil* sp. at Muscat, B. M. Cat. No. 98.12.2.

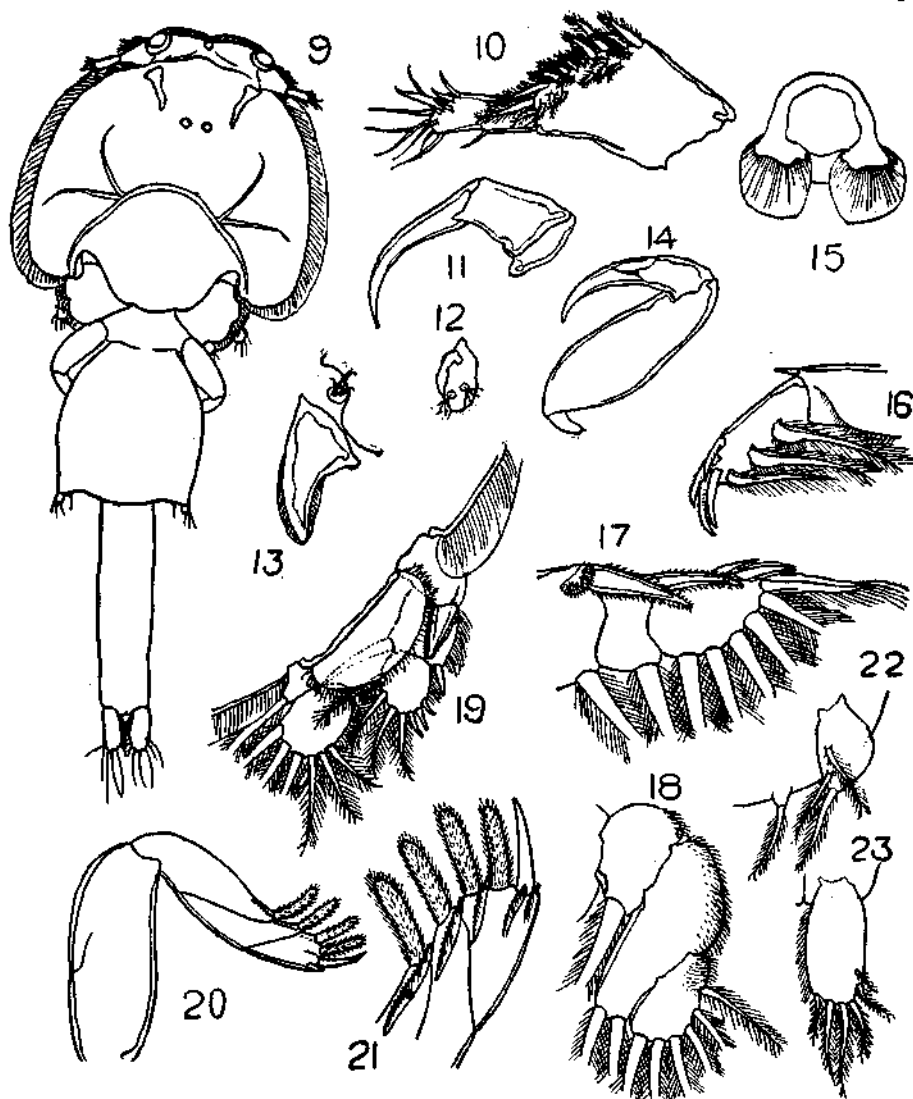
*Female*

The carapace is comparatively large, nearly equal in length and width. The frontal plates are prominent but do not project. The lunules are rather small. The median transverse rib is strongly arched and hence the cephalic area is only slightly longer than the thoracic. The posteromedian lobe of the carapace is well rounded and clearly projects beyond the lateral lobes ; the latter are just half the width of the former. The posterior sinuses are fairly deep but wide open. Fourth thoracic segment is broader than long but is partially covered by the median lobe of the carapace. Genital segment is slightly longer than broad and is posterolaterally angular so that the hind border is nearly transverse. Abdomen is long and parallel-sided and is apparently single segmented, but a faint indication of a septum is visible as shown in the illustrations. Anal laminae are large, nearly twice as long as broad, with six setae, three of which are large and three small.

First antenna is short and stout with highly plumose setae ; second antenna is of the normal type but its distal segment has a rounded process. First maxilla is reduced to a chitinous plate carrying two bunches of hairs, the usual claw is absent. Second maxilla is a stout flanged claw ; palp carries three small setae. First maxilliped is just as is typical in the genus. Second maxilliped is comparatively feeble and slender, the distal segment is strongly curved. The sternal fork is very characteristic. It has a stout base and the limbs of the fork are converted into highly flattened nearly rounded laminae. Something even remotely resembling this is not found in any other species.

Distal segment of the first leg has three barbed claws which regularly increase in length. These are followed by a simple claw which is shorter than the third

claw. The lower border carries three well developed setae. Outer border of the segments of the endopod of the second leg carries several rows of stiff spines. Each of the first two segments of the exopod has a strong, nearly straight outer spine,



FIGS. 9-23. *Caligus platytarsis*. Bassett-Smith

(9) Female, dorsal view; (10) first antenna; (11) second antenna; (12) first maxilla; (13) second maxilla; (14) second maxilliped; (15) sternal fork; (16) first leg, tip only; (17) second leg, exopod; (18) same endopod; (19) third leg; (20) fourth leg; (21) same, tip enlarged; (22) fifth and sixth legs; (23) anal lamina.

third segment carries a simple spine, two modified setae and five plumose setae. Third leg is as usual in the genus. The basal claw of its exopod is straight with a serrate flange. The outer border of the apron is corrugated. Fourth leg is very

diagnostic. It is four-segmented and comparatively stout, its second and third segments carry one claw each and the fourth three claws. All the claws except the last are blunt and digitiform and fully covered with stiff spinules. Fifth leg is a small nodule freely projecting from the genital segment and carrying three strongly hirsute setae. The sixth leg is represented by a single seta.

Length 6.0 mm.

#### REMARKS

*C. platytarsis* can be easily distinguished from all the other species of *Caligus* by the shape of the genital segment; by the long apparently one-segmented abdomen, and above all by the shape of the sternal fork and of the setae arming the fourth legs.

Rangnekar created *C. bombayensis* on the alleged differences in the shape of the sternal fork. The present study shows beyond any doubt that Bassett-Smith failed to observe the expanded tips of the sternal fork and that *C. bombayensis* is the same as *C. platytarsis*.

Bassett-Smith has shown the genital segment as triangular but it is more rounded anteriorly and the abdomen shows an indistinct partition. As already stated, the description of the sternal fork by Bassett-Smith is erroneous. The anal laminae are oblong. His illustration of the spines of the fourth leg are correct but the modified spines are shown to be much broader than they really are. The first maxilla, though reduced, is present. Bassett-Smith states that leg one carries three claws of 'nearly equal length' but the claws regularly increase in length and are armed. There is a fourth spine seta too. The two exopod joints of leg two carry well developed spines and not 'spine like claws'.

#### *Caligus arii* Bassett-Smith

(Figs. 24-34)

*Caligus arii* Bassett-Smith, 1898b, p. 82, pl. 4, fig. 1; Pillai, 1963, p. 74; fig. 3; 1965b, p. 1575, fig. 31.

