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OBSERVATIONS ON THE GENUS *HENIOCHOPHILUS* (COPEPODA) WITH A REDESCRIPTION OF THE TYPE SPECIES

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RECENTLY one of us (L.M.) made a collection of piscicolous copepods in which were twentysix females of *Heniochophilus* Yamaguti and Yamasu (1959). A detailed study of this rich collection has shown that *Anuretes branchialis* Rangnekar (1953) is the same as *Heniochophilus japonicus* Yamaguti and Yamasu (1959). As Rangnekar's description has priority, *H. japonicus* becomes a synonym of *H. branchialis* (Rangnekar). We give below a detailed description of the type species and notes on the affinities of the genus *Heniochophilus*.

Heniochophilus branchialis (Rangnekar)

Anuretes branchialis Rangnekar, 1953, p. 239, fig. 1 ; Yamaguti, 1963, p. 68.

Heniochophilus japonicus Yamaguti and Yamasu, 1959, p. 121, pl. 10, figs. 198-209 ; Yamaguti, 1963, p. 82, pl. 91, fig. 1.

Material examined : Twentysix females collected by Lal Mohan from the inner surface of the opercle of *Eleutheronema tetradactylum* (Shaw) caught at Navlakhi near Kutch (Arabian Sea).

Female : Cephalothorax is rather elongated, about one and a half times as long as broad and gradually broadening towards the tip of the postero-lateral lobes. Frontal plates are prominent, without lunules, membranous flange is fairly broad and conspicuous. Postero-median lobe of the cephalothorax is considerably enlarged and laterally overlaps the postero-lateral lobes of the cephalothorax with the result that the posterior sinuses are reduced to mere incisions. Beyond the level of the lateral lobes the median lobe expands into a large transversely oblong flap overlapping the anterior one-third of the genital segment, its hind border is slightly bilobed. The median transverse groove on the cephalothorax which demarcates the cephalic area from the thoracic is prominent and there is a pair of similar ridges just in front. A dorso-median longitudinal groove is also present. Fourth thoracic segment is much reduced in size and completely hidden under the postero-median lobe of the cephalothorax. Genital segment is roughly equal in length and width and nearly as broad as the cephalothorax, but the shape apparently varies depending on the degree of maturity of the ova within. Abdomen is almost completely fused with the genital segment and suppressed. The anal laminae, therefore, originate directly from the genital segment. Each lamina is a minute lobe

carrying five plumose setae, three of which are distal and two dorsal. None of the specimens carries egg sacs.

First antenna is two-segmented, first segment is triangular and armed with about eighteen moderately long plumose setae along the anterior border and two short dorsal setae. Originating from the posterior distal part is a long sharp spine. The distal segment is as long as the basal but slender, it carries a seta in the middle of its hind border and a distal bunch of ten setae, three of the distal setae are olfactory.

Second antenna is three-segmented, first segment is fused with the cephalothorax and produced into a backwardly directed apically rounded process, second segment is roughly rectangular, third segment is long, slender and strongly falcate and carries a small spinule on its upper margin. Associated with the second antenna is an elaborate chitinous plate.

First maxilla is very small.

Second maxilla is reduced in size and is a triangular apically rounded process. Its palp, contrary to what is usually found in caligids, is far removed from the maxilla and consists of three stiff setae one of which is very long. It appears that the maxilla got shifted from its usual position near the base of the mouth tube towards its tip and thus got separated from its palp.

First maxilliped consists of a short basal segment and a long slender distal segment, the latter carries two weak distal claws. At the distal third of its outer border the distal segment is suddenly narrowed exactly where the outer lobe is usually situated, but in the present species this lobe is absent. The inner distal claw is short and armed with pectinate wings. Outer claw is very long and at least three times as long as the inner and has broad pectinate wings.

