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On a New Genus of Amphipod Crustaceans

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XVII. *On a new Genus of Amphipod Crustaceans.* *By* Rudolph von Willemöes-Suhm, *Ph.D., Naturalist to the 'Challenger' Exploring-Expedition.* *Communicated by* Dr. Wyville Thomson.

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Leaving Gibraltar on the 26th of January, 1873, H.M.S. 'Challenger' proceeded in a south-westerly direction, and on the 28th the trawl was sent down, in lat. 35° 47′, long. 8° 23′, to a depth of 1090 fathoms, the temperature of the surface being 15°·55 C., and that of the bottom 2°·66 C. The haul was an uncommonly rich one; for, besides three species of fishes and many very interesting Echinoderms, a species of *Euplectella* was brought up and a large transparent animal, which we at first thought might be the larva of one of the higher Crustaceans.

Two enormous faceted eyes occupying the whole upper part of the head, and the presence of what seemed clearly to be an ovary, negatived, however, that supposition; and at Professor Wyville Thomson's request I made a closer examination of this animal, which was evidently of great interest in many respects.

The specimen is almost entirely transparent. Its length is 84 millims. and its greatest breadth 21 millims. The body consists of three parts:—1. The *head*, with one pair of antennæ in front, two contiguous faceted eyes occupying the whole of its upper surface, and the mouth situated at the posterior part of the under surface. 2. The *thoracic region*, composed of six segments, bearing two pairs of maxillipeds, five pairs of ambulatory legs, and three pairs of branchiæ. The second pair of maxillipeds and the first pair of ambulatory legs are on the second thoracic segment, which, as we shall see hereafter, may probably be formed by the fusion of two segments. We also remark the vulva on the under surface of the first segment. 3. The *abdomen*, which consists of five segments, three bearing pairs of *pedes spurii*, and the fourth and fifth the caudal appendages and the anus. An elevated line running along the dorsal aspect of the thoracic and abdominal regions divides them longitudinally into a right and a left half.

The Head.—The upper surface of the head is entirely occupied by two contiguous faceted eyes, which are separated from one another by a mesial line, 20 millims. in length (Plate XLIX. figs. 2 & 3). Each eye is 13 millims. in width, and its anterior and lateral borders are limited by a slightly coloured band, which will be referred to when considering the structure of the eyes. The posterior border nearly corresponds with the posterior border of the head, which arches gently over to the first segment of the thoracic region. The anterior border of the head is transverse and nearly straight,

running out at either side into a spine, which is the first and largest of a series of twelve spines bordering the outer edge of the head-shield. The mouth (Plate XLIX. fig. 1, *o*) is a very small opening on a round papilla placed near the posterior edge of the lower surface of the head. It is covered by a pair of rudimentary maxillæ, with a sort of labium between them, and by two pairs of maxillipeds (Plate XLIX. fig. 1, *mx*). A groove, the borders of which are adorned by series of one larger and five smaller teeth, runs backwards to the mouth along the middle line of the lower surface of the head. Fig. 3 gives a lateral view of the under surface, which is more easily understood from a figure than from the description. At the frontal border, separated by a distance of about 7 millims., there are two antennæ 26 millims. long. The antennæ consist of two elements, of which the proximal is longer than the distal, which is enlarged at the end, and bears a very small recurved claw.

The Thoracic region consists of six segments. The first of these bears the smaller pair of maxillipeds, and shows on its inferior surface an elevation, which is the genital papilla. The second segment is wider than the first, and bears two pairs of appendages—the longer maxillipeds and the first pair of ambulatory legs, which are more slender than the other four pairs, and have the proximal joint not so strongly denticulated; they are also inserted a little within the other four pairs, and they were held by the animal (which was still living when brought up) in the characteristic position of the accessory legs of the pycnogonid *Nymphon*. The eggs, which in this case are not held by the two rudimentary lamellæ near the vulva, were attached to these legs. The next four segments of the thoracic region bear each one pair of ambulatory legs, making, along with the pair on the second thoracic segment, five pairs in all. Of these the third pair is the longest; this is followed in length by the fourth, then comes the second, then the fifth, and finally the first. The length of the longest limb is 69 millims. The legs consist of four joints, showing denticulations and hairs. At the point of attachment of the proximal joint to the body no coxa can be distinguished. The leg is inserted into the thoracic segment, in the same manner as in *Phronima*. In the limbs of the third, fourth, and fifth pairs the proximal joint is terminated distally by a large spine. The second joint is very small in the limbs of the first pair, and still smaller in those of the fifth. In the limbs of the fifth pair the third joint is also remarkable, as it bears at its distal end a large tuft of straight hairs; and the fourth is more enlarged than the corresponding joint of the other limbs, and terminates in a stronger and more recurved claw. In *Phronima* the fifth pair of ambulatory legs, which corresponds with the third pair in the present form, presents the same modification. The enlarged distal terminations of the limbs and of the antennæ are not, like the remaining part of the appendages, transparent, but are of a milk-white colour, produced, I believe, by glands in their interior analogous to the glands in the enlarged claw of *Phronima*. To the bases of the second, third, and fourth pairs of legs three pairs of gills are attached.

