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FURTHER NOTES ON NAIDIDS AND TUBIFICIDS FROM BRAZIL

EVELINE DU BOIS-REYMOND MARCUS *

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Doctor Harald Sioli, Belterra (Pará), and Doctor Rudolf Braun, Zürich, entrusted me with a lot of worms from the State of Pará, Brazil, gathered from 20. VI. 1947 to 25. V. 1948. As this material comes from the same region, upstream from Óbidos, Belterra, and Santarém, many species of Dr Siolis's anterior collection (DU BOIS-REYMOND MARCUS, 1947) were found again this time.

Localities

(a) State of Pará

1. Rivers Cuminá and Trombetas and Lago Salgado.
2. Obidos.
3. Rio Tapajoz near Fordlândia and River Cupari.
4. Rio Tapajoz near Belterra.
5. Santarém.

(b) State of São Paulo

6. Side-waters of the river Tieté near the city of São Paulo.

List of species with their localities (in brackets)

[those marked with * are new for the Amazonian region]

- *1. *Nais communis* Pig (4).
2. *Nais paraguayensis* Mich. (1, 3, 4).
- 2a. *Nais paraguayensis* f. *chelata* Marc. (1, 3).
3. *Slavina evelinae* (Marc.) (1, 2, 3, 4).
4. *Haemonais laurentii* Steph. (3, 4).

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terior part of the intestine is only beginning to obliterate. Testes (t) and spermathecae (s) lie in segment 5, ovaries (o) and male pores (m) in segment 6. The clitellum (g) begins in the hind part of segment 5 and ends in the middle of segment 8. It is continuous, not interrupted between the male pores. The ventral setae of segment 6 are transformed into 5 strong penial setae (Fig. 1). The sperm-sac (r) hangs into the ovisac. It reaches into segment 8; the ovisac extends a little farther backwards; it contains several partial ovaries (o) of 32 ovocytes each with a non-nucleated core. Only one of the ovocytes (q) is in the second growing period. Some loops of blood-vessels (v) enter both sperm-sac and ovisac. The spermathecae (s) have a short and narrow duct and a small spherical ampulla that is empty. The male funnels (e) do not as in STEPHENSON'S material begin in the sperm-sac (r), but near the ventral side of segment 5 close to the middle line. The short efferent ducts (d) penetrate septum 5/6 and widen suddenly to form a thin-walled vesicle (u), then they turn outwards and each opens into a small, round atrium with high epithelium (a). The atrium is united to the male pore (m) by a very short ejaculatory duct. The male pores open outside the penial setae (p).

The female pores (f) lie immediately behind and slightly inward from the male pores in the beginning of segment 7.

AULOPHORUS PECTINATUS Stephenson, 1931

Figures 3-6

STEPHENSON 1931, p. 308, textf. 1, t. 17: f. 6a-6b.

The present material consists of a few fragments and one complete worm with head and gills, the hinder segments of which are recently regenerated and not yet full-grown. The length of the specimens is not more than 6 mm., their diameter 0.4-0.5 mm. The number of segments is 30-40 in the fragments, and about 50 in the regenerated worm. None of them has any signals of a fission zone.

The colour of the preserved animals is whitish, without any traces of eye-spots. The prostomium is a very short cone. The state of preservation does not allow for details of pharynx and oesophagus. The chloragocytes begin in segment 6. The blood-vessels of segments 6-14 form large coils. In segments 16-20 a blood-sinus (plexus) fills the space between the splanchnic layer and the intestinal epithelium.

The ventral setae are double-pronged crotchets, 3-4 per bundle in segments 2-5 (Fig. 3). They are longer (150-120 μ) than in the hinder segments (110 μ), where their number decreases. The prongs

are of equal length, but the lower one is thicker than the upper. The dorsal bundles begin in segment 5. They consist of a hair (230-300 μ) and a two-pronged needle (105 μ) with a nodule at 28 μ from the tip. Between the prongs are one to four fine spikes of varying aspect (Fig. 5). They are only recognizable with oil-immersion. Occasionally there are two setae of each type.

The hind end of the body (Fig. 6) is widened and contains the oblong branchial fossa, in which four pairs of short true gills are lodged. The fossa opens dorsally, and its posterior border is prolonged into two long and slender palps (450 μ long).

Family TUBIFICIDAE

BOTHRIONEURUM BRAUNI, spec. nov.

