OPISTHOBRANCHIA FROM NORTH CAROLINA

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During his study of the fauna of oyster beds at the Duke University Marine Laboratory at Beaufort, North Carolina, and on other occasions, Dr. Harry W. Wells of Duke University collected opisthobranchs which he sent to Mrs. Eveline du Bois-Reymond Marcus and me for classification, adding notes on their colors in life (The material has been returned to him). In addition, two samples came from Ocean City, Maryland. The scarcity of reports on opisthobranchs from E. Forbes' Carolinian province (Johnson, 1934: 8) accounts for the high proportion of zoogeographic and systematic novelties.

We are grateful to Dr. Wells for a linguistic revision of the manuscript and for proofreading.

1. *Hermaea dendritica* (Alder and Hancock, 1843)

Occurrence: Beaufort, N. C., 25. III. 1956; two specimens. Further distribution: Mediterranean; eastern Atlantic northward to southern Norway—Bergen; southern and middle Japan.

Odhner's reproduction of Lovén's figures (1907, pl. 3, figs. 28, 29) shows that *H. venosa* is *dendritica*, but *bifida* (Montagu, 1815) is the type species of *Hermaea* (Fischer, 1887: 542). If the absence (*bifida*) or presence (*dendritica*) of an albumen gland in the cerata were considered a generic or subgeneric character, *dendritica* would be removed from *Hermaea*. However Pruvot-Fol's assignment (1954: 186) of *dendritica* to *Placida* Trinchese, 1876 (whose type species [O'Donoghue, 1929: 740] has an albumen gland but unbranched liver diverticula in the cerata [Trinchese, 1879, pl. 15, fig. 1]) is hardly acceptable.

Dr. George M. Moore of Durham, N. H., in a typewritten list (10. III. 1956) which continues his report (1950) on nudibranchs of New England, reported the occurrence of *H. dendritica*. There are no earlier records from the American coast.

Hermaea cruciata Gould (1870: 253) is not identical with *dendritica*. *Hermaea coirala* Marcus (1955a: 108) from the coast of São Paulo may be *cruciata*, but this cannot be decided without *cruciata* from the typical locality —Naushon Island, Mass.

2. *Pleurobranchaea hedgpethi hamva* Marcus, 1955

Occurrence: Point of Cape Hatteras, N. C., 29. VIII. 1958; three specimens. Further distribution of subspecies: Coast of São Paulo, Brazil.

The present specimens were in life lighter colored than the first described ones (Marcus, 1955b: 21). The subspecies differs from *P. hedgpethi hedgpethi* Abbott, 1952, by its dorsally directed flap of the membrane around the genital aperture. In the dissected specimen of *hedgpethi hedgpethi* from the type locality (Port Aransas, Tex.), the spermatheca was much longer than broad. Another *hedgpethi hedgpethi* from Port Isabel Channel, Tex., had a globular spermatheca (Marcus, 1960c), as have the Brazilian and present slugs of *hedgpethi hamva*. Hence the form of the spermatheca varies according to its degree of filling. The slug from Port Isabel Channel (preserved, 45 mm.) had 36 rows with 56 teeth in each half-row of the radula; a Brazilian specimen (preserved, 33 mm.) had 38 and 60 as corresponding numbers; and the two present slugs (preserved, 35 and 32 mm.) have 38 and 33 rows with 70 and 57 teeth. Hence the number of radular teeth lacks systematic significance.

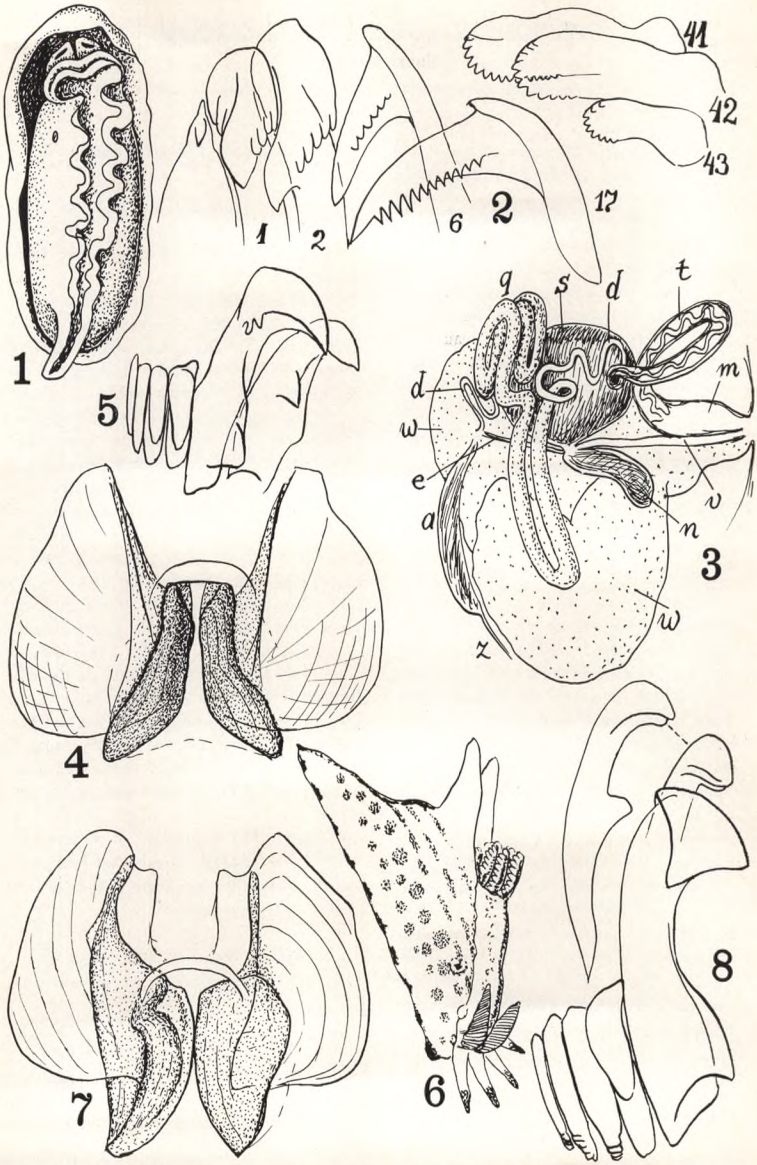
Originally, *Pleurobranchaea hamva* was described as a separate species, but with more detailed knowledge it seems better to consider it as a subspecies.