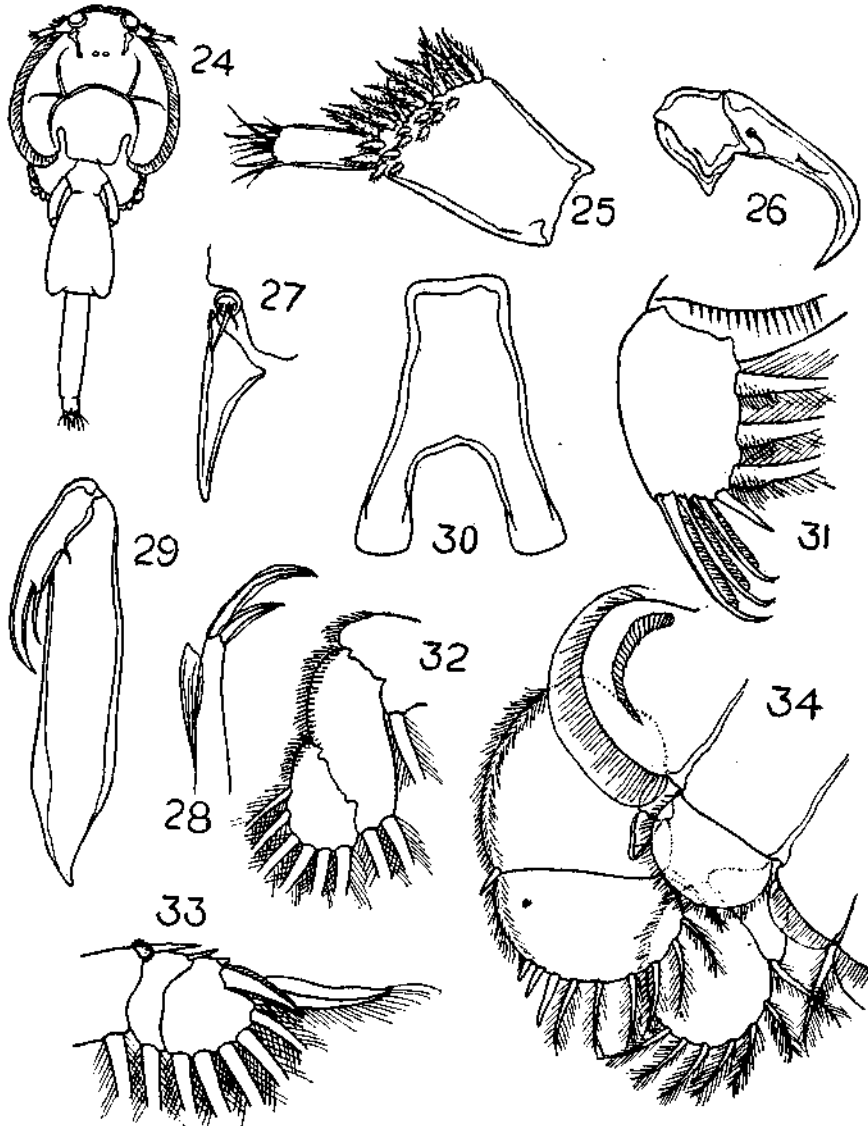
#### *Material examined*

A single female, syntype, collected by Bassett-Smith from the gills of *Arius acutirostris* at Trincomalee, Ceylon. B. M. Cat. No. 98.12.2.9.

#### *Female*

The carapace is comparatively large and circular in outline, as long as broad, cephalic and thoracic areas are sub-equal in length. The lunules are large and projecting. The posterolateral lobes of the carapace curve inwards and are just half as broad as the median lobe; the latter projects slightly beyond the former and its distal border though faintly trilobed is transverse. Fourth thoracic segment is fairly large and nearly equal in length and width. Genital segment is longer than broad and inverted U-shaped; its posterolateral corners are slightly produced. Abdomen is slightly longer than the genital segment, slender and two-segmented, the distal segment is very short; the anal laminae are deeply sunk into it,

First antenna is rather stout, its basal segment carries a row of long, strongly hirsute setae and two irregular rows of short submarginal ventral setae. Distal



FIGS. 24-34. *Caligus arii* Bassett-Smith  
 (24) Female, dorsal view; (25) first antenna; (26) second antenna; (27) second maxilla; (28) first maxilliped; (29) second maxilliped; (30) sternal fork; (31) first leg tip only; (32) second leg, endopod; (33) same exopod; (34) third leg.

segment has a bunch of about eleven to twelve simple setae. Second antenna is small, but its third segment is long and falcate. First maxilla is absent. Second maxilla is a long strong claw, its palp carries three setae. First maxilliped has a large outer lobe on the distal segment, distal claws are strong and unequal in length,

Second maxilliped is extremely slender, its distal segment is only slightly more than half the length of the second segment and has a prominent accessory spine. Sternal fork has a large base and two stout limbs slightly diverging and apically expanded and rounded.

Distal segment of exopod of first leg has three distal claws successively decreasing in length and a stout spine seta at the lower distal corner. Each of the distal claws has on its ventral side a broad frill and beyond the frill the claw is strongly curved. The lower border of the segment has three large plumose setae. Each of the first two segments of the exopod of the second leg has a small nearly straight spine, third segment has a blunt process, two modified setae and five plumose setae. Outer border of the segments of the endopod is armed with several rows of stiff spines. Third leg is very characteristic. Its apron is comparatively reduced in size and has a submarginal grooved pad on its ventral outer part. Exopod is three-segmented, first segment or spine is rather short and blunt, flattened and enormously enlarged. Second segment of the endopod is also comparatively large. Fourth leg could not be observed properly; it is four segmented.

Length 5.5 mm.

#### REMARKS

This is a very unique species to which Bassett-Smith's description hardly does sufficient justice. The posterolateral lobes of the genital segment are not so produced as shown by Bassett-Smith but it can be nearly straight as I have shown elsewhere (Pillai, 1963). First antenna carries several small setae not observed by Bassett-Smith and the setae show very conspicuous pectination all over which is quite unusual in *Caligus*. The terminal segment of antenna 2 has two small hairs and the whole organ is rather slender. First maxilliped though reduced is present. Bassett-Smith has shown the basal segment of the second maxilliped as much more thicker and shorter than it actually is. This appendage is in fact much more slender than in most species of *Caligus*. Bassett-Smith's description of leg one is very inadequate, the distal claws are very unequal and not nearly of the same length and each claw has a ventral frilled expansion very characteristic of the species and there is a fourth claw or spine seta also. Again its vestigial endopod is quite large and fully covered with fine hairs. Bassett-Smith has pointed out the peculiarity of the third leg but he failed to observe many details. But the extreme enlargement of the exopod and a corresponding reduction in the size of the apron is very characteristic.

#### *Caligus cybii* Bassett-Smith

(Figs. 35-47)

*Caligus cybii* Bassett-Smith, 1898a, p. 6, pl. 2, fig. 3; Kirtisinghe, 1964, p. 58, figs. 33-34; Pillai, 1965b, p. 1578, fig. 38.

*Caligus brevisoris* Pillai, 1961, p. 87, fig. 1.

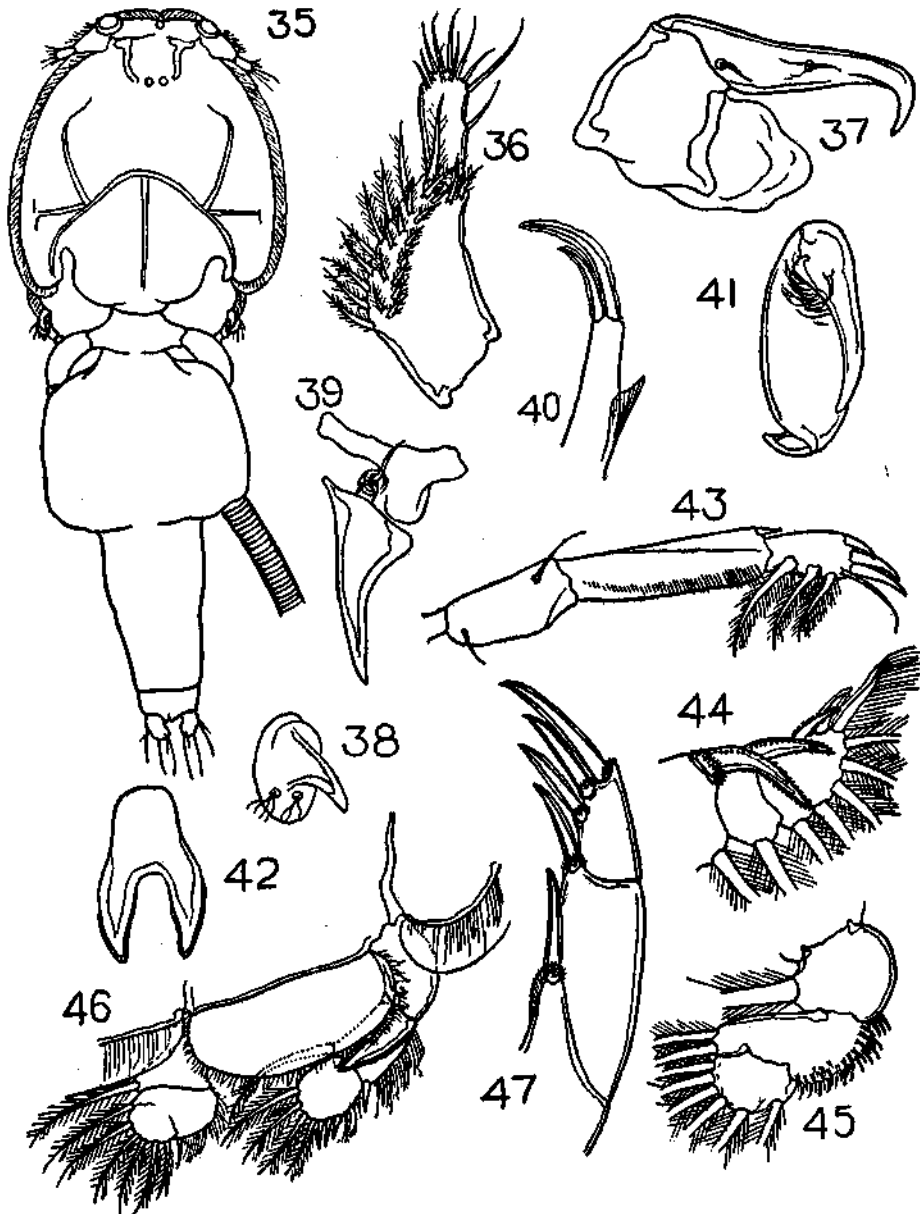
#### *Material examined*

Two females (Syntypes) collected by Bassett-Smith from the gill cavity of *Cybium lineolatum* at Trincomalee, Ceylon. B. M. Cat. No. 98.4.20.3,



