II. *On some Atlantic Crustacea from the 'Challenger' Expedition. By* Dr. R. v. Willemoes-Suhm, *Naturalist to the Expedition. Communicated by* Prof. Wyville Thomson, *F.R.S. & L.S.*

(Plates VI–XIII.)

Read May 7th, 1874.

Among the great quantity of deep-sea Crustacea which have been brought up during our cruise in the Atlantic, either by the dredge or the trawl, I have selected the most interesting ones for immediate description. Besides, readers will find in this paper the description of both sexes of an interesting *Nebalia* from the shallow water of the Bermudas, some remarks on the structure of *Cystisoma*, and a note on the development of a Land-Crab from the Cape-Verds. Some of the deep-sea forms, the *Willemoesiæ* (*Deidamiæ*), *Astacus*, *Zaleucus*, and *Gnathophausia*, have been already figured in 'Nature,' in the "Notes from the 'Challenger'" published by Prof. Wyville Thomson; and a short description, taken from my first notes on the subject, has been added. In this paper it is now intended to give a more detailed account of their structure and their systematic position. The paper is divided into the following seven parts:—

I. On a blind deep-sea Tanaid.
II. On *Cystisoma Neptunus* (*Thaumops pellucida*).
III. On a *Nebalia* from the Bermudas.
IV. On some genera of Schizopods with a free dorsal shield.
V. On the development of a Land-Crab.
VI. On a blind deep-sea *Astacus*.
VII. On *Willemoesia* (Grote), a deep-sea Decapod allied to *Eryon*.

I have only worked out such species as, from their structure and zoological affinities, present a greater interest or belong to groups about which we had a satisfactory literature on board. Should, nevertheless, a want of literary information be remarked in some point or other, the reader is asked kindly to remember that this paper was worked out on board a ship cruising in the Atlantic.

H.M.S. 'Challenger,'
Cape of Good Hope, November 1873.

I. On a blind deep-sea Tanaid. (Pl. XII. figs. 1–9.)

During our cruise in the Atlantic, members of the *Anisopoda* tribe were found twice. First, on the 2nd of May a real *Tanais* was got from a depth of 1700 fathoms off the North-American coast; I cannot determine whether this animal belongs to a known species or not. Later, when cruising among the Azorean islands San Miguel and Santa

Maria, we got from a depth of 1000 fathoms another Anisopod, which belongs to the interesting genus *Apseudes*, according to Mr. C. Spence Bate* the only Isopod in which the antennal scale, so common in the Macrura, is present on the lower antennæ, and, as we may add, one of the few in which there are two flagella in the anterior antenna. In the species of *Apseudes* hitherto known the eyes are pedunculated: in this deep-sea animal there are no eyes at all; hence we might call it *A. cæca*. It has a length of 6 millims., the females having the same length as the males.

The cephalothorax, to which is attached the first pair of gnathopods, has a spiny rostrum and two prominent spines on each side. The first antennæ (fig. 1, a^1, and fig. 2) show a very strong funiculus and two flagella, one of which consists of twenty-four, the other of eight joints. The longer is double the length of the smaller one.

The exterior or second antennæ (fig. 1, a^2, and fig. 3) have a smaller flagellum, consisting of eight joints and an antennal scale articulating with the first joint of the funiculus (fig. 3, *s*). The mandibulæ have a palpus consisting of several joints.

The maxilliped (fig. 9) has strong tufts of hairs on the last three joints. The two gnathopoda are very different in form: the first one (fig. 4) is short, and terminates in a strong recurved chela; while the second is much longer (fig. 5), and has enlarged and flattened joints with strong spines, as may also be seen in the other species of *Apseudes*. The pereiopoda are strong but not very much enlarged appendages. We have drawn the first and second as well as the top of the fourth; the third is terminated by a bifid claw, as is the sixth in *A. talpa*, Mont., which we have not drawn, as only once could we clearly get sight of it. When afterwards it was tried again to get a view of the two claws, it was impossible to separate them from each other.

The first five segments of the pleon are short, and possess small biramous pleopoda. The last segment is elongated, as in *A. talpa*, and shows at the top two pairs of caudal setæ.

In the females there are breeding-lamellæ at the base of the second gnathopoda and the first two pereiopoda, which are wanting in the males. This is the only difference which I could find out between the two sexes.

Most of the specimens which we got were washed out from the mud which the dredge had brought up. We did not meet with this Crustacean again.

This is not the first instance of blind Isopods being described, as some subterranean † and parasitical ‡ forms are well known to have no eyes, or to lose them, as *Anceus* does, when getting old. There is also a whole family, the Munopsidæ, which is blind, though most of its members live in moderate depths. A very large member of this family has also been got by us in the deep sea; it cannot, however, be described now, as the necessary literature is not at hand.

II. On Cystisoma Neptunus (Thaumops pellucida). (Pl. XI. figs. 4–8.)

In a postscript to my paper on *Thaumops pellucida* (Phil. Trans. of the Royal Society, 1873) I have described the male of this remarkable Amphipod, and given some

* Facts and Arguments for Darwin, by Fritz Müller, translated by Dallas (London), 1869, p. 132.

† *Titanethes albus* and *Typhloniscus Steinii*. ‡ *Bopyridæ* and the female of *Anceus*.

details on the structure of both sexes, which could only be discovered when it was possible to dissect one of the specimens. I now have to publish some figures which could not be given in my first paper, and add a few words to them. But before doing this, I must declare that the name of *Thaumops pellucida* must be withdrawn, as this animal has been already described under the name of *Cystisoma Neptunus* by Guérin-Méneville*, from a single specimen caught in the Indian ocean. I see this from Spence Bate's 'Catalogue of Amphipodous Crustacea' †, which I have just received, and which contains a copy of Guérin-Méneville's rather bad figure and a short description of a specimen, which probably is a male.

Guérin-Méneville (and Spence Bate ?) regards *Cystisoma* as belonging to the Hyperidæ family, and takes the antennæ (which are in front of the head) as representing the second pair. Why they should be homologous with these I do not know; nor do I think they are; for in Phronimids, Oxycephalids, and Hyperids the second antennæ have a funiculus consisting of several (more than two) joints. Now in *Cystisoma* the antennæ have got two joints, which seem to represent the one a funiculus joint, and the other the flagellum of the first antennæ of *Phronima*.

Against a union of *Cystisoma* with the Hyperids may be advanced, besides the form of the head (which is more Typhid-like) and the absence of the second antennæ in both sexes, the absence of a palpus on its mandible (Pl. XI. fig. 6). The palpus is always present, according to Claus, in Hyperids, but is wanting in Phronimids. Besides, there are so many peculiarities distinguishing *Cystisoma*, which I have enumerated in my above-mentioned paper, that I do not think it possible to keep it in one of the hitherto received families, but that now, when we know its structure better, we have to establish for it a special family called Cystisomidæ.

The first maxilla has been described, and is now figured in Pl. XI. fig. 7. The second maxilla could not be found, and is probably represented by an organ which might have arisen from the union of the second maxillæ and the under lip (Pl. XI. fig. 8). This organ (*l*) is attached to the third joint of the reduced maxillipedes, and surely acts physiologically as an under lip. The maxillipedes are reduced and fused together so as to form one organ consisting of two basal joints and two claws (fig. 8, *m*), between which is attached the organ which we suppose to represent the maxillæ and the under lip.

The male differs by the absence of glands at the top of nearly all the appendages, especially in the last pair of pereiopoda, which, according to this, have not the same clumsy appearance as in the female. The two testes begin just behind the stomach (fig. 5, *t*), and send vasa deferentia to the last segment of the pereion, where two simple genital openings are to be seen between the last pair of legs (fig. 5, *a g*).

Probably (as in *Phronima*) the full-grown male is somewhat smaller than the female, it seems that *Cystisoma Neptunus* can attain a very considerable size; for the last and largest male which we got in the trawl has a length of 103 millims. It seems that these oceanic amphipods have a very wide geographical distribution. *Cystisoma*, as we have seen, was first described from the Indian Ocean; and *Oxycephalus piscator* is

* Guérin-Méneville, in Revue Zoologique, July 1842, p. 214. † Page 311, pl. l. fig. 7.

mentioned as occurring in the same. Now we have found in the Atlantic not only four specimens of *Cystisoma*, but also numerous specimens of two species of *Oxycephalus*, one of which seems to me to be identical with *O. piscator*.

III. On a *Nebalia* from the Bermudas. (Plate VI.)

During our stay in the Bermudas Mr. Murray collected one day some small Crustacea in Harrington Sound, a bay which only communicates with the sea through a narrow passage. Among them I was very glad to find a *Nebalia*, and went then myself to the bay, where this interesting little Crustacean was not rare under stones and corals. I collected, perhaps, twenty females and two males, and was able to make some observations on them which, added to the embryological researches of Mecznikoff and the anatomical remarks of Claus * on both sexes of the Mediterranean *N. Geoffroyi*, will, I think, enlarge somewhat our knowledge of these Crustacea, which for such a long time have been considered to be Phyllopods, but, according to the above-named papers, are more rightly placed among the Schizopods.

The female of this *Nebalia*, which I am going to call *N. longipes*, has a length of 6 millims., and is, when living, of a milk-white colour. The shell, posteriorly and above somewhat flattened, has an oval form; it terminates anteriorly in a sharp and slender rostrum, which covers the pedunculated eyes; the upper surfaces of these eyes are entirely covered with small spines, so that the perception of the light is only possible through the facets of the under surface. The shell does not quite extend so far backwards as in *N. Geoffroyi*, where it reaches the fifth abdominal segment.

The *anterior antennæ* (figs. 1, 2, *a*, and fig. 5) consist of four joints, the last of which is a denticulated claw (fig. 5, *k*). From the base of this claw start two flagella (fig. 5, *a* and *b*), the shorter of which is transformed into a large squamiform appendage, fringed with hairs; the other one is more slender and densely covered with olfactory hairs.

The *posterior antennæ* (fig. 7) consist of three joints only, the last of which is densely covered on its protuberances with tufts of hairs, especially at the point of insertion of the flagellum, which itself is divided into nine imperfect joints marked by tufts of hair.

A comparison of the *mandibula* and the two *maxillæ* (figs. 8–10) with the corresponding parts in *N. Geoffroyi* shows that there are only very slight differences between them. I saw the palpus of the first maxilla ("Putzfuss," Claus) in the same position in the male as in the female, *i. e.* bent backwards.

More important are the *pectoral feet*; for on their account especially *Nebalia* was formerly supposed to be a true Phyllopod. If this Bermudan species had been the first *Nebalia* which had been noticed, I do not think that this would have occurred; for in the feet of this one the phyllopodal characters are very little perceptible. In fig. 3 I have figured a pectoral foot of *N. longipes*, and in fig. 4, for comparison, one of *N. Geoffroyi* (taken from Claus's paper); so that the corresponding parts will be easily found out. The two-eared branchial appendage of the basal joint (figs. 3 & 4, K A) is very large in *N. Geoffroyi*, and in *N. longipes* only rudimentary. The appendage of the second joint has

* Von Siebold und Kölliker's Zeitschrift für wissenschaftliche Zoologie, vol. xxii. p. 323.

entirely lost its flattened form, and is a sort of leg, which, however, like the main branch, is not jointed, but is densely covered with hairs on one side. When comparing such a foot with the pereiopod of a true Schizopod, as, for example, *Lophogaster* (Sars, Beskrivelse over *Lophogaster typicus*, tab. ii. fig. 35), we see in both on the basal joint the branchial appendages, which in *Nebalia longipes* are very simple, and in *Lophogaster* divided and arborescent. From the second joint starts the palpus, which in our case has a different shape from that of *Lophogaster*, but which morphologically is the same thing. In the foot itself we find in *Lophogaster* well-defined joints and a terminating claw, in *N. Geoffroyi* we still find the joints, but in our case we find no joints; in all three, however, it is not difficult to find out the corresponding parts.

The first four pairs of abdominal feet or pleopods (fig. 11) have a large basal joint denticulated exteriorly, to which two rami are attached, the interior of which is longer and has at its base a little appendage, which is by means of a denticulation at the top united to a similar one of the other pleopod. It has been called by Claus, who found it in *N. Geoffroyi*, the retinaculum. Such appendages have been shown by Claus also in Stomatopods, and figured by Milne-Edwards from the Decapod genus *Atya*. The fifth and sixth pair of pleopods resemble very much those in *N. Geoffroyi*.

The two joints of the *furca* are covered at the top with tufts of long and dense hairs.

Among twenty to twenty-five females I discovered two or three *males*, easily recognizable by their minute size and the enlarged flagellum of the anterior antennæ, which here are transformed into real prehensile organs. The males are only 3 millims. long, and differ from the females also by being more slender, by their shorter pleopods and their antennæ, which are on the whole somewhat shorter and bigger. The pectoral feet are exactly the same as in the females. In the males of *N. Geoffroyi* the second pair of antennæ have an enormously long flagellum, something like the *Cuma* male; while in our *Nebalia* the second antenna differs very little from that of the female, nor are the olfactory hairs to be seen in much greater quantity, unless perhaps at the top and the outer edge of the third joint. The *first antenna* (fig. 6), however, is very different in the male; for its squamiform flagellum is greatly swollen up, and the joints are only to be discerned as small protuberances with some hairs on them on one side. This conformation is rather a phyllopodal one—so far as I can make out here, something like that found in *Estheria*.

I found, like Claus, a ductus ejaculatorius directed towards the base of the eighth pereiopod, but could not exactly see its opening.

This *Nebalia* differs from the two species hitherto known, by the spines on the upper surface of its eyes, by the tuft of hairs at the top of the furca, by the *form of its legs, in which the phyllopodal character has been nearly entirely lost, and the schizopodal character has been more approached than in any other species of this genus*. In the male, however, characters have been found which are wanting in the male of *N. Geoffroyi*. We see a modification of the first antenna reminding us of *Estheria*, but no prehensile organs on any of the feet. This species therefore approaches, so far as the shape of its legs is concerned, the higher Crustacea more than *N. Geoffroyi*; but the prehensile organs of its male are characters which show, again, that there remains a good deal of phyllopodal element in *Nebalia.* We have now, however, discovered another Schizopod, in which the legs are entirely normal and the shield is phyllopodal (*Gnathophausia*), but evidently not to be derived from the *Estheria*-like shell of *Nebalia*, but from the carapace of *Apus.* And in this same *Gnathophausia* there is an abdominal segment which shows that, now being essentially a Schizopod, it is in genealogical connexion with forms which have had more segments in the abdomen than the Schizopods have.

These two forms, though both Schizopods, show characters which connect the lower Crustacea more and more with the higher ones. Perhaps the fossil forms might give some further evidence. We may also hope to get more forms from the deep sea which will enable us more and more to understand the curious genera which are known under the names of *Ceratiocaris*, *Dithyrocaris*, &c.

IV. On some Genera of Schizopods with a free Dorsal Shield.

1. *On* Gnathophausia, *a new Genus of* Lophogastridæ. (Plates IX. & X. figs. 2-4.)

During our cruise from the Bermudas to the Azores, Madeira, Cape-Verds, and from there to the Brazilian coast, three species of this new genus of Schizopods came up in the trawl or in the dredge. One of these species (now probably figured in Professor Thomson's "Notes from the 'Challenger,'" in 'Nature') is very large, probably the largest Schizopod which we know. Of this one, which I have called *Gn. gigas*, only one male was caught; of another, smaller species, *Gn. zoëa*, two males and two females; and of the third, *Gn. gracilis*, only one male. Of these I have dissected one female of *Gn. zoëa.* I have also made drawings of the legs of *Gn. gigas*, which I could not dissect; but finding that they have a close resemblance to those of the former one, I shall not publish them. A sketch of the oral apparatus, however, and of a maxilliped, of the larger species are among my figures.

