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On Western Atlantic Opisthobranchiate Gastropods

By Ernst Marcus[1]

Of the material of this study, two species came from the New England coast, one is from Pernambuco, and the remainder are from the coast of the Brazilian state of São Paulo, as follows: (1) near Ubatuba, northern base of the Oceanographic Institute of the University of São Paulo, about 180 kilometers east-northeast of Santos; (2) at Ilhabela, Island of São Sebastião, about 100 kilometers east-northeast of Santos; (3) in the Bay of Santos; and (4) at Cananéia, southern base of the Oceanographic Institute, about 200 kilometers southwest of Santos.

My wife, Eveline du Bois-Reymond Marcus, has cooperated extensively in this study. For reprints or photocopies of pertinent articles I am indebted to Drs. Libbie H. Hyman, R. Tucker Abbott, Bruno Battaglia, Ernst Mayr, Nils Odhner, Harald A. Rehder, Waldo L. Schmitt, and Stillman Wright.

The types and some of the other material in this article are deposited in the invertebrate section of the American Museum of Natural History.

The classification here adopted follows Odhner (1939).

ORDER CEPHALASPIDEA
SUBORDER SCAPHANDRACEA
FAMILY SCAPHANDRIDAE

Cylichnella bidentata (d'Orbigny, 1841)

Figures 1–14

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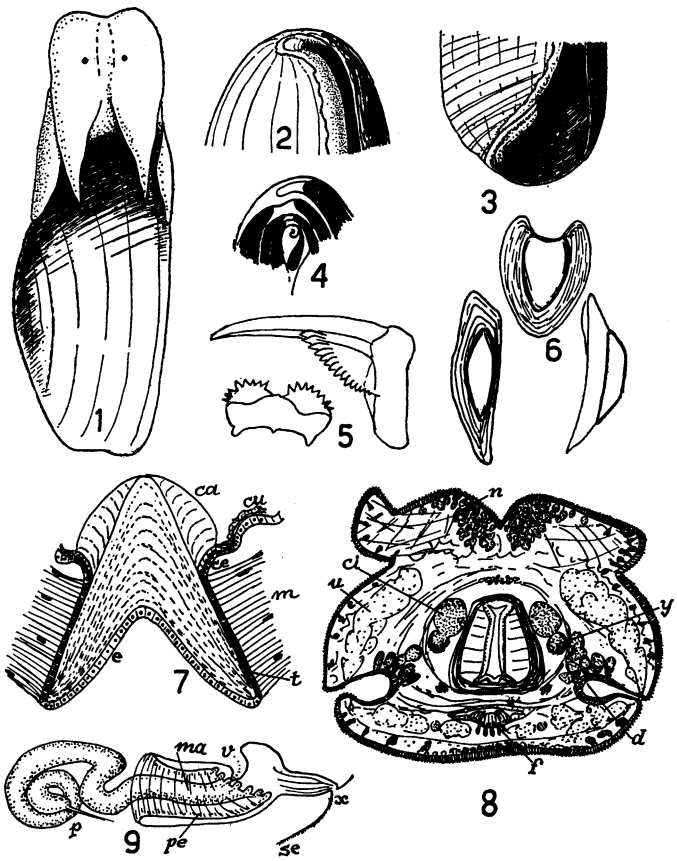
The oblong-oval shell is up to 4 mm. in length, 1.7 mm. in width, whitish, glossy, or somewhat opaque, with a colorless to grayish, yellowish, or partly orange periostracum, which is sometimes darker in the generally indistinct growth lines. The body whorl tapers at both ends and has about 15 more or less distinct spiral lines in its lower third. On its upper border there is exceptionally present a slight keel surrounding the apical depression. The body can be entirely retracted within the shell. The aperture is as long as the shell, narrow above and widened below (figs. 2, 3). The outer lip is thin and straight for most of its length (fig. 1). Along the inner lip extends a columellar callus that is continuous with a plug over the depressed apical whorls. Sometimes the spire shines through this plug but is generally completely hidden. Below, the columella is set off from the callus by a fold and bears a more or less distinct nodule. The lower lip is evenly rounded (fig. 3). The axis of the larval shell makes about a right angle with that of the adult shell. The larval shell (fig. 4) has one and a half whorls and is totally enclosed in the first of the four to five adult whorls.

The head shield and the sole are ciliated but not the furrow between head and foot. The cephalic shield is slightly depressed in the middle of the anterior border, deeply slit behind, and thus produced there into two pointed flaps (fig. 1). The inner borders of these flaps are provided with mucous glands (fig. 8, n) that begin near their base and extend about 0.1 mm. posteriorly. As in *Cylichna* (Lemche, 1956, p. 36) the pale, blue-staining, marginal shield glands (fig. 8, u) open between the true lateral margin of the shield and Hancock's organ (fig. 8, d). This organ is richly innervated by nerves from the cerebral ganglia (Lemche, 1956, pp. 146, 147) that form numerous secondary ganglia (fig. 8, y) around the organ (Guiart, 1951, fig. 51; Lemche, 1956, figs. 359, 360). Hancock's organ is smooth, not folded, as in *Cylichna*, or pigmented. The eyes (fig. 13, ei) are equidistant from the anterior margin and the posterior slit of the head shield (fig. 1); contrary to the situation in other Cephalaspidea (Hoffmann, 1932–1939, p. 626) they lie near the cerebral ganglia (fig. 13) as in *Cylichna* (Lemche, 1956, p. 191), far from the integument.

The foot is broad, with a straight posterior border connecting the hind ends of the short parapodia (fig. 12, pa). The anterior pedal glands stain more deeply than the marginal foot glands. The suprapedal gland (fig. 8, f) opens into a pouch 0.15 mm. deep, the bottom of which bears two bands of cilia.

The opening of the mantle cavity occupies two-thirds of the aperture



FIGS. 1–9. *Cylichnella bidentata.* 1. Living snail. 2. Top of empty shell. 3. Columellar end of empty shell. 4. Larval shell. 5. Radular teeth. 6. Gizzard plates. 7. Transverse section of narrow gizzard plate. 8. Combined transverse section on level of flap glands and suprapedal gland. 9. Diagram of male copulatory organ. *Abbreviations:* ca, cap of gizzard plate; ce, cap-forming epithelium; ci, cerebral ganglion; cu, cuticle; d, Hancock's organ; e, epithelium of gizzard; f, suprapedal gland; m, muscle; ma, male canal; n, flap glands; p, prostate; pe, penis; se, seminal groove; t, tendon; u, marginal shield glands; v, valve; x, male pore; y, secondary ganglia.

of the shell. Posteriorly the mantle skirts are grown together (fig. 12, ja), and the furrow of junction (z) extends to the posterior end of the mantle, corresponding to the exhalant siphon of *Actaeon* (Fretter and Graham, 1954) and the cloacal sinus of *Scaphander* (Perrier and Fischer, 1911). Where the thickened, ciliated, and bilobed left mantle skirt or infrapallial lobe (fig. 12, io) touches the shell, it has a small glandular

furrow (fig. 11, cs) that secretes the columellar callus; this furrow corresponds to the shell glands (fig. 11, si) of the right lobe.

The mantle cavity (fig. 11, cv) begins in front, on the left side, and occupies the entire dorsal surface, ending with the anus (fig. 12, a), the pallial caecum (mi), and the posterior adherence (ae) (Lemche, 1956, p. 21). In front the cavity is restricted (fig. 12, li) by the mantle commissure located over the anterior half of the gizzard (fig. 11, g). The smooth, not grooved, ciliated ridges (fig. 12, r) begin in front of the junction (ja) of the mantle borders and run obliquely backward to the right, where they coalesce in the end of the pallial caecum. They are straight, not horseshoe-shaped as in *Cylichna* (Lemche, 1956, pp. 21, 22), and are underlain with blood spaces (fig. 10, is) and accompanied by glands (zr).

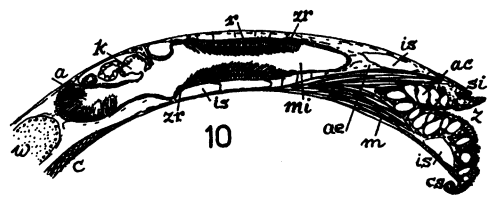
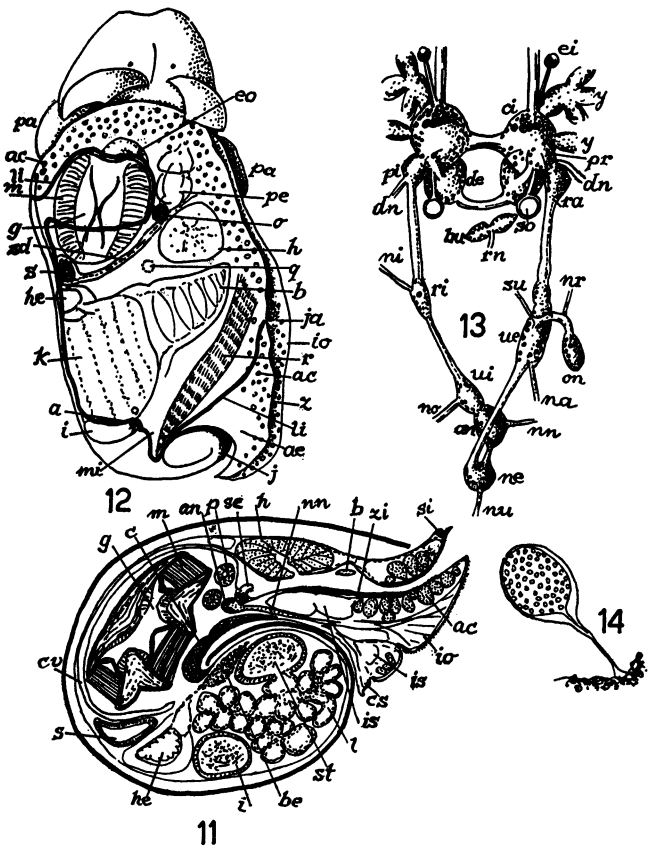


FIG. 10. *Cylichnella bidentata*, transverse section of pallial caecum. *Abbreviations:* a, anus; ac, acidophilous gland; ae, posterior adherence; c, columellar muscle; cs, callus-forming glands; is, blood sinus; k, kidney; m, muscle; mi, pallial caecum; r, ciliated ridge (raphe); si, shell glands; w, female gland mass; z, exhalant siphon; zr, glands of the raphe.

The mantle is bordered by a broad belt of large, subepithelial, acidophilous glands that are visible in the cleared snail (fig. 12, ac). These glands are unicellular as in *Cylichna*, but unlike this form the ducts are not multicellular. The glands lie in the roof and the floor of the mantle cavity and accompany the exhalant siphon and the left anterior junction. There is further a row of such glands in the ventral border of the infrapallial lobe (fig. 12, io). Between the osphradium (o) at the posterior end of the anterior commissure and the gill (b) there is a large, round, and flat, compact gland (h) the secretion of which stains pale blue. The tall cells of this hypobranchial gland are arranged around a narrow central groove. On the floor of the cavity that lies beneath the gill the epithelium consists of tall, blue-staining, gland cells (fig. 11, zi), resembling the lymphatic gland of *Cylichna* (Lemche, 1956, p. 45). Such glands extend backward and appear on the floor and on the roof of the cavity as two stripes (fig. 10, zr). The ciliated ridges



FIGS. 11–14. *Cylichnella bidentata.* 11. Transverse section at hind end of gizzard. 12. Dorsal view of decalcified and cleared snail. 13. Reconstruction of central nervous system. 14. Egg sac. *Abbreviations:* a, anus; ac, acidophilous gland; ae, posterior adherence; an, abdominal ganglion; b, gill; be, blood gland; bu, buccal ganglion; c, columellar muscle; ci, cerebral ganglion; cs, callus-forming glands; cv, pallial cavity; de, pedal ganglion; dn, dorsolateral nerve; ei, eye; eo, esophagus; g, gizzard; h, hypobranchial gland; he, heart; i, intestine; io, infrapallial lobe; is, blood sinus; j, suture; ja, limit of pallial opening; k, kidney; l, liver; li, limit of mantle cavity; m, muscle; mi, pallial caecum; na, viscero-gastric nerve; ne, genital ganglion; ni, left anterior pallial nerve; nn, greater infrapallial nerve; no, posterior pallial nerve; nr, branchial nerve; nu, genital nerve; o, osphradium; on, osphradial ganglion; p, prostate; pa, parapodium; pe, pericardial prominence; pi, left pleural ganglion; pr, right pleural ganglion; q, gonopore; r, ciliated ridge (raphe); ra, right parietal ganglion; ri, left parietal ganglion; rn, radula nerve; s, spermatheca; sd, spermathecal duct; se, seminal groove; si, shell glands; so, statocyst; st, stomach; su, suprapallial nerve; ue, supraintestinal ganglion; ui, subintestinal ganglion; y, secondary ganglia; z, exhalant siphon; zi, infrapallial gland.

(r) originate in the center of these stripes, and the narrowing glandular bands accompany the ridges into the end of the pallial caecum (fig. 10, mi).

The gill (fig. 12, b) is short and poorly folded as in *Cylichna* (Lemche, 1956, p. 101). At the junction of the suprapallium and the infrapallium lies the nearly completely untwisted heart (fig. 11, he). A long blood gland (be) surrounds the aorta over the stomach (st). The blood spaces in the kidney (k) are disposed longitudinally as in *Cylichna* (Lemche, 1956, pp. 103–104, fig. 344). The renal pore is situated immediately anterior to the anus (fig. 12, a).

The oral tube is surrounded by subepithelial glands (Lemche, 1956, p. 61), followed by a sphincter that marks the beginning of a cuticularized part of the oral tube of which the confluent pegs substitute for jaws to a limited extent. The radula (fig. 5) contains 15 rows of 1.1.1 teeth that are similar to the corresponding elements of *Cylichna*. The median tooth is 28μ broad, 15μ high, and each arch bears eight denticles. The lateral tooth is 45μ high and its 64-μ-long cusp bears 15 to 18 denticles on its wing-like expansion (fig. 5). The salivary glands enter the dorsal wall of the small pharynx near the beginning of the esophagus (fig. 12, eo). A crop is wanting. The esophagus projects into the gizzard (g), the epithelium of which (fig. 7, e) forms three pouches that contain the gizzard plates (figs. 6, 7). These are about 0.9 mm. long; the dorsal plate is almost thrice as broad (0.73 mm.) as the two lateral plates (average, 0.28 mm.). The center of each plate is reënforced by caps (fig. 7, ca) produced by columnar cells (ce) of the gastric epithelium bordering the active surface of the plates. Between the plates this epithelium secretes a thin, folded cuticle (cu). The muscle fibers (m) insert directly on the sides of the plates, piercing the epithelium with tendons (t). The left ventral plate can be retracted by a special muscle that springs from the foot retractor and inserts by ramified tendons. The esophagus enters the stomach (fig. 11, st) from behind and below, and the intestine (i) exits from it anteriorly. There are two lateral hepatic ducts. Mud and diatoms were seen in the stomach and intestine, but, as the snails were decalcified, calcareous shells possibly present had been dissolved. Large plasmatic balls in the digestive tract may be bodies of foraminifers.

The hermaphroditic gland is intermingled with the liver (fig. 11, l) through all its whorls, extending from the level of the gizzard to the top of the spire. There are two seminal receptacles, an anterior spermatheca (fig. 12, s) the long duct of which (sd) begins a little more internally than in *Cylichna* (Lemche, 1956, fig. 351), and a spermatocyst

with a long (short in *Cylichna*) sinuous duct. The common genital opening (fig. 12, q) and the seminal groove (fig. 11, se) correspond to those of *Cylichna*. The male pore (fig. 9, x) lies at the level of the passage of the oral tube into the pharynx. The male canal (ma) bends over the brain to the left side as a broad pouch, then is narrowed by a valve (v) bearing a pointed papilla. Ental to the valve lies the thick and short (0.25 mm. long) muscular penis (pe), which distally is obliquely truncate. Its free border is provided with a row of 17 papillae, similar to those of *Scaphander* (Bergh, 1901, p. 270, pl. 21, fig. 18). The male canal is continuous with a tubular, sinuous, prostatic gland (fig. 9, p). The egg mass (fig. 14) is about 2 mm. long, containing about 400 eggs, and is attached by a stalk 2 mm. long.

The visceral nerve cords are posteriorly twisted (fig. 13); more anteriorly the right one is situated beside, and the left one beneath, the digestive tract. This partial streptoneury occurs also in *Scaphander* (Pelseneer, 1894, p. 10; Guiart, 1901, p. 101). In agreement with this genus is also the occurrence of a small left parietal ganglion (fig. 13, ri), wanting in *Cylichna* (Lemche, 1956, pp. 156, 217). More scaphandrid (Vayssière, 1879–1880, pl. 11, fig. 101) than cylichnid is also the position of the genital (ne) near the abdominal (an) ganglion. As far as studied the nerves of the present species were identifiable with those of *Cylichna*, thoroughly elucidated by Lemche (1956).

The widely spaced cerebral ganglia (fig. 13, ci) are prepharyngeal, lying around the passage of the oral tube into the pharynx. The right pleural ganglion (pr) is contiguous with the right cerebral ganglion. The connectives of the anterior nerve ring are all short, but at least on the right side the cerebropleural is shorter than the cerebropedal connective, as in the aponotoneural type of most of the Cephalaspidea.

The cephalization (forward migration of the ganglia; Wirz, 1952, p. 164) and the cerebralization (fusion of the ganglia) attain a low degree in *Cylichnella bidentata*. On the other hand, the telencephalization (that is, the size of the cerebral compared with the pedal and visceral ganglia; Wirz, 1952, pp. 172, 174) is highly developed. Not only are the cerebral ganglia larger than the pedal ganglia, but even one cerebral ganglion is larger than the sum of all the visceral ganglia (fig. 13). This character, although physiologically interesting, cannot be evaluated phylogenetically, because *Bulla* is much less telencephalized (Marcus, 1957) than *Cylichnella* and is certainly not considerably more primitive. The Scaphandridae and Bullidae have each on their branches evolved almost equally far from the Acteonidae (Boettger, 1954, fig. 1).

OCCURRENCE: Near Ubatuba many empty shells were found in the intertidal zone, and a hundred living animals were dredged from mud at 1–6 meters, in September, 1956, and February, 1957. Ihering (1897, p. 169; 1915, p. 139) collected the species in the canal of São Sebastião, in the same area. The species is further known from Cape Hatteras, North Carolina, to Maldonado, Uruguay, and from St. Helena, in shallow water to 360 meters.

DISCUSSION OF *Cylichnella bidentata*

The identification of the present material could be based only on the shell, of which figures for comparison occur in d'Orbigny (1853, pl. 4, figs. 13–16), Gabb (1873, pl. 10, fig. 2), Pilsbry (1893, pl. 22, fig. 42; scale on pl. 27, fig. 9), Kobelt (1896, pl. 7, fig. 9), and Abbott (1954, pl. 26, fig. q). Pilsbry's figure from the northernmost locality where the species occurs (Bush, 1885) and Abbott's excellent photograph agree with our material and have the spiral lines restricted to the basal part of the body whorl. In Pilsbry's text (p. 325) the diameter should read 1.4 mm. The nodule of the columella is not always so distinct in the present shells as in d'Orbigny's figure 14, nor is it so distinct in all West Indian specimens (Smith, 1890, p. 279). The thickened outer lip drawn in d'Orbigny's figure does not occur in our specimens, and the spire is never so clearly visible as in his figure 15.

The only further West Atlantic species that can be allocated to *Cylichnella* with certainty is *Bulla oryza* Totten, 1835 (Gould, 1870, p. 221), from the northeastern coast of the United States. *Cylichna noronyensis* Watson (1883, p. 322) from Fernando de Noronha can hardly be assigned to the genus, to judge from the figure (Watson, 1886, pl. 50, fig. 1). Of the east Pacific species, *tabogaensis* (Strong and Hertlein, 1939, p. 171) from the Gulf of Panama is doubtless a *Cylichnella.* Of the others described by Bartsch (1918, p. 571), Dall (1919, p. 300), and Baker and Hanna (1927, pp. 127–128), perhaps not all certainly belong to *Cylichnella.* Not only species of *Cylichna* with thickened inner lip, but also species of *Retusa* with sunken spire and the inner lip spread as a thin callus over the parietal wall (Powell, 1937, p. 219), are difficult to separate from *Cylichnella,* if only empty shells are available.

The entire range of *Cylichnella* cannot be stated here, as not all descriptions are available to me. According to the literature the genus occurs on the coasts of South Africa, the Andaman Islands, New Guinea, Australia, Tasmania, and New Zealand. I give a tentative diagnosis of the genus, although this is precarious without knowing

the descriptions of all species allocated to it. Shell characters were established by Gabb (1873, p. 273), but apparently none of the succeeding authors dealt with radula and anatomy.

DIAGNOSIS: Shell oblong-oval, capable of containing the entire body; aperture as long as the shell, narrow above, expanded below; inner lip with columellar callus; columella set off from the callus by a fold and provided with a more or less distinct nodule below; head shield slit behind with long flaps; foot short, broad, straight behind; parapodial lobes short; radula as in *Cylichna,* but without marginal teeth; penis bordered with papillae.

The number of gizzard plates and the size difference between the dorsal and lateral plates are not here considered as of generic value, because *Cylichna magna* Lemche (1941, p. 15; 1956, p. 243) has only two gizzard plates and in *Utriculastra* one plate is larger than the two others in one species, smaller in another species (Hoffmann, 1932–1939, p. 1082).

Whereas the slight differences between the shells of *Cylichna,* e.g., *C. occulta densistriata* (Leche, 1878) (Lemche, 1956, p. 237), and *Cylichnella* justify making the latter a subgenus or section (Thiele, 1931, p. 391) of the former, the head shield, radula, and further anatomical features necessitate the generic separation of *Cylichnella.* Apart from its vestigial left parietal ganglion, *Cylichnella* shows higher specialization than *Cylichna,* as in the occurrence of only three teeth in the radular row and in the differing sizes of the gizzard plates. Nevertheless, *Cylichna* is the scaphandrid genus that is nearest to *Cylichnella.*

ORDER ANASPIDEA

FAMILY APLYSIIDAE

SUBFAMILY APLYSIINAE

Aplysia dactylomela Rang, 1828

An adult specimen of this species, which is not common in the upper littoral of the coast of São Paulo, was found in September, 1956, near Ubatuba. Alive and not fully extended it measured 25 cm. in length and had a strong musky odor.

