

XII. *On the double Organs of Generation of the Lamprey, the Conger Eel, the common Eel, the Barnacle, and Earth Worm, which impregnate themselves ; though the last from copulating, appear mutually to impregnate one another.* By Sir EVERARD HOME, Bart. V. P. R. S.

Read February 27, 1823.

IN May, 1806, I was so fortunate as to ascertain that the Teredines are hermaphrodites, and that the same individual both formed and impregnated the ova.

In June, 1815, I found the lamprey also to be an animal of the same tribe ; and on the present occasion, I wish to explain that the conger eel, the common eel, and the barnacle, are similar in their mode of generation, every one of these animals impregnating itself.

With respect to eels, I am disposed to agree in the opinion of the President of the Society, believing the conger and common eel to belong to the same species ; and that the only difference between them is the one living in fresh, the other in salt water, which will explain the difference in their size and colour.

What renders this probable is, that Sir H. DAVY succeeded in getting a fresh water eel to live in salt water ; and he understands that, after the eel has been accustomed to salt water for a year, its colours gradually change, acquiring a tint of green. The experiment was carried on in Cornwall, and the eel was sent alive, that we might have the opportunity

of judging for ourselves ; but it never arrived in London. He began with young small eels, which all died ; when however he took one of a tolerable size, it seemed to suffer little inconvenience.

The organs of generation in the conger and common eel are exactly similar ; and I have been so fortunate, on the first of February, 1823, to receive a conger from Plymouth, with ova distinctly visible in the microscope, and the structure of the testicles equally apparent. Out of three congers sent to me, this state of the ova was only met with in one, so that they do not breed regularly in the same month. As this has not, I believe, been noticed before, I got Mr. BAUER to represent the parts in the annexed drawing, and thought it might be satisfactory to the Society to see a magnified drawing of these double organs in the lamprey, where they are brought closer upon one another by the absence of an air bladder, on the sides of which the ovaria of the common eel and conger are spread.

In the eel tribe the kidneys are immediately behind the peritonæum, and so closely connected with the testicle, when the eels are not caught in the breeding season, that the whole mass has been taken for kidney ; and had I not been favoured with the assistance of Mr. BAUER and Mr. CLIFT, I might have failed in procuring such accurate and distinct representations of these parts.

Mr. CLIFT, upon a former occasion, made a drawing of the testicles and ovarium of the lamprey, in which the parts were only sufficiently enlarged to identify the facts they were intended to demonstrate. I have now, to establish them more completely, taken advantage of Mr. BAUER's superior skill in

the use of the microscope to give, upon the same plate, the ovarium of the lamprey, and of the conger ; wishing in my demonstration of such curious facts, that had escaped the accurate observation of JOHN HUNTER, they should, as far as may be, speak for themselves.

That species of barnacle, called *Lepas Anatifera*, has been examined, and drawings have been made of it by both these great anatomists, HUNTER and CUVIER ; but their not having met with it in the breeding season, prevented them from seeing the manner in which the ova are disposed of, and led to considerable error with respect to the organs of generation.

The ovaria are situated round the œsophagus, and may, when not met with in the breeding season, be mistaken for the salivary glands ; and the penis may be looked upon as the oviduct for depositing the ova after impregnation.

The curious circumstance in this species of lepas is, that the ova are impregnated before they leave the ovaria, by the point of the penis being bent down and carried for nearly one-fourth of an inch into them. After impregnation, the ova pass through a small opening in the outer covering into the stem by which the body of the barnacle is suspended ; in that situation the ova are both defended and supplied with salt water ; and, when the embryo is completely formed, it makes its way out, laterally from the stem, leaving behind the shell or covering of the egg attached to the inside of the tube, marking the place from which it escaped, the young lepas acquiring a stem of its own. In some cases the eggs all remain at the root of the stem, and come out externally, just opposite the opening in the outer covering.

All these circumstances are most distinctly illustrated by the drawings.

*On the Organs of Generation of the Earth Worm.*

It is now six years since Mr. BAUER very kindly offered me his assistance in this enquiry. Our joint labours have been frequently interrupted by subjects of more interest ; we have, however, at last completed this investigation, and so much is represented in the drawings, that little is left for verbal description.

The mode of copulation resembles that of the leech more than of the snail ; but when the animals are separated there is this curious difference : in the leech, an animal much smaller than the earth worm, there remains protruded a penis an inch long ; a little lower down on the belly is the orifice leading to the uterus or ovarium ; so that the first impression I received was, that the length of the penis enabled the leech to copulate with itself, till my friend, Dr. JOHNSON, laid before the Society an account of its copulation with another individual, which he had seen.

When two worms in copulation are forced asunder, there is upon neither of them any appearance of penis or vagina. There is a pair of longitudinal slits or suckers a little way from the head on each side of the belly of both worms ; lower down a pair of hooks corresponding to each pair of suckers.

Their mode of copulation is as follows :

Two worms come out of two neighbouring holes a few inches apart, so that there is sufficient space for them to copulate, and for one-third of the length of each worm to remain

in the hole, which enables them to keep their hold of the ground ; and whenever they are disturbed, they pull themselves asunder and retreat into their holes. In the act of copulation, as in the leech, the heads lie in opposite directions, so that the hooks of one worm attach themselves to the suckers of the other, which at that time swell out exceedingly, and form a cavity which is filled with mucus. The act of copulation is continued for a considerable time ; Mr. BAUER has watched them for several hours before they separated.

The testicles and ovaria (in the breeding season) are shown in the annexed drawings to be very conspicuous in each individual worm ; and although no canal from the one to the other has been detected, there can be no doubt that, the semen of the testicles arrives at the ovaria by the coats giving way. The ova, after impregnation, are conveyed into cells, of which there are two rows on each side of the animal, and there deposited.