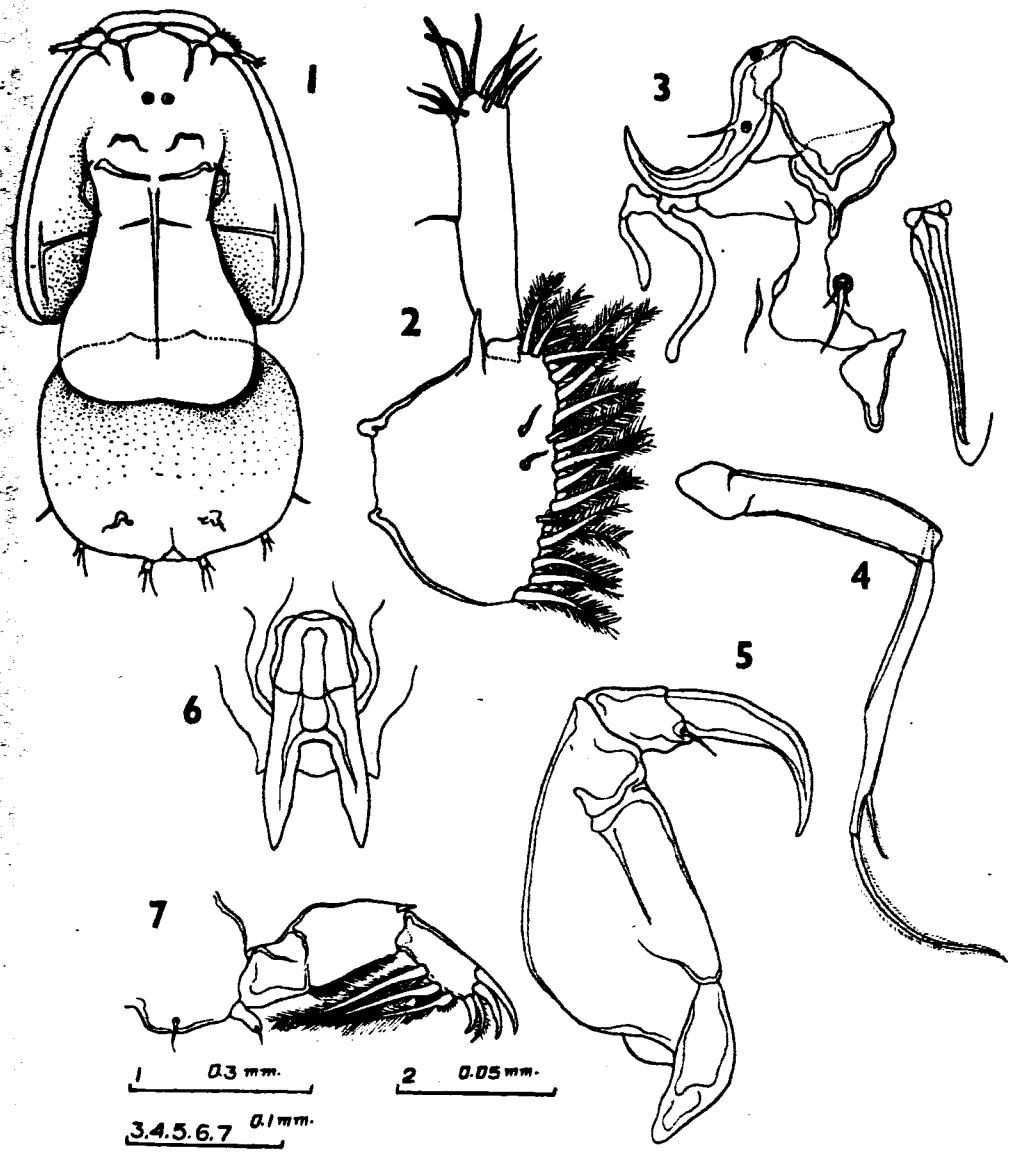
Second maxilliped is of the usual caligid type, basal segment is massive and has a nearly straight inner border, second segment is strong and distally curved at right angles, its inner border carries a spine.

Sternal fork is rather elongated, its base is nearly as long as the limbs, the latter are strong and slightly diverging with blunt tip.

Basipod of the first leg carries a seta on its hind border. Endopod is small and dumb-bell shaped, with an apical spinule. First exopod segment has a characteristic dorsal hump and a small sharp upper distal spine, its lower border is armed with a row of stiff spinules. Second exopod segment is more than twice as long as broad and is armed with three claws, a plumose spine seta and three long plumose setae. The first distal claw is long and unarmed, second is distally armed with teeth and the third is strongly barbed. The spine seta which is usually situated between the third claw and the first ventral seta is in this species placed between the second and third claws. The ventral setae are very long and their basal outer part is armed with a row of short stiff spinules and the rest of the border is plumose.

