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NOTE ON *VITTATICELLA ELEGANS* [BRYOZOA, CHEILOSTOMATA]

DIVA DINIZ CORREA *

During a trip of the staff of our Department to the sea-shore in July 1947 the above-mentioned species of the family Catenicellidae Busk (1852, p. 352) was found slightly beneath the low-water line on the rocks at the so-called Enseada de Guarujá, near Santos (Brazil). The shallow-water marine Bryozoan fauna is well known from the region of Santos, where 129 species were recorded in the course of the last ten years. *Caberea boryi* (Aud.) is included in this number, because more material was obtained since the first dead fragment was published (MARCUS 1941, p. 46). *Vittaticella elegans* (Bsk.) was only once reported for the South American coast by the "Challenger" (BUSK 1884, p. 12: off Maceió, 640 m.). The only Catenicellid hitherto described from the region of Santos is *Catenicella contei* (Aud.). (MARCUS 1937, p. 76; 1938, p. 31). The description of *V. elegans* seems useful for future workers, inasmuch as the species according to its total distribution may occur all along the Atlantic coast of temperate and tropical South America.

Publishing the present note I feel obliged to Mrs. Eveline du Bois-Reymond Marcus for her help, and to Mrs. Marta Vannucci Mendes for living material.

VITTATICELLA ELEGANS (Bsk.)

Figures 1-7

Principal references:

Catenicella elegans BUSK 1852, p. 361, t. 1: f. 2; 1852a, p. 10, t. 9: f. 1-4; THOMSON 1858, p. 82; P. H. MACGILLIVRAY 1859, p. 161; 1868, p. 143; GATTY 1877, p. LXXII; P. H. MACGILLIVRAY 1879, p. 23, t. 24: f. 10-10b; HUTTON 1880, p. 181; MACPLESTONE 1882, pp. 49-50; BUSK 1884, p. 12, t. 1: f. 2, 3, 5; P. H. MACGILLIVRAY 1887a, p. 11; 1889, p. 25; JELLY

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1889, p. 36; WHITELEGGE 1889, p. 283; ORTMANN 1890, p. 28, t. 1: f. 2; KIRKPATRICK 1890, p. 611; 1890a, pp. 16, 17; THORNELY 1905, p. 109; MARCUS 1922, p. 431, t. 24: f. 7.

Vittaticella elegans MAPLESTONE 1901, p. 203; WATERS 1913, p. 484, t. 65: f. 1-7, 12; OKADA 1921, pp. 27-28; LIVINGSTONE 1927, p. 57; 1929, p. 99; CANU & BASSLER 1929, pp. 439-440, f. 173A, E-F, 174A-N; HASTINGS 1932, p. 448; STACH 1934a, p. 19, t. 3: f. 1-4; 1935, p. 345; 1935a, p. 393; 1937, p. 382; OKADA & MAWATARI 1938, p. 460; OSBURN 1940, p. 464, t. 9: f. 78-79.

Catenaria elegans LEVINSEN 1909, pp. 255-256, t. 13: f. 3a-3b, t. 21: f. 2a. not *Catenicella elegans* BUSK 1860, p. 280.

Description: The present colonies are broad tufts, about 10 mm. in height, dichotomously branched and curled up at the tips. Uni- and bi-zoecial internodes (globuli, WATERS 1883, p. 428) separated by chitinous tubes (Fig. 2, c) alternate for the most part of the length of some branches, but series of two or several single zoecia (Fig. 1) are frequent, especially at the growing points. Also succession of two bifurcations occurs, so that a trizooecial internode is formed (Fig. 7).

The zoecia are slender with evenly arched sides. The basal wall (Fig. 4) is more gibbous than the frontal surface. As STACH (1934, p. 14) pointed out, the older zoecia tend to elongate, those near the tips of the branches are broader. A young single zoecium of the present material is 0,41 mm. long and 0,22 mm. broad, an other nearer the base of the same branch is 0,42 mm. in length and 0,185 mm. in breadth.

The orifice (aperture) of the young zoecium referred above is 0,09 mm. in height and breadth. Its protruding proximal margin is slightly concave, thickened, and has two well-developed hinge-teeth (Fig. 3, h). The frontal wall is provided with few scattered pores situated in pits; the region beneath the orifice is smooth. There are also some pores in the basal wall that correspond to the origin of the retractor of the polypide and the divaricators of the compensation-sac.

The supra-scapular chamber or compartment (Fig. 2, u) is small and lies upon and in the inner angle of the scapular (avicularian) chamber (s). The latter is developed as an avicularium directed obliquely outwards and upwards in the present specimens. The mandible (m) is small and triangular, with a sharp recurved point. The avicularium has no gland; its frontal membrane is clearly chitinized (Fig. 6, g). The scapular chamber on the adzoecial (inner) side of the daughter-zoecium (Fig. 3, b) is only occasionally developed as

an avicularium. On this place a long, raised avicularium with the mandible directed distally was found in Westpacific and Indic specimens (Barrier Reef, Arafura Sea, Aru Islands, Zanzibar), but such a giant avicularium is not developed in the material from Santos. The infra-scapular chamber (Fig. 2, i) has an oval opening and lies on the latero-frontal limit between the avicularian chamber and the zooecium. Also on the ad-zooecial side of the mother-zooecium occur the supra-scapular (Fig. 3, u) and the infra-scapular chamber, the latter is the boundary chamber (Fig. 3, d). The vittae (pedal chambers) are slightly curved, long and narrow cavities (Fig. 2, p) bounded externally by a delicate uncalcified membrane. The cavity communicates with the body-cavity (HARMER, 1902, p. 306) by a single row of six to ten tubes. In single zooecia the vittae reach up to the level of the proximal wall of the avicularia, on the adzooecial side of the daughter-zooecium (Fig. 3, b) they are short and occasionally united with the supra-scapular chamber of the mother-zooecium.

Ooecia are not present in my material of July 1947. The number of tentacles is 12 (Fig. 1). In WATERS' figure from Zanzibar there are 14 tentacles (1913, t. 65 f. 12). Radicles (Fig. 4, n) grow from circular chambers of the basal wall on a level with the proximal margin of the orifice. Besides this chamber others situated to the sides or more proximally may occur. The radicles terminate with star-like, dichotomous expansions (e).

Occurrence: Enseada de Guarujá, near Santos (Brazil), slightly beneath the low-water line; on rocks and algae.

