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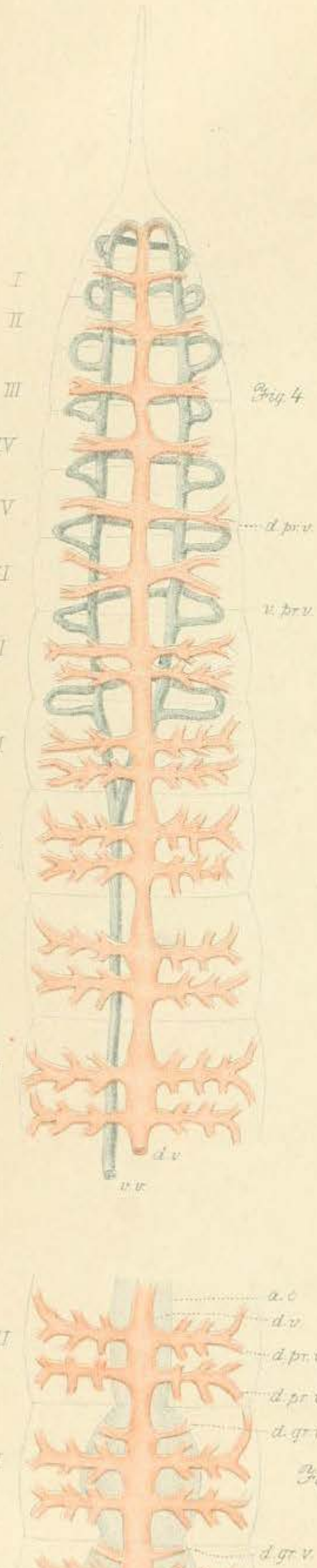

Fig. 4

Fig. 5

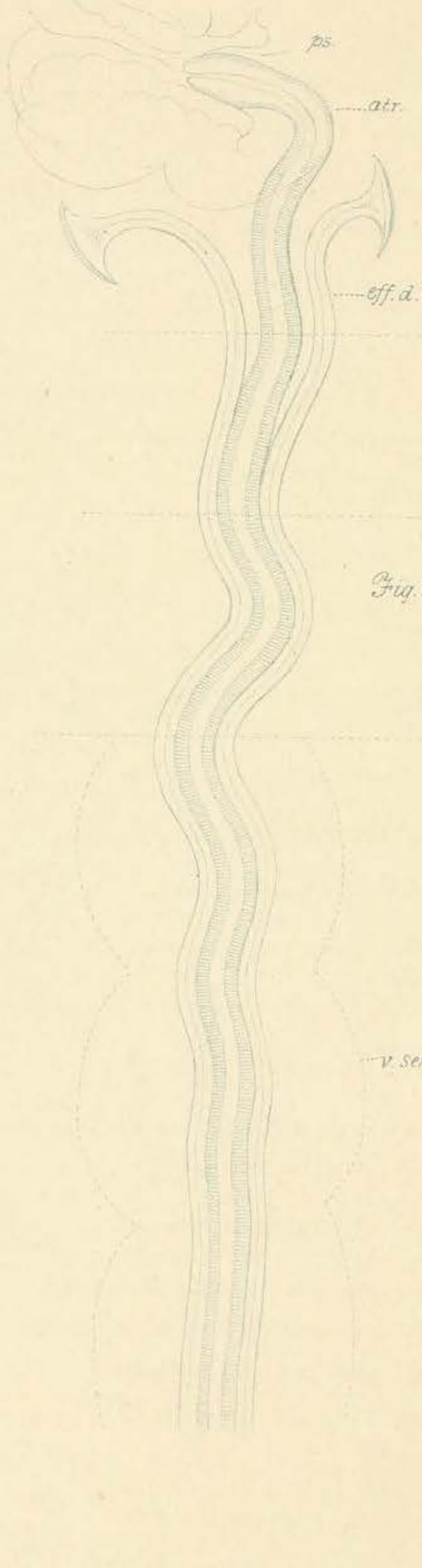

Fig. 6

Fig. 7

Fig 2

Fig 3

Fig. 1

I. On the Anatomy of Sutroa rostrata, a New Annelid of the Family of Lumbriculina.

By Gustav Eisen.

