

**The Larvæ of the Plymouth Galatheidæ. I. *Munida banffica*, *Galathea strigosa* and *Galathea dispersa*.**

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With 1 Text-Figure and Plates 1-3.

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In the Plymouth district there are five or six species belonging to the Galatheidæ, one *Munida*, and four or five *Galathea*. The species occurring are the following :—

- Munida banffica* (Pennant).
- Galathea strigosa* L.
- Galathea dispersa* Kinahan.
- Galathea nexa* Embledon.
- Galathea squamifera* Leach.
- Galathea intermedia* Lilljeborg.

Of the *Galathea* species, it is a disputed point as to whether *Galathea dispersa* and *G. nexa* are separate species. Both occur in our outside waters, the *dispersa* form being exceedingly common, the *nexa* form rare. Selbie (1914), who discusses the question in detail, regards the *nexa* form, which is more spiny and has shorter claws, merely as an old male of *dispersa*, giving them both the earlier name of *nexa*. Crawshay (1912) found both forms occurring on the outer grounds beyond the Eddy-stone and states that the males and females of *nexa* both had these characteristics and were easily distinguished from *dispersa*. Unfortunately I have been able only to examine one *nexa* but many *dispersa*, and the *nexa* form was quite different in appearance. It was a small male, probably not fully grown, but its claws were much shorter and more spiny than the males of *dispersa* of the same size. No live specimens of *nexa* have been available recently and therefore no berried females from which to obtain larvæ. The larvæ of *dispersa* have been hatched from the egg and it has been seen clearly that these are by far the commonest *Galathea* larvæ in the plankton of the outside waters and occasionally inshore. The larvæ of *Galathea strigosa* are frequently found with those of *dispersa* outside and also occur inside with those of

*G. squamifera*, which is almost exclusively an inshore form. Those of *G. intermedia* occur occasionally both outside and inside.

These four larvæ are easily distinguishable and are the only Galatheas to be found after careful search in the outside plankton, usually taken beyond the Eddystone. It does not follow, however, that there may not be another larva occurring still farther out, which may belong to *nexa*. It is regarded here as probable that the two species are distinct and therefore the species called *nexa* by Selbie (*loc. cit.*), and also by G. O. Sars (1890) when describing the larva, is here called *dispersa*, and it is presumed that the five species of Galathea occur in the district. Of these the larva of *G. nexa* is not yet known. *Munida banffica*, only recognised recently as present in the Plymouth fauna, but now found to be abundant, has been followed through all its larval stages and hatched from the egg. The larvæ agree in all respects with those of Sars (*loc. cit.*) who described and figured them as *Munida rugosa*. *Galathea strigosa* and *Galathea dispersa* have also been followed through the whole of their life-histories and hatched from the egg, *G. strigosa* for the first time, and *G. dispersa* agreeing with Sars' description of that species, described as *G. nexa*. *Galathea squamifera*, the common shore species, has not yet been hatched from the egg, but has been followed through all its larval stages until the young Galathea emerged from the last larva. *Galathea intermedia*, not nearly so common, has been found in all the larval stages, except the second, and has been kept until the last larva turned into the young Galathea. The last two species have also been described by Sars (*loc. cit.*) to a certain extent. They are reserved for a later paper in the hopes of hatching them from the egg. It is possible to recognise all these four larvæ, particularly when alive, as the colouring in each is characteristic, but they can also be recognised when preserved, by other characters as will be shown in the following notes:—

The general form of the larval galatheid is well known, Sars having described the general life-history of *Munida* and of *Galathea* with details of the appendages. *Munida* is easy to distinguish from *Galathea*, but the species of *Galathea* have hitherto been difficult to separate from one another. In an attempt to differentiate all species of the decapod larvæ from Plymouth it has been possible to distinguish these four distinct *Galathea* larvæ.