Distribution: The species was found chiefly in the Indo-Westpacific ocean, where it is recorded for the whole area from Japan to Australia and New Zealand and westward to the eastern and southern coast of Africa. In the Atlantic *V. elegans* is reported for Porto Rico, Brazil (off Maceió and Santos) and Tristan da Cunha. The locality Madeira (BUSK 1860, p. 280) refers to *Catenicella contei* (Aud.), as NORMAN (1909, p. 295) evidenced. The colonies grow on stones, seaweed (WATERS 1913, p. 484) and floating oyster-cages (THORNELY 1905, p. 109). The bathymetrical range is from the most shallow water to the depth of 2012 m.

NOMENCLATORIAL REMARKS

The nomenclature of *V. elegans* is not yet established satisfactorily. The genus *Catenicella* was introduced by BLAINVILLE (1834, p. 462) in substitution for "Catenaires" Savigny with two species:

C. Savignyi (SAVIGNY, Égypte, Zool., Polyp., pl. 13: f. 1) and *C. divaricata* (LAMOUROUX, Gen. Polypiers, tab. 80: fig. 15, 16). The generic description given by BLAINVILLE is a mixture of the characters of the two species that the French zoologist considered (p. 463) as perhaps identical. BLAINVILLE misunderstood *Catenicella*, as LEVINSEN (1909, p. 213, foot-note) has emphasized.

Apart from the question whether "Catenaires" Savigny could be accepted in the form of *Catenaria* Sav. (indeed it cannot), *Catenaria* was already in 1800 used in a helminthological work (see STACH 1935a, p. 389). WATERS (1909, p. 130) said that the genus *Catenicella* should never have been made. This holds true only for *C. divaricata*, the type of the monotypical genus *Hippothoa* Lamouroux (1821, p. 82), that must of course preserve its original generic name. The first binary name of BLAINVILLE'S *Catenicella Savignyi* is *Eucratea contei* Audouin (1826, p. 242). The quotation of SAVIGNY'S plate by BLAINVILLE and the latter's own figures (t. 78 f. 5-5b) establish this. The genotype of *Eucratea* Lamouroux (1812, p. 183) is the anascan *Sertularia loricata* L. (HARMER 1923, p. 307). Therefore BLAINVILLE was right in giving a new generic name to *Eucratea contei*, and this species is the unquestionable genotype of *Catenicella*.

After BUSK, WYVILLE THOMSON, P. H. MACGILLIVRAY, and others had, in the second half of the last century, described many recent and tertiary species of *Catenicella*, chiefly from the Australian region, P. H. MACGILLIVRAY began to unite groups of species under new generic names, separating them from *Catenicella*. He called (1895, pp. 8, 18) the vittate species *Caloporella*. As this name only differs from *Calloporella* Ulrich (1882, p. 154) by one letter, it was substituted by *Vittaticella* Maplestone (1901, p. 201). We meet the form *Vittaticella contei* (Aud.) in later papers (WATERS 1909, p. 130; OSBURN 1940, p. 465). *Catenicella contei* was even indicated as the genotype of *Vittaticella* (CANU & BASSLER 1929, p. 438), though it is not contained in MAPLESTONE'S list of vittate species. At the time of P. H. MACGILLIVRAY and MAPLESTONE *C. contei* was known only from the Mediterranean and the Red Sea, and therefore forgotten by the Australian authors. Otherwise the vittate species must have remained *Catenicella*.

I think that both genera can be maintained, because they are distinguished by the absence (*Catenicella*) and occurrence (*Vittaticella*) of avicularia. By no means *Catenicella* can become a "general term for unclassified or insufficiently studied Catenicellidae" (BASSLER 1935, p. 66). As in other groups of animals such forms must be united as "Species Catenicellidarum generis incerti". As genotype of *Vittaticella* unfortunately BASSLER (January 1935, p. 225) selected the first species of *Caloporella*, *C. insignis* P. H. MACGILLIVRAY (1895,

p. 18), a "comparatively rare" (STACH 1933, p. 92) tertiary species. The much better choice of the abundant and extraordinarily widely distributed species *V. elegans* (STACH, May 1935a, p. 393), already known from the lower Miocene, came four months too late.

As long as only a single ovicell was known of *Catenicella contei* (NORMAN 1909, t. 42: f. 3), the genus could be placed in the sub-family Catenicellinae Stach (1935a, p. 392) characterized: "in ovicelligerous internodes, where the ovicell pertains to the mother zoecium of a geminate pair, a trizoecial internode is formed by the adherence of the ovicell to the distal zoecium". In the Vittaticellinae Stach (1933, p. 87) the "ovicells are placed between and coherent to two zoecia of a straight line". As the material from Santos shows (MARCUS 1938, t. 7: f. 17A), both types of the position of the ovicell occur in the same colony of *C. contei*. Therefore it seems doubtful to me whether the two sub-families can be maintained. In any case it is certain that *Catenicella* and *Vittaticella* must be united in the same sub-family, Catenicellinae, characterized by the diagnosis of STACH (1933, l.c.) and including the two possibilities for the position of the ovicell. Perhaps it is advisable to preserve also the first of STACH's sub-families, basing it upon the ovicell exclusively belonging to the mother-zoecium of a tri-globulus, and upon the characters of the sternal area. As the oldest genus of these forms is *Claviporella* P. H. MacGillivray (1887, p. 65), the sub-family must be named Claviporellinae, subfam. nov.