Gnathophausia *, n. gen.

1. Gnathophausia gigas, n. sp.

The specimen, a male, came up from a depth of 2200 fathoms in lat. 38° 22′ N. and long. 37° 21′ W., between the Bermudas and the Azores.

It has a length of 142 millims., and much resembles at first sight a large Caridid shrimp; but the abdomen is straight and not bent down by the enlargement of the third pleon-segment, as is the case in the Carididæ.

The *Carapace.*—Its anterior part extends as a triangular rostrum (35 millims. in length), starting in the form of a high ridge from the midst of the hepatic region. From its base to the top of the rostrum the dorsal shield has a length of 64 millims.; it is a flexible parchment-like duplicature of the skin, covering entirely the lateral branchiæ, and touching with two lateral and backward-directed spines the middle of the second abdominal ring. Its upper posterior edges, however, do not quite cover the last segment of the pereion. In *Lophogaster* it leaves two segments entirely free, and its borders are not united with the pereion. Here the carapace starts from the cephalic and the first pereion segments as in *Apus* and *Nebalia.* It is in no connexion with the five posterior

* Γνάθος and φαύσιος.

segments of the pereion. On its upper surface there are five longitudinal ridges and two transverse sulci, which can best be understood from the figures (Pl. X. figs. 2 & 2 *a*), These ridges divide the carapace into five regions, which we might call the regiones cephalica, hepatica, cardiaca, branchialis, and marginalis. I think it unnecessary to give for each the exact dimensions.

In front there is a cleft for the pedunculated eyes, above which there is a sharp spine; laterally, above the cleft, which is occupied especially by the second maxilla, there is another spine. The lateral edges are more or less flattened, and form two "rounded plates," as Sars calls them in his paper on *Lophogaster* *, between which there is the just-mentioned cleft. This can best be explained by Pl. X. fig. 3, where I have figured the parts of the mouth and the upper lateral edges of the dorsal shield, seen from below. There the upper plate (*x*), to which are attached the muscles of the oral apparatus, covers to some extent the mandible; the lower plate (*y*) protects the palpus and the accessory eye of the second maxilla from behind.

In *Lophogaster* there is also to be seen a rudiment of a rostrum and the longitudinal ridge (Sars, fig. 1). The lateral spines are very much like those of *Gnathophausia*; the lateral edges of the shield, however, are not prolonged to such an extent backwards as in our genus, and the posterior margin leaves, as has been mentioned already, two segments entirely free.

The *eyes* issue from between the rostral portion of the shield and the base of the inner antennæ; they have a length of 8 millims., and show two joints in their peduncle.

The *inner antennæ* consist of a short and stout funiculus and two flagella. The funiculus is four-jointed, and attains a third of the length of the squamiform appendage of the outer antenna. It is twice the diameter of the eyes in width, and is densely covered with hairs on its inner side. The exterior flagellum is very long (130 millims.), and flattened at its base (2 millims.), but the interior flagellum rounded and much shorter (length 40 millims.). Underneath and behind the inner antennæ is the large base of the squamiform appendage, showing outside a strong spine. The appendage itself entirely covers the funiculus, and has a length of 19 millims.: its inner border is even, but densely covered with hairs; the outer one has at the base a rounded prominence, and further on four sharp spines, in addition to the top spine. A longitudinal ridge (a trace of which may also be seen in the cordiform appendage of *Lophogaster*—Sars, fig. 13 *e*) divides the appendage into a larger and a smaller portion. Underneath this appendage we see a three-jointed long funiculus of the exterior antenna (length 5 millims.), the flagellum of which has the length of the shorter one of the inner antenna (40 millims.).

Oral apparatus. (Plate X. fig. 3.)

The upper lip is a large cordiform plate ($6\frac{1}{2}$ millims. in length by 5 millims. in width), the top of which reaches upwards to the first joint of the antennæ interioris funiculus. A short groove descends from its centre towards the mouth; this organ is nearly of the same shape here as in *Lophagaster* (Sars, fig. 17). Very *Lophogaster*-like are also the strong mandibles (fig. 3, *md*), to which are attached two three-jointed palpi, the inner

* 'Beskrivelse over *Lophogaster typicus*' (Christiania, 1862), pl. i. figs. 3 & 4, and p. 2.

side of which is densely covered with hairs (fig. 3, *mp*). The palpi are situated on both sides of the upper lip, and reach higher up than the funiculus of the exterior antenna. The first pair of maxillæ could not be inspected, as they are entirely covered by the second pair, which, like the whole oral apparatus, have a strong resemblance to those of *Lophogaster* (Sars, fig. 28, *cd*). All the parts mentioned there are also to be found in our case (fig. 3, *mx*) :—on the inner side the two digitiform manducatory processes covered with stiff hairs; close to them on both sides a flagellum (fig. 3, *f*), which is jointed in *Gnathophausia*; and on the outsides the palpus (fig. 3, *p*) in the form of a large leaf-like appendage fringed with hairs and occupying, like a large cover, the whole space between mandibles and maxillipeds. From the basal joint of these maxillæ start a pair of small black pigmented *accessory eyes*, the peduncles of which have a length of 2 millims. Their position and direction are such that they just peep out between the inferior margin of the dorsal shield and the gnathopods. A dissection of these accessory eyes is of course impossible in our case; but I think one is right in supposing that they consist, like the accessory eyes of the Euphausiidæ, of a lens, nervous rods, and a pigmented substance. They have been found in the Euphausiidæ on the basal joint of the pereiopods, as well as of the pleopods, and in *Thysanopoda norvegica* even up to the number of eight pairs. In *Lophogaster* there are none, nor have accessory eyes ever been observed on the maxillæ of any animal.

There is only one pair of maxillipeds, as there is in *Lophogaster*; and in both the gnathopods are used for walking. On the large transverse basal joint of the maxillipeds we have a long flattened palpus (Pl. IX. fig. 16, *p*), and somewhat further on a small flagellum (fig. 16, *f*). The second and third joints of these maxillipeds are very short; the fourth is longer, the fifth very short again; and the sixth is the terminating claw.

Gnathopods, Pereiopods, and Branchiæ.

We have remarked already that the gnathopods do not essentially differ from the pereiopods, and are used for walking. At the base of all of them, with the exception of the last pair of pereiopods, are the arborescent gills, the branches of which are partly situated underneath the lateral parts of the dorsal shield, partly projecting into the water. There are, as far as I can see without dissecting or spoiling our specimen, three branches, one of them on the sides, one between the legs, and a larger one leaning on the pectoral shield, which is entirely covered by two rows of branchiæ. In the whole the arrangement seems to me to be exactly the same as in *Lophogaster*; and the pictures given by Sars (figs. 16, 35, 37, and 45) give also a very fair idea of the branchial appendages of *Gnathophausia*.

The gnathopods and pereiopods (Pl. IX. figs. 8–14 may be compared here, though these figures are drawn from *Gn. zoëa*) consist each of seven joints, if one counts that basal one to which the branchiæ are attached. To the second joint the palpi are attached, which differ somewhat from those of *Lophogaster*; they are shorter, and in *Gnathophausia* the ramus palpi rapidly decreases in width, and has a great resemblance to the ramus of one of the pleopods. The palpus of the first pereiopod has a length of 13 millims. The third and fourth joints are in all the legs very short, and do not offer any thing particular; but the fifth and sixth are very different from each other in different legs. In the first gnathopod they are even, very strong, and somewhat curved inwards; there are only hairs at the inner side, not on the lateral parts of the joints, which in the second gnathopod have got three lines of hairs, and in the following ones five and six. In the last three pereiopods there are not only lines of hairs on the lateral parts of these joints, but their point of attachment is strongly marked in the chitinous substance, so that these joints look as if they were divided into five and six subjoints. And the same thing is the case throughout with the fifth joint. Such subjointed pereiopods are also found in *Mysis*, but not in any other genus of Schizopods.

In the gnathopods as well as in the pereiopods the last joint is a short claw—even in the first pair of the former, where it is wanting in *Lophogaster*.

The Pleon and its Appendages.

The abdomen has a length of 78 millims. It is square-shaped; for its segments are nearly as large as they are high. The second segment, for example, is 11 millims. in height by 10 millims. in width. The edges of the segments are even; only laterally there are squamiform processes, which cover each other, and each of which has a rounded anterior and a sharpened posterior portion. The shortest segment is the fifth; the sixth is much larger, and is divided by a deep sulcus into two parts, which look perfectly like two distinct segments. One is the more inclined at first to think so, as the lateral squamiform processes, which terminate all the preceding segments, are attached to the first of these two subdivisions. In the second one there are only two short spines on each side. Sars has described something very much like this in *Lophogaster*; and as we now know that *Nebalia*, in which there are nine abdominal segments, has essentially schizopodal characters, while *Gnathophausia* in its unattached dorsal shield has decidedly a phyllopodal character, this pseudo-amplification of the abdominal segments seems to me to be exceedingly interesting, as it shows that *Gnathophausia* must be in genealogical connexion with forms (or a descendant of forms) in which there are more than seven segments in the pleon.

The telson has a length of 30 millims.; on its surface there is a longitudinal groove bordered by two ridges; the lateral borders of the telson are denticulated; at its end there are two spines, between which there is a semicircular cleft. The caudal appendages are *both* jointed (Pl. X. fig. 2); the interior are somewhat shorter than the exterior ones; and both are shorter than the telson; at their basal articulation there is a spine on both sides.

The five pairs of pleopods consist of a pear-shaped basal joint, at the posterior side of which there is a protuberance; at their inner side they are covered with a fringe of hairs. The two annulated rami do not present any thing particular. Appendages such as have been found here in the Euphausiidæ do not exist in *Gnathophausia*.

Before fixing the generic and specific characters of this large species, I shall now give a shorter description of the smaller one (of which four specimens were got), and point out especially the characters in which it differs from the larger one.

2. GNATHOPHAUSIA ZOËA, n. sp.

In its general appearance this species differs from *Gn. gigas* at once by the *presence of a long posterior spine at the dorsal shield.*

The specimens, two males and two females, were got in very different places. (1) June 30, a male was obtained off the Azores in a depth of 1000 fathoms; it has a length of 49 millims., the rostrum being 18 millims. long. (2) August 25, in lat. 1° 47′ N., long. 24° 26′ W., a male came up from a depth of 1650 fathoms: length 58 millims., with a rostrum of 17 millims. (3) August 26, a female from 1500 fathoms. in lat. 1° 22′ N., long. 26° 36′ W.: length 81 millims., with a rostrum of 14 millims. (4) September 12, off Rio San Francisco on the coast of Brazil, another female came up from 750 fathoms: length $31\frac{1}{2}$ (rostrum 7) millims. According to this the size of the males varies between 49 and 58 millims., and that of the females between $31\frac{1}{2}$ and 81.

The substance of the *dorsal shield* is flexible, like strong parchment; it is as in *Gn. gigas* a duplicature of the skin, adhering to the body only in the first segments, and in no connexion with the five posterior segments of the pereion. A ridge running over the whole length of the shield is continued into a long triangular rostrum, which, in the males, is much longer ($\frac{1}{3}$ of the length of the whole animal) than in the females ($\frac{1}{5}$ of the length). The posterior spine is a continuation of this ridge, and has in both sexes a length of 6–8 millims. Both rostrum and posterior spine are triangular and armed with small secondary spines, which in the former are to be seen on all sides, in the latter only on two sides. The posterior spine reaches backward to the third abdominal segment; and all the segments of the pereion are covered by the dorsal shield, with the exception of the lateral parts of the last one.

The posterior angles of the shield are rounded. In front there is a sharp spine above each eye, and another somewhat smaller one below it, just inside, at the place where we see the round plate, to which are attached the muscles of the oral apparatus. A transverse sulcus, a transverse ridge, and two longitudinal ridges (besides the larger central one) divide the shield, as in the former species, into cephalic, hepatic, cardiac, branchial, and marginal regions (Pl. X. fig. 4).

The inner or *first antennæ* hardly differ from those of the preceding species. Their funiculus only reaches to the middle of the squamiform appendage. The outer or *second antennæ* differ from those in *Gn. gigas* by the shape of their scale, in which only one spine is visible (Pl. IX. fig. 2, *a l*), while in the larger species there are five spines.

The parts of the mouth in this species could be dissected and submitted to microscopical examination, which showed that they are very much like those in *Lophogaster*. The very strong and big *mandibulæ* (Pl. IX. fig. 3) have a palpus the second joint of which is somewhat recurved. The third joint shows two kinds of hairs—very short ones, which also Sars has figured in his genus, and longer ones at the top. The *upper lip* has the same cordiform shape as in the preceding species; and the *under lip* (Pl. IX. fig. 4) is more clumsy than that of *Lophogaster*, and does not show so deep an incision, but has the same small hairs at its anterior border. The *first maxilla* is distinguished by very strong bristles in its inferior portion, and has a palpus which, among Schizopods, has hitherto only been found in *Nebalia* (fig. 5, *p*); at the top of this palpus we find very long hairs which by far surpass it in length. In the larger species I could not examine the first maxilla; but it probably has got a palpus too. *Lophogaster* has not got it; and it is very interesting to find it in *Gnathophausia*, as it is one more connecting link between this genus and *Nebalia*. The *second maxillæ* are large organs (fig. 6), covering the former ones and exhibiting a flagellum, a two-jointed palpus, and an accessory eye. I tried to make out the structure of this eye by hardening it and making it transparent, but did not succeed; all I saw was the cornea and a dark pigment inside. For him, however, who has seen the same organ in the larger species, there is not the slightest doubt that these sense-organs on the second maxillæ are the same things which have been called accessory eyes in the Euphausiidæ. They are present in all the specimens of the genus *Gnathophausia* in the same place.

In the *maxillipeds* (fig. 7) of this species I could not find the palpus, which in the larger is so clearly visible (fig. 16). Possibly it is wanting in the female; for I do not think that it escaped my attention as I looked for it with the microscope.

The two *gnathopoda* (figs. 8 & 9) have got at their base breeding-lamellæ and three pairs of gills, one of which is situated on the ventral side, while two are laterally covered by the shield. No subjoints can be seen in these first two legs, traces of them are to be found in the first and second *pereiopods* (figs. 10 & 11); but they are only very clearly visible on the third and fourth (figs. 12 & 13). In the last (in which I have drawn the breeding-lamella, fig. 14) they are wanting, as are also the gills at its base. Among Mysidæ we have the same thing which we find now in Lophogastridæ, for these subjoints which are wanting in *Siriella* (as they here are in *Lophogaster*) are to be met with in *Mysis*.

The *abdomen* of *Gn. zoëa* differs somewhat from that of the larger species. We do not find here those squamiform prolongations, but have simply a few small spines at the posterior and inferior angle of each segment. In the sixth we have the same peculiar arrangement of its being divided by a deep ridge into two pseudo-segments which do not articulate with each other. There is a spine bent backwards at the end of the first one, and several small spines at the end of the second.

The *telson* (8 millims. in length) terminates in a half-moon; the *caudal appendages* are both jointed; the *pleopoda* are very slender (fig. 15), and show a small tubercle at the inner posterior side.

The *male differs from the female* in this species by the length of the rostrum, which in the former has one third of the length of the whole body, and in the latter only one fifth. In the size of the inner antennæ I see no great difference. Whether the male or the female attains a larger size I cannot say; the largest specimen of *G. zoëa* which we got was a female; besides, it is very easy to tell a male from a female by the want of breeding-lamellæ in the former.

