

*Nitocrameira bdelluræ*, nov. gen. et sp., a Copepod of the Family Canthocamptidæ, parasitic in the Egg-cases of *Bdellura*. By J. A. LIDDELL.  
(Communicated by Prof. G. C. BOURNE, D.Sc., F.R.S., F.L.S.)

(PLATES 10 & 11 and Text-figures.)

[Read 21st March, 1912.]

#### OCCURRENCE.

THE specimens from which this description is taken were obtained from *Limulus* which were kept in spirit for dissection, in the Department of Comparative Anatomy at Oxford. The precise locality from which the *Limulus* came is unknown, except for the fact that they were brought from America some twenty-five years ago.

The gills of *Limulus* are commonly infested by parasitic turbellarians of the group Bdelluridæ. Wheeler has described three species of these: in the egg-cases of two, *Bdellura candida*, Girard, and *B. propinqua*, Wheeler, which measure 2.5 to 4 mm. and 1.25 mm. respectively in length, a small copepod of the family Canthocamptidæ was found, for which I suggest the name *Nitocrameira bdelluræ*.

With regard to the occurrence of these egg-cases, those of *B. propinqua* were far more common, and were situated almost exclusively near the bases of the leaves forming the gill-books. Those of *B. candida* only occurred rarely and were generally full of eggs, but three empty cases were found to contain the copepod.

The much smaller cases of *Synceolidum*, Wheeler, which are found at the margins of the leaves, never contained any inhabitants.

The copepod was only found in empty egg-cases, though a certain amount of organic debris was generally present, and in one case the remains of a turbellarian embryo were found.

They only occurred in egg-cases which were comparatively fresh. Older ones, much torn at the opening, or containing particles of sand and inorganic debris, were never occupied.

The number of copepods in each case varied considerably. One or two were sometimes found, but three to six seemed commoner. Larger numbers often occurred, one case containing 23 females and 6 males.

The number of males and females was approximately equal, the latter preponderating slightly.

Nauplius and metanauplius stages were also found in the same cases as their parents. Very few half-grown specimens were found.

## SEGMENTATION.

The adult *Nitocrameira* is minute, the total length being 1.26 mm. .37 mm. of this length represents the caudal setæ. The body is slender and almost cylindrical, though somewhat compressed in the head region. There is no sharp demarcation between the thoracic and abdominal regions, and the segments are not sharply defined at the margins.

The third, fourth, and fifth thoracic segments are distinctly ringed, though fused to the head, and the limits of the second can be seen laterally. The first is thoroughly fused to the head, no marking being apparent between them.

The articulation between the fore and hind parts of the body, which occurs between the 5th and 6th thoracic segments, allows very free movement, and in many of the spirit specimens the abdomen is flexed dorsally so as to form almost a right angle with the cephalothorax.

There are four free abdominal segments excluding the telson, the first of which bears the genital aperture.

In the female the first and second are thoroughly fused, and no articulation nor any mark is apparent between them.

In the male the genital segment bears a pair of minute, indistinctly bilobed, setose projections, which may perhaps be regarded as the vestiges of a pair of appendages.

The eggs are carried in an egg-sac regularly arranged in a double row, and number from seven to twelve.

The spermatophore is pyriform, and hooked at the "neck" end.

The rostrum is small, narrow and conical. The caudal rami are short, and bear only a few setæ. The large seta is roughly one-third of the total length of the body. Another seta less than half this length lies externally to it, and there are three small setæ in addition.

The only structural trace *Nitocrameira* shows of its semi-parasitic existence is the extreme smoothness of the urosome.

The strong claw-like posterior ramus of the 2nd antenna of the Nauplius larva may also be a modification for attachment to the walls of the egg-sac.

## APPENDAGES.

*1st Antenna.*—The first antenna is eight-jointed, the third joint being in both sexes small, and bearing the greatest number of setæ.

In the female there is a distinct bend at the third joint. The fourth bears a long three-jointed æsthetasc. The last two joints are small, but quite well defined.