The oligochætous annelid, which is the subject of this monograph, was first found by me some ten years ago in the small body of water known as Mountain Lake, situated close to the Marine Hospital, on the Reservation west of San Francisco, California. During a recent visit to the same locality, in May, 1887, I found the same worm in exactly the same part of the lake, but, as before, in very few specimens. Perceiving the necessity of creating a new genus for this oligochæte, I have done myself the honor to dedicate the same to Mr. Adolph Sutro, whose magnificent public scientific library, marine aquarium and zoölogical station on the Pacific Coast will in the near future become one of the most prominent and valuable institutions of learning in this country.

OLIGOCHÆTA.

Family. Lumbriculidæ.

A. Sub-family Trichodrilina Vejd.

No solitary albuminous gland opening on the ventral side of the body.

B. Sub-family Lumbriculina Vejd.

A solitary albuminous gland opening on the ventral side of one of the anterior segments. Of this sub-family three genera are now known:

1. Lumbriculus Grube

Four pairs of seminal receptacles in segments 8, 10, 11 and 12. A solitary albuminous gland in the ninth segment. The free secondary perigastric vessels begin in the thirteenth segment, and are all pulsating. The preseptal secondary vessels not branching, the postseptal one branching. Spines not distinctly forked.* Cephalic lobe not filiform.

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* Vejdov-ky, System, etc., der Olig chæten, Prague, 1884, pag. 52.

2. Rhynchelmis Hoffm.

One pair receptacles in the eighth segment. A solitary albuminous gland in the ninth segment. The postseptal secondary vessels are simple, the preseptal ones are feathered and branched. Spines are entire. Cephalic lobe filiform.*

3. Sutroa n. gen.

Seminal receptacles consist of several pairs of lobes, entire or forked, which all open in the so-called albuminous gland in the eighth segment. A solitary albuminous gland in the eighth segment. Preseptal and interseptal secondary dorsal vessel are branching and feathered. Postseptal vessels are gastric, not feathered nor branching. Spines simple, not forked. Cephalic lobe filiform.

It will thus be seen that *Sutroa* is nearly allied to the two other genera of the sub-family, the most prominent characteristic being the concentration of the receptacles and their opening into the albuminous gland. But the vascular system also shows some great peculiarities, which will soon be fully described.

As only one species is known of the genus *Sutroa*, the generic and specific characteristics will here necessarily be considered together.

Sutroa rostrata n. gen. et sp

Habitat.—I have found this species only in Mountain Lake, near the Marine Hospital, west of San Francisco, California. It occurs here only on the north shore, just at the mouth of a small spring, which empties into the lake. It lives in the richest mud, between the roots of aquatic plants, probably with the tail vibrating in the water. When captured and set free in the water, the worms swim rapidly through a peculiar wavy motion of the body, showing to advantage its really magnificent iridescent colors, found to the same degree in no other fresh water annelide. The color of the body is very similar to that of *Rhynchelmis limosella*, a lively fleshy red.

The worm appears to be quite rare, as I did not succeed in getting over a dozen worms during each excursion. It also seems quite restricted to a certain part of the lake, where it lives in the rich mud at the margin of the bank. On the south, east or west ends of the lake I have looked for it in vain.

The egg capsule or cocoons of *Sutroa* are in size nearly similar to those of *Rhynchelmis*, but in shape different. They can nearest be compared to the hanging nests of some birds—small, bag-shaped bodies, with a flat, somewhat concave top—suspended by a long semicircular membrane. Figure 15 gives an enlarged repre-

* Vejdovsky, l. c., pag. 52.

sentation of the same. I generally found three eggs or young worms in the capsule.

The worms appear fully developed in July and August, at which time I found mature specimens. In May only immature ones were found, but as some of those were quite small it is likely that the worms remain mature for a long period, and that perhaps the proper breeding season is during the winter months.