Second leg has a stout basipod carrying a long lower seta. First segment of exopod is as long as the second and third combined and carries a sharp tooth and a long stout barbed claw at the upper distal angle, the ventral margin is hairy and carries a seta. Second segment is short and carries one inner seta and a stout outer distal barbed claw. Third segment is twice the size of the second and carries a single short barbed claw and seven setae. The first seta is claw-like with pectinate

flange on both sides, second seta has a pectinate flange on the outer side and is plumose on the inner, the other five setae are plumose. First segment of the endopod



FIGS. 1-7. *Heniochophilus branchialis* (Rangnekar). 1. female, dorsal view ; 2. first antenna ; 3. second antenna, maxilla and mouth tube ; 4. first maxilliped ; 5. second maxilliped ; 6. sternal fork ; 7. first leg.

has an inner seta, outer part of the segment is expanded and fringed by a row of stiff hairs. Second segment has hairy outer and inner borders and there are two inner setae. Third segment carries five setae.

The apron of the third leg is comparatively very large and completely covers the fourth thoracic segment and part of the genital segment. The rami are placed close together and slightly overlap. The basal spine of the exopod is stout and only slightly curved, first segment of exopod is very small, second is large and oblong and has one inner and two distal plumose setae and four stiff spine-like outer setae. Endopod is two-segmented, segments are subsimilar, first segment has an inner spine and the second two stout plumose setae, outer border of both segments is hairy.

Fourth leg is three-segmented, first segment is slightly longer than the other two segments combined, first segment carries a long plumose distal seta, second a long spine and the third three spines, all the spines have pectinate flange, the last spine is twice as long as the penultimate.

Fifth leg consists of a single plumose seta on the lateral borders of the genital segment.

Sixth leg is formed of a short process carrying three plumose setae placed at the postero-lateral corners of the genital segment.

Length 1·7 mm.

Remarks : The description of this species by Yamaguti and Yamasu and by Rangnekar so clearly applies to the present specimens that we have no doubt that *H. japonicus* is the same as *Anuretes branchialis* Rangnekar. Of the two descriptions that of Yamaguti and Yamasu is more accurate, especially with regard to the illustrations.

