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NOTES ON FRESH-WATER OLIGOCHAETA FROM BRAZIL

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Of the limnic Oligochaetes recently studied by my husband and myself one species and one form hitherto not described were found in the vicinity of the city of São Paulo, Brazil. Along with the diagnoses of these I record the sexual phase of *Aeolosoma bengalense* that was not yet registered.

§ 1. Family Aeolosomatidae

Genus AEOLOSOMA Ehrenberg, 1831

AEOLOSOMA CORDEROI, sp. n.**

Figures 1-3

Small transparent worms with few light-red colour glands that are somewhat concentrated at the hinder end and absent on the ventral surface of the prostomium. Mucous glands were not seen.

Length of single living worms about 0,4-0, 6 mm.; chains of two zooids extended and alive up to 1 mm.; diameter 60-80 μ. Number of segments 6-10. A single fission zone was present in the seventh or eighth segment.

The prostomium is narrower than the following segment and has a very small ventral ciliated ciliated field (Fig. 1, a) that does not extend to the borders. Tactile setae on the prostomium are up to 20 μ in length. The round ciliated pits (Fig. 3, d) are ventro-lateral but not contiguous with the ventral field. Cephalic glands on the ventral side of the prostomium are distinct (Fig. 3, c). The body terminates conically.

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** Named in honour of Prof. Dr. E. H. CORDERO, Montevideo, the first South-American author who contributed (1931) to our knowledge of *Aeolosoma*.

The dorsal and ventral setal bundles consist of hairs (60-85 μ) and needles (40-46 μ). On an average there are dorsally more hairs and ventrally more needles. In the anterior segments the number of hairs is 3-5, falling towards the hinder and (0-1). The needles, posteriorly at most 2 per bundle, diminish in number towards the head and are absent in the second or more rarely in the second and third segment. The needles (Fig. 2) are strongly sickle-shaped and serrated with 6-7 points decreasing in size from the distal end towards the base.

The dilated portion of the gut extends from the end of the third segment to the middle of the sixth. Septa are wanting. The nephridia begin in the third segment; their funnels are narrow. The cerebral ganglion is broader than long with short posterior lobes. (Figure 1, b).

Locality. — An abundant material was gathered from the river Tieté, among *Utricularia* and *Eichhornia*, at Canindé (city of São Paulo, Brazil).

Like *A. travancorense* the worms of the new species live in tubes built of mud-particles tha tare glued together by means of secretion from the skin. The animals feed on algae and decaying parts of water-plants.

Discussion. — The only species of *Aeolosoma* with needles and red colour-glands hitherto known is *A. evelinae* (MARCUS 1944, p. 17) that has needles (36 μ) only in the ventral bundles, short tactile setae (5-6 μ) and the ventral ciliated field laterally extended to the dorsal surface of the prostomium.

A tube-building species with dorsal and ventral serrated needles is *A. travancorense* (ibid., p. 24). It has no colour-glands and the tactile setae reach 30 μ in length, the needles no more than 35 μ. *A. travancorense* has up to 5 needles in a bundle.

A. sawayai (ibid., p. 23) has yellow colour-glands, smooth dorsal and ventral needles and short tactile setae. These three species were found at the same locality with *A. corderoi*.

As a red species with narrow prostomium *A. quaternarium* Ehrbg. must finally be compared with the new species. We have not yet seen *A. quaternarium*. In the elder works the length of *A. quaternarium* is described as "very small" (BEDDARD 1895, p. 183, 184; MICHAELSEN 1900, p. 14) but in one of his last publications MICHAELSEN (1928, p. 8) says: "the biggest known species of the Aeolosomatids", giving its natural size in fig. 3a with 9,5 mm. In any case *A. quaternarium* is easily distinguishable from. *A corderoi* by the entire lack

of needles and the strongly curved hairs of equal length in the same bundle.

A corderoi is the eleventh species of *Aeolosoma* found in the surroundings of the of São Paulo. The genus seems to be common in South America and occurs in all continents, also in Australia (WHITELEGGE 1889, p. 146). Such a distribution together with the morphological characters of the family (MARCUS 1944, p. 48) makes it probable that the Aeolosomatids and not the exclusively northern Lumbriculids are the most archaic among the recent Oligochaetes.