Figures 7-11

One mature specimen, 14 mm. long, 0,3 mm. in diameter. The colour of the preserved worm was whitish, the number of segments about 70, without counting the pre-anal growing zone. The prostomium is pointed and about as long as broad, with a distinct dorsal sensory pit (Fig. 7, p) of 40 μ diameter. The segments are a little shorter (0,2 mm.) than their diameter. There are no papillae on the skin.

The setae (0,06 mm.) are double-pronged crotchets in the dorsal and ventral bundles; in the anterior segments the straight distal prong is a little finer and much longer than the hooked proximal one (Fig. 8), and the nodule lies in the middle of the shaft. In the posterior segments the prongs are of equal length (Fig. 9), but the proximal one is still sthicker, and the nodule is nearer the tip, at 42 μ of 70 μ total length. The setal glands that are characteristic of the genus are small and consist of only one cell each, with erythrophilic secretion. In segment 11 setae are wanting, nor are there any penial setae.

The body-wall (epidermis, muscles, and peritoneum) is very thin, in the contracted state it measures only 20 μ in section.

The pharynx (Fig. 7, j) occupies segment 3. Its roofs is densely ciliated and has partly depressed (sub-epithelial) nuclei. In segments 4 and 5 the oesophagus is accompanied by tufts of chromophilous cells (d). The chloragocytes begin in segment 6. Though the animal has well grown ovocytes, its gut continues pervious and is filled with rests of diatoms and detritus. The intestine contains a number of slender astomatous ciliates, that were also found in other Tubificids of the region. Contractile loops of the blood-vessels occur in

segments 8-10 (Fig. 11, v); an intestinal blood-plexus is strongly developed in segments 7-14 and disappears gradually backwards. The cutaneous vessels are not recognizable. The spherical coelomocytes measure 12-15 μ in diameter. They do not stain as strongly with eosine as the chloragocytes do. Of the nephridia nothing was seen in the sections.

The clitellum (Fig. 10, 11, k) extends from segments 10 to 12; its cells are lower on the dorsal side (8 μ) than on the ventral side (17 μ). The gonads are duplicated as in other species of the genus, viz. *iris* Bedd. (CERNOSVITOV 1939, p. 99); *aequatorialis* (Michaelson 1935, p. 36); *pyrrhum* Marcus (1942, p. 202). There are testes (t) on both sides in segments 9 and 10, and ovaries (o) in 10 and 11. The sperm-sac (m) formed by septum 10/11 may reach backward into segment 18. The very big male funnels (f) lie dorso-laterally in segment 10. The thin (5 μ) efferent duct (vas deferens of CERNOSVITOV and others) (e) runs to septum 10/11 and turns back into segment 10, widening to 15 μ . In the dorsal anterior region of the segment it enters the male atrium (a), a long, curved tube of 25 μ diameter, consisting of a glandular or storing epithelium covered by a thin layer of muscles and surrounded by masses of prostatic cells. The atrium passes to segment 11, widening further to 56 μ diameter (w), and losing the glandular cells. Then it suddenly narrows and opens dorso-medially into the copulatory chamber (c) close beside the paratrium (q). This consists of a bunch of gland-cells that enter into a muscular bulb lined with a high cylindrical epithelium. The epithelium is prolonged into a cone that protrudes into the copulatory chamber and is not cuticularized as in *B. americanum*. The copulatory chamber has a muscular wall and a villous epithelium. Some gland-cells lie on its outer side. The chamber is folded and twisted and forms several small pouches; finally it turns backwards and downwards and opens near septum 11/12, immediately before the female pores. Just over the opening it receives the outlets of a compact gland (g) that corresponds to the post-paratrial glands of *B. pyrrhum* and *B. iris* (MARCUS 1942, t. 10:f. 33, g; t. 11:f. 36, 37, g). The outermost, efferent, part is not cuticular as in *B. americanum* (CERNOSVITOV 1939, p. 98, f. 62).

The ovaries (o) lie in the anterior walls of segments 10 and 11. The ovisac (u) contains a number of single oocytes in different phases of growth. It is not recognizable beyond segment 14. It is like the sperm-sac provided with some loops of blood-vessels.

The ental end of each female canal is a solid disc (h) of high ciliated cells that lies on the antero-lateral surface of septum 11/12. At the base of the disc the canal opens, passes through the septum and pierces the body-wall (s) immediately behind the insertion of the septum.