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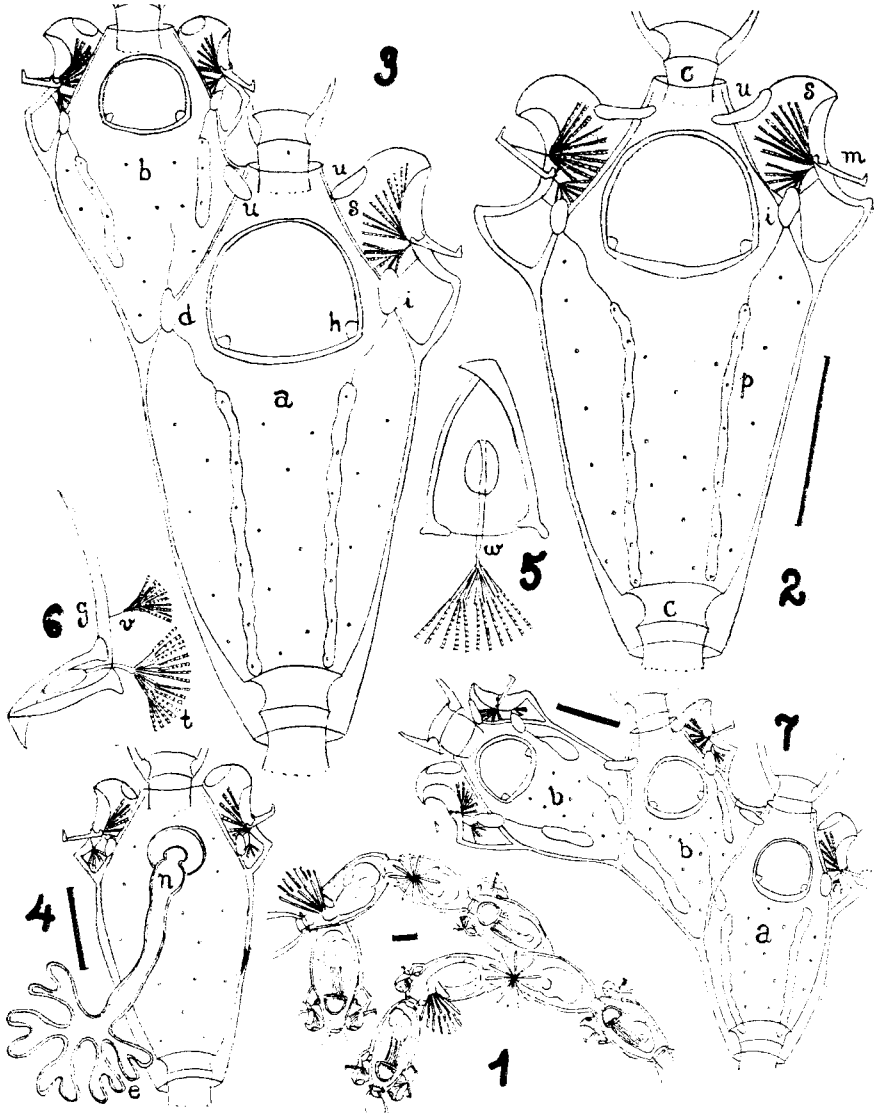
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PLATE I

1. Part of a living colony.
2. Single zooecium.
3. Bifurcation.
4. Basal view with radicle.
5. Mandible.
6. Mandible with frontal plate and muscles.
7. Mother-zooecium with two successive daughter-zooecia.

The scales indicate 100 μ .

a, mother-zooecium. b, daughter-zooecium. c, articulation. d, boundary chamber. e, terminal expansion of radicular fibre. g, frontal plate. h, hinge-teeth. i, infra-scapular chamber. m, avicularian mandible. p, pedal chamber ("vitta"). s, scapular chamber. t, adductor (occluser) muscles. u, supra-scapular chamber. v, abductor muscles. w, tendon of the adductor muscles.



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COMUNICACIONES ZOOLOGICAS DEL MUSEO DE HISTORIA NATURAL DE MONTEVIDEO

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Volumen II

NAIDIDS AND TUBIFICIDS FROM BRAZIL

EVELINE DU BOIS-REYMOND MARCUS *

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The present notes are chiefly based upon an ample collection of limnic worms (ca. 200 vials) made by Dr. Harald Sioli, Belem (Pará), in Northern Brazil in the years 1940-41 and 1945-46. The Naididae and the sexually mature Tubificidae from the system of the River Amazon that could be classified, are represented by twelve species previously listed for Brazil, three forms hitherto not recorded from Brazil, and two new species. To the account of Doctor Sioli's collection I add the description of *Chaetogaster limnaei* K. E. v. Baer, common in *Australorbis* in São Paulo, and a note on *Aulodrilus tenuis* (Cern.) contained in the last letter my husband and I received from the late Dr. L. Cernovitov, London (May 15, 1945).

Localities of Dr. H. Sioli's collection:

1. River Solimões, ca. 100 km. above Manaus (State of Amazonas).
2. Boa Vista do Rio Branco (Territory of Rio Branco).
3. River Madeira, below Humaitá (State of Amazonas).
4. Maués on the River Maués-assú (State of Amazonas).
5. Lago Grande Curuay (Villa Franca) to the South of the River Amazon opposite Obidos (State of Amazonas).
6. Alemquer, on a sidebranch of the River Amazon (State of Pará).
7. Rio São Manoel, and
8. Rio Juruena, sources of the Rio Tapajoz (State of Pará).
9. Rio Cururú, tributary of the Rio Tapajoz (State of Pará).
10. Itaituba, 300 km.,
11. Fordlândia, 180 km., and
12. Belterra, 40 km. up stream from Santarém (State of Pará).
13. Santarém (State of Pará).
14. Rio Acará, about 120 km. South of Belém (State of Pará).
15. Belém (State of Pará).

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Family NAIDIDAE

1. *Chaetogaster limnaei* K. E. von Baer, 1827

Figure 1

Chaetogaster limnaei BEDDARD 1895, p. 306.

Ch. l. MICHAELSEN 1900, p. 22.

Ch. l. STEPHENSON 1923, p. 50.

Ch. l. UDE 1929, p. 23, f. 17-18.

The length of a chain of living worms, composed of 20-24 segments belonging to two zooids with a young secondary fission zone each is 2-3 mm. or more, the diameter 0.2 mm. The skin is transparent with annular wrinkles. The prostomium is round and hardly marked off from the peristomium and the following segments. The mouth lies nearly at the anterior end of the body. The oesophagus is a simple constriction between the large suctorial pharynx and the crop that fills segments 4-6. The crop is lined with long, stiff cilia and provided with a plexus sanguineus. The stomach begins in segment 7 and ends at the secondary fission zone in segment 10. It is covered with brown chloragocytes and contains Diatoms, Protozoans and detritus.

The brain has no refractive plate. In the oesophagus region one pair of vascular commissures is delated as hearts. The nephridia begin in segment 6 or 7.

The 8-10 setae in a bundle measure 90 μ in segment 2. Their thick nodulus is situated ectally, and their distal prong is slightly shorter than the proximal one. In the hinder segments each bundle contains 9-11 setae arranged in a medio-posteriorly open semi-circle. Their length is 50-60 μ , and their nodulus lies in the middle. Their prongs are a little shorter than in segment 2, but of the same proportions.