*Female*

This is a rather stout strongly built copepod. Carapace is slightly longer than broad and gradually broadens backwards. Frontal plates are low and not project-



FIGS. 35-47. *Caligus cybiti* Bassett-Smith

(35) Female, dorsal view; (36) first antenna; (37) second antenna; (38) first maxilla; (39) second maxilla; (40) first maxilliped; (41) second maxilliped; (42) sternal fork; (43) first leg; (44) second leg, exopod; (45) same, endopod; (46) third leg; (47) fourth leg, tip only.

ing. Lunules are small. Dorsomedian transverse rib is strongly arched and hence the cephalic area of the carapace is only slightly longer than the thoracic. Posterolateral lobes are slightly less than half the width of the median lobe; latter clearly over-reaches the former. Posterior sinuses are fairly deep. Fourth segment is large, much broader than long. Genital segment is roughly squarish with bluntly rounded angles, nearly two-third the width of the carapace. Abdomen is stout, longer than the genital segment and clearly two-segmented, distal segment is very small. Anal laminae carry the usual six setae.

First antenna is rather small, its distal segment carries a few fairly long apical setae. Second antenna has a stout third segment carrying two spine setae, its distal part is bent at right angles. First maxilla has an oval or oblong base carrying two bunches of hairs, the claw though strong is only slightly curved. Second maxilla is strong, its palp carries three setae. The two maxillipeds possess no characteristics worth mentioning. Sternal fork has a comparatively narrow base, which is as long as the limbs, latter are stout and distally curved slightly inwards.

Distal segment of the first leg has three stout distal claws successively increasing in size, a long spine seta at the lower distal angle and three prominently plumose ventral setae. Outer border of the second segment of the endopod of the second leg is armed with strong sharp spines; first segment of the exopod has a long characteristically curved barbed spine, second segment has a similar but shorter spine, third segment has a still shorter spine, two modified setae and five normal setae. Outer part of the apron of the third leg is strongly spiny. The basal spine of the exopod is large and has a serrate flange; succeeding segments are comparatively narrow. Endopod is apparently three-segmented. The expansion of the apron intervening the rami is very large and consequently the rami are widely set apart. Fourth leg is four-segmented.

Length 5.0 mm.

#### REMARKS

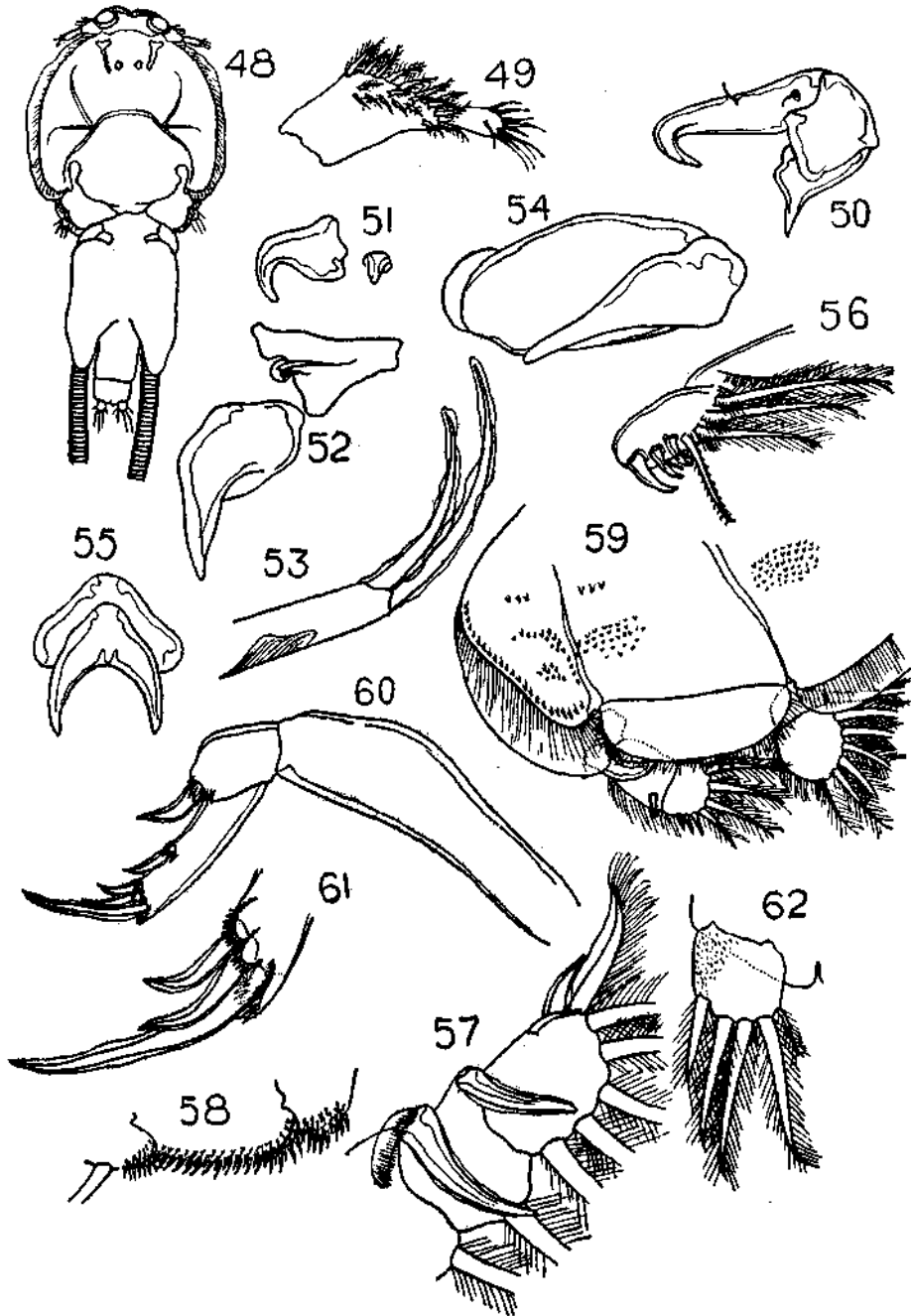
Kirtisinghe's opinion that *C. brevisoris* Pillai is the same as *C. cybii* Bassett-Smith seems to be correct. Bassett-Smith's description based on a single female is so short and his figures lack details that I had no chance to make a correct decision. The type specimen is here described in detail. The spine seta on the first leg is not plumose, and the claws successively increase in length. The claws on the exopod of the second leg are long and strongly curved, first longer than second though Bassett-Smith shows the reverse. The endopod of the same leg is three-jointed and the first two segments are armed with stiff spines. The cephalothorax is not as narrow as shown by Bassett-Smith and the median lobe is less produced than shown by him. The genital segment is broader than shown by him and its posterolateral parts slant towards the base of the abdomen. He shows them as slightly angular and faintly produced.

#### *Caligus infestans* Heller

(Figs. 48-62)

*Caligus infestans* Heller, 1865, p. 167, pl. 14, figs. 3-4; Kirtisinghe 1964, p. 52, figs. 22-24; Kabata, 1965, p. 119, figs. 2a-b.

*Caligus maculatus* Heegaard, 1962, p. 157, figs. 45-53.



Figs. 48-62. *Caligus in estans* Heller

(48) Female, dorsal view ; (49) first antenna ; (50) second antenna ; (51) first maxilla ; (52) second maxilla ; (53) first maxilliped ; (54) second maxilliped ; (55) sternal fork ; (56) first leg, tip only ; (57) second leg, exopod ; (58) same, endopod, (59) third leg ; (60) fourth leg ; (61) same, tip enlarged ; (62) anal lamina.

*Materials examined*

A single female collected by Bassett-Smith from a species of *Cybium* at Muscat. B. M. Cat. No. 98.12.2.6.

