The Metamorphosis of Corystes Cassivelaunus (Pennant).

By

Robert Gurney, B.A.(Oxon.), F.Z.S.

With Plates 29—31.

THE material upon which the following account of the development of Corystes is based has been derived entirely from tow-net collections, taken generally in or just outside Plymouth Sound, between February and May of the present year. Occurring first on February 21st, the larvæ were obtained in small numbers fairly regularly from that time onwards. Advanced stages occurred first on March 15th, and in considerable numbers. The tow-net collections of April 14th, taken in the West Channel, were remarkable for the extraordinary abundance of the zoæa stage of Corystes. They abounded on that date to the almost complete exclusion of all other zoæas, nearly all the specimens being at an advanced stage of development. Since April 14th the zoæas have continued to occur, but very few have been found in the early stages.

Zoæas taken in the tow-nets have been kept successfully in plunger jars for considerable lengths of time, and several have moulted into the Megalopa stage, the latter being kept through the next moult, either in a jar immersed in running water or in a beaker, in which the water was kept in motion by a stream of air bubbles.

Habits of the Larvæ.

The zoæa of Corystes is probably the same as that described by Weldon (1889), and figured as "a Portunid zoæa," though it differs from his figure in several respects. Weldon came to the conclusion that the long spines have the function of directing the movements, and enabling the animal to swim rapidly in a straight line. There can be no doubt that his conclusion is correct, for the larva always moves in the direction of the long axis of the spines. This is well shown when a zoæa is caught in an eddy in the plunger jar. It then makes a violent effort to escape, darting upwards, sideways, or straight to the bottom, according to the position of the spines at the moment. Normally the larva rises and falls in the water, swimming upwards vertically for a short distance, and then resting. In the plunger jar larvæ have a tendency to collect, especially the younger stages, at the surface against the side of the jar. Here they often push their dorsal spines through the surface film, and are hereby suspended. Sometimes they rest against the rod of the plunger, suspended in this manner, and to this habit I have owed the death of several specimens which were caught and drawn up upon the plunger rod. If a light is brought to the jar at night the zoæas become extremely active, swimming rapidly towards the light, the dorsal spine directed forwards. The body may, however, be in any position with regard to the axis of the spines, the animal swimming upon its back, side, or ventral surface.

It is of interest to note, in considering the function of the spines, that the period of their presence corresponds exactly with the period of the absence of an "auditory" organ. The latter, as Prentiss (1901) has shown, is not developed functionally till the Megalopa stage, when only traces of the spines remain. There is a rapid reduction in the length of the spines as compared to the total length of the body in the third and fourth larval stages, and it is in the last zoæa

that the first trace of the auditory invagination is to be found. It seems likely, then, that the spines may perform to some extent the balancing and orienting function of the auditory sac.

Besides being of balancing and directive function, the spines probably also serve as a protection. It is, of course, hard to say what are the especial enemies of the zoæas in nature. They are certainly preyed upon to some extent by Medusæ and Ctenophores, and also by each other, and in these cases the spines can be of little value. They must, however, serve as a defence against the attacks of small fish. That this is so was shown by presenting the zoæa to Gobius ruthensparri, a fish about 4·5 cm. long, and with a width of mouth of about 3·5 mm. In the first experiment a goby seized and rejected the zoæa six times, each time failing to swallow it. Finally the fish gave up the attempt, and the zoæa soon recovered and swam away, being, however, attacked and swallowed by a second goby after a number of failures. Other experiments showed the same thing, though the fish had no difficulty in swallowing small Brachyurous zoæas without great development of spines—for instance Carcinus.

A peculiar habit of the zoæa at all stages is that of frequently turning its abdomen backwards till the forked telson reaches and embraces the dorsal spine, scraping upwards as if to clean it. This action is so frequent that it seems not to be connected with the process of moulting, though possibly the stretching of the abdomen entailed may assist in preparing for the act. Moulting seems usually to take place at night, and must be a rapid process, for a successful moult was never observed. Zoæas were frequently found half freed from the larval skin, but these specimens never succeeded in completely freeing themselves. In fact, the new skin seems to harden so rapidly that unless the process is completed at once failure results.

