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ON A PARASITIC COPEPOD OF THE CLAM.

BY PROFESSOR R. RAMSAY WRIGHT.

SINCE the researches of Dana, published between thirty and forty years ago, comparatively little attention has been given to the Copepoda in America. So much is this the case that Gerstæcker in his account of the geographical distribution of the order,¹ mentions only sixteen species as inhabiting the fresh waters and coast region of North America, the described forms being all fish parasites. Of late, however, important contributions to the knowledge of the fresh-water, free-living forms have appeared in this journal,² and new parasitic species have been

¹ Bronn's *Thierreich*, Vol. v, c. 1876, p. 799.

² S. A. Forbes. *Entomostraca of Lake Michigan*, Vol. xvi.

C. L. Herrick. *Heterogenetic development in Diaptomus*, Vol. xvii.

added by Kellicott¹ and myself² to the list of those already described.

That much remains to be done in this direction may be gathered from the common occurrence in the gill-tubes of the ordinary long clam (*Mya arenaria*) of an interesting form, so large as to occasion surprise that it has hitherto escaped notice.

At the recent meeting of the Am. Assoc. for the Advancement of Science in Philadelphia, I proposed the generic name *Myicola* for the copepod in question, and shall describe the species as *M. metisiensis*, from the village of Little Metis, on the Gulf of St. Lawrence, where the specimens were taken.

The order Copepoda affords most interesting material for the study of various grades of parasitism. At one end of the series are the completely free forms, at the other the completely parasitic, in the adults of which it is often impossible to recognize any resemblance to the copepod type. But no important gap exists in the whole series. Even among those with well-developed jaws (Gnathostomata of Thorell) the Notodelphyidæ only occur as commensals in the branchial sacs of tunicates, while before we reach the completely parasitic forms, where the mouth is converted into a sucking tube (Siphonostomata), we find a large number of forms (the Poecilostomata of Thorell), some free and some semiparasitic, where the parts of the mouth are evidently formed for piercing soft tissues and thus obtaining fluid nourishment.

To the last section belong the Corycæidæ, Sapphirinidæ, Lichomolgidæ, Ergasilidæ, to which groups some authors accord family rank, while others are disposed to regard them as constituting a single family (Corycæidæ). It may be stated generally that while the fish parasites are chiefly Siphonostomata, and the ascidian commensals chiefly Notodelphyidæ, the copepod parasites of the other groups of the animal kingdom—Mollusca, Vermes, Echinodermata, Cœlenterata—are largely Poecilostomata. Thus members of this group have been found on the gills of cuttlefishes, on the delicate branchiæ of nudibranchs, in similar situations on marine annelids and holothuroids, and on the soft tissues of sea-pens and other cœlenterates.

The clam parasite also belongs to the same group, as do all

¹ Proc. Am. Soc. Micros., II and IV.

² Proc. Can. Inst., N. S. Vol. 1, p. 243.

the Copepoda parasitic on Mollusca with the exception of the *Penella* larvæ found on the gills of cuttlefishes, the *Artotrogus* from the egg-sacs of *Doris*, and certain species of *Splanchnotrophus*, which bore into the skin of nudibranchiates.

Hitherto, so far as I have been able to determine, only three cases of Copepoda parasitic on lamellibranchiates have been recorded, viz., *Anthessius solecurti* Della Valle, on the external surface of *Solecurtus strigillatus*,¹ *Modiolicola insignis* Aurivilius, from the gills of *Modiola vulgaris* and *Mytilus edulis*,² and *Pacalabius tumidus* Kossmann, from the pericardium of *Tridacna* (Philippines),³ I have not had access to the description of the last-named form, which belongs to the Ergasilidæ, and, according to Aurivilius, shares the great development of the cephalothorax, the absence of appendages on the fifth segment and the long egg-sacs with the genus *Ergasilus*. The two other forms are closely related to *Lichomolgus*, and apparently still more closely allied to each other, for a comparison of the figures shows that their most divergent characteristics, the mouth parts and the fifth pair of thoracic appendages, do not present greater differences than are to be met with in the range of the genus *Lichomolgus*.⁴ Further investigation will show whether it is desirable to retain them in separate genera.