The Abdomen consists, as in *Phronima*, of five segments, the first three of which bear

pairs of abdominal feet, consisting of a quadrate basal joint, to which are attached two feathered appendages. These are followed by two segments, to each of which are attached a pair of appendages, the four forming together the tail. Each of these appendages is bifurcate with a sharp and a rounded point. The rounded termination is milk-white, and is separated from the main piece of the appendage by an articulation. The anus is situated at the end of the last segment.

The Muscular System.—The animal is so transparent that all the main muscles are clearly visible; but they do not seem to present any thing very remarkable, with the exception of those of the thoracic legs, which are only very weakly developed. From this I suppose that the movements of the animal are not very rapid when it is obliged to walk over the sea-bottom. It may be, however, that, like *Phronima*, it makes but little use of these legs, and swims by aid of the abdominal feet only; these also are very small in relation to the size of the body.

The Nervous System.—The transparency of the body makes it possible likewise to distinguish clearly the cephalic ganglion and the ventral chain, consisting of five thoracic and three abdominal ganglia (Plate XLIX. fig. 1). The cephalic ganglion is situated in the anterior part of the head, more on the dorsal than on the ventral side; it is 3·50 millims. in width, and is horseshoe-shaped with pointed ends. From the middle of its anterior margin two large nerves run straight to the end of the antennæ, while from the opposite side two commissural cords run backwards, traversing the head and, after having encircled the mouth, uniting with the first thoracic ganglion. The nerves passing from the sides of the cephalic ganglion are all employed as ocular nerves to supply the huge compound eyes. Those of the anterior end are better seen, as they go to the anterior part of the eyes, while those of the posterior end seem to go to the posterior parts.

The first thoracic ganglion is seated just underneath the ovary in the second segment, and sends out the nerves for the mouth and for the genital organs. The two cords then separate till they are united again in the third segment in the second ganglion; thence they run backwards in a single chain and form a ganglion in each of the subsequent segments, sending nerves to the legs. Altogether we find five thoracic ganglia for six segments, and in the abdomen three ganglia for five segments. The last ganglion of the abdomen is more slender than the preceding ones, and seems to send out nerves in different directions, especially to the anus and caudal appendages. In *Phronima* there are ten pairs of ganglia, five of which, as in the present case, are thoracic and five abdominal.

The Eyes are contiguous, the line separating them being, however, clearly visible: the length of this line is 20 millims. The eyes thus occupy a rectangular space, the outer edges of which are separated from the spiny borders of the head-shield by a space 6 millims. in width. At the front of the head there is a space of 3 millims. between their anterior borders and the line into which the two antennæ are inserted.

Along the sides of the eyes there is a brownish line produced by elongated chitinous appendages, 0·140 millim. long (Plate L. fig. 8), attached irregularly to the borders of the cornea. These appendages are hollow tubes pointed and closed at the top, and

flattened and slightly denticulated at the base. The cornea of the eye is faceted externally, the facets being hexagonal (Plate L. fig. 7). Beneath the facets we find very elegant slender crystalline bodies, 0·840 millim. long, and at the top 0·147 millim. broad (Plate L. figs. 9, 9 *a*). I have figured two pairs of these, as they are always united together by their slender ends, the point of union being shown at fig. 9 *a*. In their upper part a granulation is to be seen, giving them a slightly brownish colour; and in their tapering extremities there are some clear vesicles, which have some resemblance to the varicosities of a nerve-fibre. The nerve-rods which are present in *Phronima* are absent in this form, and there is no pigment.

It is impossible to say whether organs of hearing or of touch exist, as it was not practicable to dissect the single specimen we procured in order to examine the different parts under the microscope.