3. *Chromodoris aila*, spec. nov. (Figs. 1–3)

Occurrence: Beaufort, N. C., 13. VI. 1955; one specimen.

Length 12 mm., breadth 7 mm., height 6 mm. In life, colored as *mörchii* Bergh, 1879, hence red with blue and yellowish marks; in preserved state, uniformly pinkish. Notum smooth, its free edge 2 mm. broad in front and 1 mm. broad behind, without glands. Spicules absent or dissolved. Sole 2 mm. broad, tapering behind, tail standing out beyond notum; anterior border of foot bilabiate with distinct rounded corners.

Tentacles broad, grooved; rhinophores with from 15 to 18 leaves; branchial pouch 3 mm. broad, 2 mm. long, with smooth rim; 13 uni-



FIGS. 1–3. *Chromodoris aila.* FIG. 1. Ventral. FIG. 2 Radula. FIG. 3. Reproductive organs. FIGS. 4–5. *Polycera hummi.* FIG. 4. Jaws. FIG. 5. Radula. FIGS. 6–8. *Polycera chilluna.* FIG. 6. Side view. FIG. 7. Jaws. FIG. 8. Radula.

pinnate gills. Labial grasping ring of bifid hooklets. Radula 57 × 43.1.43. Rhachidian tooth a flat triangle with minute cusp; first lateral tooth with 1 or 2 inner and 4 outer denticles; following teeth with more numerous (up to 16) outer denticles; teeth shortening from thirty-sixth tooth outward, the cups of marginal ones concave, denticulate.

Blood gland over pharynx; salivary glands long, knobby; stomach embedded in digestive gland, only pyloric region free, with ventral caecum. Digestive gland surrounded by ovotestis, except its midventral part.

Hermaphrodite duct (*z*) enters hind end of ampulla (*a*). Sperm duct (*d*) emerges from gland mass (*w*)—first thin, then becomes thick, coiled, prostatic (*q*). Following sections muscular, first thin, then sheathed (*t*)—opening into atrium (*m*). Vagina (*v*) narrow; large spermatheca (s) and narrow spermatocyst (n) neighboring; long insemination duct (*e*) plunges into gland mass near outlet of ampulla.

DISCUSSION. Following Odhner (1957), I use the name *Chromodoris* Alder and Hancock, 1855, for the species with hamate teeth (Marcus, 1960a: 900–901). *Chromodoris aila* has been compared with about forty Caribbean, American Pacific, Atlantic, and Mediterranean species. Except for a few described in the last ten years (White, 1952; Pruvot-Fol, 1953; Marcus 1955a), these species are catalogued in Pruvot-Fol's synopsis (1951b).

4. *Polycera hummi* Abbott, 1952 (Figs. 4–5)

Occurrence: Beaufort, N. C., 12. III. 1956; one specimen. Further distribution: Alligator Harbor, Franklin County, northwest Florida.

As in Abbott's specimens (1952: 3), the velum of the present one bears two pairs of processes; up to four may occur in *P. aurisula* (Marcus, 1960b: 162). The foremost gill is long, but only by degree different from *aurisula*. The same holds for the extra branchial appendages, which are blunt and club shaped in *hummi* and carrot shaped in *aurisula*. The innermost marginal tooth has five small denticles on the cusp in Abbott's material. In the present slug we found the anterior edge of all marginal teeth worn in old rows, and not quite regular in new ones, but always without regular denticles. As in *aurisula* (Marcus, 1960b, fig. 47), the cusps of the two inner marginal teeth project on the inner side. The cusp of the biggest, the second lateral tooth, has one or two denticles, absent in worn rows. Such denticles do not occur in *aurisula*. The jaws of *hummi* (Fig. 4) are 1.9 mm. broad and 1.3 mm. high, not specifically different from those of *aurisula*.

