

THE NORTH AMERICAN SEMIPARASITIC COPEPODS OF THE GENUS CLAUSIDIUM.

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INTRODUCTION.

There has been much discussion with reference to those copepods which are found upon echinoderms, worms, mollusks, etc., as to whether they were to be regarded as free-swimmers, semiparasites, or true parasites.

A number of closely related forms are constantly found in the open ocean and are apparently genuine free-swimmers. And yet even some of these, like *Sapphirina*, are known to infest various pelagic animals at times. The fact that the parasitism is usually temporary, the copepods easily changing hosts or moving about freely in the water, is the disturbing element. There seems to be an unwritten opinion that once a parasite always a parasite ought to be the prevailing rule.

And when we come to examine the mouth parts we find that they are not suited either for mastication or for suction. They are rather adapted for licking up nourishment from the surface of the various organisms or from the walls of their inner (branchial) cavities.

And yet Sars has shown in his *Crustacea of Norway* (vol. 6, p. 142) that there is no doubt about the parasitic nature of these copepods.

One of the more sedentary forms is the genus *Clausidium*, which lives in the branchial cavity of certain *Calianassa* species.

DESCRIPTIONS OF GENUS AND SPECIES.

Genus CLAUSIDIUM Kossmann.

Hersilia PHILIPPI, Wiegmanns Archiv für Naturgeschichte, vol. 5, 1839, p. 128.

Clausidium KOSSMANN, Verhandlungen der phys.-med. Gesellschaft, n. s., vol. 7, 1875, p. 11.

In 1839 Philippi established a new genus and species which he named *Hersilia apodiformis*. Thirty-six years later Kossmann found specimens of the same copepod and, not knowing Philippi's paper, again made of them a new genus and species with the name *Clausidium testudo*.

Unfortunately, the name *Hersilia* had been twice preoccupied, once in 1816 by Savigny for an Arachnid genus and again in 1834 by Déjean for a genus of Coleoptera. Consequently it can not stand for a copepod genus, and we must accept Kossmann's generic name *Clausidium* and the specific name *apodiforme* given by Philippi. With the suppression of the name *Hersilia* the family name Hersiliidae must also be dropped, and Clausidiidae substituted in its place as has already been done by Sars.¹

The family is chiefly characterized, as Sars stated, "by the non-prehensile posterior antennae, the form of the anterior lip, the peculiar armature of the maxillae, and partly also by the structure of the maxillipeds."² The genus *Clausidium* may be thus diagnosed.

External generic characters of female.—General form short, broad, and strongly flattened; first thorax segment fused with the head, second and third segments free, fourth and fifth segments fused, and covered with a single plate. No eyes visible. Genital segment of varying length, abdomen three-jointed; egg strings very short, eggs multiseriate. First antennae seven-jointed, setose; second antennae nonprehensile, tipped with long setae; mandibles bearing a tooth and a tuft of hair; first maxillae knoblike, armed with short spines; second maxillae biramose, the endopod a bipartite spine, the exopod one or more plumose setae; maxillipeds with stout basal joints and small terminal joint, tipped with plumose setae. First four pairs of legs biramose, the endopods armed with sucking disks, the first pair still further modified for prehension; fifth pair uniramous, flattened.

External generic characters of male.—General form elongate, slender, much smaller than the female. Second, third, and fourth segments free, the dorsal plate on the latter covering the base of the fifth segment.

Genital segment with rudimentary sixth legs on the lateral margins. Abdomen three-jointed. Appendages like those of the female except the maxillipeds, which are two-jointed and armed with teeth and spines.

Characteristic habit of the genus.—The male and female are fastened together in 90 per cent of the adult specimens obtained. The male clings to the abdomen of the female by means of his maxillipeds and first legs, with his dorsal surface in the same direction as hers, and this adherence is maintained even in alcohol and preservatives.

Type of the genus.—*Clausidium apodiforme* (Philippi), monotypic.

KEY TO THE SPECIES.

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| 1. Genital segment with rudimentary sixth legs on its lateral margins; maxillipeds two-jointed and tipped with spines and teeth, males..... | 2. |
| 1. Genital segment with smooth lateral margins; maxillipeds four-jointed and tipped with long plumose setae, females | 3. |

¹ Crustacea of Norway, vol. 6, pt. 11, 1917, Copepoda Cyclopoida, p. 144.

² Idem, footnote.