It is in this situation the ova are hatched ; and the young are for some time nourished by a substance supplied from a corrugated canal shown in the drawing, which is met with in the intestine, but having no communication with its cavity ; this corrugated canal is firmly attached posteriorly to the parts behind the intestine, and sends off tubes to each of the cells in which the young are hatched : there is also an external orifice leading into each of them. In these cells the young go into the crysalis state, and when the young worm is ready to leave the crysalis covering, which is of an oval form, pointed at each end, one or more of these pointed ends are thrust out at the external orifice, so as to appear

externally, like so many feet for the progressive motion of the worm. The young worm does not remain immured till the crysalis covering is expelled, but eats its way out, leaving the middle broadest part of this covering sticking in the external orifice. The total absence of penis and vagina makes it difficult to explain what purpose is answered by the copulation; from the agitation produced by it through the whole of the bodies of the two worms, it seems necessary to distribute the ova to the numerous decipimenta in which they are met with.

This is somewhat different from the leech, whose ova are deposited in lateral cells, and are squeezed out at lateral orifices, covered with a mass of mucus, which at first encloses the whole leech. The animal disengages its head by means of the teeth, and then, by the wriggling of the body, escapes, leaving the mass of eggs and mucus curled up with a hole through it in the form of a ball, which the leech deposits upon the water, and there the young go through the crysalis state, and eat their way out and provide for themselves.

## EXPLANATION OF THE PLATES.

### PLATE XV. The LAMPREY.

Fig. 1. Anterior view of a portion of the ovarium and testicles of the lamprey, before the breeding season; magnified two diameters.

Fig. 2. A small portion of the same ovarium; magnified five diameters.

Fig. 3. Posterior view of a portion of the ovarium and testicles of the lamprey, in the breeding season; magnified two diameters.

Fig. 4. A small portion of the same ovarium ; magnified five diameters.

Fig. 5. Anterior view of a portion of the ovarium, testicles, and the air bladder of the conger ; natural size.

Fig. 6. A small portion of the same ovarium ; magnified five diameters.

Fig. 7. A very small portion of the same ; magnified fifty diameters.

#### PLATE XVI. The EARTH WORM.

Fig. 1. Exhibits a posterior or back view of a dead worm, in which state it is contracted ; magnified two diameters.

Fig. 2. An internal view of the same worm laid open from behind ; magnified two diameters.

Fig. 3. The upper portion of the same parts ; magnified four diameters. In the middle line lies the great artery and the six lateral cells carrying red blood, and communicating between the great arterial and trunk, and the venal one on the opposite side or belly : the artery passes up to the head on the outside of the glandular mass surrounding the œsophagus, and through the space between the three portions of which the brain is composed, to go down the opposite or belly side of the animal. Immediately on the outside of the three lowest arterial cells are the ovaria and testicles. As the animal is divided through its whole length by decipimenta into compartments, one ovarium and one testicle lies on each side of the same compartment with the fourth arterial cell, and one testicle and ovarium in the same compartment with the fifth. In the sixth, there is an ovarium but no testicle. In the compartment below the arterial cells is one ovarium on each side very much developed, and directly between them is a hard cartilaginous circle, through which the œsophagus passes.

The other compartments contain membranous bags for the reception of ova. The two lowest ovaria are hanging loose. Before the breeding season they are empty. Towards the lower part, on each side, is the cut edge of the lateral slit, by means of which the animals adhere in the act of copulation.

In this space are included six compartments: in each of these is a large conspicuous gland of an oval form.

The course of the œsophagus, crop, gizzard, and intestine, can be traced behind the great artery.

#### PLATE XVII. The EARTH WORM.

Fig. 1. An anterior or belly view of the perfect worm after death; magnified two diameters.

Fig. 2. The internal parts of the same worm: magnified two diameters.

Fig. 3. The same parts for a certain extent; magnified four diameters.

At the upper part is seen the brain, on each side of which go down two nervous elongations from two spherical ganglions situated on the opposite side to form the spinal marrow, which in this animal runs along the belly.

The spinal marrow is traced through its course, showing the artery belonging to its coats.

Many parts already described are seen in this view.

The lower developed ovaria appear in this view suspended upon the decipimentum. Immediately below them the termination of the œsophagus is seen, under which is the crop, then the gizzard, leading to the intestine.



## PLATE XVIII. The EARTH WORM.

Fig. 1. The same section as fig. 2, Plate XVII. magnified two diameters, showing the more internal parts for which purpose the spinal marrow is turned on one side: the intestine is laid open, exposing an hexangular tube, which has no communication with the intestine itself, but is posteriorly attached to that canal, and has two lateral openings into each compartment, showing the hexangular tube to be a reservoir of nutriment for the young.

Fig. 2. A posterior view of the outside of a portion of the intestine; magnified eight diameters.

Upon this portion of intestine are seven partial contractions formed by the transverse decipimenta, between each of which are two orifices leading to the lateral membranous bags from the hexagonal tube.

Between the two rows of openings is a longitudinal passage, forming a communication between the ovaria and the cells in the different compartments.

Fig. 3. A transverse section of a portion of fig. 2, seen anteriorly.

Fig. 4. A portion of intestine magnified as in fig. 2, laid open anteriorly to show the hexangular tube.

Fig. 5. The external appearance of the mouth and head; magnified six diameters.

Fig. 6. Shows the external appearance of the parts connected together in the time of copulation; magnified six times.

In the second ring from the top are two hemispherical protuberances with transverse slits.

In the eleventh ring are two protuberances, from which, during copulation, two spoon-like suckers are projected, but at other times withdrawn.

At the eighteenth ring begin the longitudinal lateral slits, and they are continued to the twenty-second. These are shown in an expanded state, in which they are only met with at the moment of the coitus.

In this view the openings from the compartments are distinctly seen. On the middle line of the belly are two rows, and other two rows on each side; these last are only distinctly seen in this drawing where the cysales are projecting through them.

PLATE XIX. The EARTH WORM.

Fig. 1. A testicle and ovarium at the breeding season in situ; magnified twelve times.

Fig. 2. Ova taken from the ovarium; magnified fifty times.

Fig. 3. One of the membranous bags filled with eggs and worms removed from the compartment which contained it; magnified fifteen times.