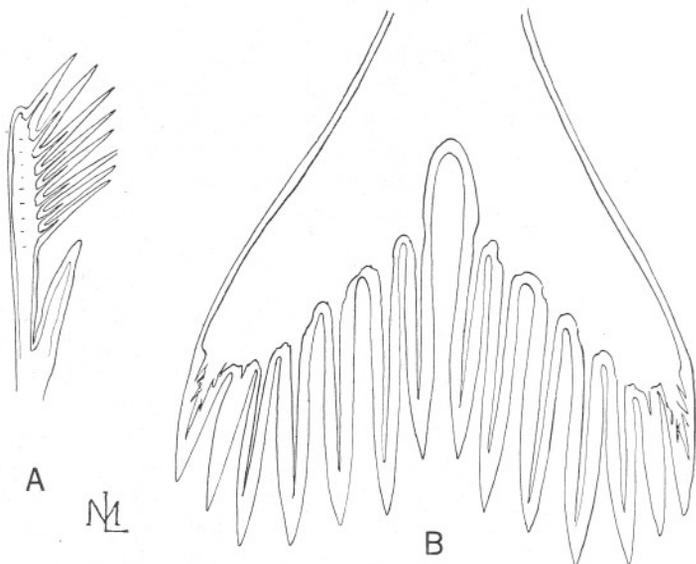
*Munida banffica*, *Galathea strigosa* and *Galathea dispersa* all occur fairly commonly on the outside grounds, *G. dispersa* being much the most numerous. *G. strigosa* and occasionally *G. dispersa* also occur inshore, but *Munida* is always outside. All occur in berry at least from autumn to spring and probably (certainly in the case of *G. dispersa*) all the year round, and the larvæ are fairly abundant in the plankton, particularly the two *Galathea* species.

Munida can be distinguished at once from Galathea by its elongated form, long spines and aciculate antennal scales. *Galathea strigosa* can be distinguished from the other Galathea larvæ by its longer spines and larger size, except in the last stage of *G. dispersa*, which is much the same size but easily separated by having spines on the fifth abdominal segment and not on the fourth. *G. squamifera* and *G. intermedia* are much smaller and although *squamifera* has spines on the fourth abdominal segments, they are much shorter than in *strigosa* and the other spines altogether smaller. *G. intermedia*, having spines on the fifth abdominal segment only, is so much smaller than any of the others that there is no mistaking it. All four can be separated when alive by their colour.

The common features of Munida and Galathea larvæ are the following : four or five larval stages ; very transparent body with orange-red pigment in certain areas, rarely a little brown, yellow or crimson ; long rostrum ; carapace produced into a spine posteriorly at each side, the margin of the carapace toothed behind laterally and on the hind margin ; eyes very conspicuous ; antennules with long base ending in two short branches, the inner with a long seta at its tip, which later disappears, and one on the inner side of the base takes its place, the outer with æsthetes and spines ; antenna with inner flagellum unjointed in all stages, the scale ending in a long apical spine and bearing several setæ internally, mandible with a simple palp in later stages ; first maxilla with two inner lobes and either a one- or two-jointed palp ; second maxilla with four inner lobes, an unjointed palp, and a conspicuous external plate. Only two pairs of maxillipedes functional in the first larva with swimming exopodites and jointed endopodites, the third pair rudimentary and only functional in the second stage. Abdominal segments denticulate, or with two spines dorsally on the hind margins, with lateral spines on the fourth and fifth segments, or on the fifth only. Telson deeply forked, armed at the end with seven spines on each side in the first stage, eight in the second ; the second spine from the outside being hair-like, the fourth becoming the longest. In the first and second stage the telson is a simple plate fused with the sixth segment, and with the outer spine the longest ; in the third, fourth and fifth (if present) uropods appear, and the telson is cut off from the sixth segment. In the third stage the telson is long and narrow, uropods are formed but their base is not cut off and there are no setæ on the inner branch, the outer branch bearing several setæ. In the fourth stage (usually the last) the inner branch is setose and the base is cut off from the uropods. The legs appear gradually until at the last stage the first is large and chelate and bulges out from the body, but no legs are functional. Pleopods appear as small knobs in the third stage and are long but unjointed in the last stage. Four larval

stages appear to be the usual number, but in *Galathea dispersa* there are four or five, five being the most frequent. By keeping the third and fourth larvæ of all the species it was found that the young Galathea emerged from the fourth larva in *Munida*, *Galathea strigosa*, *G. squamifera*, and *G. intermedia*, but although *G. dispersa* sometimes emerged as a young Galathea from the fourth stage, there was in this species a fifth stage which seemed to be usual. The fourth larva was seen emerging from the third in all the species.