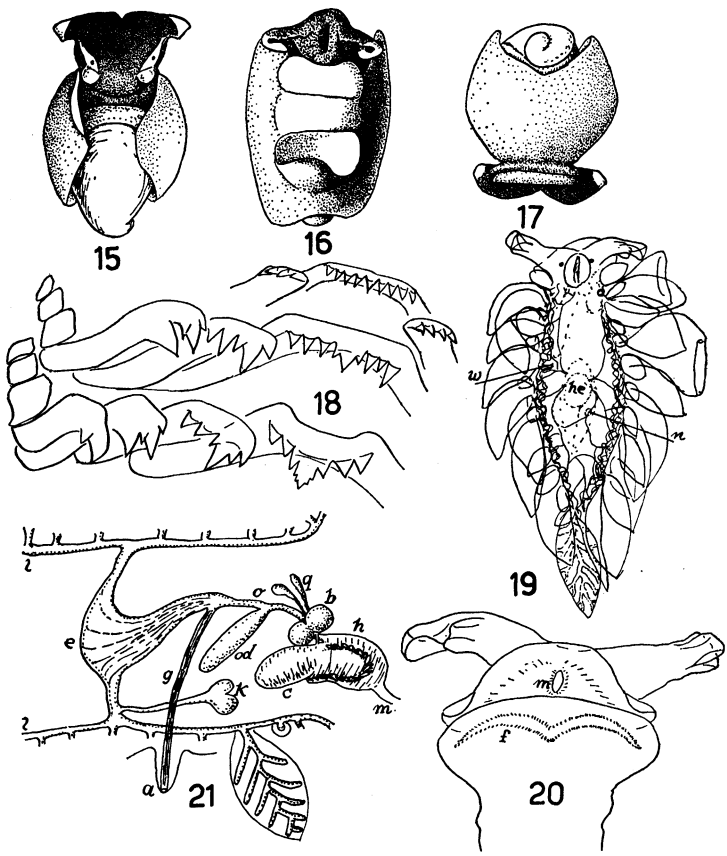
In the present state of the literature (Macnae, 1955), in which *A. fimbriata* Adams and Reeve, 1848, is recognized as a subspecies of *A. dactylomela,* the typical form must be regarded as limited to the Atlantic Ocean from about latitude 30° N. to latitude 30° S. The islands of Bermuda and the coast of Morocco in the north and the southern coast of South Africa in the south indicate the limits of its distribution. It is nearly certain that the coast of the state of São Paulo

is not the southern limit of occurrence of *A. dactylomela* on the Atlantic coast of South America, but no further data are available.

Aplysia juliana Quoy and Gaimard, 1832

Figures 15–18

For bibliography and synonymy of this species, I refer to Macnae (1955) and Marcus (1957).



FIGS. 15–18. *Aplysia juliana*. 15. Dorsal view of preserved animal. 16. Ventral view of same. 17. Same seen from behind. 18. First, tenth, and sixteenth row of radular teeth.

FIGS. 19–21. *Caliphylla mediterranea*. 19. Dorsal view of cleared slug. 20. Ventral view of same. 21. Simplified reconstruction of alimentary tract. *Abbreviations:* a, anus; b, right cerebropleural and pedal ganglion; c, crop; e, stomach; f, pedal furrow; g, intestine; h, pharynx; he, ventricle; k, unpaired liver diverticulum; l, lateral liver lobe; m, mouth; n, renal pore; o, esophagus; od, esophageal pouch; q, salivary glands; w, albumen gland.

The single specimen was 3 mm. long in life, 2 mm. preserved, of a vitreous green color, with lighter sole and darker head containing black pigment. The tips of the tentacles and the stripes that run from the bases of the tentacles over the eyes to the incipient rhinophores are whitish. The concave posterior part of the sole is set off by a fold (fig. 16), while a less marked furrow separates the two anterior thirds of the sole from each other. The parapodia, green without dark pigment, are closed behind and broadly separated in front, contrary to the condition in adult animals. The mantle border around the shell is very narrow and the aperture quite large (fig. 15). The shell is about 1.2 mm. long, 0.8 mm. broad, and rather high, resembling in shape a Phrygian cap. The larval shell is recurved onto the ventral side of the umbo (fig. 17).

The small jaws consist of rodlets as usual. The colorless radula (fig. 18) contains 21 rows of teeth, of which the most lateral are very thin. The rows begin with 1.1.1 teeth and increase to 3.3.1.3.3 in the fourteenth row, maintaining this arrangement to the end. The denticles of the first teeth are of nearly equal size; in the more lateral rows each tooth has a bigger principal cusp, and the marginal teeth are smooth plates.

The present specimen proves the identity of *Aplysia parva* Pruvot-Fol (1953, p. 38) with *A. juliana*. The denticles of the radular teeth are slightly more numerous in our animal than in Pruvot-Fol's figures, and the posterior transverse fold of the sole, distinct in our preserved specimen from Santos, was not mentioned in that from Morocco. Nevertheless *A. parva* is certainly a young of *A. juliana* and its finding near Rabat is the most northerly record for *juliana* in the Atlantic Ocean. The Indo-West Pacific distribution extends to Mutsu Bay.

ORDER SACOGLOSSA

SUBORDER ELYSIACEA

FAMILY CALIPHYLLIDAE

Caliphylla mediterranea A. Costa, 1867

Figures 19–24

The single available specimen had been mounted in balsam and was later removed and sectioned. It was 3.9 mm. long, with a sole 1 mm. broad anteriorly, decreasing to 0.6 mm. posteriorly. The mouth (fig. 20, m) is a short, vertical slit. The oral veil bears two very short, curved, labial tentacles. The rhinophores (figs. 19, 20) are bilobed, with both lobes auriculate, and the furrow of the upper lobe is directed downward, that of the lower lobe upward. The black eyes at the rhino-

phoral bases shine through the skin. The foot ends posteriorly in a long point; the upper side of its anterior border bears a deep transverse groove (fig. 20, f).

There are about 20 cerata on each side, of different sizes, up to 1.7 mm. in length. The most posterior cerata lie 0.9 mm. from the tip of the tail. The cerata are flat and pointed, dorsally concave, with smooth borders (fig. 19). The thick lateral tubes of the liver run under the bases of the cerata; more medially there pass the dark solid strands of the albumen gland which do not enter the cerata. The dichotomous ramification of the hepatic diverticula in the cerata is more regular than in Bergh's figure (1877b, pl. 9, fig. 2), thus agreeing better with Engel's drawing (1927, fig. 37g). As in *Lobiger* and *Stiliger* the liver branch and the afferent and efferent blood sinus are provided with a sphincter at their entrance into the cerata (Hoffmann, 1940, fig. 55B). The cerata contain globular marginal glands as well as smaller peg-shaped glands with granular contents that open on the dorsal and ventral sides of the ceras.

The clusters of oral glands and the salivary glands (fig. 21, q) with their long, slender ducts correspond to Bergh's description (1877b, pp. 746–747, pl. 9, fig. 5). The radular teeth are smooth. The sessile, not pedunculate, muscular crop (fig. 21, c) is cylindrical, not flattened. Our transverse sections of the crop (fig. 22) fail to show the median furrows mentioned by others (Bergh, 1877b, pl. 9, fig. 7; Hoffmann, 1932–1939, fig. 760, after Trinchese). The lateral pockets of the pharyngeal cavity are continued backward and form the two lumina of the crop (fig. 22). The two lateral diverticula of the radular pouch that occur in one of our *Elysia* species are evidently homologous with this crop. Contrary to Brüel's statement (Hoffmann, 1932–1939, p. 1061) the right lumen ends more anteriorly than the left one in our sections of the crop.

The interior of the muscular esophagus (fig. 21, o) is longitudinally folded. Also the esophageal pouch (fig. 21, od) has a muscular function as Brüel indicated (Hoffmann, 1932–1939, p. 1079), for its small epithelial cells are poor in cytoplasm and evidently not glandular. Fretter (1941, p. 194) thinks that the esophagus and its pouch pump the food through the stomach to the liver. Pruvot-Fol (1954, p. 177) who speaks of *"un appendice glandulaire,"* apparently follows Trinchese (1876) who refers to it as *"organo glandulare reniforme."* This was already contradicted by Bergh (1877b, p. 247, note 2). The surface of the esophageal pouch is smooth, as Hoffmann (1932–1939, p. 1078) rightly supposed. Comparison of Trinchese's (*in* Hoffmann, p. 760) and

Bergh's (pl. 10, fig. 2) figures with our figure 21 shows that the esophageal pouch (od) inserts on the esophagus more posteriorly than in the Mediterranean specimens, and Bergh's denomination of *"Vormagen"* for the latter is comprehensible but is not applicable to our animal.

As Bergh (1877b, p. 747) said, the hepatic system agrees with that of *Phyllobranchus* (Bergh, 1871b, pp. 70–71) in general pattern. The main or transverse liver ducts connect the stomach (fig. 21, e) with the lateral ducts (l) from which branches enter the cerata. The lateral ducts are not united posteriorly as in *C. tricolor*. Hoffmann (1932–1939, p. 1137) is certainly correct not to attribute specific value to this character. Previous observers failed to find a limit between stomach and liver. In our specimen the ciliated cylindrical cells of the folded gastric epithelium end where the main hepatic ducts begin, and these are lined by broad cuboidal cells containing vacuoles and particles. In front of the right main duct arises an unpaired tubular liver diverticulum that ends with a bilobed dilatation (fig. 21, k) in the anterior part of the foot. As in *Beccaria tricolor* Trinchese (1870, pl. 4) (= *Caliphylla mediterranea* Pruvot-Fol, 1951, p. 72; 1954, p. 177) fine liver branches enter the foot and the rhinophores, from the lateral liver ducts. Therefore the latter are more branched than indicated in our figure 21, in which only the branches to the cerata are shown. However, an aspect like that of Trinchese's detailed figure reproduced in Hoffmann (1932–1939, fig. 780D), in which a network of hepatic capillaries accompanies the lateral ducts, was not found in the present specimen. As Brüel, who studied sections, also described such a lateral hepatic net (Hoffmann, pp. 1137–1139), one cannot suppose that the liver has been confused with the albumen gland. With only one very small, although mature, slug at our command, we cannot try to explain why the liver system differs so much in the Mediterranean and the Brazilian material. Engel (1927, pp. 116–117), the only worker who previously found *C. mediterranea* on western Atlantic coasts, gave no description of the digestive organs except the radular tooth.

The intestine (fig. 21, g) is longitudinally folded inside and opens by a long anal papilla on the right side (fig. 21, a), ventral to the level of the cerata and behind the male pore. The spherical heart ventricle (fig. 19, he) lies approximately in the body center, with the long auricle to the right and the pericardium extending far anteriorly and posteriorly as in *Phyllobranchus prasinus* (Bergh, 1871b, p. 54, pl. 5, fig. 20). The renal pore (fig. 19, n) is located to the right of the median line, about halfway between the two body ends.

The hermaphroditic gland (fig. 23, zi) consists of large clustered

follicles in which the female cells occupy the walls, the male cells the center. The gland lies in the posterior body half, and from it the long, sausage-shaped ampulla (v) winds forward, situated beneath the stomach. At the end of the ampulla the hermaphroditic duct bifurcates into male and female ducts. The slender ciliated male duct, provided at first with cyanophilous glands, soon receives the ciliated duct of the richly lobulate prostate (r) the gland cells of which contain pink secretion. The prostate lies ventral to the ampulla. The male duct then becomes muscular and pursues a winding course. Its wall (fig. 24) consists of an inner epithelium, circular muscles, connective tissue containing glands, longitudinal muscles, and an outer epithelium, and is enclosed in an outer covering, the *"Peritonealscheide"* of Bergh (1871b, p. 79), of inner epithelium and circular and longitudinal muscles. The male duct ends with a small papilla (p) armed with a cuticular stylet. This stylet of *C. mediterranea* had already been drawn by Bergh (1877b, pl. 9, fig. 12, pl. 10, fig. 9) and verified by Pruvot-Fol (1951, p. 73). The muscular penial sheath (fig. 23, y) which is retracted into the atrium (z) in the sectioned animal constitutes a firm base for the penial papilla when everted. Engel (1927, p. 37, fig. j) shows the reverted sheath and protruded penis. The retractor (x) of the penial papilla comes from the right side of the back.

The female duct first receives the albumen glands (fig. 23, w), ramified strands medial to the lateral liver ducts, the slender branches of which penetrate between the organs laterally and posteriorly and descend into the upper parts of the foot (Bergh, 1877b, p. 750, designated as *"röhrige Drüsenlager"*). Then the oviduct enters the mucous gland, staining pale blue, that extends backward, then bends forward (fig. 23, j), having a slit-like ventral lumen lined with cilia. The oviduct (u) then becomes a ciliated, muscular, winding canal with folded lumen and tall gland cells, disposed in groups of four to six and staining dark blue. A short duct connects the oviduct with the ventral spermatocyst (s), an oval sac containing spermatozoa with their heads fixed to the wall. More distally the oviduct receives the longer duct of the spermatheca (t), is then provided with a sphincter (i), and proceeds to the external pore that lies in a longitudinal furrow under the anal papilla.

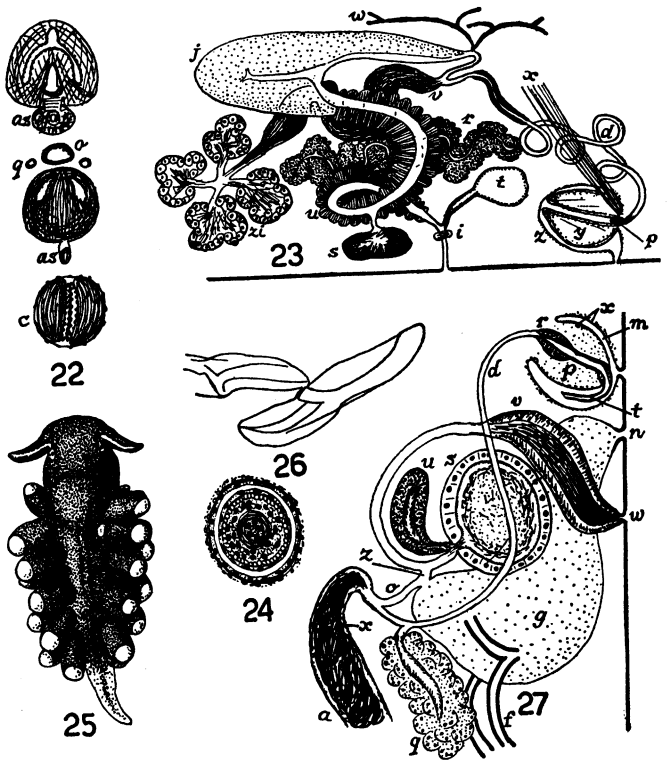
OCCURRENCE: The one specimen was found among algae in the littoral of the Bay of Santos, Ilha das Palmas; otherwise known from the Mediterranean coasts of Italy and France, the Atlantic coast of Morocco, Senegal at Dakar (Pruvot-Fol, 1953, p. 41), and St. John in the Virgin Islands (Engel, 1927, p. 116).

FAMILY HERMAEIDAE

Stiliger fuscatus (A. Gould, 1870)

Figures 25–27

Some excellently preserved specimens of this species were generously sent to us by Dr. George M. Moore of the University of New Hamp-



FIGS. 22–24. *Caliphylla mediterranea*. 22. Three transverse sections of pharynx and crop. 23. Diagram of reproductive organs. 24. Transverse section of male duct. *Abbreviations:* as, ascus; c, crop; d, male duct; i, sphincter; j, mucous gland; o, esophagus; p, penial stylet; q, salivary glands; r, prostate; s, spermatocyst; t, spermatheca; u, oviduct; v, ampulla; w, albumen glands; x, retractor of penis; y, penial sheath; z, male atrium; zi, follicles of hermaphroditic gland.

FIGS. 25–27. *Stiliger fuscatus*. 25. Dorsal view of preserved slug. 26. Radular teeth. 27. Diagram of reproductive system. *Abbreviations:* a, ampulla; d, male duct; f, albumen gland; g, mucous gland; m, male atrium; n, nidamental opening; o, oviduct; p, penis; q, prostate; r, glandular part of male duct; s, spermatheca; t, stylet; u, accessory vaginal vesicle; v, vagina; w, vaginal aperture; x, pigment; z, insemination duct.

shire; they had been collected locally by Dr. Wilbur Bullock.

The preserved specimens are 2–3 mm. long, 0.7–1.0 mm. broad, and up to 0.9 mm. high. They are black with the following parts white (fig. 25): sole, tips of cerata and tail, circumanal spot, areas around mouth and eyes, and a line along the posterior side of the rhinophores. Sometimes the bases of the cerata are united by a white line. The protruded penis shows irregular blotches of dark pigment. The anus, not mounted on a papilla, is located to the right of the median line, behind the pericardium, about in the middle of the body. The renal aperture lies immediately beside the anus. The male pore is situated behind the area of the right eye, 0.54 mm. from the anterior margin of the body; the orifice (fig. 27, n) of the mucous gland (g) occurs 0.08 mm. behind the male aperture. The vagina (w) opens under the right row of cerata, 0.9 mm. behind the anterior margin.

The anterior margin is rounded, without notch; the tail is pointed (fig. 25). The ciliated sole is broad anteriorly, although not broader than the head, and slightly notched with rounded corners. In one of the six examined slugs, the convex pericardial prominence (fig. 25) extends backward as is characteristic of the subgenus *Ercolania* Trinchese, 1872. Further, the conical rhinophores somewhat resemble those of *Ercolania*, in the presence of a white line on their posterior surface. True, the rhinophores are neither grooved nor flattened in the present specimens.

The cerata, about 0.5 mm. long, occur in two irregular rows of nine to 10, up to 12, complete cerata and buds in each row. The anterior body third and the tail are free from cerata. The cerata are obtuse, widest at about the middle or distal to the middle. Distally they have a high epithelium and are provided throughout with subepidermal cyanophilous gland cells, which also occur on the back of the animal. The body is provided with especially strong dorsal longitudinal muscles. In the interior of the eyes the pink-staining lens and a violet vitreous body are distinguishable. The radula consists of four teeth in the ascending limb, 11 in the dscending limb, and 25 in the ascus. The shape of the teeth (fig. 26) is that usual with the genus; the cusp is 82μ, the base 55μ, long. The alimentary tract agrees with that of *S. talis* Marcus and Marcus (1956, fig. 3). The hepatic diverticula have smooth external contours, but their lumina have lobate outlines.

In the reproductive system (fig. 27) the ovotestis consists of 12 or more hermaphroditic follicles. Some black pigment is present in the superficial part of their tunica, their ductules, and in the wall of the ampulla (x). The sinuous ampulla (a), simplified in figure 27, emits a

short hermaphroditic duct that bifurcates into a short oviduct (o) and a long male duct (d). Shortly beyond its origin the latter receives the ciliated duct of the lobate, pink-staining prostate (q) and continues as a muscular ciliated duct that becomes glandular (r) as in *S. talis* where it enters the penis (p). The curved penis stylet (t) is 80μ long and 8μ in diameter. The atrium (m) has a pigmented wall (x). The albumen gland (f) enters the mucous gland (g) with paired ducts as in other species of *Stiliger,* but in contrast with *S. talis* and a second species from the region of Santos the posterior duct is simple, the anterior one coiled, hence appearing four to five times in transverse sections. The large spermatheca (s) is a globular sac lined with a tall epithelium bearing short cilia; residues of sperm are found in the lumen. Where the vagina enters the spermatheca it receives the short duct of a pyriform vesicle (u) called spermatocyst by Bergh (1886, p. 15) who, however, did not state whether it contains sperm in *S. bellula.* In the sections of two specimens of *S. fuscatus* this vesicle is empty and lined by tall, cyanophilous, strongly ciliated cells. The spermatocyst of the Nudibranchia generally contains spermatozoa; hence this accessory vesicle in *S. bellula* and *fuscatus* should not be called spermatocyst. The communicating duct (z) between vagina and oviduct is provided with an epithelial valve. Distal to receiving these various ducts the vagina is a muscular tube that dilates distally to an ampulla-like expansion as in *S. bellula* (Bergh, 1886, p. 15), *S. talis,* and *S. vanellus* (Marcus, 1957). This dilatation is muscular, lined with a yellowish cuticle in *S. bellula,* and with a high, probably secretory epithelium in *S. fuscatus,* in which its lumen is filled with sperm with their heads directed outward.

Occurrence: The original material, called *Calliopaea* (?) *fuscata,* came from Boston (Gould, 1870, p. 250), that of Russell (1946, p. 96) from a salt marsh near Woods Hole, Massachusetts, and the present material was collected in a high pool in a salt marsh in Great Bay at Newington, New Hampshire. At the time of collecting, the salinity of this pool was 14 parts per thousand.

Discussion of *Stiliger fuscatus*

The specific identity of the slugs furnished by Dr. Moore with Gould's species is beyond doubt. This material enables us to distinguish *S. fuscatus* from other species of *Stiliger* more satisfactorily than in our previous publication (Marcus and Marcus, 1956). *Stiliger talis* described in that publication proves to differ distinctly from *fuscatus* in its much smaller size, lighter coloration, cylindrical shape of the

rhinophores, lack of white line on the rhinophores, characters of the radular teeth, and lack of ciliated vesicle annexed to the spermatheca. The second species of *Stiliger* that we have since found on the coast of São Paulo also differs from *fuscatus*. We are further enabled to contrast in more detail *fuscatus* with some other species of *Stiliger*.

Stiliger niger Lemche, 1935, from Denmark is distinguished from *fuscatus* by its color and by its having considerably fewer radular teeth, although its body size is much the same or perhaps larger (Rasmussen, 1951, p. 221).

Stiliger bellula (d'Orbigny, 1837) has produced and pointed anterior angles of the foot, a short base of the radular tooth, and a flagelliform stylet (Bergh, 1886, p. 16) that is eight times as long as that of *fuscatus*. Two vesicles annexed to the vagina are present in both *fuscatus* and *bellula*.