The Organs of Digestion and the parts of the Mouth.—The opening of the mouth (Plate L. fig. 6, *o*) is oval, and is situated on the top of an elevation (Plate L. fig. 6, A) at the base of the head. It is usually closed by a pair of very small denticulated maxillæ (fig. 6, *ma*), and between them a labium (fig. 6, *lab*) in the form of a small denticulated plate. Other maxillæ are entirely wanting; they are physiologically represented by two pairs of maxillipeds, which must be regarded morphologically as two pairs of ambulatory legs transformed for that purpose. Their relations become apparent on comparison with *Phronima*. These maxillipeds (Plate XLIX. fig. 1, *mx*) consist of two joints, and are terminated by a pair of claws. The external margin of the second joint is denticulated. The first pair of maxillipeds is attached to the first segment of the thorax, and the second larger pair to the second segment, to which is also attached the first pair of ambulatory legs. I therefore think that this larger second segment has arisen from the fusion of two segments.

The small mouth leads into a large slightly yellowish stomach, through a recurved œsophageal passage, in which there seems to be a chitinous layer, as a dark spot is to be seen there from the outside. The walls of the stomach (Plate XLIX. fig. 3, *cœ*) are striated and probably muscular. The stomach appears to be cæcal, and the particles of food brought into it must return in order to get into the intestinal tube, which opens from the œsophagus and runs as a thick-walled tube over the right side of the ovary (fig. 3, *in*). Its walls then become thinner and nearly transparent, so that only its reddish contents showed me the remainder of the tube running straight to the anus (figs. 1 & 2, *as*), to which muscular fibres, forming a sort of *constrictor ani*, are attached on both sides.

This configuration of the digestive system is in many respects similar to that in *Phronima*; the external parts of the mouth, however, bear but little resemblance to those in that genus. In *Phronima* there are one pair of mandibles, two pairs of maxillæ, and a labium; while of these we have here only the labium and one pair of maxillæ. In *Phronima* the two first pairs of ambulatory legs have no relations to the mouth as they have in this case.

The dark spot which we have pointed out in the œsophagus appears to answer to what CLAUS calls the "dental plates" in *Phronima*; and the cæcal appendage which he describes in that animal has, in the present species, assumed so large dimensions as to have replaced the stomach, which does not exist morphologically, but is physiologically represented by the cæcum.

CIRCULATION AND RESPIRATION.—While the animal was alive I did not succeed in seeing the heart. I only saw it when it had been put into weak spirit; and under the same treatment I also saw the nervous system much better than before. The heart is an elongated tube extending from the second to the fifth segment (Plate XLIX. fig. 3, *c*). Probably there are three openings in it as in *Phronima*, one in each segment; but of these nothing could be made out.

The respiratory organs consist of three pairs of small transparent sac-like gills at the bases of the second, third, and fourth pairs of feet (Plate XLIX. fig. 1, *br*). They are in form and number nearly the same as in *Phronima*. The water is driven over them by the action of the three pairs of abdominal feet.

GENITAL ORGANS.—The single specimen taken is a female. There is a large ovary, distinguished by its rose-colour, occupying the middle portion of the first body-segment (Plate XLIX. fig. 3, *ov*). I suspect that it consists of two ovaries lying close together, and having two excretory ducts leading to the genital papilla; but it is impossible to ascertain this without mutilating the specimen. The genital papilla is an elevation in the centre of the ventral surface of the first thoracic segment between the two limbs, which, as I have already mentioned, are destined to bear the eggs at their base, as in the females of *Nymphon*. The colour of the papilla is rose, with scattered scarlet points produced by small spines on the surface of the carapace. In the centre of the genital papilla there is a large spine (Plate L. fig. 6, *d*) with a groove leading into a depression (*c*), in which I believe are seated the apertures of the ovarian ducts. This pit is protected by two soft appendages (Plate L. fig. 6, *l*), answering to the valves which are to be found in most female Amphipods, and in which they keep their eggs. In the present species, however, they are only rudimentary, and they do not seem to be used for that purpose, as I found the eggs attached to the bases of the first pair of ambulatory legs.

EGGS AND DEVELOPMENT.—The eggs which I found adhering to the legs had a diameter of 0·7 millim., and were provided with an unsculptured chorion. They contained embryos in different stages of development. Unfortunately I discovered this only after the animal had been for a night in weak spirit, in which it had been placed for fear it should suffer decomposition.

