

COMUNICACIONES ZOOLOGICAS DEL MUSEO DE HISTORIA NATURAL DE MONTEVIDEO

Número 49

1948

Volumen II

OTOTYPHLOMERTES FROM THE BRAZILIAN COAST

DIVA DINIZ CORREA *

In January, March and September 1948 I stayed at the Island of São Sebastião, 100 km. East of Santos, collecting Turbellarians with Professor and Mrs. Marcus. When we applied WILHELM's baiting-method (1908, p. 649; 1909, p. 24) with freshly killed fishes in coarse and middle-fine sand in the tide zone, we obtained in some samples less Turbellarians than Nemerteans. Also without bait we obtained a pretty rich material of worms. The latter were for the most part statocyst-bearing Hoplonemertini (Metanemertini) and therewith easily recognizable (FRIEDRICH, 1936, p. 11) as belonging to the genus *Ototypylonemertes* DIESING (1863, p. 180). Closer examination showed that we had found two new species, a bigger one, *O. evelinae* that I take the pleasure to name for Mrs. Eveline du Bois-Reymond Marcus, and a much smaller one, *O. brevis*.

The occurrence of *Ototypylonemertes* in South-American waters has not yet been recorded. In the last monograph of the class (BÜRGER 1907) the total distribution of the genus (pp. 493, 494) comprehends the European Atlantic coast (two species, one of which uncertain), the Mediterranean (four species) and the Black Sea (one species). At that time *Ototypylonemertes* was not known from the Atlantic coast of North America (p. 497). Also in a newer list (FRIEDRICH 1936, p. 52) the two European-Atlantic species are not recorded from the American Atlantic coast. As the "Zoological Record" does not register every new locality of known species, possibly one or another of the species described in the Fauna of Naples (BÜRGER 1895, pp. 551-552) and better defined than the European-Atlantic ones has been verified on the Atlantic coast of North America. Therefore and because I cannot bring all faunistic North-American papers together, I am inclined to consider BÜRGER's statement of 1907 as not definitive, so much the more as *Ototypylonemertes* is known from California (COE 1940, p. 288).

* Department of Zoology, Faculty of Philosophy, Sciences, etc. of the University of São Paulo, Brazil. P.O.B. 105-B.

Zoogeographically *Ototyphlonemertes* is little-known, because its small and tender species are wanting in the collections of the expeditions (BÜRGER 1907, p. 484). It may be added that also the sand-dwellers among the Turbellarians are not represented in the reports of general collections; they can only be obtained by specialized work.

I. OTOTYPHILONEMERTES EVELINAE, n. sp.

Figures 1-7

External characters. The body is nematoid, cylindrical and of firm consistence. The head is transversely truncate; the hind extremity is rounded and as broad, or a little wider or narrower than the head. The movements of the worms are very similar to those of the accompanying sand-Turbellaria (Seriata). They glide by means of their cilia without visible muscle-contractions on the sand as well as in the watch-glass. Living worms attain a length of 30 mm.; the breadth varies between 0,2 and 0,3 mm. The colour is whitish or light blood-red. The cerebral pores lie immediately in front of the brain (Fig. 1). The common orifice of the alimentary tract and the proboscis is a circular, terminal pore. At the hinder level of the brain a narrow belt of low, gland-free cells surrounds the body. This belt seems to correspond to the cephalic furrows of other Hoplonemertean, although these lie farther forward than in the present and the following species (Fig. 8. cf.).

Integument and body-wall. The epidermic cells are high (e), and among them occur numerous glands with granular eosinophilous and brilliant content as well as other weakly cyanophilous ones. The cutis (g) is a thin membrane. The annular muscles are distinct on the whole length of the body, not so especially thin as in the species studied by BÜRGER (1895, p. 139). The longitudinal muscles (m) are very much thicker than the circular ones. Both layers reach the tip of the head. Dorso-ventral muscles were not observed. The parenchyma is very spare. The spongy tubes of the cephalic gland stain light pink and extend backward to the level of the cerebral organs. Their openings do not unite.