2. Posterior corners of cephalothorax, second, and third segments prolonged backwards outside each following segment; spines at the posterior corners of genital segment.....*dissimile*, new species.
2. Posterior corners of cephalothorax, second, and third segments prolonged backwards outside each following segment; no spines on genital segment; fifth leg with fine hairs between the setae.....*vancouverense* (Haddon), 1912.
2. Posterior corners of cephalothorax, second, and third segments not prolonged; no spines at posterior corners of genital segment; cephalothorax widest at posterior margin.....*apodiforme* (Philippi), 1839.
3. Cephalothorax twice as wide as long; dorsal plate of fourth segment covering the base of the fifth legs, not reaching the abdomen; anal laminae a half longer than wide.....*dissimile*, new species.
3. Cephalothorax a quarter wider than long; dorsal plate of fourth segment covering the whole of the fifth legs and most of the abdomen; anal laminae three to four times as long as wide.....*apodiforme* (Philippi), 1839.
3. Cephalothorax a quarter wider than long; dorsal plate of fourth segment covering the base of the fifth legs, not reaching the abdomen; anal laminae as wide as long.....*vancouverense* (Haddon), 1912.
3. First antennae half as long as the body, with short rigid hairs; abdomen and genital segment half the body length, but with only three segments in both.....*caudatum* (Say), 1818.

CLAUSIDIUM DISSIMILE, new species.

Host and record of specimens.—Twenty-five specimens, including both sexes, were obtained by Prof. S. I. Kornhauser at Cold Spring Harbor, Long Island, in the summer of 1915 from the gill chamber of a species of *Callianassa* dug up on the beach. Besides the adults of both sexes there were also obtained many development stages. A male and female, fastened together in the characteristic manner already noted, and mounted in balsam, have been selected to serve as types of the new species, and have been donated by Doctor Kornhauser to the National Museum, Cat. No. 54080, U.S.N.M.

External specific characters of adult female.—First thorax segment fused with the head to form a cephalothorax, which is twice as wide as long and whose posterior corners are produced laterally and backward.

The antennal area is well marked, but there are no eyes, the places mistaken for them by Kossmann being probably the points of attachment of the second antennae. Second and third segments as wide as the cephalothorax, but only a third as long, and also produced laterally and backward. Fourth and fifth segments fused and covered with a single dorsal plate, which is twice as long as those on the second and third segments, but only three-fourths as wide, with rounded lateral angles and a strongly convex posterior margin. This plate projects far enough laterally to cover the entire basal joints of the fourth and fifth legs, but their rami project far beyond its posterior margin.

Through the center of the body the various dorsal plates are thoroughly fused together, but their prolonged lateral margins are

separated by narrow sinuses. The genital segment is short and wide, the width to the length in the proportion of 3 to 2.

The abdomen is three-jointed, the joints about the same length, but diminishing in width backward. The anal laminae are oblong, square-cornered, and convergent; each is armed with two setae, the inner of which is twice as long as the outer. The egg strings are attached to the sides of the genital segment, are about the same width as the latter, are three times as long as wide, and are slightly curved. The eggs are large and spherical, 25 or 30 in each string.

The first antennae are seven-jointed, the second joint the longest, the fourth the shortest, and all the joints heavily armed with setae. These antennae are attached to the ventral surface of the head, and in preserved specimens are turned inward and backward along the ventral surface of the carapace so as to be invisible in dorsal view.

The second antennae are three-jointed; the basal joint carries a long seta at its distal anterior corner; the terminal joint has a row of four long setae across the tip and one on the dorsal surface near the outer margin. The first maxillae are somewhat like those of *Ergasilus*, consisting of a short process armed with four setae. The second maxillae are biramose; the endopod is made up of a stout spine, bipartite at the tip, the inner branch longer than the outer; to the outer margin at about the center and to the ventral surface near the base are attached slender plumose setae, one in each place. The exopod consists of a stout plumose seta bearing on its inner margin near the base a secondary slender seta, the two being the same length as the endopod spine. The maxillipeds are made up of four joints, two longer basal joints and two shorter terminal ones. Each of the former carries two plumose setae on its inner margin at the center; the terminal joint is tipped with a tuft of plumose setae while the penultimate joint carries a single seta on its outer margin.