In *size* and *form Sutroa rostrata* much resembles *Rhynchelmis limosella*, Hoffm. Mature specimen reach a length of three inches and a width of one-eighth of an inch, but generally are considerably smaller. The *form* is also similar to that of the above worm. The body is round or quadilateral; in many specimens the sides are even concave (Fig. 3). The posterior part of the body is again very much flattened out, quite transparent, and so brittle that care is necessary to get any entire specimen.

The anterior part of the worm, or the cephalic lobe proper, is elongated and filiform, its length exceeding the width of the body. This characteristic is also found in *Rhynchelmis limosella*, and indeed so similar are the two worms exteriorly that one may easily be mistaken for the other. Fig. 1 represents a *Sutroa*, nat. size; Fig. 2, the anterior portion of the body; and Fig. 3, a transverse section of a quadilateral specimen.

Vascular System.—The dorsal vessel (Figs. 4 and 5, v. d.) is pulsating. The ventral vessel (Fig. 4, v. v.) is not pulsating. In the figures the pulsating vessel is represented red, the non-pulsating one as blue. The ventral and dorsal primary vessels are connected in the cephalic lobe, where at the apex one vessel connects directly with the other (Fig. 4, I). Between this cephalic plexus and segment XIII no direct connection exists between the two primary vessels. But from segment XIII toward the posterior end of the body, we find in every one a secondary gastric vessel which undoubtedly connects the dorsal and ventral primary trunks.

The *dorsal* primary vessel (Figs. 4 and 5, d. v.) is entire, not forked, as is the case in the other genera of *Lumbriculina*. In every segment it emits secondary vessels, which are of two kinds, *gastric* and *perigastric*. The perigastric vessels occur in all the segments of the body; the gastric vessels only in the posterior, beginning with segment VIII.

In each of the six anterior segments we find only one pair of perigastric vessels, but each vessel shows a distinct forking, less so in segment I, but more dis-

tinct in the others. In segment VI the forking is so deep that it nearly divides the vessel in two (Fig. 4, I to VI). In segment VII the forking is perfect, and from that toward the end of the body we find in every segment two distinct pairs of perigastric vessels. Each of these vessels again are forked at the apex, and feathered—that is, besides the forking at the apex, it emits two pairs of side branches. All these secondary perigastric vessels end blindly in the perigastric cavity and do not connect directly with the ventral vessel (Fig. 5).

The *ventral vessel* is not pulsating. It is forked in segment VIII, the forks again uniting with the *dorsal vessel* in the *cephalic lobe* (Fig. 4). A similar forking of the ventral vessel is known in the other genera of *Lumbriculidæ*. The two forks of the dorsal vessel are again connected by secondary perigastric vessels (Fig. 4, v. pr. v.), which, however, in no way connect with the dorsal vessel or its secondary perigastric vessels. In *Rhynchelmis limosella* * as well as in *Phræatothrix* † the contrary takes place. Here the secondary ventral vessels connect the ventral forks with the dorsal pulsating vessel. My observations on the transparent *Sutroa* satisfy me positively that my above description is correct, and that the dorsal and ventral vessels are not united in those segments. The blood in all the vessels is lively yellowish-red.

The *alimentary canal* is extremely simple, consisting of a simple duct. In the twelve anterior segments this duct is narrow and quite pellucid, but in the thirteenth segment it is considerably enlarged and continues so toward the posterior part of the body. In the same segment we first meet with gastric vessels.

The *nervous system* resembles that of *Rhynchelmis*. The two ventral nerve cords are, as in *Eclipidrilus*, connected by numerous anastomosing commissures. The *cephalic ganglion* is rather long and narrow. No lateral nerves project from the ventral nerve cord.

Generative System.—The sexual organs are of two kinds—*generative* and *receptive*. The generative include:

Testes, *ovaries* and *albuminiferous gland*.

The receptive are: *Efferent ducts*, with *atrium* and *seminal vesicle; oviducts* and *receptacles*.

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* Vejdovsky: Anatomische studien. *Rhynchelmis*, Zeitsch, f. w. Zoöl. Bd. XXVII, Taf. XXI, Fig. 1.

† The same. Ueber *Phreatothrix*. Same, Bd. XXVII, Taf. XXXIX, Fig. 2.