Digestive canal. The oesophagus (h) opens into the rhynchodaeum anteriorly to the brain. Behind the brain begins a dilated and very much folded section, the stomach, that is densely ciliated and has many glands. The length of the stomach is about 0,75mm. In transverse sections it shows a dorsal concavity, not unlike a typhlosolis. The low epithelium of the stomach changes suddenly into the straight, high-cellular, and diffusely ciliated wall of the intestine. The lumen

of the latter can be completely obliterated by the mighty swollen resorbent cells. *O. evelinae* has no caecum, contrary to BÜRGER's statements (1895, p. 139; 1907, p. 426) for the genus *Ototyphlonemertes*. The lateral diverticula of the intestine are hardly developed, only in compressed worms they become more distinct. A rectal dilatation of the gut does not occur. The annular muscles of the body-wall thicken around the anus forming a strong sphincter. Of splanchnic muscles only longitudinal fibres around the oesophagus were observed. As little as BÜRGER (1895, p. 139) I could detect any traces of excretory organs. As BÜRGER said (1899, p. 292) that the examination of sections is not sufficient for a negative result, I have searched for them also in living worms, but in vain.

Proboscis. The rhynchocoelom (proboscis-sheath) is short. It extends backward not beyond the first third of the body length. Occasionally it is widened in the region of the stomach by the loops of the introverted proboscis. This dilatation also modifies the external form of the anterior part of preserved worms, that under such conditions are somewhat swollen in the mentioned region. The wall of the rhynchocoelom consists of a flat epithelium, longitudinal and annular muscle-fibres. Few fixator muscles of the proboscis are developed in the precerebral region, immediately at the insertion of the proboscis. These muscles connect the proboscis with the longitudinal muscles of the body-wall; they do not form a continuous septum. The short retractor of the proboscis originates close before the hind end of the rhynchocoelom in the dorsal wall of the latter.

The proboscis (f) has about a third of the diameter of the body, and with, 0.06-0.085 mm. it is not so extraordinarily thin as in the other species of the genus. Its layers, the rhynchocoelomic epithelium, the very thin musculature (annular, longitudinal and annular fibres) and the proboscidial epithelium, correspond to the hoplonemertean scheme. The proboscidial epithelium is even in the everted condition of the proboscis higher than that of the rhynchocoelomic surface. The anterior (a) and posterior (p) chamber of the proboscis are cylindrical and of about equal length. The middle chamber (septum) is 0.14mm. in length and composed of diaphragm (d) and bulb-like vesicle (v), both of equal length (0.07mm.). The same comparatively long diaphragm and bulbiform vesicle occur in *O. duplex* (BÜRGER 1895, t. 29: f. 9). The ejaculatory duct (t) between vesicle and diaphragm is 0.034mm. long; the passage between vesicle and posterior chamber is quite short. Many erythrophilous glands occur in the posterior chamber and also the proboscidial epithelium of the anterior chamber shows acidophilous glands. In comparison with *O. macintoshi* and *O. spiralis* the basis of the central stylet is short, only almost twice as long (0.023mm.) as broad, viz. 0.014 mm., at its widest level. The

central stylet (u) is joined into the basis (j) and measures 0,04 mm. in length. Its basal flange is 5 μ broad, the smooth dart 3 μ . There are 2-3 accessory stylets (x) in each of the two lateral pouches which are 0,04 mm. long.

Blood-vascular system. The dorsal vessel (dv) originates from one of the two lateral vessels (l) that compose the cephalic loop. A ventral connection (brain-commissure) or knot of these does not exist. For a distance of about 0,15 mm. from its offspring the dorsal vessel runs within the rhynchocoelom in its ventral part. The lateral vessels do not always lie ventrally to the lateral nerve cords but sometimes also dorsally or medially and laterally to them. The lateral vessels are united by a supra-intestinal commissure that lies near to the anus.