5. *Polycera chilluna*, spec. nov. (Figs. 6–9)

Occurrence: Beaufort, N. C., 11. VII. 1956; one specimen.

Length 18 mm. from velar appendages (3 mm.) to stretched tail (5 mm.), height 7 mm., breadth 6 mm. Colors in life fitting typical pattern of *P. quadrilineata;* light brown when preserved, with interrupted dark marks (Fig. 6). Velar appendages long, pointed, three on left, two on right side (one evidently lost). Velum continues with low ridge on either side to extra-branchial process. Shaft of rhinophores 1 mm., pointed club slanting backward 2 mm. long, containing 25 perfoliations and a small terminal knob. Foot narrow, anterior border simple. Spicules not preserved.

Jaws together 2 mm. broad, 1.4 mm. high, ventroanterior cutting portion brown, dorsolateral arched wings broad, yellow. Radula 13 × 3–4.2.0.2.3–4. Innermost tooth 0.34 mm. with small longitudinal fold on cusp and denticle in middle; second tooth 0.37 mm., cusp with transverse backward fold, base with extended inner angle. Innermost marginal tooth with cusplike anterior edge. Inner upper angles of first to third marginal teeth project over base.

Ampulla (*a*) reniform as in other species of *Polycera* (Marcus, 1956: 52); entrance of hermaphrodite duct (*z*) opposite bifurcation of spermoviduct. Oviduct (*o*) merging into gland mass (*w*). Sperm duct wide, prostatic (*q*), apposed to spermatheca (s), followed by narrow muscular efferent duct (*d*) with glandular swelling. Hook-bearing outer portion projects into deep atrium (*m*). Hooks small, in regular rows. An accessory ganglion (*l*) between male atrium and vagina (*v*). Vagina glandular, entering big spherical spermatheca (*s*) close to origin of long, coiled insemination

Explanation of Letters in Figures

a. ampulla. **b.** penis. **c.** cerebral ganglia. **d.** sperm duct. **e.** insemination (uterine) duct. **f.** fertilization chamber. **g.** abdominal ganglion. **h.** pharynx. **i.** oesophagus. **io.** spermoviduct. **j.** rhinophorial ganglion. **k.** buccal ganglia. **l.** accessory genital ganglion. **m.** male atrium. **n.** spermatocyst. **o.** oviduct. **p.** pedal ganglia. **q.** prostatic part of sperm duct. **r.** anus. **s.** spermatheca (bursa copulatrix). **t.** sheathed part of sperm duct. **u.** valvular apparatus. **v.** vagina. **w.** female gland mass. **x.** salivary glands. **y.** retractors. **z.** hermaphrodite duct.

duct (*e*). This bears longish spermatocyst (*n*) and opens into gland mass near entrance of oviduct (*o*).

DISCUSSION. The color agrees with that of narrow-striped *P. quadrilineata* (Müll.) (Larsen, 1925, col. fig. 6a). That species has much narrower mandibular wings (*ibid.*, text fig. 14) and from 10 to 12 rhinophorial perfoliations (Haefelfinger, 1960: 102; and many others); Berg's indication of up to 18 (1880: 604) is quite exceptional.

Broad wings and about 28 perfoliations (Allan, 1932: 101) occur in *P. capensis* Q. et G., frequent in the growth on ship bottoms (Macnae, 1959: 352–353) and widely distributed. It has one median and two lateral black or red (Macnae) stripes (Barnard, 1927, pl. 19, figs. 7, 8; Allan, 1932, pl. 4, figs. 12, 13; Dakin, 1953, pl. 62), and the spur of the first tooth is near the base. The cusp of the second is narrower than in *chilluna*.

6. *Acanthodoris pilosa* (O. F. Müller, 1776)

Occurrence: Ocean City, Md., 22. V. 1960; two specimens. Further distribution: Mediterranean; Aegean Sea, Palermo; European seas, including western Baltic, Murman Coast, White Sea, Iceland; Greenland; North American Atlantic coast southward to Connecticut; North Pacific southward to Vancouver Island region: northern Japan.

7. *Okenia impexa* Marcus, 1957

Occurrence: Beaufort, N. C., 25. III. 1956; two specimens. Further distribution: Brazil, coast of São Paulo.

8. *Ancula evelinae,* spec. nov. (Figs. 10–14)

Occurrence: Beaufort, N. C., 9. VII. 1955; two specimens.

Length about 3 mm., height 2 mm., breadth 1 mm. In life, cream colored; preserved, pinkish. Nearly symmetrical black blotches: In smaller specimen, one between rhinophores extended to sides of head, reaching gills; a second behind branchiae, bifurcated down to sides; on either side of body, big blotch in middle and small one on root of tail. In larger specimen, all-black areas smaller and each divided in two. Notum smooth, merges into sides without limit. Sole narrow, its borders wavy, probably due to contraction. Tongue-shaped tentacle on each side of mouth. Rhinophores each with 7 or 8 perfoliations and two divergent, finger-shaped appendages in front of their bases. Gills three, bipinnate; on either side one flattened, curved process, longer than branchiae. Tail laterally compressed, with keel.