The Megalopa stage is remarkably interesting from the point of view of its habits. It has most of the characters

and habits of the adult. Like the Megalopa of the majority of Brachyura it is very active, swimming rapidly by means of its pleopods, the antennæ being carried stretched straight forwards and parallel to one another, the thoracic legs bent up under the body. Unlike the zoæa it seems to be indifferent to a strong light at night, being neither attracted nor apparently repelled by it.

It does not seem to be a pelagic form properly speaking, and was only once obtained in the tow-net, and then within a fathom or so of the bottom, in deep water. Some of the specimens moulted in my plunger jars were provided with fine sand, and at once burrowed until covered completely except for the antennæ. The act of burrowing is performed just as in the adult by means of the four posterior legs, the chelipeds taking practically no part. If the sand, which must be exceedingly fine, is not deep enough to completely cover the body, the Megalopa pushes itself backwards till the sand is heaped up above it, often moving backwards in this way for some distance. When covered the antennæ are not necessarily held quite parallel, but the position seems to a considerable extent to depend upon the depth to which the animal has burrowed. In the buried position the respiratory current is reversed, and sets down the antennal tube, as Mr. Garstang has shown it to be in the adult. The efficiency of the antennal tube as a strainer was well shown by the sand grains resting on the interlocking hairs. One specimen of the Megalopa, and one of the succeeding post-larval stage, were obtained in some sand from Whitsand Bay.

As to the food of the earlier stages of the larva I have no direct observations to record. Though provided with a constant supply of the smaller plankton organisms, and with other small zoæas, I have never seen the zoæa of Corystes taking any food. From the appearance of the contents of the gut it seems likely that the food consists entirely of floating algæ or diatoms. I have several times seen the zoæas of other forms, such as Eupagurus, devouring other larvæ, but it is quite possible that the zoæas of Corystes, at

least in the earlier stages, are exclusively vegetable feeders. The Metazoœa and Megalopa, on the other hand, have more than once been found eating zoœas, and even those of their own kind, and I have found small pieces of worm or shrimp muscle a very satisfactory food for the Megalopa.

Development of the Larva.

There appear to be four distinct stages in the development of the larva preceding the Megalopa, but I am unable to say how many moults are included in this period. The zoœas referred to the second stage differ among themselves to a certain extent in the relative development of the parts of the body, and this stage, consequently, is not very sharply separated from those preceding and following it.

First Stage (Pl. 29, fig. 1).—The measurements of the zoœa at this period are as follows, the figures given being the average of ten specimens. I have given here, as also in the stages succeeding, the minimum and maximum for each measurement.

	Average length.	Minimum and maximum lengths.
1. Length of rostrum .	1·4 mm.	.. 1·3 to 1·5 mm.
2. „ dorsal spine	1·9 „	... 1·5 „ 2·0 „
3. Tip to tip of spines .	4·0 „	... 3·7 „ 5·1 „
4. Length of body . .	2·4 „	... 2·3 „ 2·7 „
5. „ thorax .	·8 „	... ·7 „ ·85 „
6. Ratio of 4 to 3, 1 : 1·66.		

The zoœa of Corystes is distinguished from all other Brachyurous zoœas hitherto described by the following features:—The total length from tip to tip of the dorsal and rostral spines greatly exceeds the total length of the body. In the majority of zoœas the two measurements are approximately equal. The posterior edge of the carapace bears a fringe of short setæ. The forks of the telson have

the normal form, but bear only a single[1] lateral spine on each side. The resemblance between the zoæa of Corystes and that of Thia polita as figured by Claus (**76**) and Cano (**91**) is very striking, but the latter differs in having a much longer lateral thoracic spine, and in having two lateral spines on each fork of the telson.

The colour and its distribution in the body are also characteristic. The long dorsal spine is a rich orange colour, deepest towards the tip. The rostrum has the same colour, but the chromatophores appear to be less numerous. The labrum contains a dendritic black chromatophore, and similar chromatophores are found in the carapace, one above the mandible, and two near the postero-ventral and postero-dorsal edge of the carapace. A small orange chromatophore lies at the base of the dorsal spine. The alimentary canal is enveloped in black chromatophores, which run back along it as far as the end of the second abdominal segment. A large ramified black chromatophore lies at the joint between the third and fourth, fourth and fifth, and fifth and sixth abdominal segments. To the naked eye the liver and gut appear as a yellowish-black mass continued back as a black streak through the thorax, and the orange colour of the spines is conspicuous and distinctive.