Discussion of *Bothrioneurum brauni*. — The new species with paired male pores and without penial setae is related to *B. americanum* Beddard (CERNOSVITOV 1939, p. 96), but differs from it in the following characters:

- 1) the setal glands have 5-6 cells each in *americanum*, one in *brauni*.
- 2) the small male funnels lie in the ventral part of septum 10/11 in *americanum*, while they occupy the latero-dorsal part of the segment in *brauni*.
- 3) the paratrium lies near the outlet of the short copulatory chamber in *americanum* (CERNOSVITOV 1939, f. 62), while it lies in the upper, anterior half of the segment near the beginning of the long and twisted copulatory chamber in *brauni*.
- 4) the efferent part of the copulatory chamber has a thick cuticle in *americanum* (CERNOSVITOV 1939, p. 98), that is wanting in *brauni*.

The bibliography about supernumerary gonads that are abnormal but frequent in Oligochaetes has recently been united by GAVRILOV (1948, p. 225). I agree with the author who considers the phenomenon as an atavism, the roots of which must be searched for among the Polychaetes.

I dedicate the new species to the collector, Dr. Rudolf Braun of the Technische Hochschule, Zürich, Switzerland.

Genus *SIOLIDRILUS*, gen. nov.

Setae in both dorsal and ventral bundles double-pronged crotchets. Hearts in segment 8; parietal plexus in posterior part of body. Ductus efferens (vas deferens of authors) short, but not shorter than the ovoid atrium, that has an ental, volumous, solid prostate. Ejaculatory duct a pseudopenis opening into the paired, folded copulatory chambers. Spermathecae long, tubular. No penial setae or other setae in segment 11. Spermathecal setae in segment 9 with glands. Free spermatozoa.

Type of the genus: *Siolidrilus adetus*, spec. nov.

SIOLIDRILUS ADETUS, spec. nov.

Figures 12-18

The worms have the aspect of small *Limnodrilus*. Their length is 20-30 mm., the diameter of the anterior segments 0,4 mm., the posterior 0,3 mm., in the clitellar region 0,48 mm. The number of segments is 100-140. The segmentation is hardly marked on the surface of the preserved specimens. The prestomium is a more or less blunt cone (Fig. 12).

All setae of the dorsal and ventral bundles are double-pronged crotchets. In the anterior part there are 5-8 per bundle, behind the

clitellum their number decreases to 4-3-2. The distal prong is thinner and, except in the foremost segments (Fig. 13), slightly shorter than the proximal one. The nodule lies on the limit between the outer and middle third of the length of the shaft. Between the tip of the seta and the nodule there is a strip of incomplete cuticularization that is visible only in balsam mounts. The length of the setae is 75-90 μ in the first segments, it diminishes backwards to 60 μ (Fig. 14).

The pharynx occupies segment 3. The oesophagus is surrounded by chromatophilous cells in segment 4-6. Chloragocytes begin in segment 5. They are very numerous and may fill the entire body-cavity. In the adult worms the intestine is obscured by the mighty masses of reproductive cells that lie in segments 7-16.

The brain (Fig. 12, b) is a slightly enlarged part of the pharyngeal connective with four anterior and two posterior masses of ganglion-cells. The anterior ones give rise to four bundles of pro-stomial nerves (Fig. 12).

The blood-vessels form many loops in the anterior segments and a pair of contractile hearts in segment 8. In the hinder part of the body the cutaneous blood-vessels (plexus) constitute a regular network with many anastomoses (Fig. 16). Of the nephridia nothing was to be seen in the preserved worms.

The clitellum (Fig. 17, 18, e) is only developed around segment 12. The testes (t) lie on the anterior wall of segment 10, the male funnels (f) in the hind wall. A short and narrow ductus efferens (vas deferens of CERNOSVITOV and others) (d) pierces septum 10/11, rises to the dorsal side, and enters the atrium (k) together with a compact tuft of prostatic gland-cells (g). The ental, ovoid part of the atrium is about thrice as long as its diameter (240 and 80 μ), and consists of a thin muscular wall and a high epithelium filled with eosinophilic granules. Ectally the male duct (h) narrows and forms a short tube (80 μ long, 30 μ wide), that opens sideways into the duplicated copulatory chamber (a). Probably the tip of this tube can be protruded from the male pore and serves as penis. It is not cuticularized. This organ resembles more the pseudo-penis that occurs f. ex. in *Aulodrilus*, than a true penis as in *Tubifex* and others. The copulatory chambers have folded, thin walls suspended to the body-wall by numerous muscles. The male pores (p) lie far apart one from the other, in row with the ventral setal bundles of the other segments, that are wanting in segment 11. The septa of segment 10 form two huge unpaired sperm-sacs provided with blood-vessels. The anterior one (u) occupies segments 9 and 8, the posterior one (v) segments 11-13.

