

1905

VIII.—*On the Structure of Lerneopoda Dalmanni, with Observations on its Larval Form.* By WILLIAM TURNER, M.B. (Lond.) F.R.S.E., and H. S. WILSON, M.D., Demonstrators of Anatomy (Plate IV.)

(Read 7th April 1862.)

The first example of this, apparently little known, species of Parasitic Crustacean appears to have been noted by Professor OTTO.* The celebrated Swedish naturalist RETZIUS was, however, the first to give, in 1829, an anatomical description of it.† He named it *Lernæa Dalmanni*. His description was accompanied by several figures, which, though in many respects imperfect, enable one to recognise the chief external characters of the animal. He found three specimens at Christian Sound, in the nasal cavity of *Raia Batis*. VON NORDMANN‡ obtained from RUDOLPHI the specimen discovered by OTTO, but it was so injured, that he adopted, in his account of the anatomy of the animal, the description of RETZIUS. Some years afterwards, in 1836, KRÖYER|| added it to the Danish fauna. He states that he obtained two specimens from the nasal chamber of a skate brought to him by a fisherman from Aal-back, and that specimens from Iceland had been for several years in the possession of the Natural History Society. As naturalists had now begun to subdivide the old Linnean genus *Lernæa* into various genera, KRÖYER added this animal to the genus *Lerneopoda* of DE BLAINVILLE, and, continuing its specific name, termed it *Lerneopoda Dalmanni*.

Since the time of KRÖYER but little attention appears to have been bestowed on this parasite by systematic writers. MILNE EDWARDS§ mentions it only briefly, and is inclined, from the elongated and cylindrical form of the cephalic part, and from the development of two processes from the ventral aspect of the posterior end of the body, to place it in the genus *Brachiella*.

It does not appear to have been, as yet, recognised as a British species, for no mention of it is made in the systematic works of BAIRD and GOSSE. The fortunate detection by one of us (Dr WILSON) of several specimens, early in the present year, in the nasal cavities of more than one skate, caught by the Newhaven fishermen, has enabled us to add it to the British fauna, and to investigate its anatomy.

* Mikrographische Beiträge Von A. v. Nordmann. Berlin, 1832.

† Kongl. Vetenskaps Acad., Handlingar. Stockholm, 1829. P. 109. Frorieps Notizen, vol. xxix, N. 617, p. 6.

‡ Op. Cit. p. 139.

|| Naturhistorik Tidskrift, vol. i, p. 264. Okens Isis, 1840, p. 746.

§ Hist. Nat. des Crustacées, vol. iii, p. 516.

Female (figs. 1, 2).—This is evidently one of the largest of the *Lerneadæ*. It presents decided indications of being divided into two great segments,—an anterior, or cephalo-thoracic, and a posterior or abdominal. The division is indicated by a well-marked constriction or neck. Immediately in front of this neck a pair of long arms arise from the sides of the cephalo-thorax.

The cephalo-thorax in a fully grown specimen is $\frac{1}{10}$ ths of an inch in length. It projects almost at a right angle from the anterior extremity of the abdomen. It is elongated, and somewhat compressed laterally. On its dorsal surface, about the junction of the anterior and middle thirds, a pair of antennæ is situated (figs. 3, b). Their bases are partially concealed, and connected together by a crescentic fold of the chitinic integument of the animal, the convexity of which fold is directed backwards. Each antenna is 3-jointed: the basal segment short and broad; the second much longer; the terminal smaller, and possessing a pair of hooks at its free end (fig. 5).

In front of the antennæ, and therefore close to the anterior extremity of the head, a complicated buccal apparatus is met with (fig. 3, c, fig. 6). Situated in the middle line is a short conical snout, at the free extremity of which a rounded oral aperture exists. The animal appears to possess the power of retracting and projecting this snout at pleasure. On each side of the snout is a short stump-like process, slightly bifid at its extremity. For the due examination of the structures about the mouth, the higher powers of the microscope are necessary. The buccal apparatus consists of an oral aperture, of two lip-like structures, and of a pair of jaws. The lower lip is strengthened by a peculiar arrangement of chitinic bands, which have been represented in fig. 9. Projecting not only from the margin, but also partially from the inner surface of this lip, are a number of fusiform bristle-like papillæ. On the inner surface of the central part of this lip several very delicate, faintly transversely-barred lines pass downwards and backwards as far as a chitinic bar, which stretches across the lip from margin to margin. The upper lip (fig. 8) consists of two chitinic concavo-convex plates, which fit into each other, their concave aspects being directed to the buccal cavity. The inner plate is shorter than the outer, and bears a row of long slightly undulating, transversely striped, rod-like structures, fringed at their free ends. The outer plate is covered at the margin, and for some distance on its dorsal aspect, by sharply pointed, conical, bristle-like papillæ. The lips are supported at their bases on a chitinic plate, more immediately continuous with the plates of the lower lip, and to which the upper lip is apparently connected by a moveable joint. This plate is so arranged as to be folded upon itself in such a manner as to enclose tubular spaces (fig. 6, b), in which some of the muscles of the buccal apparatus are included.