3. Gnathophausia gracilis, n. sp. (Pl. IX. fig. 1).

Only one male of this smallest *Gnathophausia*-species has been hitherto got; it came up on the 26th of August, in lat. 1° 22′ N., long. 26° 36′ W., 170 miles east of St. Paul's rocks, from a depth of 1500 fathoms. It was on this same day that one of the specimens of *Gn.*

zoëa and the male of *Petalophthalmus* were got. The specimen has a length of 41 millims., with a carapace of 24 and a rostrum of 14 millims. The length of the rostrum (one third of the whole length) and the absence of the breeding-lamellæ show that it is a male.

From the two preceding species this little Lophogastrid differs by the presence of two spines at the anterior and posterior lateral angles of the carapace and by the presence of spines at the top of the first, second, and fifth abdominal ring. From *Gn. gigas* it is easily distinguished by the presence of the middle posterior spine of the carapace and the absence of the five spines on the lamellar appendage. There are also several spines on the line which divides the carapace in its full length, which are absent in the other species.

As in other respects it shows no characters which have not already been found in the two preceding species, I refer to the figure (fig. 1), and shall not describe in detail all its parts.

Probably the genus *Gnathophausia* is represented at the bottom of the deep sea by many species; but I do not think that these species are very numerous in individuals; for the trawl always brings up many more Peneids and Caridids than Schizopods.

Colour, and Mode of Life.

All the Gnathophausias, when they came up, were bright red, a colour which is common to all deep-sea Crustacea, but which they very soon lose in alcohol.

Like *Lophogaster*, which was found by Sars at the bottom of the sea in 50–60 fathoms, these Schizopods live probably near the bottom without ever coming to the surface (except perhaps in the larval stage). They evidently live together with a rich fauna, of which the trawl has given us some idea. As to the animals which live together with the larger species, I am obliged to cite here those which were got the day before and the day after the capture of *Gn. gigas*; for on that same day when it came up the trawl contained nothing else. In the first of these stations (June 24, lat. 38° 3′ N., long. 39° 19′ W.) we found a depth of 2175 fathoms; and in the other one, two days afterwards (lat. 38° 25′ N., long. 35° 30′ W.), when we already approached the Azores, there was a depth of 1675 fathoms. We got there several sponges, a *Palythoa*, a Pennatulid, a small hydroid polyp, the Sea-urchin *Salenia*, several Asterids, some Bryozoa, one Annelid (*Hermione*), a Pycnogonid * (*Zetes*, sp. ?), and some blind Isopods, one of which belongs to the Munopsidæ family.

The smaller species were got in different localities and depths (750–1850 fathoms)—near the Azores, not far from St. Paul's rocks, and near the coast of Brazil. Together with them were found many inhabitants of the deep sea, some of which I shall now mention. We got there the sponges *Hyalonema*, *Tisiphonia*, and *Halichondria*, the celebrated *Umbellularia grœnlandica*, *Fungia symmetrica*, and a *Flabellum*. Among the Echinoderms (which were very numerous) may be mentioned *Chirodota* and *Synapta*, a *Bathycrinus*, *Astropecten*, *Astrogonium*, *Asteracanthion*, and the Urchins *Echinocyamus* and

* From several reasons I supposed, when beginning our operations, that we should get Pycnogonids in great abundance and variety; but just the contrary was the case, as hitherto, after ten months' deep-sea dredging, we have only got from two to three Pycnogonids, belonging, as far as I can make out here, to Kröyer's genus *Zetes*.

Salenia. Among the worms, which, unfortunately, usually come up in single and, in most cases, spoiled specimens, we found some Annelids, a long Nemertean, and a very large *Balanoglossus* *. Crustacea there are many—Peneids, Caridids, a *Pagurus*, and the genera *Chalaraspis* and *Petalophthalmus* (which are described in this paper). Only one Brachiopod and several genera of Gastropods (*Dentalium, Mitra, Pleuronectia, Neira, Limopsis*, and *Cardium*) belong to this fauna. There were also several fishes, one of which (the Lophioid *Melanocetus*) certainly lives at the bottom in great depths.

The Systematic Position

of our genus is easily fixed after what we have seen of its resemblances to *Lophogaster*; for, after all that has been said about it, nobody, I am sure, will doubt that *Gnathophausia* is a member of the family Lophogastridæ. Now fortunately Sars has so well discussed the affinities of *Lophogaster*, that the systematic position of our genus is easily understood when we say that it is a *Lophogaster* with a free dorsal shield (like an *Apus*), with a palpus on its first maxilla (like *Nebalia*), with accessory eyes on its second maxilla and with subjoints in its pereiopods (like *Mysis*). *Gnathophausia*, it is true, has many peculiarities which are not found in the genus *Lophogaster*; but I must nevertheless maintain that it is closely allied to that form. The gnathopoda and pereiopoda all having the shape of legs, the three branchiæ, two of which are laterally covered by the carapace and one not, and the presence of breeding-lamellæ on all the legs, are fundamental characters which, according to our present systematical arrangement of the Schizopods, assign it its place among the Lophogastridæ. The subdivision of the sixth abdominal segment, the shape of all the appendages and of the telson, are nearly exactly the same in the two genera; but there are other characters which *Lophogaster* has not, characters which one might call atavistic ones; and these are (1) the *looseness* of the *dorsal shield*, (2) the *presence* of a *palpus maxillæ primæ*, (3) the *subjoints in the legs*, and (4) the *accessory eyes on the second maxillæ*.

The *subjoints in the pereiopods* (3) have been hitherto only known as a peculiarity of the genus *Mysis*, and the *accessory eyes* (4) as occurring in some genera of the Euphausiidæ family. We therefore find characters united in *Gnathophausia* which were only known separate in the two other families of Schizopods. Hereafter, however, we shall find in a Mysid a character which until now was supposed to characterize only the Lophogastridæ, and shall see that these deep-sea forms of Schizopods combine in many ways the characters of the shallow-water forms, the types of the hitherto acknowledged families. But we shall also see that they can nevertheless be regarded as belonging to those families (with the exception of one genus), as they have not a mere mixture of characters, but are Mysids or Lophogastrids which possess some characters of the other families.

* Two fragments of this interesting worm were got August 19, in lat. 5° 48′ N., long. 14° 20′ W., off the west coast of Africa, from a depth of 2500 fathoms. The whole animal had probably a length of 4 inches; the head and a piece of the body, however, were the only things we got. These fragments were very remarkable for the vivid colours which they displayed: the head was yellow, the collar bright red, and the body of a yellowish red. Of this, the Neapolitan species and the one which I discovered in the sand near Copenhagen, in shallow water, show nothing, as they are uniformly white; *à priori* one would have been inclined to suppose just the contrary.

The *palpus of the first maxilla* (2) and the *free dorsal shield* (1) are both characters which, among Schizopods, we only find in *Nebalia*, a genus which has hitherto had a very isolated position, and was considered a connecting link between these and the Phyllopods. In Plate VI. fig. 9, we have figured the first maxilla with its long palpus in our *Nebalia longipes*. The palpus there is a mere continuation of the maxilla; here, however (where it has very little resemblance to the *Nebalia* palpus), it seems to be in articulation with the maxilla. This is a character which I have hitherto only found in *Gnathophausia*, and confirms my opinion that this genus is, next to *Nebalia*, the most aberrant one among the Schizopods.

In *Lophogaster* as well as in *Gnathophausia* the dorsal shield is of a parchment-like consistency. In the former its posterior and lateral edges are free, but the rest of the shield forms the integument of the pereion-segments. A free dorsal shield has hitherto never been found in a true Schizopod, but is also peculiar to *Nebalia*. Now *Nebalia* is considered to be an aberrant Schizopod with nine abdominal segments; and it seems to me to be very interesting for the explanation of the semidivision of the last pleon-segment in *Gnathophausia*, that this genus has two other phyllopodal characters, in the configuration of its dorsal shield and the presence of a palpus on the first maxilla; but in all the main points *Gnathophausia* is much more a typical Schizopod than *Nebalia*, and, I think, not even closely allied to it. Probably both derive their origin from a series of animals which were neither Schizopods nor Phyllopods, and to which possibly belonged the fossil forms *Dithyrocaris*, *Ceratiocaris*, &c. I do not know how far these forms are really allied to *Gnathophausia*, as I have not the literature on them on board; but I strongly suspect that also on them some light may be thrown by the discovery of this interesting genus.

The Characters of the Lophogastridæ,

therefore, ought to be modified in several points; the following characters ought to be added to the family-description:—connexion of the shield with the segments of the pereion complete or incomplete; with or without accessory eyes on the second maxilla; with or without a palpus on the first maxilla; and with or without subjoints in the pereiopods. Besides, all the family characters given by Sars are applicable to both genera.

Characters of the Genus and Species.

GNATHOPHAUSIA*, n. gen.

Carapace in no connexion with the five posterior segments of the pereion; a long rostrum; first antennæ with a short and stout pedunculus and two flagella, a long and a shorter inner one; second antennæ with an oblong squamiform appendage; stout mandibles, with a three-jointed palpus; a palpus on the first maxillæ; accessory eyes, palpus, and flagellum on the second maxillæ; maxilliped showing nothing particular. First gnathopods terminated by a claw; all the gnathopods and pereiopods leg-like, the latter showing subjoints on their penultimate joint. Six pairs of gills at the base of the gnathopods and the four anterior pereipods; two branches of the arborescent gills laterally

* From γνάθος and φαύσιος.

covered by the carapace, one branch turned inside between the legs and in free communication with the water. Well developed pleopods. Caudal appendages jointed.

1. Gn. gigas, n. sp.

Scale of the second antennæ with five spines, not jointed; short spines at the lateral angles of the dorsal shield, no spine in the midst of the upper posterior margin.

Length 142 millims. Colour red.

2. Gn. zoëa, n. sp.

Scale of the second antennæ with only one spine, jointed; dorsal shield with a sharp spine in the midst of its upper posterior margin, lateral posterior angles rounded.

Length 59 millims. Colour red.

3. Gn. gracilis, n. sp.

Scale of the second antennæ with one spine; dorsal shield with a spine in the middle of its upper posterior margin, and two spines in its anterior as well as in its posterior lateral angles.

Length 41 millims. Colour red.

2. *On* Chalaraspis, *the Type of a new Schizopod Family.* (Plate VIII.)

This little Crustacean is the commonest Schizopod of the deep-sea fauna, and seems to enjoy a very wide bathymetrical and geographical distribution; for we got it from depths of 350–2500 fathoms, off the west coast of Africa, as well as off the east coast of South America, down to the 35th degree of southern latitude. Whenever in the mid-Atlantic true deep-sea animals came up in the dredge or the trawl, I was sure to get at least a fragment of this Crustacean. Unfortunately most of the specimens were spoiled; only a few males and females were in a good state of preservation. The animal is so soft that it does not stand the long passage of the trawl through the water; and even if it is not broken to pieces, its carapace is usually overturned. On two occasions, however, I got specimens which are quite intact; and these, as well as the many fragments, furnished ample opportunity of studying this genus in all its details.

The females of this shrimp have a length of 35 millims., the carapace having from above a length of 8 millims. and laterally of 12 millims. The males are 37 millims. in length, but somewhat more slender than the females; their dorsal shield has the same length from above as that of the females, but is laterally somewhat shorter ($11\frac{1}{2}$ millims.).

The *carapace* is very soft, especially in the males, and in connexion with only the first segments of the pereion. It has a very short, rounded rostrum (fig. 1 *a*), and on the frontal border a pair of short spines underneath the eyes. The lateral anterior border is rounded in the female, and somewhat angular in the male. The posterior border of the carapace shows a deep excision, especially in the male, so that its rounded lateral borders cover a great deal more of the pereion-segments than the upper margin (fig. 1). The carapace is divided by a longitudinal ridge and two transverse sulci into several regions, which in old females are very well marked; in the males, however, they are not always plainly visible.

Underneath the short rounded rostrum, between the eyes, there is a small tubercle (fig. 1 *a, x*) which in the males is somewhat more prominent than in the females.

The *eyes* have the same position as in *Gnathophausia*, and are 2 millims. in length. They cover somewhat the first joint of the funiculus of the *first antennæ*, which consists of three joints, the last of which has a lateral prolongation (fig. 2). Between the third joint and the insertion of the flagella a small subjoint is to be seen. The external flagellum is much bigger than the internal. Hairs are in both sexes at the inner side of the funiculus, the size of which is also very much the same in both. The scale of the *second antenna* is jointed and ovoid. The slender funiculus has three joints and a flagellum, which exceeds in length the whole animal.

The *upper lip* (fig. 11) is cordiform, with the point directed upwards. The *mandibulæ* (fig. 4) are not particularly strong, and have a three-jointed palpus, the second joint of which is somewhat bent backwards, and the third rounded at the top.

The excision between the two pieces of the *under lip* (fig. 5) is not so deep as in *Gnathophausia*. On its anterior border we find the same hairs which may be seen in the Lophogastridæ.

The *first maxilla* (fig. 6) has two manducatory processes: the upper one has many strong teeth; while the under one has only a few hairs, no denticulation.

The *second maxillæ* (fig. 7) have a very elongated flagellum (*fl*) and a small two-jointed palpus (*p*).

The maxillipedes (fig. 8) have a very large palpus and a flagellum on their enlarged basal joint. They are terminated by a small denticulated claw.

The *gnathopoda* and *the first pereiopod in this genus* (which hitherto has not shown so very great differences from *Lophogaster*) *are not leg-like, but have all the shortened maxillipedal form and function* (figs. 1, 9, & 10). This is the same in both sexes. The branchiæ and (in the female) the breeding-lamellæ begin at the base of the *first gnathopod*. The form of this appendage (fig. 9) can best be seen from the figure. The terminating claw is not denticulated; the *second* is somewhat longer than the first, but shows no peculiarities.

It is very astonishing that in both sexes of this genus the first pereiopod has the same maxillipedal form and function as the gnathopoda. This is the case in no other Schizopod family. Also the form of its various joints (fig. 10) is very much like that of the gnathopod-joints.

Among the *four* remaining *pereiopods* we have again two very different forms: three of them are enormously elongated (figs. 1 & 12; they have a length of 27 millims.) and terminated by a strong and recurved claw, which has many spines at its inner side, whereas the last pereiopod (fig. 1, p^5, & fig. 13) does not end by a claw, but by a simple rounded joint, is very much shorter than the three preceding leg-like pereiopods, and all over covered with hairs.

There are arborescent *branchiæ* at the base of all the gnathopoda and pereiopoda with the exception of the last one. Each pair of branchiæ consists of three branches, two of which are laterally covered by the carapace; the third branch is bent inside between the appendages, and is accordingly in free communication with the water. In this respect there is no difference between this genus and the Lophogastridæ.

There are seven pairs of *breeding-lamellæ* at the base of the gnathopoda and pereiopoda, increasing in size towards the end of the pereion. This also is quite the same thing as has been seen in the Lophogastridæ.

The *abdomen* of *Chalaraspis* differs from that of the family just mentioned especially by the absence of the pseudo-segment. The last segment of the pleon is elongated and perfectly smooth.

The *pleopods* are very perfect; they have a strong basal joint and two rami. They offer nothing particular either in the male or the female.

The posterior borders of the quadrangular *telson* show a slight denticulation (fig. 1, *b*); the outer appendages of the caudal fin are jointed.

The males differ from the females only by being somewhat more slender and by the absence of the breeding-lamellæ. The small tubercle underneath the rostrum seems to be more prominent in the males than in the females.

Systematic Position of the Genus.