The embryonic cuticle is cast off just before hatching. It corresponds to the pre-zoea of the Brachyura. It is very interesting, for in the telson



TEXT-FIG. 1.—*Munida banffica*. A, embryonic antenna ; B, embryonic telson.

seven fully developed long spines cover the seven setæ of the first larva (Text-Fig. 1B), the second, which in the larva is represented by a hair, having quite a normal large spine covering it. The antennal scale is covered by a sheath with eight large spines on the inside corresponding to the eight setæ in the first larva (Text-Fig. 1A).

Sars (*loc. cit.*) has described and figured the appendages very fully both in *Munida* and *Galathea* ; it is therefore unnecessary to figure them again, but the chief differences and the general aspect of the larvæ are given below. The red colouring of the first larva is indicated in the figures of the plates by black. The same scheme occurs through all the larvæ of each species, but intensified in the later stages.

## Genus MUNIDA.

*Munida banffica* (Pennant).

(Plate 1).

Larvæ described by Sars (1890) as *M. rugosa*. Four larval stages (no fifth stage seen), the fourth changing to a young *Munida*. First larva from egg, second larva from first from plankton, third from second from plankton, fourth from third from plankton, first young stage from fourth from plankton.

Eggs 0.80 mm. by 0.64 mm. when nearly ready to hatch; at first orange-red, then becoming brown.

Larvæ very transparent, orange-red dorsally under the carapace in two distinct streaks and a small patch each side, two streaks on each side of the abdominal segments and at the base of the telson. Length of first larva from tip of rostrum to end of telson 6.24 mm. (Plate 1, Figs. A and B), growing rapidly so that each successive stage is conspicuously larger than the last. The size varies to some extent and a third larva of one brood may be smaller than a second larva of another brood. Rostrum very long, prickly, base of antennule long, antennal scale aciculate with long drawn-out prickly spine at the tip, carapace usually covering the first segment and sometimes part of the second, with long lateral posterior spines. Second to fifth abdominal segments with two dorsal spines on the hind margin, dwindling in size in the later stages; conspicuous lateral spines on segments four and five. In the third and fourth stages a large central spine on the hind margin of the sixth segment. Outer branch of uropods with a long apical prickly spine. Outer spine of telson very long and armed with thick spines in the early stages, dwindling later; second spine hair-like, fourth becoming the longest. In the third stage there are five smaller spines on each side internal to the fourth, and in the fourth stage there are six, making ten in all on each side; unlike *Galathea* which has only eight on each side. Palp of second maxilla one-jointed (two-jointed in *Galathea*). Gills conspicuous in last stage.

## Genus GALATHEA.

All the larvæ of *Galathea* differ from *Munida* in being much shorter with non-aciculate antennal scales, although the scale ends in a long point, the rostrum and spines of carapace not so long. The second to the fifth abdominal segments are armed on the posterior margin with a row of minute denticles. No central spine on sixth segment. Telson with outer spine in early stages not so long, in later stages with eight spines on each side. Second maxilla with two-jointed palp. Otherwise much like *Munida*.

*Galathea strigosa* L.

(Plate 2).

Four larval stages (no fifth seen), the fourth changing to a young *Galathea*. First larva from egg, second from first from plankton, third from second from plankton, fourth from third from plankton, young *Galathea* from fourth from plankton.

Eggs 0.88 mm. by 0.76 mm. when ready to hatch. At first orange-red, then brownish.

Larvæ very transparent but with more colour than *Munida*. Orange-red on base of antennules on side of eyes, on exopodite of maxillipedes, at base of rostrum and a large mass in the thoracic region. Two large streaks on the abdomen from the fourth segment to the base of telson. Tip of rostrum and carapace spines becoming pinkish in later stages, not prickly. Length of first larva *ca.* 3.5 mm., second *ca.* 4.96 mm., third *ca.* 5.36 mm., fourth (last) *ca.* 6.88 mm. Much less elongated than *Munida*, rostrum and spines of carapace and antennular scale not so long. Fourth and fifth abdominal segments with conspicuous lateral spines. Hind margin of segments two to five denticulate, the denticles dwindling and almost disappearing in the later stages. Telson a wide triangular plate in the first and second stages, having seven spines on each side posteriorly in the first stage, eight in the other stages; second spine hair-like. In the later stages the telson gradually narrows and the fourth spine becomes much the longest. Nine or ten spines in the inner uropods on the fourth (last) stage. This stage emerges from the third stage with no spines on the inner uropods.