In the peculiarly modified first legs the large flattened spine or plate on the inner margin of the endopod is short and blunt, quite different from the slender, acuminate-pointed plate of *apodiforme*. The spine at the inner margin of the second joint is foot-shaped, with a bluntly rounded toe; the spine at the base of the process on the third joint is stout and bluntly pointed. The process itself is wide, longer than the spines and tipped with a claw; it is armed with three sucking disks. The exopod is three-jointed; the two basal joints each have a single spine on the outer margin, while the terminal joint has two on the outer margin and two at the tip, of which the inner one is considerably the longer. The second, third, and fourth legs are similar to those of *apodiforme*, with slight differences. In the fifth legs there are three spines at the tip, of which the central one is the longest and a fourth on the outer margin near the center.

Total length, 1.40 mm. Width of cephalothorax, 1 mm. Length of egg strings, 0.40 mm.

External specific characters of immature female.—General body form elongate and slender, the exact reverse of that in the mature adult. In the latter the total length is to the width of the cephalothorax as 10 to 7, while in this immature female the proportion is nearly as 3 to 1. The cephalothorax is elliptical, the length and width being about the same; the prolongations at the posterior corners take more of a backward and less of a lateral direction. The second and third segments are considerably narrower than the cephalothorax, and are prolonged at their posterior corners similarly. The dorsal shield on the fourth segment is strictly confined to that segment and does not overlap even the fifth segment; it is about the same width as that on the third segment. The fifth and genital segments are uncovered and wholly visible in dorsal view. The fifth segment is contracted anteriorly into a sort of neck and then widened through the bases of the fifth legs. The genital segment is trapezoidal in outline. The abdomen is three-jointed and three times as long as wide; the anal laminae are slender, much longer than wide, and each is armed with two short setae on the outer margin and two much larger ones at the tip, of which the inner is fully twice the length of the outer.

The first antennae are relatively longer than in the adult, and the other appendages are about the same, except the swimming legs, whose rami have only two joints instead of three.

Total length, 0.90 mm. Width of carapace, 0.32 mm.

External specific characters of male.—General body form about halfway between those of the mature and immature females. It is not as slender as the young female and much less thickset than the mature adult. The cephalothorax is nearly orbicular, the same width and length. The second and third segments are considerably narrower and quite short. Their posterior corners and those of the cephalothorax are prolonged backward; those of the third segment reach well beyond the center of the fourth segment and are bluntly rounded. The dorsal plate of the fourth segment is quadrangular, three-fourths as long as wide, and overlapping the bases of the fifth legs. The genital segment is also quadrangular and carries the rudiments of a sixth pair of legs on its lateral margins at about the center; at each posterior corner is a long spine. The abdomen is three-jointed, the last joint irregularly divided. The anal laminae are oblong and like those of the female, but each carries four setae, three at the tip and one on the outer margin. The inner one at the tip is the longest and is fully twice the length of the next in size. The appendages are very similar to those of the female, the chief differences being found in the maxillipeds and first legs, both of which are used as prehensile organs.

Total length, 0.67 mm. Width of cephalothorax, 0.30 mm.

CLAUSIDIUM CAUDATUM (Say).

Binoculus caudatus SAY, Journ. Acad, Nat. Sci., Philadelphia, vol. 1, 1818, p. 437.

Host and record of specimens.—This parasite was found in considerable numbers on various parts of the body of *Callianassa major* Say, dug from the sand of the bay shore of the St. John River in Florida by Thomas Say.

External specific characters of female.—Body subovate; cephalothorax semioval or parabolic, posterior edge retuse for the reception of the free thorax; anterior antennae horizontally extended, more than half as long as the body, with short, rigid hairs. Basal segments of free thorax very short, transverse; terminal segment longer, semiorbicular, narrower than the preceding ones and concealing the genital segment; abdomen and genital segment half as long as the body, with three segments, the basal one (genital segment) longitudinally quadrate, the second one transversely quadrate, the third segment bifid and bisetous at the tip. Length, 0.82 mm.

In nine-tenths of the specimens the two sexes were taken together, the male clinging to the abdomen of the female so as to conceal by his body the two terminal segments.

Remarks.—The above description is modified from the one given by Say and somewhat condensed. The nomenclature has been changed to agree with that now in use for the copepods, but otherwise the statements are as Say gave them. They leave no doubt of two things—first, that he was describing a species of *Clausidium*, and second, that it differed from the other species in important particulars. In referring the species to its genus Say declared: "I have placed this parasite in Geoffroy's genus *Binoculus*, not in consequence of the particular definition of that genus, but from a general resemblance in the outline and similarity in the number and proportion of the segments of the body, which it unquestionably bears, to the singular animal discovered by that author, now the type of the genus." This "singular animal" was the European *Argulus foliaceus*, and it is very evident that Say was not dealing with anything belonging to that genus.