The appendages of the zoæa are of the usual type, differing in no important respects from those of Portunus, for example, and do not need detailed description.

The second maxilla (Pl. 30, fig. 9) is the only cephalic appendage which calls for any remark. In it the exopodite (scaphognathite) is characterised at this stage by the possession of only five setæ, the fifth springing almost directly from the posterior edge, and not, as in Portunus, from the end of a narrowed prolongation of the edge.

[1] Since writing the above I have found a single specimen in the second stage of development, in which the left fork of the telson bears two lateral spines as in Thia polita, while the right fork bears but one. The rarity and asymmetry of this structure seems to show that its presence is due merely to an individual variation (see fig. 4).

The two pairs of maxillipedes have each a two-jointed exopodite bearing distally four long ciliated setæ.

Behind the first and second maxillipedes there are already developed rudiments of the six remaining pairs of thoracic legs. The first pair, or third maxillipedes, are longer than the rest, and bent forwards between the second maxillipedes. The fourth pair is covered by the third, and hence is not visible without dissection (see fig. 1).

As breeding females of Corystes are not easy to obtain, and I have consequently not been able to hatch the zoæa from the egg, it is possible that an earlier stage remains to be discovered. Still, the early development of the posterior thoracic limbs is not uncommon among Brachyurous zoæas. In many forms the third maxillipede is already marked out in the first zoæa, and in some all the thoracic appendages are visible on hatching. This is the case in Portunus puber, and more especially in Inachus dorsettensis, where even the pleopods are distinctly traceable.

The abdomen, in the first stage of Corystes, consists as usual of five distinct segments, the second bearing a forwardly curved process on either side. The second, third, fourth, and fifth segments each bear a short hair on their posterior dorsal edge on either side of the middle line.

The telson (fig. 2), with which the sixth segment is united, has the usual forked shape, and bears three strong setæ on the inner surface of either fork. Each seta is minutely ciliated, the first, however, bearing several much longer cilia about the middle of its length. There is only one external spine (the sixth of Mayer's nomenclature). The spine formula is therefore 5 + 5 instead of the normal 7 + 7.

Second Stage (fig. 3).—The following measurements are the average of the first ten specimens of a number measured, and the limits of variation in those specimens.

	Average length.	Minimum and maximum lengths.
1. Length of rostrum .	2·0 mm.	... 1·75 to 2·6 mm.
2. ,, dorsal spine	2·7 ,,	... 2·5 ,, 3·0 ,,
3. Tip to tip of spines .	5·7 ,,	... 5·1 ,, 6·4 ,,
4. Length of body . .	3·4 ,,	... 3·0 ,, 4·4 ,,
5. ,, thorax .	1·18 ,,	... 1·1 ,, 1·25 ,,
6. Ratio of 4 to 3, 1 : 1·67.		

It will be seen that though the absolute length of the spines is much greater at this stage than in the preceding one, the ratio between the total length and the total length of the body has increased only by ·01.

The more important differences between the zoæa at this period and that of the preceding one are the following:—In the second antenna the flagellum, which is barely indicated in the first stage, has grown out to nearly the length of the exopodite (spina mobilis). The exopodite and inner spinous prolongation of the stem are unchanged.

The maxillæ have changed but little in form, but bear more setæ. The scaphognathite of the second maxilla (fig. 10) has now nine setæ along its inner margin, and there are three terminal setæ instead of the single one of the preceding stage.

The first two maxillipedes are unchanged, except that the exopodite bears distally six ciliated setæ instead of four. The remaining thoracic legs are more distinctly developed, and there are traces of six gills on each side, i. e. those of the third maxillipedes and three succeeding limbs.

In the abdomen the pleopods are marked out as knobs on each segment except the first, which remains limbless throughout the larval development. The third, fourth, and fifth segments are produced into a short spinous process on each side. The sixth segment is separated from the telson. In the latter (fig. 4) the number of internal setæ is increased by one or even two pairs, so that there are either six or seven on each side altogether.

