

THREE BRAZILIAN SAND-OPISTHOBRANCHIA

by Ernesto Marcus

(with 9 plates)

In march 1952 Professor Dr. ADOLF REMANE-Kiel travelled with us, Mrs. EVELINE DU BOIS-REYMOND MARCUS and me, to study the marine mesopsammon (Remane 1940, p. 52) on the coast of the island of São Sebastião. We found two small Opisthobranchia without shell in coarse sand with *Branchiostoma*. Our prominent guest was familiar with them (Remane 1951, p. 331), and he had caught related forms at Banyuls-sur-Mer together with Dr. ERICH SCHULZ-Kiel (Odhner 1952, p. 137). In november 1952 Mrs. Marcus and I searched for these minute sea-slugs thoroughly in the same sand of the uppermost sublittoral, but did not succeed to obtain any. *Branchiostoma* and also *Polygordius* were found. By chance we discovered an other area that was inhabited by four different species, three in great numbers and one in few specimens. This biotope lies in the lower tidal zone, its sand is coarse, and we noted a Ceriantharian, Turbellaria *Accela*, a Cœlogynoparine (Proseriata), the Otoplanidæ *Kata evelinæ* and *Parotoplanana moya*, several species of *Ototyphlonemertes*, *Protodrilus corderoi*, *Saccocirrus pussicus*, Ostracoda and Harpacticids in the accompanying fauna.

We are obliged to the National Research Council (Conselho Nacional de Pesquisas) in Rio de Janeiro for subvention of our studies on marine invertebrates, to Professor Dr. EURIPEDES SIMÕES DE PAULA, Director of our Faculty of Philosophy, Sciences and Letters, and to all who made the visit of Professor Remane possible.

I am indebted to the Zoological Institute of the University of Kiel for an excellent photocopy of Kowalevsky's important paper (1901).

Two of our four species belong to the group previously known as Hedyliidæ. These animals were studied by Strubell (1892), Bergh (1896), Kowalevsky (1900, 1901), Hertling (1930), Bücking (1933), and Kütke (1935), the two latter scholars of W. J. Schmidt-Giessen, and principally by the well known malacologist Nils Hj. Odhner-Stockholm (1937, 1937a, 1938, 1939a, 1952). Since Bergh (1896) they were considered as Nudibranchiata cladohepatica (Æolidomorpha) (Pelseneer 1906; Thiele 1931), but Odhner (1936, p. 1058-60) approached them to shell-bearing Tectibranchiata. He defined them as a separate order that he later on called Acochliidiacea.

The nomenclature needs a short commentary. I write "*Acochlidium* Strubell 1892" as well as "*Acochlidium amboinense* Strubell 1892" and "*Strubellia paradoxa* (Strubell)", although Odhner (1937, p. 52; 1937a,

p. 238) indicated Bücking as author for the two first, and Kütke for the third name. It is true that Strubell's description is all too short. However the names of two freshwater Gastropoda without shell, one with a broad, foliaceous moss-green mid-dorsal appendix, the other with a long tubular red-brown appendage, both from a brook (Batu Gatja) on the small island of Amboina, are not "nomina nuda". Bücking (1933) and Kütke (1935) studied Strubell's original material and published Strubell's coloured drawings of the living animals. Therewith they settled both species well, but revisors do not become authors. That *Acochlidium* is wanting in the Nomenclator of Berlin (Odhner 1937, p. 52) is no criterion for its validity. Corporaal (1940, p. 219) noted 7 omissions among 60 names in the Nomenclator of Berlin; the work of Neave contains *Acochlidium*.

The two new brazilian species of the Acochliidae make some modifications of Odhner's last diagnoses necessary (1952, p. 143-145).

Order Acochliidae Odhner (1937, p. 52 ; 1939, p. 5)

Marine and limnic Opisthobranchia with prepharyngeal nerve-ring, without shell, ctenidium or cephalic disc. Visceral hump marked off from the foot; anus on the right side, only the left lobe of the liver developed. Except in one species, *Acochlidium weberi* (Bergh), the labial tentacles are distinct; rhinophores absent in two species (genus *Ganitus*). Stomach, if present, without masticatory plates. Statocyst as far as known with one statolith. Genital ducts monaulic, diaulic (pseudomonaulic), or reduced in various degrees. Sexes separate or united.

Neither the radular formula nor the absence of jaws in Odhner's diagnosis can be maintained, as they do not agree with the brazilian species. The taxonomy of the order is difficult. Only one of the three families, the most complicated Acochliidae, is distinctly separated. Only in this family the genital ducts belong to a well defined type, the diaulic with common genital opening or pseudomonaulic type (Lang 1900, fig. 389 C; Hoffmann 1926, fig. 11 C). Already in the primitive Hedylopsidae and still more in the reduced Microhedyllidae there are sure signs of rudimentation, and as it is known of rudimentary organs, the ducts vary considerably. The monaulic type of the Hedylopsidae is distinct only in the hermaphrodite *Hedylopsis suecica* Odhner (1937, p. 59). In *Strubellia paradoxa* the sexes are separate. The genital opening is only in the male connected with a cephalic penis by a seminal groove (Kütke 1935, p. 517, 522-525). The third species of this family, *Hedylopsis spiculifera* (Kowalevsky 1901, p. 2, 21), is monœcious and has a ciliated furrow along the right side (fig. 61-64). But it has no copulatory organ, so that a first step of reduction seems to be realized. Odhner (1937, p. 60) assumes that the individual was young and therefore had not yet developed a penis. This may be right, in as much as only one mature specimen was studied (Kowalevsky 1901, p. 25). On the other hand, one of the brazilian species, the diœcious *Unela remanei* (Fig. 10, f; Fig. 13, mc), has a connection between the genital opening and the right rhinophore in both sexes. Ten males and ten females were examined and no penis in the male or corresponding organ in the female exists in these fully mature slugs. This fact shows that the absence of a penis in *Hedylopsis spiculifera* (Kow.) might also be a specific character.

Dioeciousness that is generally a primitive character in Mollusca (Pelseneer 1894, p. 35, note 47 on p. 43; Lang 1900, p. 373; Thiele 1931, p. 26) is specialized in Opisthobranchia. It is known that in marine sand-dwellers and in limnic animals there are often small numbers of big eggs (Hesse 1924, p. 35; Remane 1951, p. 345). This makes simultaneous production of sperm and eggs difficult. One might consider gonochorism in arenicole Microhedylidæ and the freshwater *Strubellia paradoxa* (Strub.) as originated from successive hermaphroditism.

To judge from the only female Küthe (1935, p. 524) has seen, the female of *Strubellia paradoxa* has no traces of hermaphroditism, as it has no ciliated furrow between genital opening and head. In *Unela remanei* the female retains a hermaphrodite feature, it has a typical ciliated furrow that in the male is closed and very narrow. Also the second Brazilian species, *Ganitus evelinæ*, is dioecious, and the female has remainders of hermaphrodite organisation in a short ciliated groove that begins at the genital opening and runs a short way forward (Fig. 36, f). The species of the other genera of the Microhedylidæ are probably all dioecious and their sperm duct or oviduct ends with the original genital opening. No furrow or other anterior reproductive organs are known from these species.

Also the liver permits separation only between the Acochliidiidæ and the rest of the order. It is subdivided into various diverticula in the former family, and tubular, unbranched in all other species. Inner folds of the digestive gland occur in the Acochliidiidæ and in *Strubellia paradoxa*, so that this character can not be used for the taxonomy of the families. In Thiele's (1931) and Odhner's classifications (1937, 1952) the curved posterior end of the liver, a reminiscence of a coiled visceral hump (Odhner 1937, p. 58) is applied as character. Recently Odhner separates the Microhedylidæ with a terminal bend from the Hedylopsidæ with a straight intestinal gland. This character is decisive only in living specimens, as the liver tube assumes different curves when the animals contract in the moment of fixation. For example both types, bent and straight hind end of the liver, occur in fixed *Unela remanei*. Also *Ganitus evelinæ*, that was studied alive, showed both types of ending of the liver. It is true that the recurvous stages prevailed in this species. The intestinal gland of *Microhedyle lactea* has sometimes (Hertling 1930, p. 6) besides the anterior bend a second directed backward like *Parhedyle tyrtowii* (Kow.).

The appendages of the head can be used in the taxonomy of the genera and species. In the two species of the otherwise best defined family, the Acochliidiidæ, the cephalic appendages are extremely different. In the Hedylopsidæ the shape of the labial tentacles separates the two genera, and the same holds true for *Microhedyle* and *Parhedyle* of the Microhedylidæ. A third genus lacks rhinophores completely.

The best characters of the families are the general aspect, viz. the form of the visceral hump and the more or less extended detachment of the foot from the rest of the body. This will be understood at once by comparing a Microhedylid (Fig. 1, 24) with a Hedylopsid (Fig. 18). We owe two specimens of the latter to Professor Dr. A. REMANE and Dr. E. SCHULZ, who collected them at Banyuls-sur-Mer. The known species of the Acochliidiacea can be determined by the following key :

- 1 Visceral hump broad and flattened; liver with lateral diverticula; genital ducts diaulic (pseudomonaulic)... 2 (*Acochliidiidæ*. One genus: *Acochlidium* Strubell 1892).
- Visceral hump cylindrical; liver unbranched; genital ducts monaulic or reduced... 3.
- 2 Foot as long as visceral hump; rhinophores as long as labial tentacles; radula with 50-52 series of teeth; borders of middle (rhachidian) tooth smooth... *Acochlidium amboinense* Strubell (1892, p. 62). Amboina, in a brook.
- Foot half as long as visceral hump; rhinophores much longer than labial tentacles; radula with about 100 series of teeth; borders of central tooth serrate... *Acochlidium weberi* (Bergh 1896, p. 5). Flores, in the mouth of a river near Bari.
- 3 Foot set off from the rest of the body in its entire extension... 4 (*Hedylopsidæ*).
- Foot anteriorly only a ciliated zone of the belly, posteriorly set off from the visceral hump... 6 (*Microhedylidæ*).
- 4 Sexes united (monœcious); body about 4 mm. long; with spicules; labial tentacles flattened; foot anteriorly rounded; inner wall of liver smooth... 5 (*Hedylopsis* Thiele 1931, p. 443).
- Sexes separated (dicecious); body 20-30 mm. long; no spicules; labial tentacles cylindrical; foot with pointed anterior corners; inner wall of liver folded... *Strubellia* Odhner (1937a, p. 237). One species: *St. paradoxa* (Strubell 1892, p. 62). Amboina, in a brook.
- 5 Radula with 38 series of teeth; spicules all over the body... *Hedylopsis spiculifera* (Kowalevsky 1901, p. 2, 21). Sea of Marmora; Ægean Sea.
- Radula with 41-49 series of teeth; spicules only in the mantle... *Hedylopsis suecica* Odhner (1937, p. 51). Swedish Skagerak Coast; Gulf of Lions.
- 6 With rhinophores... 7
- Without rhinophores... 10 (*Ganitus*, n. g.).
- 7 Radular formula 1-1-1... *Unela*, n. g. One species: *U. remanei*, n. sp. Brazil, island of São Sebastião.
- Radular formula 2-1-2... 8
- 8 Labial tentacles flattened; big glands in the epidermis... 9 (*Microhedyle* Hertling 1930, p. 2).
- Labial tentacles cylindrical; no specially big epidermal glands... *Parhedyle* Thiele (1931, p. 443). One species: *P. tyrtowii* (Kowalevsky 1900, p. 200; 1901, p. 2 and following). Black Sea; Gulf of Lions.
- 9 Radula with 34-35 series of teeth, 6-8 of which on the lower side... *Microhedyle glandulifera* (Kowalevsky 1901, p. 2, 20). Sea of Marmora; Ægean Sea; Gulf of Lions.
- Radula with 39-44 series of teeth, 8-13 of which on the lower side... *Microhedyle lactea* Hertling (1930, p. 8). Heligoland; Gulf of Lions.