When the lips are drawn asunder, so as to expose the buccal chamber, a pair of elongated scythe-like jaws (mandibles) is seen (fig. 9). These are attached

laterally close to the angles of junction of the lips. They lie obliquely across the cavity, and therefore cross each other. In some of the specimens the free ends of these mandibles projected externally through the oral aperture (fig. 7). Deeply serrated strong teeth, about six in number, with intermediate smaller teeth between the three terminal ones, are placed along the concave posterior margin of the unattached extremity of each jaw. Each mandible is articulated externally to the chitinic plate which supports the lips. The muscles which move the jaws do not present any distinct transverse striation. They are marked by delicate longitudinal striæ, which resemble nuclei in their appearance.

Connected laterally to the outer aspect of the upper lip is a very small projecting structure, which KRÖYER has described as a touch organ, and which may evidently be considered to be a labial palp (fig. 8, a). It consists of two segments, from the terminal one of which three papilla-like hairs project. The basal segment has, along its line of articulation with the terminal, a short hook-supporting tubercle, and from its outer surface, about half way towards the base, there is an elevation fringed with very short bristles.

The stump-like processes, between which the snout, bearing the mouth, lies, have been termed by KRÖYER the second pair of antennæ (fig. 6, d, fig. 10). They correspond very nearly, both in structure and relation to the mouth, to the appendages which V. NORDMANN has described and figured in *Achtheres percarum* as the upper jaws, or metamorphosed first pair of feet. Each of these structures is segmented and laterally compressed, and arises by an elongated base, which is not merely on the same line with the base of the snout, but extends forwards beyond it for a short distance towards the anterior extremity of the cephalo-thorax. Each possesses a bifid free extremity, the posterior division of which, smaller than the anterior, is armed with a well-marked terminal hook. Along its posterior margin are two elevations, studded with short, blunt, cylindrical bristles (fig. 10, a). Immediately above the lower of these elevations is a smaller space covered with conical hairs. The anterior division, very much larger than the posterior, is thickly studded, especially on its outer surface, with a corresponding bristle-like arrangement (fig. 10, b). Springing from the anterior and inner part of each of these modified feet is a segmented palp-like structure, set with three or four conical papillæ at its free extremity (fig. 10, c).

At the inferior margin of the anterior extremity of the cephalo-thorax is a somewhat pendulous nipple-like structure, which has been named by RETZIUS the chin (figs. 4, b). It consists simply of a projection of the integument, which can be retracted or protruded at pleasure.

A pair of elongated cylindrical arms arises from the sides of the cephalo-thorax immediately in front of the constricted neck (fig. 1, c). When fully extended, each arm measures an inch, but it can be contracted by the animal at least one-half. The arms pass almost vertically upwards in the direction of the long axis of the

abdomen. They lie side by side, and almost parallel to each other. Each arm ends superiorly in an expanded structure, concave on its upper aspect, which performs the office of a clasper. The adjacent surfaces of the two claspers are flat, and, when the arms are in their normal position, these surfaces are accurately adapted to, but not continuous with each other, so that they can be drawn asunder without any difficulty. The arms, therefore, cannot be regarded as blended together at their extremities. Lying in the concave upper surfaces of the apposed claspers is a curved cartilaginous-like bar (fig. 2, a), the convex outer surface of which is closely embraced by them. The bar has in its interior a distinct cavity. Projecting from the surface of the bar which is in apposition with the claspers, is a small papilla, along the axis of which the central cavity of the bar extends. Between the superior margins of the flattened apposed surfaces of the claspers a slight depression exists, into which the papilla of the bar fits. Two small oval openings exist at the bottom of this depression, one belonging to each clasper. Each communicates with a long and slender tube, which passes through the substance of the clasper to be continuous with the central canal of the cylindrical part of the arm. The substance of the bar, when examined microscopically, without the addition of any reagent, appears to be structureless. After digesting thin slices in ether, and subsequently boiling them for some time in acetic acid, a very beautiful cellular structure is perceived. These cells are about the size of primordial cartilage cells. In them the nucleus is elongated, and between it and the cell-wall a delicate concentric arrangement is seen. There is evidently a difference between the chemical composition of the bar and the chitinic integument of the animal, for on steeping a specimen for some hours in a chromic acid solution, whilst the colour of the latter was very slightly affected, that of the bar was changed to a dark brown, almost black.