Each of these sperm-sacs may contain one of the spermathecae (s) or the anterior one both. The spermathecal pores (r) lie in front

of segment 10, laterally to the ventral setae of segment 9. The spermathecae are very long, slender tubes, that are coiled into the sperm-sacs. They are thin-walled when they are extended by their contents, masses of loose sperms.

The small ovaries (o) lie in the base of septum 10/11. The ovisac (w) surrounds the posterior sperm-sac (v) and extends to segment 13. It contains several big eggs. The female ducts seem to be so rudimentary that I was not able to recognize any traces of them in the sections.

The ventral setal bundles of segment 9 are transformed. They contain only one blade-shaped, pointed seta each, 100 μ long (Fig. 15). Its follicle is connected with a big, nearly spherical gland of 150 μ diameter, that lies behind the follicle (Fig. 17, 18, q). One mature specimen that is in all other characters alike to the rest of the material, has the ventral setae of segment 10 also transformed. There is one sigmoid seta of 150 μ length on every side with a central nodule and a pointed tip. Beside these setae the body-wall is extended and forms two big, soft knobs of 150 μ in diameter.

Discussion of the genus *Siolidrilus*. — Since STEPHENSON (1930, pp. 745-754) published the diagnoses of 18 genera of Tubificids, 6 new genera have been described, viz. *Epirodriulus* Hrabe (1930, p. 4; CERNOSVITOV 1939, p. 94), *Spiridion* Knöllner (1935, pp. 471, 475), *Aktearilus* Knöllner (1935, pp. 482, 491), *Moravirodriulus* Hrabe (1935, p. 4), *Tubificoides* Lastockin (1937, p. 234) *, and *Littodriulus* Chen (1940, p. 96).

Two of the 24 known genera, *Spilodriulus* Piguët (1928, p. 92) and *Trachydriulus* Piguët (ibid.) were described without reproductive organs. Nevertheless *Trachydriulus* can easily be distinguished from *Siolidrilus* by its integument that is strengthened by a chitinous thickening in the form of a cuirass. *Spilodriulus* is characterized by segmentary rings of pigment. As FIGUET could verify these in his single specimen that was preserved in alcohol, one can expect that they would also have persisted in one or another worm of my material. Moreover the prongs of the dorsal and ventral crotchets are different in *Spilodriulus*, not in *Siolidrilus*.

STEPHENSON arranged the genera of the Tubificids in two groups, that with solid prostate or prostates, the higher Tubificids of HRABE (1939, p. 63) and others, and that without or with diffuse prostate. As *Siolidrilus* belongs to the first group, it needs no comparison with the second.

Only *Rhyacodriulus* must be considered, because KNÖLLNER has described *Rh. prostatus* with solid prostate that opens into the efferent duct. That species has also simple tubular nephridial canals as *Tubifex* and other higher Tubificids, not the post-septal glandular mass with labyrinth-like ramifications as *Rhyacodriulus* and other genera of the second group.

* I am very much obliged to Dr. Waldo L. Schmitt, Smithsonian Institution, Washington, D. C., for a copy of this paper.

When CERNOSVITOV mentioned *Rh. prostatus* (1942, p. 285) he did not criticize KNÖLLNER's classification as one should expect. The present species cannot belong to *Rhyacodrilus*, that has penial setae and no copulatory organ. Except *Rh. prostatus* all species are without bulky prostate.

In STEPHENSON's first group the following genera can at once be recognized as incompatible with *Siolidrilus*: *Tubifex* and *Tubificoides* with hair-seate at least in the anterior part of the body, and differences between dorsal and ventral setae; *Pelosclex* with cuticular and sensorial papillae; *Limnodrilus* with long efferent ducts and with spermatophores; *Limnodriloides* without parietal plexus, with a large atrium and with spermatophores; *Telmatodrilus* with a number of small prostates; *Aulodrilus* with a post-anal gill; and *Phallogdrilus* with two prostates (pseudoprostates, KNÖLLNER 1935, p. 487).