ORDER NUDIBRANCHIA
SUBORDER DORIDACEA
DIVISION EUDORIDACEA
SUBDIVISION CRYPTOBRANCHIATA
FAMILY DORIDIDAE
SUBFAMILY GLOSSODORIDINAE

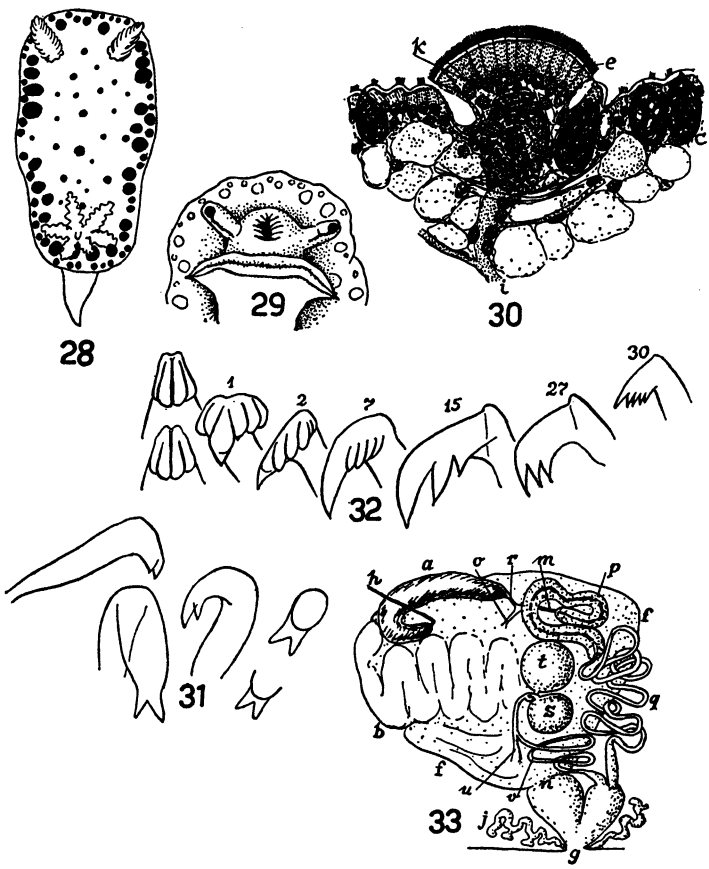
Cadlina evelinae, new species

Figures 28–33

The largest of our four specimens was 15 mm. long alive; preserved it measured 12 mm. in length and 6.5 in breadth, with the mantle brim and foot about 2 mm. wide. Body, rhinophores, and gills are a pure, slightly transparent white, with numerous golden yellow spots around the notum and a few in the middle of the notum (fig. 28). These spots are glands the color of which is preserved in Susa fixative but dissolved in alcohol. Around the border of the notum smaller glands are generally present to the outer side of the larger ones. The notum, broad in front and narrowed posteriorly, also bears small irregular bosses. The pointed foot is seen projecting behind the notum (fig. 28). The foot has a bilabiate and entire, i.e., not notched, anterior border and pointed corners. The rim of the rhinophoral pits is slightly tuberculated, that of the branchial groove smooth. The peg-shaped tentacles (fig. 29) are large for the genus and have an external fold. The rhinophores are perfoliated with 18 uniform leaves. There are five or six bipinnate gills with branchial glands at their bases. The labial disk is armed with pegs terminating in two divergent denticles (fig. 31); the

pegs are short on the borders of the disk, with a long curved shaft on the central part of the disk.

Transverse sections of the notum (fig. 30) show pads of epithelial cells (e) with basal nuclei, which occur mainly on the notal border. These pads correspond to the caryophyllidia of many other doridids,



FIGS. 28–33. *Cadlina evelinae*. 28. Living slug. 29. Head of preserved specimen. 30. Section of notum. 31. Teeth from center and border of labial disc. 32. Radular teeth of specimen with 32 teeth in the half row. 33. Diagram of reproductive system. *Abbreviations:* a, ampulla; b, albumen gland; c, cyanophilous skin gland; e, epidermal epithelium; f, mucous gland; g, genital aperture; h, hermaphroditic duct; i, nerve; j, accessory atrial glands; k, knob of sensorial cells; m, male duct; n, nidamental duct; o, oviduct; p, prostatic part of male duct; q, muscular part of male duct; r, spermoviduct; s, spermatocyst; t, spermatheca; u, insemination duct; v, vagina.

though here they are not prominent papillae and not stiffened by spicules. Under the pad is found a knob of sensory cells (k) the nervous processes of which communicate with the numerous nerves of the mantle border.

The radula (fig. 32) has up to 75 rows and up to 66.1.66 teeth. The rhachidian tooth bears four denticles, the innermost lateral tooth two inner and three or four outer denticles around the principal cusp. The second and following lateral teeth bear only outer denticles besides the main cusp, generally three, rarely four, and the more lateral ones two. Sometimes two or three marginal teeth bear four or five small denticles of equal size, without a principal cusp, or the penultimate tooth has six denticles. The outermost tooth is often incompletely developed. As usual the radular teeth increase in length from the middle laterally and decrease again near the margin.

Features of the digestive tract are the long salivary glands, the embedding of the stomach in the liver. The globular caecum lies slightly to the right of the dorsomedian origin of the intestine. The latter in our largest specimen forms a long loop attaining the level of the posterior end of the pharynx, but in a smaller slug this loop is as short as in *C. magellanica* Odhner (1926, fig. 38). Intestines of different length are also recorded for two specimens of *C. falklandica* (Odhner, 1926, p. 62).

In the reproductive system (fig. 33) the hermaphroditic duct (h) enters a sausage-shaped ampulla (a) from behind and leaves its anterior end (r), then bifurcating into the male duct (m) and the oviduct (o). The male duct shortly widens into a glandular prostate (p) that is much shorter (1.2 mm.) than the following muscular loops (q, about 5 mm.). The looped duct is proximally ciliated for about two-fifths of its length only, although the remaining unciliated part is not cuticularized, containing a coarse secretion. Two convoluted ciliated accessory ducts (j) open beside the genital aperture (g). The slender oviduct (o) enters the female gland mass, the mucous (f) and albuminous (b) parts of which can be distinguished externally. The gland mass receives the short, stout, fertilization duct (u) near the nidamental duct (n), hence rather far distally. The slender, coiled vagina (v) begins besides the termination of the male duct and leads into the seminal receptacles (seminal vesicles of Bergh and others), consisting of the larger spermatheca (t) and the smaller spermatocyst (s), definable by their contents. Although the arrangement of the seminal receptacles corresponds to Odhner's vaginal type (1926, p. 51), the crossing of their ducts makes the topography more complicated than in *C. affinis*

Odhner (1934, fig. 18). In the latter species the fertilization duct enters the gland mass even more distally than in *C. evelinae* and is still less separated from the vagina than in the present species.

OCCURRENCE: Four specimens were taken under stones in the upper littoral of Ilhabela and Guarujá near Santos; the smallest were found in December, 1953, larger ones in July, 1954 and 1956.

DISCUSSION OF *Cadlina evelinae*

Unlike *C. rumia* (Marcus, 1955, p. 119) the new species was rarely found, and therefore no material was available for the description of the spicules which must be examined in recently captured animals. In addition to the nine specimens of the original description of *C. rumia*, over 30 specimens have since been obtained at the original locality and near Ubatuba in July and December.

Cadlina rumia differs from *C. evelinae* in color, in having eight unipinnate gills, in the fewer teeth of the radular row, the greater number of denticles of the rhachidian and lateral teeth, the free stomach, the cuticularized male duct, and the semiserial disposition of the seminal receptacles. The other species of *Cadlina* listed by Marcus (1955, pp. 122–123) differ from *evelinae* in the number of their gills, or in a tuberculate rim of the branchial pit, or by a notch in the anterior border of the foot, or by details of the radula, or by details of the reproductive system. Semiserially disposed seminal receptacles also distinguish *C. sparsa* (Odhner, 1921; 1926, pp. 56–57) from *C. evelinae*.

In warmer parts of the Atlantic Ocean there occur *C. scabriuscula* (Bergh, 1890) and *C. clarae* (Ihering, 1880). The former has been reported from Florida, the latter from the Cape Verde Islands and Morocco. O'Donoghue (1929, p. 766) and Pruvot-Fol (1954, p. 265) refer to *C. clarae* as *C. pellucida* (Risso, 1818). *Cadlina clarae* has seven dark brown unipinnate gills, rhinophores of the same color, and more numerous denticles on the lateral radular teeth than *C. evelinae*. The last also holds true for *C. scabriuscula*, which further has nine unipinnate gills.

Cadlina laevis, *C. glabra*, and *C. excavata*, all occurring in the Mediterranean, must also be compared with *C. evelinae*. The first has a quite different radula (Larsen, 1925, p. 23, fig. 13) and semiserial seminal receptacles (Odhner, 1939, fig. 13). The second, probably a valid species (Odhner, 1939, p. 29), has a smooth notum and 40 to 44 radular teeth in each half row. The third has two smooth roundish areas between the rhinophores, gills in the middorsal line, and a blackish spot on each side.

SUBFAMILY ALDISINAE

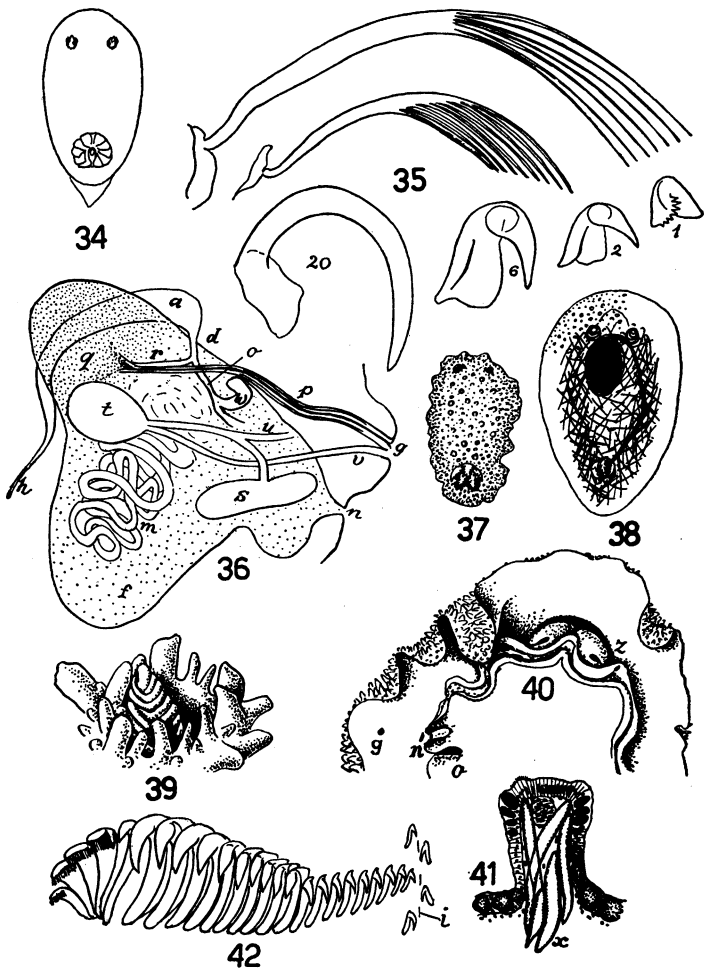
Rostanga byga, new species

Figures 34–36

The single available slug is 11 mm. long and 3 mm. high, preserved; the notum is 5 mm., the foot 3.5 mm., broad. The foot is covered laterally by the notum but projects posteriorly (fig. 34); its anterior border is bilabiate, with a notched upper lip. The dorsal surface is covered with papillae (caryophyllidia) of varying sizes, rather uniformly distributed, smaller along the notal border, tall around the branchial pit. The tentacles are digitiform; the rhinophores have 12 leaves and the shape typical of the genus (Alder and Hancock, 1845–1855, pt. 4, family 1, pl. 7, figs. 4, 5). The 10 gills are unipinnate. The animal is colored a bright brick-red, with white dots in some of the dorsal papillae.

The labial armature consists of a smooth cuticle, with rodlets in a small area on each side of the inner mouth, where approximately six rows, each with about 15 elements, are developed. The radula (fig. 35) has about 60 rows of teeth with the formula 60.0.60. The innermost lateral tooth has a larger base than cusp, which is broad and bears five to eight denticles on its medial edge. The following 21 teeth increase successively in size; those near the median line have larger bases than cusps, but laterally the cusp elongates and thins. Points other than the cusp are wanting. From the twenty-third tooth laterally, five to eight bristle-like secondary cusps appear lateral to the principal cusp. As the latter elongates and thins in passing towards the margin of the radula, it comes to resemble these bristles. Hence the marginal teeth bear six to nine equally long, thin, soft bristles resembling the bristles of a head of barley, which constitute almost half of the length of the tooth (fig. 35, above). The tooth bases decrease in size, especially on the outermost teeth, and the five most marginal bases are shorter than those more medial. The innermost lateral tooth is 25μ long, the largest marginal tooth about 120μ, of which nearly 60μ is split into bristles.

The esophagus passes through the nerve ring with a loop and then runs straight to the stomach. When filled the stomach will probably show between the halves of the digestive gland but is empty in the present specimen and does not protrude from the hepatic cleft. The intestine, at first wide and folded, proceeds first anterodorsally, then bends to the right and posteriorly. The ovotestis lies on the digestive gland, and over these two organs are spread the branches of the membranous renal tubules. The discoidal blood-gland is located over the



FIGS. 34–36. *Rostanga byga.* 34. Living slug. 35. Radular teeth 1, 2, 6, 20, largest and outermost above. 37. Diagram of reproductive system. *Abbreviations:* a, ampulla; d, spermoviduct; f, female gland mass; g, aperture of male duct and vagina; h, hermaphroditic duct; m, albumen gland; n, nidamental opening; o, inner oviduct; p, sheath of male duct; q, prostatic part in gland mass; r, male duct; s, spermatocyst; t, spermatheca; u, insemination duct; v, vagina; w, fertilization chamber.

FIGS. 37–42. *Etidoris ladislavii.* 37. Dorsal view of preserved slug. 38. Cleared specimen with spicules. 39. Left rhinophore. 40. Ventral view of anterior end of preserved slug. 41. Section of notum papilla. 42. Half row of radula of young specimen plus the innermost teeth of neighboring rows. *Abbreviations:* g, male gonopore; i, false middle tooth; n, nidamental opening; o, foot; x, spicules; z, tentacle.

pharynx, anterior to the brain. The central nervous system is even flatter than in the species examined by Bergh (1881a, pp. 101, 106). The cerebral and the larger pleural ganglia are laterally expanded, and the pedal ganglia protrude between them still more laterally. The cerebral and pleural ganglia are only partially fused as in *R. perspicillata* (Bergh, 1881a, pl. J, figs. 1, 16). The pedal commissures are united with the visceral loop by a common sheath of connective tissue.

In the reproductive system (fig. 36) the spermoviduct (d) divides as it leaves the long, fusiform ampulla (a) into male duct (r) and oviduct (o), both of which enter the gland mass (f). The male duct, glandular at first, expands to a prostate (q) apposed to the gland mass (f). The male duct leaves the prostate as a long, muscular duct provided with a sheath (p) and lined with cilia. The vagina (v), more slender than the male duct, accompanies the latter inward and leads to a spermatheca (t) embedded in the gland mass. The insemination duct (u) leaves the spermatheca at the same place as the vagina entered it and receives the duct of the spermatocyst (s). Hence the seminal receptacles are arranged serially as in *Rostanga perspicillata* (Bergh, 1881a, pl. J, fig. 15), *R. pulchra* (MacFarland, 1906, p. 121), and *Boreodoris setidens* (Odhner, 1939, p. 31, fig. 17), a genus that is closely related to *Rostanga*. The elongated spermatocyst (s) with rather long duct is empty in the present specimen. After receiving the duct of the spermatocyst the insemination duct (u) enters the gland mass. The short oviduct (o) bears a small fertilization chamber (w). The outer oviduct or nidamental duct (n) opens separately from the vagina and male duct and is expanded internal to the opening.

OCCURRENCE: The specimen was taken under a stone in the tidal zone at Ilhabela, June, 1956.

DISCUSSION OF *Rostanga byga*

The three Atlantic and Mediterranean species of *Rostanga* differ from *byga* in that their marginal radular teeth have merely bifid tips. Moreover, the innermost lateral tooth of *coccinea* (Forbes, 1843=*rufescens* Iredale and O'Donoghue or *rubra* Risso; see Pruvot-Fol, 1951, p. 11) bears a bicuspid hook (Alder and Hancock, 1845–1855, pt. 7, pl. 46, suppl.; Bergh, 1881a, pl. H, figs. 27–29). In *R. perspicillata*, the first lateral tooth is similar to that of *byga*, but the others have a denticle under the cusp (Bergh, 1881a, pl. J, figs. 7–8, 11–12). The form of the innermost tooth of *perspicillata* makes it difficult to consider this species a variety of *rufescens* as supposed by Pruvot-Fol (1954, p. 279, note). *Rostanga temerana* (Pruvot-Fol, 1953, p. 78) has a denticle

under the cusp on several inner lateral teeth. On the whole the radula of *temerana* is similar to that of *perspicillata* but is much shorter, and its rows contain about half as many teeth.

The Indo-Pacific species of *Rostanga* have marginal teeth with multifid tips. The Australian, New Zealand, and Japanese species, *arbutus* (Angas, 1864), *muscula* (Abraham, 1877), and *rubicunda* (Cheeseman, 1881) are evidently synonymous (Baba, 1935, pp. 343–344), and the first, from New South Wales, has priority (Allan, 1947, p. 445). Its first lateral tooth is hamate, with 20 to 30 denticles on its medial edge (Baba, 1949, p. 149), and its gills are generally bipinnate. With O'Donoghue (1926, p. 208, note) I am disinclined to follow Eliot (1907, p. 339) and Baba (1935) in including *R. pulchra* (MacFarland, 1905, p. 40; 1906, p. 119) in the synonymy of *R. arbutus*. The first tooth of *pulchra* differs widely from that of *arbutus*, and its gills are unipinnate. This tooth of *pulchra* has more medial denticles (seven to 11) than that of *byga*, whereas the spines of its marginal teeth are less numerous (two to six) than those of *byga*. MacFarland (1906, p. 120) indicates 10 to 12 rhinophoral leaves on each side, whence the statement of 20 to 24 rhinophoral leaves in *pulchra* by Abbott (1954, p. 300). On the whole, however, *pulchra* is very similar to *byga*, although its east Pacific distribution, from Vancouver (O'Donoghue, 1926, p. 208) to San Diego (Ricketts and Calvin, 1952, pp. 34–35) would not suggest morphological affinity.

SUBFAMILY DISCODORIDINAE

Etidoris ladislavii Ihering, 1886

Figures 37–43

The living slugs are carrot-red in color and up to 19 mm. long, 11 mm. broad, and 6 mm. high, preserved. The body (fig. 37) is ovoid, broad in front, sometimes a little pointed behind. The anterior border of the foot (fig. 40) is bilabiate but not notched. The back is covered with papillae of different sizes, larger medially in general but mixed with smaller ones, with small ones more densely disposed on the borders. The larger papillae, up to 5 mm. in height and breadth, are rough, more or less blunt, and too far apart to make the surface as villous as in *Thordisa*. Together with the many medium and smaller wart-like tubercles they give the back a granular aspect. The pits of the rhinophores are encircled by many small, pointed tubercles (fig. 39), which are less numerous on the borders of the branchial cavity. Large spicules are present, especially in a ring around the central part of the notum (fig. 38), and smaller ones occur in the papillae (fig. 41)

but generally do not project from the latter. The tentacles are barrel-shaped, with a short furrow on the outer side. The rhinophores bear 22 perfoliations, of which 12 are complete, 10 incomplete. There are five bipinnate to tripinnate gills.

The labial cuticle is smooth. The radula (fig. 42) bears up to 34 rows of teeth; the maximum formula is 4–5.45.(1).45.4–5. The tiny rachidian tooth corresponds to a *"falsche Zahnplatte"* (Bergh, 1892c, p. 115), a small, not always discernible, thickening of the radular membrane. The outer lateral plates are the highest elements, the inner ones the smallest. The size of the pectinate marginal plates diminishes peripherally; the first bears an inner cusp adjacent to the comb.

The esophagus enters the posterior region of the stomach from the ventral side, and the intestine leaves it in the middle of its anterior border and immediately bends to the right. The stomach, exposed between the lobes of the intestinal gland, contains masses of sponge, bryozoans (e.g., *Savignyella lafontii, Synnotum aegyptiacum*), teeth of its own radula, small stones, and leaves of mica. The dorsal stomach wall is thrown into thick longitudinal folds, the lateral walls have fine transverse ones, and the ventral wall is smooth. A long caecum is present.

In the reproductive system (fig. 43), the sausage-shaped ampulla (a) lies far anterior, attaining the level of the brain. The male duct, on leaving it, makes a small loop and then becomes glandular (q) as a prostatic region that recurves on itself. It then narrows (r), takes a winding course through the body wall, being here surrounded by a free muscular sheath (p), and ends in a long penial papilla (c) that projects into the male atrium (m). This opens in common with the vagina (v) by a common gonopore (g) in the middle of the under side of the notum. The female duct enters the gland mass (f), much larger in an adult slug than shown in figure 43, drawn from an immature specimen. The center of the left surface of the mucous gland is occupied by the albumen gland. The nidamental opening (n) lies in the angle between foot (o) and notum, at the same level as the common gonopore (g). The vagina (v) begins on the dorsal side of the male atrium (m) and leads anteriorly to the thin-walled spermatheca (t). The insemination duct (u) leaves the vagina near the entrance of the latter into the spermatheca and receives the short duct of the thick-walled spermatocyst (s). Hence the seminal receptacles are here arranged semiserially.

OCCURRENCE: A total of seven specimens was obtained at Ilhabela, under stones in the intertidal zone. The largest specimens were se-

cured in June, 1956, smaller ones in April, 1954, and November, 1953. The species is also known from southern Brazil, coast of Santa Catharina, Armação near Florianopolis.

Discussion of *Etidoris ladislavii*

The type of *Thordisa, T. maculigera* Bergh (1877a, p. 540), has densely disposed dorsal villosities; also later descriptions of *Thordisa* stressed this character (Bergh, 1890, p. 902; Eliot, 1906c, p. 657). Therefore the separation of *Etidoris* from *Thordisa* (Ihering, 1886, p. 234) is justified, although Bergh (1892b, p. 1098) united both genera, because of the likeness of the radulae, and Ihering (1915, p. 142) adopted this synonymy.

The larger of the two original specimens was 24 mm. long, preserved, and this size explains its more numerous radular rows (44) and more numerous lateral teeth (48–49) than in our material.