In the male the fourth and fifth joints are fused and expanded. The æsthetasc, which is blunter terminally than in the female, rises from the point of fusion of the two segments.

The joint which transforms the antenna into a grasping organ occurs between the fused fourth and fifth, and the sixth segments. The latter is provided anteriorly with four short tooth-like spines.

The seventh and eighth segments are smaller than in the female, and the joint between them is not so well defined.

*2nd Antenna.*—The second antenna is fairly long. The proximal joint is sub-divided, though not very distinctly. The outer ramus is small, unarticulate, expanded distally, and bears three spines.

The distal joint of the antenna is expanded and bears three strong geniculated setæ, which are serrated on the hinder edge, distally to the geniculation.

There are also three more slender setæ anterior to these.

*Mandible.*—The mandible is simple. The biting-edge consists of a sharp, somewhat curved blade, and about fourteen minute teeth arranged in a double row behind the blade.

The palp is biarticulate with the proximal joint slightly expanded. The distal joint bears four long setæ terminally, and a shorter one laterally.

*1st Maxilla.*—The first maxilla consists of a large terminal lobe bearing three strong, somewhat curved spines. Anteriorly there are three lobes. The first two are a little shorter than the main lobe and each bears four setæ. The third lies at the base of the most anterior of these two. It is minute and bears two setæ, one long, the other short.

*2nd Maxilla.*—The second maxilla ends distally in two lobes, each bearing a stout curved spine and a slender seta. There is also a single seta anteriorly.

*Maxilliped.*—The maxilliped or first thoracic appendage is biarticulate and ends in a stout recurved spine. The swollen distal joint is setose on its anterior edge, the whole forming a subchelate prehensile hand.

*1st true legs.*—The first true legs or second thoracic appendages are biramous, each ramus consisting of three joints. The endopodite is narrow and much longer than the exopodite, but its middle joint is short.

The number of plumose setæ is reduced, there being only one on the proximal joint, one on the middle joint, and a spine and two plumose setæ terminally on the distal joint.

In the exopodite there is only one plumose seta on the inner side, instead of three as in the second, third, and fourth legs.

There are three terminal setæ, and four external spines, the last two of which are slightly plumose.

The second, third, and fourth true legs only differ from each other in the relative length of the plumose setæ and spines, and in the relative sizes of the endopodite and exopodite. The latter is largest in the third pair of legs, and the setæ are longest in the fourth.

The fifth legs or sixth thoracic appendages are reduced in both sexes to expanded terminal and proximal joints. Those of the male are less reduced, and more like those of the female than is usual in the family.

In both sexes the distal joint bears six setæ, the apical seta in the female being stout and remarkably long.

In the male the internal expansion of the proximal joint bears three setæ, and in the female five setæ. There is an external seta on this joint in both sexes.

## MAX. I.

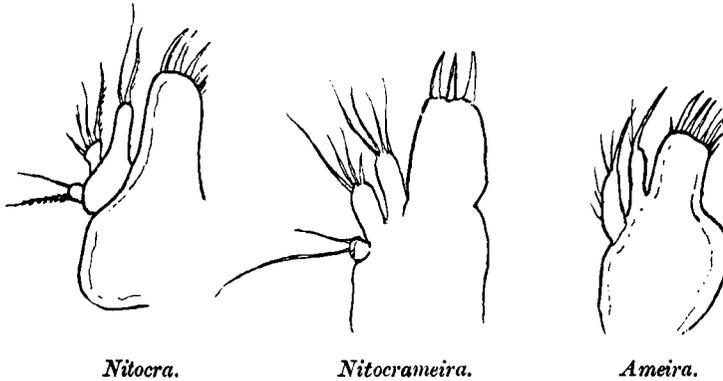


FIG. 1.

## MAX. II.

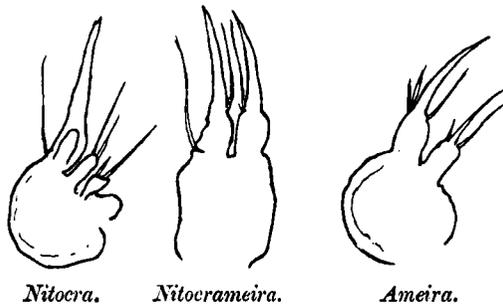


FIG. 2.