Occurrence: Many specimens in *Australorbis* sp. from a pond in the Ibirapuera Park, City of São Paulo, often together with developmental stages of flukes; and from other localities.

C. australis Davies (1913, p. 89) from Victoria, Australia, is similar to *C. limnaei*, but has no secondary fission zone. The Indian species *C. bengalensis* Ann. (STEPHENSON 1923, p. 49) has 15-17 setae in a bundle. The three species generally live at the respiratory aperture, within the mantle-cavity, and in the inner organs of freshwater snails, feeding principally on sporocysts, rediae and cercariae. *C. limnaei* sometimes becomes a true parasite (STEPHENSON

1930, p. 732). The occurrence of the latter in *Planorbis* is by no means exceptional, as CHEN (1944, p. 2) said. The limnological bibliography (LAMPERT 1925, p. 10; WESENBERG-LUND 1937, p. 334) lists various genera of snails, even the prosobranch *Viviparus*, as hosts of *C. limnaei*, that was also found on sponges (STEPHENSON 1923, p. 51) and crayfishes (MICHAELSEN 1926, p. 99). In the European winter *C. limnaei* is chiefly free-living; in São Paulo it was taken in snails in mid-winter. WARD & WHIPPLE (1918, p. 638, f. 982) and UDE (1929, p. 24) include North America in the distribution of the present species, but in 1905 (p. 169) MOORE indicated that the North American specimens are somewhat different. The records from Northern, Central and Southern Europe and Asia (India, China, Japan) are sure.

2. *Nais paraguayensis* Michaelsen, 1905

N. p. MARCUS 1943, p. 23 f. 9-13, 122-124, 129; 1944, p. 50.

Occurrence: 1, 3, 5, 8, 11, 14; generally in roots of *Eichhornia*; 0-3 m.

Distribution: Brazil; Paraguay; North America, in aquarium; Zanzibar; India; China; Sumatra; Java.

The late Dr. Cernosvitov kindly informed in a letter of May 15, 1945: "In my paper on the Omo Oligochaeta (Mission Scientifique de l'Omo, v. 4, Zoologie fasc. 38, pp. 255-318, f. 1-135. Paris 1938, Mus. Nat. Hist. Nat.) I suggested that *N. p.* is a *Dero* or *Aulophorus* which lost its gills owing to the repeated architomy. Similar view is held by STEPHENSON (1921, Rec. Ind. Mus., v. 22, part 5, no. 34). Your observation about the structure of the ventral glands in *N. p.* confirms this as you state that similar glands are present in *Aulophorus furcatus* and *Dero evelinae*".

In 1942 (p. 204) CERNOSVITOV refers to the same subject. His argument that the ventral glands confirm his suggestion is striking. On the other hand the dorsal opening of the anal fossa in *Nais paraguayensis* (MARCUS 1943, p. 24) that resembles a regenerating branchial organ of *Dero* or *Aulophorus* (ibid., t. 28, f. 109B) occurs also in other species of *Nais*, f. ex. *N. communis*, *N. obtusa*, and *N. pardalis* (id. 1944, p. 52) that divide by paratomy.

I do not consider it lucky to transfer *Nais paraguayensis* to *Dero* (♂ *Aulophorus*) as CERNOSVITOV did, because the latter genera are characterized by the presence of gills. The architomy involves no reason for a species to lose its gills, as *A. superterrenus* with a very precocious paratomy has much larger gills than *A. carteri* with

true paratomy. *Aulophorus borellii* has a complete branchial organ that did not suffer reduction although the species nearly certainly divides by architomy (fragmentation) (see no. 10). As far as known all the species of *Dero* have distinct paratomical fission zones, so that they do not prove any "transition to architomical reproduction" (CERNOSVITOV 1942, p. 204), except by the sometimes anomalous or missing branchial organ, that might as well be due to injuries by enemies.

Upon the whole the idea that paratomical worms pass to architomy is not easily to be understood from a morphological point of view. But as the development of gonads shows doubtless signs of regression in the Naidids, the simple and physiologically efficient architomy may indeed be a higher degree of evolution, that tends to substitute sexual reproduction by fission. The problem becomes still more complicated by the architomical Lumbriculidae and the Aeolosomatidae, the former considered as archaic by STEPHENSON (1930, p. 705-706), the latter by MICHAELSEN (1928, p. 86-87).

One might think of creating a new genus for *Nais paraguayensis* based upon the absence of gills and the presence of ventral glands, but these glands were certainly not investigated in the majority of the species of the genus *Nais*. The intermediate position of the reproductive organs of *Nais paraguayensis* between *Piguetiella blanci* and *Speccaria josinae* was already mentioned (MARCUS 1944, p. 53). Whether it holds true for all the varieties of *Nais paraguayensis* remains also an open question.

3. *Nais paraguayensis* f. *chelata* Marcus 1944

Nais paraguayensis forma *chelata* MARCUS 1944, p. 51, f. 39.

Occurrence: 5, 7, 13; 0-3m.

Distribution: Brazil, State of Pernambuco.

Some of the present worms correspond to the original diagnosis, while others have many segments without dorsal setal bundles, and in several specimens these are missing completely. As the first samples of the collection that I opened belonged to the latter population, I classified them, because of their typical Naidid aspect, as *Schmardaella*. They conform to the indication of uninterrupted ventral setae, wanting dorsal setae, and no fission zone. Later on I found the clue to their true systematic position in a population that contained worms without dorsal setae together with such that had them in reduced number. One worm f. ex. had dorsal bundles in 13 out of 48 segments, another had 14 segments with setae in a total of 80, a third 105 segments, all without setae.

The material that J.-P. MOORE assigned to *Schmardaella* (1905, p. 168) agrees perfectly with the present worms that have no dorsal setae. MOORE characterized his specimens as follows: form elongated as in *Nais* (p. 165); 6,5 mm.; 52 segments; anterior 2-3 somites somewhat enlarged, with more slender setae; dorsal setae totally absent; ventrally 2-3 setae per bundle, strongly f-shaped, bifid; the two prongs strongly divergent, the terminal one half as thick as the accessory. Ventral lip of anus slightly longer than dorsal, and bears a pair of small papillae.

