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ON THE ANATOMY

OF

O C N E R O D R I L U S

BY

GUSTAF EISEN.

WITH ONE PLATE.

(PRESENTED TO THE ROYAL SOCIETY OF UPSALA, THE 11 MAI 1878.)

UPSALA,
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1878.

The few, hitherto, sufficiently known, genera of *Lumbriculida*, may conveniently be arranged as follows:

A. The efferent ducts partly grown together, at the base not surrounded by prostate glands. The efferent ducts and the Receptacle open in the same porus. No atrium, but heart. The dorsal vessel in front threebranched. The ventral vessel not forked. — —

— — **Oenerodrilus.**

B. The efferent ducts free, prostata present. The receptacle opens in a separate porus. The dorsal vessel in front entire, the ventral forked. Atrium, but no heart.

I. The prostate glands surrounding atrium in all sides; the receptacle in front of the efferent ducts.

1. All secondary vessels feathered, no exterior penis:

Lumbriculus.

2. Secondary vessels both feathered and not feathered; no penis:

Rhynchelmis.

3. Secondary vessels not feathered; an exterior penis:

Stylodrilus.

II. The prostate glands surrounding atrium only at the top; the receptacle is behind the efferent ducts.

4. The dorsal lateral vessels forked. One pair of receptacles:

Phreatothrix.

5. The dorsal lateral vessels not forked, but entire. Two pair of receptacles:

Trichodrilus.

As far as our present knowledge goes the following characteristics will suffice fully to distinguish the above genera.

OCNERODRILUS nov. gen.

The *dorsal vessel* is weakly pulsating, in the 8th & 9th setigerous segments furnished with 2 pair of strongly pulsating hearts. In the 7th segment it emits two side branches, which continue toward the cephalic lobe.

The *ventral vessel* is not forked, but continues toward the buccalic segment.

The *secondary vessels* are of two kind: gastric & perigastric. The perigastric ones only connect with the ventral vessel.

The *efferent ducts* and *receptacle* open both into the same porus in the 16th segment. No atrium and no prostate glands.

The *testes* are 2 pairs in 8th & 9th setigerous segments.

The *oviduct* is very large, in the 13th segment.

The *ovaries*, 1 pair in the 11th segment.

The *receptacle* is enormously large, opening in the 16th segment, and extending towards the 25th segment.

No gland. albuminifera.

LUMBRICULUS GRUBE 1841¹⁾.

Syn.: *Lumbriculus*, CLAPARÈDE, Recherches anatomiques s. l. oligochètes pag. 39. 1862.

The *dorsal vessel* not branching, no hearts.

The *ventral vessel* is forked.

The *secondary* lateral vessels two pairs in every segment, both feathered. The posterior pair is gastric, the anterior perigastric, connecting with ventral vessel.

The *efferent ducts* enter a large atrium, which opens in the 9th setigerous segment. The prostate glands are entirely surrounding atrium.

The *testes* are large and seldom in pair, one is in the 7th, one in 9th to 12th and one in 12th to 16th setigerous segments.

The *oviduct* in the 11th segment.

The *ovaries* in the 9th " "

The *receptacles* opens in the 8th segment.

¹⁾ According to a private communication to me by Dr. F. VEJDOVSKY, is the above worm, described by CLAPARÈDE (l. c.), not identical with *Lumbriculus* of GRUBE and auct. al. For the former he proposes the name of *Claparedia*. The above generic characteristics are only compiled from the descriptions by CLAPARÈDE.

No gland. albuminifera¹⁾.

No exterior penis.

RHYNCHELMIS HOFFMEISTER 1843.

Syn.: 1843, *Rhynchelmis*, HOFFMEISTER, Arch. f. Naturgesch. Jahrg. 9. Bd. 1. pag. 183.

» 1844, *Euares*, GRUBE, Arch. f. Naturgesch. Bd. 10. pag. 204.

» 1876, *Rhynchelmis*, VEJDOVSKY, Zeitschr. f. wiss. Zool. Bd. XXVII pag. 332.

The *dorsal vessel* is not branching; no hearts.

The *ventral vessel* is forked in the 4th setigerous segment.

The *dorsal lateral vessels* two pair in every segment: the anterior, not feathered, is gastric, the posterior, feathered, is perigastric.

The *efferent ducts* enter an atrium, which is on all sides surrounded by prostate glands, and opening in the 9th setigerous segment. No exterior penis.

The *testes* one pair, in 13th to 50th segments.

The *oviducts* between the 10th & 11th segments.

The *ovaries* one pair, in 50th to 51th segments.

The *receptacles* in the 7th segment.

A large *glandula albuminifera* in the 8th segment.

STYLODRILUS CLAPARÈDE 1862.

Syn.: 1862, *Stylodrilus* CLAPARÈDE l. c. pag. 47.

The *dorsal vessel* is entire as in the preceding genus, and not furnished with hearts.