Both the claspers and the cylindrical portions of the arms contain powerful muscles, by the contraction of which the arms can be very much shortened, at which times they have a very crenulated appearance. These muscles are transversely striped, and are arranged both in longitudinal and circular bundles. A canal extends along the centre of each arm, which communicates at its root with the general cavity of the body. This canal is irregularly subdivided by connective tissue bands passing across it.

It is by means of the arms that this crustacean attaches itself to the skate on which it is parasitic. When examined *in situ*, the arms could be traced passing along the space which separates two of the nasal laminae from each other. They then enter a canal of calibre sufficient merely to contain them. This canal dilates at its end into a comparatively large space, lined by a distinct smooth vascular membrane. In this cavity the claspers, with the bar which they embrace, are situated. The bar lies transversely, its long axis corresponding to that of the space in which it is situated; and as the canal, in which the cylindri-

cal portions of the arms lie, is at right angles to the long axis of this space, it is impossible to draw the bar and claspers out without dissecting away the wall of the cavity.

We have already mentioned, that M. EDWARDS has seen reason to think, that owing to the elongated cephalo-thorax, and the existence of posterior abdominal appendages, this parasite possesses characters which hardly permit it to be classed along with the other known Lerneopoda. To these we may add the very important one, that the arms are not united at the tip. For although they are in close apposition by the flat surfaces of their clasper-like terminations, yet the parasite, when removed from the fish to which it is attached, can spontaneously withdraw one or other arm, or both, from the transverse cartilaginous-like bar, so as to separate the claspers completely from each other. After withdrawing the claspers from the bar, the animal does not appear to possess any power of re-attaching them to it. This character of ready separation of the ends of the arms from each other would also prevent us from placing the animal, as has been suggested by M. EDWARDS, in the genus *Brachiella*.

Projecting from each side of the cephalo-thorax, immediately in front of the root of each arm, is a well-marked bulb-like protuberance, noticed both by RETZIUS and KRÖYER, and termed by them the eye-like spots, although, from their colour and structure, they do not consider them to be eyes (fig. 3, a). Each has the appearance of a segment of a sphere. Through the semi-transparent integument of the most prominent part, a quantity of reddish-brown granules, aggregated in elongated masses, may be seen. Low magnifying powers also enabled us to detect a very peculiar rod-like structure, connected apparently to the deep surface of the eye-like spot. It commences in a slightly dilated bulb-like part, which passes backwards and outwards, around the base of the arm on its own side, and terminates in a dilatation similar to that by which it commences. The exact structures to which it is connected at its two ends we cannot say with certainty; but it is probable, from its position, that it may act as a sling for the support of the base of the arms. The rod has a diameter of $\frac{1}{370}$ th of an inch, the bulb of $\frac{1}{185}$ th. Its structure is characteristic, so that it can at once be distinguished from the surrounding parts. It possesses an axial portion, which is about one-third the diameter of the entire rod. Under high magnifying powers this presents a corrugated aspect, which reminded us of the well-known appearance of the coagulated medullary sheath of a nerve fibre. Surrounding this axial structure is a very transparent substance, which has many of the microscopic characters of chitine.

The abdomen is $\frac{1}{70}$ ths of an inch long, $\frac{1}{10}$ ths broad. It ends posteriorly in a rounded elevation on each side, between which is a depression, so that it possesses an inverted heart-shaped form (fig. 1, c; fig. 2, b). It is slightly convex on the dorsal, almost flat on the ventral aspect. It has an imperfectly defined segmented appearance, owing to the existence of three circular depressions in the chitinic in-

tegument, by which it is divided into four segments. These external depressions correspond to folds which project into the visceral cavity, and to which powerful muscles are connected. When these muscles are contracting, the segmentation is more manifest. The first segment lies immediately behind the roots of the long arms, and possesses on each side a bulging, corresponding in appearance, but smaller, to the eye-like spot on the cephalo-thorax, already described. The third segment has a similar pair of protuberances, placed, however, more on the ventral surface. The fourth segment is as large, or even larger than the conjoined first three segments. In the median line of its ventral surface, close to the posterior margin, is the longitudinal slit-like anal aperture. This opening is bounded on each side by a well-marked fold of integument (fig. 12, a). Attached to the outer aspect of each fold is an elongated cylindrical process, which projects downwards, and is slightly curved. It is a little broader at the free than the attached end. Each of these posterior abdominal appendages is $\frac{1}{4}$ ths of an inch long. Two elongated ova strings project also from the ventral surface. They spring from it posterior and external to the anus.