Third Stage.—Measurements (average and range of variation in eleven specimens):

	Average length.	Minimum and maximum lengths.
1. Length of rostrum .	3·0 mm.	... 2·7 to 3·5 mm.
2. „ dorsal spine	3·6 „	... 3·4 „ 4·0 „
3. Tip to tip of spines .	8·6 „	... 8·0 „ 9·0 „
4. Length of body . .	5·6 „	... 5·2 „ 7·0 „
5. „ thorax .	2·1 „	... 1·9 „ 2·7 „
6. Ratio of 4 to 3, 1 : 1·53.		
7. Length of third pleopod	·25 „	... ·2 „ ·35 „
8. Length of fourth abdominal segment . .	·41 „	... ·3 „ ·45 „

At this stage the reduction in length of the dorsal and rostral spines as compared with the total length of the body has become very noticeable, and the increased completeness of the development of the limbs shows an evident approach towards the Megalopa.

The differences between the zoœa at this period and that of Stage 2 consists more in the increased development of parts already formed than in the acquisition of new ones. The internal branch of the first antenna is developing, and the base of the antenna shows a certain degree of swelling in preparation for the formation of the auditory organ. In the second antenna the increase in length of the flagellum is very striking, and it is now about twice the length of the exopodite, showing traces, beneath the cuticle, of segmentation. The mandibular palp is present as a small two-jointed process.

In the first maxilla no change has taken place, but in the second maxilla (fig. 11) the scaphognathite has not only increased in size, but is provided with a very greatly increased number of setæ, which fringe its edge, and are of more or less uniform size. Those of the posterior border are not longer or stouter than the rest. These changes are probably associated with the further development of the

gills, which perhaps become functional at this stage. The first and second maxillipedes retain their original form, but the exopodite bears now twelve setæ instead of six at its distal extremity. Each bears also at its base a small epipodite, but there is as yet no trace of gills. The succeeding six pairs of thoracic limbs are all well developed, and show distinct joints beneath the cuticle. The third maxillipede is the only one that bears an exopodite—a simple unjointed process,—the others developing directly to the adult form.

The gills of the posterior thoracic region (fig. 8) are all distinctly formed except that the podobranch of the third maxillipede is not yet separated from the epipodite. As yet also they have not acquired the lamellate form of the adult gill. In the abdomen the pleopods are further developed on the last five segments, each being about half the length of the segment succeeding it. The lateral spines of the segments are now more conspicuous than before.

The telson at this stage (fig. 5) has generally developed a new pair of setæ on its internal edge in front of the others, but in some specimens the number was found unequal on the two sides, the formula being normally 8 + 8, but occasionally 8 + 7.

Fourth Stage (fig. 7).—Measurements (average and variation in fourteen specimens):

	Average length.	Minimum and maximum length.
1. Length of rostrum .	3·4 mm. ...	3·1 to 3·8 mm.
2. „ dorsal spine .	4·1 „ ...	3·8 „ 4·5 „
3. Tip to tip of spine .	9·6 „ ...	8·95 „ 10·3 „
4. Length of body . .	7·3 „ ...	6·5 „ 7·8 „
5. Length of thorax . .	2·9 „ ...	2·7 „ 2·9 „
6. Ratio of 4 to 3, 1 : 1·31.		
7. Length of third pleopod	·81 „ ...	·75 „ ·85 „
8. „ fourth abdominal segment . .	·63 „ ...	·6 „ ·65 „

This stage is characterised by the greater development of the antennæ, gills, and pleopods, but otherwise shows no essential difference from the preceding one. In the first antenna the inner branch is more developed, and the outer branch shows signs of segmentation beneath the cuticle and an increased number of sensory rods. The base is much swollen, and the auditory pit is forming.

The second antenna has now a flagellum (endopodite) nearly two thirds the length of the rostrum, showing two distinct joints at its base and a number of indistinct joints beneath the cuticle. The exopodite and spinous process are relatively unimportant structures, and at the approach of the moult their contents are absorbed and only the chitinous cuticle remains.

The first maxilla shows no change, but in the second maxilla the setæ are more numerous upon the scaphognathite, though they are comparatively shorter than before.

The epipodites of the first and second maxillipedes are larger, but neither podobranchs nor arthrobranchs are formed.

In the third maxillipede, however, the podobranch is being separated from the epipodite, and the arthrobranchs are both present. The anterior arthrobranch, however, shows no signs of lamellar structure, though the posterior one, like the succeeding pairs of gills, is distinctly lamellate.