SUBDIVISION PHANEROBRANCHIATA
SECTION SUCTORIA
FAMILY ONCHIDORIDIDAE
Onchidoris bilamellata (Linnaeus, 1767)

Figures 44, 45

In the spelling of the generic name, I follow Lemche (1938) and Odhner (1939), although Blainville (1816) used the form *Onchidorus* and O'Donoghue (1926, 1929), Moore (1950), and others retain this spelling. Many authors apply the historically second specific name (Lemche, 1938, p. 20, note), *fusca* (O. F. Müller, 1776). As the validity of Blainville's generic name is disputable (Bergh, 1878a, p. 603, note), Pruvot-Fol (1954) recognizes *Lamellidoris* Alder and Hancock [1855 (1845–1855), pt. 7, p. xvii].

The specimen was kindly presented to me by Mr. Robert Robertson of the Museum of Comparative Zoölogy, Harvard, who gave the following data in a letter of September 5, 1956: length, 5 mm., width, 4 mm., rhinophores cream, dorsal surface white flecked with brown, several irregular transverse stripes and the papillae and branchiae darkened, ventral surface of foot cream, mantle white. The specimen is unfortunately immature and hence does not permit a detailed description. Descriptions and figures of mature specimens appear in Alder and Hancock (1845–1855, pt. 5, family 1, pl. 1, fig. 13; *op. cit.*, pt. 6, family 1, pt. 11; *op. cit.*, pt. 7, suppl., pl. 46, fig. 11) and Bergh (1878a, pp. 606–613; 1880, pp. 62–67). I confine myself to illustrating

a notal papilla (fig. 44) and the branchial area with its papillae (fig. 45).

Adalaria proxima (Alder and Hancock, 1854), called by Abbott (1954, p. 306), the "yellow false Doris," with a similar distribution, is colored uniformly yellow, white, or orange, has fusiform or obtusely pointed papillae, contrasting with clavate, very strongly spiculose papillae of *O. bilamellata,* has nine to 11 gills whereas the adult *O. bilamellata* has up to 30, smooth lips (not as in *bilamellata* with a narrow girdle of minute rods), and 10 marginal radular teeth in contrast to the single tooth of *bilamellata.* The horseshoe-shaped arrangement of the branchiae (fig. 45) and the suctorial buccal pump (Forrest, 1953, p. 233, fig. 5d) are similar in both species.

OCCURRENCE: The specimen came from the Atlantic side of the breakwater at Cuttyhunk Island near Woods Hole, Massachusetts, on *Fucus* in a tide pool, August 23, 1956. It is also known from East and West Greenland, Davis Strait (Odhner, 1907), Maine and New Hampshire (Moore, 1950), Boston (Gould, 1870), Iceland, the Faroes, Murman coast, Norway, Skagerrak, Kattegat, North Sea, Great Britain, Netherlands (Engel, 1936), Belgium, and the northwestern coast of France. The variety *pacifica* (Bergh, 1878a, pl. 68, figs. 15, 16; 1880, p. 62; 1905a, p. 101) does not merit a special denomination (Eliot, 1910a, p. 13; O'Donoghue, 1926, p. 221). Therefore its distribution from the Bering Sea southward to Puget Sound must be added to that of *bilamellata.*

SUBORDER DENDRONOTACEA

FAMILY BORNELLIDAE

Bornella calcarata Mörch, 1863

Figures 46–54

The one preserved specimen is stout, 48 mm. long, of uniform cream or very light brown color, and quite opaque; hence neither eyes nor inner organs are visible. The body is high and narrow, with a sharp, blade-like tail (fig. 46). The greatest height, 9 mm., is attained at the pericardial prominence (h); the width is about 5 mm. The sole is anteriorly truncated (fig. 48), posteriorly pointed, and in the present specimen is contracted to form a median longitudinal furrow. The surface is rather smooth dorsally, slightly knobby laterally, especially near the sole.

The oral tentacles (figs. 46, 47, 48, t) consist of a number of pointed finger-shaped filaments, nine on the left, 13 on the right side, disposed

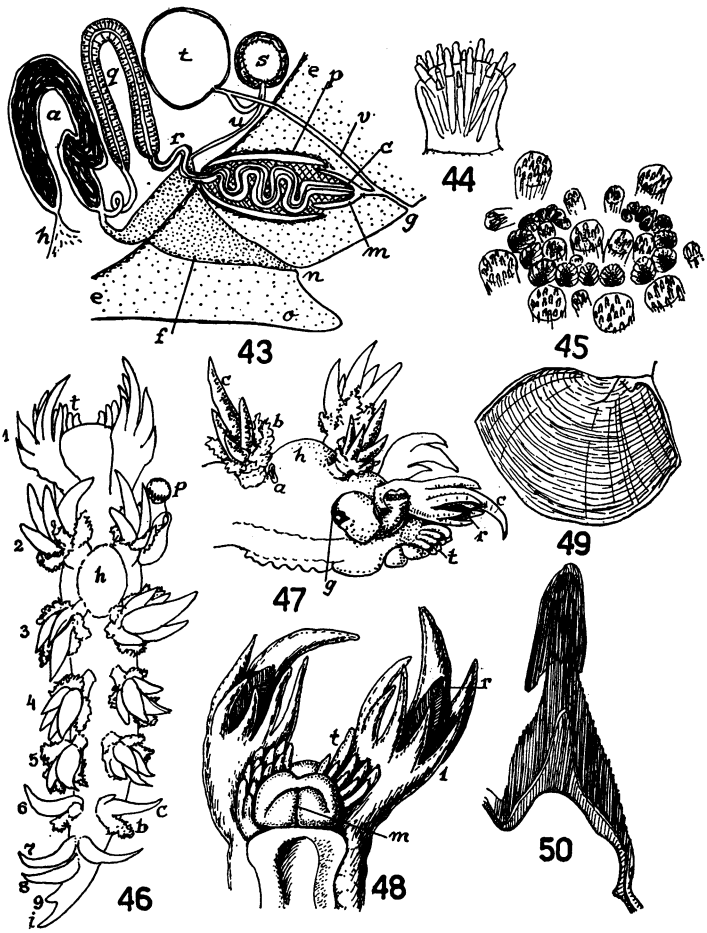


FIG. 43. *Etidoris ladislavii.* Diagram of reproductive system. *Abbreviations:* a, ampulla; c, penial papilla; e, body wall; f, female gland mass; g, aperture of male duct and vagina; h, hermaphroditic gland; m, male atrium; n, nidamental opening; o, foot; p, sheath of male duct; q, prostatic part of male duct; r, muscular part of male duct; s, spermatocyst; t, spermatheca; u, insemination duct; v, vagina.

FIGS. 44–45. *Onchidoris bilamellata.* 44. Notal papilla. 45. Branchial area with papillae.

FIGS. 46–50. *Bornella calcarata.* 46. Dorsal view of preserved slug. 47. Side view of anterior part. 48. Ventral view of head. 49. Jaw. 50. Spine of second stomach. *Abbreviations:* a, anus; b, branchiae; c, cones of cerata; g, genital aperture; h, pericardial prominence; i, tip of tail; m, mouth; p, terminal disk of penis; r, club of rhinophore; t, tentacles; 1–9, dorsal appendages.

in two rows and up to 2 mm. in length. The rhinophores (fig. 48, r) are coalesced with the first cerata, and their clubs are perfoliated with 25 to 30 leaves (27, according to Bergh, 1874b) and contained in a sheath split into a number of points. The first ceras (fig. 48, 1) consists of additional conical projections of different sizes; hence it is difficult to decide which of the seven processes around the rhinophore club belong to its sheath and which to the ceras. The original specimen of the species had nine processes, of which Bergh considered three as rhinophoral. The stalk of the rhinophore is flattened, with a high posterior crest. The eyes, supplied by a colorless optic nerve, lie in the body cavity under the rhinophores.

There are seven pairs of cerata (fig. 46, 1–7) of which the first pair, mentioned above, reach a length of 11 mm.; pairs two to seven have a maximum length of 7 mm.; and near the posterior end there are two unpaired median processes (fig. 46, 8, 9). The anterior cerata consist of a number of cones (c) of different lengths surrounded on all sides by tufts of tripinnate or quadripinnate branchiae (b) on a common stalk. The number of their elements diminishes posteriorly, although this decrease is not quite regular. Possibly those appendages that are smaller than corresponds to their position are regenerated. The seventh cerata are simple curved outgrowths without attendant gills. The more posterior (9) of the two median processes is a mere boss on the dorsal crest in front of the tail tip (i).

The high pericardial prominence (fig. 46, h) lies between the second and third cerata, and at the right side of its posterior border the broad anus (a) is hidden in a fold. The nephridiopore, which lies in front of the anus in *B. excepta* (Bergh, 1884, p. 37) was not detectable. In front of the rectum and beneath the pericardium a round white knob with a canal in its middle is evidently the renopericardial duct. The genital aperture (g) is located under the second right ceras and forms a sharp ridge around the penis (p) which is everted in the present specimen and curved upward alongside the right rhinophore.

The mouth (fig. 48, m) is surrounded by an arched upper and a cleft lower lip which are continuous laterally. The wide buccal cavity is occupied by the thick muscular labial pads. These are covered with a cuticle that lines the slit-like buccal tube and is provided with small scales standing in irregular rows, as Bergh (1874b, p. 294, pl. 36, figs. 15–16) described in detail. The horny jaws (fig. 49) project from behind into the lumen of the buccal tube. The pharynx proper is smaller than the labial pads and has the shape of a stout cone covered by the

jaws; from this cone the slender esophagus issues. A pair of solid salivary glands is attached to the posterior side of the pharynx.

The relatively small radula has 34 rows of teeth in a 12–14.1.14–12 pattern (fig. 51). The strong rhachidian tooth is cordiform and brownish, with a smooth, not dentate, margin. The cusps of the delicate, colorless lateral teeth increase from the innermost to the sixth tooth, then remain of equal size to the antepenultimate tooth. The penultimate cusp is rudimentary, and the last tooth completely lacks a cusp.

After passing through the nerve ring, the esophagus enters the first stomach, wide and thin-walled. Attached to the dorsal side of the stomach are the anterior right and left livers, each of which forms a little sac and process into the second pair of cerata. The left posterior liver is delimited from the posterior wall of the first stomach only by a fold. The posterior liver is a wide tube that extends to the sixth pair of cerata, giving off branches into the third, fourth, and fifth pairs. To the right the digestive tract continues as the tubiform second stomach, which has about 12 longitudinal folds and is lined by a strong cuticle forming rows of hollow brown spines (fig. 50) along the folds. The cuticle of these spines is evidently cast off from time to time, as many spines were found in different stages of molting and substitution. From the second stomach the intestine descends to the ventral side of the liver and then bends sharply dorsally to the anus. The parenchyma is richly developed and connects the viscera with one another and with the body wall; hence the viscera are extremely difficult to trace. Bergh (1874b, p. 298) mentions only that the liver branches are firmly fixed to the walls of the cerata and to one another by short strands of connective tissue. The digestive tract contained amorphous yellowish masses and now and then a bit of cuticular tube probably belonging to a hydrozoan.

The ovotestis consists of about half a dozen follicles lying over the posterior liver in front of its first branches to the third cerata, under the kidney, and behind the heart. The hermaphroditic duct goes around the stomach on the left side and forms a small ampulla on the dorsal side of the female gland mass. The latter lies under the stomach beside the genital opening. In its middle the small spermatheca is visible, and in front lie the coils of the male duct, the most anterior of which are thick and pinkish. These are certainly the prostatic part of the duct. They lie immediately internal to the entry of the duct into the everted penis. This (figs. 52, 53), which was retracted in the original specimen of the species, is about 8 mm. long protruded and shows

the two longitudinal crests anticipated by Bergh. The dorsal crest (d) is sharp and laid in folds and continuous distally with the border of a terminal disk (p) which is surrounded by a sinuous ribbon of tiny brown spines (s). This ribbon extends onto the ventral crest which is accompanied by a deep longitudinal furrow (f) and ends with a curl near the root of the penis. In the ribbon the singly pointed spines are arranged in three to five irregular rows (fig. 54).

OCCURRENCE: The specimen came from Recife, Pernambuco, and was kindly presented by the Oceanographic Institute of the University of São Paulo. The species is also known from St. Thomas in the Virgin Islands.

DISCUSSION OF *Bornella calcarata*

The genus *Bornella* Gray, 1850, the type of which is *B. digitata*, the "fingered sea-slug" (Allan, 1950, p. 224), was discussed by Eliot (1904, p. 100), and Odhner (1936, p. 1109) gave a synopsis of the Bornellidae. Since then there has been added *B. japonica* (Baba, 1949, pp. 88, 168) which comes near *B. excepta* Bergh in Odhner's key and differs from it by having gills on the inner side only of the cerata.

The present is the second known specimen of *B. calcarata*. The original specimen of Mörch was thoroughly reëxamined by Bergh. It had nine processes on the first cerata, paired eighth cerata, and a pigmented optic nerve, but these slight differences from the present specimen are taxonomically insignificant.

SUBORDER ARMINACEA
TRIBE PACHYGNATHA
FAMILY ANTIOPELLIDAE
Janolus comis Marcus, 1955

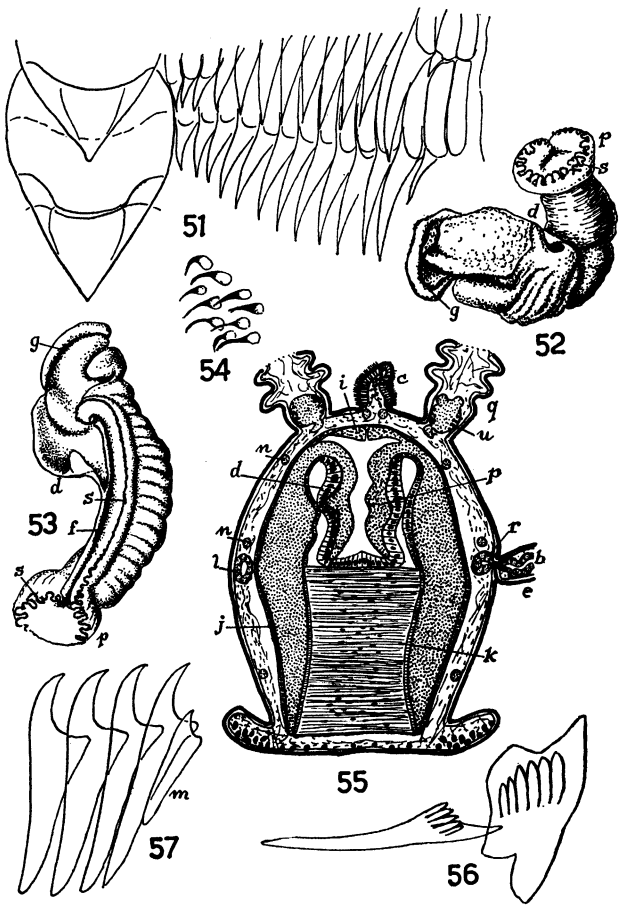
Figures 55–61

Study of more material of this species reveals some variations of color, jaws, and radular teeth as well as several anatomical details that require supplementary notes. The differences result in part from varying ages of the slugs.

The distribution of the dark, cutaneous pigment differs in different individuals. In some there are large, irregular, or even confluent blotches, in others fine black dots. As a rule the older specimens are darker than the younger ones. Pigment cells also occur on the principal branches of the liver and on the hepatic diverticula in the cerata (fig. 59, y).

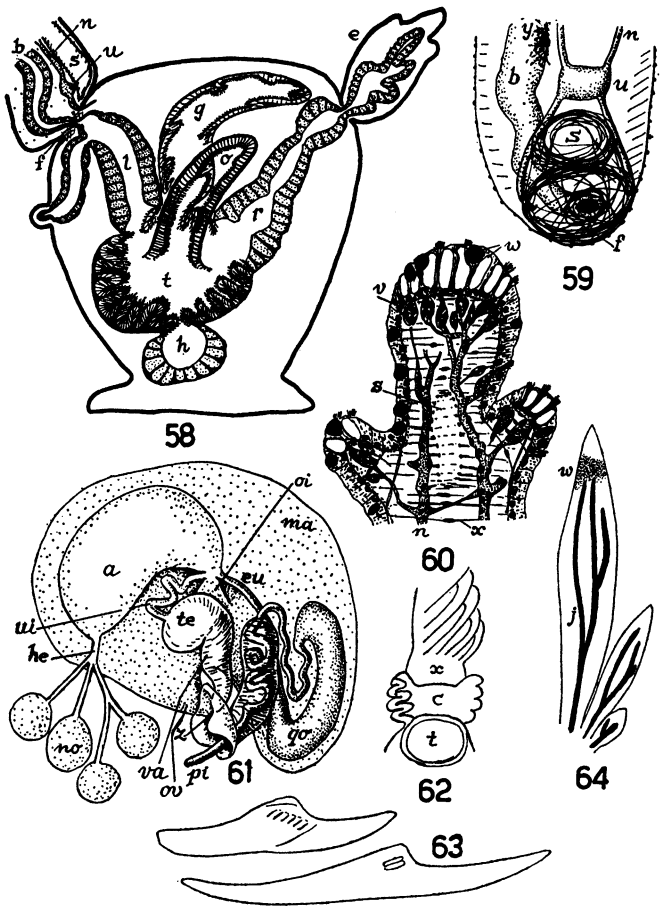
Though wavy the masticatory border of the jaws is smooth as in

J. hyalinus. In some of our slugs the masticatory border (fig. 55, p) is extremely strong and brown, whereas it is nearly absent in other, even much larger animals. Hence we suppose that the strong cuticle is re-



FIGS. 51–54. *Bornella calcarata.* 51. Radular teeth. 52. Dorsal view of copulatory organs. 53. Ventral view of same unrolled. 54. Spines of same. *Abbreviations:* d, dorsal crest of penis; f, furrow of penis; g, genital aperture; p, terminal disk of penis; s, ribbon of penial spine.

FIGS. 55–57. *Janolus comis.* 55. Transverse section of body at level of masticatory borders. 56. Oldest half-row of radula of youngest specimen. 57. Central part of radular row of adult specimen. *Abbreviations:* b, liver in ceras; c, interrhinophoral crest; d, epithelium of masticatory border; e, ceras; i, hinge of jaws; j, jaw plate; k, muscles of jaw plates; l, left liver; m, median plate of radula; n, nerves; p, masticatory border; q, rhinophore; r, right liver; u, ganglion.



FIGS. 58–61. *Janolus comis.* 58. Combined transverse section of stomach and liver branches. 59. Base of removed, cleared ceras. 60. Tip of ceras in longitudinal section. 61. Diagram of the reproductive organs. *Abbreviations:* a, ampulla; b, liver in ceras; e, ceras; eu, male duct; f, sphincter; g, intestine; h, posterior liver; he, hermaphroditic duct; l, left liver; ma, female gland mass; n, nerves; no, ovotestis; o, esophagus; oi, inner oviduct; ov, outer oviduct (nidamental duct); pi, penis in sheath; qo, prostatic part of male duct; r, right liver; s, blood sinus; t, stomach; te, spermatheca; u, ganglion; ui, insemination duct; v, sensory cells; va, vagina; w, gland cells; x, transverse muscles in ceras; y, pigment ocelli; z, genital aperture.

FIGS. 62–64. *Antiopella mucloc.* 62. Interrhinophoral crest with left rhinophore. 63. Median and first lateral tooth of radula. 64. Three cerata. *Abbreviations:* c, crest; j, liver branch; t, base of right rhinophore; w, orange spot; x, left rhinophore.

placed from time to time. The masticatory border is underlain by a high epithelium (fig. 55, d) which evidently produces a new border when the old one is worn. The size of the jaw plates (fig. 55, j) does not always correspond to the size of the slug, e.g., an animal 4 mm. long had mandibles 1 mm. long, whereas one that was 3 mm. in length had mandibles measuring 1.25 mm.

Our first drawing of the radula (Marcus, 1955, fig. 236) refers to a rather young specimen. We have now examined the radula of a still smaller slug that was 1.2 mm. long, preserved. This begins with nine rows of three teeth, i.e., one lateral tooth on each side. The number then increases to six on each side in the nineteenth row. All teeth have four to six denticles, the median tooth on both sides, the lateral teeth on the inner side only. The first median teeth are very stout and much larger (fig. 56) than the lateral teeth of the same row. In a large slug, 6 mm. long, preserved, there are 25 rows of 41.1.41 teeth, all smooth (fig. 57); the median tooth (m) is quite small, the following lateral ones almost twice its size and equal, then diminishing slightly at the outer border. Bergh (1874a, p. 603, note 4) exceptionally observed denticles on one rhachidian tooth of *Antiopella cristata;* his figure (pl. 7, fig. 12) shows that the denticulated tooth is the oldest in the radula, whereas the younger teeth are smooth. Eliot (1906b, p. 374) described slugs of the species *Janolus hyalinus,* 8 and 4.3 mm. in length, of which all the teeth had three to five or even seven denticles (pl. 11, fig. 23). He considered the denticles as variable as did also Pruvot-Fol (1926, p. 273) who related the denticulation to age. Indeed the first teeth of *J. comis* have denticles, the later ones are smooth.

The esophagus (fig. 58, o) opens into the stomach (t) from in front; the stomach emits to the right and left the anterior liver lobes (l, r). Esophagus, stomach, and intestine (g) are lined by ciliated epithelium, whereas the liver epithelium is tall, granular, and not ciliated. The posterior liver (h) leaves the ventral stomach wall by a fine pore and is on the same level with the anterior branches. The stomach interior is thrown into deep folds that extend from the cardia to the pylorus. From the anterior liver openings a series of folds runs towards a dorsal flap that lies over the origin of the intestine and probably closes the latter when food is passing from the esophagus into the liver lumina. The opened stomach of *J. comis* shows no partition between an anterior lower and a posterior upper stomach, contrary to Misuri's statement for *Antiopella cristata* (see discussion of *Antiopella mucloc*). The intestine (g) leaves the dorsal posterior wall of the stomach, curves around the

upper side of the stomach, and then turns right and ventrally. Near the posterior end of the animal it ascends to the dorsomedian anal funnel.

Contrary to Misuri's description (1917, p. 46, figs. 66, 68) for *Antiopella cristata* the three liver branches do not anastomose in *J. comis*, nor do they in Alder and Hancock's (1845–1855, pt. 5, family 3, pl. 43) and Trinchese's figures (1882, pl. 48, fig. 6) of *A. cristata*. Each branch supplies the cerata of a definite body region. The cerata anterior to the rhinophores contain hepatic diverticula in *cristata*, but not in *comis* or *hyalinus*, to judge from Eliot's figure (1910a, pl. 5, fig. 7). In some cerata of *J. comis*, the liver diverticulum (fig. 58, b) is smooth and slender; in others of the same size in the same animal it is knobby. As in *hyalinus* (Bergh, 1904, p. 10) the liver diverticulum reaches only to the middle of the largest cerata, but extends more distally in the smaller ones (fig. 58, e).

