COMUNICACIONES ZOOLOGICAS DEL MUSEO DE HISTORIA NATURAL DE MONTEVIDEO

Número 45 **1947** **Volumen II**

NERILLA MEDITERRANEA FROM BRAZIL

EVELINE DU BOIS-REYMOND MARCUS *

The shelly sand from Guarujá near Santos brought to the laboratory by our late friend Dr. Gabriella P. Zuccari in 1946 (DU B.-R. MARCUS 1946, p. 1) contained a population of worms belonging to the Family Nerillidae Pereyaslawzewa (1896, p. 324). Several generations of these animals lived in a dish with sand and seawater for many months. The attempt to classify them went through various phases, but finally my husband and I resolved upon the name *Nerilla mediterranea* Schlieper (1925, p. 233). The explanation of SCHLIEPER's figures 2 and 3 must be exchanged.

With all previous workers I accept *Nerilla* O. Schmidt, 1848, as name for the genus, and follow BEAPCHAMP's opinion (1910, p. 12), that in MILNE-EDWARDS' publication (1844, p. 20) QUATREFAGES' "*Dujardinie*" was not sufficiently defined, although this paper contains an accurate description of the characteristic movements of the graceful animals. After BEAUCHAMP also an other French authority, P. FAUVEL (1927, p. 432), used the generic name *Nerilla*.

The limits between the various forms or species of *Nerilla* have been regarded very differently by recent authors. BEAUCHAMP admits only one species, *N. antennata* O. Schmidt; SCHLIEPER distinguishes three or even more; FAUVEL and REMANE (1932, p. 27) think that there is one species with two varieties. I consider *N. antennata* O. Schmidt and *N. mediterranea* Schlieper as distinct species. As PEREYASLAWZEWA (p. 285) has noted and BEAUCHAMP (p. 13) has emphasized, the appendages of the worms are very fragile, so that their length varies "singulièrement chez un même animal" (FAUVEL, p. 434). Therefore the characters referring to the proportions of the appendages must be employed cautiously. In the Brazilian population, f. ex., the antennae (Fig. 1, r) are sometimes of the same length as the cirri of the first segment (f), the lateral tentacles of

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

SCHLIEPER, tentacular cirri of FAUVEL, and parapodial tentacles or cirri of the peristomial segment of REMANE. In other specimens of my material the antennae are twice as long as the first cirri. The same variation can be noted in the worms from Naples. PEREYASLAWZEWA (f. 2) draws the antennae twice as long as the first cirri; in GOODRICH's figures (1912, f. 1, 9, 10) these appendages have equal length.

The following criteria were applied by SCHLIEPER (characters I-VII) for the distinction of the species and mentioned by BEAUCHAMP (VIII).

I. The difference in length between the cirri of the first segment (Fig. 1, t) and the cirri of the second parapodium (v) is much greater in *antennata* than in *mediterranea.*

II. The cirri of the second segment are much shorter than the setae in *antennata,* as long or longer as the setae in *mediterranea.*

These two characters seem to me to be safe, and they separate the known materials of *Nerilla* into two species, *antennata* and *mediterranea,* the former from the Baltic, North-Sea and the Atlantic coast of France, the latter from the Mediterranean and now from Brazil.

III. The second cirrus is shorter than the width of the body at its level in *antennata,* longer in *mediterranea.* This sign would separate PEREYASLAWZEWA's and GOODRICH's worms, both from aquaria at the Zoological Station of Naples. In the Brazilian animals the length of the second cirrus and the width of the body have no fixed proportions, and therefore I must regard this mark as useless.