- 10 With eyes; hind end of foot rounded... *Ganitus* (?) *milaschewitchii* (Kowalevsky 1901, p. 2, 19). Black Sea; Sea of Marmora; Ægean Sea; Gulf of Lions.
- Without eyes; hind end of foot pointed... *Ganitus evelinæ*, sp. n. Brazil, island of São Sebastião.

Jaws and radular formula of *Hedyle milaschewitchii* are not described. Therefore its generic position is uncertain, and it is only tentatively united in the same genus with *Ganitus evelinæ*. Thiele (1935, p. 1004) unites his genus *Parhedyle* with *Microhedyle*. As the double (spiral) curve of the intestinal gland in *Parhedyle tyrtoyii* (Kow.) is perhaps not sufficiently constant for the generic separation of this species, it may be that Thiele's suppression of *Parhedyle* was right. But as I do not intend to modify more than is strictly necessary, I follow Odhner (1952, p. 144) maintaining *Parhedyle*.

Genus *Unela*, gen. nov.

Microhedylidæ with flattened tentacles and cylindrical rhinophores. Radular formula 1-1-1; no jaws. Epidermal glands volumous. Sexes separate; no copulatory organ. Female with a ciliated furrow from genital opening to basis of right rhinophore; male with a corresponding intra-epidermal duct.

Type: *Unela remanei*, spec. nov., named in honour of our friend ADOLF REMANE.

Spicules were not observed during the rapid study of the living animals. Contrary to the big spicules of *Hedylopsis* the minute ones of the Microhedylidæ are dissolved by the fixing liquids (Kowalevsky 1901, p. 8) without leaving vestiges, perhaps except cell vacuoles. Therefore the absence of spicules in *Unela remanei* is not included in the diagnosis of the genus. Although the radular formula differs from that of the previously known Acochliidiacea, it is near the others and suits to Odhner's phylogenetic connection of the Acochliidiacea with the Diaphanidæ (1937, p. 61-62). The radula of *Ptisanula limnæoides* Odhner (1914), later on (1926, p. 17) transferred to the genus *Toledonia*, is very similar to that of *Unela remanei*.

Unela remanei, spec. nov. (Fig. 1-17)

The length of the animals is 3-5 mm.; they are white, also the intestinal gland has no colour. In the anterior region the foot is recognizable only by its cilia (Fig. 10, so). From the level of the genital opening (g) backward the foot is marked off from the body by a fold. The pointed hind end of the foot attains about half the length of the visceral hump. The labial tentacles (l) are broader than high in the living animals. The rhinophores (ri) are cylindrical and have a notch limiting their slightly thickened bases in all preserved specimens. In life the form and position of the tentacles likens the horns of an indian buffalo ("Kerabau"), while the rhinophores resemble the horns of a goat.

The epidermis that covers the visceral hump, the so-called mantle, is higher than on the rest of the body and contains numerous glands (q).

These are partly eosinophilous, partly colourless, and their secretion is granular or homogeneous. The nuclei of the epidermal cells are frequently apical and longish, those of the glands basilar and round. Under the basement membrane follow muscle fibres and connective tissue. Also the inner organs are surrounded by a tunic of connective tissue, but the body cavity is ample (Fig. 9, 10). Like in *Hedylopsis spiculifera* (Kowalevsky 1901, p. 10) and other species of the Acochliidae a septum or diaphragm (d) separates the anterior body cavity from that of the visceral hump. The sole of the foot (so) is ciliated from the outer mouth opening to the hind tip. Its basophilous subepidermal glands (p) cover the whole breadth, their mucous secretion is granular. Longitudinal muscle fibres are numerous in the foot, and two strong retractors (r) run ventro-laterally in the visceral hump (Kowalevsky 1901, p. 10). Their contraction withdraws the anterior part into the hump like into a shell, and also shortens the entire animal, as is figured for *Hedylopsis suecica* Odhner (1952, t. 3 f. 10) and *Ganitus evelinæ* (Fig. 24). The anterior border contains only cyanophil and the region in front of the hump colourless, no eosinophilous glands. On the sides of this part the epithelium is high and of sensory character (Fig. 33, 36); here there are no glands. Merton (1920, p. 470) stressed the absence of glands in the olfactory epithelia of Gastropoda. Stiff cilia occur on the tentacles as in *Parhedyle tyrtowii* (Kowalevsky 1901, p. 5). Spicules were not observed.

The nervous system shows the general Opisthobranch features, concentration on one hand and development of new ganglia on the other (Hanström 1928, p. 178). The terminology applied here is that of Guiart (1901). The cerebral ganglia are confluent (1). The pleural ganglia (2) are attached to them on the sides, and the pedal ganglia (3) ventrally. The latter are united by a strong commissure under the oral tube. The ring formed by these three pairs of ganglia lies in front of the buccal bulb, as was already stated by Kowalevsky (1901, p. 15). The supra-intestinal ganglion (6) is situated on the right side near the ventral and posterior border of the buccal bulb (b), the united infra-intestinal and visceral ganglion (5) correspondingly on the left side. Their commissure is post-pharyngeal. The buccal ganglia (4), that should be called bulbo-oesophageal ganglia (Guiart 1901, p. 90), lie between the buccal bulb and the oesophagus (e), below which their commissure passes.

Small ganglia (7, 8) occur at the bases of the rhinophores (ri) and tentacles (l). The ramified anterior nerves are beset with nerve-cells and connected with groups of sensory cells (9) on both sides of the anterior region. On the anterior border, where they also occur, they are less concentrated and less distant from the epidermis than on the sides.

Kowalevsky (1901, p. 23-24) mentioned these groups as tentacular glands (t. 5 f. 57, glt) but already thought of nervous function; Hertling (1930, f. 2, K; on p. 5) called them cephalic glands, and Odhner (1937, p. 59 f. 10, og) olfactory ganglia. In clarified and stained animals they really have the aspect of ganglia. Guiart (1901, p. 96) reported "ganglions de reinforcement" in the olfactory nerve of *Philine aperta* (L.), and Odhner (1914, p. 10) observed ganglia underneath the epithelium of the olfactory organ of *Toledonia limnæoides*. The small amount of fibres in the ganglia of the Opisthobranchia (Hanström 1929, p. 111) makes it difficult to dis-

tinguish between subepithelial groups of sensory cells and ganglia, especially when the nerve itself is beset with nerve-cells. The high, gland-free, homogeneous epidermal epithelium of the anterior and antero-lateral region makes it probable that in *Unela remanei* and the following species (Fig. 32, 33, 36) sensory cells lie below the epidermis and are morphologically incorporated into swellings of the nerves. Following Merton (1920, p. 461 t. 34 f. 19) I call them sensory cells or sensory neurons (9). They are also known as cells of Flemming (Plate 1891, p. 599 t. 37 f. 103; Lang 1900, p. 252).

The statocyst (s) contains one statolith; eyes are not developed.

The anterior opening of the gut is surrounded by pedal glands and leads to a narrow vestibular canal (v), the oral tube. A two-lobed cyanophil vestibular or buccal gland (c) of variable length opens into the ventral wall of this tube. The internal orifice of the latter, the mouth, communicates dorsally with the tubular buccal cavity (es), ventrally with the buccal bulb (b) or pharynx. This bulb has no mandibles and is nearly filled out with a narrow odontophore and its surrounding masses of muscles (Fig. 10). The bend of the radula separates a much longer upper from a shorter under part, the former with 35-40, the latter with 9-14 transverse series, with 1-1-1 plates each. The maximum number of transverse series verified in one animal was 51. The central plate (Fig. 3-5) is a triangular tooth with 2 denticles on each side; it is 12 micra high and 12 micra broad. The lateral plate (Fig. 4, 6) is 14 micra high and has in the basal half a slight point on the anterior border. The channel (es) of the buccal cavity is ciliated and receives the ciliated ducts (Fig. 8, y) of the salivary glands, voluminous sausage-shaped organs (z) that meet on the ventral side behind the pharynx (b). The oesophagus (e) is a little wider than the pharyngeal channel (es) and also ciliated. It passes through the diaphragm (d) and continues into the intestine (Fig. 9, i) without an enlargement that could be considered as stomach.

The intestinal gland (m) is a simple tube directed backwards. Its shape varies from nearly straight with a bent hind end to undulate or almost serpentine, depending on the degree of filling and contraction. The histological aspect and the height of the liver-cells differs according to the phase of secretion and digestion; residues of food were not seen in the lumen of the intestinal gland. The hind end of the liver that is bent forward never contained intracellular granules.

A short terminal part of the intestine (Fig. 9, i) has no cilia and widens forming a small ampulla. The anus (a) lies on the right side under the border of the mantle, about 60 micra behind the genital opening (g).

In front of the kidney (k) thin membranes limit a tube (Fig. 10, co) that narrows and continues over the buccal bulb (b), where it ends (ao) in the connective tissue of the dorsal body wall. The tube on the right side corresponds to a pericardium and its mid-dorsal continuation to an anterior aorta. These reduced circulatory organs are not recognizable in all sectioned specimens.

The kidney (k) is a short epithelial vesicle on the right side that opens (Fig. 9, 14, 15, n) immediately above the genital aperture (g) about 70 micra in front of the anus (a). In *Hedylopsis suecica* the excretory orifice lies quite

near the anus and farther from the genital pore. The renal and pericardial cavity communicate by one reno-pericardial orifice (Fig. 10, ni).

The gonad (o, t) is a winding tube that accompanies the intestinal gland (m). Both organs are surrounded by a common tunic (Fig. 14, m, t). The female germ cells lie in their follicles on the dorsal side of the ovary (Fig. 12, o), without distinct sequence of the zones of division, growth and maturation. In the tubular ventral cavity of the ovary that continues into the oviduct (u) sperms occur, but no insemination of ovarian ovocytes was seen. These spermatozoa, and many in nerve fibres, connective tissues, and liver, come from copulations. The ventral side of the winding oviduct is ciliated; its dorsal side is enlarged by neutrophil glands (x) followed by feebly cyanophilous (ma) and farther outwards huge deeply cyanophilous ones (h). The faintly and the heavily basophil glands of *Unela remanei* correspond to the mucous and albumen gland-sac of *Hedylopsis suecica* Odhner (1937, p. 60). The oviduct (Fig. 11, u) opens below the kidney (Fig. 2, 9, g, n).