SCHMARDA's description (1861, p. 11, t. 17: f. 156) repeated by MICHAELSEN (1926, pp. 100-102; 1926a, pp. 241-243) of *Schmardaella filiformis* (Schmarda) from Peru differs so much from the present material, that both forms must be separated in spite of the character in common of wanting dorsal setae. The contrasts are the following: length 2 mm. (*Schmardaella* Mich.), 12 mm. (my material); diameter 0,1 mm. (*Schm.*), 0,5 mm. (my mat.); prostomium prolonged into a point (*Schm.*), a blunt cone (my mat.); number of segments 16 (*Schm.*), 105 (my mat.); number of setae per bundle 3 (*Schm.*), 3-7 (my mat.); shape of setae simple-curved with a single point (*Schm.*), bifid crotchets (my mat.).

The specimens that BEDDARD regarded as *Chaetogaster filiformis*? (1896, p. 5) were re-examined by MICHAELSEN and seen to have dorsal setal bundles beginning in segment 2, and called *Paranais chilensis* Mich. (1926, p. 100; 1926a, p. 241).

KONDÔ (1936, p. 383, t. 23: f. 4, 4a) classified as *Schmardaella filiformis* something quite different from the present form. The two single-pointed sigmoid setae suit better to MICHAELSEN's material.

4. *Slavina evelinae* (MARCUS, 1942)

Peloscolex evelinae MARCUS 1942, p. 157, t. 1: f. 1-3, t. 5: f. 21.

Slavina evelinae MARCUS 1943, pp. 9 note, 163; 1944, pp. 54, 57, t. 10: f. 45, t. 11: f. 46-47.

Occurrence: 6, 13; 0-4,5 m.

Distribution: Brazil; Argentine (L. Cernovitov in letter).

5. *Haemonais laurentii* Stephenson, 1915

Hemonais laurentii STEPHENSON, 1915, pp. 769, 785, 793; 1923, p. 79, f. 27.

H. l. MEHRA 1920, p. 457, 458.

H. l. MARCUS 1944, p. 63, t. 12: f. 51-52.

One specimen with the dorsal setae beginning in segment 28.
 Occurrence: 13; 5 m.
 Distribution: Brazil; Argentine (L. Cernovitov in letter); India; China.

6. *Dero multibranchiata* Stieren, 1893

Figures 2-3

Dero multibranchiata STIEREN 1893, pp. 107, 121, f. 1-4.
D. m. MARCUS 1944, p. 65, t. 13: f. 55-56.

Occurrence: 2, 3, 5, 12, 14; 0-1 m.
 Distribution: Brazil, State of Pernambuco; Trinidad.

7. *Dero quadribranchiata* Cernovitov, 1937

Dero quadribranchiata CERNOSVITOV 1937, p. 145, f. 25-30.

The present rich material corresponds well to the original description. The gonads of the species are not yet known. The gills of my specimens (Fig. 3) are slightly shorter and broader than those from Argentine, but that may be due to preservation. Fission zones occur in segments 33-35.

Occurrence: 5, 7-14; 0-2.8 m.

8. *Aulophorus carteri* Stephenson, 1931

Aulophorus carteri STEPHENSON 1931, p. 303, t. 17: f. 2-3.
A. c. CARTER & BEADLE 1931, p. 380, 386 f. 4a-c (p. 385).
A. c. MARCUS 1943, p. 60, f. 43-60, 62-65; 1944, p. 50.

The tubes were constructed of various materials; one vial contained three cases, the first built with bryozoan statoblasts, the second with particles of detritus, and the third with many grains of sand. Only the first was inhabited. In another population the worms had used beautiful gemmulae (Lago Paxiuba, locality 3).

Occurrence: 3, 5, 7, 9, 13; 0-1 m.

Distribution: Brazil; Paraguay.

9. *Aulophorus furcatus* (Oken, 1815)

A. f. CORDERO 1931, p. 350.
A. f. CERNOSVITOV 1942, p. 201, f. 16-20.
A. f. MARCUS 1943, p. 87, f. 61, 66-71; 1944, p. 50.

Occurrence: 3, 9, 10, 11, 14; 0-1 m.

Distribution: America; Europe; Asia; Africa.

10. *Aulophorus borellii* (Michaelsen, 1900)

Figures 4-6

Dero sp. COGNETTI 1900, p. 1-2, f. 1.

Dero borellii MICHAELSEN 1900, p. 522.

Aulophorus borellii STEPHENSON 1931, p. 305, t. 17, f. 4.

The worms have the aspect of Tubificids. They are intransparent and nearly quadrangular in cross-section. They have no fission zone. The biggest specimen has 177 segments, a length of 22 mm., and a diameter of 0.55 mm., another of 98 segments, 14 mm. length and 0.8 mm. in diameter.

There are no eyes traces of colour in the preserved specimens. The prostomium is a blunt cone; the dorsal body-wall continues nearly straight to the tip of the cone, while the ventral side appears obliquely truncate. The pharynx extends from the second to the fourth bundle of setae, that is, through the third, fourth and fifth segment. The chloragocytes begin in segment 7. Enlarged commissures of the blood vessels occur in segments 7-11 or only in some of these.

The ventral setae begin in segment 2. Each bundle consists of 2-5 double-pronged needle-setae. In the cephalized segments 2-5 these are slightly thinner than in the trunk segments (Fig. 4). The noduli lie about two fifths of the length of the shaft from the tip. The proximal prong is nearly twice as thick as the distal one. They are of equal length in the anterior segments, and the distal prong diminishes posteriorly. The dorsal bundles (Fig. 5) begin in segment 5, where the setae are smaller than in the following bundles. Each consists of a hair and a needle or occasionally 2 and 2. The dorsal needles are of the same shape as the ventral ones, only their noduli are situated farther ectally, one third of the length from the tip of the needle.

The dorsal hair setae are of different length in the various populations; in some they are nearly three times as long as the accompanying needle-setae, in others they are only a little longer. In a worm of 0.6 mm. diameter the dorsal and ventral needles measured 115-120 μ , the hair-setae 300-320 μ . A fragment from an other population was 0.7 mm. in diameter with needles of 120-140 μ and dorsal hair setae of 140-215 μ .

The branchial organ contains four pairs of broad true gills in

Occurrence: 9, 11, 12, 13, 14; 0.5-9 m.