It will appear from the following generic diagnosis of the clam parasite that it occupies a position intermediate between *Lichomolgus* and *Ergasilus*:

Myicola, n. g.—Cephalothorax of ♀ oblong, of ♂ pyriform, composed of six segments, the last of which is reduced in size and carries a pair of uniramous appendages. Abdomen as in *Lichomolgus*. Anterior antennæ of seven joints, posterior of four, robust, the basal joint tumid, the terminal one converted into a single strong claw; mandible with triangular base and several setose lobes. Maxilla as in *Lichomolgus*. First pair of maxillipedes robust, three-jointed, the basal joints tumid, the terminal one carrying two setose filaments. Second pair of maxillipedes absent in ♀, resembling those of *Lichomolgus* in ♂. Natatory feet as in *Anthessius* and *Modiolicola*.

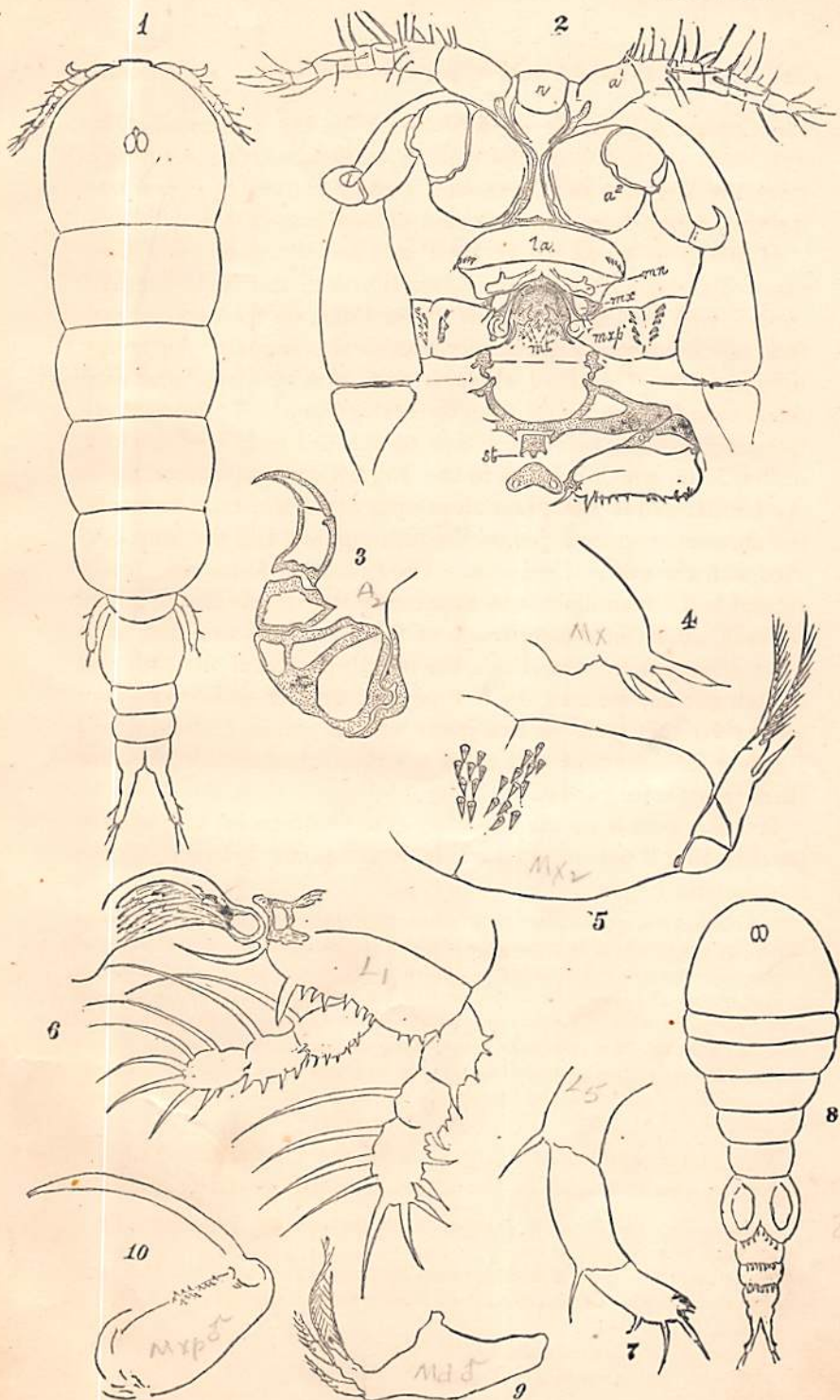
This genus approaches *Ergasilus* in the conformation of the posterior antennæ and in the absence of the posterior maxilli-

¹ Della Valle. Sui coriceidi parassiti, e sull'anatomia del gen. *Lichomolgus*. Mitth. Zool. Stat. Neapel, II, 102.