From the genital opening (g) to the front runs a ciliated epidermal groove (Fig. 10, f) that ends near the basis of the right rhinophore.

The volumous testis (Fig. 13, 14, t) is continued as spermiduct that entally forms a seminal vesicle (w) provided with thin muscles. The following part of the spermiduct (j) is narrow and widens farther ectally. A longer inner and a shorter outer ampulla are separated by constrictions (Fig. 14). The epithelium of both is glandular. The outermost part of the spermiduct is also a little widened but not differentiated as a penis. The genital orifice (g) is connected with the basis of the right rhinophore by an intra-epidermal capillary canal (Fig. 14, 16-17, mc). This canal has its own epithelium with glandular character in the beginning near the genital opening (g). It ends without a copulatory organ. Probably this male canal does not function. Although spermatophores were not observed in the 20 individuals of the present species, and only a few in the several hundred of the following, it is probable that they also occur in *Unela remanei* and are emitted through the genital opening.

A possible function of the female groove (f) is to lead spermatozoa that come out of a spermatophore fixed near the anterior end of the groove to the genital opening. It is likely that an ancestral hermaphrodite monaulic type is remembered by the ciliated groove, that in the more differentiated male has sunk into the epidermis and lost its cilia.

Locality: Island of São Sebastião, in coarse sand of the lower tidal zone; 20 mature animals, 10 males and 10 females, in november 1952.

Ganitus, gen. nov.

Microhedylidæ with flattened tentacles, without rhinophores. Radular formula 0-1-0×10-14. Two lateral jaws. Epidermal glands not specially thick. Sexes separate; no copulatory organs. Female with a short ciliated groove in front of the genital opening.

Type: *Ganitus evelinæ*, spec. nov.

Although the terms of the diagnosis given above for the Acochliidae permit to place *Ganitus* in that order, this inclusion might be questioned. The mandibles and the radula of *G. evelinæ* differ widely from the remaining Acochliidae, where neither jaws nor uniserial radulæ occur. Bücking (1933, p. 558) described the upper side of the radula of *Acochlidium amboinense* Strub. as uniserial (fig. 3, Mo). As the teeth of the radula originate on the upper side, wanting of the lateral plates here and their appearance on the under side is not intelligible. But to judge from *Hedylopsis suecica* Odh. (Fig. 19) also in the radula of *Acochlidium amboinense* the lateral plates of the upper limb are annexed to the central tooth so closely that they escaped Bücking's observation. At first sight the radula of *H. suecica* likens that of Bücking's figure 3 very much, and only after compression the elements M, S1 and S2 became distinct. In the examined animal of *Hedylopsis suecica* the two lateral plates of the left side are incompletely separated in all series (Fig. 23). Among the Diaphanidæ, that Odhner considers as the root of the Acochliidae, *Newnesia antarctica* Edg. Smith (1902, p. 208) has a uniserial radula, but the Diaphanidæ have no mandibles. The tooth of *Newnesia antarctica* is triangular with dentate borders (Smith 1902, t. 25 f. 6) like in other Diaphanidæ.

Thiele (1926, p. 104 ; 1935, p. 1044) mentions relations between *Newnesia* and the Sacoglossa (Ascoglossa) or Elysoidea, in which radulæ occur (Pruvot-Fol 1926, p. 240-241) that liken that of *Ganitus*. But the nerve-ring of the Sacoglossa lies behind the buccal bulb (Russell 1929), and in this order there are no mandibles. The uniserial radulæ seem to have originated by reduction of pluriserial ones in various systematic units, and therefore often represent mere convergencies (Pruvot-Fol 1926, p. 238, 269). The nervous system, the visceral hump, the foot, and the reproductive organs characterize *Ganitus evelinæ* as belonging to the order Acochliidae, family Microhedyliidae.

As was said above, the position of *Hedyle milaschewitchii* Kowalevsky (1901, p. 2, 19) can not be defined, as the buccal sclerites are unknown. If Kowalevsky's statement (1901, p. 20) that the inner organisation of this species does not seem to differ in anything from that of *Parhedyle tyrtowii*, except in the curves of the liver, is also valid for the radula, then *milaschewitchii* has the formula 2—1—2 and can not be generically united with *evelinæ*.

Ganitus evelinæ, spec. nov. (Fig. 24-40)

The living animals (Fig. 24) are white with brown liver and, extended, up to 2,2 mm. long. Preserved adult animals in balsam attain 1,0 mm., the youngest 0,5 mm. As in the preceding species the foot is only characterized by its ciliated sole (Fig. 30, 33, so) in the anterior nearly cylindrical part of the body ; farther backwards the foot ends pointed (Fig. 34, 39) and free from the sausage-shaped or fusiform visceral hump. The foot is much shorter than the latter in normally gliding slugs. In strongly contracted specimens (Fig. 24) foot and hump may be of equal length. The only appendages are the flattened labial tentacles (Fig. 39, 1), the anterior border of which is beset with sensory bristles.

Although spicules were not noted in living animals, their presence can be inferred from intracellular vacuoles in cells (si) of the connective tissue that involves the organs of the anterior region (Fig. 30, 36). A similar annular disposition of the spicules was described for *Acochlidium ambainense* Strub. (Bücking 1933, f. 9-13), but in that species it is attributed (p. 595) to integumentary folds due to retraction of the pharynx. In *Ganitus evelinæ* the ring of spicule-cells has nothing to do with folding of the anterior region. The latter is separated from the visceral hump by a diaphragm (Fig. 39, d) as in *Unela remanei*. Also the two retractors (Fig. 36, r) of this species are present in *Ganitus evelinæ*. Small serpentine concretions as such are common in the Opisthobranchia (Bergh 1905, t. 11 f. 11, 31, t. 12 f. 16) were observed in the epidermis of living specimens. Skin glands of the colourless type were found chiefly in the epidermis of the mantle in preserved animals. The pedal glands (Fig. 30, 33, 36, p) are strongly cyanophilous and specially numerous along the borders of the foot.

The anterior and antero-lateral region of the body shows the same subepithelial groups of sensory neurons (9) as *Unela remanei*. In some cases (Fig. 33) their sensory ends (10) could be traced extending to the epidermis and beyond the surface. Fig. 36 contains two groups of these cells of Flemming (9) connected with the cerebral ganglia (1), and an other lateral one that lies immediately beneath the epidermis. Also in farther anterior sections (Fig. 32, 33) the clusters of sensory cells (9) occupy very different levels. The central nervous system (1-6), the absence of eyes, and the statocyst (s) with one statolith are as in the preceding species.

The enteric canal begins with a narrow vestibular tube (Fig. 27, v), the ventral wall of which receives the slightly two-lobed vestibular gland (c). The buccal bulb (b) is very different from that in *Unela*. On each side of the mouth lies a fine cuticular leaflet, the mandible (Fig. 26, 27, 29, mi) with a concave anterior surface. A variable number (23, 27, 29) of plate-shaped longitudinal muscle cells (re) insert on both jaws. The half-ring of plates, that are envolved by circular fibres (ro), originates on a ventral cuticular cushion (rs) that perhaps functions as odontophore. This cushion comprises a central cavity (Fig. 26, 29), the form of which is that of the radular tooth (mr), and supports the epithelium that bears the radular membrane with its teeth. The epithelium is a ribbon constituted by a postero-anterior succession of cells that continue the odontoblasts of the radular sheath (ra). The cells of the dorsal channel (Fig. 27, es) of the buccal cavity are high, not ciliated, and possibly myoepithelial.

The uniserial radula (Fig. 26, mr) consists of 10-14, most frequently 11 teeth. The upper and under side of the radula are not sharply angled and so the number of teeth in either of them varies. Each tooth (Fig. 25) is fastened to the supporting membrane by a basal plate that forms an angle with the distal part. The latter is pointed, has entire, not indented, borders and is slightly concave on its anterior surface. *Ganitus evelinæ* has less teeth than the hitherto registered minimum in the Gastropoda that is 15 for *Acteonia corrugata* (Ald. & Hanc.) (Pelseneer 1906, p. 89; Hoffmann 1923, p. 23; Grimpe & Hoffmann 1930, p. 435).

The salivary glands (Fig. 27, z), the narrow œsophagus (e), and its continuation into the intestine agree with the corresponding organs in *Unela*

remanei. The intestinal gland (Fig. 34, 39, m) ends with a forward bend in most of the examined specimens.

The kidney (k) opens immediately above the gonopore (Fig. 39, g) and has a funnel-shaped nephrostome (Fig. 31, ni) with a distinct tuft of cilia. The adjacent cavity, that theoretically corresponds to a pericardium, has loose and incomplete walls and is still more reduced than in *Unela remanei*. No aorta was seen in the sectioned specimens.

The tubular gonads are united with the liver (m). The ovary (Fig. 34, 35, o) is short and contains only few ovocytes at the same time, while the oviduct (u) is long. From the ectal outer germ-zone the growing ovocytes proceed to the ental (inner) blind end of the ovary, where the alimentary conditions possibly are most favourable because of the doubled liver (Fig. 34, m, o). After examination of many females we are sure that only one egg is laid at a time. The oviduct (Fig. 34, 35) has the same structure as in *Unela remanei*, ventrally it is ciliated (Fig. 35, u), and dorsally it is provided with the same sequence of glands, neutrophil (x), feebly cyanophil (ma), and deeply cyanophil ones (h). From the genital opening (g) to the front runs a ciliated groove (Fig. 36, f) on the right side of the body to an extent of about 70 micra. Already very young females still without glands in the oviduct show sperm between the small ovocytes, that evidently proceeds from a copulation.

The testis (Fig. 39, 40, t) is followed by a seminal vesicle (w) with a muscous wall and a terminal ciliated ejaculatory duct (j). The lining epithelium of the latter is glandular, and this part of the male duct must produce the spermatophore (Fig. 37, 38, se). No seminal groove or copulatory organ exists in the male.

Some ten females of our rich material had a spermatophore (se) sticking to the right side of the anterior part of the body. That is the region where the ciliated groove ends. Nevertheless the sperms generally penetrate the skin directly, as can be deduced from Fig. 38 and their occurrence in various internal tissues. Possibly the thin organ full of living spermatozoa of *Microhedyle lactea* Hertling (1930, p. 7 f. 3 on the plate) was a spermatophore. Accumulations of spermatozoa that can only proceed from copulation were also seen in the body of male individuals. This process can hardly be understood as a sign of ancestral hermaphroditism in *Ganitus*, as mating of males also occurs in dicecious Prosobranchia (Ankel 1936, p. 158).

Locality: Island of São Sebastião, in coarse sand of the lower tidal zone; several hundred specimens in november 1952.

Biological notes on the new Microhedylidae

The two species were taken in the littoral of Ilhabela, "Villa Bella da Princesa" of the Times Atlas (1922), on the island of São Sebastião (plate 100 R 16 of this Atlas). They are sand-dwellers and belong to the mesopsammon or interstitial fauna. The place where they were found can be ascribed to the *Otoplana* zone (Remane 1933, p. 211; 1940, p. 97). As

such it is characterized by the accompanying fauna, some elements of which are mentioned in the introduction of the present paper, and by other environmental factors, as coarse sand in the tidal zone. But the locality where we obtained all our arenicolous Opisthobranchia is not a typical *Otoplana* zone. In the canal of São Sebastião the surf is generally weak, and in addition our locality is sheltered by a boulder. In the North Sea *Microhedyle*, *Philinoglossa* and *Pseudovermis* (Remane in Jaekel 1952, p. 253, 254 and list between p. 250 and 251) were found at 6-8 and 22 m., so that also these localities are not exposed to the breakers that whirl the grains of sand around permanently.