The *testes* consist of one pair, situated in segment IX, and attached to the dissepiment between segments VIII and IX. They present small bodies of rather irregular shape (Fig. 14, test.).

The *ovaries* also consist of one pair, situated in segment X, and attached to the dissepiment between segments IX and X. They are somewhat smaller than the testes, and of a more regular form (Fig. 14, ov.).

The *oviducts* consist of one pair of small cup or funnel-shaped organs (Fig. 14, ovd., and Fig. 11). The exterior porus is on the ventral side of the body between segments XI and XII. The interior funnel-shaped part is extremely delicate and translucent. I found the eggs quite frequently in the act of passing out. The oviduct of *Sutroa* differs from that of *Rhynchelmis*, in being somewhat more elongated, with a longer and narrower neck.

The *efferent ducts* are four, and their funnel-shaped interior openings are all found in segment XI, freely projecting from the dissepiment between segments X and XI (Fig. 17). These *efferent ducts* are extremely long, extending through some twenty segments, or from XI to XXX or XXXI. They here enter the atrium, which is similarly elongated, extending from segment X to XXXI. The exterior porus of the atrium is situated very near the center of the ventral side of the line between segments X and XI. This enormous development of the efferent ducts and atrium was previously only found in *Ocnerodrilus*.*

The efferent funnels are comparatively small (Figs. 6, 7 and 14).

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*I will here take occasion to correct an error in my former description of this latter genus, for which see "*On the Anatomy of Ocnerodrilus.* Upsala 1878." The organs which I have there described as *seminal receptacles* are undoubtedly nothing but the *atrium*. During a visit to Central America, I found four new species of *Ocnerodrilus*, and a cursory microscopic investigation showed me immediately that seminal receptacles existed in several pairs in some of the anterior segments, which makes it evident that the large bodies which open in the same porus as the efferent ducts must be considered as atrium. In the Californian species which I described as *Ocnerodrilus occidentalis*, these small seminal receptacles were evidently overlooked. Professor Fr. Vejdovsky, in his admirable work, "System der Oligochæten," page 144, takes the same view of these organs, and refers to them correctly as the atrium. I now beg to append a correct diagnosis of the genus *Ocnerodrilus: Dorsal vessel weakly pulsating*, in segments IX and X; *furnished with two pairs of strongly pulsating hearts.* In the eighth segment it emits two side *branches which continue toward the cephalic lobe.* VENTRAL VESSEL *is not forked, but continues undivided to the buccalic segment. The secondary vessels are of two kinds,* GASTRIC *and* PERIGASTRIC. *The perigastric ones only connect with the ventral vessel. The efferent ducts are not united with the atrium, but both open in the same porus.* SEMINAL RECEPTACLES *occur in pairs in several of the anterior segments.* TESTES—*Two pairs in ninth and tenth segments. Two* OVIDUCTS *in fourteenth segment.* OVARIES—*One pair in twelfth segment.* The genus *Ocnerodrilus* constitutes undoubtedly a distinct family.

The exterior porus of the atrium is in *Sutroa* surrounded by strong muscular swellings, and the atrium itself forms a kind of penis, which probably is to some degree projective. The exterior surface of the atrium is nowhere covered with glands, as is the case in *Rhynchelmis*, but consists of a long, narrow duct of a uniform width (Fig. 6, atr., and Fig. 14, atr.). No basal glands.

The seminal vesicle consists of an enormous sac-like body, entirely filling the twenty segments occupied by the atrium and the efferent ducts. I did not succeed in finding the place at which it was attached to the atrium.

The most characteristic interior organ, however, is the solitary body, for which I here adopt the name given by Vejdovsky, glandula albuminifera or albuminous gland. I am, however, by no means fully satisfied of the functions of this organ, and its structure seems somewhat different from that of the albuminous glands of *Rhynchelmis* and *Lumbriculus*. The solitary albuminous gland of *Sutroa* opens in the center of the ventral part of the eighth segment (Fig. 14, gl. alb., and Fig. 10). It has the shape of a globulous body, connecting by a narrow neck with the body wall and opening through an external large porus. But the histological construction of this gland is quite different from the gland described by Vejdovsky in *Lumbriculus* * and in *Rhynchelmis*.†

In the latter two genera this organ is distinctly glandular, but in *Sutroa* it is of nearly the same construction as the receptacles, being covered by smooth epithelium, under which are found numerous long and narrow cells (Fig. 10). I have, however, no reason to doubt but that these organs are analogous in all the three genera.