Some observations on the innervation of the cerata of two European Antiopellidae were published by Trinchese (1882, p. 82, pl. 42, figs. 9–10, pl. 43) and Pelseneer (1894, p. 48, pl. 16, figs. 140, 142). Pelseneer in *J. hyalinus*, closely related to *comis*, verified the presence of ganglia in the cerata. In *J. comis* two nerves (fig. 58, n) enter each ceras and unite to a broad ganglion (u) near the base of the ceras. These nerves proceed distally, are beset with nerve cells, and give off numerous side branches, of which one at least innervates each of the lateral papillae, while the two principal trunks innervate the terminal knob of the ceras. Transverse muscle fibers (fig. 60, x) extend between the skin and the ramified blood sinus (s) that runs near the surface of the ceras nearly to its distal end. The entrances of liver diverticulum and blood sinus into the ceras are surrounded by 8-shaped circular muscle fibers (fig. 59, f) that act as a sphincter. The cerata can be autotomized as in *Proctonotus* (Hecht, 1895, p. 605) and the Eolidacea. The terminal knob and the lateral papillae of the ceras contain subepithelial sensory cells (fig. 60, v), probably tangoreceptors and perhaps partly rheoreceptors. Although *Janolus* has no spicules, the tips of the cerata with their sensory and gland (fig. 60, w) cells resemble the notum papillae of certain Dorididae, e. g., *Jorunna* (Labbé, 1933, fig. 2 on p. 215) or *Taringa* (Marcus, 1955, p. 153, fig. 170).

Misuri (1917, figs. 65, 67, 70) described and figured an anastomosing network of blood vessels on the back of *Antiopella cristata*. We did not find any such in *J. comis*, but on the medial side of the hepatic tubes there are tubular ramifications of the kidney and these resemble Misuri's figure 65, although not the fine meshes of his two other fig-

ures mentioned. Misuri did not see the kidney in *cristata* but thought (p. 49) that the rectal glands serve as excretory organs in this species. Bergh (1874a, p. 604) described the extended kidney of *cristata* and the renopericardial duct.

In the reproductive system (fig. 61) the ductules of the follicles of the ovotestis (no) unite to form a short hermaphroditic duct (he). Immediately in front of the voluminous ampulla (a) the male and female efferent ducts separate. The slender male duct (eu) dilates into a curved prostatic part (qo) and then reduces again, entering the muscular penis sheath through which it runs as a muscular, sinuous, ciliated duct. This terminates as the penis (pi) which was protruded from the gonopore (z) in several slugs up to a length of 1 mm. The entire sheath can be everted and then prolongs the male organ considerably, as was probably the case in the single specimen of *J. flagellatus* Eliot (1906b, p. 374). The cuticular penial hooks previously indicated (Marcus, 1955, p. 172) are in reality absent. A short broad inner oviduct (oi) conducts the eggs from the ampulla (a) to the female gland mass (ma), which opens by a short peripheral outer oviduct (ov) or nidamental duct, into the genital aperture (z). A muscular vagina (va) ascends from the genital aperture and dilates into a silky shining spermatheca (te); from the inner end of this a sinuous insemination or uterine duct (ui) conducts the sperm to the point where male and female ducts separate.

Antiopella mucloc, new species

Figures 62–71

The single specimen was 20 mm. long alive and 10 mm. long, 3 mm. wide, and 2.5 mm. high preserved. Alive the slug was transparent white with a dorsal subterminal orange spot (fig. 64, w) on each ceras, and opaque white stripes running downward from this spot. Along the animal's back is a thin white line, not bifurcated as in *cristata*. The brown liver branches are visible through the skin.

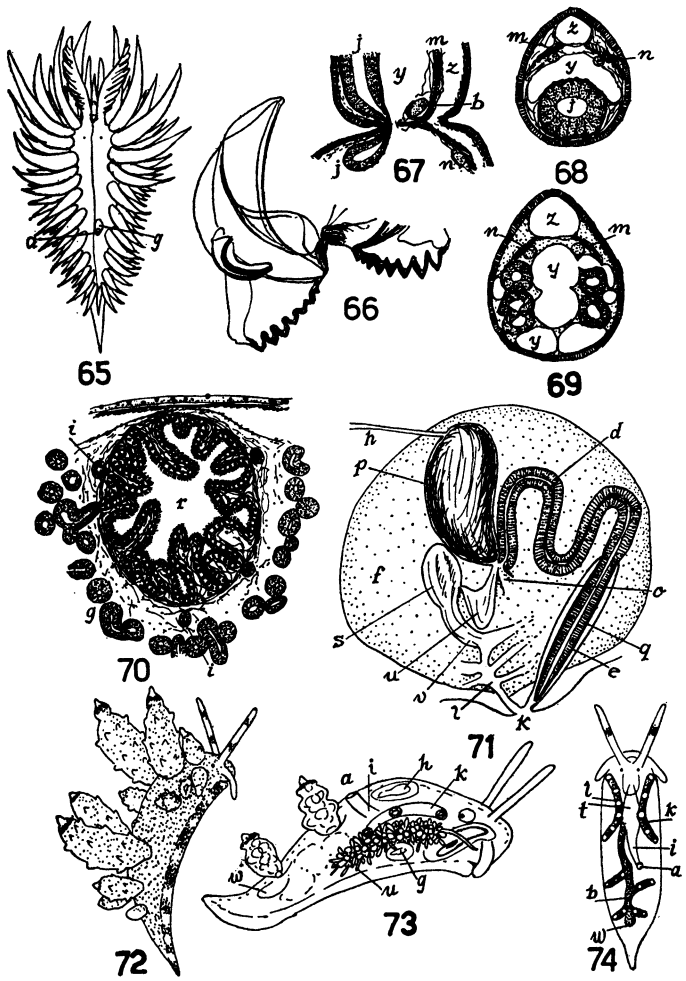
The back is flat, the tail pointed, as in *A. cristata*, and the sides are vertical. The interrhinophoral crest and the rhinophores stand upon a common socket. Numerous smooth and fusiform cerata surround the body (fig. 65), forming about three rows on each side, of which the dorsalmost rows contain the longest cerata, about 7 mm. long in life, with especially long ones beside the rhinophores. The latter (fig. 62, x) have a smooth shaft and an obliquely perfoliated club, with about eight complete leaves and eight intercalated shorter leaves. The crest (c) is medially smooth, frilled anteriorly and posteriorly. The eyes lie

rather far behind the crest. The left tentacle and anterior foot corner are missing, perhaps bitten off, and the cerata are replaced here by regenerative buds; hence the occurrence or not of an anastomosis between the right and left livers could not be determined. The right, intact foot corner projects, and the anterior border of the foot is transversely grooved. The right tentacle is short and conical. The anal papilla (fig. 65, a) lies at about the end of the third fourth of the body, a little to the right of the median line; it is surrounded by a massive cluster of glands (g). The genital papilla is located at the end of the anterior body third, the renal opening midway between the anal and genital apertures, ventral to the row of cerata, as in *Janolus comis* Marcus (1955, fig. 228, n).

The yellow jaws (fig. 66) have brown masticatory borders that bear about eight strong denticles each. On the inside of the jaw there is a strong curved spur that corresponds to the *"lamina di colore rossastro"* of *Antiopella cristata* (Trinchese, 1882, p. 79, pl. 40, fig. 9, b). The radula has 18 rows of 24.1.24 teeth. The older teeth are basally brown, with colorless cusps. The rhachidian tooth is small and stout, with four to six fine denticles on both sides. Of the long, slender, lateral teeth, the innermost and perhaps some of the following ones bear two denticles on the inner side. Towards the lateral border of the radula the teeth decrease in size.

The esophagus enters the anterior side of the stomach. Folds of the stomach roof and hepatic ducts are as in *Janolus comis*. The intestine begins widely on the left side of the stomach from which it is indistinctly separated externally; it is here wrapped in the lobules of the salivary glands that lie in the connective tissue attached to the intestinal wall. The cerata have broadly open bases with few sphincter fibers, hence differing from those of *J. comis*, and the liver diverticulum (fig. 64, j) after entering the ceras bifurcates below the latter's middle which is its widest part; the branches then extend up to the orange spot (w), running on the outer side of the ceras. The efferent arterial blood sinus (fig. 68, z) lies on the inner side, separated by a muscular septum (m) from the afferent venous sinus (y). In this septum are two nerves (n), springing from a ganglion (fig. 67, b) in the base of the ceras. There are numerous cyanophilous cutaneous glands distally in the inner side of the cerata. The anal glands (fig. 70, g) communicate with the rectum (r) by a few openings (i).

The ovotestis (fig. 71) ends approximately at the level of the anal papilla, and the hermaphroditic duct from it (h) opens into a voluminous ampulla (p). Peripheral to the latter a short oviduct (o) enters



FIGS. 65–71. *Antiopella mucloc.* 65. Living animal. 66. Jaws. 67. Longitudinal section of ceras. 68. Transverse section of ceras near base. 69. Same as 68, more distally. 70. Combined section through rectum and anal glands with their outlets. 71. Diagram of reproductive organs. *Abbreviations:* a, anus; b, ganglion of ceras; d, male duct; e, male atrium; f, female gland mass; g, rectal glands; h, hermaphroditic duct; i, outlets of rectal glands; j, liver branch; k, genital aperture; l, nidamental duct; m, muscular septum; n, nerve; o, oviduct; p, ampulla; q, penis; r, rectum; s, spermatheca; u, insemination duct; v, vagina; y, venous sinus; z, arterial sinus.

FIGS. 72–74. *Capellina conicla.* 72. Living slug. 73. Lateral aspect of cleared animal. 74. Diagram of liver branches. *Abbreviations:* a, anus; b, posterior liver; g, genital aperture; h, heart; i, intestine; k, right liver; l, left anterior liver; t, stomach; u, gland of oral tube; w, end of posterior liver.

the female gland mass (f), while a glandular male duct (d) takes a sinuous course to the proximal end of the thin-walled atrium (e) and passes into a thick, straight, penial papilla that reaches to the genital aperture (k). The nidamental duct (l) communicates with the female gland mass by multiple openings and is internally continuous with a broad vagina (v) that opens into a spermatheca (s). This is completely enclosed in the female gland mass. The insemination duct (u) and its inner opening into the oviduct (o) can be verified only in sections.

OCCURRENCE: The single specimen was taken among algae near Ubatuba, September 4, 1956.

DISCUSSION OF *Antiopella mucloc*

With Eliot (1906b, p. 373; 1910a, p. 164) and Pruvot-Fol (1954, p. 374) we apply the name *Antiopella* Hoyle, 1902, to those Antiopellidae (Janolidae, Zephyrinidae; see Odhner, 1934, p. 271) with a crest between the rhinophores and with denticulate mandibles. Whether "smooth cerata" can be added to the generic characters is uncertain, as the cerata of *Janolus australis*, the type of *Janolus*, which has smooth jaws, are not well known. Bergh (1884, p. 20) stated: "only a few of the smaller papillae were left, they appear to agree with those of the typical *Janus*." From this one infers that the cerata of *J. australis* are smooth, but without certainty. In 1884 Bergh had not yet studied *hyalinus*. When he did in 1904 he transferred *hyalinus* from *Janus* (= *Antiopa* = *Antiopella*) to *Janolus* and opposed the knobbed cerata of *hyalinus* to the smooth cerata of *cristata* without referring to those of *australis*. Some further differences between *cristata* and *hyalinus* were listed by O'Donoghue (1924, p. 15), and the liver as well as the reproductive organs seems to augment the differences.

Although we have not seen all descriptions, we try to allocate the species between *Antiopella* and *Janolus*, as follows:

Species assigned to *Antiopella:*
- *cristata* (Delle Chiaje, 1841), the type species
- *novozealandica* Eliot, 1907
- *indica* Eliot, 1909
- *fusca* (O'Donoghue, 1924)
- *aureocincta* Johnson and Snook, 1927 (Costello, 1938, p. 321)
- *mucloc*, new species

Species assigned to *Janolus:*
- *australis* Bergh, 1884, the type species
- *hyalinus* (Alder and Hancock, 1854)
- *barbarensis* (Cooper, 1863)

coeruleopictus Cockerell and Eliot, 1905, a synonym of *barberensis* according to O'Donoghue (1924, 1926)
flagellatus Eliot, 1906b
capensis Bergh, 1907
comis Marcus, 1955

Antiopella mucloc is near *A. cristata* but differs in the branching of the liver in the cerata and in the position of the spermatheca. The hepatic diverticulum of *cristata* ramifies near the tip of the cerata (Alder and Hancock, 1845–1855, pt. 5, family 3, pl. 43, fig. 8; Trinchese, 1882, pl. 43; Misuri, 1917, fig. 65), and its spermatheca lies superficially (Alder and Hancock, 1845–1855, pt. 5, family 3, pl. 43, fig. 9, k; Trinchese, 1882, pl. 37, figs. 1, 2; Misuri, 1917, fig. 72, tc).

The position of the salivary glands, which is the same in *A. cristata* as is described above for *mucloc*, induced Alder and Hancock (1845–1855, pt. 5, family 3, pl. 43, fig. 2, d) to call the beginning of the intestine "a glandular portion of the stomach." Also Misuri's description of an interior and a superior stomach (1917, p. 44) is unclear, as Hoffmann (1932–1939, p. 1110) rightly noted. It is true that Misuri recognized the topography of the salivary glands. From the presence of rectal glands in *A. mucloc* one can perhaps infer that Pelseneer's observation (1894, p. 49, fig. 139) is correct for *J. hyalinus;* opinions to the contrary were already doubted by Hoffmann (1932–1939, p. 1221). The function of the rectal glands is unknown; certainly their products are not eliminated by osmosis as supposed by Misuri (1917, p. 49).

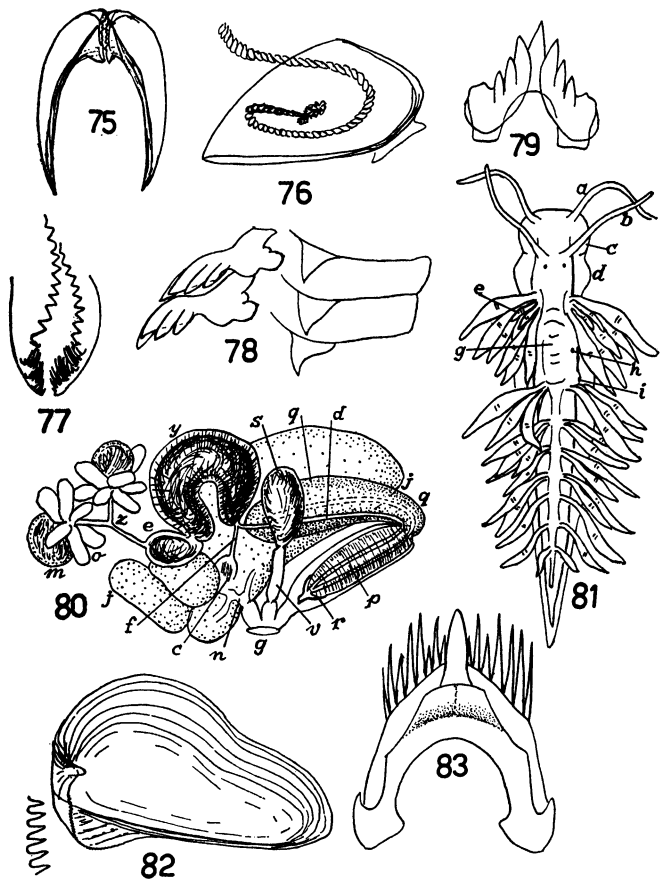
SUBORDER EOLIDACEA
TRIBE ACLEIOPROCTA
FAMILY EUBRANCHIDAE

Capellinia conicla, new species

Figures 72–80

The living slugs were about 2.5 mm. long; a preserved adult specimen measured 2 mm. in length and 0.6 mm. in breadth. The tentacles are 0.2 mm. long, the rhinophores 0.4 mm. long, and the largest ceras 0.9 mm. long and 0.48 wide, all in the preserved state. The cerata are clavate, of irregular size (fig. 72), with a more or less distinctly separated terminal knob. They have an inflated look, because the skin is distended over the liver bosses. In life they are sometimes extended into small tubercles but in other cases appear smooth except for the terminal knob. In number they varied from 10, five on each side, in the smallest specimen, through 15, seven on the left side and eight on the

right side in a specimen of medium size, to 19, 11 on the left and eight on the right, in our largest animal. The short tentacles, located beside the mouth, are bent down and back in life. The rhinophores are smooth. The foot is broadest in front where its border is straight with



FIGS. 75–80. *Capellinia conicla.* 75. Ventral view of jaws. 76. Lateral view of jaws and radula. 77. Masticatory processes. 78. Lateral view of two rows of the radula. 79. Median tooth of radula. 80. Reproductive organs. *Abbreviations:* c, fertilization chamber; d, male duct; e, proximal part of ampulla; f, oviduct; g, genital aperture; j, female gland mass; m, male follicle; n, nidamental opening; o, female follicles; p, penis; q, prostate; r, stylet; s, spermatheca; v, vagina; y, distal part of ampulla; z, hermaphroditic duct.

FIGS. 81–83. *Catriona perca.* 81. Dorsal view of living slug. 82. Jaw and border of masticatory process. 83. Radula tooth. *Abbreviations:* a, tentacles; b, rhinophore; c, head expansion; d, foot; e, small, inner cerata; g, heart; h, renal pore; i, anus.

slightly prominent corners, and simple, neither grooved nor notched; posteriorly it is pointed and on the whole narrower than the body. The anus (fig. 73, a) is situated slightly to the right of the median line, in front of the right anterior branch of the posterior liver (fig. 74, b). The renal pore is apposed to the anus. The genital aperture (fig. 73, g) lies in front of the most posterior ceras supplied by the anterior liver.

The animals are transparent, with opaque white dots and some dark pigment, appearing brown or greenish in the living mollusks. This pigment occurs in one or two rhinophoral rings, in one ring around the light-colored terminal knob of the cerata, and on the pedal border, which is consequently rather dark. The entire body is finely mottled except the pigment-free sole. The tips and tubercles of the cerata are dotted with white, and the contained liver branches are yellowish. Black eyes lie behind the rhinophores.

The right (fig. 74, k) and the anterior left (l) liver have the form of flat arches, and supply three to six cerata. The posterior liver (b) has two lateral branches on each side, supplying one to three cerata, and ends in a bud-like little sac (w) that might give rise to further branches with continued growth. The hepatic diverticula in the cerata form hollow bosses disposed in two to three rings that extend with points towards the wall of the cerata, touching these without forming cnidosacs there. There is but one cnidosac, about 0.15 mm. long, that lies as usual at the tip of the ceras. The medial side of the ceras contains spacious blood sinuses, and the outer side is occupied by "special cells" (Hecht, 1895, p. 661; Marcus, 1955, fig. 221, v).

The pale jaws (figs. 75, 76) have a reënforced, slightly yellow inferior border. The delicate masticatory processes, not projecting, bear pointed denticles (fig. 77), of which the most posterior are provided with rows of finest spines, visible under an immersion lens. The radula (fig. 76) contains about 70 rows of teeth, of which the oldest are very small and coiled, as if an ascus were present. The median tooth (fig. 79) is horseshoe-shaped, with three denticles on each side of its median cusp. The thin and smooth lateral plates (fig. 78) bear a triangular tooth; distance of this tooth from the edge of the plate about equals the breadth of the plate. The glands (fig. 73, u) of the oral tube are long, nearly attaining the body middle. Their elements are in part spherical cells, in part long, multicellular tubules. The shining muscular ducts flank the pharynx and open into the oral tube on each side.

The ovotestis (fig. 80) consists of two groups of follicles, each composed of a large central male follicle (m) and six to 10 smaller peripheral female acini (o). The globular proximal part of the ampulla (e) is

membranous, the strongly muscular distal part (y) sausage-shaped. The slender male duct (d), not glandular, enters the muscular penis (p) in company with the duct of the voluminous, claviform prostate (q); the two ducts unite near the penis tip. The penis is topped by a cuticular, colorless, obliquely cut stylet (r), having a length of 50μ, a basal width of 50μ, and an apical diameter of 15μ. Male (d) and female (f) ducts diverge at the distal end of the ampulla. The oviduct then passes through a fertilization chamber (c) into the lobate female gland mass (j), which communicates through several nidamental openings (n) with the female atrium. The vagina (v), which leads proximally to the spermatheca (s), opens externally between the male and female atria.

OCCURRENCE: Three slugs were taken in October, 1956, one near Ubatuba and two at Ilhabela.

DISCUSSION OF *Capellinia conicla*

The genus *Capellinia* Trinchese, 1874 (p. 201), is provisionally maintained here for *Eubranchus*-like species with armed penis. Cerata with knobs or tubercles into which hepatic diverticula extend are not decisive as shown in Vayssière's figures (1888b; 1913; 1928–1934) and partly also in our material. A penis stylet is known only in *C. capellinii* (Trinchese, 1877–1879, pl. 26, fig. 15); Vayssière questioned its occurrence in *C. doriae*, which, however, not *capellinii*, is the type of the genus (O'Donoghue, 1929, p. 751) although the latter is much better illustrated than *doriae*. *Capellinia doriae* was originally described as 15 mm. long; Vayssière indicated 3–5 mm., and 5 mm. for *capellinii*. Comparison of Trinchese's plates 24 and 25 shows slugs of approximately equal length, and hence Pruvot-Fol's opinion (1954, p. 420) that *doriae* is a lighter, *capellinii* a darker, form of the same species is acceptable.

Neither the aspect of the cerata nor the color pattern of *doriae* and *capellinii* agrees with *conicla*, and the triangular tooth of the lateral radular plate of *capellinii* (Trinchese, 1877–1879, pl. 26, figs. 12, 13) is nearer the inner edge of the plate than in *conicla*.

Though presence or absence of glands of the oral tube has not been mentioned for *Capellinia*, their absence was included in the generic diagnosis by Odhner (1907, p. 27) and repeated by Hoffmann (1926, p. 18) and Thiele (1931, p. 452). Trinchese's figures of the pharynx of *capellinii* indeed show no glands of the oral tube, but, even if they were present, figures of the isolated pharynx would hardly show them.

