A Comparative Study of the Genus *Philinopsis* Pease, 1860 (Aglajidae, Opisthobranchia)[1]

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ABSTRACT: A comparative study of *Philinopsis gigliolii* (Tapparone-Canefri, 1874); *P. speciosa* Pease, 1860; *P. taronga* (Allan, 1933); *P. virgo* (Rudman, 1968); *P. troubridgensis* (Verco, 1909); *P. pilsbryi* (Eliot, 1900); *P. gardineri* (Eliot, 1903); *P. cyanea* (Martens, 1879) indicates that they should be grouped in a separate genus, *Philinopsis* Pease, 1860, of the Aglajidae. The following taxonomic revision is suggested: *P. taronga* (Allan, 1933) = *Chelidonura aureopunctata* Rudman, 1968; *Philinopsis cyanea* (Martens, 1879) = *Doridium capense* Bergh, 1907 = *Aglaja iwasai* Hirase, 1936; and *Philinopsis gardineri* (Eliot, 1903) = *Chelidonura velutina* Bergh, 1905, in part. It is also suggested that two senior synonyms of *Philinopsis pilsbryi* (Eliot, 1900), *P. nigra* Pease, 1860, and *Doridium alboventralis* Bergh, 1897, should be considered *nomina oblita* under Article 23 (*b*) of the International Code of Zoological Nomenclature.

The reproductive system in which the spermoviduct is unbranched and does not open into the albumen gland is a major characteristic of the genus.

THIS IS THE SECOND of a series of papers distinguishing the genera of the opisthobranch family Aglajidae. The first (Rudman, 1972) was concerned with *Melanochlamys* Cheeseman, 1881, a group of relatively small, primitive species widely scattered throughout the oceans of the world. A further account will consider *Aglaja* Renier, 1807; *Chelidonura* A. Adams, 1850; and *Navanax* Pilsbry, 1895.

The species discussed here are all found within the Indo-West-Pacific faunal region and I will show that they are best grouped in the genus *Philinopsis,* erected by Pease (1860) for two species from Hawaii. Since that year this genus has either been considered a synonym of *Aglaja* Renier, 1807, or has been ignored. The following account, based on a detailed examination of eight species, shows that this group of Indo-Pacific species is quite distinct from *Aglaja* sensu stricto.

Among the species I would place in *Philinopsis,* anatomical investigations have been published for *P. ceylonica* (White, 1946); *P. lineolata* (H. & A. Adams, 1854) by White, 1945; and *P. minor* (Tchang-Si, 1934).

Anatomies of the following species are discussed in this paper.

Philinopsis speciosa Pease, 1860. Two preserved specimens were made available by Dr. E. A. Kay. They were collected from the reef off Ala Moana Beach Park, Oahu, in January 1966 and were approximately 45 mm in length when preserved. Color photographs were also made available by Dr. Kay.

Philinopsis troubridgensis (Verco, 1909). Two preserved specimens were made available by Mr. R. Burn. They were collected at St. Vincent Gulf, South Australia. Length of preserved specimens approximately 55 mm.

Philinopsis gigliolii (Tapparone-Canefri, 1874). Three preserved specimens collected at Tannowa on the southeastern coast of Osaka Bay, middle Japan in April 1959 were made available by Dr. Iwao Hamatani. They were found in the muddy-sand zone generally covered with *Zostera nana.* In preservative the specimens ranged in length from 20 to 30 mm.

Philinopsis taronga (Allan, 1933). Specimens from New Zealand were collected by me in a number of localities in northern New Zealand. They were found burrowing in sandy-mud in sheltered bays. The size of live animals reached 40 mm × 18 mm. For full locality rec-

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ords from New Zealand see Rudman, 1968 (as *Chelidonura aureopunctata*). Color photographs of a specimen from Australia were made available by Mr. R. Burn.

Philinopsis virgo (Rudman, 1968). The holotype, dredged from the seaward side of the Cavalli Island in 49 fathoms, by Dr. W. F. Ponder, was studied. This is the only record of this species.

Philinopsis pilsbryi (Eliot, 1900). Specimens from Fiji were collected by Dr. M. C. Miller and Mrs. A. Neads. Mr. R. Burn and Dr. T. E. Thompson kindly provided material collected at Heron Island, Great Barrier Reef, Queensland, Australia. Preserved specimens ranged up to 35 mm in length.

Philinopsis gardineri (Eliot, 1903). Specimens from Heron Island were made available by Mr. R. Burn and Dr. T. E. Thompson. Color notes and photographs belonging to Dr. Thompson were also examined. Many specimens, up to 50 mm in length, were found crawling on sand at the side of the reef by Dr. Thompson in June 1968. Specimens from Fiji collected at Fulaga in the Fiji Islands in January 1971 by J. Gawel were made available by Dr. G. B. K. Baines. The two specimens, found crawling on sandy-mud in a patch of seagrass, were 25 mm long in preservative.