The main point with regard to its embryology could, however, still be settled—namely, that there is no metamorphosis, and that the antennæ, the five pairs of thoracic, and the abdominal legs are already to be seen in the embryo. Figs. 4 and 5 of Plate L. give lateral and dorsal views of an embryo, showing the five ambulatory legs. Embryos in the stages which showed the antennæ and the abdominal legs were not in a sufficiently

good state of preservation for figuring. All the eggs seemed, as might have been expected, to be in nearly the same stage of development, and I could not determine whether the spherical organ ("kugelförmiges Organ" of the Germans) makes its appearance or not.

Systematic Position and Affinities.—We have already pointed out so many relations between the Crustacean described and *Phronima*, that no room is left for doubt that it is an Amphipod, although an aberrant one. We must now consider the characters in which the new genus differs from *Phronima* as well as from the Amphipods in general, and the position which must be assigned to it in the system of classification. I have only a very small part of the literature of the Amphipoda to refer to; but the form and the anatomical structure of this genus is so remarkable, that I think, had it been previously described in detail, either Professor Wyville Thomson or I must have seen a figure of it. As this is not the case, I venture to introduce it to science with the following generic characters under the name of

Thaumops, gen. nov.

Caput oblongum, inflatum, oculis maximis superiorem capitis partem tegentibus. Segmenta thoracica 6, abdominalia 5. Antennarum in feminis par unum, maxillarum par unum, pedum paria duo minima maxillarum locum tenentia. Mandibulæ nullæ. Pedes thoracici 5, abdominales 3 in quoque latere. Appendices caudales 4. Gangliorum pectoralium paria 5, abdominalium 3.

Thaumops pellucida, sp. nov.

Corpus longitudine 84 mm., latitudine 21 mm., pellucidum.

Locality. A single specimen of the female taken with the trawl from a depth of 1090 fathoms off Cape St. Vincent.

The segmentation of this genus presents only a very slight difference from that of *Phronima*, in which there are seven thoracic segments, while in *Thaumops* six only can be clearly discerned; but, as I have already observed, the second segment is larger than the others, and bears two pairs of limbs—the second pair of maxillipeds and the first pair of ambulatory legs. It is therefore probable that this segment represents two segments fused, in which case the segmentation of *Thaumops* would differ in no essential particular from that of *Phronima*.

The shape of the head and of the eyes in *Thaumops* is very peculiar, and so is the position of the antennæ. In the presence of a single pair only of antennæ, and in the antennæ being composed of two joints, *Thaumops* agrees with the female of *Phronima*; but in the former genus the antennæ are placed on the front of the head, while in the latter their place of attachment is close to the mouth.

The number of the joints of the legs is the same in both forms; for if we recognize the two pairs of maxillipeds as legs, we have in both Crustaceans seven pairs in the

thoracic region. Even the claw which *Phronima* usually has on the fourth leg is represented here by the enlarged terminal joint of the last pair of thoracic legs.

The three pairs of abdominal feet and the segmentation of the abdomen present only very small differences from *Phronima*, in which there is one pair of appendages more than in *Thaumops*.

In both forms the nerve-chain shows five ganglia in the thoracic region. In the abdominal region *Thaumops* has three ganglia for five, *Phronima* five for five, segments.

Both forms alike have very large compound eyes, with an externally faceted cornea and crystalline bodies. The general conformation of the stomach in *Thaumops* is similar to that of *Phronima*, only in the former the cæcal appendage is developed to an extraordinary degree. The intestinal tube presents nothing remarkable. The heart is confined, as in *Phronima*, to the anterior part of the thoracic region, and the gills are three pairs, with nearly the same form and mode of attachment in both cases.

The genital papilla in *Thaumops* is in the centre of the first thoracic segment, while in *Phronima* it is in the seventh body-segment. The ovaries in *Thaumops* seem to be double, and are of a cylindrical form, while in most other known Amphipods they are cylindrical.

Thaumops is nearly related to *Phronima*; nevertheless I do not think it can form a member of the family Phronimidæ, as the transformation of the first two pairs of thoracic appendages into maxillipeds, the absence of mandibles, the entirely different structure of the head, the genital papilla being situated in the first body-segment, and the last pair only of the thoracic appendages being enlarged and bearing claws, seem to me to be characters of more than generic value.

As to the habit of life of *Thaumops*, the question arises whether it is a pelagic animal (like *Phronima*) which may have been caught in the trawl on its way up from the depth to which it had been lowered, 1090 fathoms, or whether it lives on the bottom. I have already given my reasons for thinking that this Crustacean is not a good swimmer, and for suggesting that it may, like *Nymphon*, live at the bottom; but I am well aware that these reasons are not sufficient to establish the point, which must be kept open to be decided by future observations.