The *ventral vessel* is forked in the 4th setigerous segment.

The *dorsal lateral vessels* are not feathered, in every segment two pair, of which the anterior is gastric and the posterior perigastric.

The *efferent ducts* are not grown together, and enter an atrium, which is on all sides surrounded by prostate glands, and opening in the 9th setigerous segment. A large exterior penis.

The *testes* are three, but not in pair; one is situated in each of the segments 7, 9, 11 and 12.

¹⁾ As it therefore is likely, that the worms studied by RATZEL, VEJDOVSKY and others, and by them referred to the genus *Lumbriculus*, have really belonged to quite different, and as VEJDOVSKY suggests even new genera, have I here retained all characteristics given by CLAPARÈDE, not withstanding the opinions of later investigators.

The *oviducts* are very minute and funnelshaped, opening in the 11th segment.

The *ovaries* are small, like those of *Ocnerodrilus*, situated in the 10th segment, and attached to the dissepiment between the 10th and 11th setigerous segments.

The *receptacle* resembles that of *Lumbriculus*, and opens in the 8th setigerous segment.

No *glandula albuminifera*.

PHREATOTHRIX VEJDOVSKY 1876.

Syn.: 1876, *Phreatothrix* VEJDOVSKY, Z. f. wiss. Zoologie. Bd. XXVII pag. 541.

The *dorsal vessel* is entire and not furnished with hearts.

The *ventral vessel* is forking in the 3th setigerous segment.

The *secondary dorsal lateral vessels* are in every segment of 2 kind, both branching. The anterior pair is gastric and connected with the ventral vessel; the four to six posterior pairs are perigastric and not connected with the ventral vessel.

The *efferent ducts* are not grown together. They enter an atrium, which opens in the 9th setigerous segment, and which is surrounded at the top by numerous prostate glands. An exterior and retractile *penis* proper.

The *testes* are one pair, filling the whole body between the 6th and the 15th segments.

The *oviducts* are very minute, situated in the 12th setigerous segment.

The *ovaries* are situated in the 10th segment, and attached to the dissepiment between the 9th & the 10th segments.

The *receptacle* is wholly confined to the 10th setigerous segment, and behind the *efferent ducts*.

No *glandula albuminifera*.

TRICHODRILUS CLAPARÈDE 1862.

Syn.: 1862, *Trichodrilus* CLAPARÈDE l. c. pag. 51.

The *dorsal vessel* is not forked, but entire, and not furnished with hearts.

The *ventral vessel* is forked in one of the anterior segments.

The *secondary lateral and dorsal vessels* are neither feathered nor branching; numerous pairs in every segment, but all perigastric.

The *efferent ducts* are not grown together, and enter an atrium, which is surrounded at the top by numerous prostate glands. No exterior penis. The opening porus of the ducts is situated in the 9th setigerous segment.

The *testes* are comparatively small, in 4 pairs: in the 9th, the 10th, the 11th & the 12th setigerous segments.

The *oviducts* are not with certainty found.

The *ovaries* are bottleshaped, and situated in the 10th setigerous segment, and attached to the dissepiment between the 9th & 10th segments.

The *receptacles* are in 2 pairs, situated behind the efferent ducts in the 10th & 11th segments.

No *glandula albuminifera*.

From the above generic characteristics it can be clearly seen that the genus *Ocnerodrilus* takes an entirely isolated place in the family, and the question may even arise if it should not more properly be arranged under a separate family or subfamily. This however, as of lesser importance, will here be left without further consideration, and I will in the following only more minutely describe its organisation and point out its most characteristic features.

The alimentary canal differs in many respects greatly from those of the other genera. The mouth and pharynx are, as usually, situated in the buccal- and the first setigerous segments. In the third segment we can trace the commencement of a very muscular oesophagus, continuing as far back as to the 9th segment. The first five segments of the oesophagus are each surrounded by a pair of very large, lobed glands, similar to those in *Enchytræus*, only larger in proportion. The oesophagus is in the 7th setigerous segment furnished with two large lateral, sacklike appendices, of nearly the same structure as the oesophagus itself. When the animal is alive both sacks are very much elongated and pointing towards the head of the worm, but when the animal is dead and contracted, also they are found to be considerably shortened and with their free, exterior ends pointing towards the ventral part of the worm. A similar structure is as far as I am aware, not known to exist in any other *Limicolide* genus and can therefore be considered as very characteristic of the genus *Ocnerodrilus*. Both sacks are entirely enclosed

within the 7th segment¹). The muscular structure of the oesophagus is largely developed and very much contrasting with the intestine proper, which is furnished with muscles in a much smaller degree.