The slugs were obtained by our usual method for the collection of sand Turbellarians and Nemerteans in the inclined dish (Corrêa 1949, p. 5 t. 1 f. 3). They are all positively geotactic in slightly moved water. When they are exposed to a jet of the catching pipette, they attach themselves to the substratum, as Hertling (1930, p. 4) described it. Principally *Ganitus evelinæ* often sticks in the pipette and glides down only in the course of various minutes. The species is as haptic (Remane 1933, p. 185) as the Gastrotricha. As it does not possess special adhesive organs, the mucus produced by the pedal glands (Fig. 30, 33, 36, p) and the flattening of the foot evidently fasten the slug like in Dorididæ (Remane 1933, p. 186) and Patellidæ (Ankel 1936, p. 85). Kowalevsky (1901, p. 3-4) and Hertling (1930, p. 3) already described the agility of the Microhedylidæ, all regions of which, even the visceral hump, are highly contractile. They do not swim, but reaching the surface of the water in the dish they glide along the film with their back hanging down.

Of our two monœcious Microhedylidæ both sexes occurred in equal numbers in november 1952. By far the most common species of the above mentioned association was *Ganitus evelinæ* of which we took up to 300 specimens in thousand cc. of sand. Hertling gathered 3,3 *Philinoglossa helgolandica* and 1 *Microhedyle lactea* in the same quantity of sand.

Order Philinoglossacea Hoffmann (1933, p. 192)

Small oblong and flat Opisthobranchia with cilia on sole and notum that are separated by a non-ciliated fold. Nerve-ring prepharyngeal; statocyst with one statolith; no external shell, ctenidium, cephalic disc, or appendages. Radular formula 3—0—3, teeth sickle-shaped. No jaws or masticatory plates. Anus at the hind end, median. Monœcious, marine.

This diagnosis is that of Odhner (1952, p. 145) with minor modifications. Odhner (l. c.) derives the Philinoglossacea from the Diaphanidæ. Only one family: Philinoglossidæ Hertling (1932, p. 9).

Pluscula, gen. nov.

Philinoglossidæ with an internal reduced shell, an oviduct opening near the hind end on the right side and a copulatory male organ below the oral tube. A ciliated groove on the right side, between the female aperture and the anterior part of the body, where it disappears in front of the level of the cerebral ganglia. Intestinal gland a broad sac in the posterior body cavity; anus in the fold that separates notum and foot.

Type: *Pluscula cuica*, spec. nov.

The present species differs externally from *Philinoglossa helgolandica* Hertling (1932, p. 1, 8) only by bigger size, viz. up to 2,5 mm. against 1,5 mm., the absence of eyes, and the lack of cutaneous pigment (Hertling 1932, f. 2; Odhner 1952, t. 4).

The sections however revealed that the two species can not be united generically. The present species has separate male and female efferent organs that lie at nearly opposite poles of the body. The presence of a ciliated furrow resembles the monaulic type, but the groove is not connected with the penis. The ovotestis of *Ph. helgolandica* opens through a spermoviduct, the aperture of which lies on the right side a little in front of the middle. The hermaphrodite gland of *Ph. helgolandica* is slightly lobate, not follicular as that of *Pluscula*. A seminal groove or a penis were not observed in *Ph. helgolandica*. It is however possible that the european species also possesses an anterior copulatory organ. What Hertling called gland of the oral tube (fig. 4, 6, Md), and only found in mature animals a little to the right side (p. 5), is likely to be a penis. There are no indications in Hertling's description for a possible posterior oviduct in *Ph. helgolandica*. This species has no internal shell, its anus opens at the hind end of the foot, the liver has a short anterior and a S-shaped posterior limb, and the gonad nearly reaches the level of the buccal bulb (Hertling 1932, fig. 6 c). The radula and the central nervous system agree in *Philinoglossa helgolandica* and *Pluscula cuica* in most details. Hertling has examined more than 100 specimens collected in all seasons, and his description is detailed. All that, I think, hinders so many and so audacious interpretations as would be necessary for a generic union of Hertling's species with the present one. I prefer to run the slight risk that a renewed study of *Philinoglossa helgolandica* reveals *Pluscula* as a synonym of *Philinoglossa*.

Pluscula cuica, spec. nov. (Fig. 41-49)

Living adult animals are 2,5 mm. long and about 0,7 mm. broad. They are flat, nearly ribbon-like, dorsally a little convex (Fig. 41), anteriorly truncate, posteriorly lengthened to form two corners, between which the hind border is concave (Fig. 42). The general colour is ivory, more grayish or more yellowish to brownish. The liver is brown, and a caudal round spot, the pallial gland (p), orange.

Two lateral folds (fo) separate the dorsal notum from the ventral foot. The greatest depth of these folds, their extension towards the median plane, lies in the anterior part of the body (Fig. 43). Here they also attain their maximum height, viz. dorso-ventral extension. Farther in front notum and foot approach one another closely and narrow the folds to small furrows that end on the anterior border to the sides of a central pit (ci). The latter is divided by two lateral lips into a dorsal and a ventral deepening (Fig. 44), the openings of the vestibular or oral tube (v) and the male copulatory organ (ep).

The foot ends pointed approximately on the transverse level of the pallial gland (Fig. 46, 48, p), so that the notum exceeds the foot for about one sixth of the body length. In the anterior half of the body the foot is broader than the notum in preserved specimens (Fig. 47). The anterior

third of the body cavity is separated from the rest by a diaphragm that is nearly perpendicular to the sagittal and horizontal planes of the body.

Notum and foot are not different histologically, both bear cilia, and their epidermis contains colourless (Fig. 47, 49, q), acidophil, and basophil glands. The biggest are the colourless glands which are subepithelial, the two other types are epithelial. Insunk unicellular basophil glands (c) lie in groups in the parenchyma of the lips, the borders of which are filled with thick masses of blue secretion. The foot has no special glands. Glands and cilia are wanting in the folds (Fig. 47, fo) between notum and foot. In adult animals however a ciliated zone (f) that corresponds to a seminal groove occurs in the fold of the right side. A reduced round shell (sh), the lime of which is not in all sections completely dissolved, is situated in the parenchyma of the median mantle region over and behind the pallial organs.

In many of the living specimens a yellowish or orange ball (Fig. 45, 46, p) appears under and in front of the shell. Although it lies in the mid line in *Pluscula cuica*, the yellow spot observed somewhat to the left side in *Philinoglossa helgolandica* might be the same organ. Hertling (1932, p. 4) did not recognize its significance. In sections of the present species (Fig. 48, p) it reveals to be a gland with a minute epithelial duct and a fundus composed of big, nearly colourless secretory cells and supporting cells, and envolved by fine muscle fibres. Similar glands were described by Köhler (1893, p. 23 t. 2 f. 30) and Thiele (1897, p. 648-650 t. 31 f. 13, t. 32 f. 25), such with more distinct epithelial ducts are known from *Aplysia* (Blochmann 1883, p. 411, 413-414). The dorso-median position of the gland of *Pluscula cuica* does not suit to the type of a hypobranchial gland, therefore we adopt the denomination "pallial gland" after Guiart (1901, p. 69-70).

The parenchyma forms a compact mass below the epidermis. This parenchyma is followed by a distinct layer of longitudinal muscles (Fig. 49, r) that surrounds a spacious body cavity lodging the internal organs.

The central nervous system (Fig. 44) is similar to that of *Philinoglossa helgolandica* and corresponds to completely distorted Tectibranchia with approximation of the centres and shortened visceral loop. The same fundamental type occurs in the Acochlidiacea. The volumous cerebral ganglia (1) are united by a 40-50 micra long commissure over the vestibular tube. Latero-ventrally to them lie the pleural ganglia (2) and farther backward and more ventrally the pedal ganglia (3). The cerebro-pleural and cerebro-pedal connectives are short. The posterior face of the pleural ganglia and the anterior of the pedal ganglia are very near to one another, and the pleuro-pedal connectives are dorsally united with the cerebro-pleural connectives. The static nerve and the cerebro-pedal connective have their cerebral origins united in the same bundle. On the right side the visceral loop contains the supra-intestinal (6) or right parietal ganglion, to the medial face of which an accessory parietal or pallial (11) ganglion (terminology of Guiart 1901) is apposed. From the supra-intestinal ganglion a nerve runs along the right wall of the body cavity and forms a loop around the rectum (Fig. 48, nr). On the left side of the visceral commissure lie the left pallial (12) and the sub-intestinal (5) ganglion, the latter is coalesced with the visceral ganglion (5a).

A subepidermal ganglion (14) 50 micra in front of the female genital opening (Fig. 45, g) can not be defined, because its connective with the centre could not be followed, nor the nerves that arise from it. As *Pluscula cuica* has no ctenidium and no osphradium, this ganglion perhaps supplies the reproductive organs. With all reservation we call it genital ganglion. The bulbo-oesophageal (4) or buccal ganglia (Fig. 44) lie to the sides between the buccal bulb (b) and the oesophagus (e).

Of the several nerves that arise from the cerebral ganglia one strong anterior tractus that branches near its origin is provided with "ganglions de renforcement" (Guiart 1901, p. 96). The ventral branch forms a special volumous ganglion, G2 of Hertling's denomination (1932, p. 7), but also the farther anterior ganglia (13) and the three ganglia of the dorsal branch are conspicuous. They all have a distinct sheath and are true ganglia, not groups of sensory cells as in the Microhedyliidæ. Even the small groups of nerve cells still more in front, drawn in Fig. 45, are of ganglionic character. Sensory cells lie under the epidermis of the anterior end, partly diffusely disposed and partly in clusters. The statocyst (s) contains only one statolith; there are no eyes.

The enteric canal begins in the central anterior pit (ci) with a thin-walled vestibular or oral tube (v). Besides the above mentioned glands of the lips (c) others of the same insunk cyanophil type open into the walls of this tube. True oral glands (Fig. 45, bc) around the internal opening of the vestibular tube, the mouth, are cyanophilous too. The buccal bulb (b) consists chiefly of strong circular muscles. The odontophore has thick longitudinal muscles and bears a radula composed of 17-18 transverse series of plates. The lower limb of the radula is short. The three approximately sickle-shaped teeth of each side decrease in size from the inner to the outermost one like in *Philinoglossa helgolandica* Hertling (1932, fig. 7, 8). Also the broad process on the outer border of the biggest tooth is like that in the european species, but the inner border is smooth, not crenulate, in *Pluscula cuica*.