Description of the Plates.

PLATE XLIX.

Fig. 1. *Thaumops pellucida*, seen from below. $1\frac{1}{2}$ nat. size.

A. Head with the cephalic ganglion and the nerves departing from it.

o. The mouth.

B. Five pairs of feet attached to the thoracic region.

gp. Genital papilla.

mx. Maxillipeds.

br. Branchiæ.
C. Three pairs of abdominal feet.
as. The anus.

Fig. 2. The same, seen from above. The head entirely covered by the faceted eyes (*oc*).
as. The anus.

Fig. 3. The same. View from the side.
oc. Eyes.
ap. Line of brownish appendages.
o. Mouth.
cæ. Gastric cæcum.
in. Intestine.
gp. Genital papilla.
ov. Ovary.
c. Heart.

PLATE L.

Fig. 4. Embryo in the egg, seen from above. ×70.

Fig. 5. The same, seen from the side. ×70.

Fig. 6. Papilla of the mouth (A) and genital papilla (B), seen from below. ×10.
ma. Maxillæ.
lab. Labium.
o. Opening of the mouth.
c. Depression for the oviducal apertures.
l. Breeding lamellæ.
sp. Small scarlet spines.
d. Large spine at the entrance of the vulva.

Fig. 7. Facets of the cornea. ×70. Represented diagrammatically.

Fig. 8. Chitinous appendages at the lateral line of the eye, showing also the chitinogenous layer of the carapace. ×120.

Fig. 9. Two pairs of crystalline bodies. ×120.

Fig. 9 *a.* Point of union of one pair of the crystalline bodies. ×120.

APPENDIX.

On the Male and the Structure of Thaumops pellucida.

Received October 24,—Read December 11, 1873.

SINCE my paper on the large Hyperid was read at the Royal Society, three males of *Thaumops* have been caught by us. One of these, which was taken at the surface in the towing-net during the night, was very much spoiled; and I dissected its oral apparatus in order to elucidate several points about which I remained doubtful when I examined the female.

The largest of the males is 103 millims. in length, exceeding in length the large female by 19 millims., and showing that *Thaumops* attains a prodigious size. It was caught by the trawl in lat 5° 48′ N., long. 14° 20′ W. Another very well-preserved male is younger, only 46 millims. long, but shows the genital organs better. These males differ from the females by the absence of the genital openings at the base of the first segment and of the breeding lamellæ. The two elongate testes begin just behind the cæcum of the stomach, and their vasa deferentia run down to the last segment of the pereion, where they terminate by two simple openings between the last pair of pereiopods.

There is not a trace of a second pair of antennæ, either in the male or in the female. In the former, however, the first pair of antennæ, the five pairs of ambulatory pereiopods, and the caudal appendages are distinguished by the want of the glandular apparatus. In the female these glands cause an enlargement at the top of each of the appendages in question, and this enlargement is of course also wanting in the male.

The anterior antennæ have, in the large male, a length of 18 millims., and consist of two joints, the first of which is very short. The oral apparatus presents the same papillar shape which I figured in the female; but the mandibles, which at first I thought were entirely wanting, have now been found. They are very much like those of *Phronima*, only shorter and not so elongate as in that animal; the palpus, which is present in the mandibles of the male *Typhidæ*, could not be detected in *Thaumops*. The first maxillæ are also very small, and differ by their shortness from those of *Phronima*, but otherwise show the same characters. The second maxillæ could not be found with certainty; they are either wanting or represented by an organ which I thought was the labium (Plate L. fig. 6, *lab*). This organ arises from the second joint of a very peculiar appendage, which I have interpreted in my first paper as maxillæ (Plate L. fig. 6, *ma*). I am now satisfied, however, that these are the maxillipeds, consisting of three joints. Two of these joints are united together, the first being attached

to the oral apparatus, and the second giving rise to a peculiar organ which consists of two chitinous claws united by a thin layer of the same substance, so as to form a sort of plate. I have already mentioned that I am not quite sure whether this is a labium or, as it seems more probable, the result of the displacement and union of the second maxillæ. This organ is situated at the inner side of the maxillipedes, the third joint of which consists of two strongly denticulated and separate claws. The two appendages (Plate XLIX. fig. 1, *mx*) which I first thought act as maxillæ are the gnathopoda of SPENCE BATE, followed by five pairs of pereiopods. The pleopods or swimmerets consist in the male, as well as in the female, of only three pairs.