The gill formula at this stage is therefore as follows:

	A.	B.	C.	C′.	
VI.	Ep.	—	—	—	= Ep.
VII.	Ep.	—	—	—	= Ep.
VIII.	Ep.+1	1	1	—	= 3+Ep.
IX.	—	1	1	—	= 2
X.	—	—	—	1	= 1
XI.	—	—	—	1	= 1
XII.	—	—	—	—	
XIII.	—	—	—	—	
					7+3 Ep.

The pleopods are now well developed, each exceeding the length of the next succeeding segment. The first four pairs consist of a broad basal part bearing a long exopodite and a short stump representing the endopodite, but there are no setæ and no trace of segmentation. The fifth pair, on the sixth segment, are simple unbranched appendages. The telson is exactly the same as in the preceding stage.

The Megalopa (fig. 13).—Measurements (average of ten specimens):

Length of carapace . . .	3·6 mm.
Breadth across third lateral spine .	3·1 „
Length of antennæ . . .	4·5 „

The last larval stage passes by a single moult to the Megalopa, which is distinctly recognisable as Corystes, though retaining certain features characteristic of the zoæa.

The rostrum and dorsal spine are still present, though very greatly reduced.

The rostrum has now the form of a broad plate extending forwards between the eyes, its lateral margin arched upwards and crenulated. Its extremity is trifid, the median process representing the last trace of the original long rostral spine and retaining the orange chromatophores of the previous stage, the lateral processes by which it is flanked being new formations. A few hairs are borne upon the upper anterior surface of the rostrum.

The dorsal spine is now an inconspicuous orange-red process, situated not immediately over, but somewhat behind the heart. From it a ridge runs forwards for some distance along the middle line of the carapace.

On either side of the middle line, in the region of the stomach, there is a single short spine on the dorsal surface. These spines appear first at this stage, and are lost again with the next moult.

Laterally the carapace bears three strong teeth on either side, the first immediately behind the eye, and the third above the first ambulatory leg. The postero-lateral margin

of the carapace is fringed with a number of setæ. The appendages have now taken on essentially the form of those of the adult. The second antennæ are considerably longer than the carapace, many-jointed, and provided with the characteristic dorsal and ventral row of setæ. The antennæ have, as already described, the same function of serving as a respiratory tube as they have in the adult. The mandible palp is now three-jointed, the distal joint bearing a number of setæ and overhanging the mouth opening in front.

The first maxilla differs from that of the preceding stage in the form of the endopodite, which is now not jointed, and bears but a single well-developed seta. This reduction in the number of setæ is remarkable from the fact that in the adult there is a rich clothing of setæ.

There is but little change in the form of the inner lobes, and the only change from this stage to the condition in the adult consists in a relative reduction of the superior lobe and an increase in number of spines.

In the second maxilla there is a great increase in size of the scaphognathite and simplification of the structure of the endopodite (fig. 12).

The first and second maxillipedes show an intermediate condition between the swimming limb of the zoæa and the masticatory limb of the adult. The two-jointed exopodite is practically unchanged, except that in the first pair it bears but five terminal setæ, and in the second pair eight. The endopodite of the first pair (fig. 15) is no longer jointed, but has not acquired the lamellate form characteristic of Corystes. The two basal joints are richly setiferous at their inner margin, and the epipodite is greatly developed. The endopodite of the second maxillipede (fig. 17) has practically the adult form, while the podobranch and small arthrobranch are both developed.

The third maxillipede develops directly to the adult form, the second joint of the endopodite having the characteristic anterior prolongation. The remaining thoracic legs have in all essential respects the form of those of the adult. The

abdomen still retains some larval characters. The lateral spines of segments 2—5 are still retained, and the telson still shows traces of bifurcation, being deeply indented posteriorly. The five pairs of pleopods have the shape characteristic of the typical Brachyurous Megalopa. Those of the first four pairs each consist of a stem bearing a long exopodite armed with numerous long ciliated setæ. The endopodite is very small, and interlocks with that of the opposite appendage as a retinaculum. The last (fifth) pair of pleopods have no endopodites, and are shorter than the telson itself.

First Post-larval Stage (fig. 14).—Measurement:

Length of carapace . . .	4·0 mm.
Breadth (across third lateral spines) .	3·2 „
Length of antennæ . . .	6·7 „

The cast skin of the specimen from which these measurements were taken had the following dimensions:

Length of carapace . . .	3·4 mm.
Breadth	2·5 „
Length of antennæ . . .	4·0 „

The Megalopa stage lasts, according to my observations, from eighteen to twenty days, but possibly a more abundant food supply in natural conditions would somewhat shorten the period.