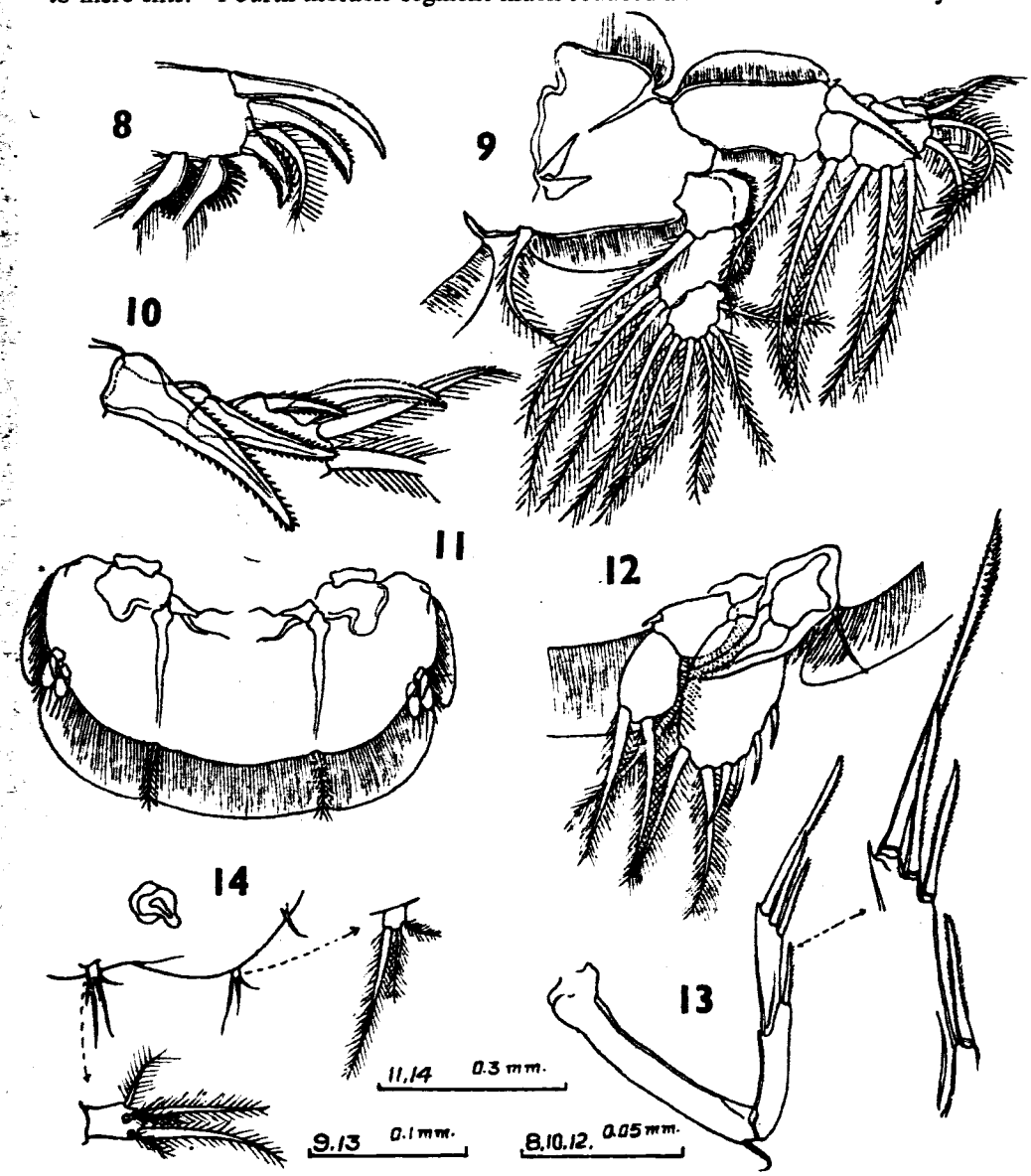
Rangnekar has shown the genital segment as narrowing backwards and Yamaguti and Yamasu as roughly squarish. We have illustrated it as more rounded. As already observed the shape of the genital segment shows a good deal of variation probably depending on the maturity of the ova. Rangnekar has shown the setae on the basal segment of the first antenna as almost of the same size but they are dissimilar as illustrated by Yamaguti and Yamasu. Rangnekar makes no mention of the palp of the second maxilla. This, as observed by Yamaguti and Yamasu, consists of one long and two short setae, slightly removed from the maxilla. Both Rangnekar and Yamaguti and Yamasu have not shown the spine on the distal segment of the second maxilliped. In the description and illustrations of the first leg both authors failed to record the fine structure of the claws and the setae arming the distal segment of the exopod of the first leg ; Rangnekar has shown four claws on this segment but as shown by Yamaguti and Yamasu there are actually three claws and a plumose spine seta. Yamaguti and Yamasu have not shown the vestigial endopod of the first leg. Rangnekar has illustrated the rami of the third leg as single-jointed, but they are clearly two-jointed.

Genus **Heniochophilus** Yamaguti and Yamasu

Heniochophilus Yamaguti and Yamasu, 1959, p. 124 ; Yamaguti, 1963, p. 81.

Definition : Head fused with the first three thoracic segments to form a cephalothorax which is longer than broad, cephalic area much shorter than thoracic. Frontal plates with broad membranous flange, lunules absent. Postero-median lobe of cephalothorax enlarged and produced backwards covering the fourth thoracic

segment and part of the genital segment, posterior sinuses of cephalothorax reduced to mere slits. Fourth thoracic segment much reduced and hidden both dorsally and



FIGS. 8-14. *Heniochophilus branchialis* (Rangnekar). 8. first leg, tip enlarged ; 9. second leg ; 10. same, tip of exopod ; 11. third leg ; 12. same, rami enlarged ; 13. fourth leg ; 14. fifth leg, sixth leg and anal laminae.

ventrally. Genital segment enlarged, nearly equal in length and breadth, as broad as cephalothorax. Abdomen reduced, anal laminae attached directly to the genital segment or the abdomen represented by a conical lobe carrying the anal laminae. Egg sacs cylindrical, with a single row of eggs.