Nervous system. The dorsal (dg) and ventral (vg) ganglia are thick and of about equal volume. Externally the upper and under half of the brain are well separated, but internally they are coalesced in the anterior part. The lateral nerve cords (e) lie medially to the longitudinal muscles of the body-wall and are connected by a supra-intestinal commissure in the anal region. Each cord includes a number of longitudinal muscle fibres (r) on its medial border, as such were described in some other Hetero and Hoplonemertean (BÜRGER 1895, p. 341, 358; 1898, p. 91; "Seitenstamm-Muskeln" BÖHMIG 1929, p. 42). One or sometimes two neurochords (n) were seen in the center of the lateral nerve cords. The outer neurilemma is strongly developed everywhere; it stains dark brown and makes possible to accompany nerves given off from the lateral cords to the integument and the gut.

Sense organs. As a rule one pair of statocysts (s) with a longer diameter of about 0,02 mm. occurs. Their shape is ovoid with the pointed pole directed inwards in compressed worms; in the free swimming ones the statocysts are more or less spherical (Fig. 7). They lie in the posterior region of the brain (b) on the dorsal surface of the ventral ganglia, the nerve cells of which surround the statocysts. Exceptionally the statocyst may be duplicated, on one or both sides, one lying behind the other with a rather small space between them. Transverse sections show elliptical nuclei in the strong membrane of the capsule of the statocyst. The statolith does not fill the cavity. It lies somewhat excentrically in the statocyst, towards the median line of the body. This position may change, if the worm is compressed for examination. The statolith is in most cases composed of two globules (Fig. 7). These are generally so closely united that one bipartite statolith results, the two halves of which are flattened in the plane where they touch. Sometimes the two globules meet only in one point and exceptionally they are united by a narrow cylindrical middle piece. In this case the statolith is dumb-bell shaped (Fig. 7). Rarely

a tripartite statolith was seen. The lateral sense organs that were described of *O. spiralis* COE (1940, p. 289) do not occur in the present species. The cerebral organs (o) are small, as is the rule in such that lie before the brain. They extend inwards for about 0.05 mm. Their pores lie at the level of the insertion of the proboscis in short transverse slits. The cerebral canal passes through epidermis, cutis, annular and longitudinal muscles and is composed of three different parts: the bulb-like external one (er) has a wide cavity, the middle (mr) capillar tube shows erythrophil secretion in its cells and the inner slightly dilated section is the sensory region (sr), as far as can be concluded from its lining epithelium. A small field of nerve cells (nc) lies around the blind inner end of the cerebral canal. These cells connect the sensory cells of the internal part of the canal with the dorsal ganglion. The presence of a nervous connection between the organ and the neighbouring ganglion on the one hand and its far remoteness from the epidermis on the other corresponds to the type represented in BERTA SCHARRER's figure 4 (1941, p. 116). Two groups of gland cells (q) occur on the dorsal and ventral side of the inner part of the cerebral canal; they open into the middle section where this passes to the inmost.

Gonads. The species is dioecious. The ovarian and testicular sacs lie latero-dorsally and latero-ventrally in the posterior half of the body. Up to four sacs (y) occur in one transverse section. As the intestinal pouches are indistinct, they do not alternate with the gonads, and the reproductive organs of the two sides are often not symmetrically disposed. That is uncommon in the Hoplonemertean (BÜRGER 1895, p. 430). At most the topography of the gonads in *O. evelinae* can be compared with the systematically related *Nemertopsis peronca* (QUATREF.) (i.e., t. 15: f. 5). However in the present species the pores (k) do not open only dorsally but also ventrally to the lateral nerve cords. Also in *O. spiralis* the gonads do not regularly alternate with the intestinal diverticula. The maximum number of eggs on one side counted in *O. evelinae* was 64.

II. OTOTYPHILONEMERTES BREVIS, n. sp.

Figures 8-13

External characters. The worms have a cylindrical and consistent body. The head is still more distinctly truncate than that of *evelinae*. The hind end has a peculiar ventro-caudal plate (cp) produced by salient epithelial cells which are much higher here than on the rest of the body. This plate is divided by a median furrow. The movements

are the same as in the preceding species. The length of the living animals is up to 10 mm., preserved they measure 3 mm. The breadth is uniform throughout the body, 0,5 mm. in the living and 0,2 mm. in the preserved worms. The distance between the anterior end of the body and the beginning of the dorsal ganglia is small, 0,22 mm. Also in *O. brevis* occurs the cephalic furrow (cf) described in *O. evelinae*. The colour is whitish or light pink, depending on the state of nutrition. The proboscidal and oral opening is circular and lies terminally. There are no traces of cerebral organs.