All the other particulars described in the female may also be found in the male.

The question now arises whether the systematic position which I assigned to *Thaumops*, as a representative of a new family of *Hyperidæ*, to be placed next to the *Phronimæ*, can still be maintained. After having carefully examined the question, I think it not only can but must be maintained. As Professor CLAUS was kind enough to write to me, and as I had remarked already before getting his letter by studying living specimens of *Oxycephalus*, there are several points by which *Thaumops* approaches the *Typhidæ*, especially the elongate shape of the head, with the mouth underneath and the claws terminating the gnathopods. On the other hand, however, the want of the second antennæ in the male, the elongate slender shape of its first antennæ, which show nothing of the enlargement and the olfactory hairs peculiar to the male *Typhidæ*, and the want of the palpus in the male mandible, show that it differs widely from the *Typhidæ*. I therefore think that the position I first proposed for this animal is the right one. The characters, however, which I assigned to it must be changed somewhat in the following way.

THAUMOPS, nov. gen.

Caput oblongum, oculis maximis superiorem capitis partem tegentibus. Segmenta thoracica septem, abdominalia quinque. Antennarum in utroque sexu par unum. Mandibulæ et maxillæ minimæ. Maxillipedum par unum conjunctum. Pedum thoracicorum paria septem, anteriora duo parva et chelis armata. Pedum abdominalium paria tria.

Thaumops pellucida, n. sp.

Corpus longitudine 84–103 mm. In maris Atlantici parte septentrionali.

There is no doubt that *Thaumops* is a pelagic crustacean; and it is probably spread all over the Atlantic, for we got it off the coasts of Portugal and very near the equator. It was caught once at night in the towing-net and three times by the trawl, coming up from a great depth; therefore it seems probable that, like many other pelagic animals which in the daytime live in a depth of 40–100 fathoms and come up only in the night, it retreats to a considerable depth; and this is probably the reason why it has so long remained unknown.

H.M.S. 'Challenger,' Bahia, September 1873.

Fig. 1.