The intestine proper is divided into two distinct parts: one anterior beginning in the 10th segment, much broader, covered with minute pigmented cells, and one posterior, narrower, nearly devoid of the above cells. Fig. 5 & 6. Pl. I. The anterior larger part of the intestine occupies generally 25 segments in fullgrown specimens. Any large flasklike cells, covering the alimentary canal like those in *Phreatothrix*, do not exist in our present form. The underside of the dissepiment between the 6th & 7th segments is entirely covered by muscular strata, all uniting in two large bands, one on each side of the ventral ganglion, and with their posterior ends attached to the dissepiment and integument between the 7th & 8th segments. Fig. 5 Pl. I.

The vascular system of *Ocnerodrilus* differs already at first sight so considerably from that of any other known Limicolide, that it not only characterizes the animal, but also places it in an isolated position in the system. In other genera a separate heart is not differentiated, but in *Ocnerodrilus* we find two large and distinct pairs, one in the 8th and one in the 9th setigerous segment. Both communicate with the ventral vessel.

The forking of the *dorsal* vessel is however that which characterizes *Ocnerodrilus* the most. In all other Limicoles the dorsal vessel is entire, but in our present genus we find in the 7th setigerous segment two lateral branches besides the main trunk, which is continued towards the cephalic lobe, all three connected with each other and with the ventral vessel which is not forked, and forming, especially in the foremost segments a perfect net of anastomosing bloodvessels. Pl. I fig. 8.

The other lateral vessels are of two kinds: *a*, *gastric*, partly enclosed in the walls of the alimentary canal, and: *b*, *perigastric*, free in the perigastric cavity of the body.

The former ones are plainly visible on the intestine, especially when subjected to some pressure. We find of them two pair in every segment: One anterior situated just under the dissepiment between the two segments, and one posterior, in the first anterior quarter of every

¹) In the figure 5 Pl. I. the ends of the sacks are drawn as if they were extending into the segments in front. That is however not the case. The dissepiment betw. the 6th & 7th segments should be represented as more bent, in a half circle, just as the sacklike appendices themselves.

segment. Those gastric vessels seem not to be connected with the ventral bloodvessel, but end in or on the walls of the intestine.

Between the large gastric vessels a very minute rectilineal net of vessels is seen entirely covering the intestine and oesophagus. The blood itself is yellowish red, pulsating in all dorsal vessels.

Of perigastric vessels are found one pair in each segment, close to its posterior integument, or in the middle of its last quarter. They are connected with the ventral vessel, and emit many secondary branches, which partly communicate with each other, partly with the perigastric system of the next segment in front, partly also end in the perigastric cavity. Two of those tertiary branches are considerably larger than the others, and take their origin near the junction of the ventral vessel and the main perigastric vessel, and project from there obliquely toward the front part of the body, and communicate with the perigastric vessels of the next segment. I have no doubt that those perigastric vessels are homologous to the two lateral branches in the 7th segment, and with the hearts in the 8th and 9th segments.

In the 6 anterior segments the perigastric vessels form a perfect ring, connecting the two main, and the two lateral vessels with each other. All perigastric vessels emit minute secondary branches, which spread in the integument of the body, here constituting the dermal vascular system. Fig. 8 Pl. I.

Thus the vascular system of *Ocnerodrilus* differs considerably from that of any previously known *Limicole*, but resembles that of *Lumbriculidæ* in having gastric vessels which do not communicate with the ventral main vessel. It also resembles *Tubificidæ* in having large pulsating hearts.

The segmental organs are present in all setigerous segments except in the 13th & 16th. In the former they are replaced by the oviducts, and in the latter by the efferent ducts and receptacle, which both open in the same segment and into the porus. The whole organ resembles more that of a *Limnodrilus* or *Tubifex*, than those described as belonging to any genus of *Lumbriculidæ*. The interior opening is not surrounded by any large brown glands, as is the case in *Rhynchelmis*, *Phreatothrix*, etc., and the entire duct is devoid of all large translucent cells, like those found in *Rhynchelmis*¹⁾ or in certain species of *Limnodrilus*.

The interior opening is situated close to the exterior one, and the main body of the organ extends far up towards the dorsal part of the body. Pl. II Fig. 13.

¹⁾ VEJDOVSKY, Z. f. w. Z. Bd. XXVII. T. XXIII.

The nervous system resembles more that of *Tubificidæ*. The supra-oesophagialganglion is broad and narrow, with both its margins deeply emarginated. Fig. 10. The anterior one emits two pair of dichotomous nerve-trunks. A distinct infra-oesophagialganglion, as that of *Rhynchelmis*¹⁾ hardly exists, or seems rather replaced by the first ganglionic swelling of the ventral nerve. The first three ganglionic swellings are much nearer together than the succeeding ones, and the lateral nerves of the first two ganglia running more obliquely, than those of the others, which are nearly rectangular with the ventral trunk. The first two ganglia emit only two pair of nerves each, but all the other ganglia emit three pair. Of those the first two are situated near the middle of the ganglion and are much closer together, than to the third one, which is situated near the posterior dissepiment of the segment. Fig. 10. Pl. II.

As in the other genera of *Lumbriculidæ* the reproductive organs are of two kinds:

Male and female.