Among the three families of Schizopods (Mysidæ, Euphausiidæ, and Lophogastridæ) hitherto known, this new form no doubt approaches most the latter, with which it has in common the position and shape of the branchiæ, the breeding-lamellæ, and the pleopods; but the presence of only four leg-like appendages, and the fact that four pairs of appendages act here as maxillipedes, do not allow us to class it together with them, as here both genera (*Lophogaster* and *Gnathophausia*) have got seven pairs of leg-like appendages. It depends, of course, on what one considers the main point of view from which a classification of the Schizopods ought to be made, whether from the form and position of the branchiæ, or from the number of appendages which are transformed to maxillipedes. I think the best plan is to carry on the hitherto accepted principle—to establish different families for those groups in which there is a different number of leg-like appendages. One should only deviate from this principle in case an animal should be discovered which in every other respect is so closely allied to a certain group that the conformation of the legs appears only as a very secondary acquisition; but from what we have hitherto seen of the steadiness in which the same number of maxillipedal appendages is kept in forms which differ so much from each other as *Gnathophausia* does from *Lophogaster*, or *Petalophthalmus* from *Mysis*, I doubt very much whether such forms will ever be found.

For the genus *Chalaraspis* one ought therefore to establish a separate family, Chalaraspidæ, holding its place between the Euphausiidæ and Lophogastridæ, and characterized (until further discoveries show whether it has got several living members differing from each other) by the

Characters of the Genus.

CHALARASPIS*, n. g.

Dorsal shield or *carapace in no connexion with the posterior segments of the pereion*; rostrum short, rounded; eyes present; no accessory eyes; first antennæ having a stout

* Χαλαρὸς and ἀσπίς.

funiculus and two flagella; scale of the second antennæ jointed; upper lip triangular; mandibulæ with a three-jointed palpus; no deep excision in the under lip. Second process of the first maxilla without denticulation; second maxilla with an elongated flagellum and a small palpus; maxillipedes terminated by a denticulated claw, with large palpus and flagellum. *Gnathopoda* and *first pereiopod used as maxillipedes, shortened and recurved*; second, third, and fourth pereiopod having nearly the length of the body, terminated by a long denticulated claw; last pair of pereiopods shorter, terminated by a rounded joint, very hairy, and without branchiæ. Three branches of branchiæ on the base of the gnathopoda and first four pereiopoda, two of which are covered by the carapace. Breeding-lamellæ on all the gnathopoda and pereiopoda. No pseudo-segmentation on the sixth segment of the pleon. External caudal appendages jointed.

CHALARASPIS UNGUICULATA, n. sp.

Length 35–37 millims.

Mode of Life, and Colour.

We have already seen at the beginning of this description that this is the commonest deep-sea Schizopod with as wide a geographical as bathymetrical distribution. It lives together with the same fauna as *Gnathophausia zoëa*, which several times came up accompanied by *Chalaraspis*. Its colour is a bright red.

3. *On* PETALOPHTHALMUS, *a Mysidiform Schizopod.* (Plate VII.)

In Prof. Wyville Thomson's 'Depths of the Sea,' p. 176, there is a quotation from a preliminary note of the Rev. A. Merle-Norman, according to which specimens of *Ethusa granulata*, a brachyurous Decapod, taken in 110–370 fathoms, are apparently blind, but have two remarkable spiny eye-stalks, *with a smooth rounded termination, where the eye itself is ordinarily situated.* In other specimens of the same crab the rostrum disappears entirely, and the two eye-stalks, approaching each other, assume its functions. In accordance with the altered conditions of life, the eyes and their stalks seem to undergo in *Ethusa* the most extraordinary modifications.

The same thing which now-a-days happens to a crab living in different conditions of life has evidently also happened (but in the course of ages probably) to a Schizopod, in which we find at the top of the eye-stalks, instead of organs of vision, two flat spherical terminations in which no trace of an eye (which one would expect to find in this place) has been left. But this peculiarity in the Schizopod seems not to be a modification of individuals exposed to certain conditions of life; for we got specimens from very different depths (1590–2500 fathoms) and latitudes, from the mid-Atlantic near St. Paul's Rocks down to the southern regions of Tristan d'Acunha, in both sexes of which the conformation of the eye is exactly the same. Though in the whole these Schizopods approach the genus *Mysis*, we shall find that they have several peculiarities which do not allow us to suppose that this is a *Mysis* which, like the above-mentioned *Ethusa*, has changed when exposed to certain conditions of life, and of which specimens might exist now-a-days in full possession of their organs of vision. Once, of course, this process must have taken place, but probably at a time when such Schizopods as *Gnathophausia* and

Chalaraspis were the only representatives of the order, from which only in later periods of the earth the well-known shallow-water members of the Schizopod families have developed.

I have called the animal which I shall now describe *Petalophthalmus*, and the species *P. armiger*. The first specimen, a female, was caught by the trawl in lat. 2° 25′ N., long. 20° 1′ W., about midway between Cape Palmas and St. Paul's Rocks, from a depth of 2500 fathoms. We afterwards got a male in lat. 1° 22′ N., long. 26° 36′ W., about 170 miles east of St. Paul's Rocks, from 1500 fathoms, and, finally, a female in lat. 35° 41′ S., long. 20° 55′ W., from 100 fathoms, about 400 miles west of Inaccessible Island (Tristan d'Acunha group). The male has a length of 37 millims., the largest female of 44 millims., and the smaller one of 30 millims.

The *carapace*, soft and parchment-like, is in no connexion with five posterior segments of the body. In the *female*, where it has not quite one half of the total length of the animal (it is 18 millims. in length in a specimen of 44 millims.), it covers in its ordinary position nearly all the segments of the pereion. It has a small rostrum (fig. 1), which is very little prominent, a small spine at its anterior border underneath the eye, and sharpened anterior angles. The posterior and inferior angles are rounded; and the surface of the whole carapace is perfectly smooth. A slight transverse sulcus divides it into an anterior and a posterior portion, the latter of which is by far the largest.

Underneath the rostrum are the *eye-stalks*, terminated by concave spherical plates having a diameter of 3 millims.; they are simply a duplicature of chitinous matter. On examining them under the microscope I could not find a trace of any eye-like structure.

The first antennæ have a three-jointed funiculus (I consider the small joint in fig. 3, which is not to be seen in the first antenna of the male, to be not a fourth, but an external pseudo-joint) and two flagella, the external of which is enlarged at its base and covered with hairs at the inner side.

On the second antenna (fig. 4) there is a lamellar appendage (fig. 5) which has no spines.

The *labrum* is subcordiform (fig. 6). The *mandibulæ* (fig. 7) have a very strong manducatory portion, with many denticulations and stiff hairs. The second joint of their palpus is enlarged; the third has a rounded point and many strong hairs at its inner side. The *under lip* is somewhat like that of *Chalaraspis*, and bordered anteriorly with small hairs. I could not draw it, as I saw only a part of it, the organ being broken when I tried to take it out.

The *first maxillæ* have two processes, showing many hairs and a strong denticulation (fig. 8); they have no palpus. The *second maxillæ* (fig. 9) have both palpus (*p*) and flagellum (*fl*). The *maxilliped* (fig. 10) has a much more perfect palpus, quite close to its flagellum, than *Gnathophausia* has; besides, there is at the inner side of the third joint one of those flat lamellar appendages which are known in the maxilliped and first gnathopod of *Mysis* and *Siriella*, and which in the male of our genus are indeed present on both appendages, in the female, however, only on the maxilliped.

The *first gnathopod* (fig. 11) has still maxillipedal functions, though it is rather elongated; its penultimate joint, however, is enlarged and recurved, and terminated by a rounded claw, which fits into an excision at its top. The *second gnathopod* (fig. 12) is perfectly leg-like. Its tarsus, like that of the following pereiopoda, is not subjointed, as in *Mysis* and *Gnathophausia*, though there are hairs at intervals on it as in those Crustaceans.

The five *pereiopoda* are all very much alike; only the fifth is somewhat shorter than the rest. I have only drawn the *third* (fig. 13).

At the base of *all* the gnathopoda and pereiopoda we find *breeding-lamellæ* (fig. 1, and figs. 12 & 13), the posterior ones nearly as long as the legs. This is a character not found in any other Mysids, and, among all the Schizopods, hitherto only known in the Lophogastridæ.

The rings of the *pleon* are perfectly smooth, and do not present any thing particular. The sixth segment is longer than the rest. The five pairs of pleopoda are only rudimentary and exceedingly small (fig. 14); they consist of a small basal joint and only one ramus. The last ones, especially the fifth, are longer than the first.

The *tail* (fig. 1 *a*) is formed by the telson, which shows a little excision and two appendages on each side, the exterior one of each pair jointed.

Branchiæ are entirely wanting.

The *male* differs very much from the female. Its soft and free carapace is much shorter, not much more than $\frac{1}{4}$ of the total length; for in a specimen of 37 millims. it has a length of 10 millims. Thus the last two segments of the pereion are entirely uncovered; while several of the preceding ones are laterally uncovered, the upper part of the carapace being much longer than its lateral parts.

Very extraordinary are the prehensile organs of the male—the first antenna, the palpus mandibularis, the maxilliped, and the first gnathopod—altogether forming a formidable prehensile apparatus (fig. 2).

The funiculus of the *first antenna* is enlarged, and all the joints are elongated; it has a length of 10 millims. Its flagella, however, are of ordinary size, the exterior one being not enlarged at the base. The second antennæ (fig. 2, a^2) do not differ from those of the female. The principal prehensile organ is the palpus mandibulæ (fig. 2, *pm*), the second and third joints of which are enormously enlarged, and the third armed with strong setæ. The maxilliped (fig. 15) and the first gnathopod (fig. 16) have enlarged joints, and are terminated by strong claws. At their inner side is the lamellar appendage (figs. 15 & 16, *la*), which we found in the female only in the maxilliped.

Unfortunately the only male which we caught has lost the second gnathopod and the first pereiopod. The second pereiopod is terminated by a tuft of hairs instead of a claw (fig. 2, prp^2). The three last ones do not differ from those of the female, except by being somewhat more slender.

In the male the pleopods are more perfect (fig. 17); for, besides being stronger, they have two rami, one of which is broad and bordered at its rounded top with hairs, the other pointed and nearly filiform. The last pleopoda are longer than the preceding ones.

The telson of the male (fig. 2 *a*) does not show such a deep excision as that of the female.

No traces of branchiæ are to be seen.

Surely these characters of the *Podophthalmus* males are quite exceptional among Schizopods, and much more like what we find in certain Phyllopods than what we should expect to find among the higher Crustaceans.

Systematic Position of the Genus.

The six pairs of leg-like appendages, the rudimentary condition of the abdominal feet, and the absence of the branchiæ assign to this Schizopod its place among the Mysidæ. It differs from them only by the free dorsal shield and the presence of breeding-lamellæ on seven appendages, which it has in common with the Lophogastridæ. It is also surprising to find that a member of this latter family has a Mysid character (the subjoints of the legs in *Gnathophausia*), which, however, is only a peculiarity of one of its generic groups (genus *Mysis* and subgenera). It accordingly stands in the same relations to Mysidæ as *Gnathophausia* stands to Lophogastridæ—there being in both a character which shows some distant relationship to the other group, and both having a free carapace, which is not to be found in the hitherto known Schizopods.

Among Mysidæ there are two generic groups:—*Mysis* and the genera connected with it, characterized by joints in the tarsal parts of the legs and the absence of branchial appendages on the pleopoda; and *Siriella*, in which the legs are simple and terminated by a claw, as in our case, but in which there are branchial appendages on the pleopoda, which *Petalophthalmus* has not got. This genus therefore belongs to none of these generic groups, and can only be united with the Mysidæ if the family characters are so far enlarged as to allow the entrance within it of an animal which has a free dorsal shield and breeding-lamellæ on seven appendages.

The eyes having disappeared, and the eye-stalks having assumed a spherical termination, are of course entirely secondary characters, and probably not even of generic value.

Characters of the Genus.

PETALOPHTHALMUS*, nov. gen.

Carapace in no connexion with the five posterior segments of the pereion; rostrum very short; three joints in the funiculus of the first antennæ; scale of the second antenna without spines; labrum subcordiform; mandibulæ having a large manducatory process and a three-jointed palpus. Very strong teeth and setæ on both processes of the first maxilla; second maxilla consisting of a manducatory portion (two elongated processes and a larger lamellar one), a ciliated flagellum, and a palpus. Maxilliped in both sexes with a lamellar appendage on one of the basal joints; first gnathopod having the same only in the male; in the female it is elongated, and its last two joints are clumsy and recurved; second gnathopod and the five pereiopoda leg-like; pleopoda in the female quite rudimentary, with only one ramus; in the male somewhat more perfect, with two rami; telson showing a slight excision at the top; outer appendages jointed.

No branchiæ on the pereion, nor any branchial appendages on the pleopoda of the male. *Seven pairs of breeding-lamellæ at the base of the pectoral appendages.*

* Πέταλον and ὀφθαλμός.

The male differs from the female by the rudimentary condition of its carapace and the metamorphosis of the first antennæ, the palpus mandibularis, the maxilliped, and first gnathopod into prehensile organs.

PETALOPHTHALMUS ARMIGER, n. sp.

Eyes wanting. Eyestalks with spherical concave terminations at the place where one would expect to find the eyes. Length 37–44 millims.

Habits of Life, and Colour.

Petalophthalmus is a member of that deep-sea fauna which we sketched when describing *Gnathophausia zoëa*, in which, however, it seems not to be common. Its colour is a bright red.

We have now described (1) a lophogastriform genus (*Gnathophausia*), with three species, (2) a genus allied to the former, but forming a new family (*Chalaraspis*), and (3) a Mysidiform genus (*Petalophthalmus*)—all of which have a free carapace and certain peculiarities which show that their existence dates from a period in which the family characters of Schizopods were not so sharply defined as they are now. They are precursors of the Mysidæ and Lophogastridæ, and representatives of another family, having characters which, among the Schizopods, are only shared by *Nebalia*, but in all other respects entirely different from this genus. Now the idea presents itself whether it would be advisable to bring all these Schizopods together into one group, the chief and only universal character of which would be that they all have a free dorsal shield. We could best describe this in the following synoptical way :—

Group I. Dorsal shield free.	9 abdominal segments, palpus maxillæ primæ		NEBALIA.
	7 abdominal segments.	7 legs, subjoints, palpus maxillæ primæ, supplementary eyes, *Lophogastriform*	GNATHOPHAUSIA.
		6 legs, no subjoints, 7 breeding-lamellæ, *Mysidiform*	PETALOPHTHALMUS.
		4 legs, no subjoints, branchiæ as in *Lophogaster*	CHALARASPIS.
Group II. Dorsal shield fastened to the pereion.	7 abdominal segments.	7 legs, no subjoints, no palpus maxillæ primæ, no supplementary eyes	LOPHOGASTER.
		6 legs, with or without subjoints, 2 breeding-lamellæ	MYSIS and SIRIELLA.
		8 legs (the last wanting or rudimentary), branchiæ free, supplementary eyes	EUPHAUSIA.

This arrangement of the Schizopods would, no doubt, have a certain advantage, as it prevents the destruction of the family characters of our old and well-known forms in favour of a few deep-sea genera, all of which have a certain peculiarity which they share only with *Nebalia*. But it is not a natural genealogical arrangement; for, from what has been said, there is no doubt that *Gnathophausia* is, if I may use the expression, an ancient *Lophogaster*, and *Petalophthalmus* an ancient *Mysis*. I therefore propose to unite these with the families of the shallow-water forms, and would suggest for the Schizopods the following systematic arrangement:—

9 abdominal segments,	8 legs	I. Nebaliidæ.
7 abdominal segments,	6 legs	II. Mysidæ.
	8 legs	III. Euphausiidæ.
	4 legs	IV. Chalaraspidæ.
	7 legs	V. Lophogastridæ.

In order to expose the genealogical connexion between the genera of these families, it would be necessary to prepare a large table; but I think that their relations will be well understood from what I have said about the subject in the preceding pages, as well as from a comparison of my plates with the figures given on the other genera by Sars, Claus, and other authors.