The *receptacles* in *Sutroa* consist of three pairs. In *Rhynchelmis* and *Lumbriculus* we find the receptacles open each in a separate porus; in *Sutroa*, however, there exists the great anomaly that all the six seminal receptacles open into the narrow neck of the above described solitary gland (Fig. 10, re. sem.). These receptacles consist of long narrow sacks, containing fully developed spermatozoa (Fig. 8). Generally there are three pairs of receptacles, but in some specimens I found three receptacles on one side and only two on the other. Sometimes the interior end of a receptacle is forked; generally, however, they are entire. That these elongated bodies are real receptacles is proved by their being full of spermatozoa fully devel-

* Vejdovsky, System der Oligochæten. Taf. XII, 16. g. alb.

† Same. An. stud. Rhynchelmis. Taf. XXIII, Fig. 17.

oped. In the albuminous gland, however, I have searched in vain for any, though I must confess the number of specimens at my disposal has been very small.

The *segmental organs* are found in all the segments posterior to XII. They consist of long slender organs, the body of which is destitute of any glandular appendices or cells similar to those found in *Rhynchelmis*. The interior opening of the organ is surrounded by brown glands, behind which there is a larger head-like enlargement of similar structure to the duct proper (Fig. 12).

The *spines* are eight in every segment and occur in four pairs. They are slightly S-shaped, entire, not forked (Fig. 13).

EXPLANATION OF THE FIGURES.

Plate I.

Fig. 1. *Sutroa rostrata*, natural size.

Fig. 2. Front part of the worm, with the cephalic lobe, showing its filiform elongation.

Fig. 3. Transverse section of the body of a quadrilateral specimen.

Fig. 4. The front part of the worm, showing the vascular or circulatory system. The dorsal vessel is represented red; the ventral vessel, blue.

d. pr. v.: dorsal perigastric vessel.

v. pr. v.: ventral perigastric vessel.

Fig. 5. The twelfth to fourteenth segments, showing the vascular system in those segments.

ac.: alimentary canal.

dv.: dorsal vessel.

d. pr. v.: dorsal perigastric vessel.

d. gr. v.: dorsal gastric vessel.

Fig. 6. The efferent ducts and atrium.

ps.: penis.

eff. d.: efferent ducts.

atr.: atrium.

Fig. 7. Efferent funnel more magnified and seen in different aspect.

PLATE II.

Fig. 8. Ventral nerve trunk and cephalic ganglion.

Fig. 9. Seminal receptacles and albuminous gland.
re. sem.: seminal receptacles.
gl. alb.: albuminous gland.

Fig. 10. Interior extremity of one of the receptacles, showing the spermatozoa accumulated in the same.

Fig. 11. One of the oviducts, with eggs in the act of descending.

Fig. 12. The interior extremity of one of the segmental organs.

Fig. 13. One pair of spines.

Fig. 14. Interior view of the ventral part of the worm.
gl. alb.: albuminous gland.
re. sem.: seminal receptacles.
test.: testes.
ov.: ovaries.
ovd.: oviducts.
atr.: atrium.
eff. d.: efferent ducts.

Fig. 15. One of the egg capsules or cocoons. In the interior are seen three young worms, magnified about five times.

The Roman numerals everywhere indicate the segments. In numbering the same I have everywhere in this paper referred to the first segment as segment I, thus following Vejdovsky and others. In former papers I have always referred to the first setigerous segment as segment 1, and believe yet this way to be the least confusing. But as uniformity in numerating the segments is highly desirable, and as every investigator seems to have his pet way, leading to endless misunderstanding, I shall for the future accept the system used in this paper, hoping all other investigators will do the same.