Distribution: Brazil, São Paulo and Alagoas; Argentine.

12. *Pristina longiseta* Ehrenberg, 1831

One specimen in poor conditions of preservation.

Occurrence: 3.

According to the description and figures of CERNOSVITOV (1942, p. 198, f. 1-15) the material from São Paulo (MARCUS 1943, p. 107, f. 84A-E, 92-97, 100) belongs to CERNOSVITOV's variety *bidentata*.

In 1944 CHEN introduced a *Pristina schmiederi* (p. 4, f. 2), that has all the characters of *P. plumaseta* Turner 1935, a form that CHEN did not compare with his species. I consider *P. schmiederi* to be a synonym of *P. plumaseta*.

13. *Pristina peruviana* Cernovsikov, 1939

Pristina peruviana CERNOSVITOV 1939, p. 83, f. 1-7.

The dorsal hair setae, described and drawn as finely toothed on one side in the original diagnosis (f. 4), are beset with a row of fine hairs in the present specimens.

Occurrence: 3, 6, 9, 12; 1.5-6 m.

Distribution: Lake Titicaca. Perú.

14. *Pristina proboscidea* Beddard, 1895

Pristina proboscidea BEDDARD 1895, p. 293.

Pristina proboscidea f. *typica* MICHAELSEN 1905, p. 359.

Pristina proboscidea f. *typica* CERNOSVITOV 1937, p. 136.

Pristina proboscidea MARCUS 1943, p. 111, f. 87-88.

Several of the populations belong to the typical form with finely serrated dorsal hair setae (localities 3, 12), while others have completely smooth dorsal hair setae (localities 10, 14).

Distribution: South America; Zanzibar; India; Sumatra and Java.

15. *Opistocysta flagellum* (Leidy, 1880)

Opistocysta flagellum MARCUS 1944, p. 69, f. 60-61.

No sexual worms were seen.

Occurrence: 3, 4, 11, 13, 14; 0-3 m.

Family TUBIFICIDAE

1. *Limnodrilus hoffmeisteri* Claparède, 1862

Figure 8

L. h. UDE 1929, p. 82, f. 97c.

L. h. CERNOSVITOV 1945, p. 530.

Occurrence: 15.

Distribution: North America; Europe; Palestine; Turkestan; Japan.

This is the first record of the typical *Limnodrilus hoffmeisteri* for South America.

CERNOSVITOV's re-examination of specimens that STEPHENSON had classified as *L. socialis*, has revealed that they belong to *L. parvus*. That proves that it is advisable to give a combined diagnosis of *L. hoffmeisteri* based upon descriptions referring to material of very different origin. Therefore I restrict the confrontation of the present *Limnodrilus* to UDE's diagnosis relative to Central-European taxonomically well-established material.

My specimens are identical with the typical form and differ from *L. hoffmeisteri* f. *divergens* MARCUS (1942, p. 169 f. 6-9, etc.) previously described from Brazil (l. c., p. 174), by the smaller number of setae (4-8 in European and the present worms; 7-11 in f. *divergens* with pointed prongs (blunt in f. *divergens*). The number of segments is 60 and more; 55-95 in European *L. h.*; 90-210 in f. *divergens*.

The penis-tube with 450 μ length and 40 μ ental width = 11:1 is equal to the European. In a smaller, probably younger, specimen it measures 380 and 30 μ .

The spermathecae contain spermatophores of very different size in the same lot (Fig. 8). The total length varies from 200 to 420 μ . The ampulla is 90 to 150 μ long and 60 μ in diameter. The width of the tail-piece is 30-45 μ .

2. *Limnodrilus parvus* Southern, 1909

Figure 9

Limnodrilus parvus SOUTHERN 1909, p. 137, t. 8: f. 5.

Limnodrilus hoffmeisteri CERNOSVITOV 1939, p. 104, f. 76-85.

Limnodrilus hoffmeisteri f. *parva* MARCUS 1942, p. 167, f. 4-5.

Limnodrilus parvus CERNOSVITOV 1945, p. 528, f. 13-19.

Occurrence: 14; 0-1 m.

Distribution: South America; Europe; India; Africa.

The present specimens have spermatophores in their spermathecae that are of different proportions in the same animal, total length: 1) 270 μ , 2) 420 μ ; ampulla: 1) $100 \times 65 \mu$; diameter of tail: 1) 40 μ , 2) 35 μ .

3. *Limnodrilus siolii*, sp. n.

Figures 10-14

Of the rich material a great number was immature and could not be classified. The mature specimens were of very different diameter and number of segments. All the biggest worms were lacking the hinder part of their body, and many showed signals of moniliform desintegration. The longest worms, 25 mm., had 90-110 segments and a diameter of 0,35 mm. in the anterior part. The thickest worms were 8 mm. long, 0,7 mm. in diameter, and had about 20-30 segments.

The prostomium is generally small and pointed, but in some specimens it is quite blunt. The first segments are bi-annulate, with a narrow anterior and a broad posterior ring separated by a constriction. The dorsal and ventral setae begin in segment 2. All are sigmoid, double-pronged crotchets (Fig. 10). In the anterior segments there are as a rule 4-7 setae, the maximum seen was 9; in the post-genital bundles there are 2-3 per bundle. The shape is the same in all segments. The distal prong is longer and a little thinner than the proximal one, and the nodulus lies one third of the length from the tip. The length of the setae varies with the diameter of the worm. It increases from segment 2 (60-95 μ) to 10 (90-170 μ) and decreases backwards (60-100 μ).

The pharynx occupies segments 2 and 3. The chloragocytes begin in segment 6. One pair of hearts lies in segment 8. The commissures in the posterior segments (in young, mature worms) are parietal as in *L. chacoensis* (STEPHENSON 1931, p. 310) and form two arches in every segment.