*Female*

Carapace is nearly as long as broad. The median transverse groove is arched so that the cephalic and thoracic areas are sub-equal in size. Frontal plates project prominently. Posterolateral lobes of the carapace are only a third of the width of the median lobe and curve towards the latter so as to close the posterior sinuses. Median lobe clearly projects beyond the lateral lobes. Fourth thoracic segment is fairly large and drawn out at the base of the fourth legs. Genital segment is most characteristic, its anterolateral regions are drawn out into large distally rounded lobes almost reaching the distal end of the first segment of the abdomen. Abdomen is as long as the genital segment minus its posterolateral lobes, two-segmented, basal segment is twice as long as the distal. Anal laminae are broader than long and sunk into the abdomen, each lamina carries on its ventral side a patch of fine denticles. There are five setae, outer seta is spine-like but plumose, remotely resembling that of *Caligus coryphaenae* Steenstrup and Lütken.

First antenna carries two to three rows of long setae on its basal segment, distal segment has about ten stiff apical setae. The basal segment of the second antenna is proximally produced into a strong pointed process, third segment carries two setae and its tip is strongly curved backwards. The first maxilla is a strongly curved stout claw as in the male of some species of *Caligus*. It does not carry the usual bunches of hairs but inner to its base is a small chitinous process. Second maxilla is a very stout claw, its palp carries a very long and a short seta. Maxillipeds have no special features. Sternal fork has a broad base, the limbs of the fork are strongly divergent and very slightly incurved at their tips.

Distal segment of the first leg has the usual three distal claws which are strongly curved and successively decrease in size, second and third claws carry a prominent accessory spine. The spine seta is sparsely plumose. The three setae on the ventral side are very large. The outer border of segments of the endopod of the second leg is spiny. The claws on the first two segments of the exopod are stout, strong and curved and are flanged, third segment has a slender spine, two modified setae and five normal setae. Outer and middle parts of the apron of the third leg carry prominent spines distributed as shown in the figure. The basal spine of the exopod is strongly curved and the rami are situated fairly wide apart. Fourth leg is three-segmented, slender but strong, second segment is short and carries a curved flanged claw at the base of which is a crescentic row of spines. Third segment has four claws, all flanged and having at their base rows of strong spines. The last claw is unusually long, more than twice as long as the penultimate claw. Fifth and sixth legs were not observed.

## REMARKS

This species can be easily identified by the shape of the genital segment of the female which is posterolaterally produced into two large lobes. The fourth leg is three-segmented, the second segment has a characteristic inner projection and each claw is subtended by a prominent spiny frill.

The British Museum specimen is wrongly labelled as *C. irritans* Heller.

- Caligus bonito* Wilson, 1905, p. 589, pl. 13, figs. 150-153; Yamaguti, 1936, p. 8, pl. 5, figs. 69-71; Shiino, 1960, p. 527, fig. 1; Lewis, 1967, p. 124, figs. 46-48.
- Caligus kuroshio* Shiino, 1959, p. 51, figs. 1-2; Pillai, 1963, p. 80, fig. 9; Yamaguti, 1963, p. 55, pl. 71, fig. 3; Kabata, 1965, p. 120, fig. 2 D, E.

#### *Material examined*

Two females and one male, cotypes, collected at Woods Hole. Norman collection. B. M. Cat. No. 1911. 11.8.47989.991.

#### *Female*

Carapace nearly equal in length and width and almost circular. Posterolateral lobes curved towards the median lobe but the posterior sinuses are left fully open. Median lobe is nearly three times as broad as the lateral lobes and only slightly projects beyond the latter. Frontal plates are rather deep and projecting with large circular lunules. Fourth segment is rather broad but short, expanded over the base of the fourth pair of legs. Genital segment large, longer than broad, with a neck-like constriction at the anterior part, anterolateral parts rounded and shoulder-like, posterolateral produced into rounded prominent lobes reaching well beyond the base of the abdomen. Abdomen is as long as the genital segment and two-segmented, basal segment nearly four times the length of the distal and somewhat swollen at the basal three-fourths producing a spindle shape. Anal laminae had their setae broken off. Egg sacs long and slender.

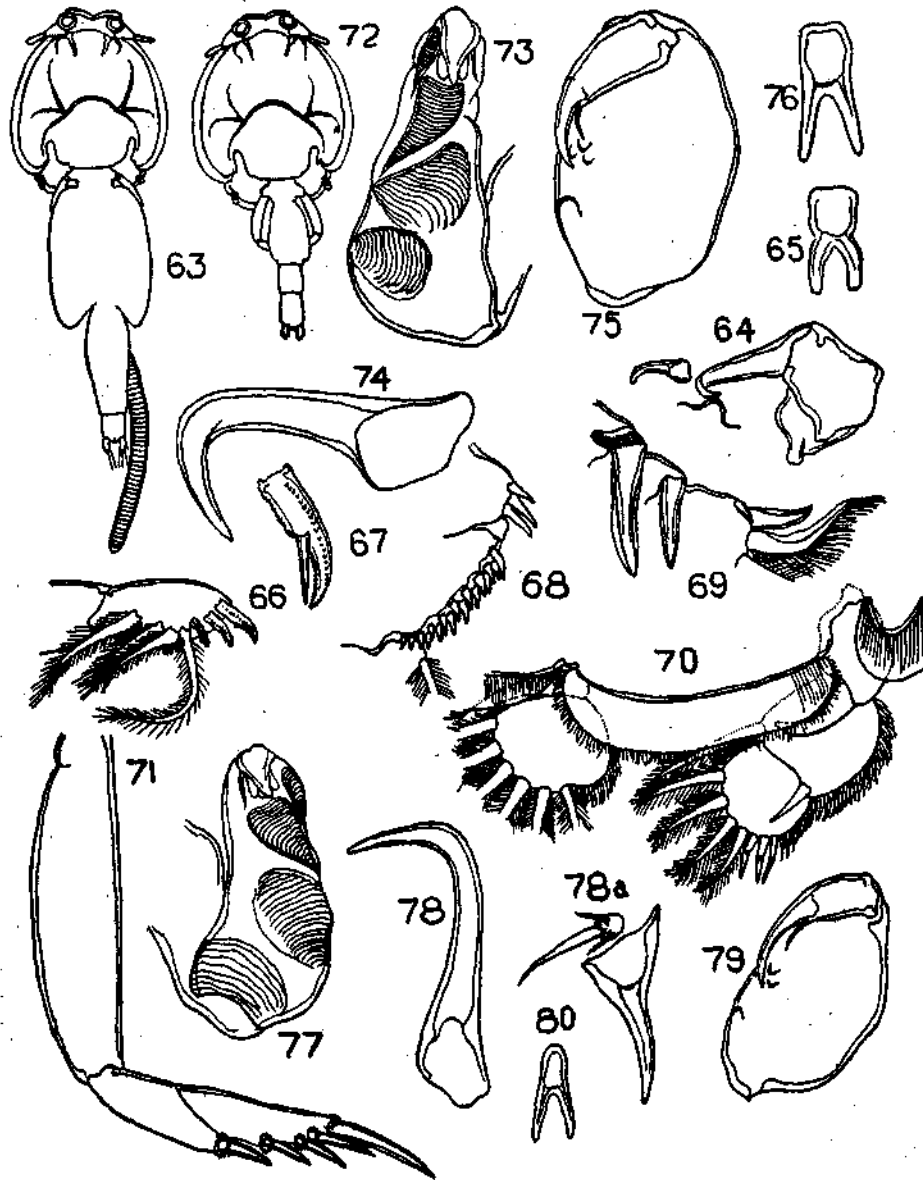
Basal segment of the second antenna has a blunt apically truncate process, the apex of the third segment is sharply curved backwards. First maxilla is a slightly curved blunt claw. Sternal fork has apically blunt bracket-shaped rami which are as long as the roughly squarish base. Distal segment of the first leg has three claws, an exceptionally long spine seta and three plumose setae. All claws are armed with teeth and successively decrease in size, the second and third claws have a strong barb. The spine seta is plumose and larger than the setae on the ventral side. The latter carry on their outer side a row of short spines rather than hairs, 5 to 6 of them on the slightly swollen base are real spines but the others slowly get transformed into stiff hairs. First two segments of the exopod of the second leg carry a stout claw each, rather sharply bent downwards, both are flanged, third segment has a small flanged spine, two modified setae and five normal setae. Outer border of the first segment of the endopod carries three large teeth, that of the second segment carries about 20 teeth arranged in two slightly alternating rows. The claw at the base of the exopod of the third leg is well curved, with a narrow outer flange, second segment has its outer spine overlapping the third segment. The rami are separated by a comparatively long interval. Fourth leg is three segmented, with five flanged claws placed fairly close together.

Length 8.0 mm.