The young Corystes has now attained the structure of the adult in almost all respects. The rostral spine is reduced to an insignificant tubercle lying at the base of the indentation between the two anterior spines. The dorsal spine is completely lost, though a small orange chromatophore still marks its position on the carapace. The dorsal surface of the carapace is smooth, the median ridge of the previous stage and the two anterior dorsal spines having disappeared.

Besides the three lateral teeth of the Megalopa a fourth tooth is developed behind on each side close to the posterior edge of the carapace, so that the number characteristic of the adult is attained. The cephalo-thoracic appendages show no changes worth noting, except that the endopodite of the

first maxillipede has attained its final lamellar form (fig. 16). The abdomen, however, has changed considerably. It is now kept normally bent up under the body, the young crab having taken definitely to a burrowing habit. The first two segments are broad and flattened at the sides, while the remaining segments narrow out posteriorly and bear no lateral spines. All the segments bear setæ on their lateral margins. The telson has now an evenly rounded posterior margin.

The pleopods are no longer swimming organs, having lost all their setæ. The first four pairs remain biramous, and of about the same size as before, but the fifth pair is reduced to a simple stump. There is still no appendage upon the first abdominal segment, so that apparently in the female this appendage never develops, while in the male it is retarded till at least the second post-larval stage. I have hitherto obtained no later stage than that now under consideration, so that I cannot say at what period the distinctive sexual characters appear. The specimens of the first post-larval stage in my possession show also no difference in the relative size of the chelipeds.

Conclusion.

The Corystidæ, though placed by Milne Edwards (1834) and by Heller (1863) among the Oxystomata, have by more recent authors, such as Claus and Miers (1886), been assigned to the Cyclometopa. The resemblance between the Corystidæ and the true Oxystomata has been shown by Mr. Garstang (1897, etc.) to be largely superficial, and due to adaptive modifications of an essentially different character, though directed to the same ends. He has, in fact, brought forward clear evidence that the Corystidæ and the Oxystomata have been independently derived from Cyclometopous ancestors.

This view is to some extent supported by my observations on the development of Corystes, though the great uniformity in the structure of the zoæa throughout the Brachyura prevents any conclusion being drawn from the earlier stages.

In fact, it must be confessed that the most striking feature of the zoœa of Corystes, namely, the great length of the spine, recalls the zoœas of such Oxystomata as Dorippe and Ethusa —forms from which it differs essentially in other respects— more than those of the Portunidæ.

Still the final stages of the metamorphosis show that the peculiar emarginate rostrum of the adult (which recalls that of the Oxystomata) is preceded by a three-toothed rostral prominence which exactly resembles that found in most Portunids. That the central tooth represents more than a mere entogenetic stage in the reduction of the long rostral spine of the larva is also confirmed by the retention of a trifid rostrum in the adult of Pseudocorystes and Trachycarcinus (Faxon).

The existence of this Portunid stage in the development of Corystes was, I understand, the subject of a verbal communication made by Mr. Garstang to the Toronto meeting of the British Association in 1897 under the title "On Recapitulation in Development, as illustrated in the Life-history of the Masked Crab (Corystes)." As Mr. Garstang has been unable hitherto to write up his observations for publication, and as he informs me that the material at my disposal is more complete than in his own case, I am glad to be able to give a full account of the metamorphosis, and to confirm his observations. I may here express my indebtedness to him for his kind advice and many suggestions during the carrying out of my work.

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EXPLANATION OF PLATES 29—31,

Illustrating Mr. Robert Gurney's paper on "The Metamorphosis of Corystes Cassivelaunus (Pennant)."

All figures drawn with the aid of the camera lucida.

Fig. 1.—(× 32.) Zoœa of the first stage, showing distribution of chromatophores.

Fig. 2.—(× 100.) Telson of the first zoœa.

Fig. 3.—(× 47·5.) Zoœa of the second stage.

Fig. 4.—(× 100.) Telson of the second zoœa.

Fig. 5.—(× 47·5.) Telson of the third zoœa.

Fig. 6.—(× 35.) Third maxillipede of the first post-larval stage.

Fig. 7.—(× 26.) Zoœa of the fourth stage.