§ 2. Family Naididae

Genus AULOPHORUS Schmarda, 1861

AULOPHORUS SCHMARDAI Mich., forma COSTATA, f. n.

Figures 4-10

The tubes are quite straight, up to 4 mm. in length, but frequently only 2 mm. long; the diameter is about 0,22 mm. The case is made up of black mud, quartz-granules and diatoms. These particles are of nearly uniform size and 40-60 μ in diameter. Peritrichous Ciliates grow on the tubes.

Length of living worms with one fission zone 4 mm., single individuals smaller; thickness 0,12-0,15 mm. Number of segments in worms without fission zone 13-22. The fission zone lies behind the thirteenth segment (n=14).

The prostomium of triangular form as in *A. carteri* (STEPHENSON 1931, p. 304) is without eyes.

The ventral setae are double-pronged crotchets, in the second to fifth segment 4-6 per bundle and 80-89 μ in length (Fig. 4). Both prongs are long and slender, the outer (distal) of the two is longer and a little thinner than the inner (proximal). The nodulus is ental. From the sixth segment backwards there are generally 3-5 setae per bundle, towards the hinder end 3 setae. The setae from the sixth segment backwards are 39-44 μ long (Fig. 5); those of the same bundle may be different in length. Both prongs are short and the inner (proximal) of the two is thicker and slightly longer than the outer (distal). The nodulus is ectal.

The dorsal setae begin in the sixth segment. The bundles are composed of one hair-seta and one needle (Fig. 6). The hairs are straight, without serration. In length they are 80-100 μ and therefore shorter than the diameter of the body. The needle-setae are about 60 μ long. Their nodulus is ectal and well marked. At a short distance from the nodulus the needle is curved and widened.

The two equal prongs are connected by a transparent web with numerous (8-16) ribs (3 μ in length) on its distal border.

The hinder end is almost cylindrical, very little expanded (Fig. 7-10) It shows an oblique funnel-shaped depression, the small branchial fossa, loowing as usually in the genus, backwards and slightly upwards. The gills are two pairs. The dorsal margin of the fossa has a rather deep median notch. On every side of this the border forms an accessory gill about as long as broad. Only slightly longer are the true gills (60 μ), a pair of which projects backwards from the ventral floor of the fossa. The thin palps diverge moderately; they are 0,25-0,3 mm. long.

Locality. — A few worms appeared in an aquarium with plants from the river Pinheiros (city of São Paulo, Brazil). By HYMAN's method (1941) of feeding them with boiled lettuce their number was rapidly increased.

Discussion. — The dorsal accessory and the ventral true gills of the present form are of almost equal length. Therefore it is impossible to decide for one of the characters indicated in the key of the genus (MARCUS 1943, p. 59) under 12. In consequence the new form must be compared with all species and varieties that have palmate dorsal needles and less than four pairs of gills.

The median notch in the web excludes *A. vagus* and *A. caraibicus* immediately. The broad web of the needles of *A. flabelliger* has a partly indented border; there are three pairs of gills. *A. carteri,* also with three pairs of gills, is larger than the present form, as is shown by the recently published measurements (ibid., p. 60-61) of worms and tubes. Moreover, the dorsal needles of *A. carteri* have a smooth web.

The same holds true for the typical form of *A. schmardai* (PIGUET 1928, p. 82 f. 1 D) and generally for *A. tonkinensis* (STEPHENSON 1931a f. 3; id. 1923, p. 91: "a web which may appear ribbed"). These two species are difficult to distinguish one from another (STEPHENSON 1931, p. 295, mainly because the former has not been studied alive. Stephenson (l.c.) bases the separation on the gills that are long and cylindrical (up to 0,12 mm., CHEN 1940, p. 62) in *A. tonkinensis* (STEPHENSON 1923, p. 91), though of variable length (id. 1931a, pp. 43-44). In the preserved worms of *A. schmardai* the gills are practically indiscernible. Therefore the septal glands in the fifth to seventh segment of the latter (PIGUET 1928, p. 81) seem till now to be its most important particularity. Perhaps these "glands" are groups of chromophile cells which occur in various species of the genus.

These glands or clusters of cells are absent in *A. schmardai*

var. *huaronensis* with 3 pairs of gills and in the present form with 2 pairs. The web of the dorsal needle is smooth in the typical form of A. *schmardai* ribbed, in var. *huaronensis* and in the new form. In *huaronensis* there are about three basal ribs, in *costata* 8-16 marginal ones.