The male organs consist of:

1. *Testes* & 2. *Efferent ducts*, and the female ones of:
3. *Ovaries*, 4. *Oviducts* and 5. *Receptacles*.

In *Rhynchelmis*, *Phreatothrix*, *Lumbriculus* and *Stylodrilus* the testes reach a voluminous degree of development, often entirely filling the segments they occupy. In *Trichodrilus*, *Rhynchelmis* and *Phreatothrix* they always occur in pairs, but in *Lumbriculus* and *Stylodrilus* they are mostly single and only occasionally the first one is found double²⁾. In all the above genera their volumes seem to be more or less variable. In *Ocnodrilus* on the contrary we find always two pair of testes of rather minute development and constant size. One pair is situated in the 8th setigerous segment, where it is affixed to the dissepiment between the 8th & the 9th segments. The second pair is found in the 10th segment, but is affixed to the dissepiment between the 9th & 10th segments. Thus we find the testes affixed to two consecutive dissepiments, but not in two consecutive segments. The form of the testes is pretty regular and nearly the same in both segments, and also in the different specimens. Fig. 17. Pl. II.

The arrangement of the spermatozoa is the same as that of the ova; the largest ones being situated nearest to the upper margin of the lobes. The smallest or least developed spermatozoa-cells resemble ex-

¹⁾ VEJDOVSKY, l. c. Taf. XXI fig. 12.

²⁾ CLAPARÈDE, Recherches anat. s. Oligoch. pag. 53.

actly eggcells with a conspicuous nucleus and are found nearest the dissepiment. Fig. 17. Pl. II.

The efferent ducts differ from those of other *Lumbriculide* genera in having no prostate glands, and also in opening in the same segment and into the same external porus as the receptacle. This porus is situated as far back as in the 16th segment. Fig 9. Pl. I.

In *Lumbriculus*, *Stylodrilus*, *Trichodrilus* and *Phreatothrix* the efferent ducts are confined to only two segments, in *Rhynchelmis* they extend through five¹⁾ segments, but in *Ocnerodrilus* they are found extending through 8 segments or from the middle of the 16th to the middle of the 9th. The lower and larger part of the efferent ducts seems at first sight to consist of a single duct, which is divided in the 11th segment in two separate ducts, each one carrying at the end the usual funnelshaped organ. But viewed with a high magnifying power, the apparently single duct is found to consist of two different ones, which however are closely grown together, and more so the nearer we approach the exterior opening (Fig. 3). This growing together is however never perfect, as even close to the external porus the two interior ciliated canals are seen to be divided or separated by an extremely fine and tender membrane, in which no cells are visible. Fig. 14 represents a part of the efferent ducts in the 11th segment, fig. 15 & 16 again parts nearer to, and close by the exterior porus in the 16th segment. Fig. 18 represents the porus of the reproductive organs as seen in optical section, showing the junction of the efferent duct and the receptacle.

No atrium can be said to exist, as the ciliated epithelium which always is absent from the atrium, here extends clear down to the lower end of the genital porus. The said porus is surrounded by several circular muscles, but no traces of prostate glands can be found.

The first efferent-funnel is engaged in the dissepiment between the 9th & 10th segments and the second or lower one in the dissepiment between the 10th & 11th segments. In all other genera of *Lumbriculidæ* the efferent funnels are situated nearer to the male porus, and in fact always, even in *Rhynchelmis*, in the segments surrounding the same.

The ovaries are found in the 11th segment attached to the *dissepiment* between that and the 12th segment. Their general form is unlike that of the said organs in *Trichodrilus* and *Phreatothrix*, but resembles more that of other genera, such as *Lumbriculus* and *Stylodrilus*. The

¹⁾ VEJDOVSKY, Z. f. w. Z. Bd. XXVII. T. XXII.

largest eggs are always found nearest the upper margin of the organ. No eggs are ever seen floating in the perivisceral cavity; on the contrary they seem to enter the oviducts immediately after having left the ovary.

The oviducts are two, one on each side of the ventral nervetrunk in the 13th setigerous segment. Its exterior porus is not situated *between* the segments, but in the *middle* of the segment, close to the two inferior spines. Fig. 20. The whole organ is considerably larger than that of any previously known *Lumbriculide* genus, and nearly reaching the size of the ovaries or testes. Its interior opening is engaged in the dissepiment between the 11th & 12th segments. Their form is somewhat resembling that described by CLAPARÈDE as belonging to *Stylodrilus*¹⁾. I have frequently found the funnelshaped opening full of matured eggs, which fact clearly showed the function of the organ.

The receptacle reaches an enormous development and occupies the whole length between the 16th & the 25th segments, or sometimes even more. It opens in the 16th segment, in the same porus as the efferent ducts, and has the shape of a very long and narrow bag, with thick walls, in which the cells and cellnuclei are plainly visible. Fig. 4, 11 & 12. The interior lumen of the organ is comparatively narrow, being broadest in the middle and narrowest at the genital porus. Fig. 3 & 4. The junction of the receptacle and the efferent ducts takes place at the very opening of the genital porus, neither forming any atrium or cloaca. Fig. 18.