#### *Male*

Carapace is very much like that of the female. Fourth segment is constricted at the anterior and posterior ends and produced as rounded lobes over the fourth legs. Genital segment is elliptic, with two posterolateral lobes carrying the sixth legs. Abdomen is two-segmented, segments are similar. Anal laminae are comparatively large.

*Caligus bonito* Wilson  
(Figs. 63-80)



Figs. 63-80. *Caligus bonito* Wilson

(63) Female, dorsal view ; (64) second antenna and first maxilla ; (65) sternal fork ; (66) first leg ; (67) same, one claw enlarged ; (68) second leg, endopod ; (69) same, exopod ; (70) third leg ; (71) fourth leg ; (72) Male, dorsal view ; (73) second antenna ; (74) first maxilla ; (75) second maxilliped ; (76) sternal fork ; (77-80) *Caligus kuroshio* Kabata, male ; (77) second antenna ; (78) first maxilla ; (78a) second maxilla ; (79) second maxilliped ; (80) sternal fork.

The second antenna is considerably modified. Its second segment is very large and carries four adhesion pads as shown in the figure. The distal segment is small and flattened into a trifid process carrying on its base a spine seta. Compared to that of the female the first maxilla is a large stout claw distally curved at right angles. The second maxilliped is also massive compared to that of the female. Its second segment is swollen and carries on its inner surface a proximal blunt but low projection and just where the folded claw touches there are three small tubercles placed at the corners of a triangle, the third segment carries a stout lower seta. The sternal fork has straight, diverging rami which are longer than the base. The legs are exactly like those of the female.

Length 5.3 mm.

#### REMARKS

Wilson's description contains many inaccuracies. The distal claws of the first leg are greatly dissimilar and not of the same length as suggested by Wilson. Wilson has shown only a single row of teeth on the second segment of the endopod of the second leg, but there are two rows; similarly he failed to observe the spine and the first modified seta on the third exopod segment. The rudimentary fifth legs are certainly visible in the male and it is placed far in front and consists of a single seta.

Wilson makes no mention of the peculiar modification of the second antenna of the male. He simply states that the second antennae are not as stout as those of the female. In fact compared to the size of the two sexes the male has a stouter antenna. Of the second maxilliped Wilson states that in the male this appendage is reinforced at its distal end by a thick bony plate on the inner side. No such plate is present but the part mentioned is somewhat swollen. On the other hand, Wilson failed to observe the tubercular projections.

Wilson's original description is very lengthy but unfortunately lacks details. It is surprising that though the species is very common on bonito no attempt was hitherto made to redescribe the species, nor to re-examine the type.

Recently Shiino (1959) described *Caligus kuroshio* from *Katsuwonus pelamis* and *Thynnus thynnus* and the author (Pillai 1963) described the same from *Euthynnus affinis*. Kabata (1965) described it from *Euthynnus alleteratus*. While describing the material collected from Kerala as *C. kuroshio* I expressed the doubt that *C. kuroshio* might be the same as *C. bonito* Wilson. The present study shows beyond doubt that my suspicion is true. The only difference one finds in the females of the two species is the shape of the genital segment which in the Japanese species is comparatively broader. But outweighing this one finds exact resemblance even in the detailed structure of all the appendages. The second antenna, second maxilla and second maxilliped are the same in the respective males. Most interesting is the palp of the second maxilla which has an unusually stout seta present in both species.

If one compares the exceedingly good illustrations of *C. kuroshio* published by Shiino with those of *C. bonito* by Wilson one will be tempted to conclude that they are different. But the present illustrations of *C. bonito* based on cotype will I hope convince anyone that both are the same. Kabata found the two extremely similar but stated that in *bonito* the mandible is toothed on both sides but only on the inner

side in *kuroshio*. Actually Wilson illustrates and mentions teeth on both sides, but is this true? I have not seen this in any species of *Caligus*, at any rate it is not so in *C. bonito*. The oral aperture is guarded by a circlet of setae and if examined *in situ* these setae can appear as a row of spines on the outer border of the curved tip of the mandibles within. This is clearly what misled Wilson to describe the mandibles as serrated on both sides. On p. 498 (1905) he himself states that the mandible is serrated or crenated along the inner edges. Hence this cannot be a distinction between the two species. To substantiate my contention I am giving a few figures of *C. kuroshio* identified as such by Kabata.

### *Caligus savala* Gnanamuthu

(Figs. 81-101)

*Caligus savala* Gnanamuthu, 1948, p. 591, figs. 1-8; Pillai, 1965b, p. 1592, fig. 75.

*Caligus affinis* Kurian, 1961, p. 71, figs. 37-45.

*Caligus acutus* Kirtisinghe, 1964, p. 66, figs. 58-67.

#### *Material examined*

Two females and one male (cotype) collected by Gnanamuthu from Madras plankton. B. M. Cat. No. 1950. 2.3.1.

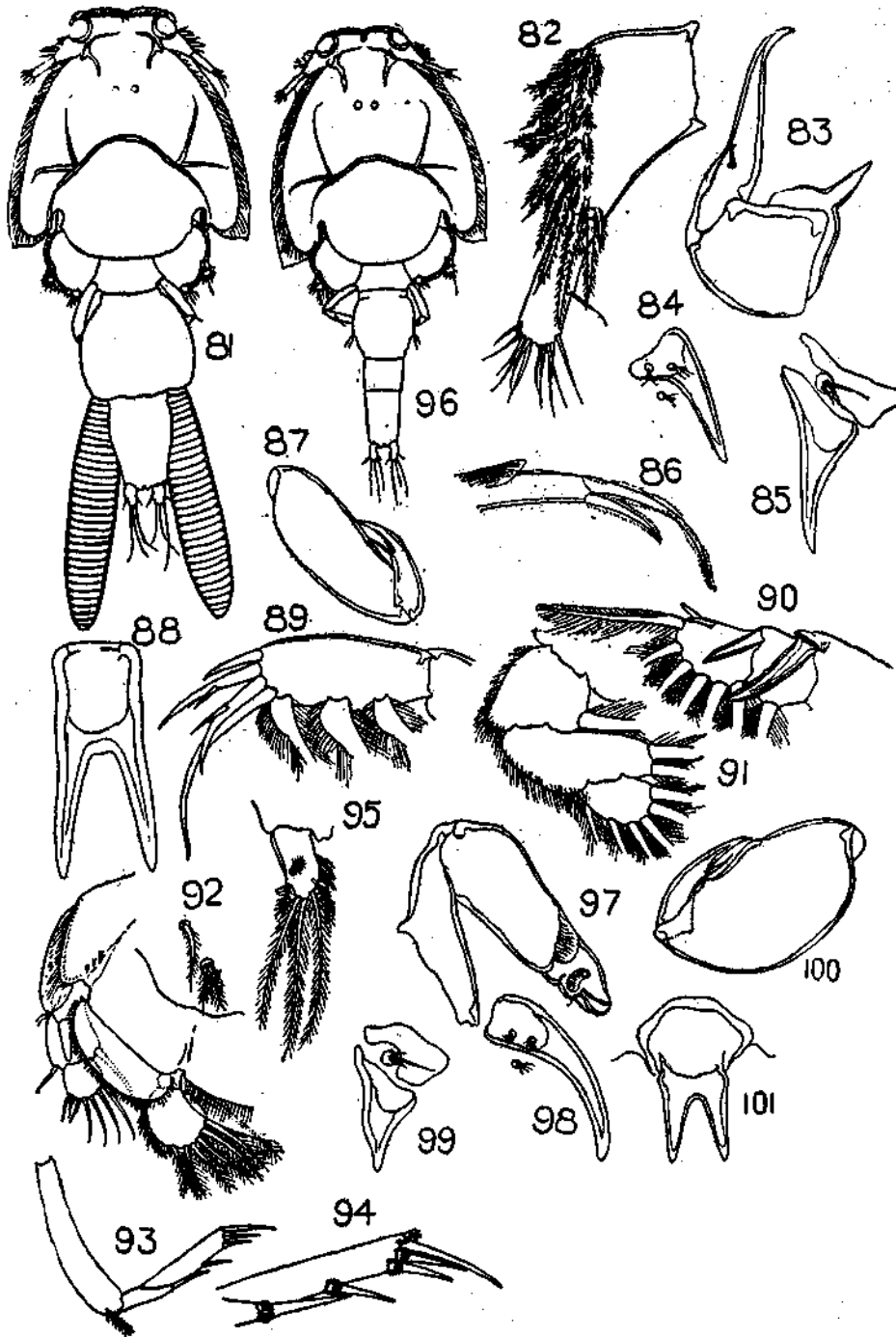
#### *Female*

Carapace is somewhat triangular with large projecting frontal plates. Lunules are comparatively large. Posteromedian lobe is perfectly rounded and projects well beyond the lateral lobes which are nearly one-third as broad as the median lobe. Posterior sinuses are wide open. The membranous flange of the carapace is fairly broad and posterolaterally projects as acute points giving the carapace a very characteristic appearance. Fourth thoracic segment is fairly large, as broad as long, overlapped by the median lobe of the carapace. Genital segment is swollen with a short anterior neck-like constriction, sloping anterolateral parts and rounded shoulder-like posterolateral parts. Abdomen is swollen, one-segmented and as long as the genital segment minus its neck. Anal laminae are large and each carries three long and three short setae. Egg sacs are short but stout, nearly twice the length of the abdomen.