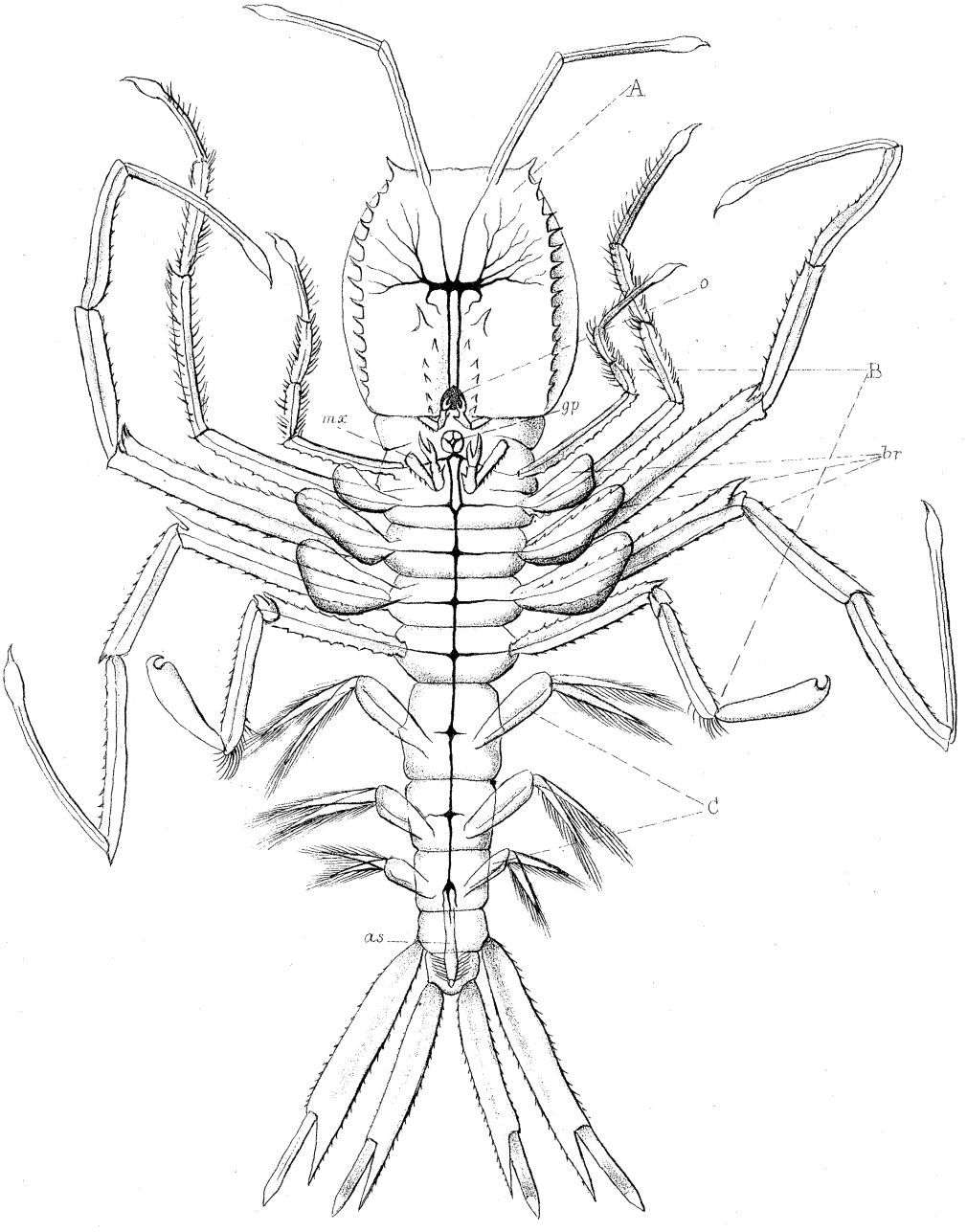


Fig. 2.

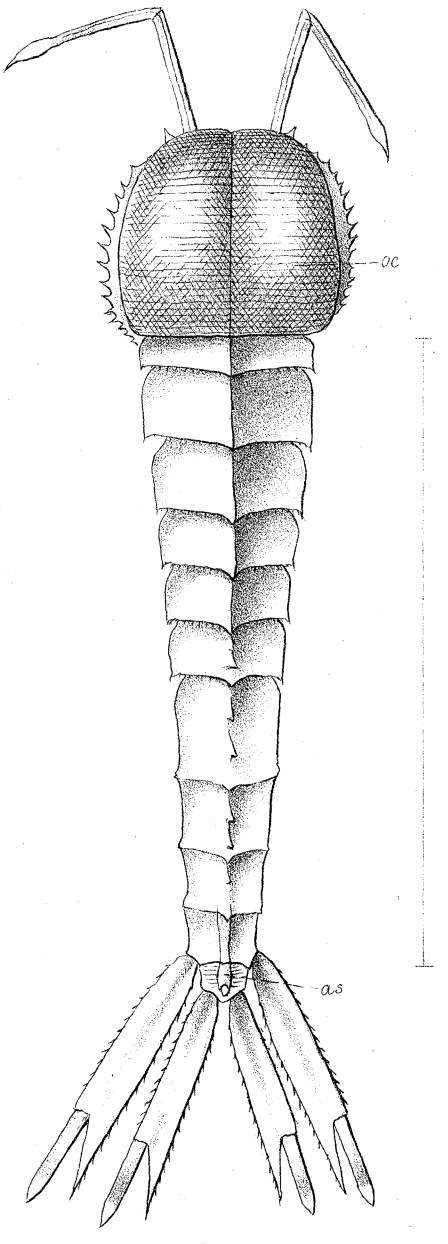
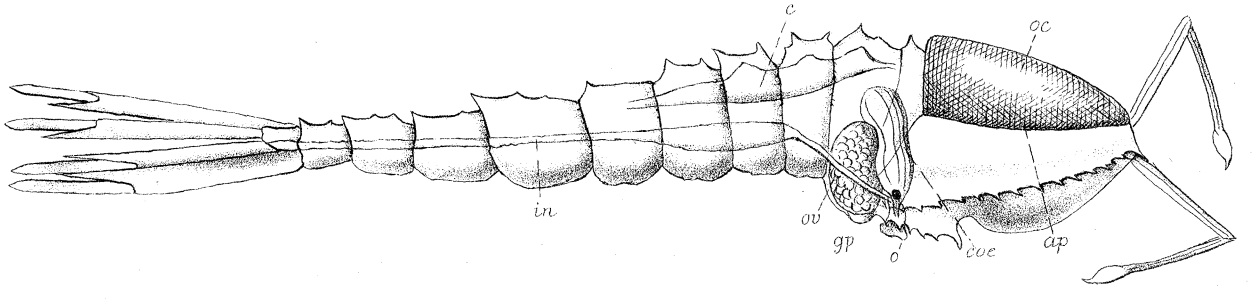


Fig. 3.