Philinopsis cyanea (Martens, 1879). Fifteen specimens were collected by me in Zanzibar during July 1971. All except one were found in sandy-mud just north of the breakwater at the port of Zanzibar. At low tide the animals lie just below the surface of the sand and appear to break the surface as the tide begins to rise. The area was covered with *Zostera* and other seagrasses. *Bulla ampulla* was also common at this locality and was apparently the sole diet of *Philinopsis cyanea.* Specimens, when alive, ranged in size from 30 × 12 mm to 70 × 30 mm. Within 2 or 3 hours of capture all specimens had regurgitated 3 to 5 empty shells of *Bulla ampulla* each, ranging in length from 5 to 15 mm. A specimen 50 mm in length regurgitated two 15-mm-long shells. One specimen was collected crawling over sand in a bed of sea grass in 2 feet of water at Mazzizini Bay on the west coast of Zanzibar. The full color range of this species is discussed in a later section of this paper.

The taxonomy of these species is discussed at the end of this paper.

EXTERNAL FEATURES AND MANTLE CAVITY

Both the external features and the structure of the mantle cavity are constant within the species studied. The body is elongate-oval, the headshield being between two-fifths and one-half the body length. The posterior corners of the headshield are rounded whereas in the posterior midline the edge extends into a rounded point, this pointed crest being raised while the animal is moving. The posterior shield is rounded anteriorly and extends back just beyond the end of the foot. At the back of the shield, small flaps extending posteriorly from each side fold down to partially enclose the posterior end of the mantle cavity. As in *Melanochlamys* Cheeseman, 1881, a narrow ciliated duct from the internal shell cavity opens dorsally in the posterior left quarter of the posterior shield.

The parapodia, lateral extensions of the foot, are large and fold up, covering the sides of the headshield and posterior shield (Fig. 1). The mouth (Fig. 2) is bordered by a pair of large mounds which bear long retractile sensory bristles. Below each mound is a groove which runs into a deep pocket below the mouth (G.V.). Two types of mucous glands open into this vestibule (Fig. 3) and they have identical staining properties to the labial glands in *Mela-*

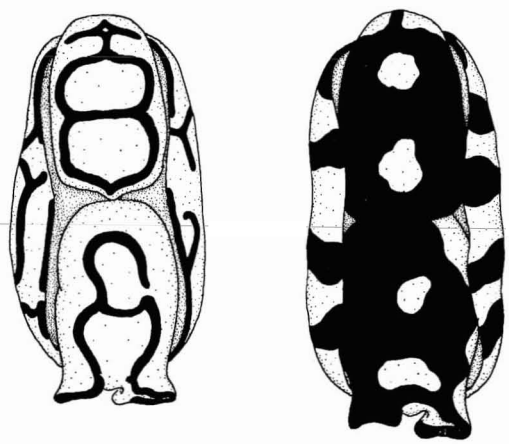

FIG. 1. Color variation in *Philinopsis pilsbryi.* Left, from Fiji; right, from Hawaii.

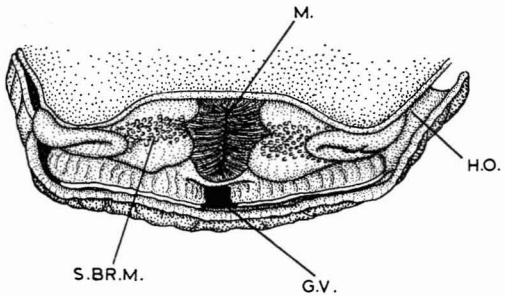

FIG. 2. *Philinopsis taronga,* anterodorsal view of head region.

SYMBOLS: G.V., vestibule of labial gland; H.O., Hancock's organ; M., mouth; S.BR.M., mound bearing sensory bristles.

nochlamys cylindrica Cheeseman, 1881. One gland (L.GL.1), the cells staining deep blue in Mallory and Heidenhain, opens along the dorsal surface of the vestibule and the lower edge of the mound bearing the sensory bristles (Fig. 3*A*, *B*). The second gland (L.GL.2), with cells only lightly staining in Mallory and Heidenhain, opens along the bottom of the vestibule. A labial gland of the second type also opens above the mouth.