The dorsal channel (es) of the buccal cavity is not ciliated (Fig. 47). Cilia appear in the oesophagus (e). The size of the salivary glands (z) varies greatly like in the Acochlidiacea (Kowalevsky 1901, p. 12, 13, 24). If they are fully developed, they have large nuclei, and their basophil cytoplasm contains pale pink granules of secretion. The oesophagus slants ventrally and opens into the intestinal gland (m). The latter is a spacious sac that generally extends backwards to the posterior end of the ovotestis, but sometimes attains the hind extremity of the body cavity. The outer surface of the liver is smooth; the inner epithelium (Fig. 49, m) is more or less, generally little, folded, and contains the known two types of cells: high ferment cells with colourless, pale blue and deeply blue vacuoles and small basilar nuclei, and large lime cells with homogenous blue plasma and big nuclei at their base. The contents of the ample liver cavity are only coagulated pink masses, never traces of recognizable food. The anterior surface of the liver bulges irregularly (Fig. 46).

The ciliated outlet of the intestine (Fig. 45, 46, i) is funnel-shaped and leaves the liver on the dorsal side. Then the gut narrows and bends to the right side. It continues ciliated and runs between the longitudinal muscles

and the liver on varying levels, generally equidistant from back and sole. This part of the gut often contains empty shells of Diatoms. The anus (a) lies in the middle of the pallial cavity. Immediately over the gut opens the pallial gland (p). On the right side of the anus lies the renal pore (n) and in front of the latter the female genital opening (g).

The heart (au, ve) is situated before the kidney (k) and entirely on the right side of the animal. The kidney is a broad sac that extends over the gut into the left half of the body cavity (Fig. 45, 49). Near the outer opening of the kidney the renal wall forms a long ciliated tube, the renopericardial duct that enters the ample pericardial cavity (co). The latter lodges two sacs, the posterior auricle (au) and the anterior ventricle (ve), from which the aorta (ao) arises. This artery runs parallel to the gut along the muscles that surround the body cavity. Continuing on the right side it forms a loop (Fig. 46, ao) in front of the buccal bulb and turns back to the left side on the horizontal level between cerebral and pedal ganglia. The further course on the left side could not be followed. From the loop some thin arteries run farther forward.

The follicular hermaphrodite gland (Fig. 45, o) lies dorsally to the liver (m) and more or less symmetrically on both sides of the mid line. It does not extend into the anterior half of the body and never exceeds the anterior border of the intestinal gland. The ovotestis consists of about seven acini connected by ciliated ductules (u) that open into the dorsally running hermaphrodite duct. The bottoms of the acini are directed towards the ventral side. Here the ovocytes surrounded by big follicle cells are situated, while the spermatozoa occupy the distal part of the acinus, near the efferent ductules, as is the rule in molluscan hermaphrodite glands (Pelseneer 1894, p. 32; Ankel 1936, fig. 128). The most distal acinus is exclusively masculine (Fig. 45, 49, t). It contains spermatogenesis too, but seems mainly to store ripe sperms as an internal seminal vesicle.

In the lumen of the hermaphrodite duct near its most distal acinus we once found a developed embryo with a helicoid shell. It was a little smaller than a full grown ovocyte of the present species. One can not know but only suppose that it is a *Pluscula cuica*-embryo originated from a fertilized egg that had not succeeded to be freed. We only mention it, because the shell was not unlike that of larvæ of *Diaphana hyalina* (Thorson 1946, p. 251 fig. 147).

The hermaphrodite duct is a winding tube with ciliated floor and glandular dilated roof. The two proximal sacs with pink secretion (x) lie more on the right side of the body, a big distal one with blue staining glands (h) on the left side. The terminal efferent part (Fig. 45, u) runs almost transversely to the right side where it curves backwards to its external opening (g). Approximately in the angle between the longer transverse and the shorter backward course opens the duct of a spermatheca or receptaculum seminis (sp) that contains spermatozoa and red and blue staining secretion.

From the genital aperture forward a ciliated groove (f) runs on the right side along the non-ciliated fold between notum and foot. It is true that this "groove" likens a ribbon more than a groove or furrow for the most part of its course. Anteriorly it ends with the fold near the anterior border of the slug. However it does not reach the central pit (ci) that contains

the openings of the male copulatory organ and the oral vestibulum. Notwithstanding the "seminal groove" of *Pluscula cuica* does not seem to be without function. Near its anterior end are dorsal and ventral insunk glands with acidophilous secretion (Fig. 47, ce) as such do not occur in any other region of the body. Only mature animals show these glands, so that it is evident that they have something to do with reproductive processes.

One might perhaps suppose that a protective secretion could secure the passage of the spermatozoa from the anterior end of the seminal groove to the male copulatory organ, in as much as no internal spermiduct connects the above mentioned male acinus (t) with the penis (pe). Nevertheless the spermatozoa leave the male acinus, this internal seminal reservoir, passing through its wall and move through the posterior and anterior body cavity. In our oldest slugs they are numerous between liver, gonad, gut and salivary glands, and this track understood as outward way of the own sperms suits well to the details of the efferent male organs. These are represented by a tube of varying length in immature animals. In one extreme case this tube extends between the acini of the hermaphrodite gland, but it is always closed at its inner end. In mature slugs the tube is differentiated into a seminal vesicle (w), a prostata (j), and a penis (pe).

The seminal vesicle that might be distinguished as external vesicle from the male acinus or internal seminal vesicle lies (Fig. 45, w) under the salivary glands (z) behind the buccal bulb (b). Its lumen lodges masses of spermatozoa, its epithelium is ciliated and contains red secretion, and its wall is surrounded by thin muscle fibres. The prostate (j) is serpentine, tubular, and also ciliated. Its epithelium produces red granular secretion. The anterior part of the male efferent organ is the penis (Fig. 47, pe) that lies nearly below the oral tube (v), not as far to the right side as was drawn in the diagrammatic dorsal view (Fig. 45). The penial lumen is narrow, the ciliated epithelium low, and the surrounding circular musculature strong. The nuclei of the muscle cells form a mantle around the fibres. The penis opens into an epidermal pouch (ep) with weak muscles that ends in the anterior central pit (ci).

Locality : Island of São Sebastião in coarse sand of the lower tidal zone, about 50 specimens of all ages in november 1952.

Resumo

Entre os Opistobrânquios, os Acochliidae ocupam posição especial, porque possuem saco visceral saliente sem concha ; são, em parte, unissexuais, e ocorrem também na água doce. O colar nervoso prefaríngeo aproxima-os aos Tectibranchia. Odhner (1952) estabelece 3 famílias dos Acochliidae. Duas destas, as Hedylopsidae e as Microhedyliidae, distinguem-se respectivamente pela separação completa (Fig. 18) e apenas posterior (Fig. 1, 2, 24, 34) entre o pé e o corpo restante.

Unela remanei, sp. n., representante de um novo gênero das Microhedyliidae, distingue-se dos outros gêneros desta família pela fórmula da rádula (Fig. 3, 4) que é 1-1-1×44-54, pelo canal intra-epidérmico do macho

(Fig. 13, 17, mc) e o sulco ciliado da fêmea (Fig. 2, 10, f). Os sexos são separados. Animais viventes têm até 5 mm. de comprimento; 10 machos e 10 fêmeas foram encontrados na areia grossa da zona inferior das marés, na ilha de São Sebastião.

No mesmo biótopo ocorre *Ganitus evelinæ*, n. g., n. sp., da mesma família. As lesmas desta espécie atingem de comprimento 2,2 mm. Na localidade pesquisada constituem os elementos predominantes do mesopsammon, havendo 300 indivíduos por litro de areia. São também unisexuais. Em oposição à fórmula dos outros Acochliidae (2-1-2) a de *Ganitus evelinæ* é de 0-1-0×10-14; a forma do dente (Fig. 25) lembra a dos Ascoglossa. Rinóforos faltam como em *Hedyle milashevitchii* Kowalevsky 1901 que possivelmente pertence ao mesmo gênero. Mandíbulas, ausentes nos Acochliidae restantes, ocorrem em *Ganitus evelinæ* (Fig. 26, 27, mi). Anteriormente ao orifício genital (Fig. 34, 39, g) existe nas fêmeas (Fig. 36, f) um curto sulco ciliado. Na copulação, um espermatóforo (Fig. 37, 38, se) é fixado ao lado direito da fêmea; os espermatozoides atravessam a pele e migram pela cavidade do corpo à gônada feminina.

Juntamente com os Acochliidae mencionados encontramos uma espécie dos Philinoglossacea, *Pluscula cuica*, n. g., n. sp.. Obtivemos ca. de 50 exemplares, entre grandes (2,5 mm.) e pequenos (0,5 mm.). *P. cuica* distingue-se da até agora única espécie dos Philinoglossacea, *Philinoglossa helgolandica* Hertling 1932, pelos caracteres seguintes: possui concha interna reduzida (Fig. 45, 46, 49, sh); o orifício feminino (Fig. 45, g) situa-se perto da extremidade posterior, no lado direito, e daí corre um sulco ciliado (Fig. 47, f) até à cabeça. O órgão copulador masculino (Fig. 44, 46, pe) encontra-se ventralmente ao tubo oral (v), abrindo-se em bolsa epidérmica abaixo da bôca externa (ci). A glândula do intestino médio (Fig. 46, 49, m) é um saco largo na cavidade posterior do corpo, e o anus (a) abre-se na dobra entre notum e pé. A glândula hermafrodita compõe-se de ca. de 7 folículos ("ácinos"), dos quais o mais distal é puramente masculino (Fig. 45, t). Os outros contêm, entalmente, os gonócitos femininos; ectalmente, os masculinos. Do ácido masculino, os espermatozoides migram através da cavidade do corpo para a vesícula seminal (Fig. 46, w) e daí passam pela próstata (j) ao penis (pe). A rádula de *Pluscula cuica* difere pouco da de *Philinoglossa helgolandica*; o sistema nervoso central (Fig. 44) concorda nas duas espécies, nos seus traços fundamentais.

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Of **Odhner 1939a** the author kindly sent me a photocopy, while the present paper was in print.

Explanation of lettering

- a — anus.
 ao — aorta.
 au — auricle.
 b — buccal bulb.
 bc — mouth glands.
 c — vestibular and labial glands.
 ce — erythrophil glands at anterior right side of *Pluscula*.
 ci — central pit.
 co — pericardial cavity.
 d — diaphragm.
 e — oesophagus.
 ep — external penial pouch.
 es — pharyngeal canal.
 f — ciliated groove.
 fo — lateral fold.
 g — genital opening.
 h — deeply cyanophil female glands.
 i — intestine.
 in — mantle epithelium
 j — spermiduct, in *Pluscula* prostata.
 k — kidney.
 l — tentacle.
 m — digestive gland (liver).
 ma — feebly cyanophil female glands.
 mc — epidermal canal.
 mi — mandible.
 mr — radula.
 mu — muscle.
 n — renal pore.
 ni — nephrostome.
 nr — nerve near anus.
 o — ovary, in *Pluscula* hermaphrodite acini.
 p — pedal glands, in *Pluscula* pallial gland.
 pe — penis.
 q — skin glands.
 r — retractors, in *Pluscula* longitudinal muscles of wall of body cavity.
 ra — radula sheath.
 re — longitudinal muscles of buccal bulb.
 ri — rhinophore.
 ro — circular muscles of buccal bulb.
 rs — radula support.
 s — statocyst.
 se — spermatophore.
 sh — shell.
 si — spicule cell.
 so — sole.
 sp — spermatheca (receptaculum seminis).
 t — testis, in *Pluscula* masculine acinus.
 u — oviduct, in *Pluscula* hermaphrodite duct and efferent ductules.
 v — vestibular (oral) tube.
 ve — ventricle.
 w — seminal vesicle.
 x — female neutrophil, in *Pluscula* pink glands.
 y — salivary duct.
 z — salivary glands.
 M — central radular tooth of *Hedylopsis suecica* Odh.
 S1 — larger lateral plate of same.
 S2 — smaller lateral plate of same.
 1 — cerebral ganglia.
 2 — pleural ganglia.
 3 — pedal ganglia.
 4 — bulbo-oesophageal (buccal) ganglia.
 5 — sub-intestinal + visceral ganglion, in *Pluscula* sub-intestinal ganglion.
 5a — visceral ganglion.
 6 — supra-intestinal ganglion.
 7 — rhinophore ganglion.
 8 — tentacle ganglion.
 9 — antero-lateral sensory cells.
 10 — receptors of sensory cells.
 11 — right pallial (accessory parietal) ganglion.
 12 — left pallial (accessory parietal) ganglion.
 13 — precerebral ganglia.
 14 — posterior, perhaps genital ganglion.