*Galathea dispersa* Kinahan.

(Plate 3).

Larva described by Sars (1890) as *G. nexa*. It differs from *G. strigosa* in its smaller early stages, absence of lateral spines on the fourth abdominal segment, narrower telson, and in its pigmentation.

Four or five larval stages. Five is probably normal, but the young *Galathea* has been seen to emerge from the fourth stage, and the normally fifth stage has been seen to emerge from the third stage with no spines on the inner branch of the uropods; thus the fourth or fifth stage may be omitted.

Eggs measure 0.64 mm. by 0.48 mm. when nearly ready to hatch. At first orange-red, then brownish.

Larvæ very transparent, first obtained from egg, second from first from plankton, third from second from plankton, fourth from third from

plankton, fifth from fourth or occasionally from third from plankton, young *Galathea* from fourth or normally from fifth from plankton.

Orange-red on base of antennules, on maxillipedes, at base of rostrum, much on thorax, on first, second and third abdominal segments (not always on third), on the fifth and at the base of the telson in two streaks. In the later stages there is a good deal of yellow in the thorax. Rostrum and carapace spines becoming pinkish, smooth. First larva *ca.* 2.5 mm., second *ca.* 3.1 mm., third *ca.* 3.9 mm., fourth *ca.* 5 mm., fifth *ca.* 6.56–6.8 mm.

The young stages of *Galathea* from the last larva are much alike, but *Munida* is easily recognised by its three-pronged rostrum (Plate 1, Fig. F), the long central spine having a small tooth each side near the tip. The first young stage of *Galathea strigosa* and *G. dispersa* closely resemble the figure of *G. intermedia* given by Sars. All have a fairly long pointed rostrum with three prominent teeth on each side and usually with one or two smaller teeth at the base, and five prominent teeth at the sides of the carapace, usually with smaller teeth in between. The legs bear many spines and hairs but external specific characters are hardly apparent. *Galathea dispersa* (Plate 3, Fig. J) has a longer rostrum and more prominent teeth on the carapace than *G. strigosa*. Both are of a yellowish colour with red, no blue being apparent as yet in *G. strigosa*.

#### LITERATURE.

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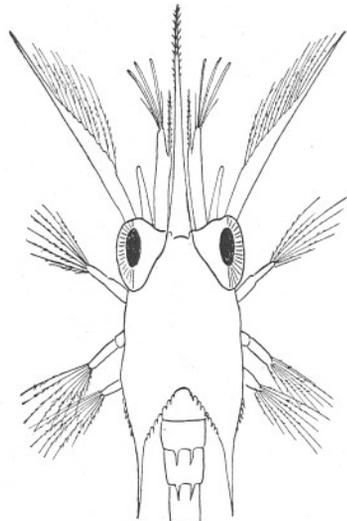
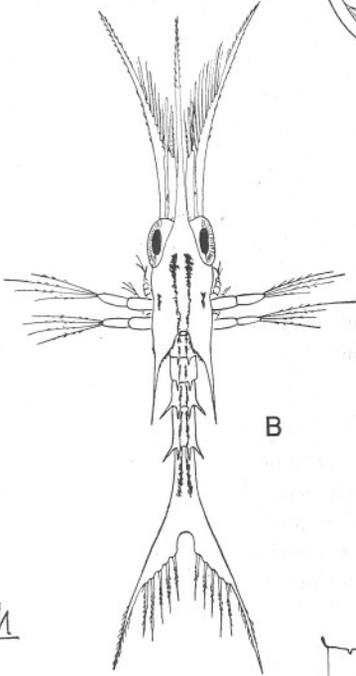
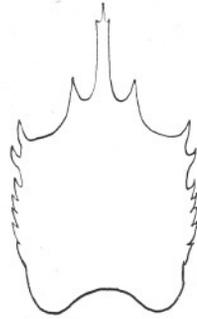
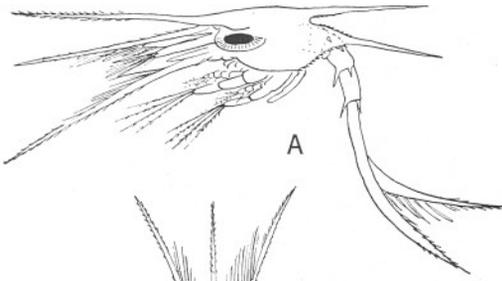
## EXPLANATION OF PLATES.