The clitellum, (Fig. 11, c), begins at the level of the setae in segment 10 and covers segments 11 and 12. The testes (t) develop in segment 10, the sperm-masses are lodged in two un-paired sperm-sacs (seminal vesicles) (e), one directed forward into segment 9, the other backward through segments 11 and 12, and may attain segment 17. The posterior sac is provided with blood-vessels. The efferent ducts (d) begin with funnels (m) in segment 10 and

coil in segment 11. They are 40-50 μ in diameter and enter the atrium (a) at its ental tip. The atrium (Fig. 12) is first directed dorsally and then bends down to the ventral side. At the inner side of the bend the compact prostata (r) joins it. The atrium is ca. 550 μ long and 120-150 μ in diameter. It is surrounded by a layer of circular muscles. The cells of the inner epithelium are stuffed with eosinophilous granules, secreted in the prostata. A distinct narrow ejaculatory duct (j) unites the atrium to the short and oblique penis-papilla (p). The conical penis has a shorter vertical anterior wall (60 μ) and a longer, oblique, posterior wall (100 μ), its ental diameter is 100 μ . The retracted penis lies in a deep copulatory chamber, that opens into a transverse furrow. The protruded penis is surrounded or even prolonged by the wall of the chamber. Both papilla and chamber are covered with a thin cuticular layer.

The ovaries (o) lie in segment 11. The ovisac (v) can attain segment 19. The small female funnels (f) pierce the body wall in front of the septum 11/12.

The spermathecae fill segment 10. Their pores (b) lie beside the ventral setae of the segment. They have a broad sphincter. A long duct (s) leads into a wide ampulla (u) that can partly extend into segment 11. The lumen is lined with a high epithelium. It contains one to four spermatophores, the narrow stalks of which lie in the duct, the broad ends in the ampulla.

The spermatophores (Fig. 13) are of varying length, 420-800 μ , the bulb on the broad end is 100-200 μ long and 50-110 μ in diameter, the stalk is 20-40 μ thick and often widened once more at the tip. The entire surface is covered with free tails of spermatozoa.

One population (locality 14) has spermatophores sticking to the outer side of segment 10 or 11. In several of these specimens no spermathecae were developed. The shape of the free spermatophores (Fig. 14) is different from those in the spermatheca. Their ampulla is longer and their stalk shorter; the end of the ampulla that is an inward bent funnel in the young spermatophore, is opened outward and the wall is a homogenous, dark staining membrane glutinating the mass of confluent sperm tails.

Occurrence: 2, 3, 4, 5, 7, 8, 9, 11, 12, 13, 14; 0,5-28 m.

L. sioli belongs to the group of species without a rigid chitinous penis-tube (MARCUS 1942, p. 166). It is closely related to *L. chacoensis* Stephenson (1931, p. 309) and *L. kleerekoperi* Marcus (1944, p. 71 f. 62-65), and differs from the rest of the group by the same characters as these (ibid., p. 72).

From *L. chacoensis* the present species is distinguished by the longer distal prong of the setae, and the size of the atrium (300 μ

in *chacoensis*). Unfortunately STEPHENSON did not figure the atrium and penis of his material, and his description (p. 311) refers only to the covering of the penis and not to its shape. Perhaps the papilla on which the cavity of the penial chamber opens, even while the penis is retracted, is a distinctive character. The atrium has a vertical position in *L. chacoensis* and "may sometimes be bent on itself" as in *siolii*, but the efferent duct joins it "not at the dorsal pole, but some little distance below this", while it opens into the ventral end of the atrial tube in *siolii*.

In *L. kleerekoperi* the distal prong of the setae is thicker than the proximal one. The atrium continues immediately into the penis-papilla, without an ejaculatory duct. The penis is a regular cone, and the spermatophores are twice as long as in *siolii*.

The species is named in honour of the collector, Dr. Harald Sioli, Belém (Pará, Brazil).

4. *Aulodrilus tenuis* (Cernosvitov, 1937)

Paranais tenuis CERNOSVITOV 1937, p. 143, f. 21-24.

Aulodrilus limnobioides MARCUS 1944, p. 78, f. 69-76.

Dr. L. Cernosvitov in his letter of March 15, 1945 says: "There is no doubt that my *Paranais tenuis* belongs to the genus *Aulodrilus*, but I doubt very much the correctness of your suggestion of its identity with *A. limnobioides*. I had no possibility of examining now my specimens of *A. limnobioides* from Europe, as they are stored in the British Museum, but I can point out to the following: In *A. limnobioides* (according to KOWALEWSKI) the intestine enlarges behind 7/8, in *tenuis* behind 6/7. The brain in *limnobioides* has a sort of ganglion attached to its anterior margin (fig. 9 of KOWALEWSKI), while in *tenuis* the margin is simply pointed. The copulatory chamber in *limnobioides* is very large, its diameter considerably greater than that of the atrium, its walls are folded. In your specimens from Brazil the chamber is small, its diameter is smaller than that of the atrium, its walls are simple. The length of the setae is greater in *limnobioides*. According to KOWALEWSKI it is up to 53 μ , and even greater according to LASTOCHKIN ("Oligochaeta limicola des Oka-Flusses". Arb. Biol. Oka-Station, Muroni, v. 5 no. 1, p. 16, 1927) up to 60.7 μ (ventral and dorsal of 4th segment) in adults, smaller in immatures. Neither KOWALEWSKI nor LASTOCHKIN mention the difference of shape of the anterior and posterior segments and it might not exist".

We agree with Cernosvitov that the South American material must be separated from the European *A. limnobioides* Bretscher.

5. *Aulodrilus cernosvitovi**, sp. n.

Figures 15-21

The worms are 2 mm. (27 segments) to 18 mm. (63 segments) long, or more. The number of segments in the examined specimens varies between 19 (5 mm.) and 100 (9 mm.). The segments are shorter than high. Frequent fragments without head or tail or both indicate that *A. cernosvitovi* like several other species of the genus multiplies by fission. The size of the worms is as different as we have observed it in other architectural forms, f. ex. *Nais paraguayensis* (MARCUS 1943, pp. 24-25) and *Aulodrilus tenuis* (id., 1944, p. 82). In the largest individuals the diameter of the first 8 segments is 0,4 mm., in the following 0,5 mm., and decreases farther backwards. In the smallest worms it is about 0,2 mm.

The first complete septum separates segments 3 and 4. The conical, pointed prostomium is very short but distinctly marked off from the peristomium (Fig. 19). The transverse mouth leads into a short tubular buccal cavity lined with a fine cuticle. The pharynx occupies the third segment. The intestine is strongly sinuous. In the middle of segment 8 it widens suddenly and in the following segments it fills the entire body-cavity, decreasing gradually from the middle of the body backwards. The wall of the post-anal respiratory tube is transversely wrinkled. The tube measures 400 μ in length and diminishes from 140 to 80 μ in width. It opens terminally.

