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Volúmen en homenaje a Ergasto H. Cordero (1890 - 1951)

THE NUDIBRANCH RHODOPE FROM SOUTH AMERICA

EVELINE DU BOIS-REYMOND MARCUS & ERNST MARCUS

To the memory of our great friend, ERGASTO H. CORDERO, who's work synthetizes european and south-american Zoology.

In Brazil the term "Lesma" is applied as well to terricole Triclads as to slugs. Who ever turned stones to look for animals and found resting Geoplanids and Vaginulids together under them, will immediately understand this common name for both Flatworms and Molluscs. It is true that professional zoologists are more critical: "And if the aspects are multiplied by the hundreds with a visit to the sea shore, and the markets in sea towns receive new and newest forms, also the stranger appearances of Molluscs will not, by the examining and comparing eye, be confounded with forms of the Vertebrate and Arthropod realm not excluding the Worms". When we read this in the introduction to the chapter on the Mollusca in the last edition of Brehms Tierleben, we thought it was said by the great malacologist H. SIMROTH (1918, p. 388) of Leipzig. But in fact he only repeats the words of OSCAR SCHMIDT (1878, p. 183), who was not specialized in Mollusca.

The animal presented here (Fig. 1-2) is an exception to the rule, that Molluscs are always easy to recognize. It was described as a Gastropod by KÖLLIKER (1847), who discovered it in the littoral of Messina, but his genial classification was accepted only after many later, more detailed studies.

Of all Classes of Metazoa the Gastropoda have conquered the most manifold biotopes where animals can thrive. They live on glaciers and in deserts, in dark caves and in hot and sunny lagoons and salines, in the sand of the beach, on rocks and reefs in the surf, in jungles and lettuce beds, in brooks, and in the cold calm depth of the sea. Some of them are sessile or parasites, but the majority is free living, they crawl, swim, or float. Many Opisthobranchs browse on the dense bushes of Hydrozoa, Corals, Bryozoa, and Algae. Thus the rudimentation of the shell in the Nudibranchs seems

to be an advantage. In KÖLLIKER's time Nudibranchs were known, but none as simple as his *Rhodope veranyi*.

Though KÖLLIKER was not quite certain of the presence of rectum and anus (p. 552), he admits and figures these organs on the right side of the body. On the same side, a little farther in front, he indicates the opening of the ovariotestis. These characters and the ganglionic mass around the oesophagus define *Rhodope*, after KÖLLIKER, as a Gastropod. That "the liver is formed by numerous tubules not united in a mass" (p. 560) was not confirmed; these tubules are cutaneous glands (BÖHMIG 1893, p. 52, 57). Neither do the sensory organs separate *Rhodope* so safely from the Worms as KÖLLIKER, as a Gastropod. That "the liver is formed by numerous maricole Triclads, and two statocysts not only apposed to the surface of the brain (BÖHMIG 1893, p. 77) but lying between the ganglia occur also in *Ototyphlonemertes* (BÜRGER 1897, p. 174; CORREA 1948, p. 4).

Some years after KÖLLIKER MAX SCHULTZE described a Turbellarian, *Sidonia elegans*, from Triest (1854, p. 223), apparently without knowing the paper on *Rhodope*. GRAFF (1882, p. 73-74) evidenced the identity of SCHULTZE's Rhabdocoel with KÖLLIKER's slug.

Among the authors that discussed *Rhodope* in the interim between KÖLLIKER and GRAFF we stress IHERING (1877, p. 36, 165, 170) who saw in *Rhodope* a primitive Gastropod related with the Turbellaria. Also GRAFF (1882, p. 81-82) considered it as a primitive Nudibranch connected with the genus *Acmostomum*, that belongs to the Holocoela Separata of the present system of the Turbellaria (KARLING 1940, p. 232). GRAFF (p. 77) was doubtful as to the existence of an anus in *Rhodope*. He interpreted the liver tubules described by KÖLLIKER as optic sections of the rings that are formed by constrictions of the splanchnic muscles. The terminal cells of the excretory apparatus, that GRAFF discovered, he expounds as a sign of relationship with the Platyhelminthes. To GRAFF we further owe good figures of the total animal (t. 2 f. 2) and the compressed anterior end (f. 3). The band or cross of brick-red pigment in the dorsal epidermis varies after GRAFF. One specimen from Madeira was quite white, as are the two from the Brazilian coast that we have seen. As far as we infer from the Zoological Record, the list of findings cited in GRAFF's paper: Messina, Triest, Naples, and Madeira, was not increased since then.