(All drawn to same scale.)

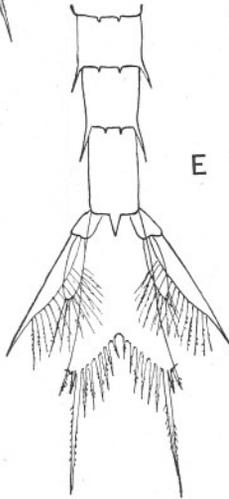
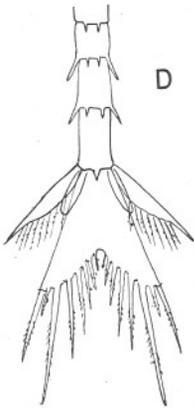
## PLATE 1.

*Munida banffica.*

- A, B. 1st larva from egg, 6.24 mm. long.
- C. 2nd larva from first from plankton.
- D. Posterior end of 3rd larva from plankton.
- E. Posterior end of 4th larva from plankton.
- F. Carapace of 1st juv. from last larva from plankton.



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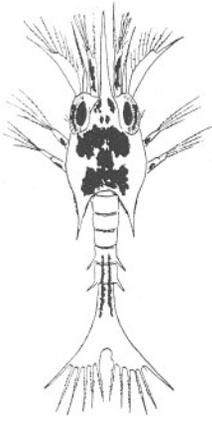
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C

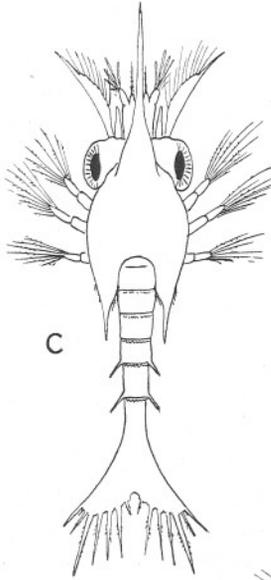
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*Galathea strigosa.*

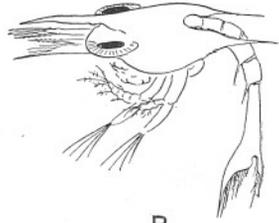
- A, B. 1st larva from egg, 3.5 mm. long.
- C. 2nd larva from plankton, 4.96 mm. long.
- D. 3rd larva from plankton, 5.36 mm. long.
- E. 4th larva from plankton, 6.88 mm. long.
- F. Carapace of 1st juv. from last larva from plankton.