Of the genus *Ocnerodrilus* only one species is known, which I here describe under the name of

OCNERODRILUS OCCIDENTALIS n. sp.

Special characteristics the same as those of the genus. The spines are not forked but entire, like those of *Rhynchelmis*, and 8 in every segment.

The size of the worm in contracte state is about 2^{mm}. wide by 20^{mm}. long. In extended state the worm is longer and narrower in proportion. The colour is that of rawmeat, and the worm presents the general appearanae of a small *Lumbriculus*, as *A. tenuis* or allied species. Its motions are extremely slow, and quite the contrary to those of *Lum-*

¹⁾ CLAPARÈDE, Rech. anat. Pl. 4. fig. 17.

briculus and *Rhynchelmis*, which are often seen swimming with great rapidity.

Like other worms of this family *Ocnerodrilus* is also sometimes found hidden in the mud, but with its tail motionless extending above the bottom.

Hab. Fresno County, California, in an irrigation box, where it was found climbing on the alyæcovered boards or hiding in the crevices of the same. Mature in the latter part of *October*.

Explanation of the figures.

Pl. I.

- Fig. 1: *Ocnerodrilus occidentalis* nat. size.
- » 2: two of its spines, highly magnified.
 - » 3: the efferent ducts and receptacle.
 - » efd = efferent ducts.
 - » eff = efferent funnels, or the interior openings of the ducts.
 - » gp = genitalporus, in which the ducts and the receptacle unite.
 - » rs = receptaculum seminis.
 - » 4: Receptaculum seminis. The lower end marked with a + is a continuation of the receptacle as represented in fig. 3.
 - » 5: A part of the alimentary systeme.
 - » gl. = glands in the setigerous segments 2 to 6.
 - » m = muscles between the integuments and the dissepiment in the 7th segment.

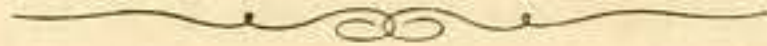
In the 7 segment are also seen the two lateral sacklike appendices, opening in the oesophagus.

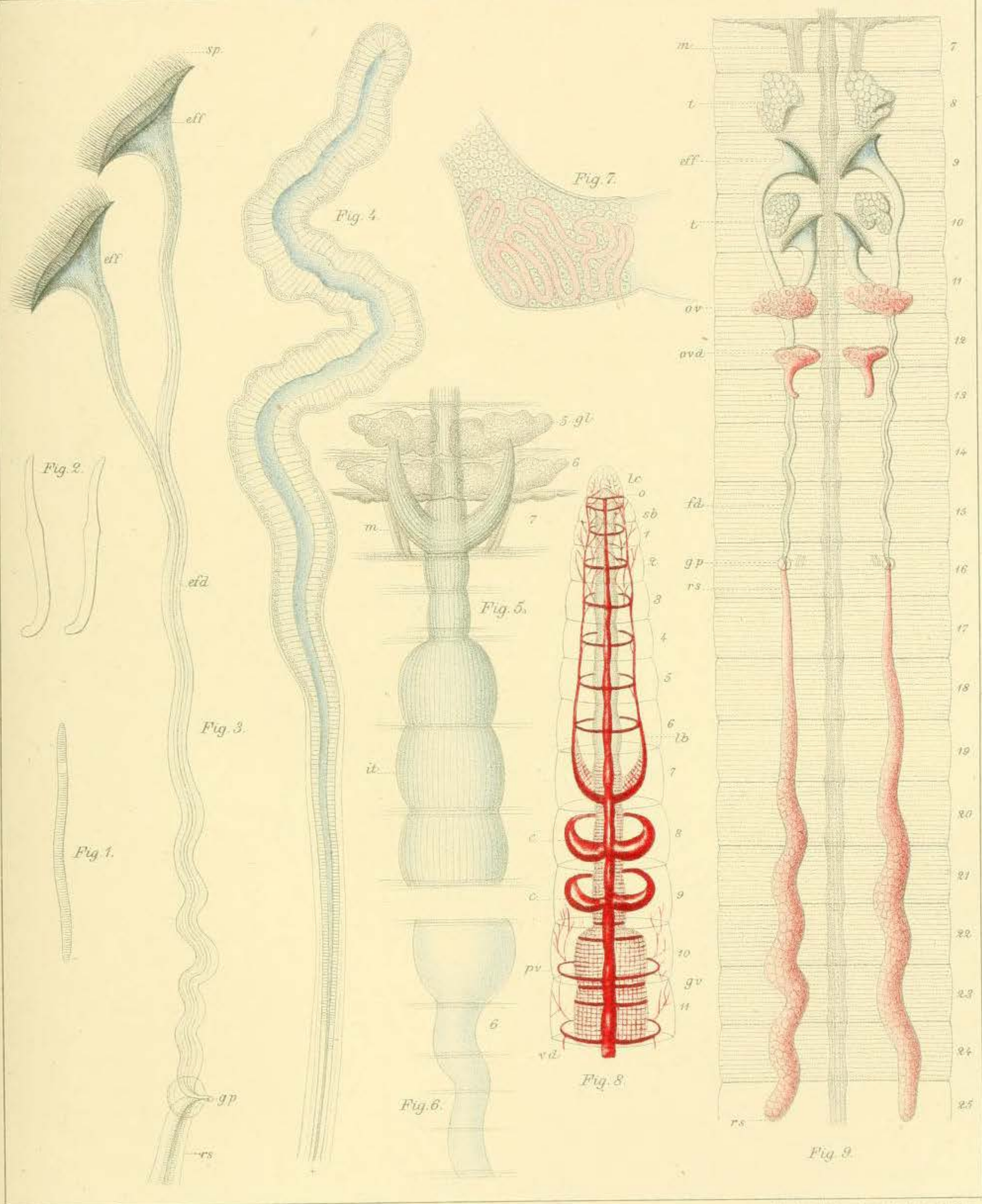
 - » it = intestine.
 - » 6: The intestine in some of the posterior segments of the body.
 - » 7: a part of the upper side of the supra-oesophagial ganglion, showing the windings of the dorsal vessel.
 - » 8: the front part of the worm, showing the vascular system.
 - » o = mouth.
 - » lc = cephalic lobe.
 - » s.b. = buccal segment.
 - » 1—11 = the first 11 segments of the body.
 - » l. b. = lateral branches of the dorsal vessel.
 - » cc = hearts.
 - » p. v. = perigastric vessels.
 - » g. v. = gastric vessels.
 - » 9: The reproductive organs in their natural position.
 - » 7—25 = numbers indicating the setigerous segments.
 - » m = muscles.