BERGH (1882), a great authority on Gastropods, was contrary to KÖLLIKER, IHERING and GRAFF. He asserts (p. 2) that the missing of a heart, a nephro-pericardial connection, and a liver, the presence of protonephridia and a spatulate tail with adhesive papillae are opposed to the organisation of Molluses. He considers *Rhodope* as a modified Turbellarian, the nervous system of which somewhat

likens that of a Nemertean. "Certainly the larva of *Rhodope* will neither have a velum nor a larval shell, and then *Rhodope* is not a Nudibranch" (p. 4).

This bold prophecy of BERGH came true with the study of TRINCHESE (1887), a specialist of the Opisthobranchs. The development of *Rhodope* is direct. None of its phases shows any traces of a velum, a foot, a shell, or a shell gland. TRINCHESE further completed the excretory system and stated the presence of an anus definitively. In spite of this TRINCHESE maintains with certainty that *Rhodope* is not a Mollusc, but a Worm. Among the Worms *Rhodope* might wait for its "liberatore" in a kind of limbo near the Rhabdocoela.

This came in the person of GRAFF's first scholar, L. BÖHMIG (1893), an excellent analyser of Turbellarians. His paper of 77 pages and 72 figures closes with the sentence in wide print: "*Rhodope* is not a Turbellarian". If the embryology of *Rhodope* did really not reveal molluscan features and TRINCHESE's indications were confirmed, it would after BÖHMIG be necessary to introduce a new Class for *Rhodope*, that must provisionally be annexed to the Scolecida.

From BÖHMIG's study the morphology of *Rhodope* is well established, but its systematic position in only negatively defined. The Scolecida of HATSCHEK have no positive characters in commom. They have no celoma, no metamery, and no nephridia. Nemerteans and Entoprocts are the "Scolecidan" Classes that have a permanent anus and a parenchyma in the body cavity. With the inclusion of *Rhodope* the Scolecida would become even more heterogeneous.

Treatises and Text-Books reflect the problematic position of *Rhodope*. SIEBOLD (1848, p. 297) adopts KÖLLIKER's system of the Gasteropoda and ranges *Rhodope* among the Apneusta Anangia. Also in the "BRONN" (1862-66) and in Brehms Thierleben (O. SCHMIDT 1878, p. 183) *Rhodope* is considered as the most primitive Nudibranch, as such corresponds to the ideas of IHERING (1877, l. c.; 1887, p. 522). Though CARUS (1868-75, p. 708) and FISCHER (1887, p. 547) mention *Rhodope* behind the Sacoglossa, (Ascoglossa, Elysoidea), they say that it does not seem to be a Mollusc (CARUS) and is provisionally considered as a Turbellarian (FISCHER).

In CLAUS' Grundzüge der Zoologie the Rhodopidae range behind the Tethyidae (1882; see BÖHMIG 1893, p. 45, note 1; MOQUIN-TANDON 1884, p. 1054). In the tenth edition of CLAUS' Text-Book (CLAUS-GROBBEN-KÜHN 1932, p. 779) *Rhodope veranyi* is mentioned as probably belonging to the nudibranchiate Opisthobranchia, but not ascribed to a determined Family. LANG (1892, p. 868-70), and in the second edition HESCHELER (1900, p. 482-85), treat *Rhodope* in an appendix to the Mollusca, but not as a link between

these and the Turbellaria. "If *Rhodope* was a Molluc", says HESCHELER, "it could only be a greatly specialized form, but not primitive".