Of the 6 genera described after the publication of STEPHENSON's monograph 3 possess solid prostates, but to none of them the Amazonian species can be attributed. *Spiridion* has penial setae and neither spermathecal setae nor a copulatory organ. *Aktedrilus* has an unpaired spermatheca with dorsal opening and besides the atrial prostate two pseudoprostates associated with the penis-sheath. In *Tubificoides* already separated from *Siolidrilus* by its hair-setae, the nephridia are substituted by large vacuolated cells; the genital system is of the type of *Tubifex*.

One genus of STEPHENSON's group with solid prostate, *Ilyodrilus* must be considered more closely, because some of its characters are similar to those of *Siolidrilus*. *Ilyodrilus* comprises five species without hair-setae, four mentioned by HRABE (1941, pp. 25, 32), and *asiaticus* CHEN (1940, p. 78). The ductus efferens is short in *Ilyodrilus*, and spermathecal setae occur like those of the present species. These setae may also be provided with a gland. In *I. hammoniensis* such setae and glands are combined with the missing of penial setae. Therefore it seems that *Siolidrilus* is more closely related to *Ilyodrilus* than to any other genus of the Tubificidae. It differs however by the short ovoid atrium, the tubular spermathecae, and the absence of spermatzeugmas or spermatophores. *Ilyodrilus* has a long tubular atrium that is bent on itself, bag-shaped spermathecae with globular or ovoid ampullae, and spermatzeugmas or spermatophores. The presence of a true penis in *Ilyodrilus* is a less important disjunctive character.

As in various species of *Ilyodrilus* the solid prostate is small, nearly rudimentary, two species, *I. moldaviensis* (Vejd. & Mraz.) and *I. bavariensis* Oschm. without any prostate have been included in the genus. STEPHENSON (1930, p. 746) doubted of this classification. Notwithstanding *I. orientalis* Cernosvitov (1935, p. 545) and *I. asiaticus* Chen (l. c.), both without solid prostate, have been added to *Ilyodrilus*. A copulatory organ is wanting in *I. orientalis*. *I. asiaticus* even lacks spermatophores or spermatzeugmas, and has an efferent duct that is four times as long as the globular atrium. It is true that CHEN (1940, p. 78) says: "vas deferens extremely short", but neither the figures (f. 24 A, E), nor the measurements (efferent duct about 0,2 mm., atrium about 0,05 mm.) show that. With regard to the ductus efferens, the atrium, and the spermatophores

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I. orientalis may perhaps be maintained in *Ilyodrilus*, but *I. asiaticus* cannot remain there without abolishing the taxonomic unity of *Ilyodrilus*. Even less than the typical species of *Ilyodrilus* the four without a solid prostate make it advisable to include the Amazonian species in this genus.

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PLATE I

Haemonais laurentii Steph.

1. Penial seta.
2. Reproductive organs in a combined section.

a, male atrium. b, brain. c, spermathecal pore. d, ductus efferens. e, funnel of efferent duct. f, female pore. g, clitellum. h, pharynx. i, intestine. j, mouth. k, muscle of the penial setae. m, male pore. n, ventral nerve-cord. o, partial ovaries in ovisac. p, penial setae. q, ovocyte in second growing period. r, sperm-sac. s, spermatheca. t, testes. u, widening of efferent duct. v, blood-vessels. w, intersegmental septum.

Aulophorus pectinatus Steph.

3. Ventral seta of segment 3.
4. Ventral seta of segment 20.
5. Various shapes of dorsal needle setae.
6. Hind end with branchial fossa in dorsal view.

Bothrioneurum brauni, spec. nov.

7. Sagittal section of anterior region.
8. Tip of seta of segment 6.
9. Tip of seta of segment 18.
10. Reproductive organs in ventral view.