Integument and body-wall. The epidermal cells are high, increasing in height towards the caudal plate. They are lower on the ventral surface in the middle of the body. Between the epithelial cells lie many eosinophil glands and a few cyanophil ones that are less brilliantly stained than the former. The gland cells are more numerous on the dorsal than on the ventral side. The cutis is no more than a distinct membrane. The muscular layers are well developed on the whole length of the body. The longitudinal layer is four or five times as thick as the outer annular one. Dorso-ventral fibres were not seen. The parenchyma is inconspicuous. The spongy tubes of the cephalic glands (cg) are very long; they reach the hind end of the body. In horizontal sections they form two lateral bundles that lie between the longitudinal muscles and the intestine. Their united outlets open dorsally to the rhynchodaeal pore. In transverse sections the glands surround the whole intestine. Their contents stain faintly blue.

Digestive canal. The oesophagus parts from the rhynchodaeum before the brain. It is wider than in *O. evelinae*. Behind the brain the stomach (st) has a richly folded, densely ciliated epithelium with numerous gland-cells. The stomach is 0.2 mm. long. Behind it the intestine (i) has a very high epithelium intermingled with very many gland-cells (cg) that extend from the base of the epithelium to the free surface. Their granular erythrophilic content resembles that of the granular club-shaped cells of Minot in Turbellaria. In total mounts the lumen of the intestine is visible for the whole length of the gut. There is no caecum, as in *O. evelinae*. The intestine has no true lateral diverticles, but the gonads lying in intervals form depressions between which pouches are produced. The rectum is not dilated. A thickening of the annular muscles around the dorso-terminal anus (an) constitutes a strong sphincter. The gut contained Crustaceans and many setae of Polychaetes. Neither in living nor in preserved and sectioned worms did I succeed to see any excretory organs.

Proboscis. The elliptic rhynchocoelom is very short; in living worms with the proboscis in repose it extends backwards only to the limit between stomach and intestine. The length of the rhy-

chocoelom everted proboscis corresponds to three times the breadth, with retracted proboscis it is four times as long as broad. The wall of the rhynchocoelom is composed of an epithelium with flat nuclei and a thin layer of longitudinal and annular muscle-fibres. The retractor muscle (rm) inserts at the hind end of rhynchocoelom. This point is also the hind end of the posterior chamber of the proboscis.

The extremely short proboscis measures 0.25 mm. in preserved worms; the diameter is 0.08 mm. Its layers are the same as in *O. evelinae*; there are abundant acidophilous glands in the proboscideal epithelium. The posterior chamber (p), the biggest part of the proboscis, is 0.105 mm. long. The middle chamber composed of diaphragm (d) and bulb-shaped vesicle (v) is nearly as long, 0.1 mm.; the anterior chamber (a) is 0.045 mm. in length. The ovoid posterior chamber directs its pointed pole backward. While the bulb-shaped vesicle is very similar to that of the preceding species, the diaphragm and the stylet (u) are different. The diaphragm is square. Basis and dart of the principal stylet are of equal length, 0.015 mm. each. The basis (j) is cylindrical with slightly waved borders. The dart is smooth; its greatest breadth is 4 μ . There are 4-5 accessory stylets (x) in each pouch, all of which are directed with their points backward.

The blood-vascular system corresponds to that of the previous species, as far as I could see.

Nervous system. Particularities of *O. brevis* are 6-8 successive constrictions in the beginning of the lateral nerve-cords (c), that cause a moniliform aspect. The lateral nerve-cords contain one small neurochord and include the same medial longitudinal muscle-fibres as in *O. evelinae*; these are more distinct than in the latter. The rest, the brain and the neurilemma, resemble those in the preceding species.

Sense organs. Generally there is one pair of slightly ovoid statocysts (Fig. 12), the bigger diameter of which is 0.02 mm. Their position is the same as in *O. evelinae*. Exceptionally there may be two pairs of statocysts, then the anterior pair is much smaller than the posterior one. The round statolith (Fig. 12) is composed of a number of more than ten spherical crystals. In the optical section there is one central sphere surrounded by 5-6 others of equal size.