Also PELSENEER (1897, p. 177) describes *Rhodope* as appendix to the Mollusca, but introduces it with the words: "The majority of the malacologists does not accept it among the Mollusca, and the zoologists that are specialized in Turbellaria refuse to admit it in this group". Later on PELSENEER himself (1906) suppresses *Rhodope* in the Mollusc volume of RAY LANKESTER's Treatise and in his Ethology (1935). This is so much the more astonishing, as PELSENEER in 1899 discovered the abbreviated development of *Acteonia (Cenia) cocksi* (ALD. & HANC.). The latter hatches in the adult form, and during its embryonic life a reduced and transitory velum is the only larval organ. Most clearly the negative position of *Rhodope* is revealed in those Manuals that treat Worms as well as Molluses and omit our animal both times. This occurs f. ex. in the Cambridge Natural History (Mollusca 1895; Worms 1901), in LAMEERE (Worms 1931; Mollusca 1933) and PERRIER (finished 1933).

THIELE's attitude is positive (1926; 1932). His classification and the names are not quite the same in his two publications, but in both *Rhodope* represents a "Sippe" or "Stirps" (a category between Suborder and Family) for itself, the last of the Nudibranchia. HOFFMANN (1933, p. 193) and we accept this opinion.

The first French antarctic expedition lead by Dr. JEAN CHARCOT (1903-05) brought an animal from gravel of the shore of Wandel Island at Lat. 65º S., Long. 64º W. It was described as a Rhabdocoel by VAYSSIÈRE (1906, p. 149). He called it *Rhodoplana wandeli* and compared it with *Rhodope* and *Geoplana*. WILHELMI (1907, p. 14) referred to the paper as the description of a Geoplanid, but the few characters that are mentioned, terminal mouth, buccal bulb a truncate cone, wide intestinal cavity, and pedunculate eyes with lenses, as well as the occurrence, are incompatible with Tricladida Terricola. GRAFF (1912-17, p. 2609) qualified VAYSSIÈRE's description as quite insufficient. In a second paper (VAYSSIÈRE 1907, p. 44), which we have not seen, the place of *Rhodoplana wandeli* in the Turbellaria or Mollusca was left open.

RHODOPE VERANYI Kölliker (Lám. I, figs. 1-2)

The two present specimens are, preserved, no longer than 2 mm. The indication for living European animals is up to 4 mm. The preserved slug is cylindrical with arched back and slightly flattened ventral side. The fore end is more or less pointed, without tentacles or rhinophores. The hind end is rounded. The colour of

the present slugs is white; the mediterranean specimens have a dorsal band of brick-red pigment in varying length, that anteriorly often broadens to the sides.

The slugs glide slowly, and especially the fore end can be strongly contracted. The conical hind end is often fixed to the substratum with help of its adhesive glands (k) and can be widened spatulately. In the living animals the black eye cups (d) with their refractive lenses are conspicuous as well as the statocysts (j). Refractive curved spicules (x) of 0,05-0,13 mm. length are situated in the parenchyma.

The entire epidermis is covered with dense cilia. Short cyanophilous glands (q) occur chiefly on the ventral side. Near the hind end they cluster and form an adhesive pad (k). Two bundles of longer blue gland cells (l) open on the sides of the mouth (m). The feeble dermal muscle layer consists of outer circular and inner longitudinal fibres. The parenchyma between the muscle layer and the inner organs is loose, generally lining the muscular tube. It forms a net-work of fine canals that are strongly cyanophilous and are in many places connected with the excretory system. The latter as well as intestine and gonad are covered with a flat epithelium.

The central nervous system is composed of two masses of ganglia lying over (c) and under (u) the oesophagus (f) and united by connectives. The analysis of these ganglia is difficult as always in highly concentrated brains of Opisthobranchs (HANSTRÖM 1928, p. 178). Probably the separated centres of cerebral, pleural and pedal ganglia are united in the supra-oesophageal complex (c) that also comprises the buccal ganglia. The sub-oesophageal mass (u) might correspond to the parietal and visceral ganglia (see also HOFFMANN 1936, p. 848-52 f. 582).