§ 3. Sexual stages of *Aeolosoma bengalense* Steph.

Figures 11-12

On 1st May the Licentiate Edmundo Nonato collected water-plants and mud containing numerous worms of the abovementioned species in the hills of Tremembé, in the vicinity of the city of São Paulo. The population was fed with lettuce in an aquarium; the temperature of the water was 18-20° C. On May 23rd 50 % of the population developed sperms and young eggs (the terminology applied is that of STEPHENSON 1930, p. 454). As far as I can judge from new samples brought at this time by Mr. Nonato, there were no sexual individuals under natural conditions. In the following month the number of specimens with germ-cells diminished and the temperature fell to 15-18°. From the beginning of July no more sexual worms were seen. The population was examined weekly. In September the temperature began to rise. On September 29th huge eggs were verified in various animals and mobile sperms in many. Already on 2nd October the number of worms with gonads was smaller and in the next days eggs were no longer visible, only some spermatozoa.

As in *Aeolosoma headleyi* (MARCUS 1944, p. 38), the female germ-cells occur in several segments (Fig. 11), but full-sized ones only in the fifth to eighth. Only in one ovocyte at a time yolk granules are formed. In the segment that contains the growing ovocyte a clitellum develops with the primordium of a female pore in its center (Fig. 12). Eggs were not laid in this population. The full-grown egg degenerates, and can be substituted by one of the 2-3 other ovocytes in the same segment. The female germ-cells of all other segments disintegrate. The factor that determines which of the segments between the fifth and eighth becomes fertile is unknown; this question must be studied in earlier stages of growth of the ovocyte. The disposition of the eggs in *Aeolosoma bengalense* is intermediate between *A. headleyi* Bedd. and *A. kashyapi* Steph. In the former the female germ-cells appear in many segments and grow simultaneously in various segments (MARCUS 1944, t. 7, f. 29). In the latter eggs are formed in the sixth segment (ibid., p. 44-45), or exceptionally in one of the neighbouring segments. After degeneration of the oldest ovocyte one

of the younger ones grows to full size, as in *Aeolosoma bengalense*.

The largest ovocytes of *A. bengalense* are 0,25-0,3 mm. in length and 0,1 mm. in height and thickness. Such a size is in disproportion to the body, the diameter of which was 0,2-0,25 mm. in the worms of this population. The female germ-cells lie in groups in the coelom between the two parietal layers. Though *A. bengalense* has no true septa, the somatopleure and splanchnopleure are connected by strands of loose cells and muscle-fibers (Fig. 12, m.) and are united at the mouth, anus and in the budding zone. Within their groups the smallest ovocytes lie generally in front of the bigger ones. In *A. bengalense* like in *A. headleyi* the group of young eggs touches the ventral vessel. When the growing ovocyte lengthens, it reaches one of the commissural vessels (Fig. 11, s) that pass from the ventral vessel to the intestinal blood-plexus. here Where the egg approaches the wall of the intestine, the layer of chloragocytes is interrupted, perhaps after being depleted (LIEBMANN 1942). Peritoneal cells of the somatopleure (Fig. 12, e) invest the full-sized ovocytes with a layer of flattened follicular cells. The yolk granules are of differente size.

With the progressive growth of the first ovocyte the epidermis of the fertile segment becomes high and glandular on the side that contains the egg. Some colour-glands (Fig. 12, g) persist between the epidermic glands The sharply defined clitellum thus developed is restricted to that part of the skin that covers the ovum. In the middle of the clitellum some high, columnar cells without granular contents surround a cutaneous invagination. This primordium of a female pore never was seen to be pervious, neither in *A. bengalense* nor in *A. headleyi* or *A. kashyapi*.

Male and female germ-cells occur in the same worm, or only male cells were observed. The fixed spermatospheres (morulae) were found in all segments from the backwards, even in the young zooid behind the fission zone. Free floating ones fill the entire body-cavity including the prostomium. The cytophore (blastophore) bears 128 spermatids. The spermatozoa are agglomeratd in tufts (Fig. 11, t. 12, s) to the nephridial funnels, except to the first pair. The number of the nephridia is not always complete. Part of the spermatozoa moved their tails.