The mantle cavity (Fig. 4) is similar to that described for *Melanochlamys*. The major difference is that in *Philinopsis* the cavity is more open; in *Melanochlamys* the spiral of the raphe is in a vertical plane whereas in *Philinopsis* the plane is at an angle, so that the raphes, instead of running down, run out posteroventrally. The gill is relatively larger in *Philinopsis* and the yellow gland, opening near the anus, is much smaller than in *Melanochlamys*.

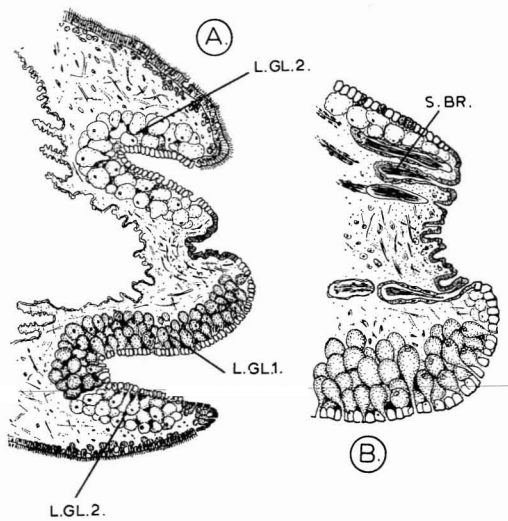

FIG. 3. *Philinopsis taronga*: *A,* longitudinal section through head region to left of center; *B,* longitudinal section through ridge bearing sensory bristles.

SYMBOLS: L.GL., labial glands; S.BR., sensory bristles.

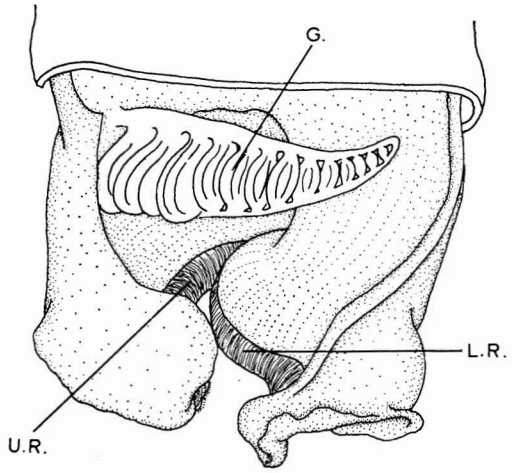

FIG. 4. *Philinopsis taronga,* mantle cavity from ventral view.

SYMBOLS: G., gill; L.R., lower raphe; U.R., upper raphe.

BODY CAVITY AND ALIMENTARY CANAL

The body cavity, separated into two parts by a vertical diaphragm, is similar to that of *Melanochlamys*. The anterior part contains the buccal bulb, esophageal crop, and penis; and the hind part, the visceral mass. A full description of the form and functioning of the gut in *Philinopsis taronga* has been published separately (as *Aglaja aureopunctata,* see Rudman, in press). Of the other species studied, *Philinopsis virgo, P. troubridgensis, P. gigliolii, P. speciosa,* and *P. cyanea* are similar to *P. taronga* in having a large, oval buccal bulb capable of partial eversion. In *P. pilsbryi* and *P. gardineri* the buccal bulb has developed into a long muscular tube (Fig. 5*A*, *B*) leading to a small esophageal crop. There are four pairs of protractor muscles attached to the elongate buccal bulb. A dorsal and ventral pair are attached to the anterior end of the tube and run forward to the body wall