First antenna is stout, its basal segment is armed with exceptionally long prominently hirsute marginal setae and one or two rows of short sub-marginal ventral setae. Distal segment is comparatively long. Second antenna has its basal segment produced into a very long apically acute spine; distal segment is only slightly curved at the tip and carries a proximal spine seta. First maxilla is an elongate triangular chitinous plate. Second maxilla is a similar plate with a broader base, its palp carries three setae. First maxilliped has the usual outer membranous lobe and two distal claws which have prominent flanges. Second maxilliped is comparatively feeble, its distal segment carries a prominent seta on the lower side. Sternal fork is very prominent, its stout base is as long as the tines which diverge towards the narrowly rounded apices.

The third segment of the first leg has three distal claws which are all slender and slightly curved, the claws regularly increase in size from the first to the third, second





FIGS. 81-101. *Caligus savala* Gnanamuthu

(81) Female, dorsal view; (82) first antenna; (83) second antenna; (84) first maxilla; (85) second maxilla; (86) first maxilliped; (87) second maxilliped; (88) sternal fork; (89) first leg, tip only; (90) second leg, exopod; (91) same, endopod; (92) third leg; (93) fourth leg; (94) same tip enlarged; (95) anal lamina; (96) Male, dorsal view; (97) second antenna; (98) first maxilla; (99) second maxilla; (100) second maxilliped; (101) sternal fork.

and third claws carry a prominent subsidiary spine. The spine seta at the lower distal corner is exceptionally large and devoid of hairs. The armature of the distal segment of the leg is very characteristic. First segment of the exopod of the second leg has a large, curved and flanged claw, second has a similar but smaller claw, third segment has a small claw, a blunt process corresponding to the first modified seta, one modified seta and five normal setae. Outer border of the segments of the endopod is armed with stiff hairs. Third leg has its rami set wide apart. The spine at the base of the exopod is straight and apically blunt. First segment of the exopod has one and second segment three-jointed spines and the latter four setae. The part of the apron outer to the insertion of the exopod is armed with sharp spines as illustrated. Fourth leg is three-segmented, basal segment is longer than the rest of the limb, second segment carries one and third four setae. The distal seta is abruptly longer than the penultimate. Fifth leg is represented by one and the sixth by two plumose setae.

Length 4.0 mm.

#### *Male*

Carapace is exactly like that of the female. Genital segment is barrel-shaped and only slightly longer than the second abdominal segment, it has a median lateral declivity housing the vestigial legs. Abdomen is two-jointed, second segment is nearly twice as long as the basal.

Second antenna is as usual modified, the second segment carries 2 corrugated pads, third segment is small. First maxilla is comparatively very large and slightly curved. Second maxilla is shorter but broader. The second maxilliped is very broad and where the dactylus closes there is a slight projection. The sternal fork has a broad base and feeble tines. There is no difference in the legs.

#### REMARKS

Kurian described *C. affinis* from *Euthynnus affinis*. As the name was preoccupied Kirtisinghe renamed it as *C. acutus*. There is no doubt that *C. acutus* is the same as *C. savala* Gnanamuthu. But one should admit that the original description of the species is far from satisfactory.

#### *Pseudocaligus parvus* (Bassett-Smith)

(Figs. 102-116)

*Caligus parvus* Bassett-Smith, 1898a, p. 5, pl. 2, figs. 1-2 ; Yamuguti, 1963, p. 57.

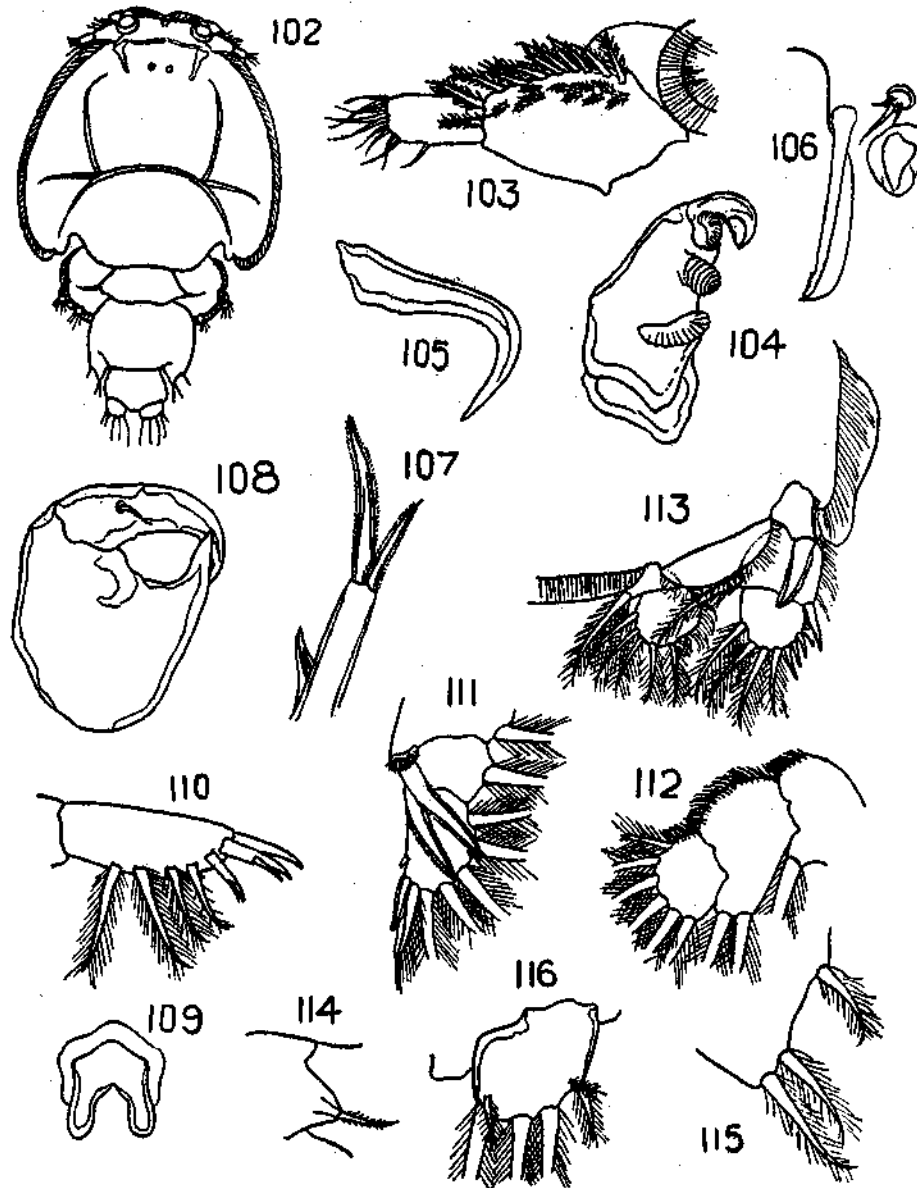
#### *Material examined*

Two males collected by Bassett-Smith from the gills of *Tetradon oblongus* at Bombay. Syntypes. Though Bassett-Smith's original collection included females I failed to locate any.

#### *Male*

Carapace is nearly as long as broad, with the cephalic area much longer than the thoracic. Frontal plates are low. Posteromedian lobe of the carapace is very broad and about three times the width of the lateral lobes, slightly overreaching the

latter and overlapping the fourth thoracic segment. Posterior incisions of the carapace are shallow. Fourth thoracic segment is broader than long and laterally drawn out. Genital segment is broader than long with perfectly rounded antero-



FIGS. 102-116. *Pseudocaligus parvus* Bassett-Smith

(102) Male, dorsal view; (103) first antenna; (104) second antenna; (105) first maxilla; (106) mouth tube and second maxilla; (107) first maxilliped; (108) second maxilliped; (109) sternal fork; (110) first leg, tip only; (111) second leg, exopod; (112) same, endopod; (113) third leg; (114) fourth leg; (115) fifth and sixth legs; (116) anal lamina.

lateral parts, posterolateral parts are drawn out into prominent lobes carrying the fifth and sixth legs. Abdomen is short and one-segmented. Anal laminae are partly sunk into the abdomen and each lamina carries four large and two small setae.