Without a revision of the genus *Eubranchus*, I cannot decide which species should be transferred to *Capellinia*. *Eubranchus exiguus* (Alder

and Hancock) with an unarmed penis (Bergh, 1878b, p. 835; 1879, pl. 7, fig. 20, d) cannot be a *Capellinia*, although Pruvot-Fol (1948a, 1951, 1954) considers Trinchese's species as synonyms of *exiguus*. The penial stylet distinguishes at least *capellinii* from *exiguus*. The reniform egg mass of the latter (Alder and Hancock, 1845–1855, pt. 5, family 3, pl. 37, fig. 6; Löyning, 1922, fig. 23) and the collar-shaped egg mass of *Capellinia doriae* (Vayssière, 1888b, pl. 7, fig. 128) and *C. capellinii* (Trinchese, 1877–1879, pl. 26, fig. 1) depend, according to Meyer and Möbius (1865, p. 36), on the size of the slug. The "second penial appendage" of *Eubranchus farrani* (Alder and Hancock) and *E. exiguus*, described by Bergh (1878b, pp. 833, 836; 1879, pl. 7, figs. 20, 21) certainly deserves attention in a future revision of *Eubranchus*, but is not sufficiently established to be considered a generic character of *Capellina* (Pruvot-Fol, 1954, p. 420) and attributed as such to *doriae* and *capellinii*.

Galvina farrani of Vayssière (1901, pl. 1, fig. 25; 1903, p. 86) and that of Pruvot-Fol (1951, pl. 4, fig. 4; *Eubranchus*) are evidently conspecific. The penis is armed, contrary to the North Atlantic *farrani* (Bergh, 1878b, pl. 13, figs. 17, 18). According to Lemche (1935, p. 146) and Odhner (1939, p. 66) the northern *farrani* (Alder and Hancock, 1844) is a synonym of the type of *Eubranchus* Forbes, 1838, *E. tricolor*, whereas the Mediterranean *farrani* might be a *Capellinia*, although no tubercles of the cerata are mentioned. Its color differs from that of Trinchese's species as well as from that of *conicla* and of *Tergipes fustifer* Lovén, possibly also a *Capellinia* (Odhner, 1907, pp. 30, 81), which has six to seven tufts of two to three cerata each, and tentacles and rhinophores of equal length.

Vayssière's statement of numerous cnidosacs in the bosses of the cerata of *Capellinia doriae* (1888b, p. 95) was not repeated in his later descriptions, probably because he had confounded glands of the cerata with cnidosacs.

Eubranchus montraveli Risbec (1937, p. 161; 1953, p. 139) can hardly be a *Capellinia*, in spite of its armed penis, because its anus is quite lateral, almost beneath the cerata.

FAMILY CUTHONIDAE

Catriona perca, new species

Figures 81–87

Preserved animals, sections, some drawings, and data on live slugs, egg sacs, and larvae were kindly presented by Miss Kaoru Hosoe.

Living specimens are up to 12 mm. in length. The transparent body

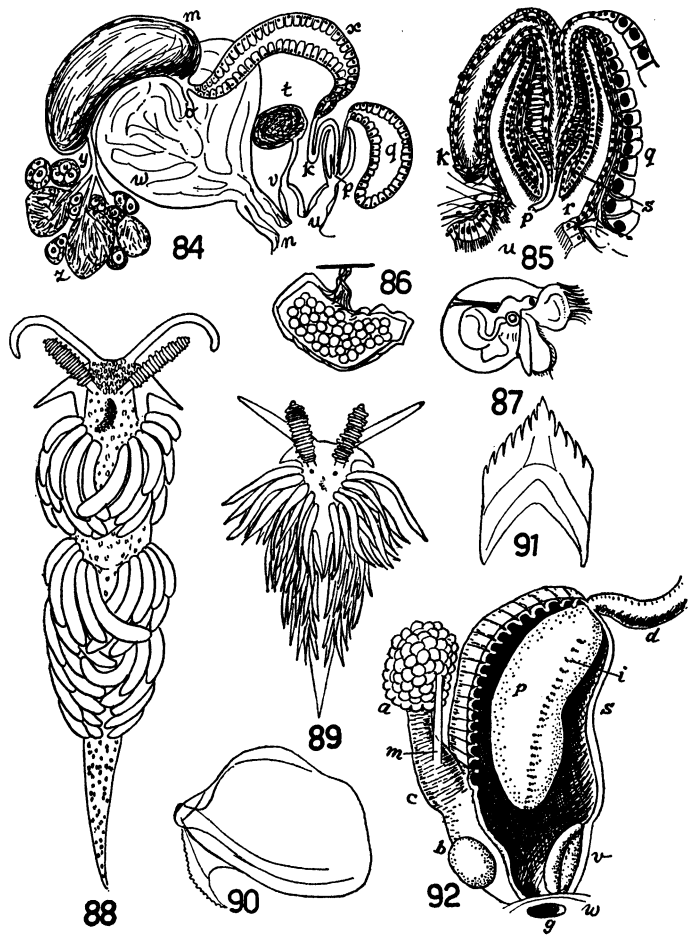
is light orange, and the dark liver and other internal organs can be seen through the skin. The orange color is more intense on the sides of the head than elsewhere, and the anterior end of the head is dark brown. The sole is colorless. Silvery white stipples forming blotches of varied extent and broad rings around the appendages occur as in many Eolidacea (see plates of Pruvot-Fol, 1951, 1953). All pigments except the black in the liver cells have faded out in the preserved slugs.

The head is widened laterally (fig. 81, c), with slender tentacles (a) 1.5 mm. long and smooth, slightly longer, rhinophores, behind the bases of which lie the black eyes. The foot projects along the body sides. The slender fusiform cerata, up to 2.5 mm. long, have cnidosacs 0.2 to 0.3 mm. in length. On disturbance, the cerata bristle and are directed forward as described by Macnae (1954, p. 19). The right liver and the left anterior liver branch form arches on each limb of which the cerata stand in one row in young specimens. In the larger slugs one or two small cerata (e) appear on the angle between the two rows and connect them to form a horseshoe. There are 12 cerata in this first horseshoe; behind this there are seven groups on each side of the posterior left liver, disposed in slanting rows, with a maximum of five in each group, diminishing in numbers to the tail.

The genital openings occur in front of the first horseshoe of cerata. The heart (fig. 81, g) lies in the anterior body third, the anus (i) behind it in the interhepatic space, and the renal pore (h) is situated in front of the anus.

The strong, light yellow jaws (fig. 82) bear a single row of about 30 pointed teeth on their masticatory process. The radula has up to 33 teeth that increase in size from 35μ at the end of the lower limb to 65μ at the end of the upper, which is slightly longer than the lower limb. The strong median cusp (fig. 83) is flanked by six to seven slender, lateral denticles of varied length, of which the longest equal the median cusp in length.

The follicles of the ovotestis (fig. 84, z) are separate, composed of numerous small female acini around a few central, larger, male ones. The ductules of the follicles unite to form the hermaphroditic duct (y) which widens into a large ampulla (m), about 0.3 mm. long, 0.25 mm. broad, and 0.2 mm. high. Immediately after leaving the ampulla the spermoviduct bifurcates. The male duct at once widens into the glandular prostate, 0.4 to 0.5 mm. long and 0.12 mm. in diameter, lined by a ciliated epithelium of tall cells 50μ to 60μ in height, containing fine granules of red secretion and having nuclei 20μ in



FIGS. 84–87. *Catriona perca*. 84. Diagram of reproductive organs. 85. Longitudinal section of penis. 86. Egg mass. 87. Veliger. *Abbreviations:* k, male duct; m, ampulla; n, nidamental opening; o, oviduct; p, penial stylet; q, accessory male gland; r, penial pouch; s, penial sheath; t, spermatheca; u, male atrium; v, vagina; w, female gland mass; x, glandular part of male duct; y, hemaphroditic duct; z, ovotestis.

FIGS. 88–92. *Facelina coenda*. 88. Living slug with retracted cerata. 89. Another specimen with extended cerata. 90. Jaw. 91. Radular tooth. 92. Copulatory organs in the opened atrium. *Abbreviations:* a, stalked male accessory gland; b, glandular fold of atrium; c, stalk of male accessory gland; d, male duct; g, genital aperture; i, penial spines; m, muscle between accessory gland and stalk; p, male copulatory organ; s, genital atrium; v, oviduct; w, body wall.

diameter. Following the prostate the male duct narrows suddenly in two steps and after the second constriction becomes a slender, muscular, non-secretory duct (k), ciliated, however. This enters the penial papilla and therein opens by a short, curved, cuticular stylet (p). Before opening into the stylet, the male duct receives the duct of a penial gland (q), 0.6 mm. long, 0.18 mm. in diameter, and lined by epithelial cells 30μ high with nuclei 20μ long in their longer axis. The lining cells contain a granular, eosinophilous secretion. The penial papilla is about 0.17 mm. long, the stylet 76μ; a narrow folded sheath surrounds the insertion of the stylet (s). A longitudinal section of the penis is shown in figure 85, in which there is seen the ciliated papilla in the penial pouch (r), lined by a smooth, flat epithelium. Distal to the papilla the male atrium is lined by a tall, folded, ciliated epithelium.

The short oviduct (fig. 84, o) enters the folded female gland mass (w) from which the nidamental duct, also folded, proceeds distally, opening (n) into the posterior part of a common cavity that also receives the narrow vagina (v) and the male orifice (u). The vagina leads internally into a small spherical spermatheca (t), lying to the right and dorsal to the genital pores, ventral to the liver, and containing an irregular mass of sperm.

The egg mass (fig. 86) is a reniform sac containing about 100 eggs and fastened to the substrate by a mucous stalk. It resembles the egg sac of *Embletonia pallida* (Rasmussen, 1944, fig. 15) but differs from figures of egg sacs of other species of *Catriona* (Löyning, 1922, figs. 38, 43). Individuals only 5 mm. long were seen already laying eggs.

The veliger (fig. 87) of *Catriona perca* hatches after about eight days at a temperature of 23° to 25° C. Its shell is intermediate between that of Thorson's type B (1946, p. 268), represented by *Polycera quadrilineata* (Vestergaard and Thorson, 1938, fig. 2) and *Favorinus branchialis* (Rasmussen, 1951, fig. 27), and that of type C (Thorson, 1946, p. 268), which occurs, among others, in *Catriona coerulea* and *foliata* (Thorson, 1946, p. 269), *Eubranchus pallidus* (Vestergaard and Thorson, 1938, fig. 4), and *Tenellia*, studied by Vannucci and Hosoe (1953, figs. 2, 3).

OCCURRENCE: A total of 22 slugs was collected in February, 1953, in lagoons at Cananéia, by Miss Kaoru Hosoe (Mrs. Moriguchi).

DISCUSSION OF *Catriona perca*

The following list is intended to separate the present species from those formerly assigned to *Cratena* and *Amphorina*. It is not limited

to species really belonging to *Catriona* but also includes some species of *Cuthona* and other genera. The list contains species with produced anterior foot corners. These do not conform to Winckworth's definition of *Catriona*. Also Risbec's species of *Cratena* with a long middle cusp of the radula cannot be transferred to *Catriona*. The descriptions of the Indo-West Pacific *Cuthona annandalei* Eliot (1910b) and of *Cratena rubra* Volodchenko (1941) were not available for comparison, but identity of either species with *Catriona perca* is improbable.

alberti (*non* Quatrefages, 1844) Trinchese, Vayssière, Bergh, Eliot. The species *Amphorina alberti* of Quatrefages is *Eubranchus tricolor* Forbes, 1838, that of Trinchese *et alii* is *Catriona foliata* (Forbes and Goodsir, 1839) or perhaps in part *C. genovae* O'Donoghue, 1926. Bergh's material of the "Ingolf" expedition (1900, pp. 41–42) is *C. foliata* (Lemche, 1929, p. 19).

amoena (Alder and Hancock, 1845) belongs to *Cuthona* (White, 1938, p. 17).

angulata (Alder and Hancock, 1844) is mentioned by Hoffmann (1926, p. 17) and Jaeckel (1952, list) as belonging to *Cratena* but falls under, perhaps as a variety (White, 1938), *Aeolidiella* (or *Eolidina*) *glauca* (Alder and Hancock, 1845). Pruvot-Fol (1951, 1954) calls the latter *rubra* (Cantraine) and questions (1954, pp. 429, 446) the systematic position of *angulata*, because its radula is not known. However, Eliot (1906b, p. 357) found the radula agreeing with that of *glauca*.

anulata (Baba, 1949, pp. 98, 175) has three to four rows of cerata on the right liver and a series of annular constrictions on the rhinophores.

arenicola (Forbes, MS; Alder and Hancock, 1846) is a color variety of *Cratena viridis* (Forbes, 1840) according to White (1938, p. 15).

aurantia (Alder and Hancock, 1842) is the type species of *Catriona* Winckworth, 1941. The right liver bears four rows of cerata (Odhner, 1939, p. 70). The variety *pallida* (Loman, 1893) is no longer considered distinct from *Catriona aurantia* (Engel, 1936, p. 108).

bicolor (Bergh, 1904, p. 3) was described as a *Cuthona*, but the radula is consistent with that of *Catriona*. Baba, who found it again (1937, 1949), allocated it to *Catriona* in 1955, although the foot corners are angulated.

bylgia (Bergh, 1870, p. 4) has two rows of cerata on the right liver as in *Catriona perca*, but its jaws differ, resembling those of *Facalana*.

capensis Barnard (1927, p. 204) is cleioproct and belongs to *Cratena* Bergh, 1864, as defined by the type species, *C. peregrina* (Gmelin) (Macnae, 1954).

cavanca (Bergh, 1898, p. 545) has transverse rows of cerata indistinctly separated and apparently an unarmed penis.

cingulata (Alder and Hancock, 1846) belongs to *Eubranchus* (Eliot, 1910a, p. 170, assigns it to *Galvina*).

coerulea (Montagu, 1804) has four rows of cerata on the right liver (Bergh, 1883, p. 58; Marcus, 1955, p. 173).

columbiana (O'Donoghue, 1922, p. 160) has 65 to 69 teeth in the radula; teeth with one median cusp, two lateral spines on each side, and tiny spicules between.

concinna (Alder and Hancock, 1843) with unarmed penis (Eliot, 1906b, p. 366, note) belongs to *Cuthona* (White, 1938, p. 18).

cornuta (Risbec, 1928, 1953) has produced foot angles and unarmed penis.

cucullata (Bergh, 1905b, p. 230) resembles *perca* in having two rows of cerata on the right liver but differs in the black rings around tentacles and rhinophores.

diffusa (Risbec, 1928, 1953) with produced foot corners has a penis stylet (Risbec, 1953, p. 134) as in the type of *Catriona* (Odhner, 1939, p. 74).

exigua (Thiele, 1912, p. 251) was described as a *Cratena* but is possibly identical with *Cuthona georgiana* Pfeffer (Odhner, 1926, p. 27; but Odhner later, 1944, p. 22, thought it "cannot be classified generically").

exigua (Risbec, 1928, 1953), with three lateral denticles on each side of the radular cusp and black rings around the middle of the rhinophores, must be renamed as it is homonymous with Thiele's species.

foliata (Forbes and Goodsir, 1839) has four rows of cerata on the right liver (Odhner, 1939, p. 75).

fructuosa (Bergh, 1892a, p. 4) has 61 radular teeth, cerata disposed in two arches in front of the anus, one postanal arch, behind this a series of seven to eight cerata, and an unarmed penis.

genovae (O'Donoghue, 1926, 1929, p. 744) has up to 70 radular teeth; see also *alberti* Trinchese and others (above).

glotensis (Alder and Hancock, 1846) with foot angles slightly produced (Alder and Hancock, 1854) and 54 radular teeth, with five lateral denticles on each side of the cusp (Alder and Hancock, 1845–1855, pt. 7, text to pl. 47, supplement) is possibly a color variety of *coerulea* according to Pruvot-Fol (1951, p. 65; 1954, pp. 381, 385).

gouldii (Verrill, 1873, p. 667) has slightly prominent anterior foot angles and moderately stout cerata.

grisea (Risbec, 1928, 1953) has broad round jaws.

gymnota (Gould, 1870, p. 249), with short cerata slightly enlarged towards the tip and five rows of cerata on the right liver (Bergh, 1886, p. 31), is closely related to *concinna* (Bergh, 1892b, p. 1023).

henrici (Eliot, 1916, p. 377) has rather thick cerata, dark olive green, with variable black markings at their bases; they are disposed in four groups.

hirsuta (Bergh, 1861) has five rows of cerata on the right liver (Bergh, 1864, p. 77).

hystrix (Alder and Hancock, 1842), not *histrix* (Otto, 1823; Pruvot-Fol, 1954, p. 441), was the original name of *cingulata* (Alder and Hancock, 1846).

leopardina (Vayssière, 1888b), with a radula as in *genovae*, is considered a variety of *alberti* by Trinchese and others but regarded as a distinct species by Pruvot-Fol (1954, p. 383).

longibursa (Bergh, 1870, p. 8) is provided with cnidosacs along one-third to one-half of the length of the cerata.

longicauda (Heincke, 1897) has olive cerata, with yellowish tips and a much lengthened posterior end (Eliot, 1910, p. 173; Hoffmann, 1926, p. 17; Jaeckel, 1952, list).

lugubris (Bergh, 1870, p. 9) lacks cnidosacs and has five rows of cerata on the right liver.

molios (Herdman, 1881), with four rows of cerata on the right liver (Bergh, 1886, p. 38), is possibly a synonym of *coerulea* (Eliot, 1906b, p. 364, note; 1910, p. 172).

nigricolora (Baba, 1955, pp. 29, 52) has four rows of cerata on the right liver.

obtusalis (Alder and Hancock, 1842) is indicated by Jaeckel (1952) as a synonym of *"Cratena" angulata* but actually is a synonym of *Aeolidia papillosa* (Linnaeus, 1767).

olivacea (Alder and Hancock, 1842) is a synonym of *Catriona foliata* (Forbes and Goodsir, 1939) (Odhner, 1939, p. 70).

olrikki (Mörch, 1857), with a radula of 69 teeth, is probably identical with *stipata* (Alder and Hancock) (Lemche, 1941, p. 29).

ornata (Baba, 1937, p. 331) has angulated foot corners, 35 to 50 radular teeth (Baba, 1955, pp. 27, 51), and three rows of cerata on the right liver.

pallida (Eliot, 1906a, p. 155) has its cerata in four rows of two each, a radula with 80 teeth and three denticles on each side of the cusp; the absence of a stylet is uncertain.

peachii (Alder and Hancock, 1848) has been considered to belong to *Cuthona* (Eliot, 1906b, p. 365; White, 1938, p. 18) but was made the type of *Precuthona* by Odhner (1929, p. 16; 1939, p. 70).

pilata (Gould, 1870) has stout clavate cerata, suddenly contracted near the tip, triangular foot angles, one single row and two fused rows of cerata on the right liver (Bergh, 1886, p. 30), and unarmed penis (*ibid.*, pl. 7, fig. 13).

pinnifera (Baba, 1949, pp. 99, 175) has three rows of cerata on the right liver and five to eight semicircular pinnae on the rhinophores.

puellula (Baba, 1955, pp. 28, 52) has four rows of cerata on the right liver and 55 radular teeth.

pumilio (Bergh, 1871a, p. 1281) is characterized by the arrangement of the cerata in 16 to 20 rows of three to four short cerata each and the location of the anus under the seventh to eighth row from the rear.

pusilla (Bergh, 1898, p. 547) has the anus in the posterior body half and an unarmed penis.

pustulata (Alder and Hancock, 1855) belongs to *Cuthona* (radula in Odhner, 1929, fig. 18b); penis unarmed (Odhner, 1939, p. 72).

sibogae (Bergh, 1905b, p. 231) is considered by Macnae (1954, p. 9) as a *Catriona*, but the equality of length of foot angles and tentacles and the unarmed penis are incompatible with this genus.

speciosa Macnae (1954, p. 4), similar to *coerulea*, has three rows of cerata on the right liver and 35 radular teeth with four denticles on each side of the median cusp.

stipata (Alder and Hancock, 1843) has 69 radular teeth with five denticles on each side of the median cusp (see also *olrikki*).

tina Marcus (1957) has one row of cerata on the right liver and 49 radular teeth in specimens with four to five series of cerata.

valentini (Eliot, 1907, p. 352), with armed penis, differs from *Catriona perca* in having five to six groups of cerata on each side, each consisting of one large ceras and one very small one.

venusta (Baba, 1949, pp. 98, 174) has three rows of cerata on the right liver, 55 to 60 teeth in the radula, and location of genital orifice just below the second series of cerata.

vermifera (Verrill, 1873, p. 666) is distinguished by the wrinkled rhinophores and produced, triangular, foot angles.

veronicae (Verrill, 1881, p. 389) is 25 mm. long, with slightly wrinkled rhinophores and rather stout, obtuse cerata in 12 to 15 rows, with an anterior group in front of the rhinophores.

viridis (Forbes, 1840) has four to five rows of cerata on the right liver (Odhner, 1939, p. 70) and somewhat produced foot angles (Löyning, 1927, p. 253).

yatsui (Baba, 1930; 1937, p. 328) later became the type of *Herviella* Baba (1949, pp. 107, 180) which belongs to the cleioproct family Favorinidae, subfamily Favorininae.

TRIBE CLEIOPROCTA

FAMILY FACELINIDAE

To facilitate further subdivisions, it is advisable to raise Odhner's (1939, p. 77) subfamilies Facelininae and Rizzoliinae to the rank of families. Both are cleioprocts with cuspidate, not pectinate, radular teeth. As *Rizzolia* Trinchese, 1877, had been introduced with the same type species, *Doris peregrina* Gmelin, 1791, as *Cratena* Bergh, 1864, it is invalid.