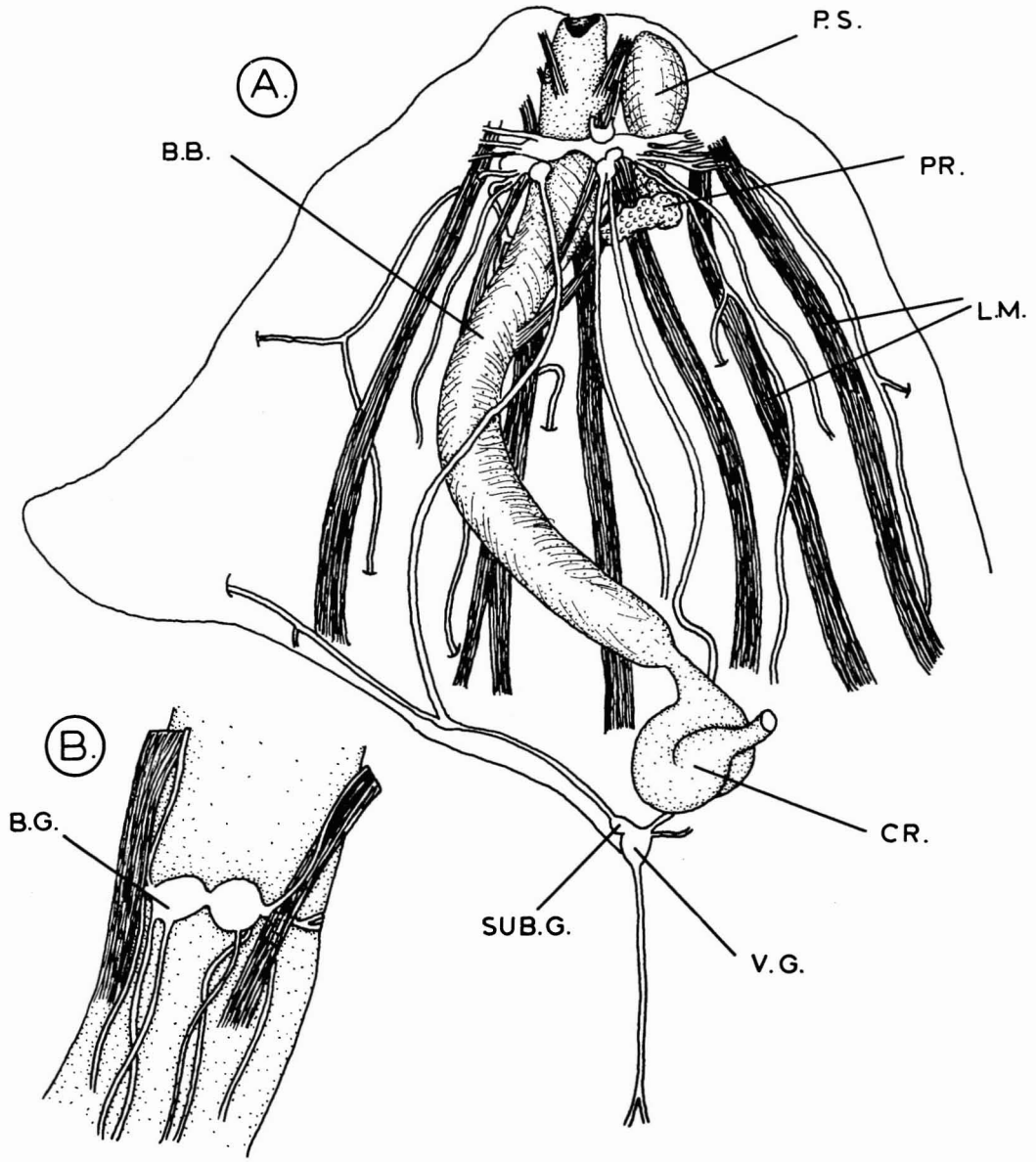

FIG. 5. *Philinopsis pilsbryi*: *A*, organs of anterior body cavity; *B*, ventral section of buccal bulb showing buccal ganglion.

SYMBOLS: B.B., buccal bulb; B.G., buccal ganglion; CR., crop; L.M., lateral muscle; PR., prostate; P.S., penial sac; SUB.G., subesophageal ganglion; V.G., visceral ganglion.

near the mouth. Dorsal and ventral pairs also leave the buccal bulb approximately halfway along its length. The buccal ganglia are attached ventrally (Fig. 5*B*) near the ventral pair of posterior protractor muscles. From the crop, the esophagus passes through the diaphragm to enter the stomach which lies under the digestive gland.

REPRODUCTIVE SYSTEM

In six of the eight species studied here, the penis is very similar in form. There is a large

thin-walled penial sac with a short prostate gland opening at the base of it. A large, ciliated, incurrent sperm groove runs from the opening of the sac down to the inner end by the opening of the prostate gland. There is a large, flat, muscular flap attached to the sac wall posteriorly, and this lies folded in the penial sac. A muscular papilla extends from the posterior end of the muscular flap. From the prostate opening, the excurrent sperm groove, enclosed by large folds, runs along the edge of the papilla. In *P. taronga* (Fig. 6*A, B*) the papilla is broad and short; the description given by Burn (1966, as *Doridium taronga*) is incorrect (Burn, personal communication). The papilla in *Philinopsis troubridgensis* is very long and narrow and lies coiled in the penis sac (Fig. 7*A, B*); in *P. virgo* both the muscular flap and papilla are relatively small (Fig. 7*C, D*). The penis of *P. gigliolii* is similar to that of *P. taronga,* whereas those of *P. cyanea* and *P. speciosa* approach that of *P. troubridgensis.*

The penis complex in *P. pilsbryi* and *P. gardineri* is quite different, the prostate being extremely long (Fig. 8). In *P. pilsbryi* (Fig. 8*A–C*), the edges of the incurrent sperm groove are developed into thick muscular flaps, and the penial papilla, lying free in the penial sac, is huge. In *P. gardineri* (Fig. 9*A–C*), the incurrent sperm groove is covered by a muscular flap developed from the left edge of the groove. The