Basal segment of first antenna with a lower distal process. First maxilla very small. Second maxilla small, shifted to the tip of the buccal tube away from its palp. Distal segment of first maxilliped without outer lobe. Sternal fork present. First and fourth legs uniramous, second and third biramous, apron of third leg enlarged and covering the fourth thoracic segment and part of the genital segment.

Male unknown.

Type species : *Heniochophilus branchialis* (Rangnekar).

Type locality : Bombay.

Type host : *Katsuwonus pelamys.*

Other hosts : *Heniochus acuminatus* and *Eleutheronema tetradactylum.*

Affinities : The one important character which distinguishes *Heniochophilus* from the other members of the family Caligidae is the extreme enlargement of the postero-median lobe of the carapace. To some extent the total suppression of the abdomen is also characteristic.

When the genus was created Yamaguti and Yamasu placed it unhesitatingly under Caligidae. In his most recent work Yamaguti (1963) created a new order Caligidea and under this recognised three superfamilies, Caligoidea, Dichelesthioidea and Lernaeoidea. Under superfamily Caligoidea there are five families, Dissonidae, Trebiidae, Cecropidae, Pandaridae, Euryphoridae and Caligidae. In the family Caligidae five subfamilies, Caliginae, Echetinae, Lepeophtherinae, Anuretinae and Mappatinae were created. *Heniochophilus* was placed under Lepeophtherinae.

According to the key given by Yamaguti (1963, p. 46) subfamily Caliginae differs from all the other subfamilies in the presence of lunules. But lunules are certainly present in the subfamily Echetinae also. On page 69 Yamaguti characterised the subfamily Echetinae as ' Caligidae without lunules ' but in the same page, under genus *Echetus* he says that the ' frontal plates are well defined, with lunules.' Lepeophtherinae is characterised as ' Caligidae without lunules, otherwise resembling Caliginae in general anatomy.' Under this subfamily he included *Abasia* Wilson. This genus, as shown elsewhere (Pillai, 1963) possesses lunules, though comparatively indistinct. Apparently Yamaguti relied on Wilson's original description which contains a few inaccuracies.

Following the key provided by Yamaguti one finds such close resemblance between *Heniochophilus*, *Pseudanuretes*, *Mappates* and *Eirgos* that it appears more natural to place all of them under the same subfamily. But Yamaguti placed *Pseudanuretes* under Anuretinae, *Heniochophilus* under Lepeophtherinae, *Mappates* under Mappatinae and *Eirgos* in a separate family Eirgidae. In *Eirgos* the third thoracic segment is said to be free and covering the fourth thoracic segment and part of the genital segment. If this is so the same is true of *Mappates*. Yet Yamaguti placed *Mappates* in Caligidae and *Eirgos* in Eirgidae. A detailed discussion on the taxonomic arrangement adopted by Yamaguti is beyond the scope of this paper but it appears that *Heniochophilus*, *Pseudanuretes*, *Mappates* and *Eirgos* should be placed in the same taxon, whether it is family or subfamily.

As stated above *Heniochophilus* shows affinity to several genera. In the reduced

condition of the abdomen it is related to *Anuretes* Kroyer and *Pseudanuretes* Yamaguti (1936). But in *Anuretes* the first maxilla is present and the postero-median lobe of the cephalothorax is not produced. In the last character also *Pseudanuretes* resembles *Heniochophilus* but can be distinguished by the absence of the maxillae and the much reduced condition of the fourth leg. *Mappates* Rangnekar (1958) resembles *Heniochophilus* in almost all characters. The postero-median lobe of the cephalothorax is considerably produced and covers the fourth thoracic segment and part of the genital segment. The apron of the third leg covers the fourth thoracic segment and part of the genital segment ventrally. As pointed out by Kirtisinghe (1964) Rangnekar's description of the abdomen of *Mappates* is wrong. It is reduced as in *Heniochophilus*. *Eirgos* Bere (1936) resembles *Heniochophilus* in the enlargement of the postero-median lobe of the cephalothorax and the complete suppression of the abdomen. Thus we find that the two characters, namely the prolongation of the postero-median lobe of the cephalothorax and the reduction of the abdomen, are found at least in four genera and these appear to indicate close affinity.

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