From the supra-oesophageal ganglia seven pairs of nerves go out, and from the sub-oesophageal one pair. On either side of the supra-oesophageal mass lies an eye (d), behind and below it a statocyst (j) with inner cilia and one statolith. The black pigmented retina cells together with the transparent cornea cells form a capsule that contains a gelatinous lens. The central ganglia are covered with a parenchymal capsule that is continued on to the roots of the nerves. In the anterior end of the body there are many groups of subepidermal sensory cells (z).

The mouth (m) lies in the middle of the anterior face of the head. From it a narrow vestibulum (w) leads to the buccal bulb (b), so termed because it has higher cilia and a thicker muscle layer. Its lumen is triangular in cross section with the tip directed to the ventral side. It does not contain any mandibles nor a ra-

dula. From both sides tubular salivary glands (v) with erythrophilous secretion open into the buccal bulb. The last part of the fore gut, the oesophagus (f), leaves the bulb on the ventro-caudal side. It passes through the nervous ring and enters the mid gut (i) from the ventral side.

The tubiform intestine (i) runs almost to the hind end of the body. Anterior to the entrance of the oesophagus (f) it forms a caecum (ci) that covers the brain and has the same structure as the rest of the mid gut. There is no separate intestinal gland or liver. Approximately in the middle of the body a short tubular rectum (r) leaves the gut. The rectum is thin and ciliated and ends on the right side with a ciliated anal opening (y).

In front of the anus lies the renal pore (n) that leads into a short ciliated ureter, into which the anterior and posterior excretory canals open. These longitudinal canals run on the dorsal side of the mid gut and are provided with tufts of ciliated cells. The canals are connected with the before mentioned parenchymatic tubular system.

There are neither respiratory nor circulatory organs.

Ventrally to the intestine the ovariotestis extends in the posterior half of the body. The 2-10 caudal lobes are male (t), the anterior 6-10 lobes female (o). The ental position of the male follicles is uncommon in the gonad of monoecious Gastropoda. The ventral wall of the hermaphrodite duct (h) is ciliated. Where this duct leaves the ovariotestis, it is widened by a sperm mass (s). Then it passes through a four-lobed albumen gland (a). The following part is a wide and muscular bulb. From its upper hinder wall projects on the right side a conical, ciliated, unarmed penis (p), that probably forms a furrow for the sperms during copulation. The bulb that lodges the penial cone, the so-called penis sheath, is connected with the genital opening (g) by a short canal, the genital antrum (ai), that receives two tufts of cyanophilous glands. The antral cilia beat towards the pore. The ciliated genital aperture (g) lies on the right side on the level where the oesophagus (f) enters the intestine (i), a little to the ventral side.

Occurrence: Bay of Santos, Ilha das Palmas, in Algae, chiefly Sargassum stenophyllum, from rocks in the tidal zone. One specimen, October 1946. Island of São Sebastião, 100 km. east of Santos, among Algae (Padina) growing on small stones in sand of the lower tidal zone. One specimen, November 1952.

Further distribution: Madeira; Messina; Naples; Triest.

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EXPLANATION OF FIGURES

1. *Rhodope veranyi* Köll., lateral view, combined from clarified total slug and sections.
2. *Rhodope veranyi* Köll., ventral view, combined from living specimen, clarified total slug and sections.

a — albumen gland.
ai — genital antrum.
b — buccal bulb.
c — supra-oesophageal ganglia.
ci — intestinal caecum.
d — eye.
e — excretory canal.
f — oesophagus.
g — genital opening.
h — hermaphrodite duct.
i — intestine.
j — statocyst.
k — caudal adhesive glands.
l — mouth glands.
m — mouth.
n — renal pore.
o — ovarial part of ovariotestis.
p — penis.
q — ventral glands.
r — rectum.
s — sperm mass in hermaphrodite duct.
t — testicular part of ovariotestis.
u — sub-oesophageal ganglia.
v — salivary glands.
w — vestibulum.
x — spicules, omitted in Fig. 1 and drawn only in part in Fig. 2.
y — anus.
z — groups of sensory cells.