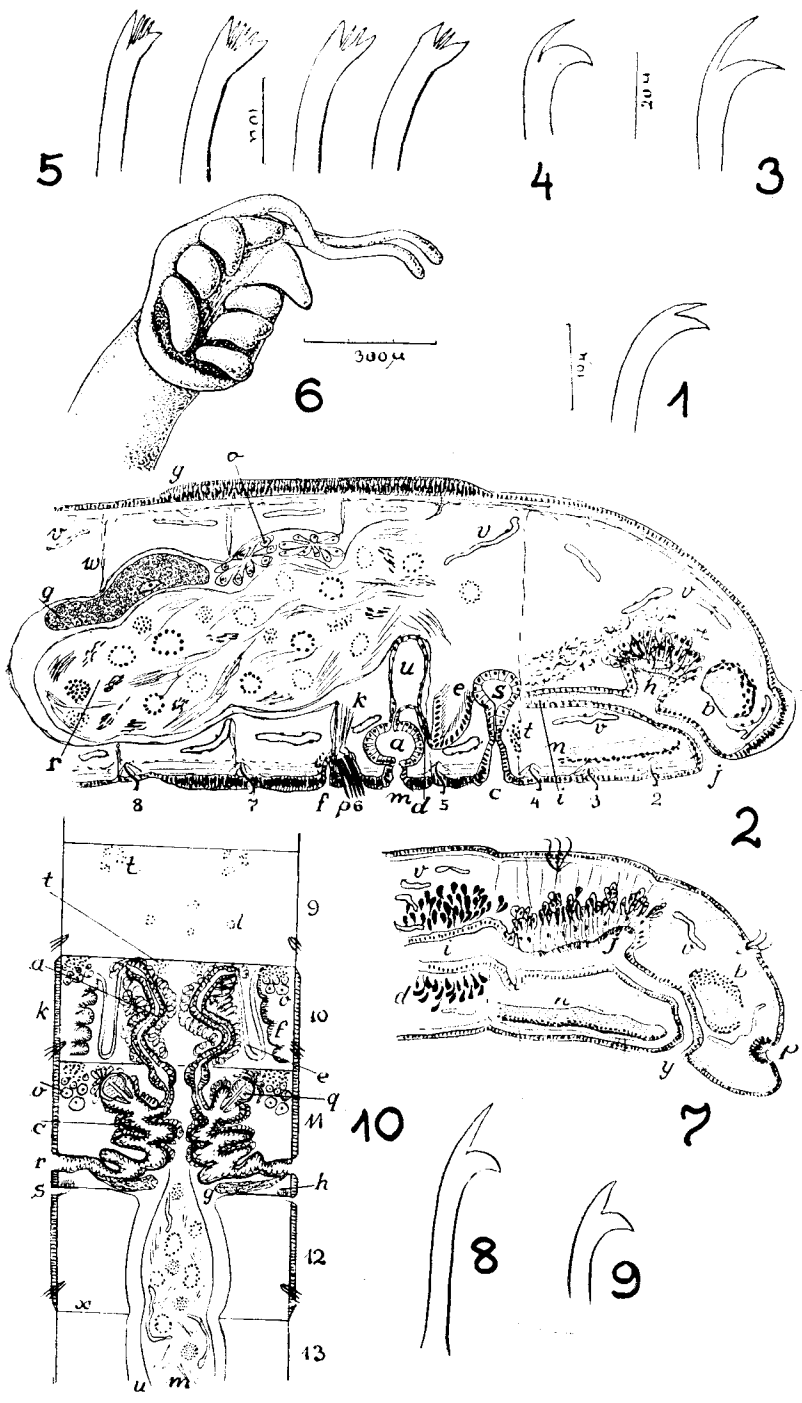


PLATE II

Bothrioneurum brauni, spec. nov.

11. Combined sagittal section of segments 10 and 11.

a, male atrium. b, brain. c, copulatory chamber. d, chromophilous cell. e, efferent duct. f, male funnel. g, post-paratrial gland. h, female funnel. i, oesophagus. j, pharynx. k, clitellum. l, spermatospheres. m, sperm-sac. n, ventral nerve-cord. o, ovary. p, sensory pit. q, paratrium. r, male pore. s, female pore. t, testes. u, ovisac. v, blood-vessel. w, widening of the atrium. x, septum. y, mouth.

Siolidrilus adetus, gen. nov., spec. nov.

12. Head with brain, mouth and pharynx in ventral view.
13. Seta of pre-clitellar segment.
14. Seta of post-clitellar segment.
15. Spermathecal seta.
16. Cutaneous blood-vessels.
17. Reproductive organs seen from the ventral side.
18. Reproductive organs in lateral view.

a, copulatory chamber. b, brain. d, efferent duct. e, clitellum. f, male funnel. g, prostatic gland. h, male genital canal. j, pharynx. k, male atrium. l, mouth. n, ventral nerve-cord. o, ovary. p, male pore. q, spermathecal gland. r, spermathecal pore. s, spermatheca. t, testes. u, anterior sperm-sac. v, posterior sperm-sac. w, ovisac with ovocytes.