In the majority of the worms with female and male germ-cells fission went on simultaneously with sexual development. The fragments of degenerated ovocytes were taken up by phagocytic amoebocytes. Some of these wander into the body-wall, and I observed in various cases that the yolk was removed through the skin. Elimination of yolk by the nephridia did not occur.

§ 4. Phylogenetic consideration of the sexuality in the Aeolosomatidae

The sexual organs of the genus *Aeolosoma* are imperfect. Moreover they exhibit a strange combination of primitive and of probably regressive characters. Ancestral traces are: the origin of the germ-cells in many segments with only a beginning of fixed genital segments, and the nephridia as only male ducts. The rarity of sexual reproduction and still more the inadequacy of the efferent organs can hardly be understood if not due to regression. The idea of a partial involution of the reproductive organs somewhat disturbs our conception of the archaic position of the Aeolosomatidae among the Oligochaetes. But one might suppose that Aeolosomatids like *Potamodrilus* (LASTOCHKIN 1935) wiht female pore, male ducts (nephridia) and without fission, gave rise to the Naididae in which the efferent organs are less imperfect than in *Aeolosoma*. From the Naididae it is not difficult to pass on to the Tubificidae (*Aulodrilus*). In this case the genus *Aeolosoma* would among the first annelidan immigrants into the fresh-water represent a branch in which the well-known substitution of larvae by a huge amount of food-yolk in the eggs was exaggerated.

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EXPLANATION OF PLATE I

1-3 *Aeolosoma corderoi*, sp. n.

1. Dorsal view of a chain of two zooids. a. limit of the ventral ciliated field. b. cerebral ganglion.
2. Needle-seta.
3. Head, lateral view. b. brain. c. cephalic glands. d. ciliated pit.

4-10. *Aulophorus schmardai* (Mich.) forma *costata*, f. n.

4. Ventral crotchet of the fourth segment.
5. Ventral crotchet of the tenth segment.
6. Dorsal setal bundle.
7-8. Lateral views of the hinder end.
9. Dorsal view of the hinder end.
10. Ventral view of the hinder end.

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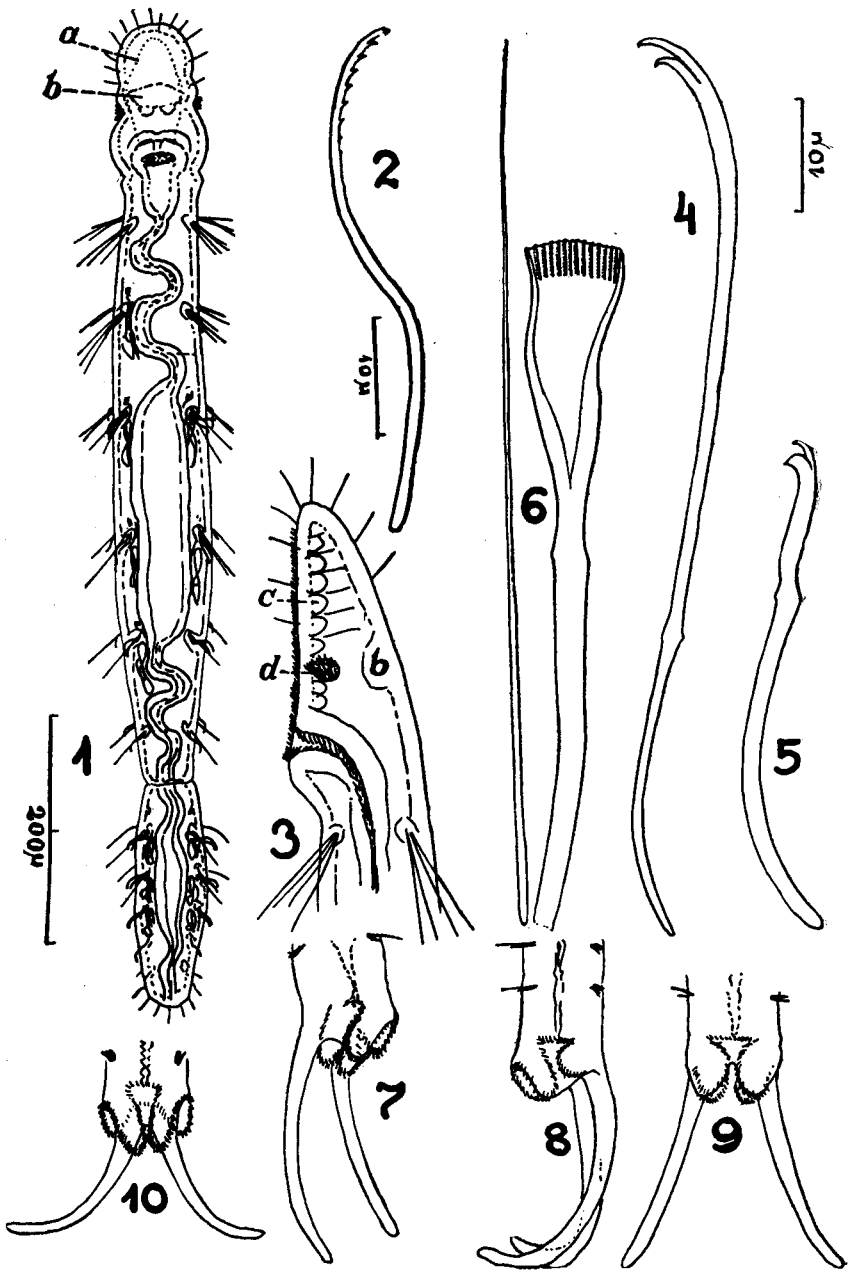
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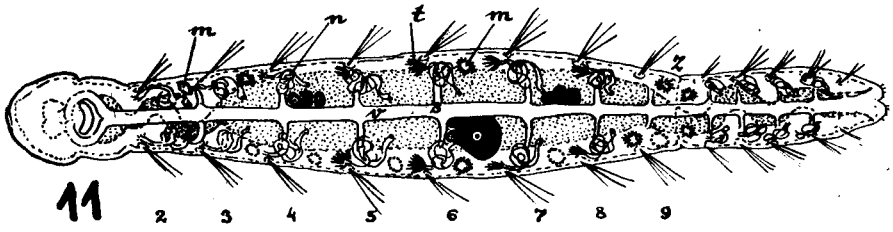
Explanation of plate II