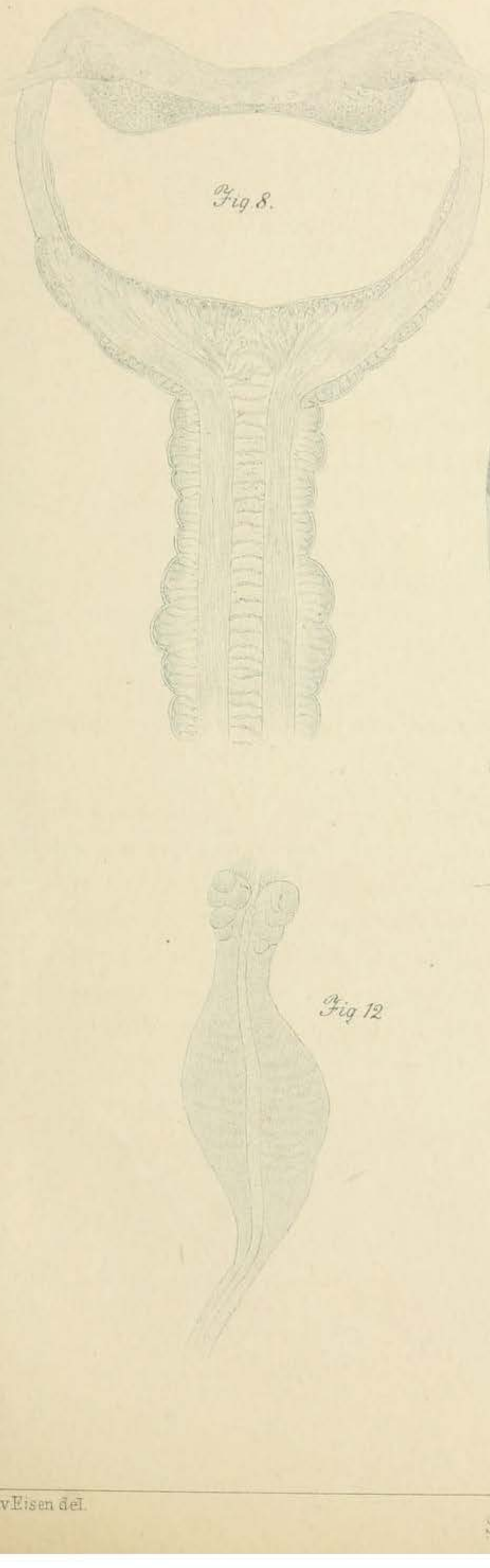

Fig. 8.