The intestinal canal lies in the axis of the cavity of the abdomen. It is retained in its position by numerous delicate bands, which pass from it to various parts of the inner surface of the wall of the cavity. It is of almost uniform calibre throughout, and presents a crenulated appearance. Distinct muscular fibres, arranged longitudinally and circularly, enter into the formation of its wall. It terminates posteriorly in the slit-like anal aperture. At the anterior end of the abdomen the canal bends, so as to pass into the cephalo-thorax, along the axis of which it extends. It makes a slight bend towards the dorsal aspect of the anterior extremity of the cephalo-thorax, so as to open at the oral aperture. The canal is more dilated in the cephalo-thorax than in the abdomen. It communicates with the buccal chamber, not by a broad expanded opening, but through a chink-like fissure, between two plates of chitine.

Lying in the visceral chamber external to the alimentary canal, is a quantity of what appears to the naked eye to be merely brown granular material. From its position, colour, and general appearance, it probably represents the liver in this creature. When highly magnified, it looked like gland tissue, for it consisted of vesicular dilatations, or saccules, apparently containing cells and granules. Special collections of a similar gland-like substance are to be seen at the roots of the arms, and extending for some distance along their central canals, in the eye-like spots, the lateral dilatations of the abdomen, and the posterior abdominal appendages.

The ovaries, two in number, are situated in the abdominal cavity, and are confined to the fourth segment. They lie on each side of the intestine. Each consists of a ramified system of tubes, which communicate with a duct. This duct runs almost parallel to the intestine. It opens on the ventral aspect of the fourth seg-

ment, close to the posterior margin. The orifice is supported by chitinic bands. The cement organ consists of a simple delicate tube. It commences in the anterior part of the abdomen, and passes backwards close to the lateral wall. Its position may be frequently recognised through the integument without dissection, especially in the living animal. It joins the ovarian duct close to the genital orifice. In all the animals we examined the ovaries were distended with ova. They formed opaque, white masses, readily seen through the semi-transparent integument of the abdomen.

The ova-strings are $\frac{1}{10}$ ths of an inch long, cylindrical in form, of greater circumference at their attached than free ends. They are slightly curved, the concavities being directed inwards. The ova lie in longitudinal rows, with a spiral tendency. When a transverse section is made through an ova-string, the ova at the periphery are seen to be very elongated, whilst those in the centre are nearly circular. When the ova-strings rupture, in order that the ova may be discharged, they burst along the inner concave aspect. The margins along the line of rupture become everted, and thus the exposure of the ova in the interior of the string is facilitated.

The animal possesses a very powerful muscular system. The largest bands are situated on either side of the dorsal and ventral mesial lines, being attached to folds of the chitinic integument. The buccal apparatus, antennæ, and arms, have special muscular arrangements. In many of our dissections the complex structure of striped muscular fibre was very beautifully illustrated. Resolution of the fibre in some cases into fibrillæ, in other into discs, not unfrequently taking place.

We have looked carefully for a nervous system, and think that we have seen appearances indicative of its existence. We slit open the animal along the dorsal mesial line, and carefully removed the ovaries and intestinal canal. On examining the internal surface of the abdominal wall with a magnifying power of 200 diameters, collections of cells could be seen in many places. These were especially manifest in the space between the roots of the two arms. These cells had many of the characters of nerve-cells, such as delicate outlines, granular contents, and connecting processes. The processes from many cells were evidently two in number, though, from the close manner in which the cells were crowded together, it was not possible to distinguish in some more than one process, and in others again none could be observed. The investigation of the arrangement of the nervous system in these creatures is evidently attended with considerable difficulties, partly owing to the delicacy of the structures, and partly on account of the strong ventral muscular bands and the gland-tissue surrounding the intestinal canal, the presence of which interferes greatly with its due examination.