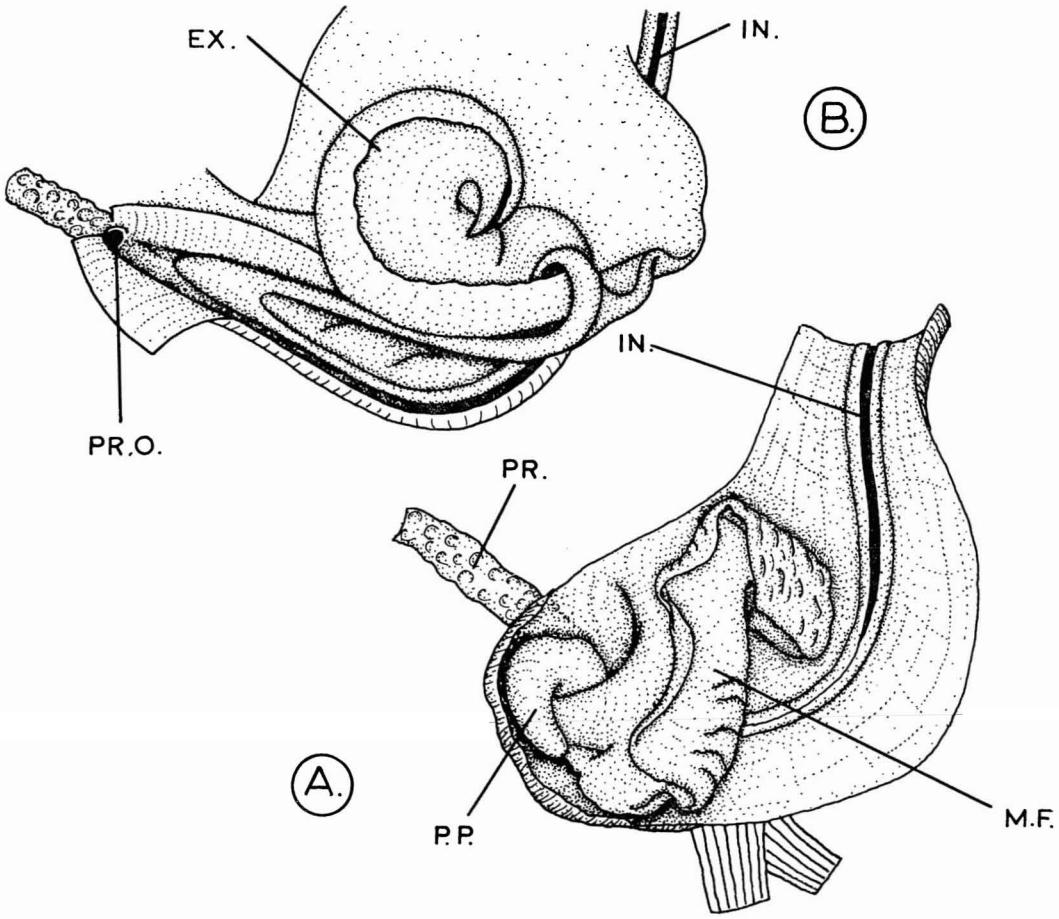

FIG. 6. *Philinopsis taronga,* penis structure.
SYMBOLS: EX., excurrent sperm groove; IN., incurrent sperm groove; M.F., muscular flap; P.P., penial papilla; PR., prostate gland; PR.O., prostate opening.