Besides *Facelina* Alder and Hancock, 1855, the genera *Acanthopsole* Trinchese, 1874, *Moridilla* Bergh, 1889, and *Learchis* Bergh, 1896, were correctly assigned to the Facelinidae (Macnae, 1954, p. 7). Also *Phidiana* Gray, 1850, *Phestilla* Bergh, 1874c, *Hermissenda* Bergh, 1879, *Caloria* Trinchese, 1888, *Facelinella* Baba, 1949, *Rolandia* Pruvot-Fol, 1951, and *Facelinopsis* Pruvot-Fol, 1954, are Facelinidae. Macnae (1954, p. 11, note) considers the two last genera to be subgenera of *Facelina*. Contrary to Macnae's opinion (1954, pp. 9, 25) *Rizzolia australis* Bergh (1884, p. 27) and *Hervia rosea* Bergh (1889, p. 677; 1890, p. 877) must be transferred to the Facelinidae. Barnard (1927, p. 203) thought his *Hervia quadricolor* might be identical with *Rizzolia australis*, but as the penis of the former bears a spine and that of the latter is unarmed, the two species are certainly not conspecific; further the Australian species belongs to the Facelinidae, the other to the Favorinidae. The ramifications of the right liver of *Hervia rosea* are so distinctly described that it, too, can be recognized as a facelinid. Its smooth rhinophores and, more importantly, its jaw, the upper border of which was folded in Bergh's specimen, suggest proximity of *H. rosea* to the genus *Caloria*. Evidently also *Hervia dangeri* (Risbec, 1928, p. 252; 1953, p. 136) belongs to the Facelinidae.

Facelina coenda, new species

Figures 88–96

The largest specimen was 25 mm. long in life, 15 mm. preserved.

The following measurements obtain for a living specimen 15 mm. long: tentacles, 6 mm.; rhinophores, 3 mm.; foot angles, 2 mm.; and cereta, up to 6 mm. The animals are white or light orange, with pink lips, yellow rhinophores, and brown liver branches in the white-tipped cerata. Behind the black eyes the winding esophagus shows red through the skin. Nervous system and inner organs are colorless. The pointed tail (fig. 88) is 2 mm. long in the preserved state. At the pericardial eminence a height of 3 mm. is attained. The width is 2.5 mm., of which 1 mm. pertains to the flat, folded border of the foot. The distance between the innermost cerata is broader than each pad bearing a group of cerata. The cnidosacs are over 1 mm. in length.

The right liver group of cerata consists of six rows, with two, three, four, five, five, and six cerata (figs. 88, 89); replacing buds occur between their bases. The left anterior group comprises six series, with two, three, four, four, six, and six cerata. The posterior liver bears seven pairs of right and left groups on pads. The first group has five rows on both sides, with two, three, four, five, and seven cerata on the right, two, three, five, four, and six on the left; the second group with three rows on each side has three, four, and seven cerata on the right, two, four, and five on the left; the third group with two rows on each side has six and six cerata on the right, four and four on the left; the fourth group with two rows has five and four cerata on the right, four and four on the left; and the fifth to seventh rows have five, three, and two cerata each on the right, three, three, and two on the left. It will be perceived that there are always more cerata on the right than on the left side. The largest specimen has 154 cerata, the smallest 60, and one of medium size has 177. In living animals the cerata may be blunt, thick, and curved as in figure 88, or long, thin, pointed, and nearly straight as in figure 89, and in preserved specimens generally.

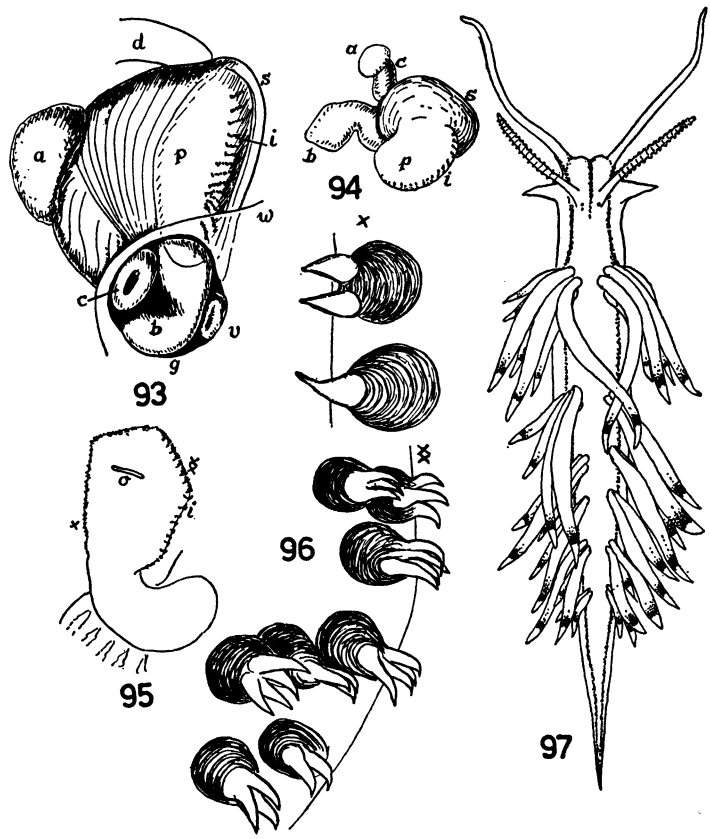
The tentacles (figs. 88, 89) are smooth and pointed, somewhat wrinkled in the preserved state, and stand on the sides of the mouth. The rhinophores are encircled completely or in part with 14 to about 21 irregular, broad perfoliations and terminate in a knob.

The mandibles (fig. 90) are light, thin, and somewhat thickened anteriorly with a convex, not emarginate, upper border, and weak masticatory process bearing a row of denticles. The radula consists of 17 teeth and one quite young thin tooth. The anterior border of the teeth forms an angle of about 80 degrees. The median cusp is slightly longer than the lateral denticles, of which there are five to eight, most often six to seven, on each side (fig. 91).

Immediately behind the nerve ring, the esophagus dilates into a

stomach that passes gradually into the intestine, running to the right and dorsally and bearing a dorsal fold. The alimentary tract is filled with cuticular parts and incompletely digested tissues of hydroids. Between the fourth and fifth row of the first group of posterior liver cerata the gut opens on a high papilla. The nephroproct is located anterior to this group of cerata, and medially in front of this pore the reno-pericardial duct may be seen through the skin.

The ovotestis lies under the posterior liver, and the ampulla winds on the posteroventral part of the genital mass. Alongside the proximal



FIGS. 93–96. *Facelina coenda*. 93. Copulatory organs partly everted, cleared. 94. Fully everted male organs. 95. Penial leaf unfolded. 96. Penial spines from the places marked x, xx, on figure 95. *Abbreviations:* a, stalked male accessory gland; b, glandular fold of atrium; c, stalk of male accessory gland; d, male duct; g, genital opening; i, penial spines; o, opening of male duct; p, male copulatory organ; s, genital atrium; v, oviduct; w, body wall.

FIG. 97. *Dondice occidentalis*, dorsal view of living slug.

end of the ampulla the spermatheca is embedded in the gland mass as in *Facolina auriculata* (Odhner, 1939, fig. 46). The oviduct (figs. 92, 93, v) runs from the ampulla through the gland mass and opens into the most distal part of the genital atrium (figs. 92, s). The genital aperture (g) lies centrally under the group of cerata belonging to the right liver.

The soft, thick, and sinuous male duct (figs. 92, 93, d) enters the copulatory organ from the dorsal side. The penis is enclosed in the ample atrium (fig. 92) of which the inner surface is folded on the external side, smooth on the internal side. When the atrium is cut open from the anterior side, the penis appears rolled up in such a manner as to expose its border provided with groups of spines (fig. 92, i). The unrolled male organ (fig. 95) comprises a strong, transversely folded shaft and a leaf that inserts obliquely, not terminally, on the shaft. The male duct opens on the leaf by an eccentric slit (fig. 95, o). The leaf border is provided with irregular groups of small conical eminences of which the thin cuticle is prolonged into one to four brown spines (fig. 96). These groups form more or less distinct transverse rows on the border of the penial leaf.

The outer atrial wall contains a glandular fold (figs. 92, 93, b) opposite the entrance of the oviduct (v). When the genital opening is dilated and the atrial organs everted, this glandular fold is protruded as a broad tongue (fig. 93, b). Proximal to it there occurs a hollow, mulberry-like gland (figs. 92, 93, a) mounted on a hollow muscular stalk (c). A free muscular strand (fig. 92, m) runs from the gland to the stalk. The aspect of the completely everted male organs is given in figure 94; the mulberry gland (a) and the male atrium (s) are evaginated, the penis (p) and the glandular fold (b) project.

OCCURRENCE: Three specimens were taken among algae in the upper littoral near Ubatuba in September, 1956; 13 animals were obtained at Ilhabella in October, 1956; and six specimens taken at Cananéia were kindly presented by Miss Liliana Forneris.

DISCUSSION OF *Facelina coenda* AND THE FACELINIDAE

We have thoroughly pondered the possibility of applying to our species one of the two following names: (1) *Facelina drummondi* (Thompson). This has a pink esophagus and lips (Trinchese, 1882, pp. 41–42; Pruvot-Fol, 1954, p. 388), but such color also occurs in *F. annulata* and other species of the genus. More important is the presence of two or three spines on one or the other of the marginal sockets of the penial leaf in *drummondi* (Bergh, 1877b, pl. 11, figs. 10, 11) or the

occurrence of spines on the surface of this leaf (Bergh, 1875, p. 407; *janii*). (2) *Facelina bostoniensis* (Couthouy) with penial spines mostly in two rows, occasionally in one or three rows (Bergh, 1886, p. 44).

However, comparison of our figure 95 with Bergh's and Trinchese's drawings convinced us that, at least provisionally, a separate name for our material would be less troublesome for future workers than an insufficiently founded identification with species from very distant coasts. It should be recalled that *F. bostoniensis* from Jamaica (Haas, 1920, p. 142) is identical with the favorinid *Dondice occidentalis* (Engel, 1925, p. 40).

The genus *Acanthopsole* can hardly be maintained. Smooth, nodose, ringed, and perfoliated rhinophores are sometimes specific but not generic characters in the Facelinidae (Trinchese, 1882, p. 34; Bergh, 1886, p. 41; Löyning, 1922, p. 54; Odhner, 1939, p. 79). A peculiar "acanthopsole type" of penial armature (Macnae, 1954, p. 15) cannot be defined (Bergh, 1883, p. 27, note; 1886, p. 41; Pruvot-Fol, 1954, p. 387, note). For the liver branches I refer to *rubrovittata, vicina,* and *albida* in the following lists.

As Bergh (1875, p. 407, note 1) and Pruvot-Fol (1953, p. 58) have stressed, the details of the penial leaf are important in *Facelina.* The shape and disposition of the spines seem to be specific, further possibly also the location of the male opening, whether on the margin of the penial leaf (e.g., *coronata,* Bergh, 1878b; *quatrefagesi* and *rubrovittata,* Vayssière, 1888b) or on the under side proximal to the margin (e.g., *drummondi,* Bergh, 1877b; Trinchese, 1882; *bostoniensis,* Bergh, 1886). Whether the modern unions of differently named species will be maintained when these characters are studied in different aspects must be decided by future research.

The armature of the male organ in *Phidiana* (Engel, 1925, pp. 55–72; Marcus, 1955, pp. 178–181) differs widely from that in *Facelina.*

The following is an alphabetical list of *Facelina* species with armed male organ:

annulata Macnae (1954, p. 14) has eight incomplete rings on the rhinophores.

auriculata (O. F. Müller, 1806) is, according to Odhner (1939, pp. 79–80), the oldest species referable to *Facelina.*

bostoniensis (Couthouy, 1839); Gould (1870, p. 231); Bergh (1886, p. 44).

bourailli (Risbec, 1928, p. 254; 1953, p. 147) has four rhinophoral rings.

coronata (Forbes and Goodsir, 1839) is the type of *Facelina* Alder and Hancock, 1845–1855, pt. 7, appendix p. xxii; see also Trinchese (1882, p. 42), Vayssière (1888b, p. 42). According to O'Donoghue (1929, p. 746) and White (1938, pp. 15, 18), *coronata* is a synonym of *longicornis* (Montagu,

1808) and both are synonyms of *auriculata* (O. F. Müller, 1806), according to Odhner (1939, p. 80).

curta (Alder and Hancock, 1843) is considered by O'Donoghue (1929, p. 745) the valid name of *rufibranchialis* and *drummondi* (Thompson, 1844).

drummondi (Thompson, 1844) is referred to by Trinchese (1882, p. 41; Löyning, 1922, p. 52; Pruvot-Fol, 1953, p. 57; 1954, p. 388) and is considered by Odhner (1939, p. 79) a synonym of *auriculata*.

dubia Pruvot-Fol (1948b, p. 99; 1954, p. 391) has nodulous rhinophores.

fragilis (Risbec, 1928, p. 257; 1953, p. 151) has smooth rhinophores, or very fine perfoliations are present.

gigas (Costa, 1866; see also Bergh, 1877b, p. 753), is a synonym of *drummondi* (Bergh, 1891, p. 38).

janii (Verany, 1846; see also Bergh, 1875, p. 404) is a synonym of *drummondi* (Bergh, 1891, p. 38) but has spines also on the penial leaf as well as along the margin.

lineata Eliot (1904, p. 288) has jet-black rhinophores.

longicornis (Montagu, 1808) is a synonym of *auriculata*, according to Odhner (1939, p. 80).

lugubris (Bergh, 1883, p. 34) is considered by Pruvot-Fol (1954, p. 393) who correctly gives the author as Bergh.

moesta Bergh (1886, p. 46) has tentacles and rhinophores of equal length (Pruvot-Fol, 1954, p. 394), is a synonym of *lugubris* according to Bergh (1891, p. 38).

olivacea Macnae (1954, p. 11) has a broadly arched radular tooth, with the middle cusp twice as long as the lateral denticles.

panizzae (Verany, 1846; see also Bergh, 1875, p. 407) is a juvenile stage of *drummondi* in the opinion of Bergh (1891, p. 38).

quatrefagesi (Vayssière, 1888b, p. 42). The deeply emarginate posterior border of the jaw (*ibid.*, pl. 7, fig. 140) makes it impossible to unite this species with *drummondi* (Bergh, 1891, p. 38) or *curta* (O'Donoghue, 1929, p. 745); hence it must be maintained as a separate species (Pruvot-Fol, 1954, p. 390).

rubrovittata (A. Costa, 1866) is the type of *Acanthopsole* Trinchese, 1874; see also Vayssière (1888b, p. 33). According to Macnae (1954, p. 7) the three-branched right and simple or crescentic posterior liver groups justify generic separation from *Facelina*. According to Pruvot-Fol (1951, p. 56; 1954, p. 392) *Hervia berghii* (Vayssière, 1888a, p. 128; 1888b, p. 52; 1928) is a juvenile stage of *rubrovittata*.

rutila Pruvot-Fol (1951, p. 57; 1954, p. 390) has angulate, not tentaculiform, foot angles.

vicina (Bergh, 1883, p. 29) is, according to this author (Bergh, 1891, p. 38), a synonym of *rubrovittata*, but the liver branches differ.

The following is a chronological list of Facelinidae with unarmed copulatory organ:

Eolis punctata Alder and Hancock, 1845 (see also Vayssière, 1888b, p. 45; 1928–1934; Pruvot-Fol, 1954, p. 388), with well-defined specific characters,

should perhaps be removed from *Facelina*, where it had been placed by Trinchese (1882, p. 32).

Hermissenda Bergh, 1879, should be maintained as a separate genus because of the serrulate median cusp of the radular tooth.

Caloria Trinchese, 1888 (see also Pruvot-Fol, 1951, p. 60; 1954, p. 396), may include *Hervia rosea* Bergh (see introduction to *Dondice*, below), *Caloria guenanti* (Risbec, 1928, p. 244; 1953, p. 155), and *Caloria australis* Risbec (1937, p. 162; 1953, p. 156), if the dorsal indentation of the jaw is considered as the decisive generic character, although Risbec's species do not have smooth rhinophores.

Facelinopsis marioni (Vayssière, 1888a, p. 126; 1888b, p. 49; Pruvot-Fol, 1951, p. 58; 1954, p. 394).

Moridilla Bergh (1889, p. 680; 1890, p. 878) is justifiably separated generically on the basis of the peculiar club of the rhinophore and the radular tooth, which has only two denticles.

Learchis Bergh (1896, p. 385) differs from *Caloria* by the evenly rounded, not emarginate, jaw. The male organ is cylindrical in *Caloria maculata*, conical in *Learchis indica*. Two further species may belong to *Learchis*, although their rhinophores are smooth: *Rizzolia australis* Bergh (1884, p. 27) and *Hervia dangeri* (Risbec, 1928, p. 252; 1953, p. 136).

Facelina faurei Barnard (1927, p. 205; Macnae, 1954, p. 15) has a male organ similar to that of *Rolandia dollfusae* Pruvot-Fol, 1953. As the mandible of *F. faurei* has not been described, I dare not allocate it to the genus *Rolandia*.

Rolandia Pruvot-Fol (1951, p. 58; 1954, p. 396) was allocated a second species by Pruvot-Fol (1953, p. 58).

The following is a chronological list of Facelinidae of which the male organ is undescribed or published in unavailable papers:

Eolis elegans Alder and Hancock [1855 (1845–1855), pt. 7, p. 49] has a slender, deeply arched, radular tooth, with a very strong central cusp (*op. cit.*, pt. 7, pl. 47, suppl. fig. 8). This species is ascribed to *Facelina* by White (1938, p. 15). The article of Fisher (1936) was not available.

Eolis conspersa Fischer, 1869, was ascribed to *Acanthopsole* by Vayssière (1913, p. 273); according to Pruvot-Fol (1954, p. 448) this is probably identical with *Spurilla neapolitana*.

Phestilla Bergh, 1874c, lacks tentacles (Hoffmann, 1932–1939, fig. 125C; Bergh, 1905b, pl. 20, figs. 4, 5) and cnidosacs. The radulae of the three known species differ greatly from one another (Hoffmann, 1932–1939, fig. 704E; Bergh, 1905b, pl. 20, fig. 7; Risbec, 1928, fig. 78, 3; 1953, fig. 93).

Acanthopsole albida Bergh (1883, p. 27) was later (Bergh, 1891, p. 38) made a synonym of *Facelina rubrovittata*, but the liver branching differs.

Facelina variegata Oliveira (1895; Nobre, 1938–1940, p. 73) is insufficiently characterized; it has reddish rhinophores and tentacles and fusiform, blackish gray cerata.

Facelina stearnsi Cockerell (1901; O'Donoghue, 1926, p. 230; 1927, p. 105) has 21 to 23 radular teeth, with the central cusp twice as long as the four (Cockerell) or five to six (O'Donoghue) denticles. A slug from Dunedin, New

Zealand, with a radula similar to that in Cockerell's material, had penial prominences or spines (Eliot, 1907, p. 331).

Facelina goslingii Verrill (1901, p. 34) is of uncertain generic position; the radular tooth has 10 to 20 denticles on each side of the median cusp.

Facelina agari Smallwood (1910, p. 141), with tuberculated rhinophores, is of dubious generic position.

Acanthopsole pselliotes Labbé (1923, p. 266; 1931, p. 450) has annulate rhinophores and the middle cusp of the radular tooth broadest at its middle and much broader than the four denticles to each side.

Acanthopsole schwobi Labbé (1923, p. 266; 1931, p. 450) is pinkish, with violet pericardial eminence, and the median cusp of the radular tooth is thicker and much longer than the seven lateral denticles.

Facelina hiltoni O'Donoghue (1927, p. 104) is characterized by the black pigment on the cerata and the fact that the 19 radular teeth have seven to eight lateral denticles, with six projections in the spaces between them.

Facelinella Baba (1949, pp. 108, 181) has two species of which *Hervia quadrilineata* Baba, 1930, is the type.

Further species of *Facelina* are regarded by Bergh (1891; 1892b) and Pruvot-Fol (1954) as dubious.

FAMILY FAVORINIDAE

Macnae (1954, p. 8) separated two genera with a single row of cerata on the liver branches, *Cratena* Bergh, 1864, and *Amanda* Macnae, 1954, from two others with more than one row, *Godiva* Macnae, 1954, and *Echinopsole* Macnae, 1954. This principle seems valid and justifies the separation of the family into two subfamilies, Favorininae and Facalaninae.

SUBFAMILY FAVORININAE

This subfamily comprises *Favorinus* Gray, 1850, *Cratena* Bergh, 1864, *Pteraeolidia* Bergh, 1876, *Herviella* Baba, 1949, *Amanda* Macnae, 1954, and *Nanuca*, based on a minute species from Pernambuco (Marcus, 1957).

Favorinus horridus Macnae (1954, p. 19), with multiserial cerata, must be removed to the Facalaninae and is further excluded from *Favorinus* by the smooth border of its masticatory process. *Favorinus* and its synonym *Matharena* Bergh (1875, p. 412) have several series of denticles on this process (*"margo masticatorius mandibulae seriebus denticulorum praeditus"*). This character was indicated by Bergh (1879, p. 568; 1883, p. 38), Trinchese (1882, p. 68), Löyning (1922, p. 80), Thiele (1931, p. 457), Hoffmann (1932–1939, p. 996), Odhner (1939, p. 53), and Pruvot-Fol (1954, p. 400).

Pteraeolidia, the type of which was described by Bergh (1870, pp. 18–30), also has several series of denticles on the masticatory process. It

differs from *Favorinus* by the high, prominent cushions on which the cerata are inserted. As such cushions are not developed in *Favorinus perfoliatus* Baba (1949, pp. 102, 177) or *F. mirabilis* Baba (1955, pp. 30, 53), these remain in *Favorinus* despite their perfoliated rhinophores. Probably the same applies to *Favorinus violaceus* (Risbec, 1928, p. 251; 1953, p. 145), of which, it is true, the position of the anus was not indicated. These rhinophoral differences cannot be utilized for generic distinctions in Facelinidae and Favorinidae as I show in my 1957 article.

On the other hand, *Hervia serrata* Baba (1949, pp. 105, 179), with small lateral denticles restricted to the median cusp of the radular tooth as in *Favorinus*, cannot be ascribed to this genus because it has but one row of denticles on the masticatory border. It must be assigned to *Cratena*, as already done by Macnae (1954, p. 9) and Baba (1955, p. 56).

The type species of *Ennoia*, *E. briareus* Bergh (1896, p. 393), has the first two rows of cerata approximated to each other, with two additional rows removed farther posteriorly. The anus lies between the second and third row, and this is evidently an acleioproctic condition. The second species doubtfully allocated to *Ennoia*, *E. longicirrha* Bergh 1905b, p. 234), is cleioproct, with the anus situated in the second hepatic arch. The right liver has one arch, and the cerata are uniserial on all liver branches. Therefore *E. longicirrha* belongs to the Favorininae and must be removed from *Ennoia*. Bergh stressed the smooth masticatory border in *briareus* and the denticulate one in *longicirrha*, but this character is much less important than the topography of the anus.