*a a a.* Eggs ready to hatch; magnified fifty times.

*b b b.* Eggs hatching; magnified fifty times.

*c c.* Two embryos hatched.

Fig. 4. A membranous bag taken from a compartment lower down in the worm; magnified fifteen times.

*a a.* Clusters of eggs and embryos agglutinated together; magnified thirty times.

Fig. 5. *a a.* The embryo in motion just before going into the cysalis state; magnified thirty times.

*b.* The change into the cysalis begun; magnified thirty times.

*c.c.* The same, magnified fifty times.

Fig. 6. The tail portion of a worm opened from behind ; magnified four times.

To show that the ova and membranous bags are not met with at the lowest part of the worm, the compartments containing clusters of agglutinated ova, embryos, and cysales.

Fig. 7. One of the clusters of the last figure ; magnified thirty times.

Fig. 8. The same cluster kept in water for fifteen minutes, and its contents exposed.

Fig. 9. Two perfect cysales from the same cluster ; magnified fifty times.

#### PLATE XX. BARNACLES.

Fig. 1. A portion of the pedicle, with the shell from which the left valve is removed.

Fig. 2. A Longitudinal section of Fig. 1, to show the eggs within the fibrous substance of the pedicle ; and the animal removed, to show the mantle in its natural position lining the shell ; natural size.

Fig. 3. The entire animal taken out of the shell, and the mantle or lining of the shell turned back ; magnified two diameters.

Fig. 4. The animal with the external membrane turned back, to show the eggs which accumulate there before they pass into the pedicle ; magnified two diameters. In these two figures the tentacula of the right side are removed, to prevent confusion.

Fig. 5. The animal with all its integuments removed, and also the tentacula of the left side removed to show the natural position of the penis ; magnified two diameters.

Fig. 1.

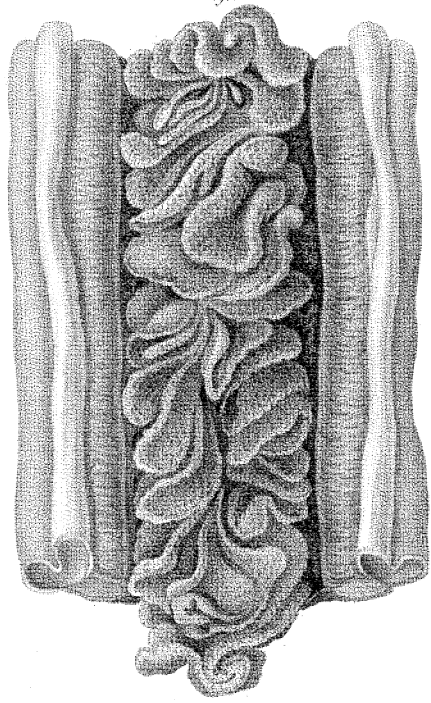


Fig. 3.

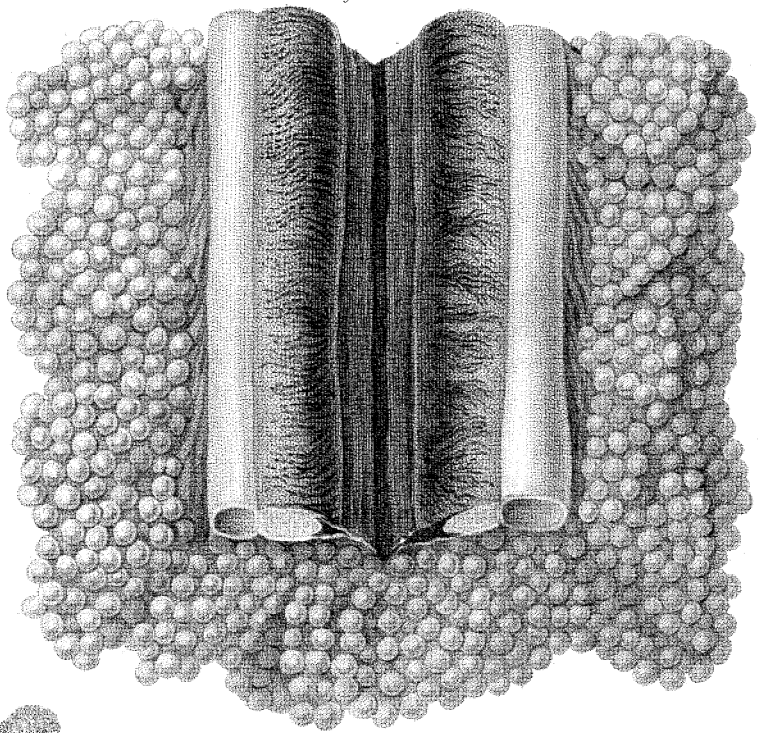


Fig. 2.

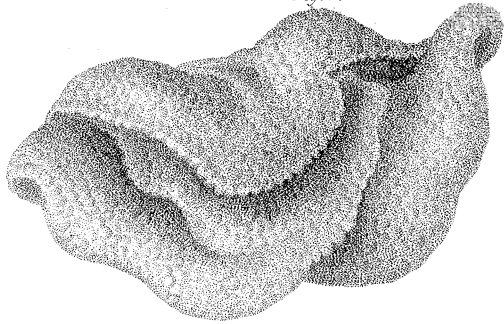


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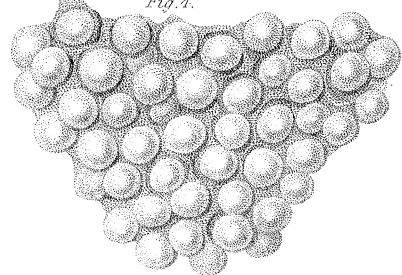