- Fig. 9: t. t = testes.
 » eff = efferent ducts.
 » ov = ovaries.
 » ovd = oviducts.
 » g. p. = genital porus.
 » rs = receptacle.

Pl. II.

- Fig. 10: The front part of the nervous systeme.
 » 11: a part of the receptacle.
 » 12: The same part seen in optical section.
 Fig. 13: One of the segmental organs.
 » ex. or. = exterior orifice.
 » in. or. = interior orifice.
 » d.ss. = dissepiment.
 » 14: A part of the efferent ducts just at their junction.
 » 15: same ducts half way between the junction and the genital porus.
 » 16: same ducts close to the genital porus.
 » 17: one of the testes.
 » 18: the junction of the efferent ducts and the receptacle in the genital porus.
 » 19: one of the ovaries.
 » 20: one of the oviducts. In the interior opening are seen several matured eggs.





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Oenodrilus occidentalis n. sp.

Fig. 11.

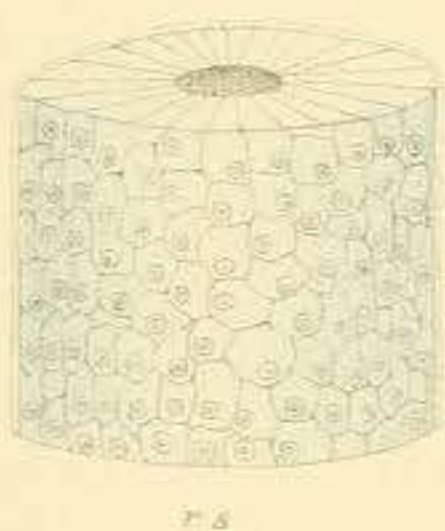


Fig. 10.