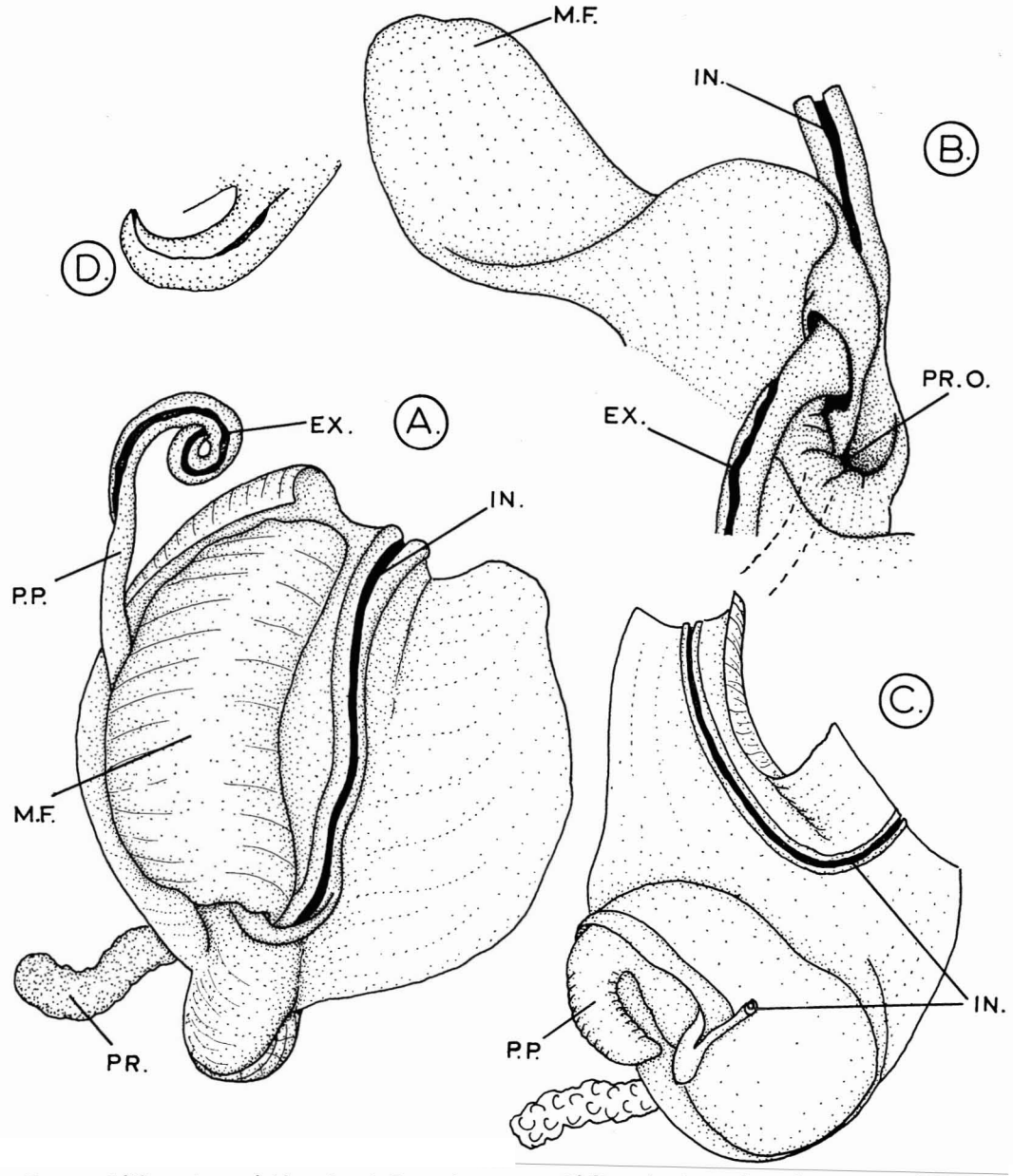

FIG. 7. *Philinopsis troubridgensis*: *A, B,* penis stucture. *Philinopsis virgo*: *C,* penis structure; *D,* ventral view of penial papilla.

SYMBOLS: EX., excurrent sperm groove; IN., incurrent sperm groove; M.F., muscular flap; P.P., penial papilla; PR., prostate gland; PR.O., prostate opening.

penial papilla is a large fleshy bulb with a deep, thin, excurrent groove.

A study of serial sections of *P. taronga* and dissections of the other species showed that the genital system is similar throughout the genus. The following detailed account is of the system in *P. taronga.* From the ampullar region of the spermoviduct, the tube narrows and is lined with a simple ciliated epithelium. The tube runs down to lie coiled alongside the albumen-cap-

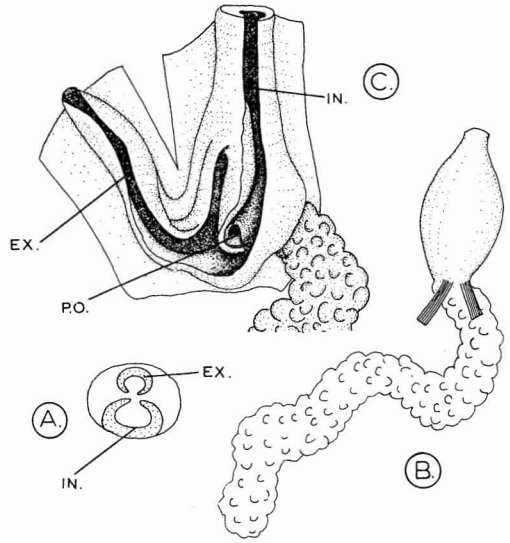

FIG. 8. *Philinopsis pilsbryi,* penis structure: *A,* section through penial sac; *C,* penial sac opened.
SYMBOLS: EX., excurrent sperm groove; IN., incurrent sperm groove; P.O., opening of prostate gland.