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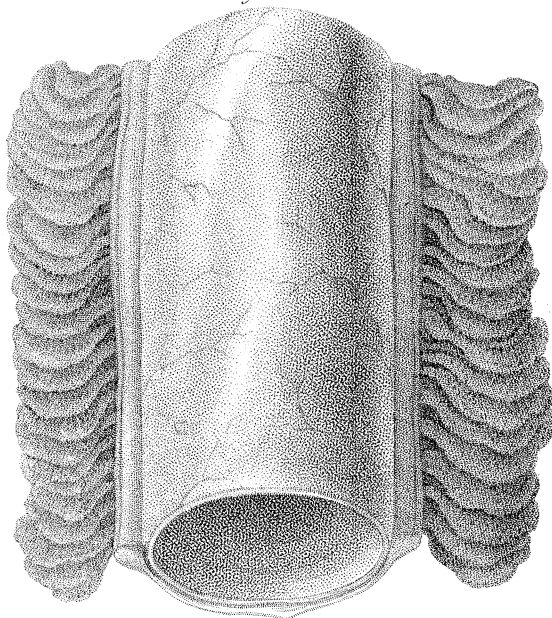


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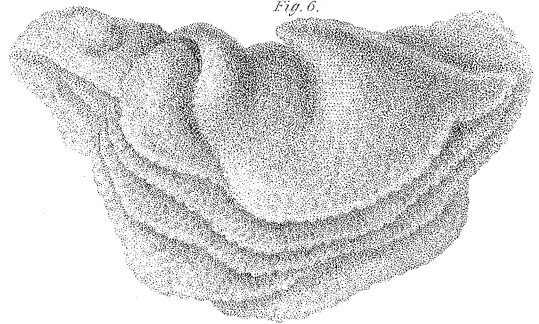


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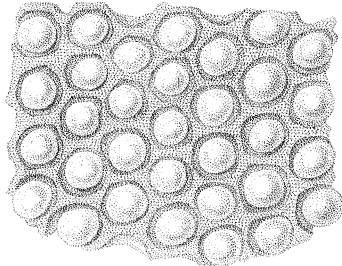


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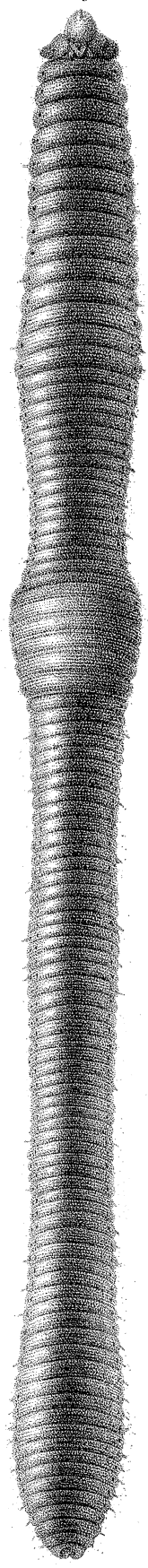


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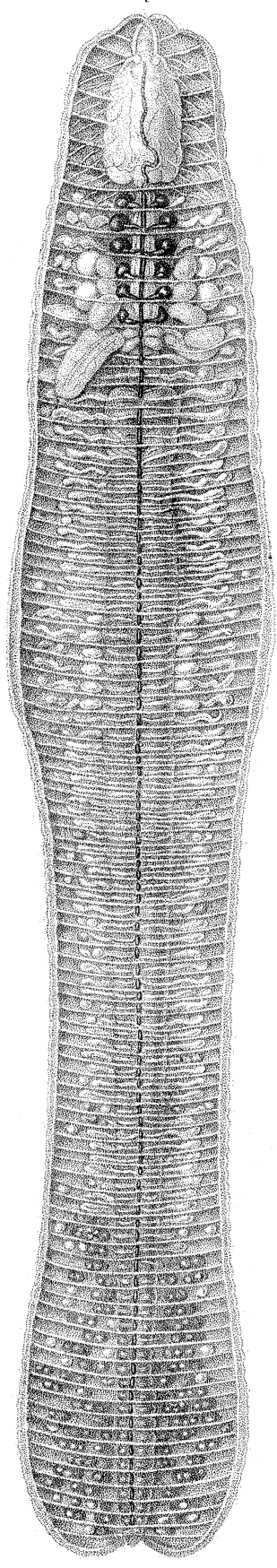


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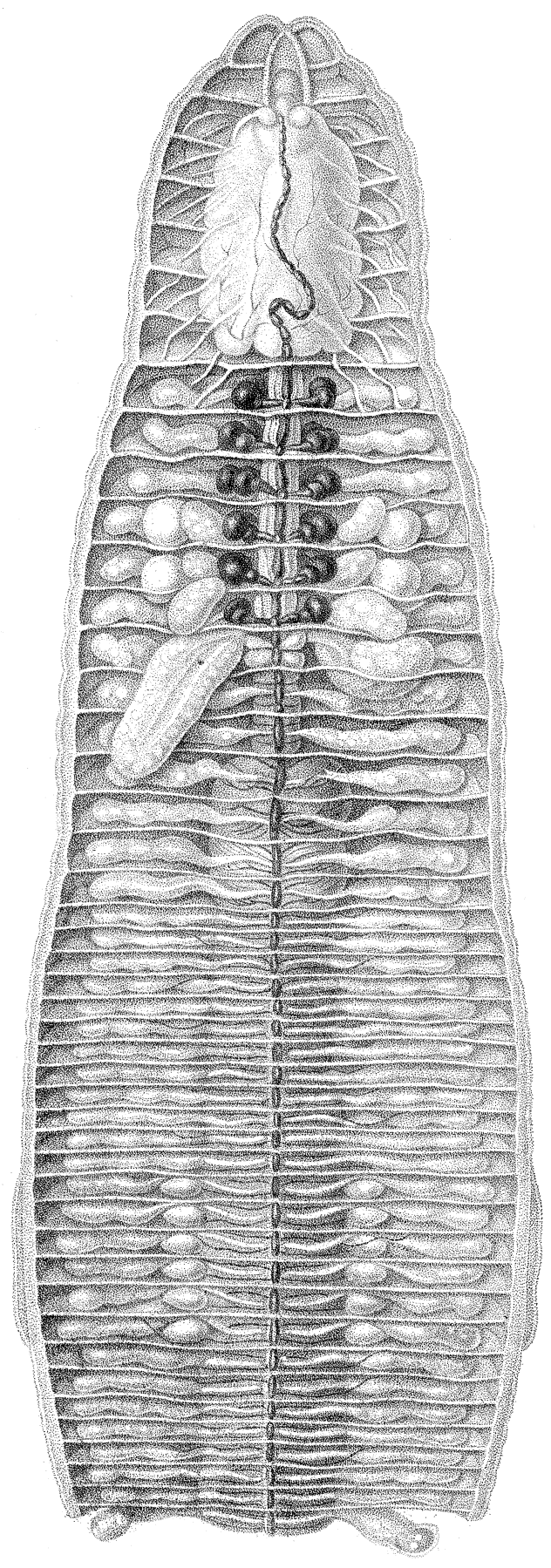