PLATE 1

Unela remanei, g. n., sp. n.

- Fig. 1 — Living animals.
Fig. 2 — Organisation, right side view.
Fig. 3 — Side view of 6 central radular teeth and 2 lateral plates.
Fig. 4 — One central radular tooth with 2 lateral plates.
Fig. 5 — Central tooth of radula.
Fig. 6 — Lateral plate of radula.
Fig. 7 — Central nervous system in stained clarified animal.
Fig. 8 — Diagram of central nervous system.

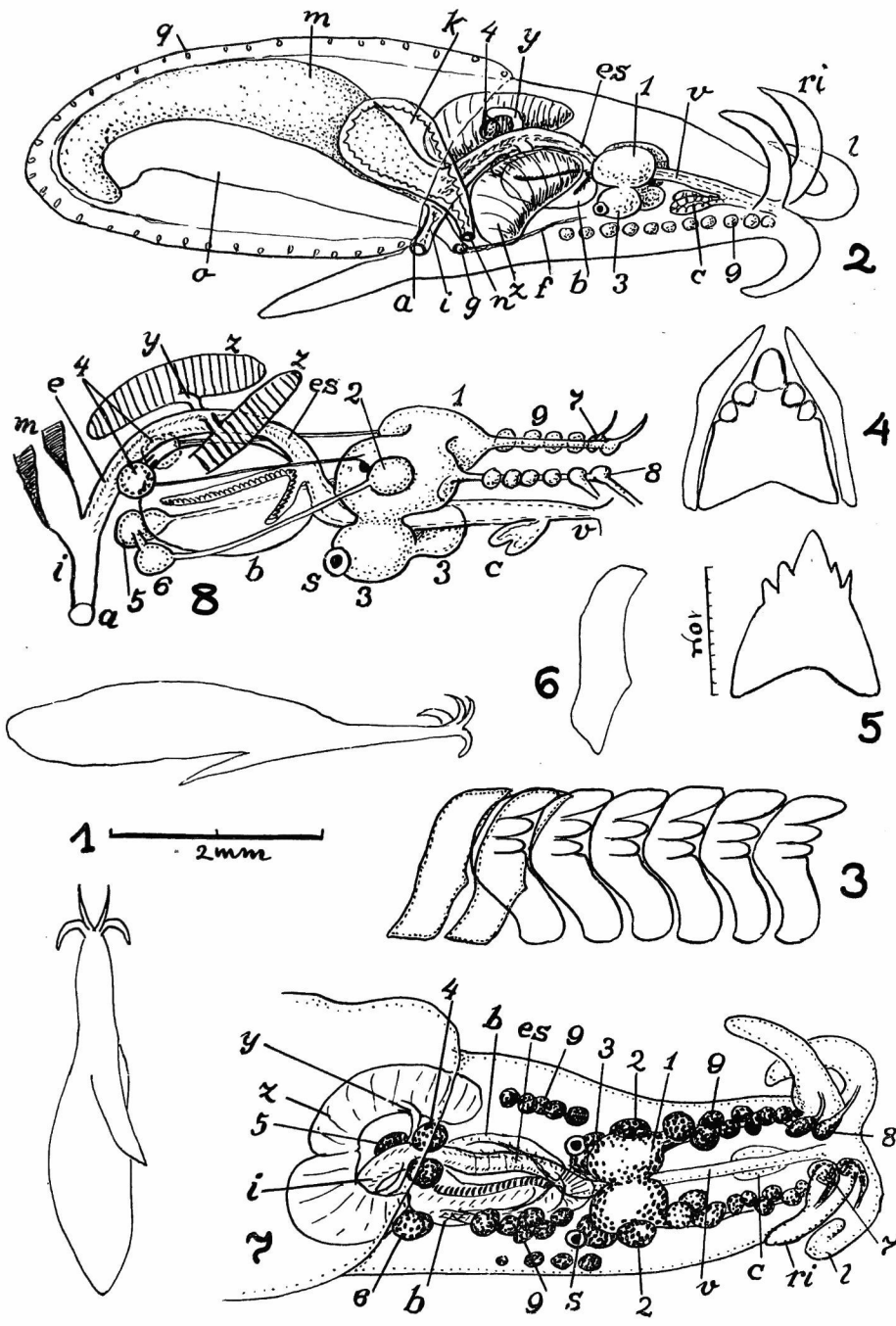
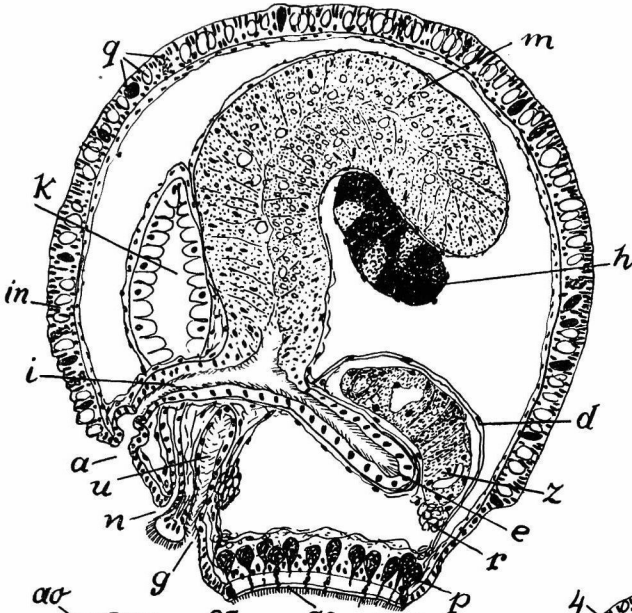


PLATE 2

Uncla remanei, g. n., sp. n.

Fig. 9 — Combined transverse section with female, renal and anal opening.

Fig. 10 — Transverse sections of female; the first and last 0,16 mm. apart.



9
100μ

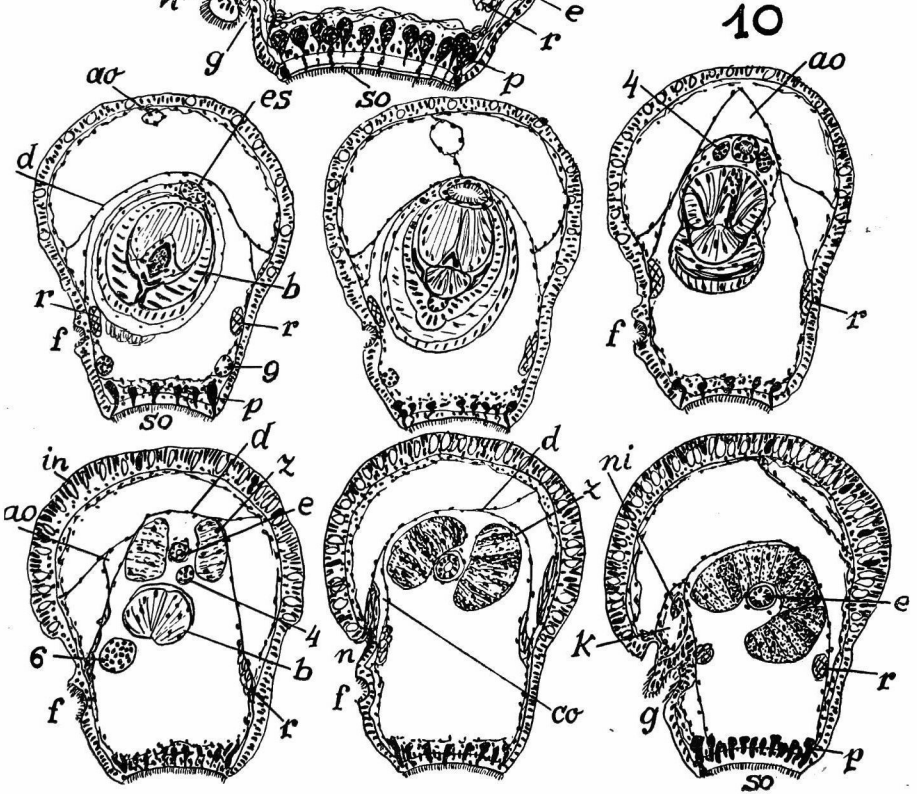


PLATE 3

Unela remanei, g. n., sp. n.

Fig. 11 — Organisation of female.

Fig. 12 — Sagittal section of female.

Fig. 13 — Anterior part of male.

Fig. 14 — Combined sagittal section of male.

Fig. 15 — Transverse section of male opening.

Fig. 16 — Transverse section of epidermal canal near male opening.

Fig. 17 — Transverse section of epidermal canal near right rhinophore of male.