Accordingly we may transfer his species to the genus *Clausidium* and retain its specific name until future research can furnish us the details necessary to fully establish it.

EXPLANATION OF THE PLATES.

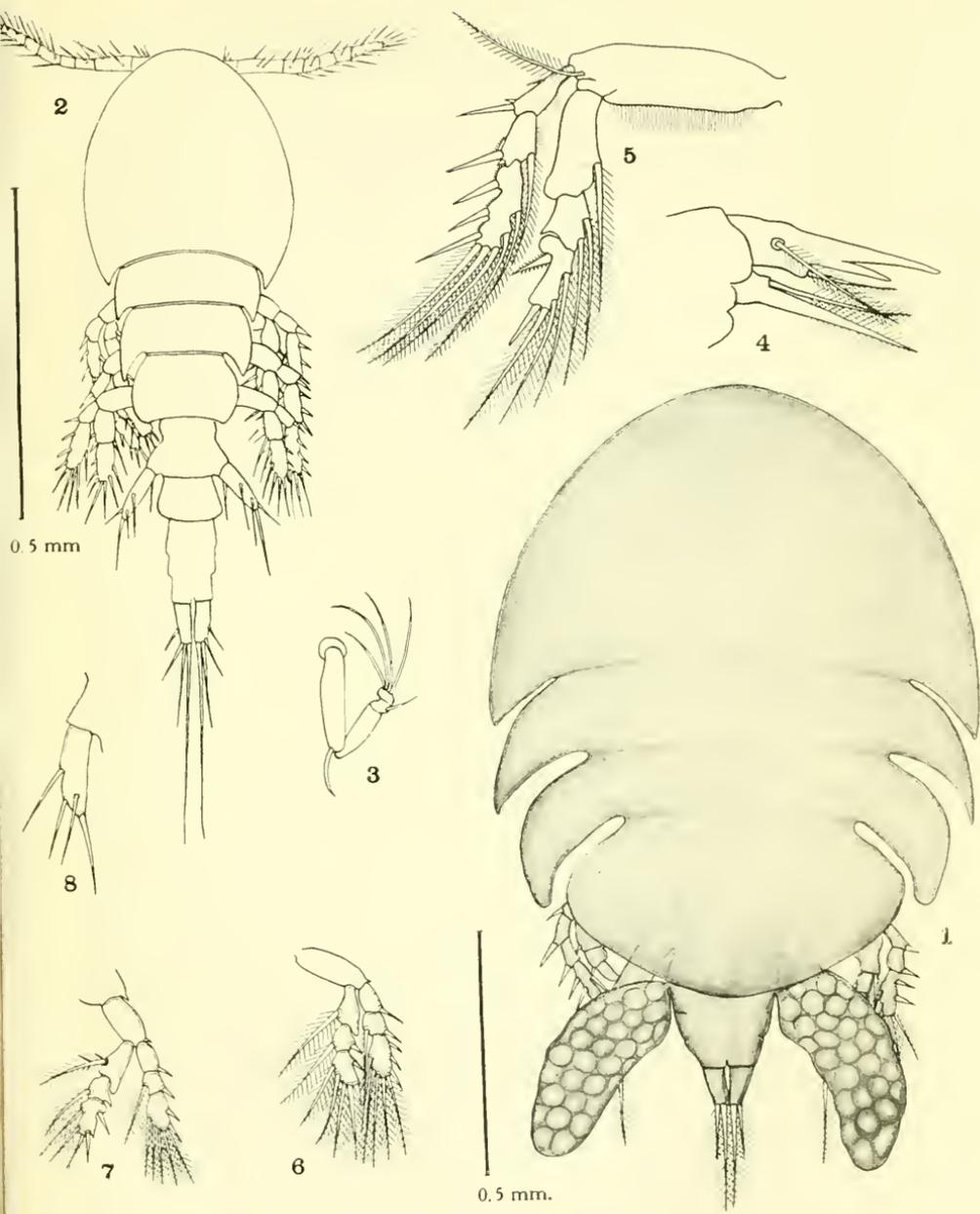
PLATE 94.

Clausidium dissimile, new species.

- FIG. 1. Dorsal view of adult female.
2. Dorsal view of immature female.
3. Second antenna of female.
4. Second maxilla of female.
5. Second legs of adult female.
FIGS. 6-8. Third, fourth, and fifth legs of male.