Fig. 8.—(× 65.) Second maxilla and thoracic appendages of the third zoœa.

Ep. 1—Ep. 3. Epipodites of maxillipedes 1—3.
a 1—a 3. Arthrobranchs 1—3.
p^1, p^2. First and second pleurobranchs.
mxp^3. Third maxillipede.

FIG. 9.—(× 260.) Second maxilla of the first zoœa.
FIG. 10.—(× 170.) Second maxilla of the second zoœa.
FIG. 11.—(× 105.) Second maxilla of the third zoœa.
FIG. 12.—(× 65.) Second maxilla of the Megalopa.
FIG. 13.—(× 20.) The Megalopa.
FIG. 14.—(× 20.) The first post-larval stage.
FIG. 15.—(× 45.) First maxillipede of the Megalopa.
FIG. 16.—(× 40.) First maxillipede of the first post-larval stage.
FIG. 17.—(× 45.) Second maxillipede of the Megalopa.

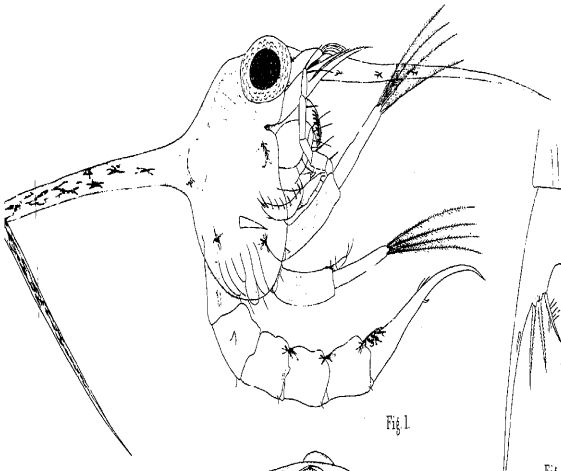

Fig 1.

Fig 2.

Fig 5.

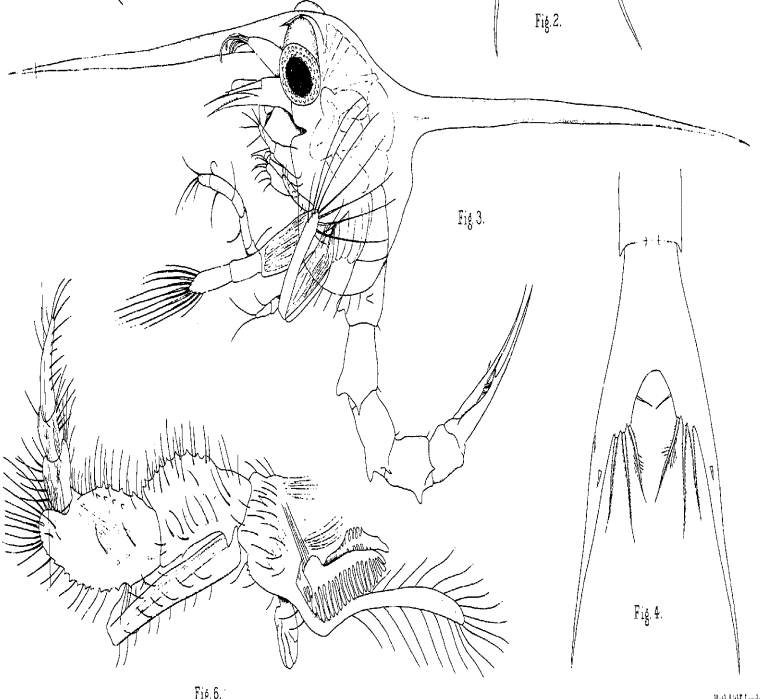

Fig 3.

Fig 4.

Fig 6.

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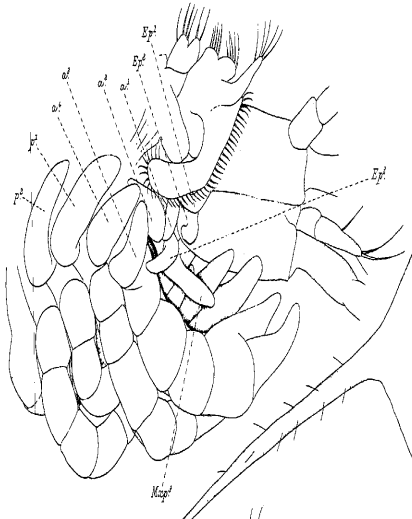

Fig. 8.