Two questions will arise, of course, from a comparison of the deep-sea forms with the shallow-water forms:—(1) Are there no Schizopods in the depths which show the ordinary conformation of a shield fastened to the pereion? and (2) As the Mysidæ and Lophogastridæ have relations of very extraordinary characters living in the deep sea, are there no forms which represent the third of the hitherto acknowledged families—the Euphausiidæ? These questions are partly answered by the discovery of a very large member of this family, which came up in the trawl in lat. 35° 41′ S., long. 20° 55′ W., from a depth of 1900 fathoms. This animal is a male, has a length of 84 millims., and *belongs to Dana's genus* Euphausia; for its *dorsal shield is perfectly fastened to the pereion,* and of the eight pairs of legs only six are developed, the last two being only represented by the branchial appendages and the palpi. But, unlike all other species of *Euphausia* hitherto known, it has *no accessory eyes.* There are very long olfactory hairs on the enlarged first antennæ, and the peculiar appendages to the pleopoda which characterize the males of this genus. I shall figure and describe this species, which I intend to call *Euphausia simplex,* n. sp., when we come home, and when it will be possible to compare it with the other species of the genus (which have been described by Dana and Claus). From the discovery of this *Euphausia,* it appears that not all the deep-sea Schizopods offer the said peculiarity, and that, among very peculiar genera such as have been described above, a form is also to be found which differs from the surface-*Euphausiæ* only by the absence of accessory eyes. These, I think, are to be considered a secondary adaptation to pelagic life; and therefore *E. simplex* is probably a more ancient form than *E. Mülleri, splendens,* and *superba.* Probably, however, this will not be the last discovery we make in this interesting group; and I think it is very likely that a form will come up which is in the same relations to the Euphausiidæ as *Gnathophausia* is to the Lophogastridæ, and *Petalophthalmus* to the Mysidæ. Then we should have made one step forward in the knowledge of Schizopodal genealogy, a step which will probably lead to further discoveries concerning the relations of the Phyllopods to the Schizopods—of the lower to the higher crustaceans. Perhaps it will now also be possible to understand certain fossil forms which seem to be allied to *Nebalia* and to *Gnathophausia.*

V. On the Development of a Land-crab.

(Plate XI. figs. 1–3.)

In most books on natural history we find concerning the land-crabs a remark that, according to Mr. Westwood's observations, they migrate to the sea when the time for depositing their eggs has come, and that the young ones, when coming out, have the same form as their parents. The same thing is to be observed in *Astacus fluviatilis*; and the knowledge of these two facts has been much in the way of the general acceptance of Mr. Vaughan Thompson's first observations on the Zoëa-stages of crabs. Also his state- that he found Zoëa-brood in the eggs of a *Gecarcinus* has been doubted; for, according to Fritz Müller *, Mr. Bell considered himself justified in eliminating Thompson's observation, because he could only have examined ovigerous females preserved in alcohol. The following lines, however, will show that there is no reason to doubt Mr. Thompson's statement. Fritz Müller himself, though we owe him many observations on land-crabs, says only that there is Zoëa-brood in *Ocypoda* and *Gelasimus*, but had no occasion to observe the Gecarcinoids.

Watching the habits of these crabs is always attended with some difficulties, as most of them are nocturnal. In St. Thomas I only succeeded in getting a few *Gelasimi*. Only in the Bermudas did we get Gecarcinoids:—the large *Cardisoma guanhumi*, which was caught by torch-light in the interior of the island, but all the specimens we got were males; besides, Mr. Moseley caught *Gecarcinus lateralis* and *Ocypoda rhombea*, and I myself caught several crabs allied to *Boscia*. I watched there also for a long time the lively *Grapsus cruentatus*, which lives in great quantities in Hungry Bay, among the mangrove trees. It has entirely taken to terrestrial habits, makes deep holes and runs up and down the mangrove trees. The holes, however, it always makes so near the shore, that it is sure to find water at a depth of 2 or 3 feet. What its mode of development is I could not find out, as it was evidently not their breeding-season (June). Arriving in the beginning of August at the Cape-Verd Islands, I found in St. Vincent many holes on shore inhabited by *Ocypoda hippeus*, a crab running with marvellous velocity over the sand, and very valuable to me, as it gave me ample opportunity of studying the interesting entrance to the branchial cavity described by Fritz Müller. But also in these I could discover no trace of eggs or of young. Holes made by the same crab we found again in the island of San Jago, where they are to be seen in abundance near the houses of the little village which surrounds the old cathedral of Ribiera Grande. But besides *Ocypoda hippeus*, we got in San Jago another large land-crab, caught by Mr. Moseley's seining-party at night in the bay of Porto Praya, a true Gecarcinoid, belonging to the same genus (*Cardisoma*) to which the Bermuda ones belonged. Unfortunately I cannot make out its specific name, as it is not mentioned in Milne-Edwards's 'Histoire Naturelle des Crustacés' †; but I suppose it is an animal well known to European carcinologists as inhabiting the Cape-Verd Islands, and, very likely, also the coast

* 'Facts and Arguments for Darwin,' by Fritz Müller (translated by W. S. Dallas. London: 1869), p. 48.

† Probably described in the same author's 'Crustacés des îles du Cap Vert.'

of the African continent. This *Cardisoma* inhabits large holes all along the shore, especially in the palm-groves on both sides of the town. But when I went there the next day to catch more of them, the difficulties in getting them were too great; for the holes were more than 3 feet deep. The one, however, which Mr. Moseley had caught, a female, proved to be very interesting; for after having killed it in spirits, I found the next day that its abdominal feet were covered with strings of eggs, that most of these eggs were empty, some of them containing an embryo, and that among the empty eggs there was a good number of young animals newly come out. These *young ones, however, were not like their mother, but Zoëas.* The greater number of them had evidently left the mother already; some were still to be found among the empty capsules; and others had not yet emerged. In fig. 3 Mr. Wild has drawn me such a string of eggs (each 0·42 millim. in diam., having the form of a grape), in which the berry-like pedunculated eggs surround a common axis.

The Zoëa of *Cardisoma* (fig. 1) leaves the eggs in a somewhat more advanced state than the Zoëa of *Carcinas mænas.* If we compare it with the figures given by Mr. Spence Bate ('Philosophical Transactions,' 1858, pl. xl.), we find that it represents a middle stage between the larva of *Carcinus mænas* which has just left the egg and the one after its first moult (figs. A and B). With the former it has in common the want of the frontal spine, with the latter the presence of setæ on most of the appendages, and the more developed caudal fin.

The carapace is very globular, and its dorsal spine is only small. The frontal spine, entirely wanting now, is probably only developed after the next moult. The eyes are very large. I could not see the pedunculus; but as I had only dead animals before me, which had been for some time in spirit, I do not deny that a very short pedunculus might exist. The first antenna has a few more hairs than in the second stage of *Carcinus mænas*; but the second ones are very much like each other in both cases (a^1 and a^2, fig. 1). The parts of the mouth (m) had equally already got their hair. I had some difficulty in getting a side view of them, and could have only isolated them with very great difficulty, which was not worth while, as there was no chance of getting later stages of this larva. The two gnathopoda have four long hairs in the last joint, which in our case (gp^1 and gp^2) are not so long, and not feathered, as they are in the second Zoëa-stage of *Carcinus mænas.* I have not seen any buds of the pereiopods behind those two legs, which are present in the young *Carcinus mænas.*

Each segment of the pleon presents some black pigment spots, some of which were also observed in the carapace. There are no appendages on the pleon. The last segment is bifurcate; and at the inner side of the two terminal pieces six feathered setæ may be observed, very much like those in fig. 21″ of Spence Bate's larva.

I think there is no doubt that these Zoëas, as they partly had done already, leave the mother and lead a pelagic life until they have undergone all their metamorphosis; and I hope that in other parts of the world which we are about to visit, I shall be able to complete these observations on the propagation of the land-crabs, and to make out in which genera there is a metamorphosis, and in which not.

I may add here an observation which I made some years ago in Italy, and which, if not quite directly concerning our subject, at least touches it; for the animal I am to speak about is the freshwater crab of Southern Europe, *Telphusa fluviatilis*. In the mountains above Spezzia I caught some specimens at a spring coming out from the Bocca Lupara; and one of these being a female, carried with it nearly 150 young ones under the abdomen, the smallest of which had a length of 3 millims. I think this shows clearly that also *Telphusa* is, with *Gecarcinus* and *Astacus*, one of the few Decapods which develop directly without metamorphosis.

VI. On a blind deep-sea Astacus.

(Plate X. fig. 1.)

In a very successful haul on the 15th of March near Sombrero Island, W. I., we got, from a depth of 450 fathoms, a blind *Astacus*, one of the claws of which is developed to an extraordinary extent. In the notes which I gave about it to Professor Thomson, I have called this animal *Astacus zaleucus*; for, strange as it may seem at first sight, there is no reason for separating this animal from the genus *Astacus*, except perhaps the want of the eye and its pedunculus. The male of *Astacus zaleucus* has a length of 110 millims., the cephalothorax having a length of 50, the abdomen of 60 millims.

The carapace is laterally very much compressed, and divided by a deep transverse sulcus into two portions or regions. At the top of the anterior one is the rostrum, having a length of 9 millims. Its borders have six small teeth. Before the rostrum there are two large triangular patches, which are densely covered with short hairs; and these continue from both sides towards the rostrum. On both sides of the anterior portion there are besides several small spines, and two sulci, which establish again a small marginal and triangular subdivision. The posterior portion of the carapace can also be subdivided, into a quadrangular upper portion and two lateral regions. The last segment of the pereion is in articulation with the carapace, quite in the same way in which it is in all *Astaci*.

On both sides of the rostrum there are two vacant places, where in other species the pedunculus of the eye is fastened. Here there is not a trace of it.

The four-jointed funiculus of the antenna interior bears two very hairy flagella, of the length of 40 millims. The base of the antenna exterior terminates on one side in a sharp spine. The squamiform appendage is somewhat curved outwards, reaches the middle of the second funiculus-joint, which is rather long, and has at the inner side eight sharp spines. The flagellum of the antenna exterior has a length of 130 millims. Underneath its base the large opening of the "green gland" is clearly to be seen.

The margin of the upper lip is somewhat tilted upwards, and beset with 6 small spines. About the mandible I have nothing particular to say. The chewing-plates of the first maxillæ are very strong, and the palpi of the maxillipedes very large. They look nearly like a ramus of one of the swimmerets. The palpi of the two gnathopods, however, have the ordinary form. The second gnathopod has thrice the length of the first one.

The pereiopods are all very hairy, especially their first two joints, which, with the exception of the right claw, are all densely covered with hairs. To three pairs there are chelæ; the fourth has a small recurved claw at the end; and in the fifth the sixth joint is nothing but a very small stump. Very remarkable are the first pair of pereiopods; the chela of the right one has a length of 100 millims., and that of the left one of only 48. Between the two chelæ, however, there is not only the difference in length, but also in width, as the carpus in the right one is very much expanded, spiny, and hairless; in the left one it is even and covered with hairs and spines. The two digiti chelæ have large teeth at their inner side, 57 on the digitus mobilis, and 62 on the opposite one; so that the claws of the larger pereiopod look like the jaws of some ferocious reptile.

The genital openings are here at the base of the third pereiopod, where we also found them in the male of *Deidamia leptodactyla.*

Between the last pairs of pereiopods there is a small triangular pectoral plate.

The pleon is very flat; and the sharp angles formed by a longitudinal line on both sides give it nearly a square shape. Its lateral pieces do not terminate in sharp spines, nor are they very large; the edges of these, as well as the whole surface of the third and fourth segments, are covered by dense and short hairs. The telson is a square, as it is in many *Astaci*; its lateral appendages are very large, and extend, like wings, to both sides.

The pleopoda of the first, very short segment are styliform appendages; the other pleopods have a very solid unjointed base and two broad rami, the interior of which is longer than the exterior (fig. 1 *a*). All these, as well as the caudal appendages, are densely fringed with hairs.

Characters of the Species.

ASTACUS ZALEUCUS, n. sp.

Eyes and eyestalks wanting entirely. Chelæ of the first pereiopod unequally developed, the right one having more than double the length of the left one. Eight spines at the squamiform appendage of the outer antenna. Genital opening of the male at the base of the third pair of pereiopods.

Those who consider the eyestalk an appendage of a separate segment of its own would probably be inclined to make another genus of this form. But I think this could be the only reason for separating it generically from *Astacus*, and for me not a sufficient one. We find in *Deidamia* that the genital opening of the male is, in one species, at the third pereiopod, and in another, undoubtedly belonging to the same genus, at the fifth. I therefore think that also this cannot be a reason for separating it generically from *Astacus*, in which genus this species will be the first one made known as an inhabitant of the sea.

To the *Astacus* of the Mammoth-cave this crayfish has only a physiological resemblance; for even in those species in which the eyes are abortive the stalks at least are present. But we have another form, which we got in deep water near the Bermudas, in which the eyes have the same hidden position as in *A. pellucidus*, to which it has in all other respects an extreme likeness; only in the marine species the squamiform appendage of the outer antenna is entirely wanting. The same thing is the case in a crustacean recently described by Mr. Wood-Mason from deep water near the Andaman Islands, which he calls *Nephropsis Stewarti* *. I am inclined to think that the crustacean which we got near the Bermudas belongs to the same genus; but as I have not seen the plate which Mr. Mason has added to his original paper, I shall defer its description until we come back.

Colour, and Mode of Life.

A. zaleucus came up on the swabs of the dredge, together with the large chelæ of another, smaller specimen, the body of which was lost. The one we got had the red colour of all deep-sea Crustacea. It lived on a bottom of globigerine ooze, evidently frequented by a great many animals. Several sponges and seven echinoderms (*Ophiomusium, Luidia, Archaster, Astrogonium, Cidaris,* and *Echinus*), a *Planularia, Mopsea,* and an *Isis,* several Annelids and a *Sipunculus,* a *Galathea,* a Peneid, an *Arcturus,* and the fine crustacean to which was given the name of *Willemoesia crucifera*—four Bryozoa, a *Dentalium,* and many small shells—finally, a fish probably belonging to the genus *Chauliodus,* were got in the same place with this extraordinary *Astacus.* Unfortunately our stay in the West Indies was only a very short one. The few hauls, however, which we had near Sombrero Island and St. Thomas showed us that a great quantity of new and probably also interesting animals live there in moderate depths (300–400 fathoms).

VII. On *Willemoesia*, a deep-sea Decapod allied to *Eryon*.

(Plate XII. fig. 10, and Plate XIII.)

In the "Notes from the Challenger," sent by Professor Wyville Thomson to 'Nature,' two blind crustacea have been described, both of which were found on our cruise from Teneriffe to St. Thomas. The larger one of these remarkable animals was called by me *Deidamia leptodactyla,* obtained on the 4th of March, by the dredge, in a most perfect state, from a depth of 1900 fathoms, in lat. 21° 38′ N., long. 44° 39′ W. Another specimen was caught in the trawl in lat. 35° 41′ S., and long. 20° 55′ W., about 400 miles W. of Inaccessible Island (Tristan d'Acunha), from the same depth at which the first was got. The second, smaller species, which I proposed to call *D. crucifera,* was got on the 15th of March, close to Sombrero Island, West Indies, from a depth of 450 fathoms, and equally well preserved. I shall now give a description of both of them, but especially of the larger one, which may be considered the type of the genus, and of the smaller one as far as it offers any differences of importance.

The generic name *Deidamia,* however, must be dropped, as (according to Mr. Grote, who has done me the honour of proposing for it the name *Willemoesia*) it was given by Dr. Clemens in 1859 to a genus of North-American Sphingidæ.