² Aurivilius. Bidrag till Kännedomen om Krustaceer som lefva hos Mollusker och Tunicater, pp. 9 and 39, Sep: imp: from "Oef: Kongl: Vet-Ak: Förh.," Stockholm, 39 Arg.

³ Kossmann. Zool. Ergebnisse, Leipz., 1877.

⁴ cf. Brady. Brit. Copepoda, Vol. III.



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pedes in the female. In the proportionate size of the thoracic segments, the position of the mouth and the conformation of the natatory feet, it approaches on the other hand the Lichomolgidae, and especially those forms already found in Lamellibranchiata. The dimorphism of the cephalothorax, which is more striking than in any of the allied genera, is no doubt to be attributed to the cylindrical form of the water-tubes of the gills in which the females live.

If Lichomolgus and the Saphirinidae be merged into the family Corycæidæ, as seems the most natural arrangement (cf. Claus, Lehrbuch der Zoologie, p. 554; and Brady, Zoölogy of the Challenger expedition, Vol. VIII, p. 109, *et seq.*), then the existence of the above described genus renders imperative the acceptance of Della Valle's proposal to include Ergasilus in the same family (*l. c.* p. 83). So extended, the family of the Corycæidæ would embrace some free and some semiparasitic forms, some parasites of pelagic animals, and a few whose females at least are constant parasites of Pisces, Mollusca, Vermes and Cœlenterata.

The following description of the species will, with the help of the figures, serve to elucidate its most important characteristics:

Myicola metisiensis, n. sp. ♀ 3^{mm} long, of which 1^{mm} belongs to the abdomen, inclusive of the furca. ♂ 1.75^{mm} and less. First four free thoracic segments of ♀ subequal, broader than long, the fifth smaller than the first abdominal segment and chiefly developed dorsally. Thoracic segments of ♂ gradually decreasing in breadth from before backwards. Double genital segments of ♀ abdomen nearly as long as remaining three segments. The posterior borders of the genital and two following abdominal segments of ♂ denticulated. Furcal segments as long as two last abdominal; setæ six, of which three are apical and one subapical. Rostrum shield-shaped; anterior antennæ as long as the head, the first, second and fifth joints the longest. Posterior antennæ directed downwards; shorter than the anterior. Labrum with lateral borders denticulated, and posterior border emarginate. Mandible with two setose lobes and two setose filaments. Maxilla with three setæ, of which the mesal is longest. Two basal joints of anterior maxillipede tumid, with two converging oblique patches of spines, the distal joint with a strong seta and terminating in two curved setose filaments of which the slenderer is attached like a palp. Posterior maxillipede of ♂ with basal joint denticulated. Basal joint of 1st pair of natatory feet with a row of strong spines on the ventral surface, decreasing in strength on the 2d and 3d pairs, and absent on 4th; 5th pair uniramous, with three joints, the two proximal of which carry each a distal seta, while the distal has two apical setæ and a subapical group of spines.

Egg-sacs two, cylindrical, 1^{mm} × 0.5^{mm}.

Spermatophores subpyriform, 0.2^{mm} × 0.1^{mm}.

♀ parasitic in the gill-tubes of *Mya arenaria*, at Little Metis, Quebec, Canada.

♂ free in the mantle cavity of *Mya*.

I have not thought it necessary in the above diagnosis to give

an exhaustive account of the form of the appendages. If a second species of the genus should be found, diagnostic marks will be readily obtainable from the figures. The anatomy of the soft parts appeared to agree so completely with Della Valle's account of *Lichomolgus sarsii*, that I abstain from any description thereof.

There are two points of some interest which I have not referred to in the diagnosis. The mouth corresponds in position nearly to the notch of the labrum, and is situated between the points of the mandibles. Behind this point is a sort of vestibule bounded by the distal joints of the anterior maxillipedes, the dorsal wall of which is formed by the sternal surface between the basal joints of the mouth parts. A crescentic row of minute spines follows the curve of the maxillipedes, and two pointed chitinous processes project into the vestibule further back. These are connected with the chitinous framework surrounding the sockets of the mouth-parts. I have not had the opportunity of observing whether they play the part of teeth. They appear to me comparable to the lobes of the *Metastoma* (unterlippe) described by Claus¹ for *Nereicola*. A further agreement with that genus is the presence of a chitinous process which corresponds in position to the absent posterior maxillipede, and is no doubt a rudiment of that member.