First antenna is short but stout, its second segment is less than half the length of the first. Second antenna, as usual among males, is provided with grooves and ridges, two on the large second segment and one at the base of the third; third segment is small and hook-like and carries a stiff seta at its base. First maxilla is very stout and curved almost at right angles in the middle. Second maxilla is very small, a mere blunt chitinous process; its palp carries three setae, one of which is very long. First maxilliped, as usual carries two unequal distal spines and a membranous lamina a little away from the tip. Second maxilliped is very characteristic, large and stout. Its second segment is produced on its inner aspect into a long stout apically pointed process against which the strongly falcate distal segment closes to produce an efficient chela. Sternal fork is rather small, the limbs are short, subparallel and apically rounded.

The distal segment of the first leg carries three distal hooks, of which the second and the third carry accessory claws. The lower border carries three plumose setae. The spine seta at the lower distal corner is sparsely plumose. The outer border of the segments of the endopod of the second leg carries weak spines in a row. Each of the first two segments of the exopod carries a long spine on its outer distal corner and the third segment carries a short blunt knob, two modified setae and five normal setae. Exopod of the third leg is three-segmented, the claw is only slightly bent inwards and has a serrate flange, endopod is two-segmented. Fourth leg is represented by a single seta, fifth by one seta and the sixth by two setae.

Length 2.2 mm.

#### REMARKS

In his description of both the male and the female of this species Bassett-Smith makes no mention of the fourth leg and his figures also do not show it. From this one should assume that he did not notice them or did not attach any importance to their absence. In the males that I studied the fourth leg is represented by a seta and this makes the transfer of this species to *Pseudocaligus* necessary.

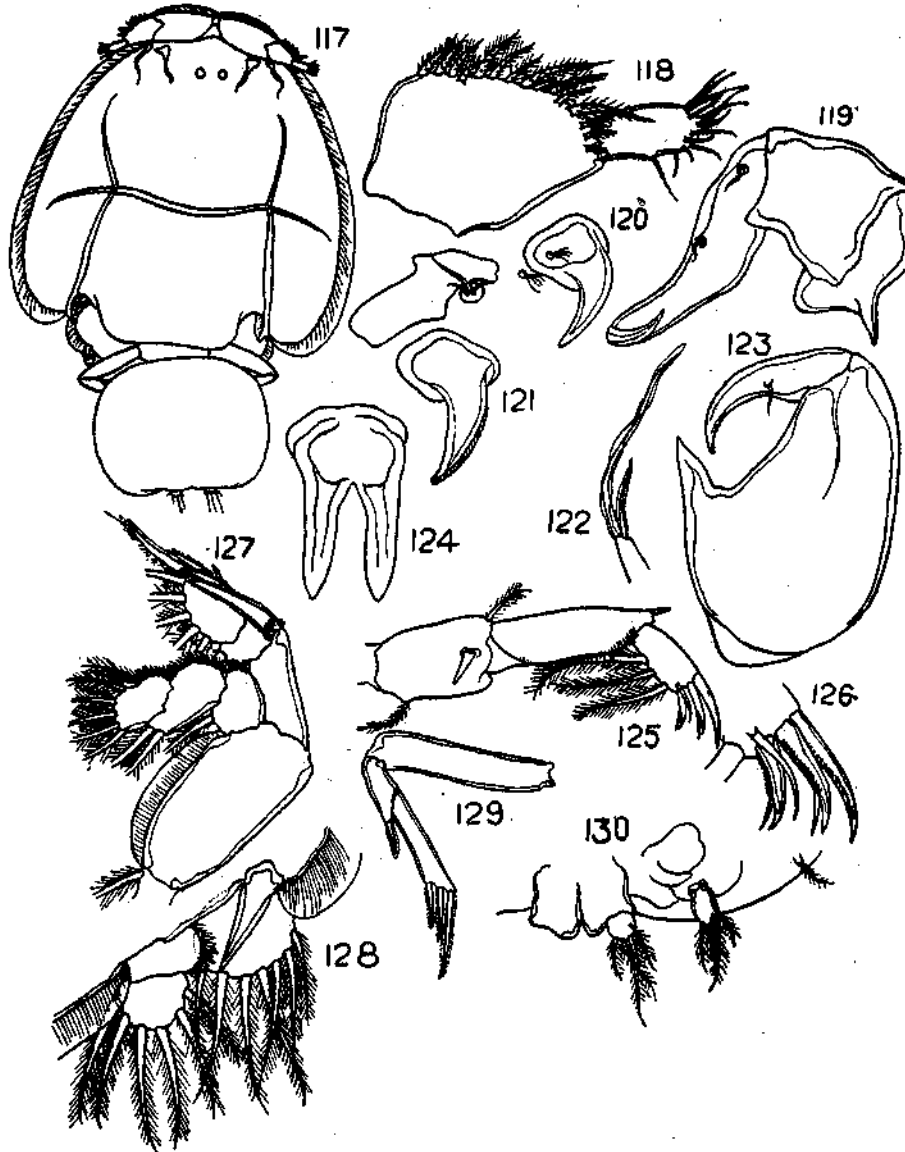
Bassett-Smith does not make any mention of the peculiar armature of the second antenna and in both sexes he seems to have failed to observe the second maxilla. In the second maxilliped the third segment carries a seta. In the description of the legs Bassett-Smith gives very few details. For example, the accessory spines on the claws of the end segment of leg one are omitted, the rami of the second leg are shown to be two-segmented, but they are three-segmented and the first two exopod segments carry very long spines not shown by Bassett-Smith. Likewise the basal claw of the exopod of leg three is flanged. His figures of the second maxilliped convey a wrong impression. It is exactly as in the female illustrated by him. He has mentioned only the sixth leg and not the fifth.

Wilson (1924) collected a single female from a larger group in Galapagos but apparently did not describe it.

*Anuretes perplexus* Bassett-Smith

(Figs. 117-130)

*Anuretes perplexus* Bassett-Smith, 1898a, p. 88, pl. 5, fig. 3; Kirtisinghe, 1964, p. 78; Pillai, 1965b, p. 1610, fig. 117.



Figs. 117-130. *Anuretes perplexus* Bassett-Smith  
 (117) Female, dorsal view; (118) first antenna; (119) second antenna; (120) first maxilla;  
 (121) second maxilla; (122) first maxilliped; (123) second maxilliped; (124) sternal fork; (125)  
 first leg; (126) same, tip enlarged; (127) second leg; (128) third leg; (129) fourth leg; (130) fifth  
 and sixth legs and anal lamina.

*Material examined*

Two females collected by Bassett-Smith from the gills of *Lutianus* sp. at Ceylon. B. M. Cat. No. 98.12.2.10.

*Female*

Carapace is comparatively very large and broad, nearly equal in length and width and gradually narrows backwards. Median transverse rib is slightly arched backwards so that the cephalic part of the carapace is longer than the thoracic. Frontal plates are prominent but do not project. Posterolateral lobes of the carapace are nearly half as broad as the median lobe, latter projects beyond the lateral lobes. Posterior incisions are wide open. Fourth thoracic segment is broader than long and is partly overlapped by the median lobe of the cephalothorax, but this is evidently due to slight distortion of the specimens on preservation. Genital segment is broader than long, with smoothly rounded sides. Abdomen is very small, almost obsolete and displaced to the ventral side of the genital segment. Anal laminae are just visible beyond the hind border of the genital segment, small and with five setae, one of which is very small.

First antenna has a stout basal segment carrying a row of long setae, distal segment is comparatively small. Basal segment of the second antenna is produced into a strong backwardly directed process, third segment is long and distally curved backwards, it carries two spine setae. First maxilla consists of a chitinised plate carrying a strongly curved claw. Second maxilla is similar to the first but larger and the claw is more straight, the palp with three setae, one of which is very long. The distal segment of the first maxilliped carries two greatly unequal apical spines, the longer of the two is nearly three times the length of the other. Second maxilliped is very stout, its second segment is produced at its proximal inner part into a pointed process which together with the third segment forms an efficient pincer. But the third segment when folded fails to reach the process of the second segment. Sternal fork has stout parallel limbs narrowing towards their apices. Apices are bluntly narrowed.