1. Willemoesia leptodactyla.

The body of this crayfish approaches in form closer to the well-known fossil *Eryon* than any other crustacean known to me, the body being flattened above, and there being

* "On *Nephropsis Stewarti,* a new Genus and Species of Macrurous Crustaceans," by James Wood-Mason, 'Annals and Magazine of Natural History,' No. 67, July 1873.

no lateral compression as in *Astacus* or in *Palinurus*. The cephalothorax exceeds in width half of its length; and the abdomen too is very flat. The whole animal, being a male, has a length of 120 millims.* (Plate XIII. fig. 1.)

The *cephalothorax* has a length of 60 millims. by 33 in width at its base. Its upper lateral edges are very sharp, and formed by a series of lateral spines, those of the underside, however, rounded. The whole cephalothorax, owing to this configuration of the carapace, is square, the upper surface being wider than the under one, and somewhat convex, the side parts being not rounded as in *Astacus* but perfectly flattened; also the upper surface forms a square, the angles of which are terminated anteriorly by two spines, and are posteriorly rounded. A line of spines runs longitudinally through the midst of the carapace, and divides it into two portions, being terminated anteriorly by a sharp spine. The lateral spiny edges are divided by small but clearly perceptible fissures into four portions, the first of them containing 8, the second 5, the third 5, and the last 6 larger spines. A deep transverse sulcus divides the carapace into an anterior and a posterior portion, which by secondary elevated lines are again divided into several regions, which we might call the stomachal, hepatic, lateral, cardiac, and branchial regions, each of which will be easily seen in the drawing (fig. 1). The inner borders of the carapace of the under surface are perfectly smooth; and the rounded exterior edges of the same surface are covered by a fringe of long and beautiful hairs. The whole carapace is covered by very small spines, all directed forward, giving it a certain likeness in appearance to the well-known chagrin of the sharks.

The *eyes are entirely wanting*; nor is there, as in *Astacus zaleucus*, any place left open where you might expect to find them.

Immediately underneath the frontal edge of the carapace we find in a prominent place the wing-like expansions of the joints, funiculi *antennarum anteriorum*. They are (especially at the inner side) densely covered with hairs, and very closely approach each other. The funiculus consists of three joints, and has a length of 10 millims. Its internal flagellum, consisting of very many rings, has a length of 65; while the external is very short, being only 10 millims. in length. On the same line with the inner antennæ and close to them, are the *outer ones*, the funiculus of which is a little more elongated, and consists equally of three joints (12 millims. in length). The squamiform appendage is very small (8 millims. in length by 2 in width), lancet-shaped, and inserted at the base of the first joint. The flagellum is 60 millims. in length.

The *opening of the mouth* is angular (fig. 4); and you find above its rejected border a small tuft of hairs. I could not find any *labrum*. The *mandibulæ*, covering nearly the whole opening with their strong manducatory processes, have behind these a strong and hairy palpus (fig. 5, *pm*), and at their base the two slender organs (fig. 5, *lab*) which represent the *labium* or *under lip*. The *first maxilla* (fig. 6 *a*) shows a very small rudiment of a flagellum (*fl*), which in the *second maxilla* (fig. 6 *b*) attains so considerable dimensions.

The *maxilliped* has two manducatory processes (fig. 7), a palpus (fig. 7, *p*), and a flagellum, which is divided into two portions, the upper one (fl^1) being attached to the palpus, and the under one to the base of the maxilliped (fl^2).

* This description refers to the larger of the two males procured.

The *first gnathopod* (fig. 8), as well as the *second* (fig. 9), are terminated by a denticulated claw, and covered by hairs at their inner side. *It is quite certain that the gnathopods* (or the second and third maxillipeds) *have no palpi.*

The pereiopods (fig. 1) are all terminated by chelæ, but of very different sizes. The length of the first pair, enormously developed, is 155 millims., thus exceeding by 35 millims. the length of the whole body. The basal joint (the coxa) is very large and flat, the second, however, very thin at its articulation, bent somewhat backwards, and increasing in size only at its top, where it articulates with the broad base of the third joint. This is the longest one, being covered on its upper surface by a series of small spines, and terminated at its top articulation by two recurved spines. The fourth joint is again very slender; and so is also the delicate chela, the immovable finger of which is armed with a large transverse spine. This first pair of pereiopods are perfectly smooth ; all the others, however, are covered with hairs up to the top. They are much smaller and clumsier, the second pair having only a length of 39 millims. At the coxal joint of the *third* pereiopod are the genital openings.

As to the underpart of the cephalothorax, it may still be mentioned that there is no distinct opening for the so-called green glands, that there is a strong spine between the two maxillipeds above the entrance of the mouth, and that an elevated line, covered with a fringe of hairs, runs over the sternal shield between the first pair of pereiopods.

The abdomen (pleon) has a length of 60 mm., and consists of six segments and the telson. The top of the second to fifth segments is marked by a strong spine, which is bent forward, and which in the first and sixth segments is only represented by a small elevation. There are also in the first segment no squamiform lateral appendages, which in the subsequent ones are very large, but decrease in size from the second to the sixth. All of them are fringed with long hairs ; and so are also the telson and the caudal appendages, the form of which can best be seen from Mr. Wild's excellent drawing.

The first pair of pleopods is transformed to styliform appendages (fig. 2), our specimens being both males. The four subsequent ones have a length of 33 millims., and are evidently very powerful organs of locomotion. They consist (fig. 3) of a very strong basal joint, to which the external palpus is attached, of smaller second joint, which goes laterally over into the second interior palpus, and of a very small and styliform third joint (fig. 3, *a*)—quite the same arrangement which we find in *W. crucifera* and in an undescribed Palinurid from the deep sea near the Bermudas (fig. 12). All the four pleopods are alike; and the posterior ones are very little smaller than the anterior ones.

Of the internal organization I can only say that the carapace is wonderfully transparent for the size of the animal, and permits the heart to be seen, which is situated just between the hepatic and stomachal regions.

2. Willemoesia crucifera, n. sp. (Plate XII. fig. 10, and Plate XIII. figs 10 and 11.)

The species we have hitherto considered is very delicate, and has very long fringes of hairs on the legs, the carapace, and the pleon. All this is less the case in the smaller species, which is much more solid, not transparent at all, and in which the fringes are not so large and beautiful. Nevertheless also this one is a very elegant creature, which on the whole has a strong family likeness to *W. leptodactyla*. It has a length of 42 millims.

The form of the carapace is nearly the same as in the former species. It has a length of 19 millims., by 18 of greatest width; at its base, however, it is only 10 millims. wide. The denticulation of the edges is a much stronger one than in the preceding species; there is a line of spines divided by two incisions into three divisions, the first of which contains 7, the second 5, and the third 17 spines on each side, all bent forward and somewhat upward. Two very prominent lines, one longitudinal, ending at the front with a spine, and one transverse, form the figure of a cross; and following the lines of caruncles, you might trace the same regions which we have described in the former species, but which in this case are not so clearly visible. At the frontal border there are two spines on the right side and four spines on the left side of the median spine. The whole carapace is finely covered by very small spines, which look like very fine chagrin.

The interior antennæ have several spines on the inner side of their three funiculus-joints, but not such a wing-like expansion as we have observed in the former species. The exterior flagellum has a length of 17, the interior of 7 millims. The exterior antenna does not offer any thing particular.

The parts of the mouth have exactly the same form as in the preceding species; and the absence of palpi at the base of the gnathopods can also be stated in this case.

Of the five pairs of pereiopods *only four are terminated by chelæ*; and this is the chief difference from *W. leptodactyla*. The first pair also are proportionally much shorter, (only 34 millims. long), and have no spine on the slender fingers of the chela. In the third and fourth pairs of pereiopods the chelæ are much more slender than in the first. The last one is terminated by a simple recurved claw. The last four pairs of pereiopods are covered with hairs, but not so densely as in *W. leptodactyla*. The genital opening is, in this species, not on the coxal joint of the third pair of pereiopods, but, as is usually the case, on that of the fifth.

The abdomen has a length of 23 millims. Its first segment bears one spine; and all the following ones have two spines on a little prominence. Telson, caudal appendages, and lateral processes of the segment are fringed with hairs.

The first pair of pleopods is transformed into two styliform and flattened appendages. In the second pair (fig. 10) we observe the peculiarity that the third styliform joint is covered by another, smaller joint, the morphological value of which I do not understand. In the other three pairs (fig. 11) this supernumerary joint is not attached to the third one; so that these are very much like the pleopods of *W. leptodactyla*.

Colour, and Habits of Life.

Especially the larger of these two species was very beautiful when it came up; for it was of a fine red, while the hairs bordering it were yellowish. The smaller one also was red. This colour, however, rapidly disappeared when the specimens had been for a certain time in spirit.

As was also the case with *Gnathophausia*, the larger species of the two was caught in very deep, the smaller one in shallower water. *W. leptodactyla* was found on a plateau which probably extends southwards from Greenland, and on which in the north are situated the Azores, and in the south Tristan d'Acunha. Before getting to it from Teneriffe we had the greatest depth of that section of the ocean, 3150 fathoms; and afterwards again we gradually came down to a depth of 3000 fathoms before getting into the shallower water of the West Indies. On that plateau we got with the first specimen a sponge, some Bryozoa, a Brachiopod, a Lamellibranchiate, a Gastropod, and a small Shrimp, besides this magnificent Decapod, which was entangled in the swabs of the dredge. With the second specimen a great many animals came up, among which I may mention a *Palythoa*, a *Fungia*, and a Pennatulid. A *Holothuria*, an *Archaster*, and an Urchin represented the Echinoderms. Crustacea were present in large numbers—especially Peneid and Caridid Shrimps and the Schizopods which I have called *Petalophthalmus* and *Chalaraspis*, together with a large species of *Euphausia*. The smaller species was got near Sombrero Island, W. I., in a depth of 450 fathoms, together with *Astacus zaleucus*; and in describing this species I have already given an idea of the fauna which lives in the same place with these crustacea.

Characters of the Genus, and Systematic Position.

WILLEMOESIA, Grote *.

Carapace large, flattened, and quadrangular. Anterior margin and lateral borders denticulated, the latter divided by two incisions into three denticulated portions. A longitudinal line divides the carapace into a right and a left portion. Eyes and eye-stalks entirely wanting. Funiculus of the first antennæ rather large, its inner flagellum longer than the outer one. Small lamellar appendage at the base of the second attennæ, the flagellum of which has the same length as the longer one of the inner antennæ. Manducatory portion of the mandibula very strong. A large flagellum attached to the second maxilla. The palpus and flagellum of the maxillipedes reach the base of the first antennæ. No palpi at the base of the gnathopoda (second and third maxillipeds). First pair of pereiopoda very elongated, terminated by a slender pair of chelæ. Subsequent pereiopoda much shorter.

Small styliform appendages at the inner side of the ramus interior of the pleopoda. Abdomen flattened, divided by a longitudinal line of spines into a right and a left portion. Telson rapidly decreasing in size, longer than the shield-like caudal appendages.

1. W. LEPTODACTYLA, n. sp.

Lateral borders of the carapace not very much expanded. Denticulation not very deep. First pair of pereiopoda longer than the body. *All the pereiopoda terminated by chelæ*, Length 120 millims.

2. W. CRUCIFERA, n. sp.

Carapace with wing-like expanded lateral borders. Deep incisions and strong denticulation at its lateral borders. First pair of pereiopoda shorter than the body. *Only four pereiopoda terminated by chelæ*. Length 42 millims.

* In 'Nature,' October, 1873.

Among the living Decapoda Macrura there is hardly a group with which *Willemoesia* could be said to be very closely allied. Nearest to it are undoubtedly the Scyllarinæ; but these, like all the genera of the family Palinuridæ, differ from it in the absence of the lamellar appendage of the second antennæ, and in the presence of palpi at the base of the gnathopoda, which, as we have seen, are wanting in this new genus. Nor can it, for this latter reason, be referred to the Astacidæ, with which it has in common the presence of the antennal scale.

It is very astonishing, indeed, that, among all crustaceans known to us, *Willemoesia approaches most closely the fossil Eryontidæ.* If we compare, for example, our figure of *W. crucifera* (Plate XII. fig. 10) with a figure of *Eryon arctiformis,* and the description of the "Tribu des Eryons," given by Milne-Edwards * (and probably taken especially from Desmarest's 'Crustacés Fossiles'), we find most striking resemblances between the two forms. In *W. crucifera* as well as in *Eryon* the carapace has nearly half the length of the whole body; and in both forms its lateral borders are wing-like expansions which are divided by two deep incisions into three portions. The anterior border of the carapace is nearly straight in both forms.

Eryon was probably not blind; for the eye-stalks have been found in several specimens. Its antennæ seem to be somewhat more reduced than in *Willemoesia*; but the second pair of them has, according to Desmarest, " une écaille assez large, ovoïde et fortement échancrée." This is the chief difference between *Eryon* and the Palinuridæ, and the same in which also *Willemoesia* differs from that group.

Milne-Edwards says nothing on the parts of the mouth; but according to Quenstedt they had a very large mandibula, one of the teeth of which was preeminently strong. This is very much like what we find in *Willemoesia*; but in the fossil genus palpi were present at the base of the first and second gnathopods, which are wanting in the living genus. The first pair of pereiopoda is in both forms longer than the following ones, and terminated by a pair of long and slender chelæ. In *Eryon* three pairs of pereiopoda, in *W. leptodactyla* five, and in *W. crucifera* four are terminated by chelæ. The form of the last pereiopod in *E. arctiformis* is exactly the same as in *W. crucifera*; and the abdomen of these two forms is, as the above-mentioned figures show, so very much alike in the two forms, that, if the last pair of pereiopoda and the pleon of *Eryon* were presented to me without my knowing to what they belonged, I should undoubtedly declare them to be parts of the genus *Willemoesia.* There are the same line of spines at the top of the rings, the same winglike expansions on both sides, and that characteristic " nageoire caudale, dont la lame médiane est pointue et les quatre lames laterales moins longues que la médiane et hastiformes." Also the fine fringe of hairs which distinguishes the caudal fin of *Willemoesia* is to be seen in the fossil crustacean.

Eryon differs from the living genus chiefly by the presence of eye-stalks and of palpi at the base of the gnathopoda. According to Quenstedt the latter were observed only with some difficulty; and their presence seems not to be beyond all doubt. I shall only on my return be able to look myself over the original specimens and papers, and then, I hope, be able to give a more detailed account on the relations of *Willemoesia* to *Eryon.*

* Histoire Naturelle des Crustacés, tome ii. (Paris, 1837) p. 278.

That they must be very close appears already from what we have said; and among the Eryontidæ this new deep-sea genus must take its place. The Eryontidæ, now consisting of two genera, must either form a new family intermediate between the Astacidæ and Palinuridæ, or be united with the latter.

During our cruise in the Atlantic we got deep-sea animals (*i. e.* from more than 350 fathoms; stations where only Foraminifera-shells have been got are *not* included) from 67 stations. After every haul a list of these animals, as much specialized as our knowledge of the thing allowed us to do, has been put down by me in the so-called Station-book. As it might be of some interest to know how often the different groups of animals have been got, I have made the necessary additions, and shall terminate this paper by giving the results as far as Crustacea are concerned. According to this,

Cirripedia have been got	9 times.
Ostracoda	1 time.
Amphipoda	7 times.
Isopoda	6 „
Cumacea	2 „
Stomatopoda	1 time.
Schizopoda	12 times.
Decapoda Macrura	22 „
Decapoda Brachyura	11 „

EXPLANATION OF PLATES.

Plate VI.