Fig. 7.

Fig. 9.

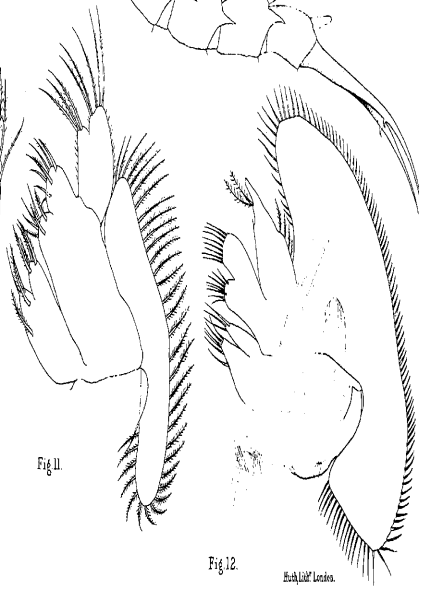

Fig. 11.

Fig. 10.

Fig. 12.

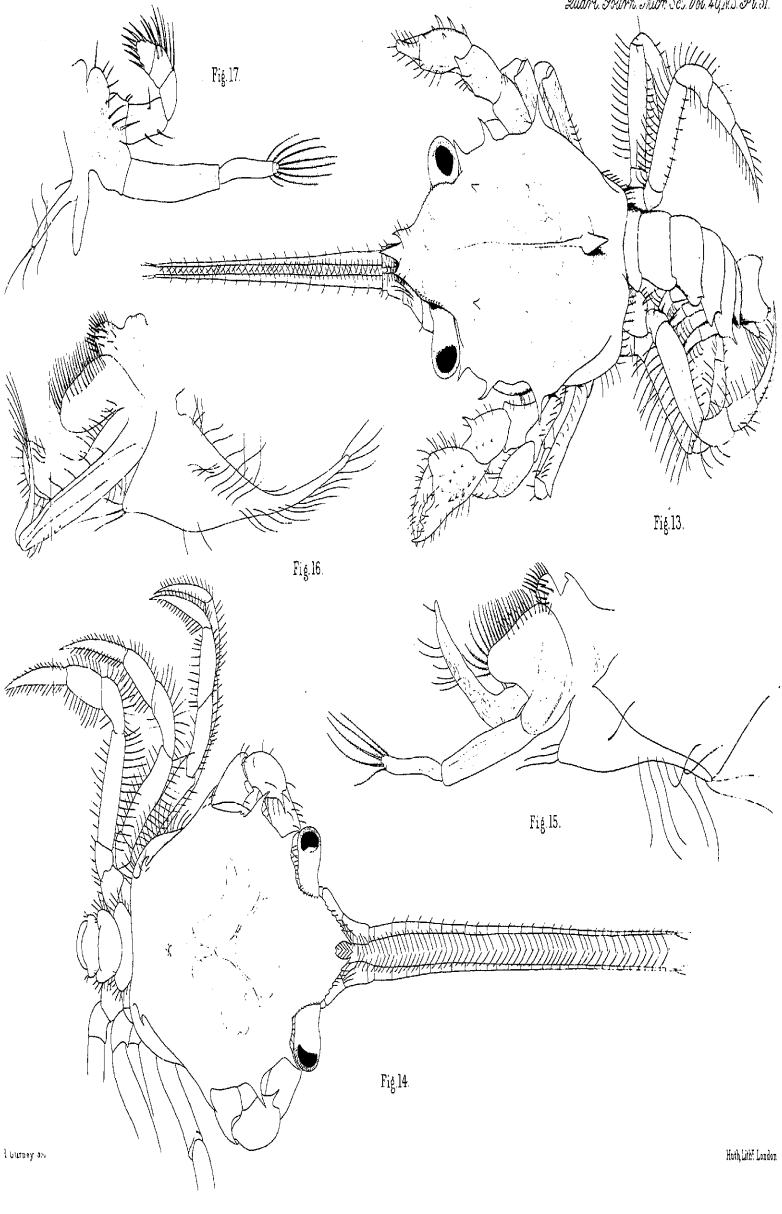

Fig. 17.

Fig. 13.

Fig. 16.

Fig. 15.

Fig. 14.