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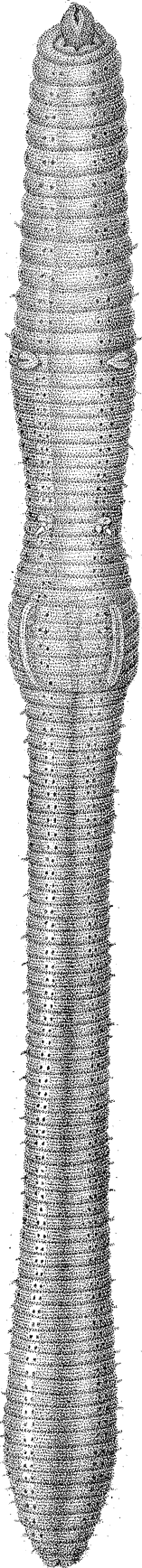


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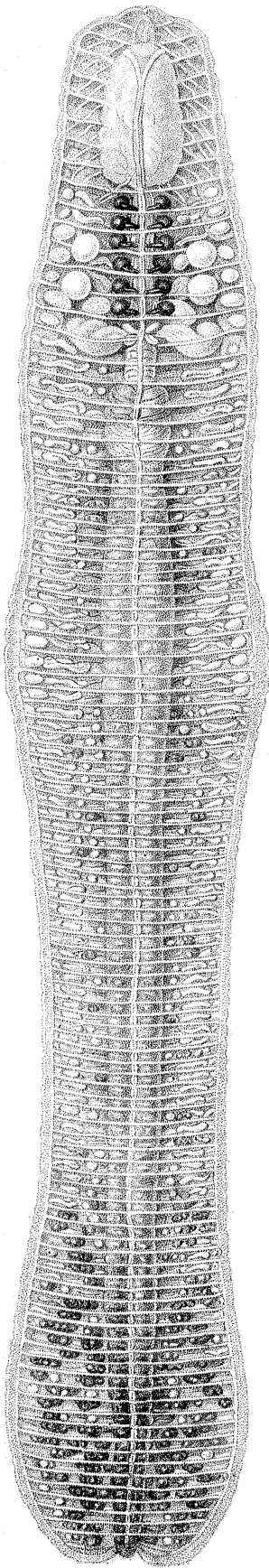


Fig. 3.

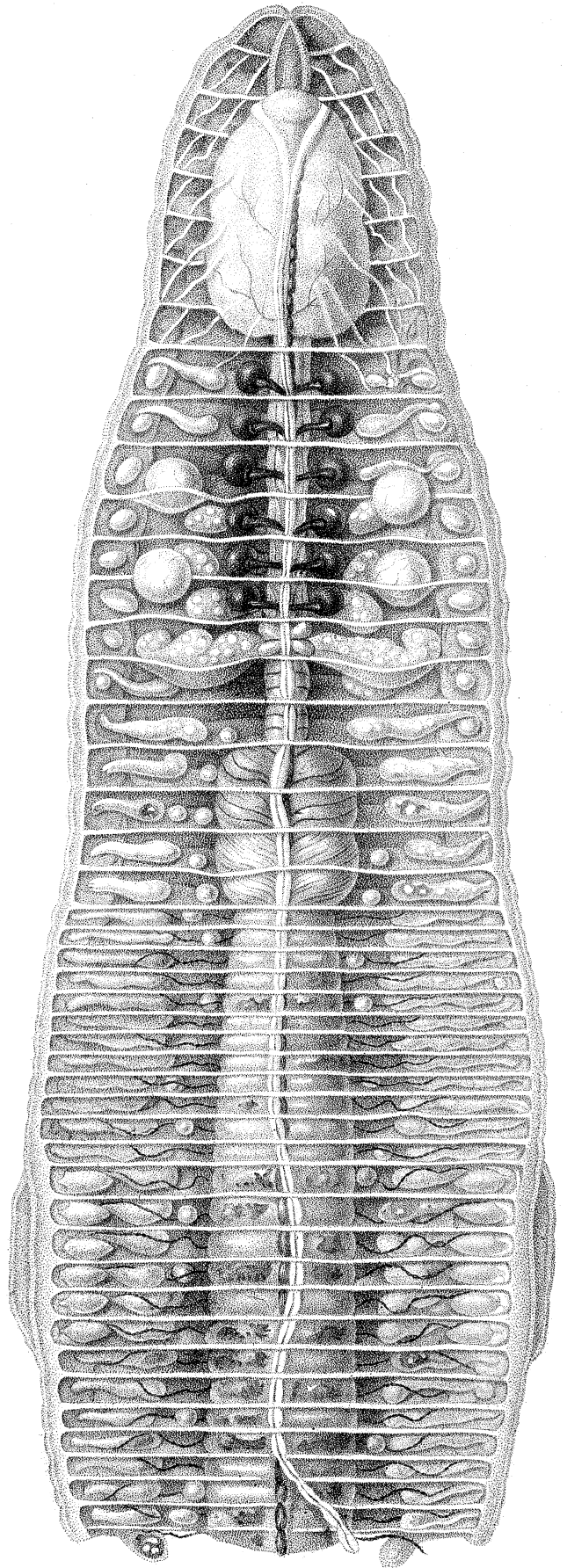
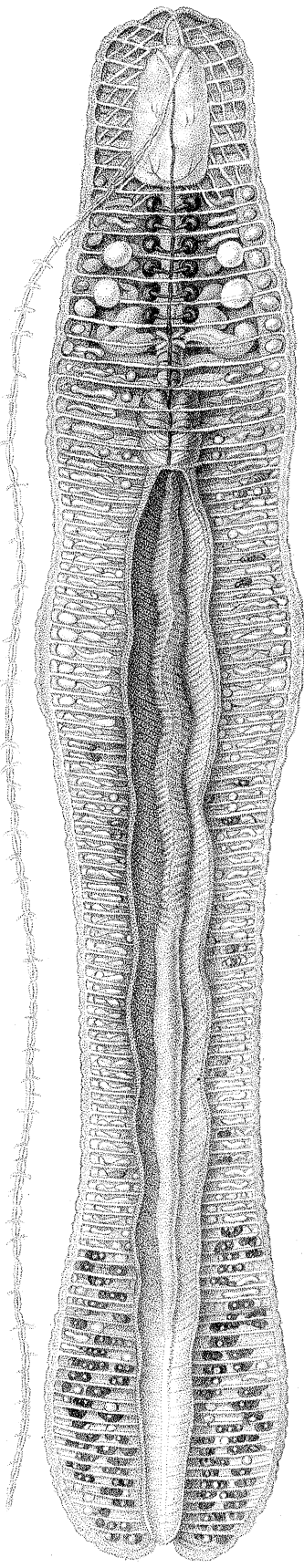
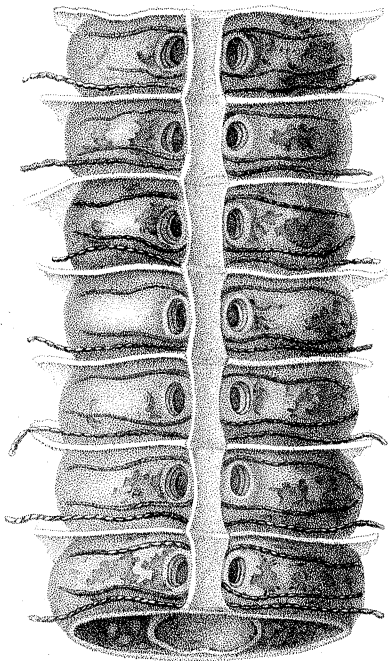