Distal segment of the first leg has three strongly barbed claws successively becoming shorter, second and third claws have prominent accessory spines. The spine seta usually seen between the claws and the setae is shifted to a position between the second and third claws. The setae arming the lower border are very long. Outer border of the endopod segments of the second leg is armed with a row of small but strong spines. Each of the first two exopod segments carries a long nearly straight spine with serrate flange. Third segment has two spines, a modified seta and five normal setae. Rami of the third leg slightly overlap. Basal spine of the exopod is straight and in addition to the spine there is only one more segment. Endopod is two-segmented or even one-segmented. What appears to be the basal segment may be the expansion of the apron, usually found in the leg of caligids. Fourth leg is three-segmented, third segment carries three spines of which the third is usually twice the length of the second. All the claws have a thin serrate flange. Fifth leg is composed of a single seta mounted on a small tubercle, and the sixth of a distinct oblong process carrying four setae.

Length 3.0 mm,

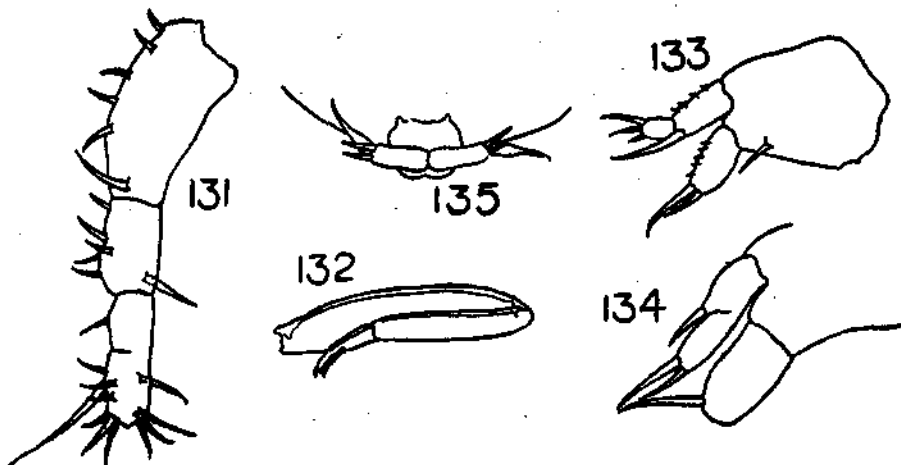
## REMARKS

In the figure of the entire animal Bassett-Smith shows the median lobe of the carapace as much more produced than it really is. Also the genital segment is clearly broader than shown by Bassett-Smith. He says that the sternal fork is small with short thick branches, their lengths equalling the breadth between the points. But in the specimen figured here the branches are really long and quite different from what he describes. The distal segment of leg one carries three strong claws, second and third with accessory spines and the spine seta is displaced which is of some significance in this genus and in some allied genera (Pillai, 1967). As shown by Bassett-Smith the anal laminae originate from the ventral side but their position may vary depending on the size and degree of contraction of the genital segment. The sixth leg also arises from the ventral side.

## Family DICHELESTHIIDAE

Genus *Hatschekia* Poche*Hatschekia ovalis* Bassett-Smith

(Figs. 131-135)



FIGS. 131-135. *Hatschekia ovalis* Bassett-Smith  
(131) First antenna; (132) second maxilliped; (133) first leg; (134) second leg; (135) anal lamina.

*Pseudoclavella ovalis* Bassett-Smith, 1898b p. 95, pl. 6, fig. 1; Yamaguti, 1963, p. 171, pl. 196, fig. 4.

*Material examined*

A single female 3.0 mm. long from the gills of *Serranus* sp. collected at Muscat, Gulf of Oman. B. M. Cat. No. 98.12.2.13.

## REMARKS

The British Museum has two females and these undoubtedly belong to *Hatschekia*. As described by Bassett-Smith the first antenna is three-segmented but

the third segment appears to be formed by the fusion of at least two segments. Contrary to what is stated by Bassett-Smith all the segments of the first antenna carry setae, one seta on the third segment is very long.

I did not make any attempt to study the cephalic appendage in detail. The end segment of the maxilliped is apically forked, and carries a prominent accessory spine. First pair of legs have a two-segmented exopod, first segment carries one and the second two setae. Endopod is one-segmented and carries two setae. Both rami have scale-like spines on the outer margin. Basipod has a spine seta inner to the insertion of the endopod. Second leg is larger than the first. First segment of the exopod carries one and the second two setae. Endopod has only one seta. Anal laminae carry three setae of which one is large with swollen base and slender drawn out distal part.

It is surprising that Yamaguti placed this species under Pseudocycnidae.

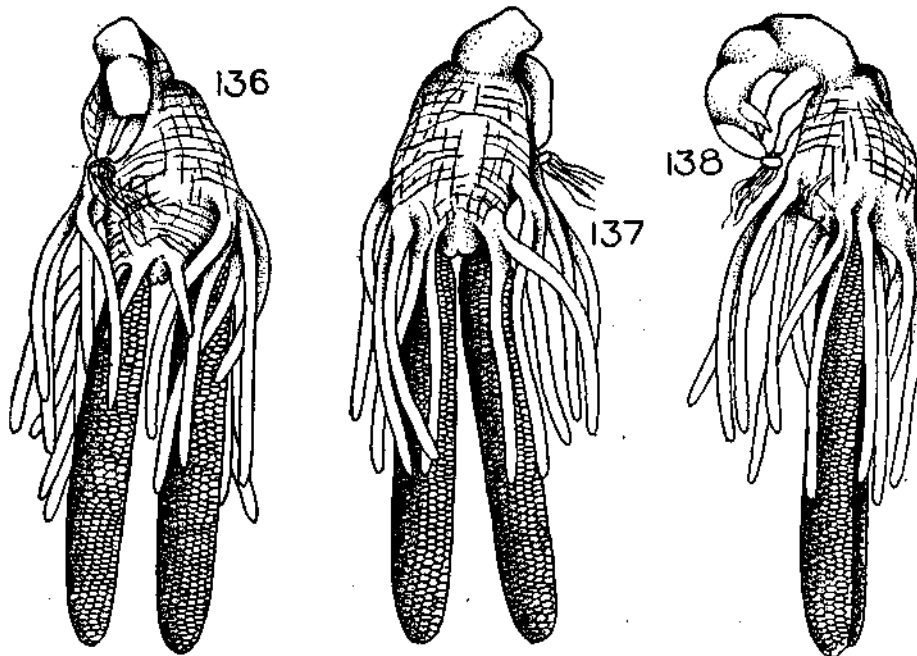
Suborder LERNAEOPODOIDA

Family LERNAEOPODIDAE

Genus *Thysanote* Kroyer

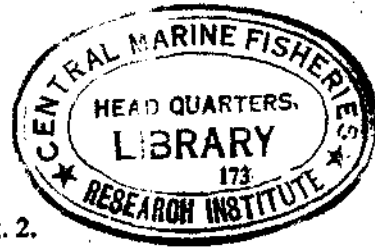
*Thysanote multifimbriata* Bassett-Smith

(Figs. 136-138)



FIGS. 136-138. *Thysanote multifimbriata* Bassett-Smith  
(136) Female ventral view ; (137) same, dorsal view ; (138) same, lateral view.





#### NOTES ON SOME COPEPOD PARASITES

*Brachiella multifimbriata* Bassett-Smith, 1898b, p. 96, pl. 6, fig. 2.

*Thysanotella multifimbriata*, Yamaguti, 1963, p. 264, p. 290, fig. 1.

#### REMARKS

There are two specimens of this species 7.0 mm. long in the British Museum, collected by Bassett-Smith from the gills of *Serranus* at Muscat, Gulf of Oman. B. M. Cat. No. 98.12.2.13. Wilson transferred this species to *Thysanotella* because of the peculiar nature of the male. But Bassett-Smith's figure of the male is obviously not correct and I do not have any hesitation to place this species in *Thysanote*.

The body of the female is very clearly demarcated into a long cylindrical cephalothorax bent downwards and a remotely triangular, dorsoventrally flattened trunk; the trunks show an abrupt expansion. The head is covered over by a distinct carapace. The trunk carries at its anterodorsal and ventrolateral corners a bunch of long cylindrical processes, each of which is composed of two dichotomously branched processes. In all, there are sixteen processes and they appear to form a girdle around the hind end of the trunk. The hind end of the trunk has a small bilobed abdominal process and a pair of ventral anal laminae, ventral to the egg sacs.

I did not study the appendages.

As the single male collected was lost while studying, there is no possibility of giving any information on that.

Evidently Bassett-Smith made his figures from a mounted specimen and that gave him a wrong impression of the shape of the genital segment of the trunk. As in other species of *Thysanote* the trunk is pear-shaped and rather thick with slight dorsoventral flattening and the processes originate from the four corners rather than from the two sides. This is evident from my figures of the animal from three different positions. The presence of body processes originating from the hind end of the trunk and from the maxillae is the crucial character of *Thysanote* and hence this species must come under it.

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