All the figures, with the exception of fig. 4, refer to *Nebalia longipes.*

Fig. 1. A female. Low power. *a,* antenna of the first pair; *b,* antenna of the second pair; *Oc,* eye; *R,* rostrum; *M,* stomach; *D,* intestine; *F,* joint of the furca.

Fig. 2. A male. Letters the same as in fig 1. *d,* palpus of the first maxilla ("Putzfuss" Claus); *G,* ductus eiaculatorius.

Fig. 3. Leg of a female: *a,* basal joint with the branchial appendage (*K, A*); *β,* second joint with lateral appendage (*N, A*); *γ,* main branch.

Fig. 4. Phyllopodal foot of the female of *N. Geoffroyi,* copied from Claus. Letters the same as in fig. 3. *γ–v,* Joints of the main branch.

Fig. 5. First antenna of a female. *k.* fourth joint, a claw. *a,* External, *b,* internal flagellum.

Fig. 6. First antenna of a male. Letters the same as in fig. 5.

Fig. 7. Second antenna of a female.

Fig. 8. Mandibula; *p,* palpus }
Fig. 9. First maxilla; *p,* palpus } of a female.
Fig. 10. Second maxilla }

Fig. 11. One of the anterior pleopoda: *a,* basal joint; *β,* ramus exterior; *γ,* ramus interior; *δ,* retinaculum corresponding to the same on the other side.

Fig. 12. Fifth } pleopod of a female.
Fig. 13. Sixth }

Plate VII.

All the figures refer to *Petalophthalmus armiger*. All drawn with very low power, except figs. 7–9.

Fig. 1. A female, × 2 nat. size. a^1, first antenna; *ap*, appendix lamellaris; a^2, second antenna; *pm*, palpus mandibulæ; *mp*, maxilliped; *gn*, gnathopoda; *prp*, pereiopoda; *la*, breeding-lamellæ.

Fig. 1 *a*. Caudal fin of the same.

Fig. 2. A male, × 2 nat. size. a^1, first antenna; *ap*, appendix lamellaris; a^2, second antenna; *pm*, enlarged palpus mandibulæ; *mp*, maxilliped; gn^1, first gnathopod; prp^2, second pereiopod; prp^5, fifth pereiopod.

Fig. 2 *a*. Caudal fin of the same.

Fig. 3. First antenna of the female.

Fig. 4. Second antenna of the same.

Fig. 5. Scale of the second antenna.

Fig. 6. Upper lip.

Fig. 7. Mandibula of the female: *pm*, palpus mandibulæ.

Fig. 8. First maxilla of the same.

Fig. 9. Second maxilla of the same: *p*, palpus; *fl*, flagellum.

Fig. 10. Maxilliped of the same: *al*, appendix lamellaris; *p*, palpus; *fl*, flagellum.

Fig. 11. First gnathopod of the same.

Fig. 12. Second gnathopod of the same.

Fig. 13. Third pereiopod of the same.

Fig. 14. Pleopoda 1–5 of the same.

Fig. 15. Maxilliped of the male: *la*, lamellar appendage.

Fig. 16. First gnathopod of the same: *la*, lamellar appendage.

Fig. 17. First, fourth, and fifth pleopoda of the same.

Plate VIII.

All the figures refer to *Chalaraspis unguiculata*.

Fig. 1. A male, × 2 nat. size. a^1, first antenna; a^2, second antenna; *gn*, gnathopoda; *p*, pereiopoda.

Fig. 1 *a*. Head of the male, seen from above: *sc*, small tubercle beneath the rostrum and between the eyes.

Fig. 1 *b*. Caudal fin of the same.

Fig. 2. First antenna of a female.

Fig. 3. Second antenna, with lamellar appendage of the same.

Fig. 4. Mandibula of the same.

Fig. 5. Under lip of the same.

Fig. 6. First maxilla of the same.

Fig. 7. Second maxilla of the same: *p*, palpus; *fl*, flagellum.

Fig. 8. Maxilliped of the same: *p*, palpus; *fl*, flagellum.

Fig. 9. First gnathopod } of the same.
Fig. 10. First pereiopod }

Fig. 11. Upper lip of the same.

Fig. 12. Fourth pereiopod
Fig. 13. Fifth pereiopod } of the same.
Fig. 14. Anterior pleopod

Plate IX.

Fig. 1. *Gnathophausia gracilis*, male, × 4 nat. size.
Fig. 2. Second antenna of *Gn. zoëa*: *al*, appendix lamellaris; *fu*, funiculus; *fl*, flagellum.
Fig. 3. Mandibula of the same; *p*, palpus.
Fig. 4. Labium of the same.
Fig. 5. First maxilla of the same, higher power: *p*, palpus maxillæ.
Fig. 6. Second maxilla of the same: *fl*, flagellum; *p*, palpus; *o*, accessory eye.
Fig. 7. Maxilliped of the same: *fl*, flagellum.
Fig. 8. First
Fig. 9. Second } gnathopod of the same.
Figs. 10–14. The five pereiopoda of the same.
Fig. 15. One of the anterior pleopoda of the same.
Fig. 16. Maxilliped of *Gn. gigas*: *fl*, flagellum; *p*, palpus.
Fig. 17. Outlines of the eye of the same.

Plate X.

Fig. 1. *Astacus zaleucus*, male, nat. size
Fig. 1*a*. One of its right pleopoda.
Fig. 2. *Gnathophausia gigas*, male, nat. size.
Fig. 2*a*. The same, side view (the carapace is lifted somewhat to show that it is not connected with the pereion), nat. size.
Fig. 3. Oral apparatus of the same: *l*, labrum; *md*, mandibula; *mp*, palpus mandibulæ; *p*, palpus of the second maxilla; *fl*, its flagellum; *ac*, accessory eyes on the second maxilla; basal joint of the maxilliped with its palpus (the other joints of *m* have not been drawn, in order not to confuse the figure); *x* and *y*, plates formed by the flattened inferior borders of the carapace.
Fig. 4. *Gnathophausia zoëa*, male, × 4 nat. size.

Plate XI.

Fig. 1. Zoëa of *Cardisoma*, sp.? from San Jago (Cape-Verd Islands). High power. a^1, first, a^2, second antenna; *m*, parts of the mouth; *gp*, the gnathopoda.
Fig. 2. Caudal fin of the same, seen from above. High power.
Fig. 3. A string of eggs and egg-capsules, partly containing zoëas, partly left by them. Taken from the abdominal feet of the mother. Low power.
Fig. 4. *Cystisoma neptunus* (*Thaumops pellucida*), male. Nat. size.
Fig. 5. Genital organs of a smaller male: A, segments of the pereion; B, first segment of the pleon; *t*, testes; *vd*, vasa deferentia; *ag*, aperturæ genitales.
Fig. 6. Mandibula of the same. High power.
Fig. 7. Maxilla of the same.
Fig. 8. Maxillipedes (*m*) and second maxilla, with (*l*) labium (?) of the same.

Plate XII.

Figs. 1–9 refer to *Apseudes cæca*.
Fig. 1. A female, × 4 nat. size: *a*, antenna; *gn*, gnathopoda.

Fig. 2. First antenna.
Fig. 3. Second antenna: *s*, scale; *f*, flagellum.
Fig. 4. First gnathopod.
Fig. 5. Second gnathopod.
Figs. 6, 7. First and second pereiopods.
Fig. 8. Last joints of the fourth pereiopod.
Fig. 9. Maxilliped.
Fig. 10. *Willemoesia crucifera*, × 4 nat. size.

Plate XIII.

Fig. 1. *Willemoesia leptodactyla*, male, nat. size.
Fig. 2. First styliform pleopod.
Fig. 3. Second pleopod of the right side: *a*, styliform appendage to the inner ramus.
Fig. 4. Upper border of the opening of the mouth.
Fig. 5. Mandibula, with the palpus (*pm*) and the left labium (*lab*).
Fig. 6 *a*. First maxilla: *fl*, rudiment of a flagellum.
Fig. 6 *b*. Second maxilla: *fl*, flagellum.
Fig. 7. (First) maxilliped: *p*, palpus; fl^1, upper half of the flagellum; fl^2, under half.
Fig. 8. First gnathopod (second maxilliped).
Fig. 9. Second gnathopod (third maxilliped).
Fig. 10. Second left pleopod of *W. crucifera*, with two styliform appendages.
Fig. 11. Third right pleopod of the same, with one styliform appendage.
Fig. 12. Second right pleopod of an undescribed Palinurid from deep water near the Bermudas.

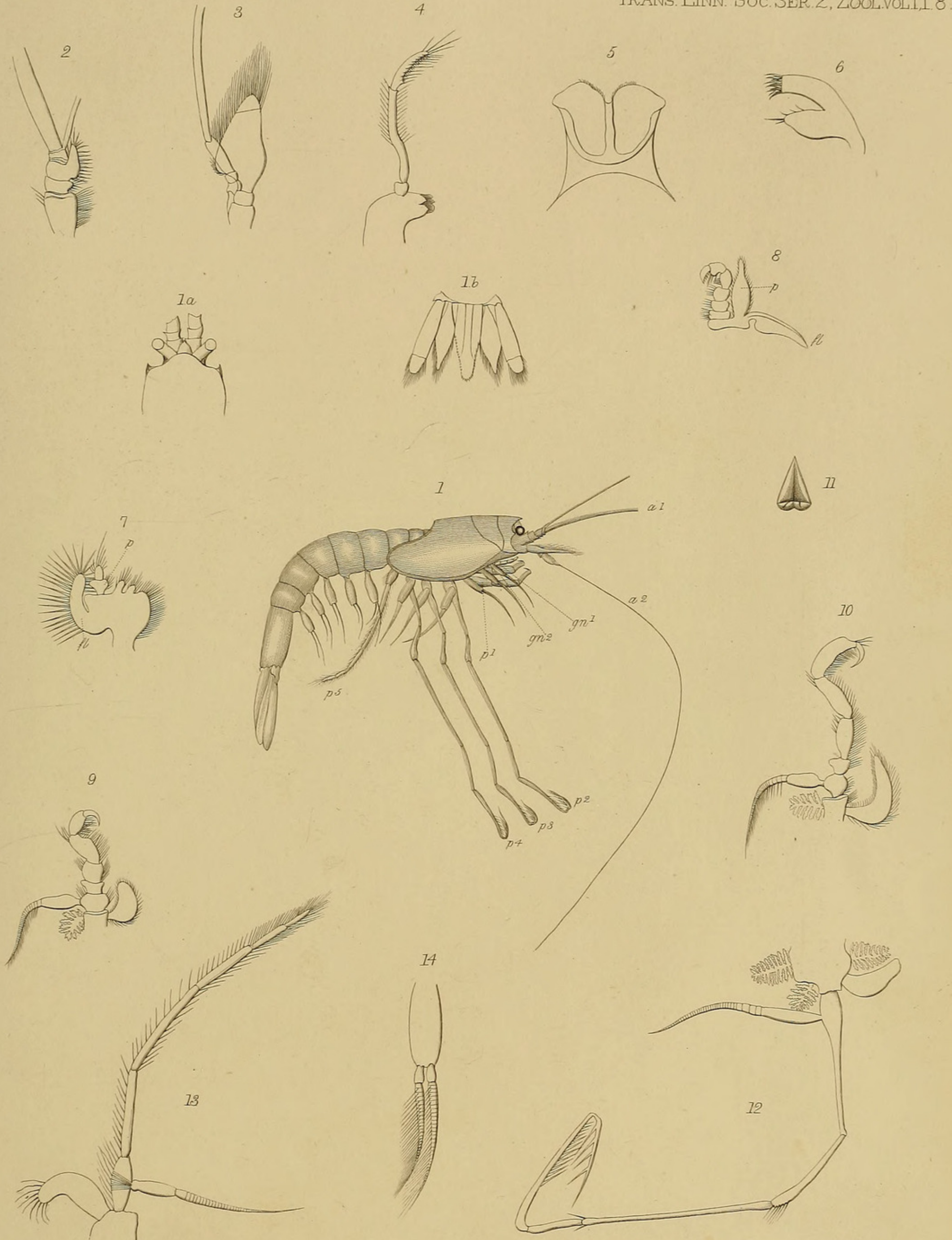
Wherever the words "high power" are not added, a low power of a Hartnack's microscope, or, in case it was not possible to dissect the animal, a loupe has been used.

J. J. Wild et autor del.

G. Jarman sc.

J. J. Wild et autor del.

G. Jarman sc



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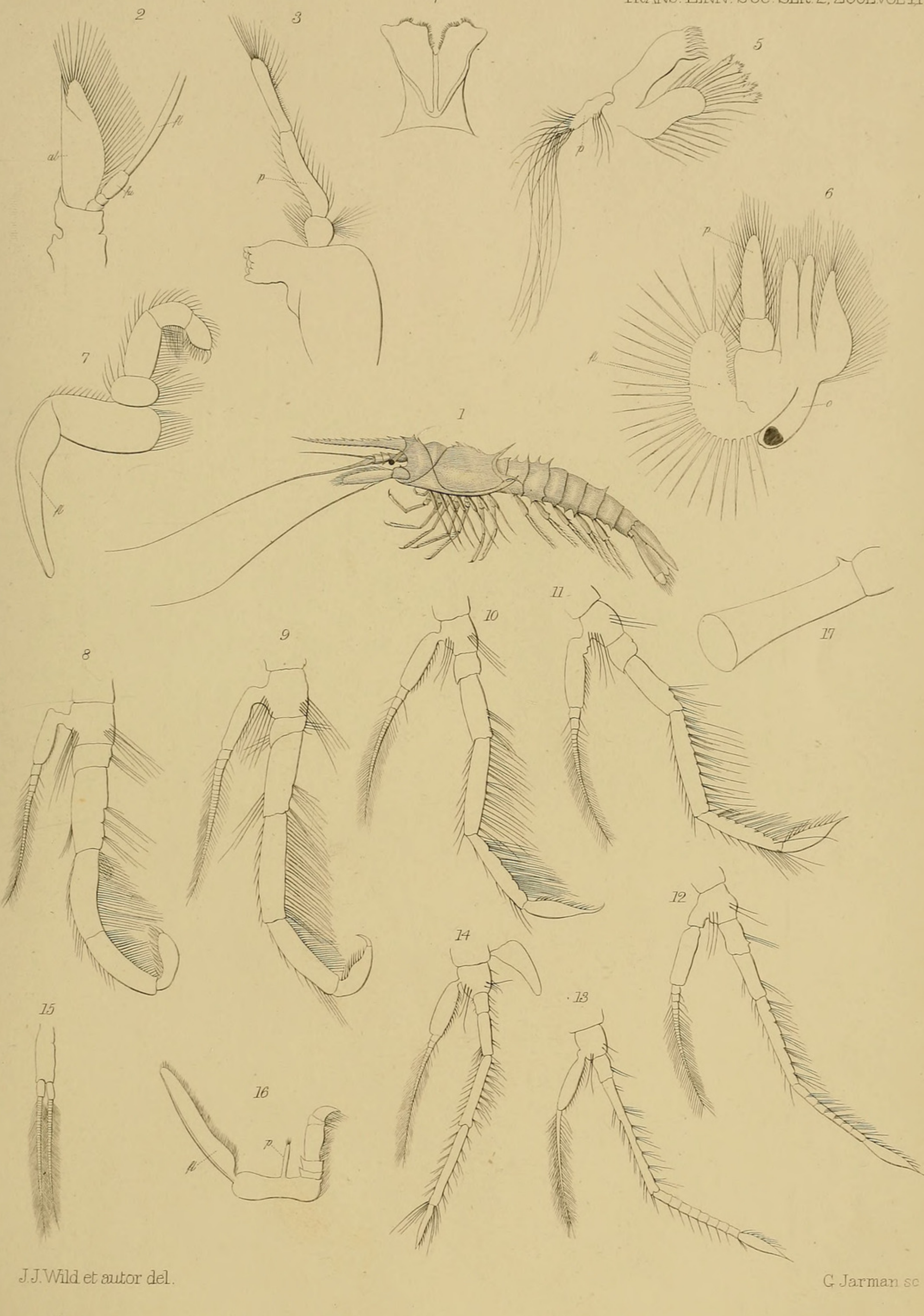