sule gland complex (A.C.GL.). From a large sphincter blocking this region of the spermoviduct, the tube widens and beneath the ciliated epithelium are large gland cells staining only faintly in Mallory and Heidenhain. It then opens directly into a large vestibule communicating with the genital opening. The albumen-capsule gland complex also opens directly into the vestibule through a wide ciliated slit. There is no direct connection between the spermoviduct and these glands. The albumen gland (A.GL.) occupies the distal part of the gland mass and opens into the capsule gland region (CAP.GL.), which, in turn, opens into the vestibule (Fig. 10). The cells of the albumen gland are packed with secretory spherules staining blue in Mallory and Heidenhain and light brown in Weigert's iron haemotoxylin. The cells of the capsule gland stain gray-blue in Weigert's iron haemotoxylin and van Gieson and only slightly in Mallory and Heidenhain. The large exogenous sperm sac, which is histologically similar to that described separately for *Melanochlamys cylindrica* Cheeseman, opens into the vestibule through a relatively short duct (Fig. 11). The duct is lined with a simple, ciliated epithelium and is divided by a high, longitudinal ridge (Fig. 10). The vestibule is ovate in shape and lined with a simple, ciliated epithelium; at one end opens the duct from the exogenous sperm sac and at the other end opens the duct from the gametolytic sac. The mucous gland is large, having a long curved arm lying on the floor of the body cavity and a short arm lying alongside the albumen-capsule gland complex. Both arms open into the vestibule below the openings already mentioned.

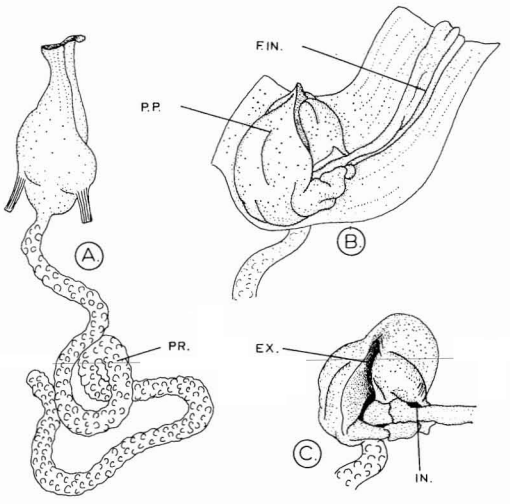

FIG. 9. *Philinopsis gardineri: A,* penis structure; *B,* opened penial sac; *C,* penial papilla.
SYMBOLS: EX., excurrent sperm grove; F.IN., flap over incurrent sperm groove; IN., incurrent sperm groove; P.P., penial papilla; PR., prostate gland.

The reproductive systems of *Philinopsis virgo, P. pilsbryi, P. gardineri,* and *P. gigliolii* are identical to that of *P. taronga,* and the only difference in *P. troubridgensis, P. cyanea,* and *P. speciosa* is the extremely long duct to the exogenous sperm sac (Fig. 12). This reproductive system is distinctly different from that of *Melanochlamys* in which the spermoviduct branches, the sperm duct runs to the genital opening, and the oviduct passes through the albumen gland and capsule gland. It is not known where the eggs receive the secretions from the albumen and capsule gland. The proximal region of the spermoviduct may act as a fertilization chamber and fertilized eggs may be moved from the vestibule up into the gland complex.