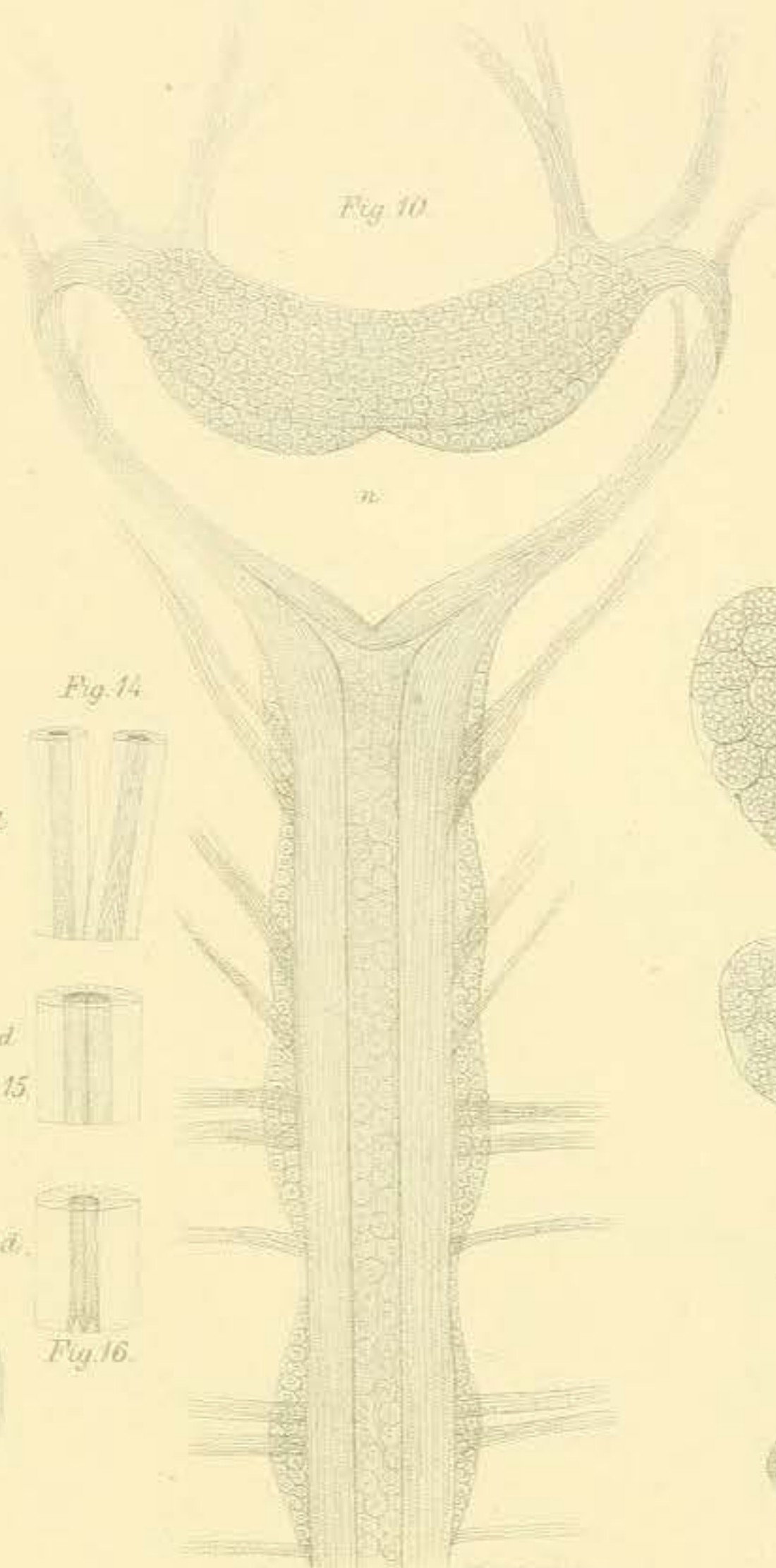


Fig. 12.

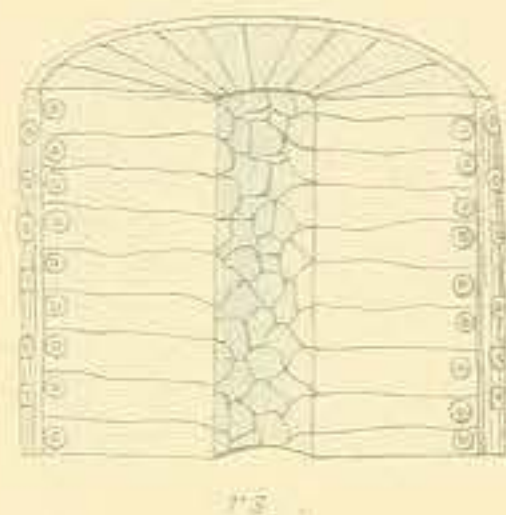


Fig. 14.