11. Ventral view of *Aeolosoma bengalense* with germ-cells. m, fixed spermatospheres. n, nephridium. t, spermatozoa on a nephridial funnel. s, commissural vessel. v, ventral vessel. z, fission zone. 2-9, second to ninth segment.

12. Combined sagittal section of the fertile segment of *Aeolosoma bengalense*. c, chloragocytes. d, epidermis. e, peritoneum. g, colour gland. i, intestine. m, septal muscle. n, nephridium. o, ovocytes. p, female pore (not pervious). s, spermatozoa. t, clitellum. u, splanchnic circular muscles.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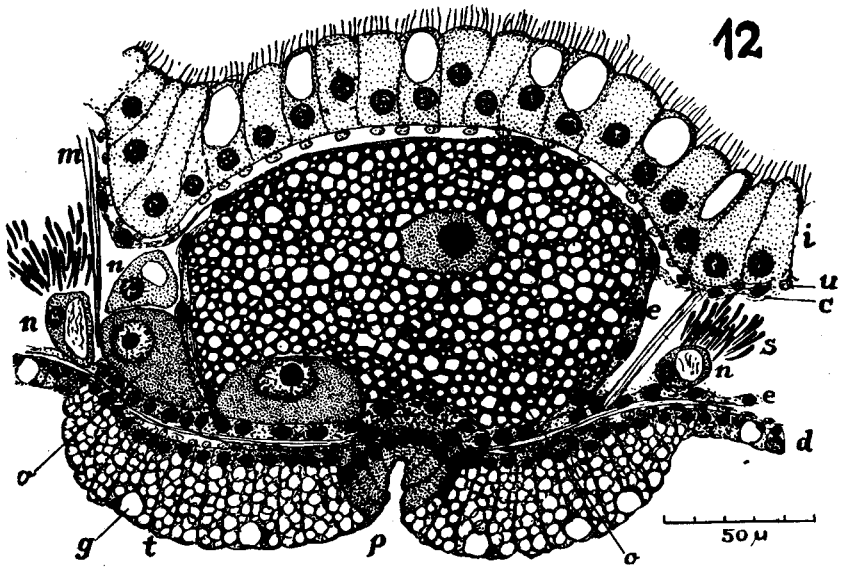
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