The intestine of several worms (locality 7) contains a number of slender astomatous Ciliata. The same were observed in the intestine of *Limnodrilus siolii* from the same locality. In both species the Protozoa occupied the first post-genital segments.

Dorsal and ventral setae begin in segment 2. The ventral setae are all S-shaped bifid crotchets (Fig. 15). Their proximal (lower) prong is distinctly longer and thicker than the distal (upper) one. The nodule lies on the limit of the outer and second third of the length. The setae in a bundle are more numerous in the anterior part of the body, where there are up to 10. The length of the setae is 65-78 μ , they are ca. 3,5-4 μ thick.

The dorsal bundles consist of needle-setae and hair-setae. Segments 2-4 have only bifid crotchet needles (Fig. 17) with a longer and stouter proximal prong, 2-8 to a bundle; in segment 5, 6, or 7 the crotchets begin to alternate with slightly curved hair setae.

* Named in memory of Dr. Lev Cernosvitov, to whom much valuable work on South American Oligochaeta is owed.

From segment 7 to 10 the bifid crotchets are gradually substituted (f. ex. 7: 3+1; 8: 3+1; 9: 2+3; 10: 1+4; 11: 0+5) by broad-bladed, oar-shaped setae (Fig. 16) with a strong middle rib and a distinct nodule (Fig. 18). The maximum seen were 8 hair-setae and 8 needle-setae in a bundle; backwards the number decreases. The dorsal needle setae (segment 2-10) measure 65-80 μ , the oar-shaped ones 54-72 μ ; the latter have the nodulus at 48 μ , the blade is 14 μ long by 6 μ wide. The hair setae are 90-140 μ long. The ventral setae in segment 7 of sexual worms (penial setae) are less numerous (4-6) and slightly shorter than in common ones, but also bifid.

The small cerebral ganglion (Fig. 20,b) is a crescent-shaped widening of the circum-pharyngeal ring. The circulatory system consists of: 1) the contractile dorsal vessel that lies on the left side of the intestine from segment 7 backwards to the growing zone; 2) the ventral vessel; 3) the commissures between dorsal and ventral vessel that are branched and form numerous anastomoses in the anterior segments; 4) the contractile hearts in the sixth segment (Fig. 20,h); 5) the simply winding, integumental commissures in the posterior part of the body; 6) an intestinal blood sinus that is visible in segments 10-12 in the region of the widened digestive tract.

Reproductive organs (Fig. 20, 21): The clitellum (q) reaches from the setae of segment 6 to the end of segment 8. Segments 7 and 8 are more than twice as long as the other segments in fertile worms. No rudimentary testicles were seen in segment 4. A small number of spermatozoa in segment 5 may indicate the presence of functioning testes. Septum 5/6 is distended forward; segment 6 contains masses of spermatospheres (t). Spermathecae and spermathecal pores are missing completely in the two available fully mature specimens. The large seminal funnels are situated ventrally before septum 6/7, the thin efferent ducts (e) pierce the septum and run straight into the atrium. The atrium (a) is a sausage-shaped and curved tube with a compact prostate gland (g) attached to the ental point near the entrance of the duct. The ental and ectal end of the atrium are constricted by circular muscles. The male canal continues into a bulbous ductus ejaculatorius (d) that projects with a papilla into a wide copulatory chamber (c). The male pores are situated in front of and slightly laterally to the ventral setal bundles of segment 7.

The small ovaries (o) lie on the posterior surface of septum 6/7 below the seminal funnels. The female pores (f) are lateral grooves in the clitellum at septum 7/8. A wide ovisac (w) extends this septum to the setae of segment 9.

Occurrence: 7: 4-6 m.; 12, 13: 18-28 m.

The key of classification for *Aulodrius* (MARCUS 1944, p. 77) leads to *A. prothecatus* Chen (1940, p. 68). From the Chinese species *A. cernosvitovi* differs by the lack of spermathecae (present in *prothecatus*) and by paired latero-ventral male pores (one ventro-median opening in *prothecatus*).

The absence of spermathecae in Tubificidae is exceptional (MARCUS 1942, p. 200). In *Bothrioneurum* they are functionally substituted by spermatophores. Whether the present species produces such could not be verified. The shape of the ejaculatory duct permits me to presume its function of forming spermatophores.

ZOOGEOGRAPHICAL REMARKS

The limnic oligochaetous fauna of South America is certainly still far from well-known. Principally the exploration of Andean biotopes will increase the number of species. Notwithstanding the present state of knowledge, based upon substantial samples from the La Plata-states (Argentine, Uruguay, Paraguay), Southern Middle and Northern Brazil, affords some preliminary zoogeographic aspects that probably will not be modified radically with regard to extra-Andean South America by future work. Limnic Oligochaetes are primary fresh-water animals, that is immigrants from marine, not terrestrial, biotopes. The Oligochaetes have no stages that can dry up and be transported by wind. Therefore we must consider the universal or at least vast distribution of many species as an index for old immigration from the sea. I do not see any possibility to explain the occurrence of well-analyzed species in Eurasia and North and South America otherwise. The endemisms of lakes that have been practically isolated for a long time (Baikal, Ochrida, Tanganyika, etc.) prove that the transport of small fresh-water animals in moist mud adhering to the beak or feet of ducks and other migrating birds is only exceptional.

As to the intra-South American distribution of Naidids and Tubificids, an accentuated, of course not absolute, uniformity is evident. This corresponds to the approximation of the great fluvial systems of South America (Amazon, São Francisco, the three great streams of the La Plata), the sources of which may have been in connection, as are today the river Guaporé and the Amazon, or the Orinoco and the Amazon (Casiquire). The inconstancy of many inland waters has hindered isolation in various continents (MARCUS 1933, p. 127, 128). Moreover the limnic Oligochaetes are not as variable animals as f. ex. mussels and rotifers. Modifications at deter-

mined localities as are shown by the shells of limnic snails and bivalves, or the temporal variations of shape and differences in the reproductive cyclus of the Cladocera are not known from Oligochaetes. The substitution of sexual reproduction by fission that is frequent in the species of Aeolosomatidae and Naididae, is particularly unfavorable for the origin of new species, because only a relatively small number of new mutations is offered to selective processes. So much the more one must admire, how vastly these worms are distributed and able to thrive under extremely different conditions.

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PLATES I-III