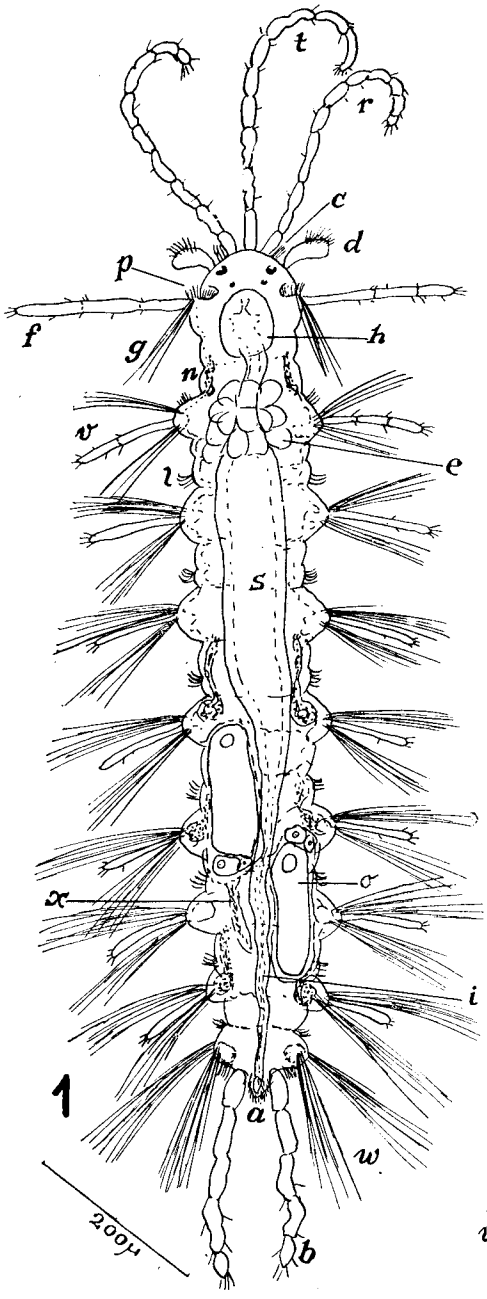
IV. The setae of the first segment are, after SCHLIEPER, 1-3 in *antennata,* 4-6 in *mediterranea.* As BEAUCHAMP's description gives 4-5, this sign contrasts with the separation resulting from characters I and II and must be abandoned.

V. The setae and cirri increase in length backwards in *antennata,* diminish in *mediterranea.* This character was already depreciated by FAUVEL (p. 434).

VI. The setae of segment 9 (Fig. 1, w) are as long or longer than the anal cirri (b) in *antennata,* shorter in *mediterranea.* As they are shorter in QUATREFAGES' and BEAUCHAMP's figures of *antennata,* this sign does not serve.

VII. The tufts of cilia between the parapodia (Fig. I, 1) are 1-5 in *antennata,* 1 in *mediterranea.* SCHLIEPER saw the sub-division of the tufts only in certain regions of some of his specimens from Kiel. It is obvious, that this is not sufficient for taxonomic purposes.

VIII. BEAUCHAMP distinguished a form with te antennae twice as long as the first cirri from an other with equal length. In the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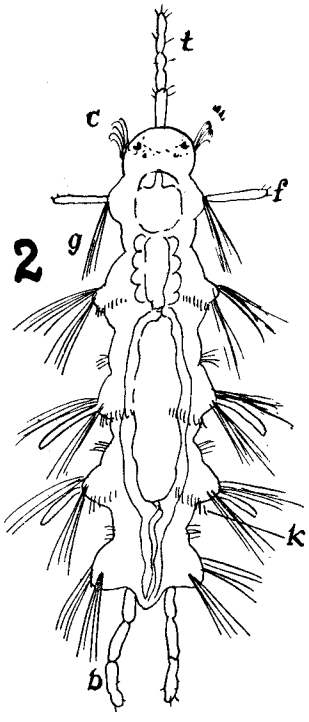
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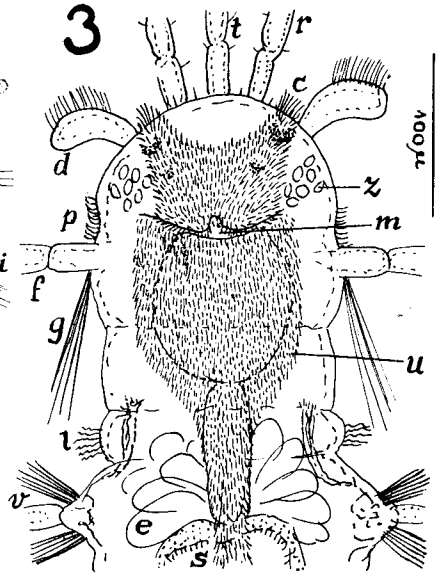
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first group we would have to unite CLAPARÈDE's and PEREYASLAWZEWA's worms, and part of mine; in the second, QUATREFAGES', and BEAUCHAMP's, GOODRICH's, and the rest of mine. This proves the character to be valueless.