I have met with no trace of the sixth pair of limbs described by Della Valle as projecting from the anterior half of the genital segment in *Lichomolgus* and do not hesitate to reckon all of the double genital segment to the abdomen.

The presence of female *Mycolæ* in the gill-tubes of a clam is readily detected by local swellings of the tube corresponding to the length of the parasites. With a needle they are readily freed, and swim about with considerable velocity considering that their legs have not been stretched since they were imprisoned in the gill. I am unable to say by what channel they reach their resting place. I have found some in the suprabranchial chambers, which would seem to indicate entry through the cloacal siphon, while I have found others, head upward, in the gill-tubes, which would appear to argue an entry, while still in the nauplius-stage, through the inhalant siphon and the water-pores of the gill-plates.

¹ Zeit : wiss : Zool., xxv, p. 342, pl. xxiii, fig. 21.

No considerable irritation appears to be set up by the presence of the parasite in the gill-tubes. The claws of the posterior antennæ and the setæ of the various appendages are often invested by a yellowish film undoubtedly derived from the blood of the host, but no greater exudation resulting in the formation of a cyst round the foreign body is to be observed, such as, *e. g.*, surrounds a Trematode sporocyst in a fresh-water mollusk. The granular contents of the intestine of the Copepod have a bluish-green tint, which is most readily noticed in the wider rectum, but I must leave undecided whether these are derived from the blood of the host.

The development of *Mycicola* appears to resemble that of *Lichomolgus* closely. When I first collected the parasite in June, the eggs were in various stages of development; in August, when I was at liberty to study them, the females had lost their egg-sacs.

The difference in form of the male has been already referred to; the contrast in locomotion is just as striking; its movements are as rapid as those of a Cyclops. Further investigation must show how the females are impregnated. The presence of a well-developed posterior maxillipede in the male would appear to indicate that the female is clasped by these, while the spermatophores are attached to the genital orifice. If such is the case this must occur in the suprabranchial chamber before the female has become tightly wedged into a gill-tube.

Whether *Mycicola* will turn out to be associated with *Mya arenaria* wherever the latter occurs, must be left for the future to decide. A search for Copepoda in other lamellibranchiates would probably yield other interesting forms, although they are hardly likely to be of such large size as the species at present described. I searched *Mytilus* and *Mesodesma* at Metis without detecting any such.

Some idea of the frequency of the copepod may be gathered from the circumstance that twenty-five females were obtained from fifteen clams out of forty examined.¹ Only one male was observed in this gathering, but their small size and comparatively free life favor their escaping notice. This observation, further, was made in August, when the females had, almost without ex-

¹ Three Malacobdellæ were found in the same.

ception, lost their egg-sacs. It is possible that the males would be more frequently met with in June or July.

EXPLANATION OF PLATE III.

(The drawings are all outlined by Zeiss camera lucida, and reduced by one-third.)

Fig. 1, Gundlach $1\frac{1}{2}''$ \times Zeiss Oc. II.

Figs. 2, 3, 8, Zeiss A \times Zeiss Oc. II.

Figs. 4, 5, 6, 7, 10, Zeiss D \times Oc. II.

Fig. 9, Zeiss Hom. Im. $\frac{1}{8}$ th \times Oc. II.

FIG. 1.—*Myicola metisiensis* Ramsay Wright, ♀ from above.

- " 2.—Head and part of 1st thoracic segment from below. *r*, rostrum, *a*¹, anterior, *a*², posterior antenna; *la*, labrum; *mn*, mandible; *mx*, maxilla; *mxp*¹, anterior maxillipede; *mt*, metastoma; *st*, the somewhat complicated sternal apparatus of the 1st pair of natatory feet.
- " 3.—Posterior antenna, indicating the chitinous framework of the different joints.
- " 4.—Maxilla.
- " 5.—Anterior maxillipede.
- " 6.—First pair of natatory feet.
- " 7.—Fifth pair.
- " 8.—♂ from above.
- " 9.—Mandible of ♂.
- " 10.—Posterior maxillipede of ♂.