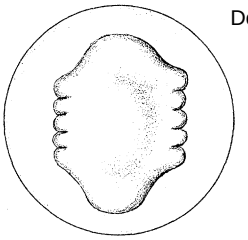


Fig. 4.

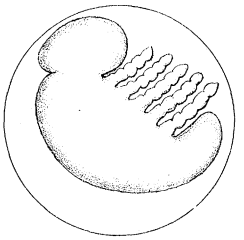


Fig. 5.

Fig. 6.

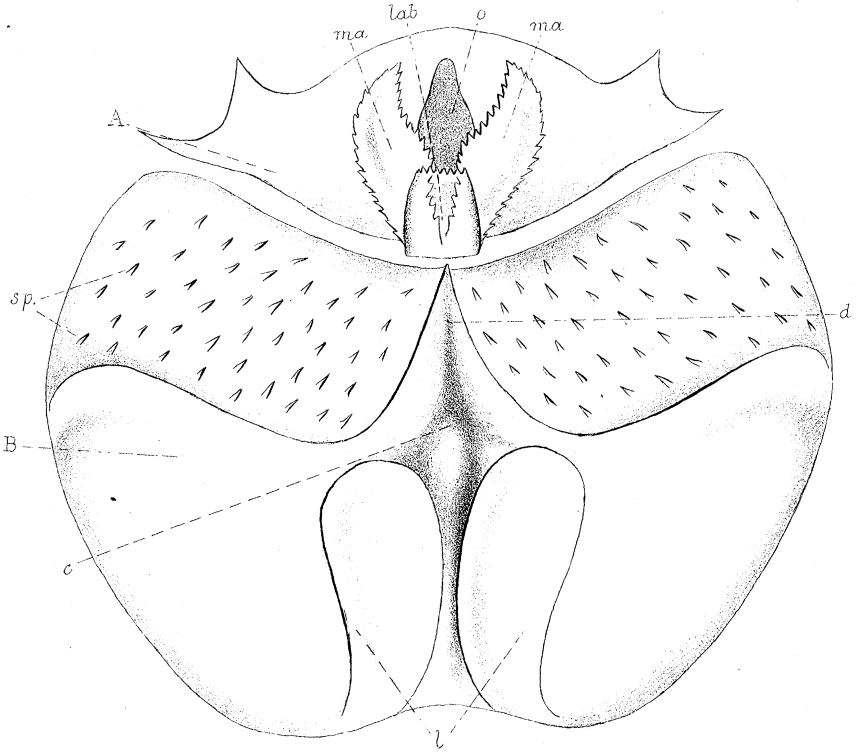
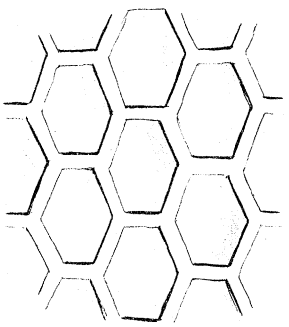
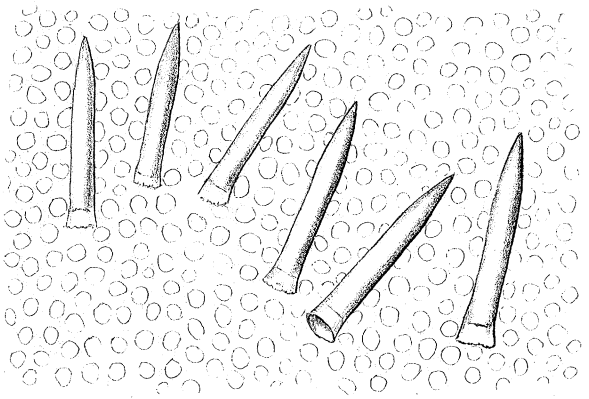


Fig. 8.

Fig. 7.





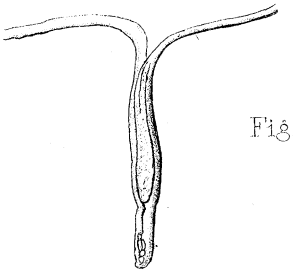


Fig. 9 a.

Fig. 9.