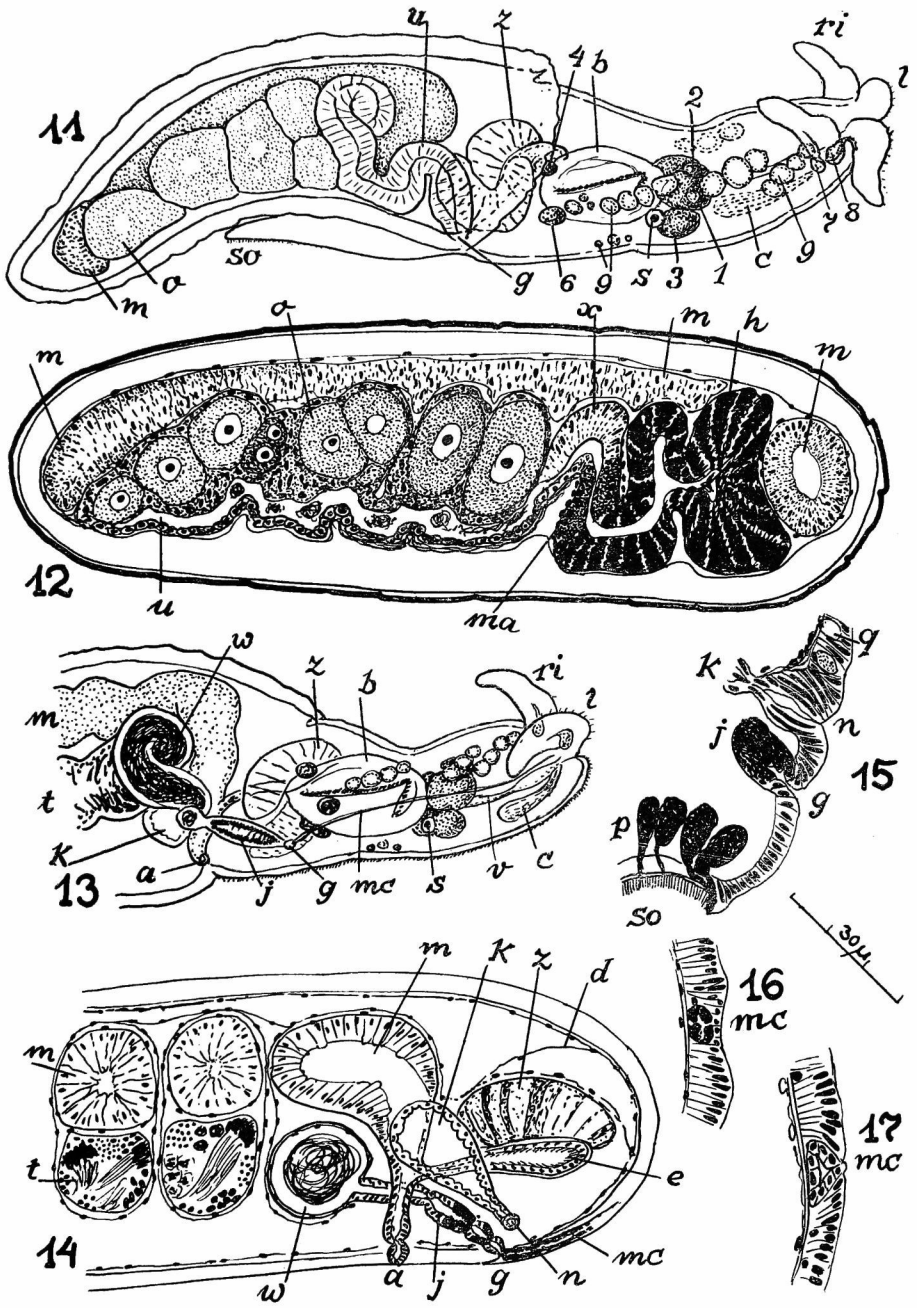


PLATE 4

Hedylopsis suecica Odh. from Banyuls-sur-Mer (A. REMANE & E. SCHULZ leg.)

Fig. 18 — Two preserved specimens.

Fig. 19 — Three series of the radula ; one of the central teeth deficient ; the outlines of the lateral plates stippled.

Fig. 20 — Central tooth of radula, side view.

Fig. 21 — Central radular tooth.

Fig. 22 — Three lateral plates of right side.

Fig. 23 — Three lateral plates of left side.

Ganitus evelinæ, g. n., sp. n.

Fig. 24 — Four living specimens, one well stretched and one contracted.

Fig. 25 — Three teeth of radula.

Fig. 26 — Buccal bulb clarified in KOH and slightly pressed.

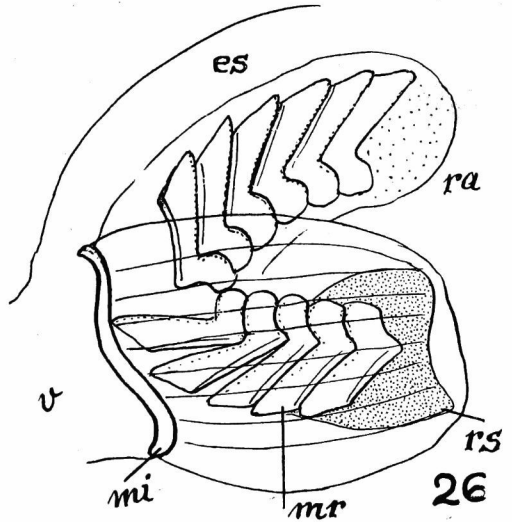
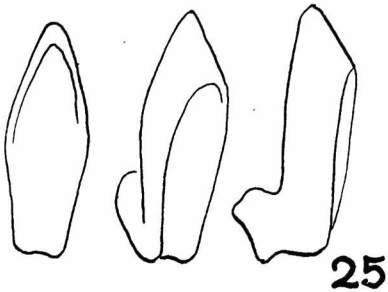
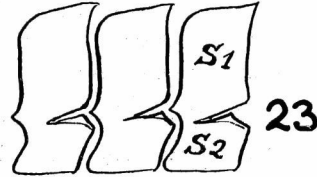
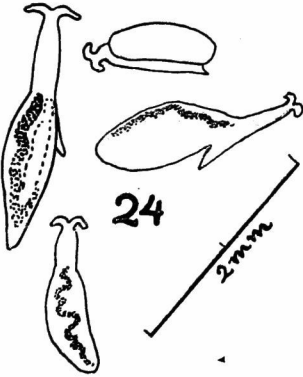
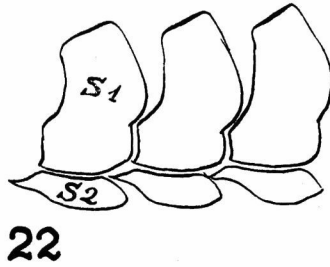
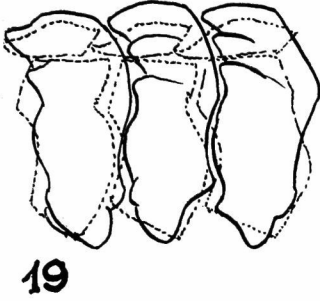
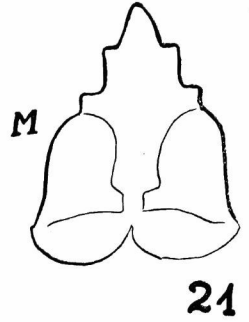
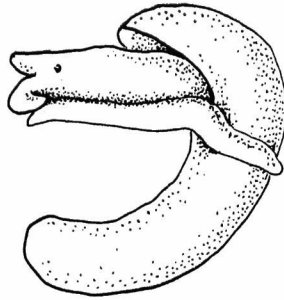
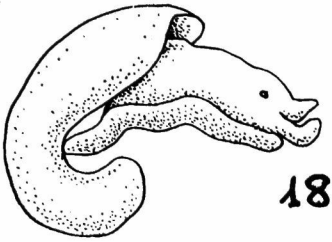


PLATE 5

Ganitus evelinæ, g. n., sp. n.

- Fig. 27 — Sagittal section of buccal bulb ; the lines indicate the directions of Fig. 28 and 29.
- Fig. 28 — Upper horizontal section of buccal bulb.
- Fig. 29 — Lower horizontal section of buccal bulb.
- Fig. 30 — Transverse section of body on level of buccal bulb.
- Fig. 31 — Section of kidney with nephrostome.
- Fig. 32 — Transverse section of anterior vestibular opening ("outer mouth").
- Fig. 33 — Transverse section of body in anterior region.

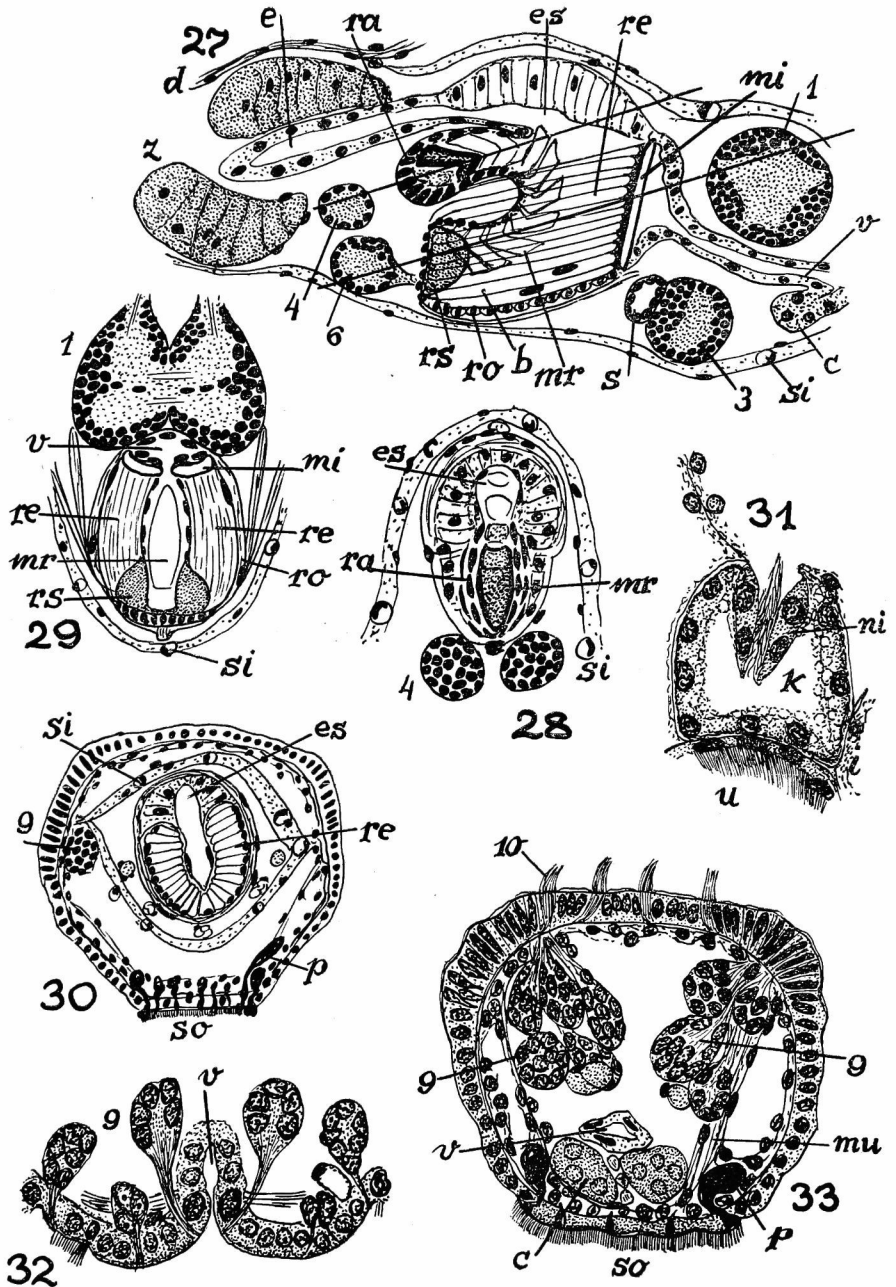


PLATE 6

Ganitus evelinæ, g. n., sp. n.

- Fig. 34 — Stained and clarified female, right side view.
- Fig. 35 — Sagittal section of ovary and oviduct.
- Fig. 36 — Transverse, slightly oblique section of female with ciliated groove (f).
- Fig. 37 — Preserved contracted animal with spermatophore (se).
- Fig. 38 — Horizontal section of spermatophore (se) attached to right side of female.
- Fig. 39 — Stained and clarified male, right side view.
- Fig. 40 — Sagittal section of testis and spermiduct.