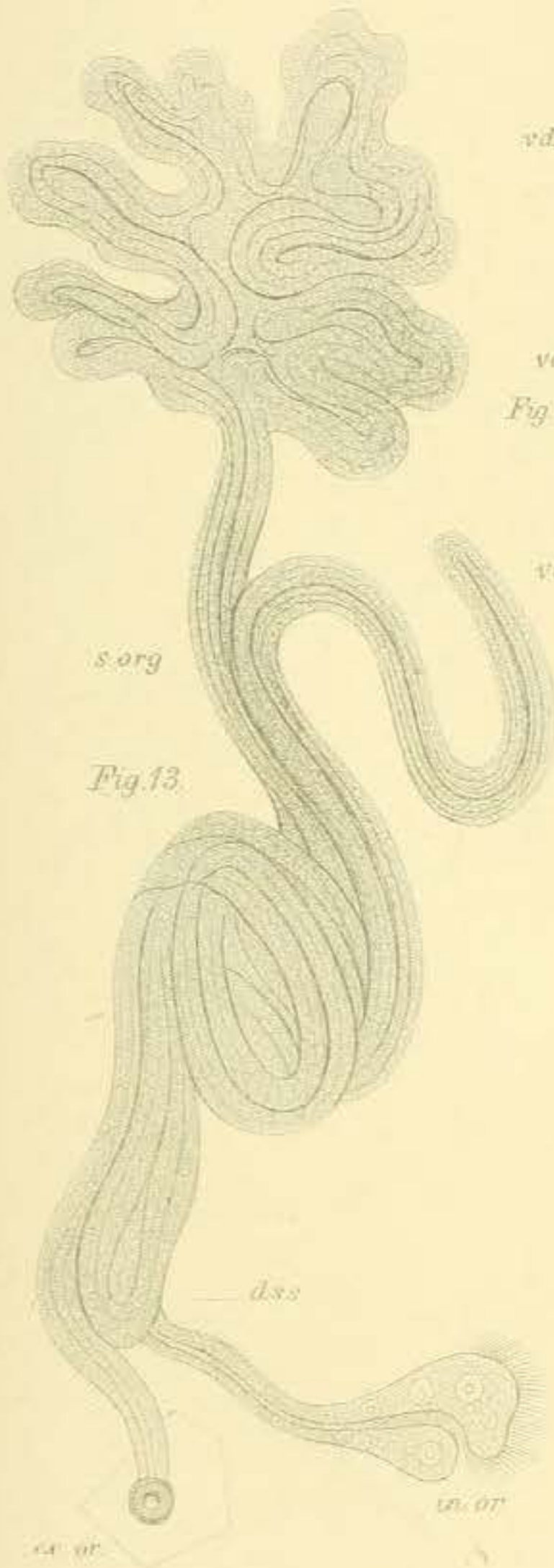
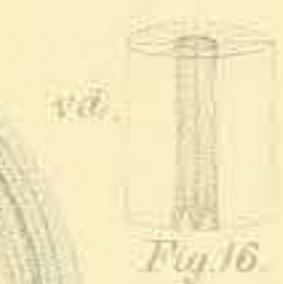
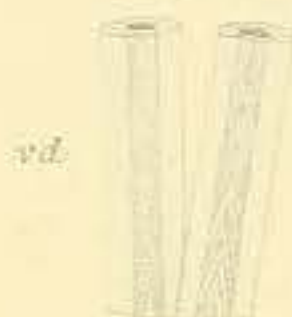


Fig. 17.



Fig. 18.



Fig. 20.

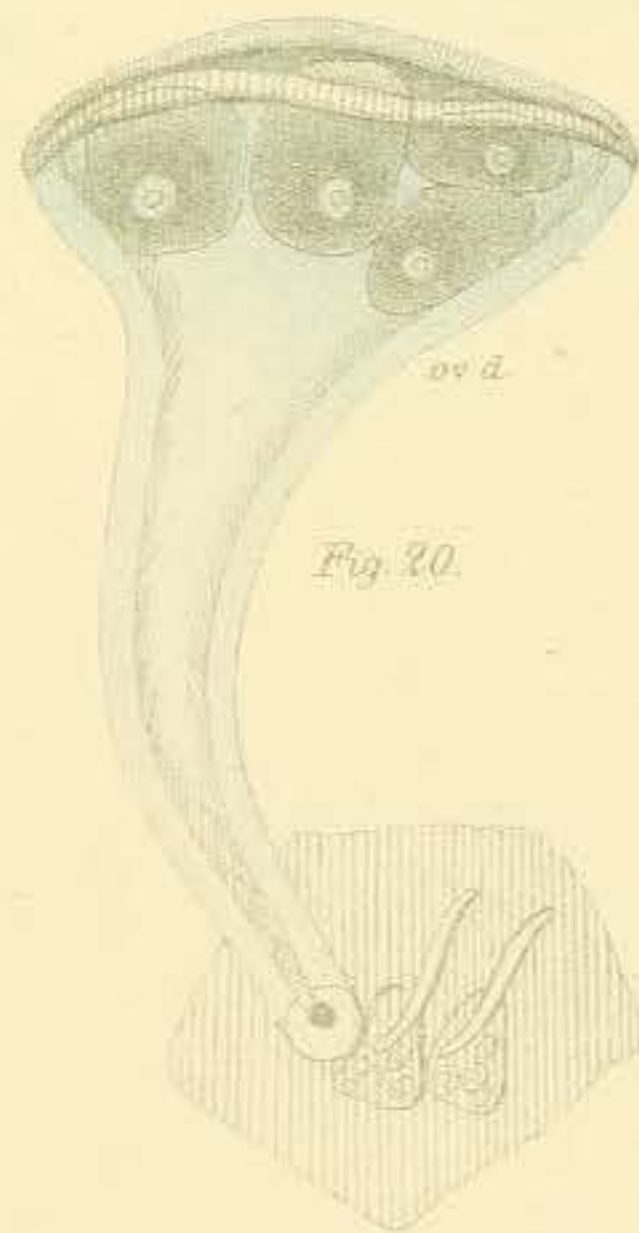


Fig. 19.