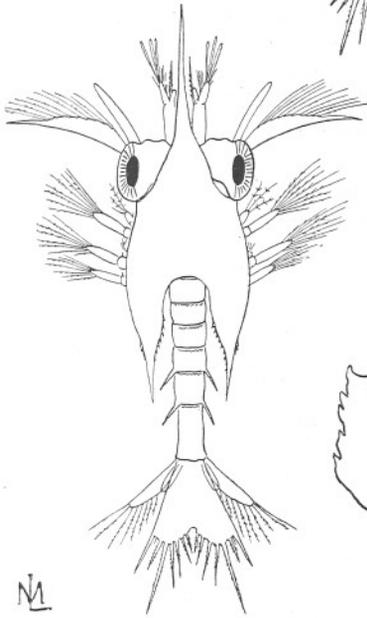
A



C

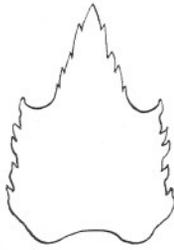


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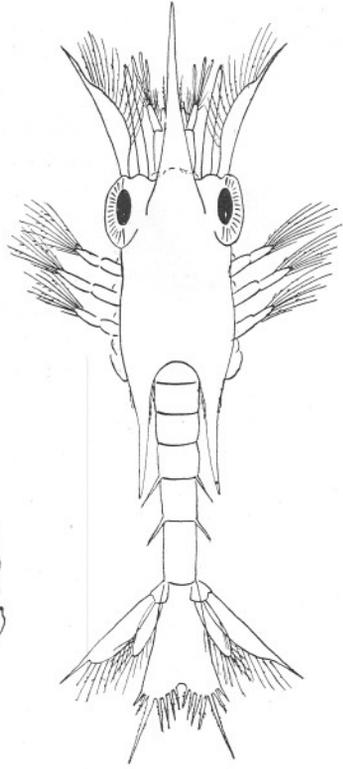


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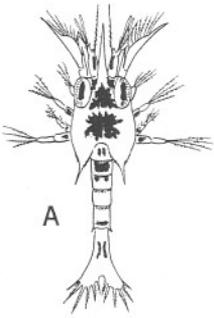


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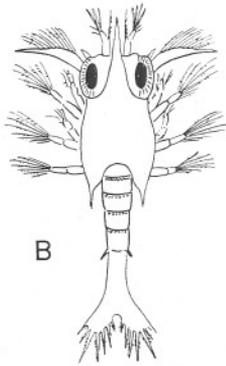
## PLATE 3.

*Galathea dispersa.*

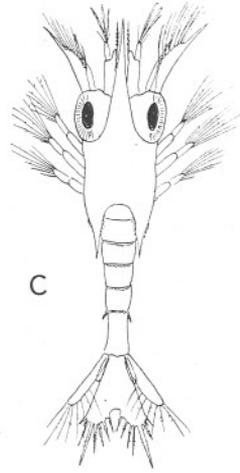
- A. 1st larva from egg, 2.5 mm. long.
- B. 2nd larva from plankton, 3.12 mm. long.
- C. 3rd larva from plankton, 3.9 mm. long.
- D. 4th larva from third, 5 mm. long.
- E. 5th larva from fourth, 6.56 mm. long.
- F. Posterior end of a larger fifth larva.
- G. Antennule of same.
- H. Antenna of same.
- J. Carapace of 1st juv. from last larva.



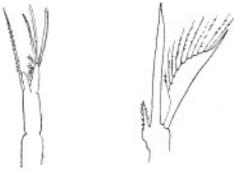
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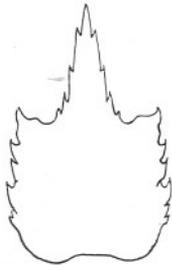


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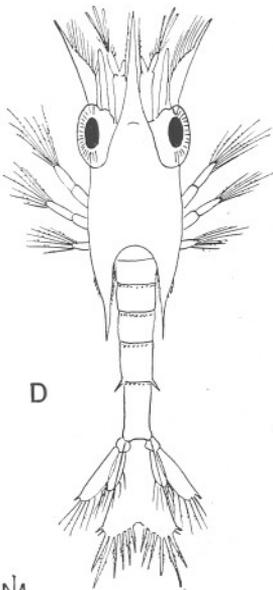


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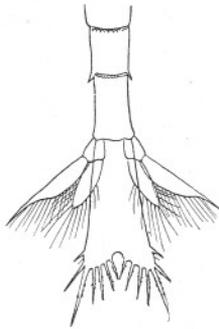
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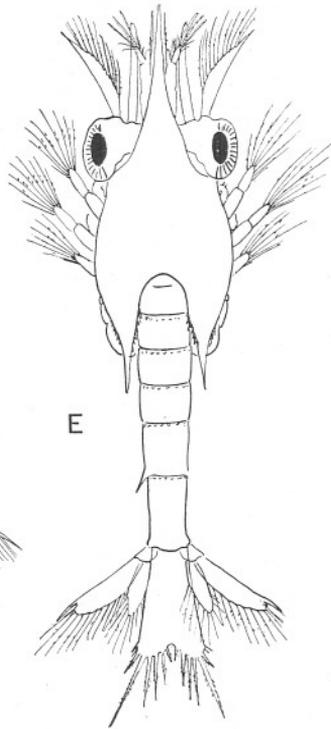
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