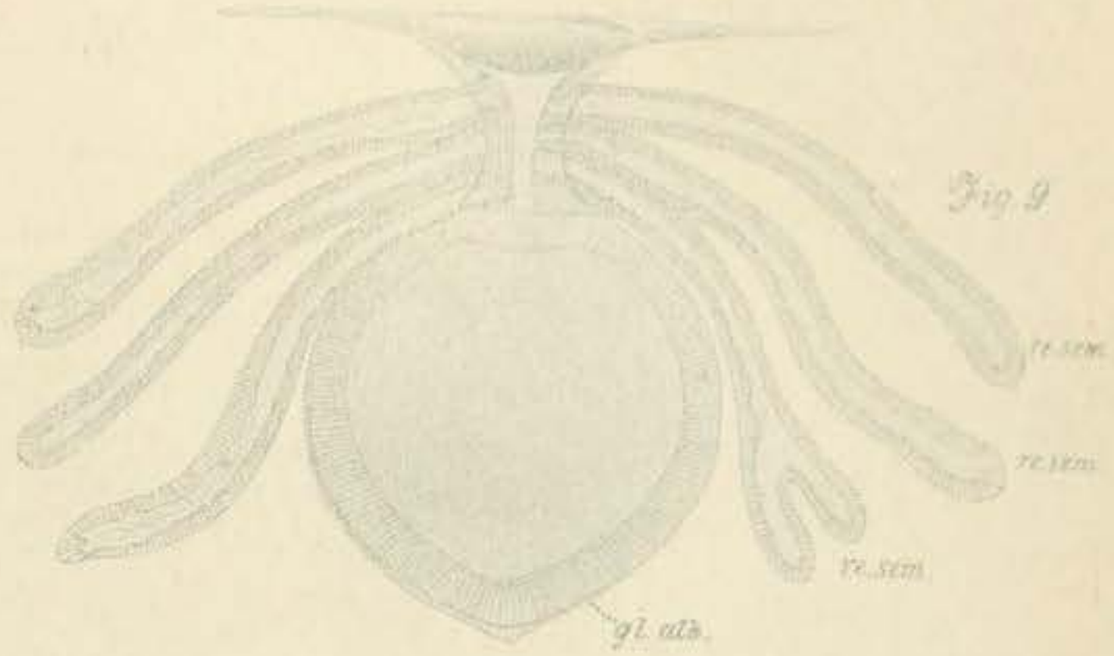

Fig. 9

Fig. 15

Fig. 10

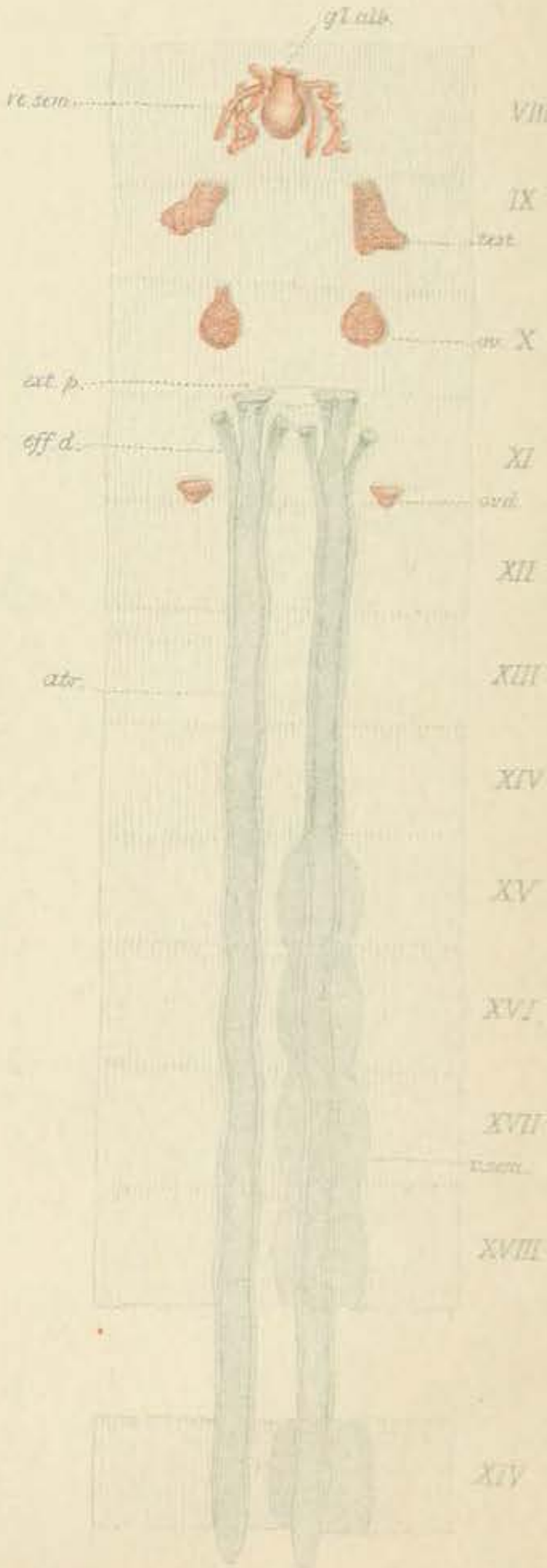

Fig. 14

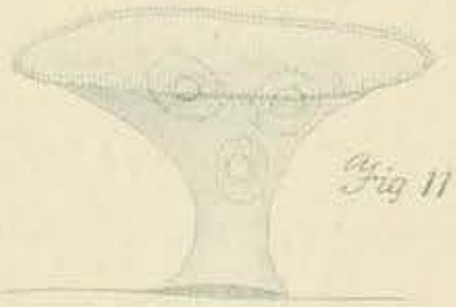

Fig. 11

Fig. 12

Fig. 13.