## CLASSIFICATION.

*Nitocrameira* does not fall under any recognized genus, according to the generic characters given by Sars in his Monograph on the Crustacea of Norway.

The two genera it approaches most nearly are *Nitocra* and *Ameira*.

In its general appearance it resembles the latter, owing to the smoothness

of its urosome, but in a large number of other important characters its affinities are with *Nitocra*.

The simplest way of showing its resemblance to these genera, is by arranging the generic characters of the three genera in tabular form (see p. 92).

With regard to the 1st maxillæ of *Nitocra* and *Ameira*, Sars's figures do not help to make the description very clear.

That of *Nitocra* is described as having the exopodal and epipodal lobes defined, and the accessory lobe wanting.

Sars's figures, as will be seen in text-figure 1, show three setiferous lobes in front of the jaw-like terminal portion, as is also the case in *Nitocrameira*.

That of *Ameira* is described as having the exopodal and epipodal lobules not defined and the accessory lobe present.

The figure shows two setiferous lobes anterior to the jaw-like portion.

The resemblance of the 2nd maxilla of *Nitocrameira* to that of *Ameira* is shown in the second text-figure.

#### LIFE-HISTORY.

The life-history and habits of *Nitocrameira* are necessarily incompletely known, but a certain amount can be deduced from the specimens found.

It is evident that reproduction takes place in the egg-cases.

The figure shown in fig. 3 (Pl. 10) contained two females and one male. Each female has a brood of eggs, and also a brood of larvæ. Numerous other cases were found containing numbers of larvæ with their parents.

No stage was found between the older larvæ shown in fig. 3 and half-grown adults. The inference is that the egg-case is left by the larvæ when they have reached the stage of development shown in fig. 3. They then lead a free swimming existence until half or three-quarters grown, when they enter a fresh egg-case for their reproductive life. In cases that contained large numbers of copepods, as for instance that with 29, the aperture was so small and the inmates so tightly packed, that it seems evident that they entered when very small.

They might have been hatched in the same egg-case in which they were found, but it is difficult to see where the food would come from.

In practically all individuals the gut was well filled, the food probably consisting of embryo triclads. Generally the organic detritus present was so macerated as to be unrecognizable, but in one case the half-devoured remains of an embryo were certainly present.

#### LITERATURE.

WHEELER.—Journal of Morphology, ix. 1894, p. 167.

SARS, G. O.—An Account of the Crustacea of Norway. Vol. v. parts xvii. and xviii. p. 211 *seq.* 1907.