Labial ring of conical platelets in several irregular rows; outer cones short, blunt; inner ones long, pointed. Radula 40 × 1.1.0.1.1. Inner tooth 21 μ high in oldest rows, outer one absent. Inner tooth of younger rows 52 μ. Its cusp with prominent outer denticle and from 14 to 18 fine ones, base elongated on outer side. Outer tooth claw-shaped, touching base of inner one.

Ovotestis covering digestive gland. Hermaphrodite duct (*z*) rather long, opens into ampulla (*a*) opposite origin of immediately branching spermoviduct. Sperm duct prostatic (*q*), U-shaped. Invaginated efferent duct an acrembolic penis (*b*) with ciliated papilla and hook-bearing collar. Muscular vagina (*v*) leads to longish spermatheca (*s*) and before it enters, gives off long, coiled insemination duct (*e*). Spermatocyst (*n*) with rather long canal. Fertilization chamber (f) lies where insemination duct and oviduct enter into gland mass (*w*). Common genital aperture wide, folded.

The species is named for Mrs. Eveline du Bois-Reymond Marcus. The holotype is the slightly larger, nearly entire slug.

DISCUSSION. Absence of blotches, shorter extrabranchial process, and shape of inner tooth distinguish *A. fuegiensis* Odhner (1926a: 45) from *evelinae*. Color, inner tooth, and several extrabranchial appendages separate *cristata* and *pacifica* (see Bergh, 1881: 631 ff.; MacFarland, 1906: 148). Moreover, *pacifica* has rhachidian teeth behind the first 8 to 10 rows.

9. *Corambella baratariae* Harry, 1953

Occurrence: Beaufort, N. C., and Cape Hatteras, N. C., 30 V. 1956 and 20. VIII. 1959; a total of five specimens. Further distribution: Grand Isle, La. (Harry, 1953); Port Aransas, Tex. (Marcus, 1960c).

10. *Doriopsilla leia,* spec. nov. (Figs. 15–18)

Occurrence: Beaufort, N. C., 20. VII. 1955; three specimens.

Length 7 and 8 mm., breadth 3 mm. Body nearly round, pinkish, soft and smooth. Spicules wanting, possibly dissolved. Free notal edge 0.5–1 mm. broad, with slight radial stripes. Tentacles minute; eight rhinophorial leaves. Genital papilla distinct; anal papilla (*r*) high, to the left of the four tripinnate gills (Pruvot-Fol, 1951a: 40; 1953: 91–92). Foot 1 mm. broad, evenly curved behind and in front, without transverse groove.

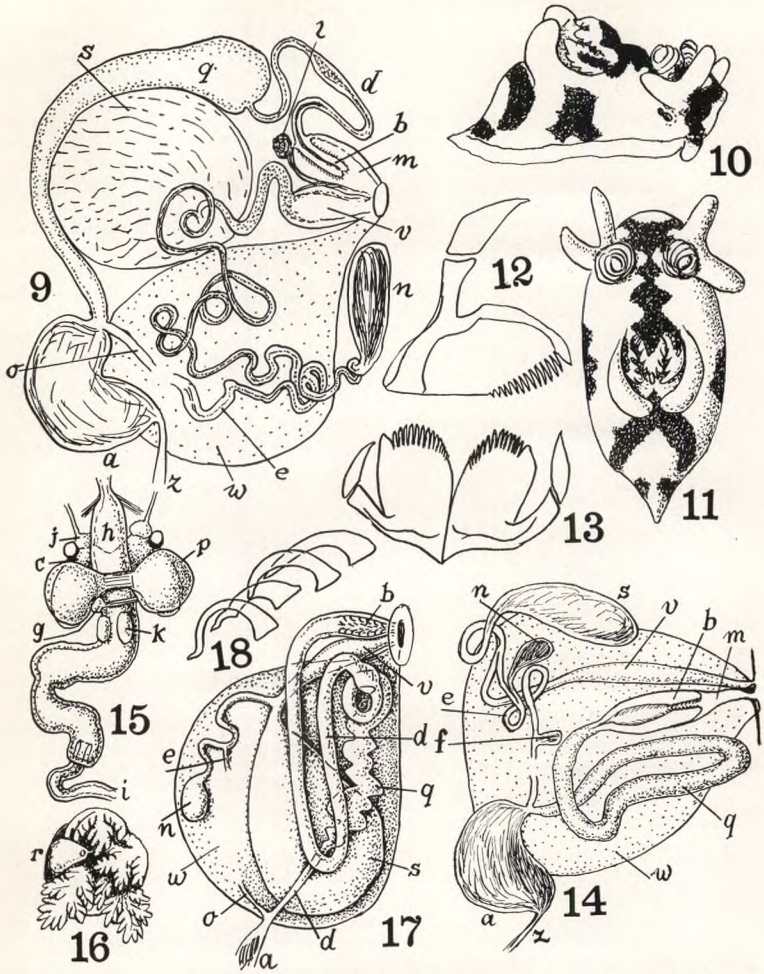


FIG. 9. *Polycera chilluna*, reproductive organs. FIG. 10–14. *Ancula evelinae*. FIG. 10. Lateral. FIG. 11. Dorsal. FIG. 12. Radular row. FIG. 13. Half-row of radula. FIG. 14. Reproductive organs. FIGS. 15–18. *Doriopsilla leia*. FIG. 15. Anterior gut, ventral. FIG. 16. Gills. FIG. 17. Reproductive organs. FIG. 18. Penial hooks.