IX. Possibly the difference between the developmental (postembryonic) stages may in future furnish a criterion to distinguish living populations. Al present such stages are only known from the Baltic material of *antennata* (SCHLIEPER, p. 234, f. 4), and from worms here classified as *mediterranea* from Naples (PEREYASLAWZEWA, p. 278, t. 7: f. 15), and Brazil (Fig. 2). In the following the youny worms are described.

If we apply only the two first criteria to the figures of the previous authors, we succeed to attribute all of their forms either to *antennata* or to *mediterranea*. This mode of proceeding keeps the right medium between the use of too many marks that would lead to create further species for CLAPARÈDE's and BEAUCHAMP's worms (FAUVEL, p. 433), and a complete neglection of real differences.

Through BEAUCHAMP's population of antennata also QUATEFAGES' *rotifera* (1865, v. 2, p. 67) is approached to CLAPARÈDE's and SCHLIEPER's material; the widening of the first segment of *rotifera* is sufficiently explained by FAUVEL (p. 433-434). One point still remains obscure: *rotifera* is said to be 8-10 mm. long, whereas *antennata* has no more than 5 mm. (O. SCHMIDT 1848, see CLAPARÈDE 1863, p. 48) or after recent authors, 1-2 mm. Even if we assume that the worms of QUATREFAGES had been very much stretched, the correctness of his measurements remains doubtful. If *rotifera* really attained a length of 10 mm., the cilia between the parapodia drawn by QUATREFAGES would measure at least 0,15 mm. This seems unlikely.

DESCRIPTION OF THE BRAZILIAN SPECIMENS OF *Nerilla mediterranea*

Figures 1-3

Full-grown specimens are up to 1 mm. in length (without appendages) and about 0,1 mm. in breadth. The slender delicate body is transparent and nearly colourless. Light yellow balls that look like zooxanthellae (Fig. 3, z) occur in the coelom-cells of the head. In mature worms yellow-ochre epidermal pigment is present on the ventral side of segments 5-7. The wall of the stomach (Fig. 1, s) is tinged by greenish-brown granules. The ripe male and female gonocytes are white and opaque. The pigment of the four eyes on the back of the prostomium is light brown. As in *antennata* the eyes of the anterior pair are bigger than the posterior ones.

PLATE I

Nerilla mediterranea Schl.

1. Dorsal view of a female adult worm.
2. Dorsal view of newly hatched worm.
3. Ventral view of the anterior part.

Reference letters

a, anus. b, pygidial cirrus. c, cilia before the palp. d, palp. e, oesophagic glands. f, cirrus of the first parapodium. g, setae of the first parapodium. h, pharynx. i, intestine. k, dorsal ring of cilia. l, lateral patch of cilia. m, mouth. n, nephridium. o, ovarian sac. p, ciliated pit. r, lateral tentacle. s, stomach. t, median tentacle. u, ventral cilia. v, cirrus of the second parapodium. w, setae of the ninth parapodium. x, oviduct. z, zooxanthellae.

Also the composition of the body is characteristic of the genus: a prostomium, nine trunk segments with slightly retractile parapodia, and a pygidium. The limits between the segment are indistinct; insignificant folds appear in all segments. The second segment is longer than all others, and the segments diminish in length backwards.

The appendages are: 3 prostomial jointed tentacles (Fig. 1, t. r), one median (0,4 mm.) and 2 lateral ones (0,35 mm.), and one pair (d) of ciliated palps (0,04 mm.), also on the prostomium. The peristomial or first trunk segment bears a pair of parapodia, each with a jointed cirrus (0,18-0,2 mm.; Fig. 1, f) and 4-6 setae (0,1 mm.; g). These are directed backwards and form one dorsal bundle. The cirri of the second segment (Fig. 1, v) are generally the shortest cirri (0,08-0,1 mm.). There are no further constant differences in the size of the cirri 2-8 (0,09-0,1 mm.), all not or only indistinctly jointed. The dorsal and ventral bundles of setae on the parapodia 2-9 contain 6-12 setae each that increase in length from the second (0,09-0,1 mm.) to the ninth (0,18 mm.) segment. As in *antennata* the parapodia of the ninth segment have no cirrus, but the same dorsal and ventral bundles of setae (Fig. 1, w) as the anterior parapodia. The jointed pygidial cirri insert ventrally to the anus and measure 0,2 mm.