Cerebral organs are absent. I have looked for them carefully in the living worms, in whole mounts and in many series of sections. The absence of cerebral organs was hitherto only established (FRIEDRICH 1936, p. 12) in some Palaeonemertean, in the Bdellomorpha (genus *Malacobdella*), and among the Hoplonemertean in the Polystilifera and the parasitic monostyliferous genus *Carcinonemertes*.

Ototyphlonemertes brevis seems to be the first monostyliferous free-living Hoplonemertean without cerebral organs.

Gonads. The sexes are separated. Testes (y) and ovaries begin shortly behind the limit between stomach and intestine and extend to the hind of the body. They are distributed irregularly on both sides, not altering with the indistinct intestinal pouches. Their number is up to 15 on one side. The localization dorsally and ventrally to the lateral nerve-cords, as described in *O. evelinae*, results in the same position of the gonopores. The male ducts (k) are especially well developed in this species; they are narrow in the region of the muscular tube and widen at the level of the epidermis.

III. COMPARISON OF *O. evelinae* AND *O. brevis* WITH THE PREVIOUSLY DESCRIBED SPECIES OF THE GENUS *Ototyphlonemertes*

In his key for classification BÜRGER (1904, p. 27) used as taxonomic characters the number and the shape of the statocysts, the number and the form of the statoliths, the length and the colour of the body. Of these criteria the number of statocysts proves to be worthless, as *O. evelinae* and *O. brevis* may occur with 2, 3 or 4 statocysts. The shape of the statocyst, spherical or ovoid, seems to be constant in the various species. As is shown by *O. spiralis* COE (1940, p. 288) with 8, 12 or 16 globules the number of the statoliths can only be indicated in general terms, for example distinguishing those composed of few or many crystals. The form of the statoliths is somewhat variable; those of *O. evelinae* are as rule bipartite (Fig. 7) but exceptionally dumb-bell shaped and tripartite ones occur. The maximum length attained in a great population of mature worms is certainly a specific character. The colour of the body must be used with caution, as for example specimens of the two present species are bright red when they had fed recently upon fish-blood. The length of the three chambers of the proboscis as well as the length of the central stylet in proportion to its basis and the shape of the latter offer valuable disjunctive criteria for classification.

The hitherto known species and subspecies of *Ototyphlonemertes* are:

(1) *O. pallida pallida* (KEFERSTEIN 1862, p. 60; BÜRGER 1904, p. 28), the type of the genus, based upon one young specimen. The distance between the tip of the head and the cerebral pores is twice the breadth of the body. In *O. evelinae* it is maximally one and a half times the breadth of the body. In *O. brevis* the distance between the anterior extremity and the beginning of the brain is not bigger than the breadth of the body.

(1a) *O. pallida czerniavskyi* BÜRGER (1904, p. 28). Each statocyst con-

tains one pair of big and one of small statoliths (against *evelinae* and *brevis*). The breadth of the body is nearly one fourth of the length (against *evelinae* and *brevis*).

(2) *O. aurtia aurita* (ULJANIN 1870; see BÜRGER 1904, p. 28). Bath extremities taper, whereas in *O. evelinae* and *O. brevis* the head is truncate.

(2a) *O. aurita suchumica* (CZERNIAVSKY 1881; see BÜRGER 1904, p. 28). Has the same body-shape as *aurita aurita*, and the same orange colour as the latter.

(3) *O. claparèdei* (DU PLESSIS 1891, p. 414: *claparèdii*). This is the species identified by CLAPARÈDE (1863, p. 22) with *O. pallida* (KEFERSTEIN). CLAPARÈDE's immature specimen attained 30 mm. in length (against *brevis*); at this size *O. evelinae* is mature. *O. claparèdei* was found on the Northwest of France, at St. Vaast la Houghe, and so poorly described that already BÜRGER (1904, p. 28) considered it as an uncertain species.