If the female be carefully separated from the skate, and placed in clean seawater, we have found it possible, by occasionally changing the water, to keep the

animal alive for three weeks. If, in the act of separation, the bar be removed from the claspers, death takes place at an earlier period.

Male.—We have not succeeded in finding the male of this species. Following the rule pursued by these parasites, we had expected to have seen it attached to the body of the female, but we have carefully searched the different specimens we have obtained without meeting with it. RETZIUS makes no mention of the male. KRÖYER thinks that he found on one of his specimens a male attached at the anus. He describes a creature “about one-third of a line long, with somewhat of a crustacean form, with two 2-jointed antennæ, a 3-jointed thoracic portion, a curved tail, and two strong hooked feet. The head appeared to present the trace of an eye. He can say nothing further about it.”

Larva.—Neither RETZIUS nor KRÖYER have given any description of the larva. In two of our specimens the ova were in such a stage of development that we were enabled to examine the form of the larva. In some of these ova the larva could be studied at the stage immediately preceding the rupture of the ovum; in other cases the free larvæ were obtained. Length of larva, $\frac{1}{37}$ th of an inch; breadth, $\frac{1}{47}$ th. When viewed from dorsal aspect, its shape appears ovoid (fig. 13). When a profile view is made the ventral surface appears nearly flat, the dorsal very convex (fig. 14). A pair of antennæ project from the ventral surface close to the anterior margin. They possess indications of being three segmented, the terminal one having at its free end a pair of long hairs. The limbs consist of two pairs; the anterior pair arises from the ventral surface, close to the antennæ. Each limb is bifid (fig. 15, A). The upper branch bears four or five very long hairs at its extremity; the lower, in addition to two long hairs at its free end, has a spinous hook projecting from it. The posterior pair arises from the ventral aspect, nearer the posterior than the anterior end of the larva. Each limb is shorter and thicker than the anterior, and in none of the specimens examined could we see, on a dorsal view, their extremities projecting beyond the lateral margin of the larva. Each divides into two branches, one somewhat larger than the other (fig. 15, B). A strong spinous hook, which appears to be capable of retraction within a sheath, arms the branches of each limb. In addition to these appendages the larva possesses a somewhat complicated arrangement, springing from the ventral aspect, close to the posterior margin. It consists of a triangular prolongation, folded over the posterior part of the convex dorsal aspect, so that the apex only can be seen when the dorsal surface is looked down upon. It gives off laterally three pairs of processes, each of which has connected to it two lappets, bearing long pinnate hairs (fig. 16). It terminates by a lappet-like process, which bears short, stiff hairs. The antennæ, limbs, and tail-like appendages, have transversely striped muscular fibres connected to them. The

intestinal canal commences behind the antennæ, by a trumpet-shaped mouth. It passes backwards and upwards towards the convex dorsal aspect, then curves downwards and forwards towards the ventral aspect, and ends abruptly close to the oral opening. In the cavity of the body there are numerous collections of oil drops, especially towards the posterior end of the larva. The eye-spots are situated on the dorsal aspect, not far from the anterior margin. Two large branched masses of dark-red granules may be seen, one close to the eye-spots, the other farther backwards; and in the free larva these masses are connected by long streaks of reddish pigment.

The further development of the larva we have had no opportunity of observing.

ADDENDUM, *June 24th*.—When we read our paper before the Royal Society, none of the more typical and best-known species belonging to the genus *Lerneopoda* had come under our notice. Since that time, through the liberality of Mr ROBERT BROWN, we have had the opportunity of examining three specimens of the *L. elongata*, which were obtained by him attached to the eye of a Greenland shark (*Scymnus borealis*) caught in Ponds Bay, Davis' Strait, in the summer of last year.

We have especially directed our attention to the distal extremities of the arms, with the view of making a comparison between the mode of attachment of this species to the cornea of the shark, and that of *L. Dalmanni* to the skate. The arms of *L. elongata* taper abruptly at their distal ends, and are connected to a small, rounded, horny, or chitinic disk. This attachment is evidently of a very close and intimate description, for in attempting to separate them from it, the substance of the arms gave way, rather than permit the connection between them and the disk to be severed. We could not say with absolute certainty whether the structures composing the arms were anatomically continuous with that of the disk, but there were appearances which led us to suppose that the chitinic investment of the arms was continuous with that of the disk. The arms themselves are evidently not united at their tips, except through the medium of the common plate to which they are both connected. In our specimens we saw nothing to lead us to suppose that the arms were inserted into the substance of the cornea, as is stated by BAIRD* to have been the case in the specimen he examined, for the disk was undoubtedly attached to the surface of the cornea. Of the two eyes of the shark obtained by Mr BROWN, one had two parasites connected to it, the other only a single one. But each cornea had, in addition, a number of circular