## Tabulation of Generic Characters of :—

	<i>Nitocra.</i>	<i>Nitocrameira.</i>	<i>Ameira.</i>
Body .....	Slender, cylindric. Coarsely spinulose urosome.	Slender, somewhat compressed anteriorly. Practically smooth urosome.	A. Slender, somewhat compressed anteriorly. A. Less spinulose than <i>Nitocra.</i>
Anal opercle.	Denticulate at edge.	Smooth.	A. Smooth.
Caudal rami.	Short and covered with spinules.	Short, almost smooth.	A. Short, scarcely spinulose.
Rostrum ...	Very small, narrow, conical.	Small, narrow, conical.	N. Almost obsolete.
Ant. I. ....	Moderate size, 8-articulate, densely fringed with setæ; last two joints not very reduced.	Moderate size, 8-articulate, densely fringed with bristles; last two joints distinct.	Last two joints very small, not well defined. N.
Ant. II. ....	Outer ramus short, uniaarticulate, dilated distally.	Outer ramus short, uniaarticulate, dilated distally.	Outer ramus uniaarticulate and narrow. N.
Mandible ...	Palp biarticulate, basal joint slightly dilated.	Palp biarticulate, basal joint slightly dilated.	Mand. palp more developed, basal joint dilated into a setiferous expansion. N.
Maxilla I. ...	Three lobes inside jaw-like portion.	Three lobes inside jaw-like portion.	Two lobes inside jaw-like portion. N.
Maxilla II. .	Two setiferous lobes inside terminal claw-bearing part.	A single claw-bearing lobe, inside claw-bearing part.	Only a single lobe (setiferous) inside the terminal claw-bearing part. A.
First pair of legs.	Rather strongly built, distinctly prehensile. Inner ramus 3-articulate, with outer two joints more or less bent on inner.	Somewhat more slender than <i>Nitocra</i> . Inner ramus much longer than outer, 3-articulate, last joint as long as first.	Distinctly prehensile, but more slender than <i>Nitocra</i> . Inner ramus much longer than outer and distinctly 3-articulate. A.
Natatory legs.	Rather fully developed, with inner ramus of all distinctly 3-articulate, and not transformed in male.	Well-developed; both rami 3-articulate, inner not transformed in male.	Both rami well developed, 3-articulate, inner not transformed in male.
Last pair ..	Distal joint compressed. Large inner expansion of proximal joint fairly produced.	Distal joint long and compressed. Inner expansion of proximal joint not much produced. Male much less reduced in comparison than either <i>Nitocra</i> or <i>Ameira</i> .	Small distal joint, more or less contracted distally. Inner expansion of proximal joint not much produced.

Letter N denotes resemblance to *Nitocra*.Letter A denotes resemblance to *Ameira*.

## SUMMARY.

*Nitocrameira bdellura*, nov. gen. et sp., from egg-cases of *Bdellura propinqua*, Wheeler; and less frequently those of *Bdellura candida*, Girard.

## HARPACTICOIDEA, family CANTHOCAMPTIDÆ.

## Genus NITOCRAMEIRA.

*Body.* Long, smooth, almost cylindrical, somewhat compressed anteriorly. Rostrum small; caudal rami short.

*Ant. I.* 8-jointed, setose anteriorly, last two joints well-defined. 3-jointed æsthetasc on segment 4. Female antennæ bent at 3rd joint. Male 4th and 5th joints fused; whole forming a strong clasping organ.

*Ant. II.* Basal joint sub-divided; outer ramus uniaarticulate and much reduced.

*Mandible.* One cutting-blade and crown of short teeth. Palp biarticulate, proximal joint slightly expanded. Distal joint only, bears setæ.

*Maxilla I.* Expanded jaw-like portion bearing three spines and two almost equal lobes and a third very minute setose one anteriorly.

*Maxilla II.* Two lobes with stout terminal spines.

*Maxilliped.* Subchelate prehensile hand.

*Thoracic legs.* Endopodite and exopodite three-jointed, except last which is reduced.

First pair prehensile, last pair much reduced, but more similar in male and female than is usual in the family.

In some generic characters resembles *Nitocra*, in others *Ameira*.

## EXPLANATION OF THE PLATES.

## PLATE 10.

- Fig. 1. *Nitocrameira*, female, lateral view. Partly diagrammatic as the appendages of the right side only are shown.
2. View of last thoracic and first abdominal segments of male, showing last thoracic limbs, rudimentary abdominal appendages, and spermatophore.
3. Egg-case of *Bdellura propinqua* containing one male and two female *Nitocrameira*. Each of the females has a brood of developing eggs, and two stages of larvæ are shown, six of each stage.
4. Young Nauplius larva about .09 mm. long. This was the commonest larval stage that occurred.
5. First antenna of female.
6. First antenna of male.

## PLATE II.

- Fig. 7. Second antenna of male.  
8. Mandible. The anterior side is to the right.  
9. 1st maxilla. " " " " "  
10. 2nd maxilla. " " " " "  
11. Maxilliped. The anterior side is to the right.  
12. First thoracic swimming leg.  
13. Second " " "  
14. Third " " "  
15. Fourth " " "  
16. Fifth or reduced leg, male.  
17. Fifth or reduced leg, female.
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