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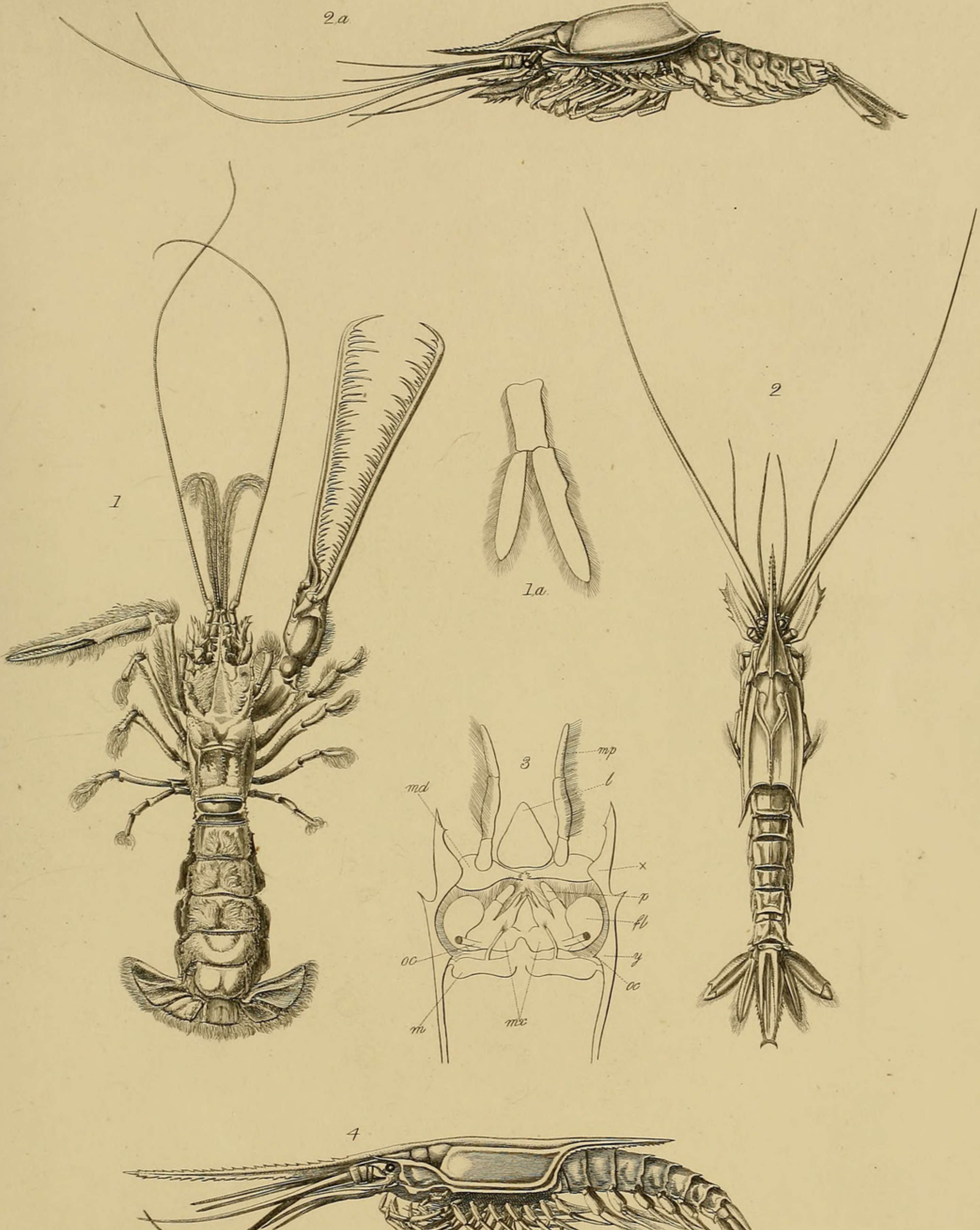

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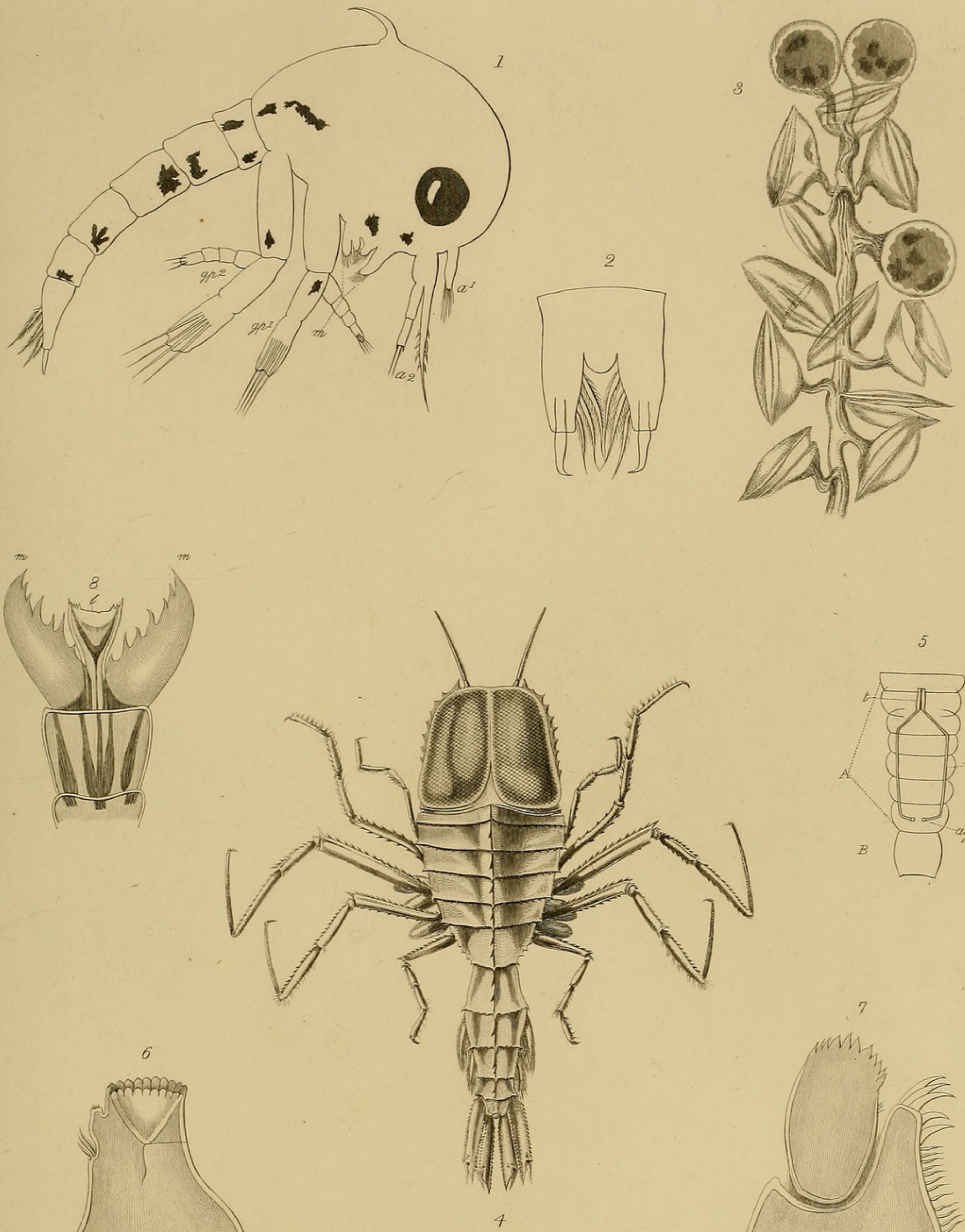

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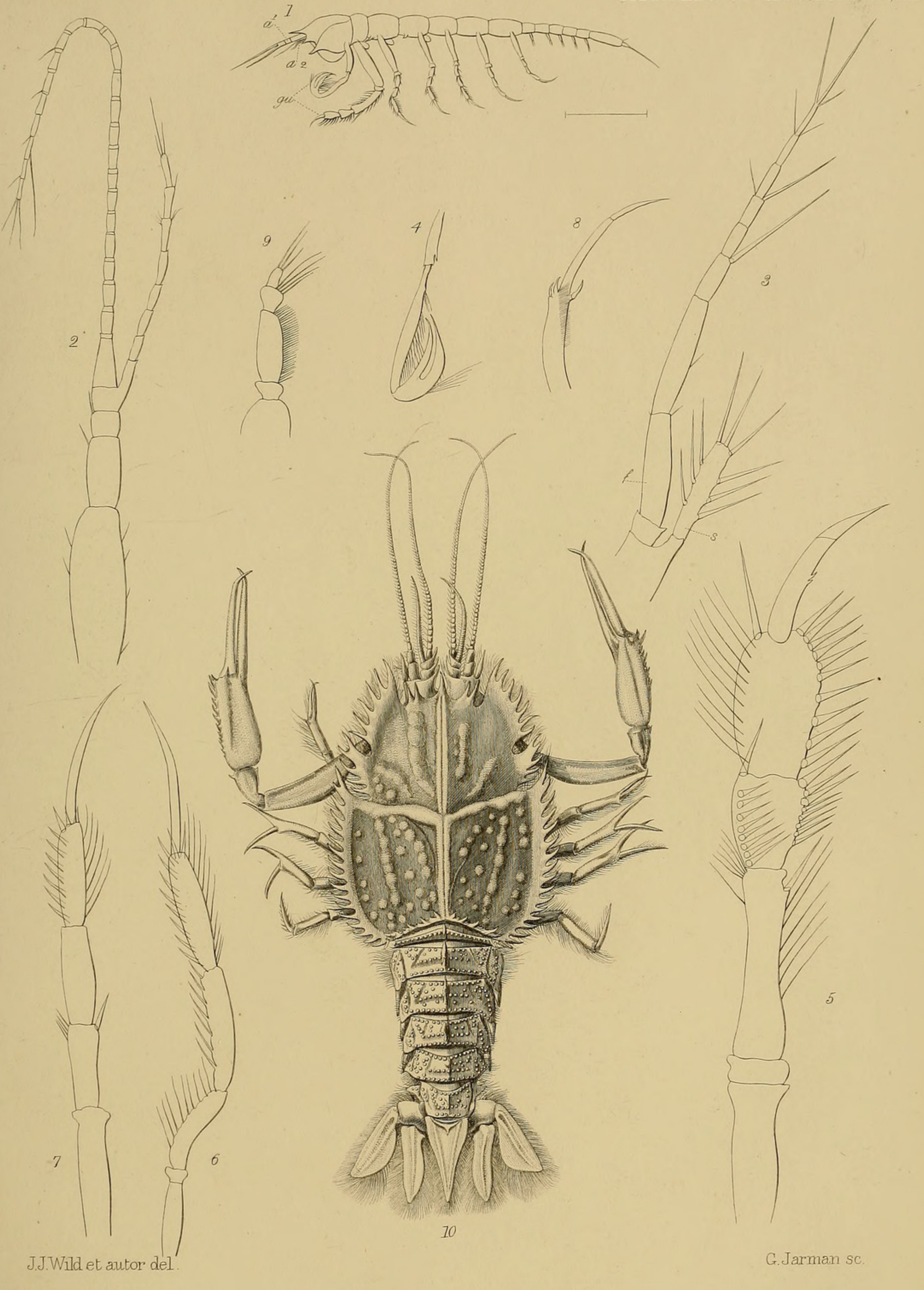

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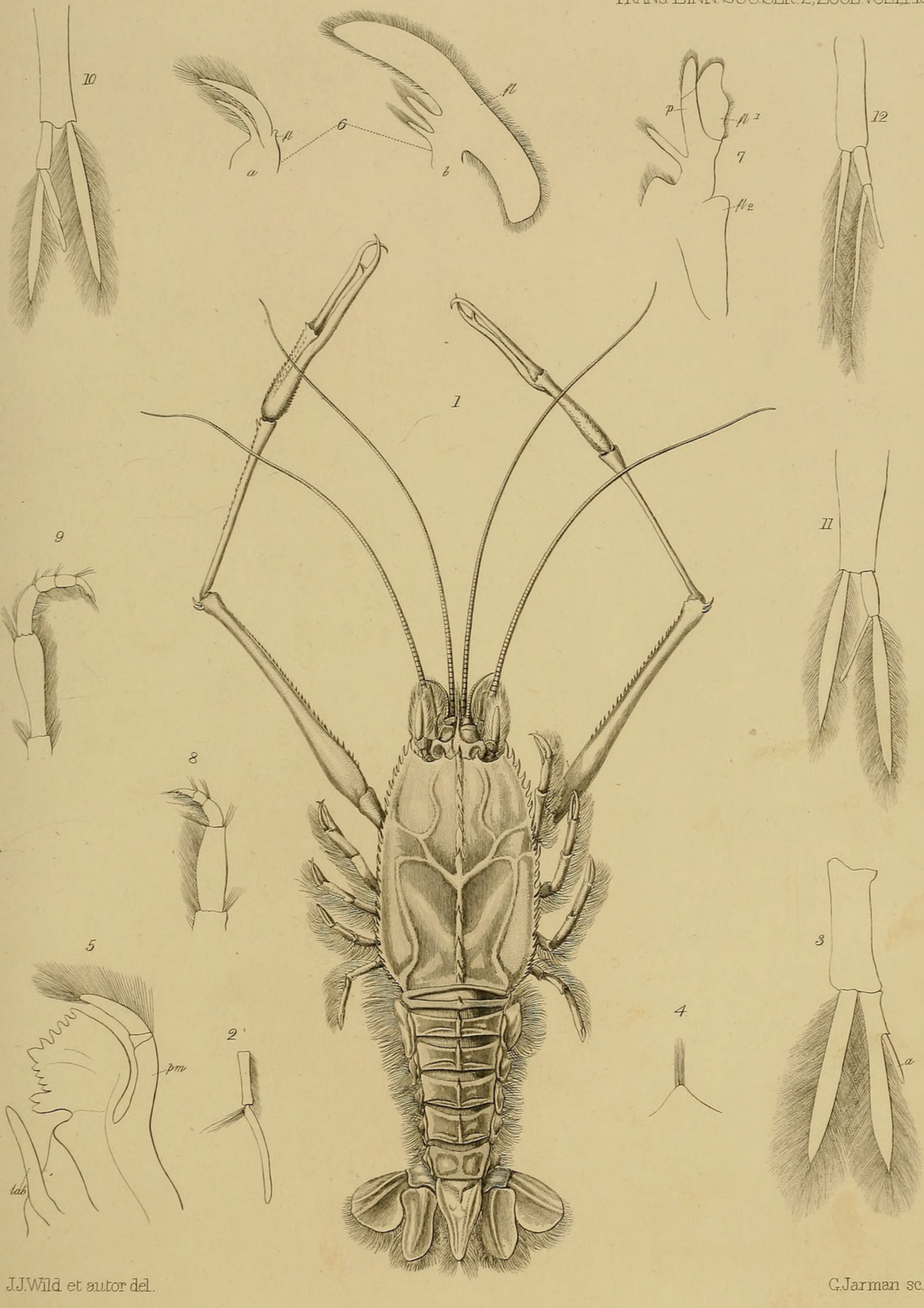

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