On the level of the mouth (Fig. 3, m.), in front of the first cirri (Fig. 1, 3, f) lie the nuchal organs or ciliated pits (p). The ventral cilia (Fig. 3, u) and those of the anterior region correspond to GOODRICH's description (pp. 401-402). Also one lateral patch of cilia (Fig. 1, 1) on each side of the trunk between the parapodia 1-2, 2-3, etc., to 8-9, is well developed. Dorsal rings of cilia behind each parapodium are wanting in all adult specimens.

The ventral mouth (Fig. 3, m.) is a transverse slit with a bilobed upper lip. The muscular pharynx (Fig. 1, h) is protruded in feeding. The oesophagus is provided with a dorsal tuft of glands (e); the stomach (s) begins in the second segment and narrows in the fifth to form the gut (i) that ends with a dorsal anus (a). The entire alimentary tract is ciliated.

Nephridia (n) are present in segments 2, 5, 9, (male) and 2, 5, 6, 8, (female). The sperms are furnished by the first pair of testes that lies in the fifth segment. The ovaries lie in segment 6; one ovarian sac (o) extends forwards into segment 5, the other backwards into 7. The position of the sacs is not correlated with the right or left side.

PLATE I

YOUNG STAGES AND HABITS

Development in *Nerilla* is direct. As described and drawn by PEREYASLAWZEWA (pp. 278-9, t. 7: f. 15), the young are hatched as little worms. Our youngest specimens (Fig. 2) show the same anterior appendages as her figure and have also five segments. The newly hatched worm (0,4 mm. with appendages) has a median prostomial tentacle with three joints (Fig. 2, t.); the lateral tentacles and the palps are wanting. The ciliary tufts (c) in front of the place of the palps are very long. The cirrus (f) of the first parapodia is not jointed; the cirri of the second and fifth segment are wanting. The dorsal incomplete rings of cilia (k) behind the parapodia, known from the adults of *N. mediterranea* (GOODRICH, p. 402, t. 38: f. 1), are present in segments 2, 3, and 4. Specimens of six segments measure 0,6 mm. with appendages and show budding lateral prostomial tentacles and cirri on the parapodia of all segments. Worms of eight segments are sometimes still without palps; others have them.

The youngest stage known of *N. antennata* (SCHLIEPER, p. 234, f. 4) has six segments, and all appendages are relatively much shorter than in *N. mediterranea*. On the prostomium the median tentacle has two joints, the lateral tentacles are budding. The first cirri are half as long as the width of the body on their level, the first setae are wanting. The 2. to 5. cirri are about twice as long as broad, the caudal appendages are slightly longer; the 6. cirri are missing. The setae of segments 2-6 are very short.

We found *N. mediterranea* only in the sand with many shell fragments in the upper litoral of Guarujá, whereas *Saccocirrus gabriellae* from the same locality has in the mean time also been registered in a similar environment on a small beach at the Ilha das Palmas in the bay of Santos, and from the inner side of the Ilha Porchat. In contrast with the latter species *N. mediterranea* does not depend upon the substratum of shell fragments and can be kept alive for months in a watch-glass with sea-water and some grains of sand. The worms feed on Diatoms and other algae. They are negatively phototactic (GOODRICH, p. 398). This reaction is directed (topic, KÜHN 1919, p. 8), not phobic; probably it is a phototropotaxis.

Locomotion has various means and is always efficient. Since QUATREFAGES (1844, p. 20) the movements of these charming worms have attracted several observers, f. ex. GOODRICH (pp. 398-399), but as the synopsis of REMANE (p. 25) does not mention the present genus in the very short paragraph dedicated to the physiology of locomotion, the principal facts may be resumed here. On a flat surface the worms glide by means of their ventral cilia (Fig. 3, u), or as BUDDENBROCK

(1930, p. 274) expresses it, "walk on their cilia". They also move on the surface film of the water with the ventral side upward. When gliding the worms of the present species curl their prostomial tentacles upwards (Fig. 1) and hardly move them; the head turns slowly from side to side. A worm lightly touched by another animal, but also one that has not been disturbed, "may rise up from the bottom swimming, or rather darting, swiftly for a short distance with a sudden rapid sinuous motion of the body" (GOODRICH, l. c.). When swimming the worms meander like Chironomid larvae, but much faster. The parapodia are only used in climbing between the shell fragments. GOODRICH could take up his worms easily in a pipette; when the current hit mine, they attached themselves to the substratum with the glandular ventral surface of their pygidium.

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Imprenta "EL SIGLO ILUSTRADO"
Montevideo, 15 de Noviembre de 1947