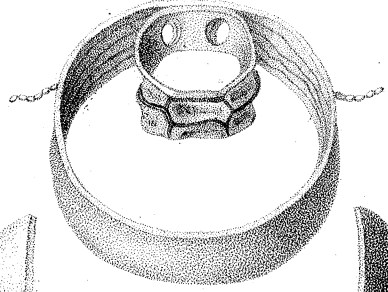
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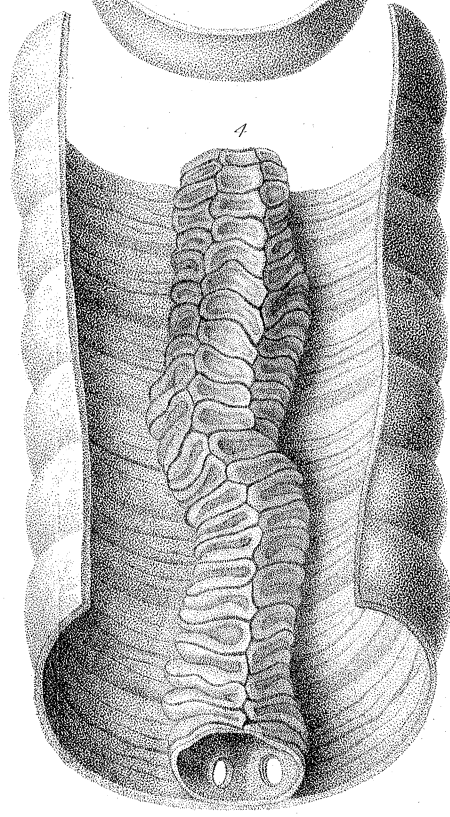
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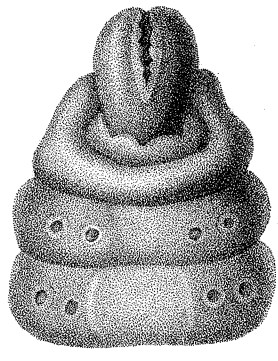
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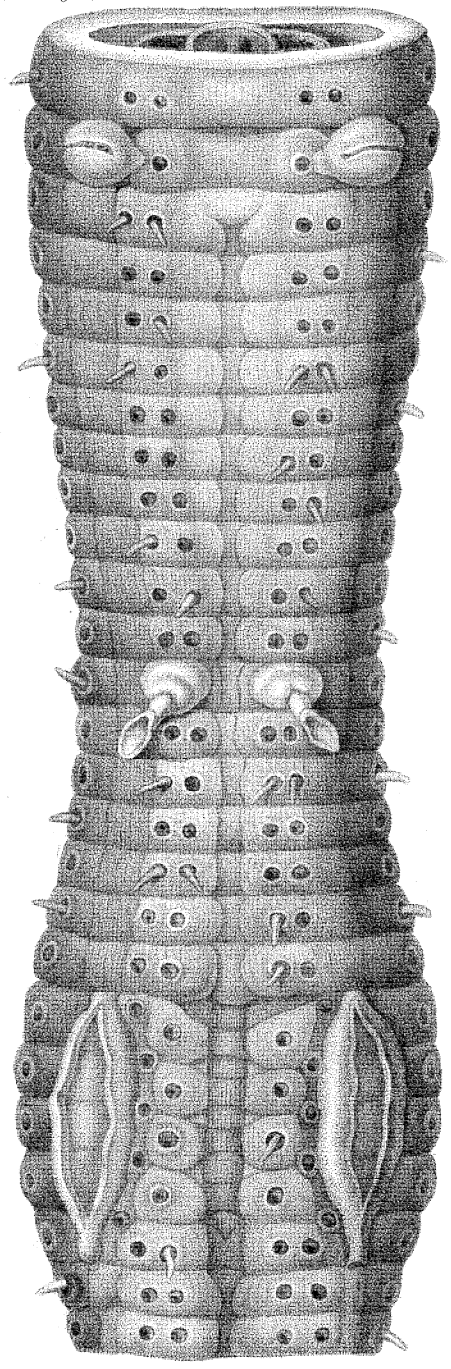
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a Fig. 1. b