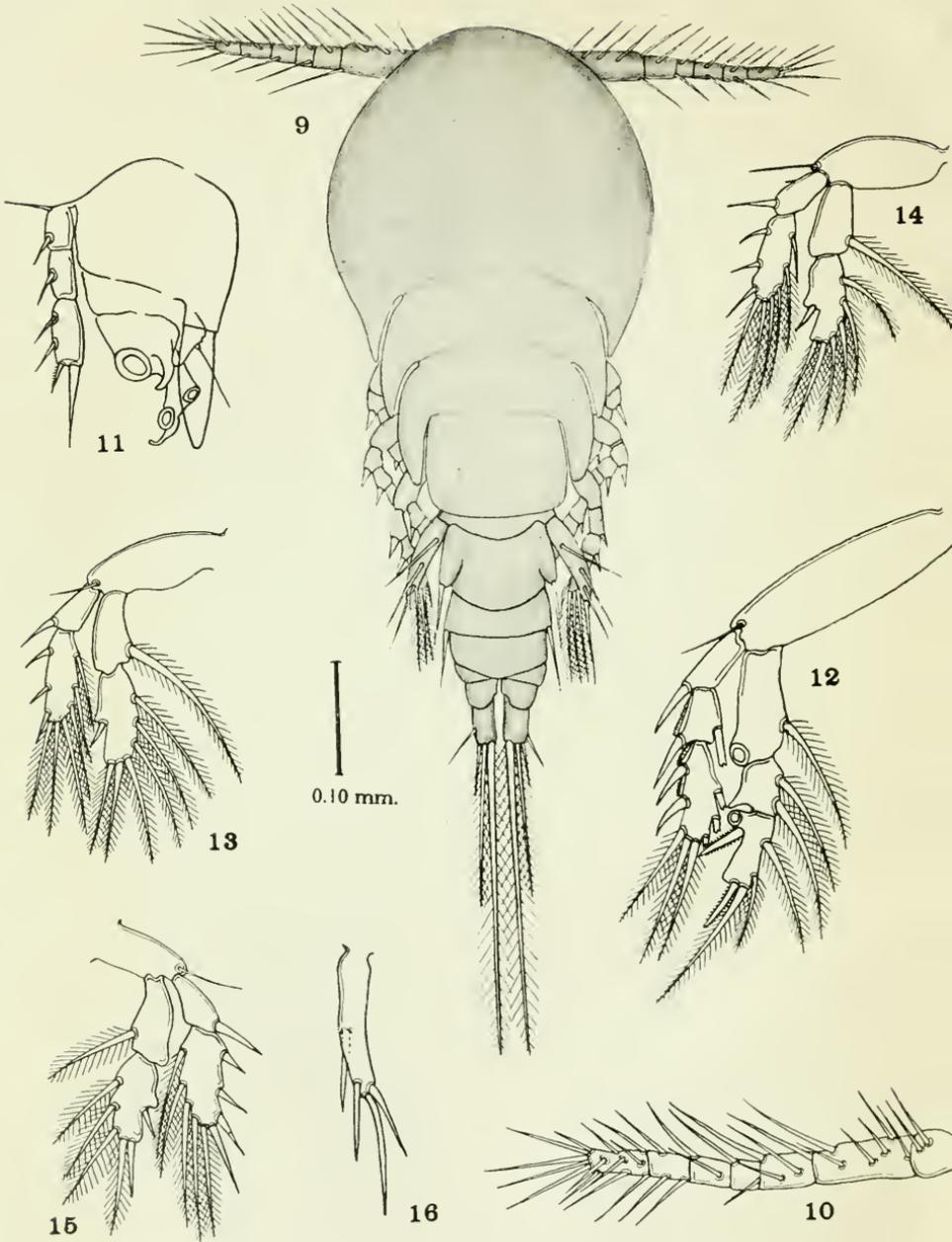
PLATE 95.

- FIG. 9. Dorsal view of male.
10. First antenna of female.
11. First swimming leg of female.
12. Fourth swimming leg of female.
FIGS. 13-15. Second, third, and fourth swimming legs of immature female.
FIG. 16. Fifth leg of adult female.



CLAUSIDIUM DISSIMILE, A NEW SPECIES OF COPEPOD.

FOR EXPLANATION OF PLATE SEE PAGE 431.



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