The two rings around the rhinophores of *Hervia affinis* Baba (1949, pp. 106, 179) are not decisive for its generic position. It can be assigned to *Cratena*, as was done by Baba (1955, p. 56), only if its penis is unarmed.

Macnae (1954, p. 32) approaches his *Amanda armata* to *Zatteria*, but the penis of *Zatteria browni* Eliot (1902, p. 62) is unarmed; further, neither this species nor *Dunga nodulosa* Eliot (1902, p. 63) can be recognized as acleioproct or cleioproct.

SUBFAMILY FACALANINAE

Facalana Bergh, 1888, *Godiva* Macnae, 1954, *Echinopsole* Macnae, 1954, and *Dondice*, new genus, all with produced foot corners, constitute the genera of this subfamily. The penis is armed with a terminal hook in *Godiva*, with a belt of tiny spines around the orifice of the

male duct in *Echinopsole*. The copulatory organs of *Facalana* and *Dondice* lack cuticular spines. *Facalana* has *Glaucus*-like, *Dondice* simple, mandibles. *Facalana pallida* Bergh (1888, p. 784) is the only species of the subfamily with true perfoliate rhinophores. *Dondice* comprises species with smooth and with annulated rhinophores.

Dondice is defined as a facalanine with simple jaws, unarmed penis, and produced foot corners. As the type species I designate *Caloria occidentalis* Engel (1925, p. 73). The other characters of *Dondice*, that is, position of the anus, form of the right liver, radula with one tooth, of which the median cusp is accompanied by more or less strong lateral denticles, and disposition of the cerata in more than one row, are indicated by the names of the suborder, section, family, and subfamily to which the genus belongs.

I place the following species in *Dondice:*

Facelina veranyana Bergh (1875, p. 401). Bergh (1881b, p. 156) and Pruvot-Fol (1954, p. 398) consider this species synonymous with *Cratena peregrina* (Gmelin), but in the latter the cerata occur in single rows, whereas they are mostly in double rows in the former.

Rizzolia modesta Bergh (1881b, p. 156). Eliot (1910a, p. 74) and Barnard (1927, p. 202) thought that *Rizzolia* Trinchese, 1877, and *Hervia* Bergh, *in* Mörch, 1871 (see also Bergh, 1875, p. 409) are congeneric, but the description of the type species of *Hervia, H. modesta* Bergh (1875, p. 410), enables its recognition as a *Facelina*. According to Odhner (*in* Macnae, 1954, pp. 8–9), Bergh's specimen is an abnormal individual of *Facelina drummondi* (Thompson). *Hervia* is a synonym of *Facelina, Rizzolia* of *Cratena. Hervia modesta* (*in* Mörch, 1871) is distinct from *Rizzolia modesta* Bergh (1881b). As long as *Rizzolia* was fused with *Hervia* (Eliot, Barnard), there were two species named *Hervia modesta*. Because of this Baba (1937, p. 329), on rediscovering *Rizzolia modesta*, renamed it *Hervia japonica*. As *Hervia* (=*Facelina*) and *Rizzolia* (=*Cratena*) are now recognized as widely separated genera, Baba's name *japonica* is unnecessary. The species is here transferred to *Dondice*, and its name then becomes *Dondice modesta* (Bergh, 1881b).

Hervia ceylonica Farran, 1905. Eliot (1913, p. 42) verified that the penis is unarmed. Baba found the species also in Japanese waters (1937, p. 329; 1949, pp. 104, 178; 1955, pl. 20, figs. 54–56).

Caloria occidentalis Engel (1925, p. 73). Pruvot-Fol (1951, p. 60) excluded this species from *Caloria* by reason of its annulated rhinophores, but this character has only specific value. The type species of *Caloria, C. maculata* Trinchese (1888, p. 291), belongs to the Facelinidae, *C. occidentalis* to the Favorinidae, hence must be removed from *Caloria*. Engel (1925, p. 73) recognized the differences between *maculata* and *occidentalis* as regards the disposition of the cerata and the location of the anus.

Favorinus horridus Macnae (1954, p. 19). As above mentioned, pluriserial cerata and the smooth masticatory border of the mandible exclude this species from *Favorinus*, although smooth masticatory borders and those

with a single row of denticles may occur in different species of the same genus. The *Favorinus*-like radula of *horridus* is a good specific character but cannot by itself decide the generic allocation. Baba (1955, p. 56) was induced to unite *horridus* with *serrata*, probably by reason of the similar shape of the radula, but the cerata of all liver branches are uniserial in *serrata* and arranged in double rows on most of the liver arches in *horridus*.

Two further Facalaninae may belong to *Dondice*, *Cuthona* (*Hervia*) *emurai* Baba (1937, p. 329) and *C.* (*H.*) *inconspicua* Baba (1938, p. 18), but, as the male copulatory organ of these species has not been described, their generic position remains uncertain.

Dondice occidentalis (Engel, 1925)

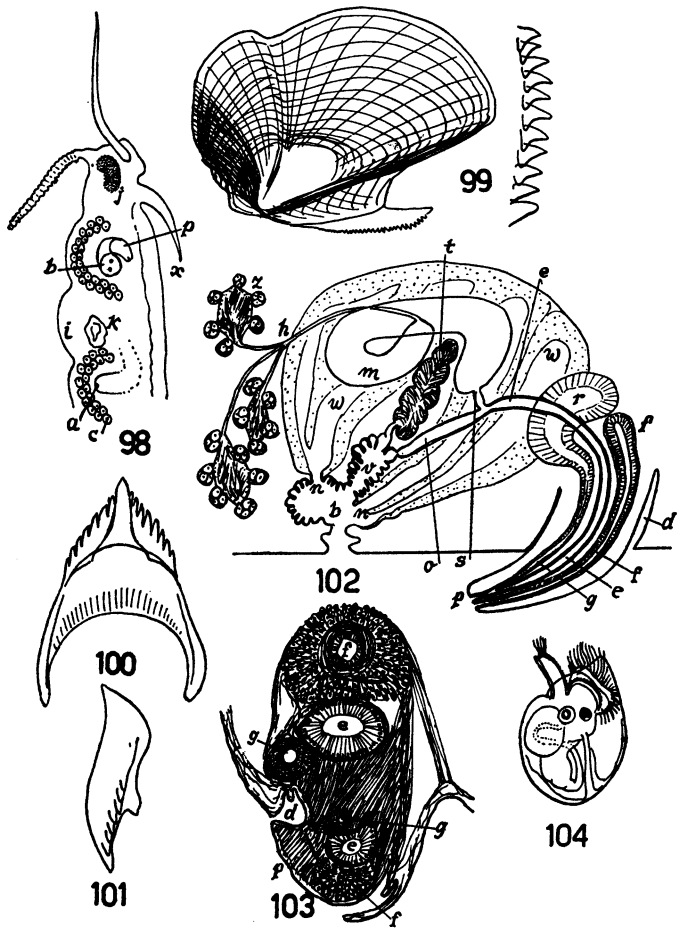
Figures 97–104

The living slugs are 20 to 30 mm. long, with tentacles 7 mm., rhinophores 4 mm., in length, pointed tail 8 mm. long, and cerata reaching a maximum length of 8 mm. Measurements of preserved slugs are: length, 20 mm.; height, 5 mm.; breadth, 3.5 mm.; tentacles, 5 mm.; rhinophores, 3 mm.; cerata, up to 5 mm.

The living animals were white, with red markings. There is a median red stripe along the head and a stripe along each side that extends from the tentacle base dorsally to the genital pores, ventrally to the cerata, and caudally to the tail tip. Under the cnidosacs, brilliantly white or pink, the cerata bear an orange-red ring. The ovotestis was pink in one preserved specimen. The light brown or reddish color of the liver is evidently derived from the food, a *Eudendrium* of the same color. The skin contains refractive white elements as in many other Eolidacea. Black pigment located in the epithelium covering the jaws (fig. 98, j) shines through the skin.

The tentacles are slender and pointed in both living and preserved specimens (fig. 97). The rhinophores are annulated with 15 to 18 rings that are but slightly evident in sections. In life the foot is notched and has a transversely grooved anterior border. Its lateral angles are prolonged into tentaculiform appendages (fig. 98, x) that are 2.5 mm. long in the preserved animal. The foot has prominent lateral borders, also in transverse sections. The cerata stand on low cushions in up to six groups on each side (fig. 97). The first three or four groups form horseshoes, the more posterior ones short transverse rows. Each group contains more than one row of cerata, except in the youngest specimens in which the cerata stand in single file. On the first arch of the largest preserved specimen there are 25 cerata, on the second 19, on the third 14, on the fourth nine, of which many were small and recently regenerated. Sites of lost cerata are marked by a liver duct and

afferent and efferent blood sinuses. The genital apertures (fig. 98, b, p) lie under the first arch of cerata; the anal opening (a) is located in the center of the second arch. The heart (i) occurs between the first and second groups; the renal pore, verified only in sections, is found to



FIGS. 98–104. *Dondice occidentalis*. 98. Lateral view of anterior end. 99. Jaw and denticulation of masticatory border. 100. Radular tooth. 101. Side view of radular tooth. 102. Diagram of reproductive organs. 103. Section of the curved penis. 104. Veliger. *Abbreviations:* a, anus; b, female atrium; c, bases of cerata; d, male atrium; e, male duct; f, prostate; g, duct of accessory penial gland; h, hermaphroditic duct; i, heart; j, jaw; k, cushion of cutaneous glands; m, ampulla; n, nidamental opening; o, oviduct; p, penial papilla; r, accessory penial gland; s, spermoviduct; t, spermatheca; v, vagina; w, female gland mass; x, angle of foot; z, ovotestis.

the right in the interhepatic space, near a cushion of blue-staining cutaneous gland cells (k).

The mandibles (fig. 99) are covered with an epithelium containing black pigment granules that leave the cell borders and nuclei free. When this epithelium is destroyed by potassium hydroxide, the jaws are revealed as strong, light yellow, convex objects with concave dorsal margin and elevated anterior part. The masticatory process, shown enlarged to the right in figure 99, bears about 40 stout pointed teeth, some of which are narrowed suddenly at the base, and hence present a second point directed forward. The radula has about 21 teeth, each with a large median cusp and five to nine smaller lateral denticles (figs. 100, 101), of which the more median ones may stand on the sides of the median cusp. The number of denticles is not correlated with size and age of the teeth. From the colorless base of the tooth a process stands out at right angles. In a radula of 16 teeth, the smallest first tooth was 87μ broad, the largest last, 146μ.

The cnidosacs are connected directly to the liver diverticula, without the intermediate gland that occurs in *Caloria maculata.*

The ovotestis (fig. 102, z) is composed of large male follicles that bear numerous small female acini. The hermaphroditic duct (h) expands to a long, sinuous ampulla (m) that continues as a short, narrowed spermoviduct (s); this immediately bifurcates into the male duct (e) and the oviduct (o). The male duct has a thick glandular epithelium and a coat of circular muscles. It constitutes the core of the long, muscular, penis papilla (p) that is keeled and has a spiral furrow. The papilla protrudes from a small male atrium (d) or is enclosed in it. Included in the penis papilla is a tubular prostatic gland (f) of which the epithelium, subtended by a thick muscular layer, stores the red secretion of the surrounding long glands (fig. 103, glands shown around f). The prostate opens independently of the male duct at the tip of the penis papilla. The duct (fig. 102, g) of an accessory penial gland (r) accompanies the male duct (e) and opens into it near the tip of the penis papilla. Proximally this gland (r) surrounds the base of the papilla with an ample vesicle, the secretory epithelium of which continues along the duct.

The oviduct (fig. 102, o) is a wide, muscular, and ciliated canal that opens into the vagina (v) alongside the spermatheca (t), a tubular sac in which the sperm lie fastened to the wall by their heads. The richly folded female gland mass (w) is connected to the female atrium (b) by several wide nidamental openings (n) that lie before and behind the vagina. The eggs must pass through the vaginal pouch and the

proximal part of the female atrium (b) to reach the female gland mass.

According to information furnished by Miss Kaoru Hosoe, the eggs are laid in a long ribbon. The larva (fig. 104) has a very bristly foot and a shell of the egg-shaped inflated type (Thorson, 1946, p. 268).

OCCURRENCE: Twelve specimens, collected on the hydroid *Eudendrium* at Cananéia below low-water line on February 7, 1955, and January 28, 1956, were kindly presented to us by Miss Kaoru Hosoe and Miss Liliana Forneris. The species is also known from Montego Bay, Jamaica (Engel, 1925, p. 73).

DISCUSSION OF *Dondice occidentalis*

The present material differs from the Jamaican specimens in some details. The black pigmented epithelium covering the jaws of our species is very striking, even in living slugs, but apparently is wanting in the Jamaican material as Engel does not mention it. Moreover the mandibles of our material are rather solid, not delicate and fragile as in the Jamaican material. The inferior border of the basal surface of the radular tooth is especially dark in Engel's material but not in ours. If these differences were expressed by a special subspecific name, one would risk a specific separation by a later author. To maintain the Brazilian specimens close to Engel's, I prefer to give them the same specific name without addition of subspecies, forma, or variety.

Other species of *Dondice* are clearly distinct from *occidentalis*. *Dondice modesta, ceylonica,* and *horrida* have smooth rhinophores; in *D. veranyana* only the right and the left anterior liver are horseshoe-shaped, and the radular tooth is a much broader arch than in *occidentalis;* the two species *emurai* and *inconspicua,* which possibly belong in *Dondice,* have over 50 cerata in the first group.

FAMILY AEOLIDIIDAE

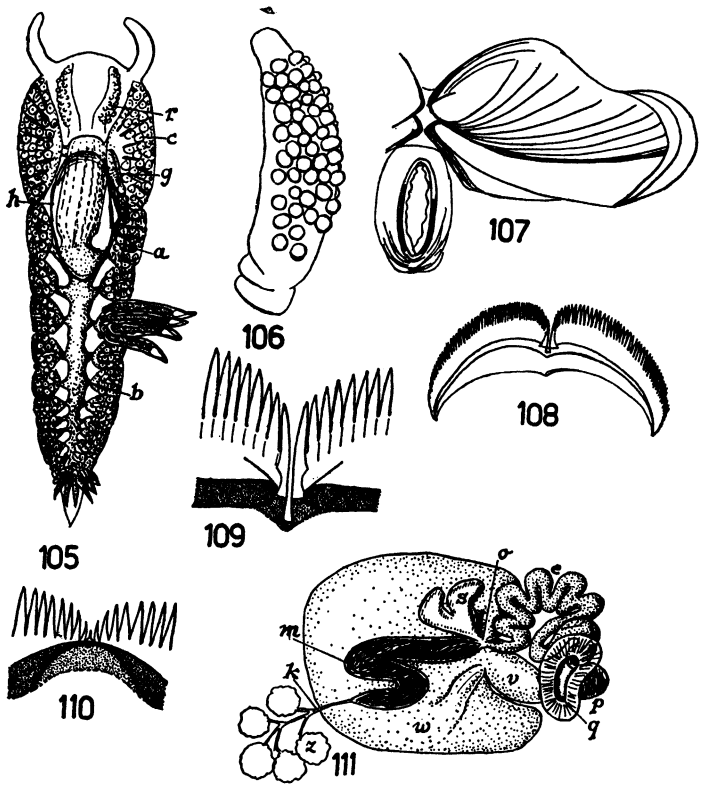
Baeolidia benteva, new species

Figures 105–111

The two available specimens are 15 and 12 mm. long, preserved. The larger one has the following dimensions: 4.5 mm. broad, 3 mm. high, tentacles 2 mm. long, rhinophores 1.5 mm. long, cerata up to 3 mm. in length, and tail 2 mm. long. The preserved animals are whitish gray, without color marks, and were not conspicuously colored in life. The foot has pointed anterior corners, is transversely grooved in front, without notch, and has a broad lateral brim, about 1.5 mm. wide on each side. The tentacles are smooth and thick, somewhat curved in preserved specimens (fig. 105). On their outer and posterior

sides the rhinophores (r) bear more or less uniform round papillae, irregularly disposed, except for the uppermost ones, which tend to occur in transverse rows. The other sides of the rhinophores are smooth.

The cerata are arranged in pectinate groups, with about eight rows of about seven cerata each on the right liver and the anterior left liver. Although the disposition of the cerata is rather irregular, in general the cerata are largest medially, decreasing in size marginally. There are 12 groups of cerata on each side of the body (fig. 105), and



FIGS. 105–111. *Baeolidia benteva.* 105. Diagram of liver branches. 106. Right rhinophore seen from behind. 107. Jaw and labial cuticle. 108. Eighteenth radular tooth. 109. Middle part of same. 110. Middle part of oldest tooth. 111. Diagram of reproductive organs. *Abbreviations:* a, anus; b, liver branch; c, insertions of cerata; e, male duct; g, intestine; h, heart; k, hermaphroditic duct; m, ampulla; o, oviduct; p, male atrium; q, genital aperture; r, rhinophore; s, spermatheca; v, vagina and nidamental duct; w, female gland mass; z, ovotestis.

the number of rows in these groups decreases posteriorly. The first group of the posterior liver has five rows; the second, third, and fourth groups have four each. Each row contains three to five cerata, but many are wanting or in regeneration.

The genital aperture (fig. 111, q), with a raised border, lies beneath the right liver group. The renal pore is located below the second row of the first posterior group, and the anus (fig. 105, a) lies behind the third and in front of the fourth row of the same group.

The posterior part of the oral tube receives the oral glands (glandulae ptyalinae of Bergh) just in front of the inner lips. These long and winding glands extend posteriorly beyond the pharyngeal bulb. Their proximal portion is thin and brownish; their middle and distal parts are thick and white. The labial cuticle (fig. 107) is smooth. The jaws (fig. 107) are brown in front, thin behind, concave on their dorsal border, with a short, smooth, masticatory edge lacking a process. The radula (figs. 108–110) consists of 19 teeth, of which the most posterior is still incomplete. The oldest tooth is 0.13 mm. broad, the youngest 0.51 mm. broad. The two oldest teeth have a minute median cusp, while the third and following ones are medianly notched. The longest lateral denticles occur near the notch, not immediately beside it, where they are slightly smaller; they then decrease in size from the longest denticle laterally.

The fusiform cerata each contain a liver diverticulum with a smooth or knobby surface. The cnidosacs vary in length from 0.5 to 0.8 mm. but are not correlated with the length of the cerata. The esophagus is wide. The intestine (fig. 105, g) leaves the stomach anterodorsally, surrounded by thick gastric folds. The anterior left and the right liver begin with one tube each. Each of the posterior groups has its own duct (b) that exits from the fundus of the stomach and then branches to supply the rows of cerata. The heart forms a conspicuous prominence (h).

The numerous follicles of the ovotestis (fig. 111, z) are disposed ventrally in approximately two rows that extend to the posterior end of the body. The hermaphroditic duct (k) formed by the union of ductules from the follicles enters the ampulla (m) on the posterior surface of the gland mass (w). The ampulla is a long, sinuous tube that gives origin to the male duct (e). This is coiled, thick-walled, and glandular, widening still further towards its distal end that opens into a muscular male atrium (p). The ampulla communicates further with the female gland mass (w) near the duct of the bilobed spermatheca (s). The voluminous gland mass (w) is connected with the genital

aperture (q) by a broad canal (v). This canal contains the vaginal and nidamental ducts, separated by folds, and gives rise to the spermathecal duct some distance from the genital opening.

OCCURRENCE: Two specimens were collected from the bottom of a boat near Ubatuba in July, 1956, by Drs. Edmundo Nonato and Claudio Froehlich.

DISCUSSION OF *Baeolidia benteva*

If the criterion, evenly curved and emarginate radular teeth, that distinguishes *Baeolidia* and *Berghia* in Bergh's synopses (1891; 1892b) be applied, then the present species would have to be classified under *Berghia.* Evenly curved and deeply incised teeth can furnish a generic character, as in *Aeolidia* and *Aeolidiella* (see Löyning, 1922, figs. 54, 61), but a small incision is not important, as our material of *Spurilla* shows (Marcus, 1955, pl. 30). Also the notch in the upper lamina of the anterior pedal border does not characterize *Baeolidia* sufficiently, as we have specimens of *Berghia coerulescens* with notch and without it. *Berghia* should be restricted to species with the right liver branch forming one arch or two rows (*fusiformis*) and the anus situated in the first group of the posterior liver. This excludes the type of *Baeolidia* which has at least three anterior rows, depending on the position of the genital aperture (Bergh, 1888, p. 779), with the anus located between the sixth and seventh rows (p. 778); as there are a total of 10 rows, the anus probably does not lie in the first group of the posterior liver.

Hence only the type species, *B. moebii* Bergh, 1888 (O'Donoghue, 1929, p. 796), can safely be maintained in *Baeolidia.* The second species, *B. major* Eliot (1903, p. 252), with its color variety *ornata* (p. 254), cannot be defined with regard to the composition of the right liver. The position of the anus behind the second group of cerata suggests that *major* really belongs to *Baeolidia,* and not to *Berghia,* but this is uncertain. The deep cleft in the upper "lip" of the pedal border distinguishes *major* from *benteva.*

Baeolidia amakusana Baba, first described as *B. major* (Baba, 1933, p. 178; Allan, 1947, p. 460), later as a subspecies, *B. major amakusana* (Baba, 1937, p. 335; 1955, pp. 32, 54), *B. japonica* Baba (1933, p. 282; 1937, p. 336; 1949, pp. 113, 184), and *B. fusiformis* Baba (1949, pp. 113, 184) should be transferred to *Berghia.* In *fusiformis* the cerata are rounded in section, in *amakusana* and *japonica* flattened as in *moebii* and *major.* The radular teeth are evenly curved in all three species, but sometimes slightly indented in the middle in *amakusana* and *japonica.*

A notch in the upper lip of the pedal border is mentioned for *amakusana*. The right liver (as opposed to *moebii* and *benteva*) and the position of the anus correspond to the above-mentioned characters of *Berghia* in all three of Baba's species.

According to Pruvot-Fol (1953, p. 53) *Baeolidia* occurs in the eastern Atlantic at Dakar. She indicates her species as *moebii*, but her drawing of the cerata makes this improbable; in any case her form differs from *benteva* by characters of the radula and the mandible.

Baeolidia moebii differs from *benteva* in the fewer rows of cerata, the flattened form of the cerata, the notch in the upper lip of the pedal border, the lack of indentation of the radular tooth, and the evenly convex border of the mandible.

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