(4) *O. aurantiaca* (DU PLESSIS 1891, p. 415). The colour of the body is golden, and the length is up to 20 mm. (against *evelinae* and *brevis*). The ovoid statocysts each with one bilobed statolith distinguish *aurantiaca* from *brevis*.

(5) *O. duplex* BÜRGER (1895, p. 551). Differs from *evelinae* by its maximum length of 10 mm. and from *brevis* by the dumb-bell shaped statolith.

(6) *O. macintoshi* BÜRGER (1895, p. 551). The cylindrical not bulb-like middle chamber of the proboscis separates this species from the Brazilian ones.

(7) *O. brunnea brunnea* BÜRGER (1895, p. 552). Differs from *evelinae* and *brevis* by brownish pigment and two brown spots on the head. The statolith is dumb-bell shaped (against *brevis*).

(7a) *O. brunnea davidoffi* OXNER (1907, p. XC). As the colour of the body is the same as in *brunnea brunnea*, this subspecies differs from both Brazilian species.

(8) *O. spiralis* COE (1940, p. 288). By its length up to 50 mm., lateral sense organs and spiral ridges of both central and accessory stylets the species can be separated from *evelinae* and *brevis*.

IV. BIOLOGICAL OBSERVATIONS

Ototyphlonemertes evelinae and *O. brevis* dwell in the sand in the zone from about the middle between tides to the normal high water line. While the water is quiet, the worms stay near the surface; with heavy waves they go deeper into the sand and can be caught only in small numbers or with bait. Of the acoele Turbellarians *Convoluta* with statocyst it is known that the worms are negatively geotactic in quiet and positively geotactic in agitated water. Positive geotaxis as reaction to shaking was described in a species of *Otoplana* (Turbellaria, Seriata) by JÄGER (1932, p. 302). The same positive geotaxis can be observed by heaping the sand that contains worms and is just covered with water on one side of the dish and then carefully inclining the dish. Immediately the worms.

begin to glide out of the sand and accumulate in the water on the deeper side of the dish. For my experiments I used transparent salad-bowls of plastic material, of 25 cm. diameter and ca. 8-10 cm. height. I counted the worms and found that 96 worms came out into the water and 48 remained in the sand; in other experiences 111, 36 and 96 came out and 73, 3 and 6 stayed in the sand.

One might say that these experiments show a negative rheotaxis, as the water in this arrangement flows downwards. But some water is retained between the sand-grains, especially if the dish is inclined in an angle of less than 30° to the horizontal plane. Certainly the movement of the water gives the impulse for the positive geotaxis of the worms, but they are by no means washed out of the sand with the current. I also often left the lower border of the sand heap covered with water, so that no current affected this zone. Nevertheless the worms left also this stripe of sand and glided positively geotactic into the deeper water. Some minutes after the impulse had passed, the positive geotaxis ceased and the worms glided about on the walls of the bowl and also crept upwards and sometimes back into the wet sand. The disposition for this experience proved to be of value also for obtaining sand-dwelling Turbellaria, that we had till then piked from small samples of sand with much trouble. Also forms without statocyst creep downwards in the inclined dish, for example *Macrostomum evelinae* MARC.

I consider my experiences as quite preliminary, and must still find an arrangement in which the worms do not go from the drier to the wetter medium as in the described disposition but can only go upwards or downwards. Negative geotaxis does certainly also occur, else the worms would always remain in the lower layers of the sand and not return to the higher levels with quiet water. It is also possible that the worms follow the rhythm of the tides, descending with low tide and rising with the flood, vertically following the level of the water. In the days when I experienced with the inclined dish, at the end of our stay, we generally collected our worms during falling tide. From earlier collections I remember that the worms sometimes crept upwards out of the sand to the rim of the water and remained there. This was not due to wanting oxygenium, as the phenomenon occurred immediately after filling the sand into the dish on the beach. I think that these worms possibly were "rising with the flood".