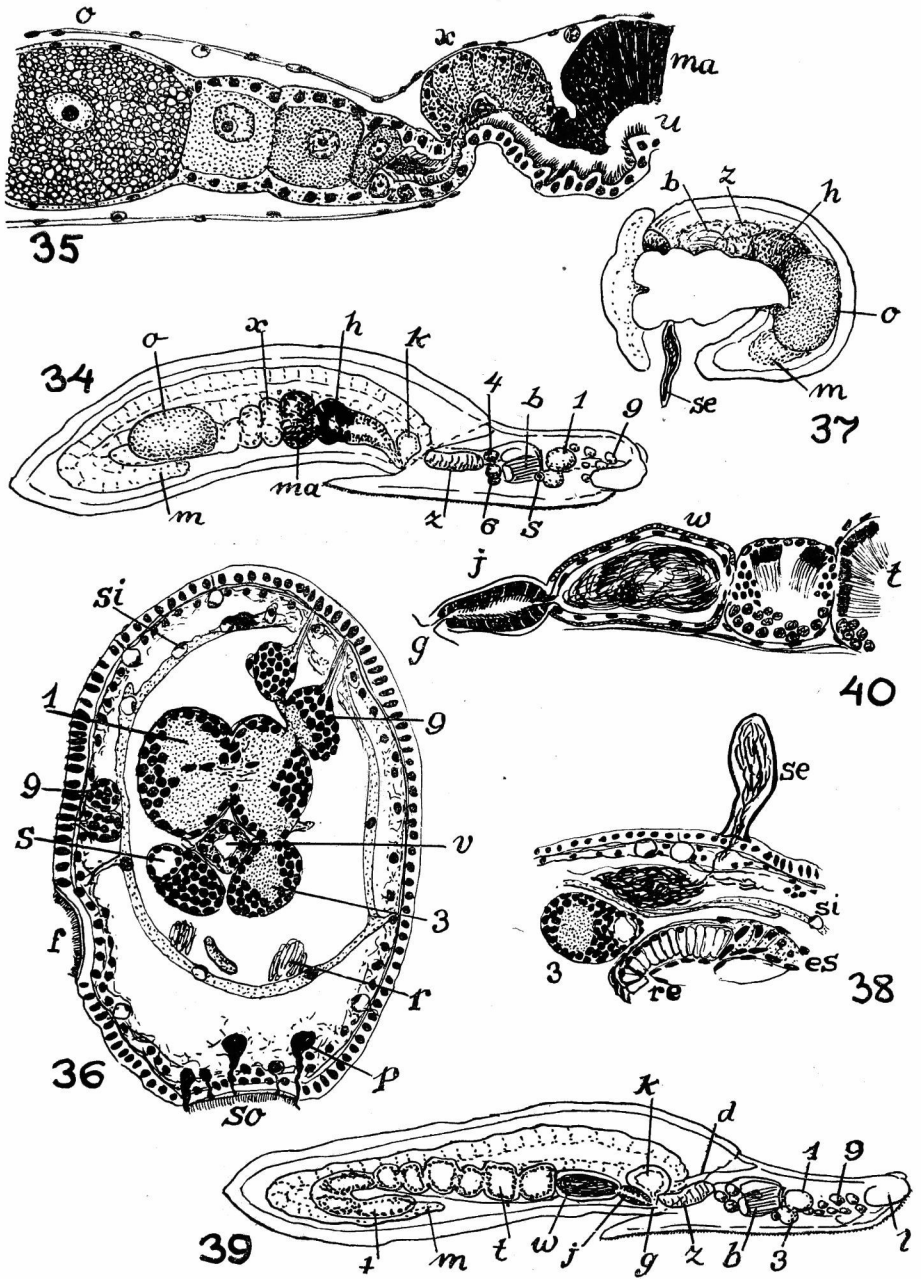


PLATE 7

Pluscula cuica, g. n., sp. n.

Fig. 41 — Living specimen, lateral view.

Fig. 42 — Living specimen, dorsal view with the outlines of the foot.

Fig. 43 — Aspect of anterior end.

Fig. 44 — Diagram of central nervous system.

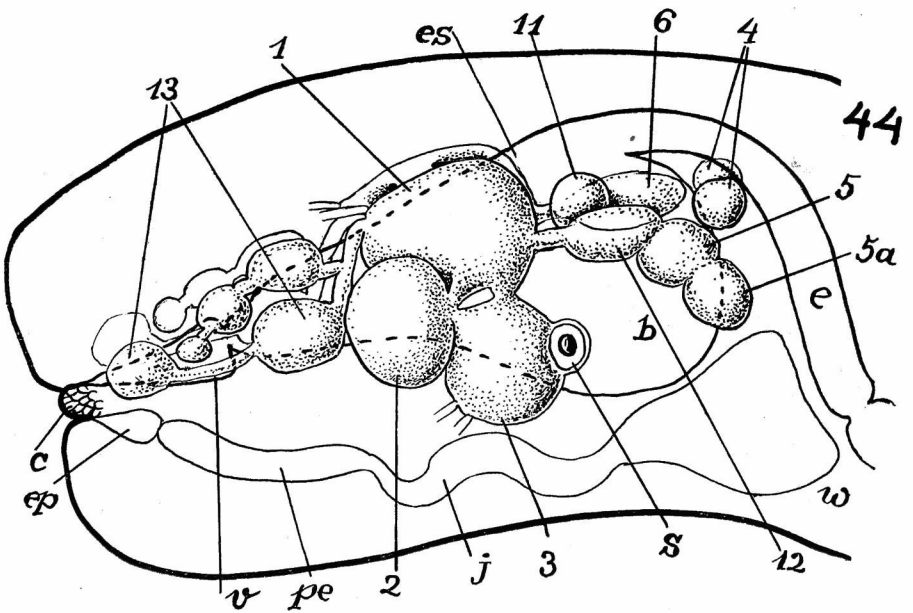
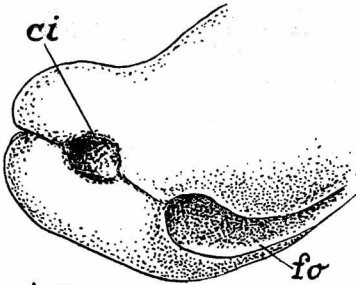
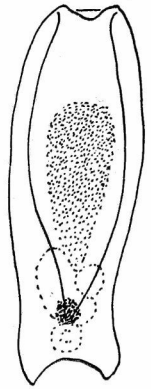
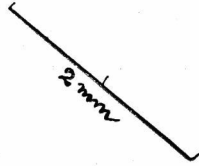
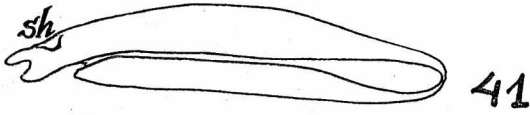


PLATE 8

Pluscula cuica, g. n., sp. n.

Fig. 45 — Organisation in dorsal view.

Fig. 46 — Diagram of organisation, lateral view without gonad and female efferent organs.

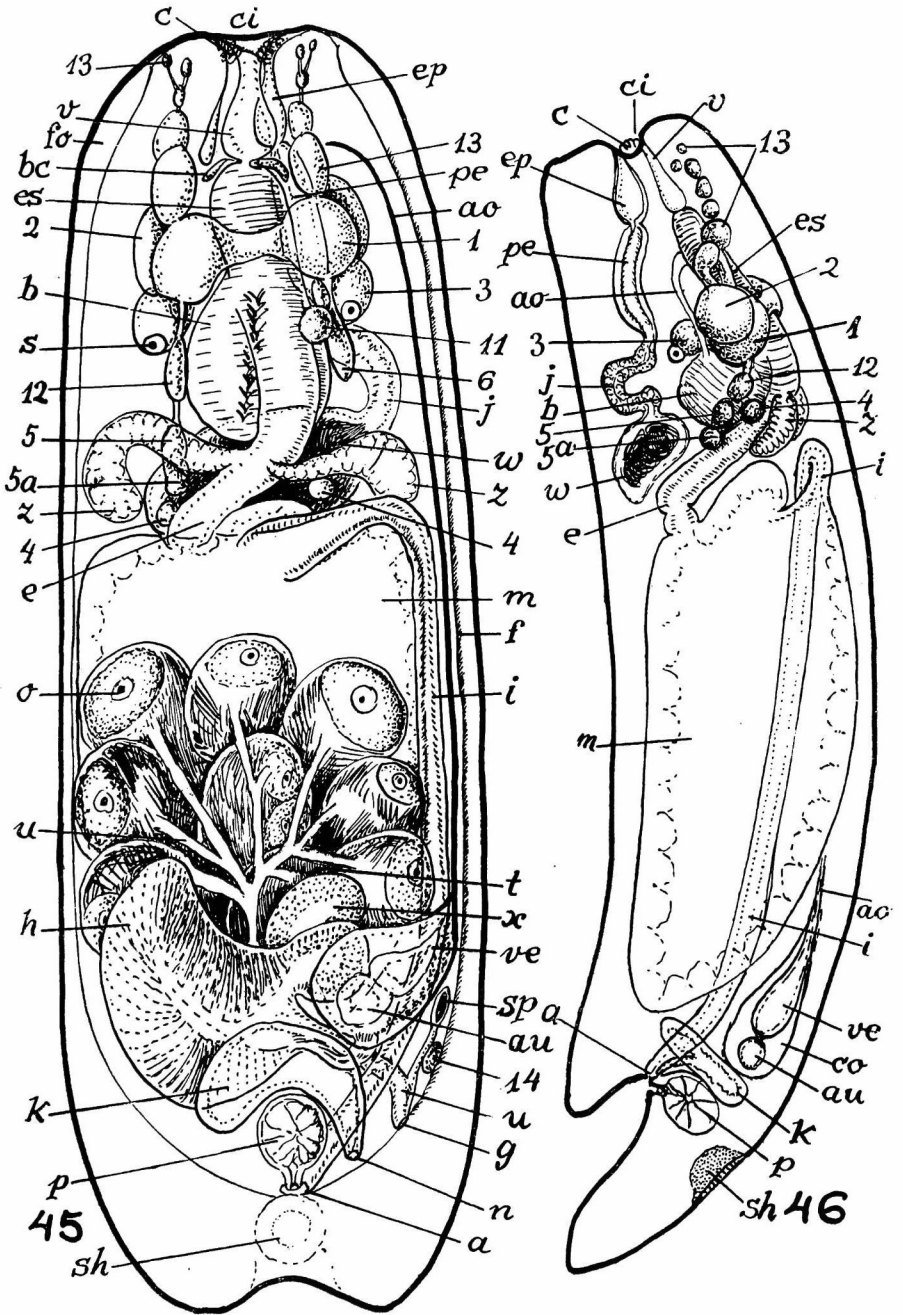


PLATE 9

Pluscula cuica, g. n., sp. n.

Fig. 47 — Transverse section on level of beginning of cerebral ganglia.

Fig. 48 — Median section of pallial gland and anus.

Fig. 49 — Combined horizontal section of posterior region.