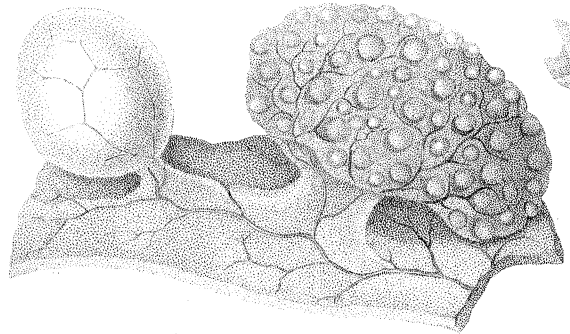


Fig. 3.

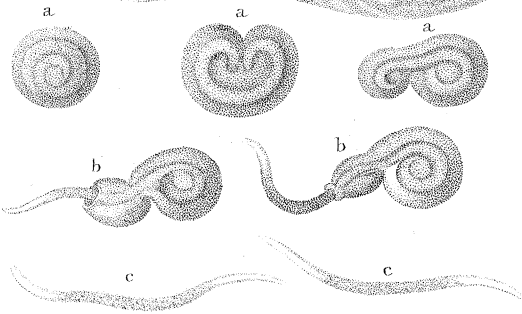
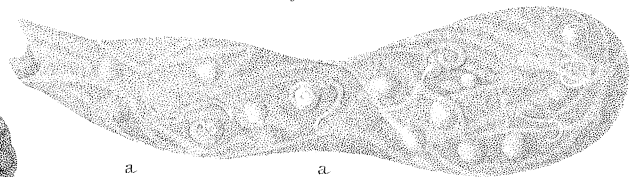


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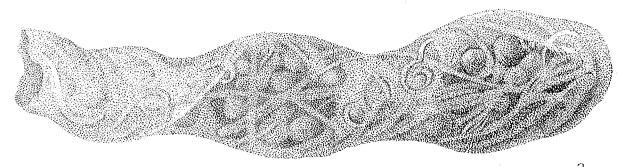
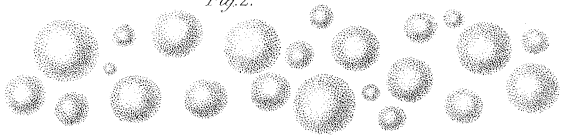


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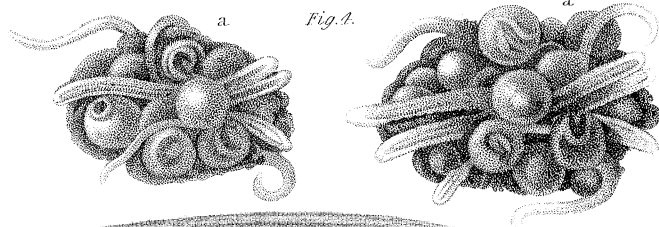


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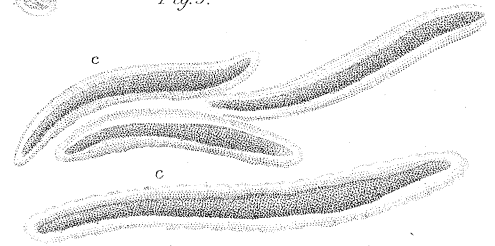
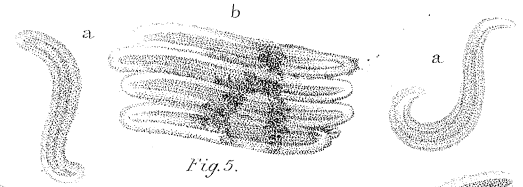


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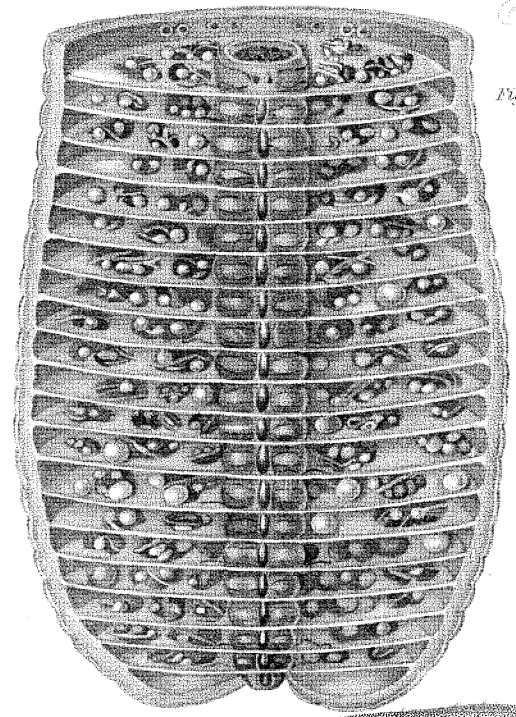


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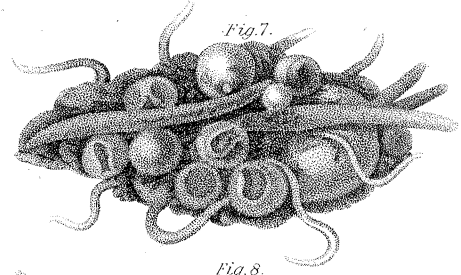