It is known that the positive geotaxis of *Convoluta roscoffensis* GRAFF, a species with eyes, is conditioned by shaking and by darkness. To see whether *Ototyphlonemertes* has any photodermatical sense, I put some worms into a dish, one half of which was exposed to daylight, the other shaded. The glass dish of 10 cm. diameter was filled

with sea-water 5 mm. high without any substratum and was half covered by a pasteboard box. The worms showed no reaction to the different intensities of light. They glided in the light and in the dark, without directing themselves to the one or the other half, and did not react phototactically on the limit, nor did they come to rest in one or the other field. They have no photodermatal sense.

The worms are in a high degree positively thigmotactic. If one covers a part (about one tenth) of the bottom of the big bowl with sand, all the worms gather in this sector and remain there. Of course one or the other creeps out of the sand again, without recoiling from the light, but after an hour (temperature of the water: 20° C.) all worms are in the sand with exception of such that had been damaged during the transmission into the experience dish. It is the effect of positive thigmotaxis that some or even many worms remain in the sand, when the bowl is inclined. If I place the sand on the lower side of the bowl all worms glided down and crept into the sand. In this experiment positive thigmotaxis and positive geotaxis act together. The worms find the sand by trial and error. I did not observe any effect at distance of the sand or any chemical perception. When I let the worms glide out of a pipette into the bowl at the edge of the water on the side opposite to the light, they move downwards in a straight line and continue in this direction for a while on the bottom. Then they often turn at a right angle and glide to the border, where on the left side a heap of sand was placed, on the right a heap of fine glass-tubes (0.5-0.8 mm. in diameter). In a preliminary experience with fine sand (diameter of grains 0.5-2 mm.) and gravel (diameter 2-5 mm.) I had by the sharp turn of the worms to right or left the impression of a directed reaction. But when I replaced one of the heaps by glass-tubes, I saw that a directed movement does not occur. The same fact was revealed by the behaviour of the worms when they came near the sand or crept out of the sand heap. Their movement away from the sand is not delayed and the proximity of the sand does not attract them. Between the two sizes of sand there is no preference, for example, in one experience 118 worms remained in the fine sand and 102 in the gravel. This indifference the worms also show by their occurrence on the beach. On the other hand the round and smooth surface of the glass-tubes is not thigmotactically efficient. Worms that glide in between them are not retained, but soon creep out again and glide about till they by chance find the sand and stay there.

It seems that the *Ototyphlonemertes* do not live exclusively as scavengers on the food that stays back on the beach at low tide. At least I saw one *O. brevis* with a recently eaten Crustacean in its intestine. An enormous aggregation of worms was obtained by baiting

with a fresh fish that was rinsed after lying on the sand under a stone for half an hour. The worms that had fed on the liquids of the fish were blood-red.

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PLATES I-II

Plate I

Ototyphlonemertes evelinae, n. sp.

1. View of the anterior part.
2. Transverse section at the level of the origin of the dorsal vessel.
3. Transverse section of a lateral nerve cord.
4. Transverse section of the middle region of the body with four testes.
5. Combined view of the stylet-region of the introverted proboscis.
6. Cerebral organ combined from various sections.
7. Two types of statoliths.

Significance of the lettering

a, anterior chamber of proboscis. an, anus. b, brain. c, lateral nerve cord. cf, cephalic furrow. cg, cephalic glands. cp, caudal plate. d, diaphragm. dg, dorsal ganglion. dv, dorsal vessel. e, epidermis. eg, erythrophilous gland cells. er, external region of cerebral organ. f, proboscis. g, cutis. h, oesophagus. i, intestine. j, basis of stylet. k, gonopore. l, lateral vessels (that on the right hand in Fig. 2 gives origin to the dorsal vessel). m, longitudinal muscles of the body-wall. mr, middle region of cerebral organ. n, neurochord. nc, nerve cells. ne, nerve. o, cerebral organ. p, posterior chamber of proboscis. q, gland cells. r, intra-neural longitudinal muscles fibres. rm, retractor muscle of the proboscis. s, statocyst. sr, sensorial region of cerebral organ. st, stomach. t, ejacutatory duct. u, central stylet. v, bulbiform vesicle. vg, ventral ganglion. x, accessory stylets. y, testes. z, vessel.