Eyes black, located close in front of nerve ring, shine through skin behind rhinophores. Nerve ring overlain by coalesced blood glands. Pedal commissure distinct. Buccal ganglia (*k*) close behind nerve ring, ventral to pharynx. Rhinophorial ganglia (*j*) set off from cerebral ones (*c*). Abdominal ganglion (*g*) at right root of visceral loop.

Inner organs unpigmented; pharynx (*h*) wide; no ptyaline gland. Oesophagus narrow (*i*), can be projected into pharynx (Vayssière, 1901, pl. 3, fig. 19, b). Farther behind, oesophagus widens, forms loop and enters stomach, which is embedded in digestive gland. Small caecum close behind pylorus. Gut fastened by muscles.

Spermoviduct bifurcates near outlet of ampulla (*a*). Oviduct (*o*), to the left, enters voluminous gland mass (*w*). Sperm duct (*d*), to the right and forward—first narrow, straight, then wide, coiled, prostatic (*q*). Following loop (*d*), muscular, enters short penial pouch formed by atrium. Here, efferent duct ends as invaginated penis (*b*) with many colorless hooks. Muscular vagina (*v*) leads to large, pyriform spermatheca (*s*). At its entrance sinuous duct to spermatocyst (*n*) begins. Insemination canal (*e*) goes out from this duct.

The holotype is one of the 8-mm.-long slugs.

DISCUSSION. The position of the buccal ganglia is the disjunctive character of the genus. Muscles which move the anterior gut must not be confounded with cerebro-buccal connectives (Eliot, 1906a: 366). Pruvot-Fol (1951a: 39; 1952: 413; 1954: 336) stressed absence of ptyaline gland in *Doriopsilla*, but Bergh (1896: 457) described such for the type species, *D. pallida* (1902: 194) and *D. capensis* (1907: 64). *Doriopsilla laevis* Bergh, 1905, can be separated from *leia* by its dorsal skin glands, 0.12 mm. in diameter. The other previously described species of *Doriopsilla* have dorsal granules or tubercles.

11. *Doriopsilla pharpa,* spec. nov. (Figs. 19–21)

Occurrence: Beaufort, N. C., 20. VII. 1955, VII. 1956, 25. IV. 1960; a total of six specimens.

Length from 4 to 17 mm. In life, orange with brown specks produced by chromatophores in connective tissue, or bright yellow. Biggest mature slug 9 mm. broad, 4.5 mm. high; free edge of notum 2 mm. broad; genital aperture 5 mm. behind fore end. Body flat, firm; notum with irregular papillae stiffened by bundles of small spicules, 15 μ in diameter. In connective tissue spicules larger: 1.2 mm. long, 70 μ in diameter, disposed diagonally, crossing at right angles. Rim of branchial and rhinophorial pockets smooth. Tentacles small; rhinophores with twelve perofilations. Foot rounded in front, pointed behind. Eyes, four gills, and anal papilla as in *D. leia.*

Pedal ganglia (*p*) contiguous; buccal ganglia (*k*) touch nerve ring; salivary glands (*x*) attached directly to hind end of foremost wide (pharyngeal) part of gut. No ptyaline gland. Oesophagus (*i*) a long loop; digestive gland covers stomach; pylorus with small caecum.

Genital organs essentially as in *D. leia.* Long ampulla (*a*) with hermaphrodite duct (*z*) and spermoviduct (*io*) at opposite ends. Spermoviduct divides a certain distance from ampulla. Sperm duct (*d*) begins narrow, continues as widened prostatic loop (*q*) and ends as eversible hooked penis (*b*). Hooks touch one another. Vagina (*v*) begins very wide, then narrows and enters pyriform spermatheca (*s*). At its entrance, duct to spermatocyst (*n*) emerges. Insemination duct (*e*) enters gland mass (*w*), approaching oviduct (*o*).

DISCUSSION. This species differs from *D. leia* by the possession of dorsal tubercles and contiguous pedal ganglia. Distinguishing characters of other valid species of *Doriopsilla*:

albopunctata (Cooper, 1863); synonym: *reticulata* (Cockerell and Eliot, 1905). Rhinophores with 30 leaves.

miniata (Alder and Hancock, 1864). Back with whitish reticulum.

areolata Bergh, 1880. Type species. Whitish network on notum; 25 rhinophorial perfoliations.

pelseneeri Oliveira, 1895. Dorsal tubercles enormous, 8 per cent of body length.

pallida Bergh, 1902. Ptyaline gland.

laevis Bergh, 1905. Cutaneous glands, 0.12 mm. in diameter.

capensis Bergh, 1907. Ptyaline gland; six gills.

unnamed species White, 1951. Eleven branchiae.

rarispinosa Pruvot-Fol, 1951. Penial hooks widely interspaced.

pusilla Pruvot-Fol, 1951. Four thick tubercles in two rows.