* British Entomostraca, p. 334.

markings on its outer surface, evidently the scars which indicated the former attachment either of the same, or other parasites. A similar appearance was described and figured by GRANT in his specimen.* It will thus be seen that there are considerable differences in the mode of attachment of the *L. elongata* and *Dalmanni*. These differences are doubtless due to the varying nature of the localities in which they are met with. The *L. elongata*, being adherent to a flat surface, has connected to the ends of its arms a sucker-like disc; whilst the *Dalmanni*, being to some extent buried in the substance of the skate, has the clasper-like terminations of its arms attached to a transverse bar, which is lodged in a special cavity.

The comparison which we have been enabled to make between the *L. elongata* and *Dalmanni* has convinced us that the differences existing between them are so great, that the latter animal ought no longer to be included in the genus in which it is at present placed. The mode of termination of the arms at their distal ends presents such striking peculiarities, that, conjoined with the elongated head, the flattened, inversely heart-shaped abdomen, and the existence of posterior abdominal appendages, we consider it ought to constitute a new genus.

* Brewster's Edin. Journal of Science, 1827, p. 150.

PLATE IV.—*Explanation of Figures.*

- Fig. 1. Profile view of Female, a little below natural size; *a*, cephalo-thorax; *b*, "eye-like spot;" *c*, prehensile arms terminated by apposed claspers (bar not indicated); *d*, abdomen; *e*, abdominal appendages; *f*, ova-strings.
- Fig. 2. Ventral aspect of female; cephalo-thorax seen raised above its normal position; arms distinct up to the apposed claspers, which embrace the transverse bar, *a*; *b*, abdomen, the four segments faintly indicated. At its posterior extremity may be seen the integumentary folds bounding the anal fissure, and having connected to them the abdominal appendages. Close to these are the ova-strings.
- Fig. 3. Dorsal aspect of cephalo-thorax, enlarged; *a*, bulb-like protuberance ("eye-spot") *b*, antennæ (their connected bases are indicated); *c*, buccal apparatus, consisting of a central conical mass bearing the mouth, by the sides of which are the two lateral, short, stump-like processes (modified feet); *d*, integumentary fold for protecting the oral apparatus.
- Fig. 4. Profile of cephalo-thorax, enlarged; *a*, dorsal aspect, with antennæ, base of modified feet and protective fold indicated; *b*, projectile process ("chin").
- Fig. 5. Antennæ; dorsal aspect magnified.
- Fig. 6. Buccal apparatus; ventral aspect magnified; *a*, dorsal and ventral lips, containing between them the oral slit; *bb*, chitinic arrangement supporting the lips, and affording protection to their muscles; *c*, labial palp; *d*, stump-like process (modified foot), to which a palp-like structure is connected.
- Fig. 7. Oral aperture, enlarged; *a*, dorsal (upper) lip, presenting an inner plate bearing numerous rods, and an outer, fringed with papillæ; *b*, ventral (lower) lip, also bearing papillæ. Close to the latter, and projecting for a short distance through the buccal orifice, are seen the jaws.
- Fig. 8. Portion of upper lip, greatly magnified; *a*, labial palp.
- Fig. 9. Lower-lip, greatly magnified, and having connected to its base a pair of jaws; *aa*, chitinic masses for supporting the upper lip.
- Fig. 10. Stump-like process or modified foot, magnified; *a*, posterior hook-bearing terminal division; *b*, anterior portion studded with short bristles; *c*, its palp.
- Fig. 11. Portion of upper lip magnified, to which is connected a chitinic arrangement, presenting a chink ("pharyngeal fissure"); *a*, commencement of the œsophagus.
- Fig. 12. Posterior extremity of the abdomen, enlarged; *a*, anal folds, to which the abdominal appendages are attached, and between which the slit-like anal aperture lies; *b*, ova-strings passing from the genital orifices.
- Fig. 13. Dorsal aspect of the larva; *a*, antenna; *b*, first pair of limbs.
- Fig. 14. Profile of the larva; the intestinal canal, bent upon itself, is indicated.
- Fig. 15. *A*, anterior limb of the larva.
B, posterior limb of the larva.
- Fig. 16. Caudal appendage of the larva. One of the lappet-bearing masses has been raised, so as to show the opposite aspect.