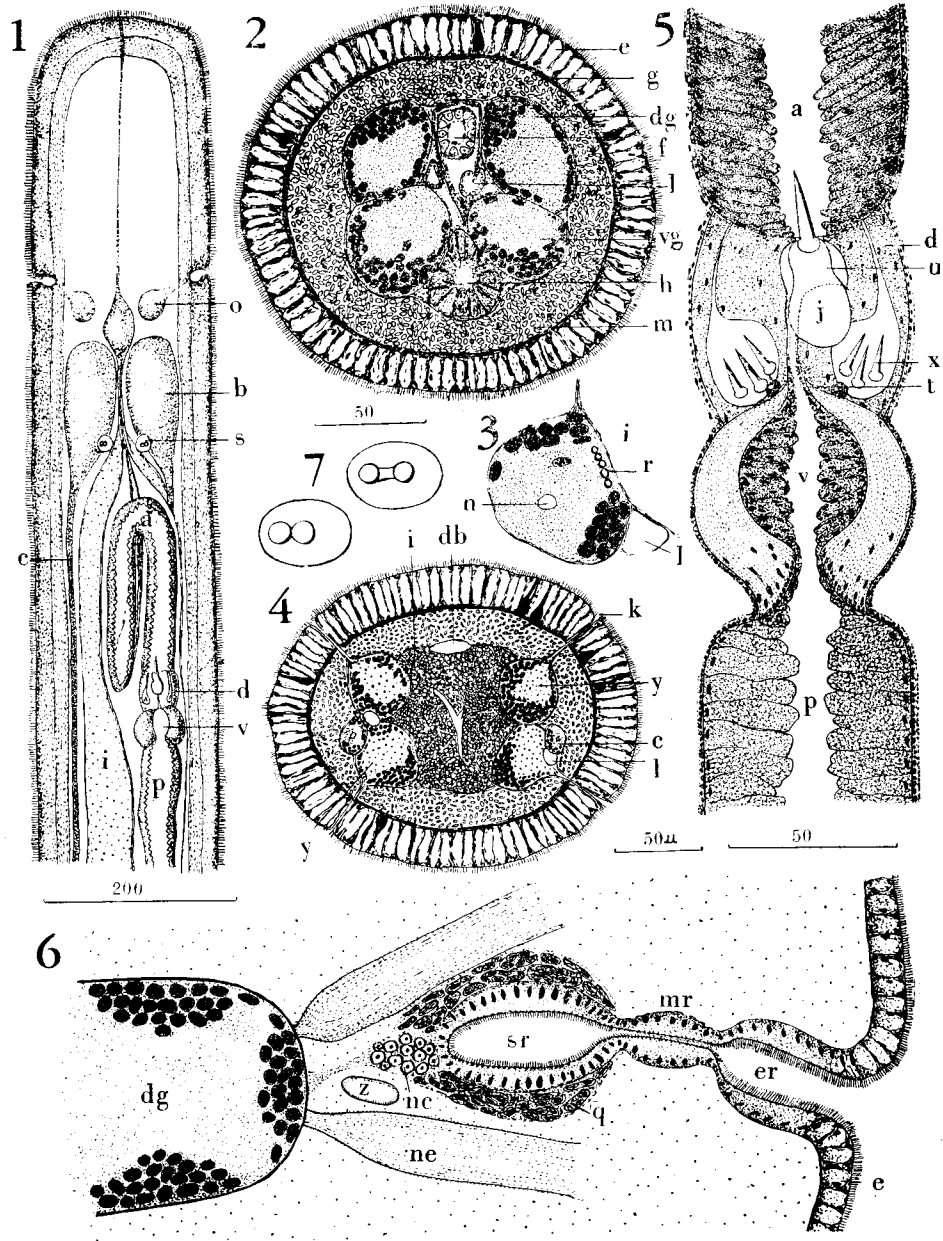


Plate II

Ototyphlonemertes brevis, n. sp.

8. View of the anterior part.
9. Combined view of the stylet-region of the introverted proboscis.
10. Horizontal section of the anterior part of a worm, the proboscis of which was protruded.
11. Median section of the hind end.
12. Statocyst.
13. Horizontal section of a testis with its efferent duct.

[For significance of the lettering see plate I]