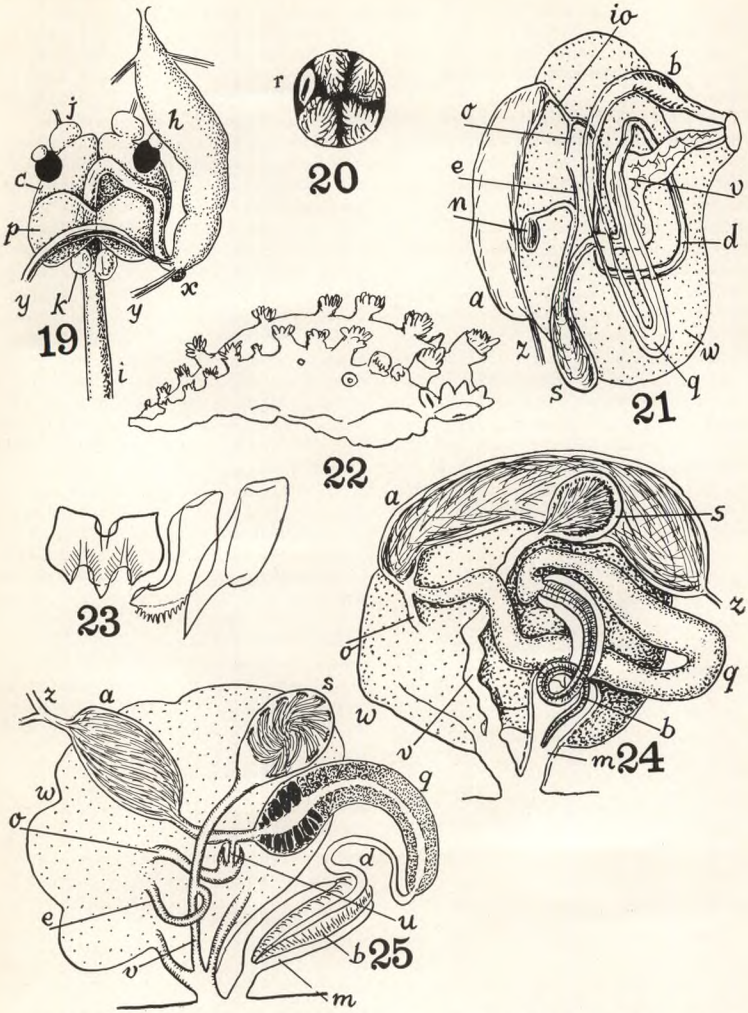
fedalae Pruvot-Fol, 1953. White net between tubercles; penial hooks absent or minute.

12. *Tritonia* (*Tritonidoxa*) *wellsi,* spec. nov. (Figs. 22–24)

Occurrence: Beaufort, N. C., 9. VII. 1956; three specimens.

Length 5, 6, and 7 mm., height of last specimen 3 mm., breadth of notum and sole 2 mm. In life, inner organs orange or salmon, showing through body wall; gills translucent whitish. Back and sides smooth; hind end tapers. Genital papilla broad, under second or third branchial tuft; anus near fourth. Veil small, not bilobed, with six appendages, the two outermost of which are spoon-shaped tentacles. Rhinophorial sheaths high with smooth borders. Edge of notum webbed between bases of tenth and eleventh gills. Fully developed branchiae of rather uniform size and simply ramified.

Masticatory border of jaw with about eight rows of pointed denticles, quincuncial uniform cones, larger in middle than on margins. Radula 21 × 11.1.1.1.11. Median tooth tricuspidate,



FIGS. 19–21. *Doriopsilla pharpa.* FIG. 19. Anterior gut, ventral. FIG. 20. Gills. FIG. 21. Reproductive organs. FIGS. 22–24. *Tritonia* (*Tritonidoxa*) *wellsi.* FIG 22. Side view. FIG. 23. Middle of radula. FIG. 24. Reproductive organs. FIG. 25. *Miesea evelinae,* reproductive organs.

lateral teeth hook-shaped. Innermost lateral tooth hollowed on inner side, cusp with about twelve denticles.

Ampulla (*a*) distended, farthest to the left. Outlet bifurcates; oviduct immediately enters gland mass (*w*); sperm duct prostatic (*q*) on entire course. Glandular sperm duct attains fundus of long sac, a penial pouch, set off from atrium (*m*) by fold. Penis (*b*) muscular, flagelliform, curled, 1 mm. long, 30–40 μ in diameter; projects into atrium. Ectal parts of vagina (*v*) and nidamental duct in common.

Vagina about 0.7 mm. long leads into globular spermatheca (*s*) (diameter: 0.35 mm.). Here spermatozoa fastened to wall with heads.

This species is named for Dr. Harry W. Wells. The holotype is the 6-mm. long, entire slug.