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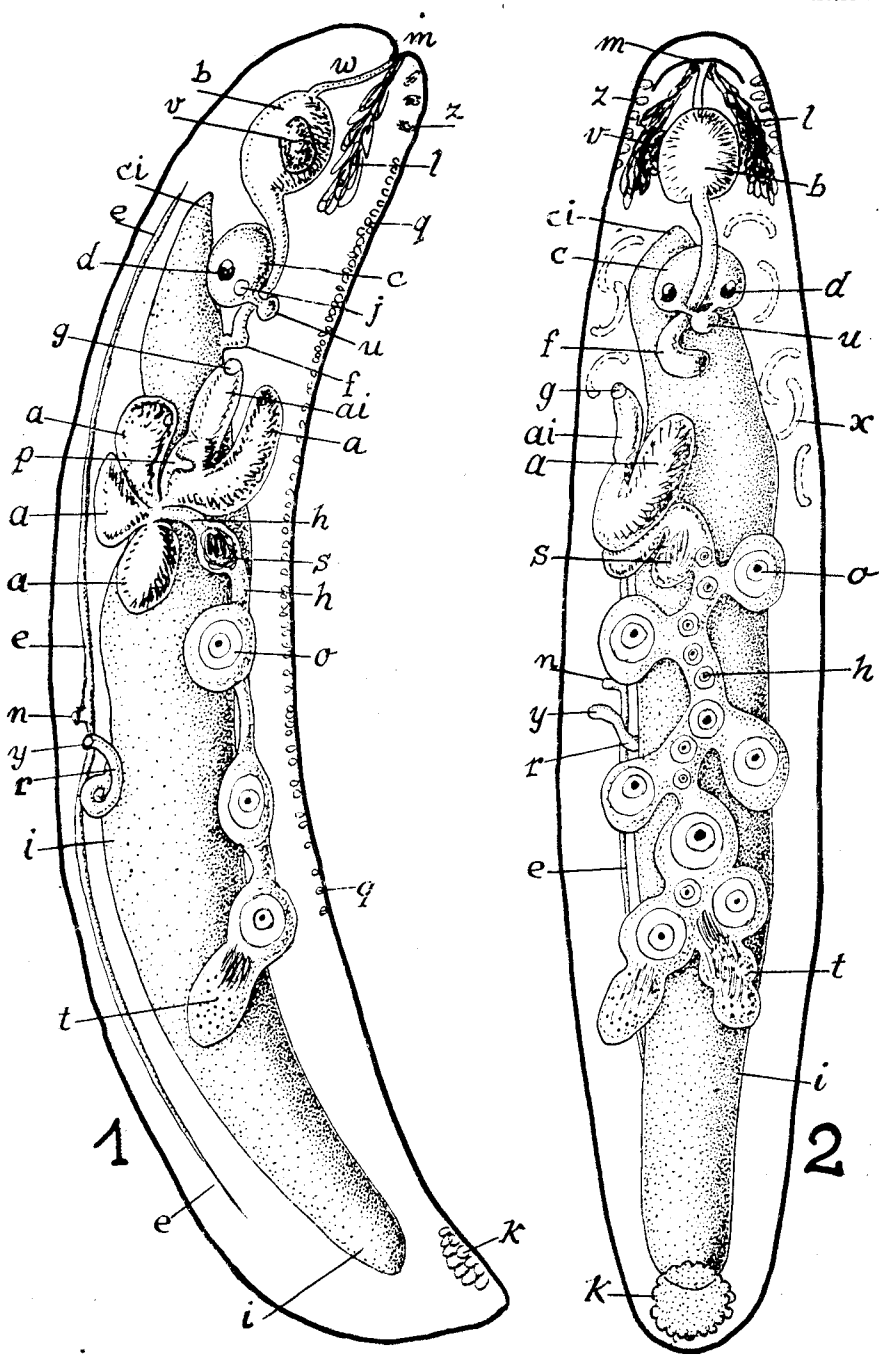
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