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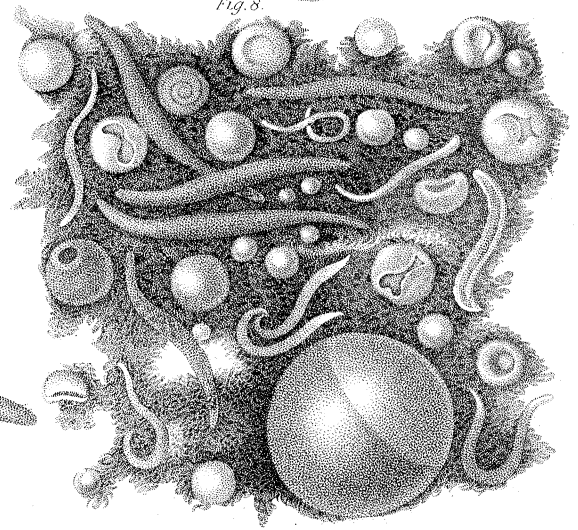
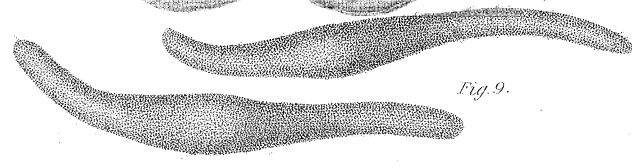


Fig. 9.





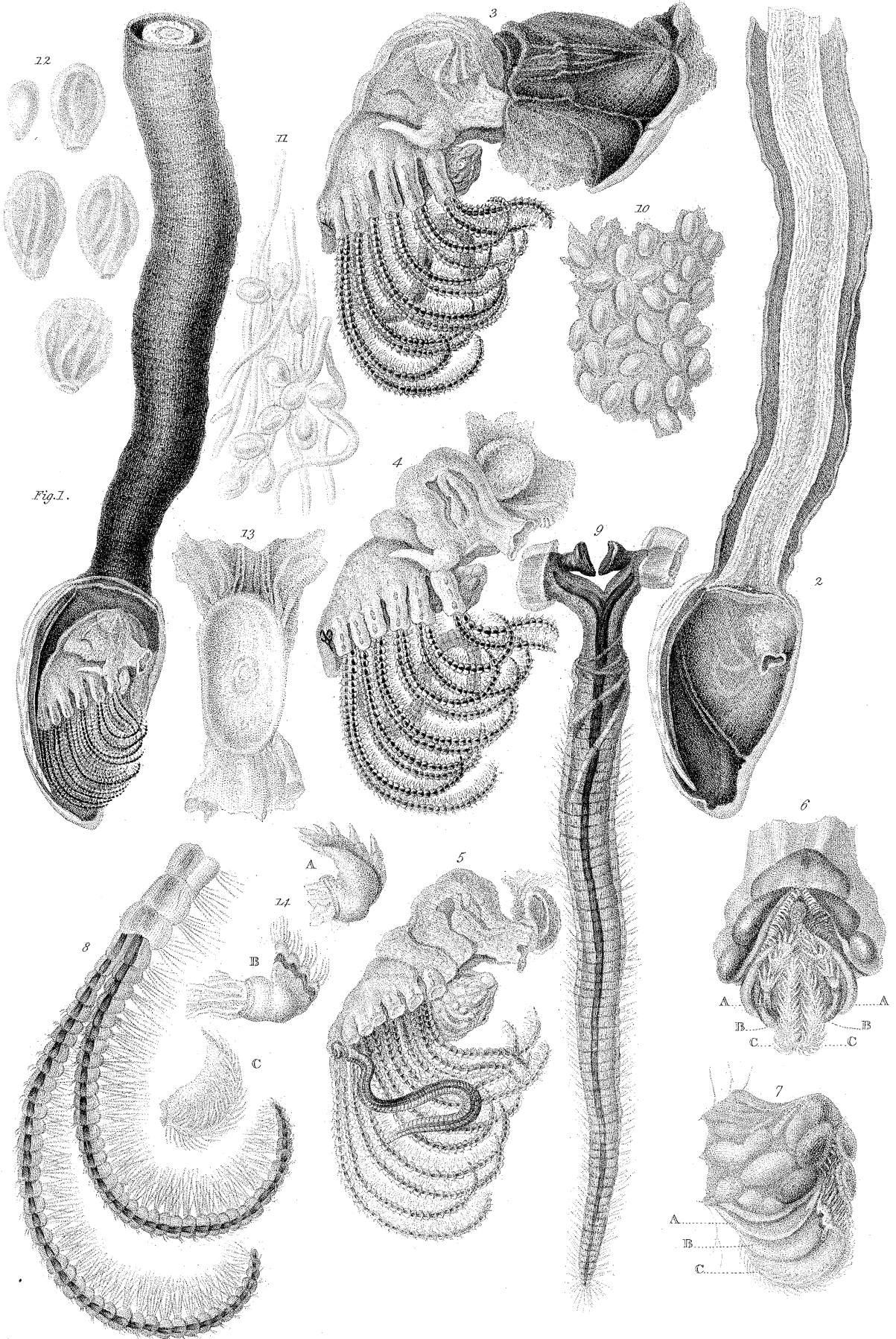


Fig. I.

Fig. 6. A front view of the animal's head ; magnified four diameters.

A. External jaw.

B. Middle jaw

C. Internal jaw.

Fig. 7. Side view of the same ; magnified four diameters.

Fig. 8. One of the tentacula ; magnified four diameters.

Fig. 9. The penis ; magnified four diameters.

Fig. 10. A small portion of the eggs which are accumulating under the external integuments of the animal ; magnified fifty diameters.

Fig. 11. A small portion of the fibrous substance and eggs from within the pedicle ; magnified fifty diameters.

Fig. 12. Some separate eggs ; magnified one hundred diameters.

Fig. 13. The membrane lining the shell at the base of the pedicle, and of which the mantle is a continuation ; magnified two diameters.

Fig. 14. One of the outer jaws seen in fig. 6.

B. The middle jaw.

C. Internal jaw.