DISCUSSION. It is advisable to use the same term for the ectal (in most cases sole) "seminal vesicle" (Bergh) of Dendronotacea and the always single one of Eolidacea. The spermatheca has a short duct (vagina) in the type species of *Duvaucelia* Risso, 1828 (Odhner, 1939: 43), and a long one in that of *Tritonia* Cuvier, 1797 (Odhner, 1926b, fig. 12). The later name (Pruvot-Fol, 1931: 314, 747–748) is generally accepted. Evidently in correlation with the flagelliform penis (Odhner, 1926b: 17) the vagina is still longer in *Tritonidoxa* Bergh, 1907 (Odhner, 1926a: 32–33, emend.). In *T. capensis* Bergh (1907: 87) (the type species of *Tritonidoxa*) and *T. ingolfiana* (Bergh, 1900: 19) the masticatory border is smooth; in *griegi* Odhner (1922: 6, 8) and *wellsi*, this border is denticulate. Smooth cusp of intermediate tooth separates *griegi* from *wellsi*.

13. *Scyllaea pelagica* Linné, 1758

Occurrence: Beaufort, N. C., VII. 1956; one specimen.

Further distribution: Pelagic in warm and warm-temperate seas, clinging to floating seaweeds, chiefly *Sargassum*, feeding on hydroids, and also swimming in open sea. In the Atlantic occasionally northward to the British Isles (Eliot, 1910: 163) and Woods Hole region, southward to South Africa. In the Indo-West Pacific from Red Sea to middle Japan and New Caledonia. One record from eastern Pacific without locality (Bergh, 1894: 145).

14. *Miesea evelinae* (Marcus, 1957) (Fig. 25)

Occurrence: Beaufort, N. C., 1. VIII. 1955; one specimen. Further distribution: Brazil, coast of São Paulo.

The species described as *Embletonia evelinae* Marcus (1957: 466) has since then been found also 350 km. southwest from the original locality. It must be transferred to the Dotonidae and becomes the type species of the new genus *Miesea*.

Miesea, gen. nov.

Dotonidae without sheaths of the rhinophores; cerata simple, without gills; veil small; radula 0.1.0.

In sections of some Brazilian specimens the shafts of the rhinophores show a fold around their basal third, but no sheath into which the club can be retracted. In some preserved animals the skin of the cerata is somewhat shrunken around the racemose digestive gland, so that an illusion of bosses is produced.

Independently of systems of classification used for the Nudibranchia, such as that of Odhner considering rhinophorial sheaths "an essential characteristic of the Dendronotacea" (1934: 231; 1936: 1060), or that of Pruvot-Fol (1954: 402, 410) separating Dotoinae and Embletoninae as subfamilies of the Dotoidae, this species would at first sight be allocated to *Embletonia*.

The veil and the at most vestigial tentacles separate the Embletoniidae from the Eolidacea (Odhner, 1939: 50), but their radulae are cuthonidan. The main duct of the digestive gland is dorsal to the ovotestis, as in most eolidacean nudibranchs (Bergh, 1892: 1012–13). In *Doto* the gonad lies over the main liver duct (Alder and Hancock, 1846: fam. 3, pl. 4; Odhner, 1922: 37; Pruvot-Fol, l.c.). *Miesea evelinae* has this dotoidan topography. The generative organs (Fig. 25) with unarmed penis (*b*) and ciliated valve (*u*) at bifurcation of spermoviduct agree in *Doto* and *Miesea*. In *Embletonia* and *Tenellia* the penis is armed, and the valve described of *Tenellia fuscata* is heavily muscular (Chambers, 1934: 621).

Anterior glands around mouth; a big, left-sided posterior gland; salivary glands; extremely delicate jaws; and radula with slanting, converging rows brought about by variable position of lateral denticles are characters which *Miesea* has in common with *Doto*.

15. *Catriona tina* Marcus, 1957

Occurrence: Beaufort, N. C., 1. VIII. 1955; one specimen. Further distribution: Brazil, coast of São Paulo; Virginia Key, Miami, Fla.

16. *Dondice occidentalis* (Engel, 1925)

Occurrence: Beaufort, N. C., 12. VI. 1956; two specimens. Further distribution: Brazil, coast of São Paulo; Jamaica; Virginia Key, Miami, Fla.

17. *Cratena kaoruae* Marcus, 1957

Occurrence: Beaufort, N. C., 30. V. 1955; Cape Hatteras, N. C., 12. II. 1959; two specimens. Further distribution: Brazil, coast of São Paulo; coasts of Texas and Louisiana.

18. *Aeolidia papillosa* (Linné, 1767)

Occurrence: Ocean City, Md., 22. V. 1960; two specimens. Further distribution: White

Sea (Mileikovsky, 1960: 668); North Atlantic, southward to Portugal, possibly to the Mediterranean, on the American coast southward to Rhode Island; North Pacific, from Alaska to Southern California, on the Asiatic coast to Sakhalin and east coast of Hokkaido. Specimens from South America, Valparaiso to Falkland Islands, may perhaps be separable as var. *serotina* Bergh, 1874.

19. *Baeolidia benteva* Marcus, 1958

Occurrence: Cape Hatteras, N. C., 8 X. 1959; three specimens. Further distribution: Brazil, coast of São Paulo.

20. *Berghia coerulescens* (Laurillard, 1830)

Occurrence: Beaufort, N. C., 30. V. 1956; one specimen. Further distribution: Mediterranean; East Atlantic, northward to French Channel, southward to Morocco; West Atlantic: Brazil, coast of São Paulo; West Indies; coast of Texas.

Zoogeographic Remarks

To the twenty above-mentioned species can be added *Aplysia morio* Verrill, 1901, and *Aplysia willcoxi* Heilprin, 1886, from Beaufort, N. C., identified by Dr. Harry W. Wells. The former ranges from Rhode Island to Texas and Bermuda (Eales, 1960: 328), and the latter from Woods Hole to Guadeloupe (*ibid.*, 350). Six species from North Carolina are new. These and the pelagic species, *Scyllaea pelagica*, cannot be analyzed zoogeographically. Of the remaining species and subspecies, two eurythermal boreo-arctic ones—*Acanthodoris pilosa* and *Aeolidia papillosa*—have their range extended on the North American east coast from the Cape Cod region to Maryland. This is not surprising with regard to their Mediterranean (*A. pilosa*) and western American (*A. papillosa*: Laguna Beach, Calif.) occurrences.

Contrary to these species whose ranges in both northern temperate oceans are connected by the Arctic, the distribution of the non-arctic species, *Hermaea dendritica*, cannot be understood in the present state of knowledge. Its transatlantic distribution leads to the supposition that the Atlantic Ocean in Tertiary times was narrower than today. Its occurrence in southern and middle Japan makes probable the possibility that it also lives in the Red Sea and the Indian Ocean; hence it exhibits a Tethyan distribution. The species feeds chiefly on *Codium*, which does not belong to the ordinary growth on ship bottoms. Hermaeids are easily overlooked by collectors (Macnae, 1954: 60), so that the gap in the range of the temperate-water species *Hermaea dendritica* is certainly due to the present state of knowledge. This gap cannot be filled by uniting *H. capensis* Macnae (1954: 59) and *H. aoteana* Powell (1937: 123) with *dendritica*, though these species from Cape Province and Auckland, respectively, have *dendritica*-like appearances. Their radulae, however, are different, while that of the Japanese *dendritica* (Baba, 1955: fig. 9) agrees with the European one (Pruvot-Fol, 1954: fig. 71, i).

The range of *Berghia coerulescens* could, theoretically, have been brought about by drifting logs bearing hydroids. The larva has a shell (Trinchese, 1881, pl. 78, figs. 6–8) of Thorson's type B (1946: 268), small velum, and no eyes, hence is very poorly equipped for planktonic life (*ibid.*, 270). It is possible that such larvae hatched from eggs laid on the raft settle on it a few hours later; the slugs themselves hardly live for more than one year. Transatlantic distribution of such short-lived nudibranchs is better explained by a former narrower Atlantic Ocean than by the raft hypothesis.

Of the analyzable species from North Carolina (*Aplysia morio* and *A. willcoxi* included), 69 per cent are West Atlantic warm-water elements. Only *Polycera hummi* and *Corambella baratariae* seem to be restricted to the southeast coast of the United States. Both have a range disjunct by a break in southern Florida, as do Hedgpeth's examples *Littorina irrorata* and *Sesarma cinereum* (1953, figs. 43, 44). It is not known whether this break also applies to the rather eurythermal *Aplysia morio*.

Of the analyzable species from North Carolina, 62 per cent are also known from southern middle Brazil. This is less than the corresponding 72 per cent found in a collection from Miami (Marcus, 1960b). The available species are relatively few in number, and the compared collections cover small areas. However, they indicate a certain uniformity of the intertidal opisthobranch fauna between northern and southern tropic waters which decreases northward.

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AN EXPERIMENTAL ANALYSIS OF FACTORS AFFECTING THE DEVELOPMENT OF ADRENAL GLANDS WITH SPECIAL REFERENCE TO *AMBLYSTOMA PUNCTATUM*[1]

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It is generally accepted that the adrenal glands of adult vertebrates are composed of two parts, each arising from a different embryonic germ layer. The adrenal medulla is known to arise from ectoderm, especially the neural crest, while the cortex has been shown to originate from the intermediate mesoderm. The latter component appears first and is invaded by the former. The extent to which this invasion takes place varies in each of the vertebrate classes. In elasmobranchs, the cortical tissue, referred to as interrenal bodies, is separated from the medullary part, called the suprarenal or chromaffin bodies. In mammals the invasion of the future medullary cells into the adrenal cortical primordia is so great that they eventually become surrounded by cortex, which continues to proliferate around them.

Normally mammalian adrenal tissue is confined to two discrete glands, one lying anterior to each kidney. In the intervening classes between elasmobranchs and mammals, there are examples of varying degrees of proximity and juxtaposition of the two adrenal components. Reference is frequently made to the anomalous condition reported in man and other mammals of accessory adrenal nodules along the inferior vena cava and aorta. Nodules have been found which contain either both adrenal components or only one component. (Nelson, 1939; Lasher, 1947; Graham, 1953.) This type of gland, although abnormal in mammals, normally occurs in urodeles. Figure 1 shows the location of adrenal tissue along the walls of the vena cava and efferent renal veins in an adult *Amblystoma punctatum*. In amphibia, as well as in mammals, the normal inherited pattern of behavior of the adrenal components can be

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