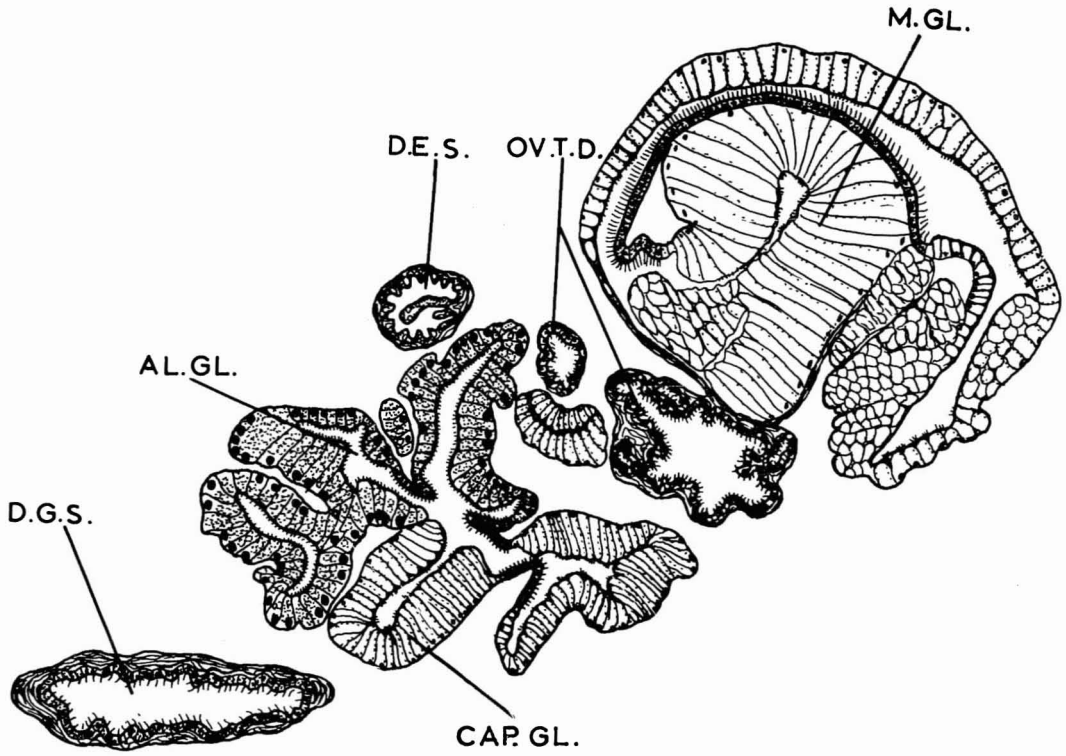

FIG. 10. *Philinopsis taronga,* section through reproductive gland mass.
SYMBOLS: AL.GL., albumen gland; CAP.GL., capsule gland; D.E.S., duct of exogenous sperm sac; D.G.S., duct to gametolytic sac; M.GL., mucous gland; OV.T.D., ovotestis duct (spermoviduct).

NERVOUS SYSTEM

The nervous systems of *Philinopsis taronga, P. pilsbryi, P. virgo,* and *P. troubridgensis* were studied and found to be essentially the same (Fig. 13). The systems differ only slightly from that of *Melanochlamys.* In *Philinopsis* a thick cord from the right of the visceral ganglion branches, one branch being the connective to the supraesophageal ganglion, whereas the other runs out to a small ganglionic thickening from which nerves issue to innervate the genital gland mass. In *Melanochlamys* a distinct genital ganglion is joined to the visceral ganglion. The arrangement of the pedal nerves also differs from the characteristic pattern in *Melanochlamys.* In both genera there are eight homologous pedal nerves which I have numbered identically. In *Melanochlamys* all the pedal nerves, except P_3 and P_4, arise separately from the pedal ganglion; P_3 and P_4 arise from a common thick cord. In *Philinopsis* P_5 and P_6 also branch from a common cord. Although these differences may seem trivial they were found to be constant both within each species and within each genus. In White's (1945) account of the nervous system of *P. pilsbryi* she suggested that paired genital ganglia are connected to the buccal ganglion and that the "osphradial" ganglion is linked to the visceral ganglion. This is not the case in three specimens of *P. pilsbryi* that I investigated and is not the case for other species of *Philinopsis* and *Melanochlamys.*

TAXONOMY

The following section defines the species under consideration. The history of the Aglajidae has been greatly confused by the many species described inadequately. In this group, which lacks such useful taxonomic features as the radula and jaw plates and in which the shell is often very reduced and fragile, good taxo-

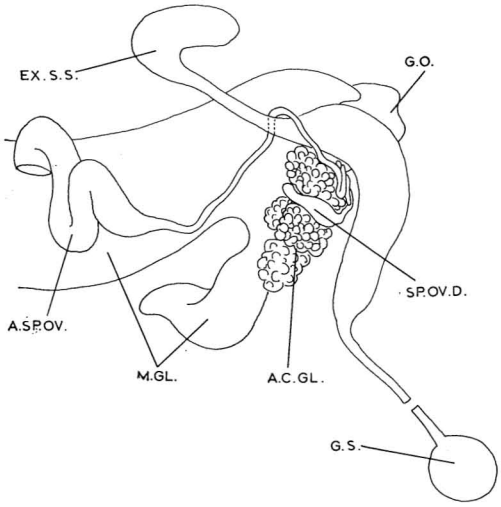

FIG. 11. *Philinopsis taronga,* reproductive gland mass.

SYMBOLS: A.C.GL., albumen and capsule gland complex; A.SP.OV, ampullar region of spermoviduct; EX.S.S., exogenous sperm sac; G.O., genital opening; G.S., gametolytic sac; M.GL., mucous gland; SP. OV.D., spermoviduct.

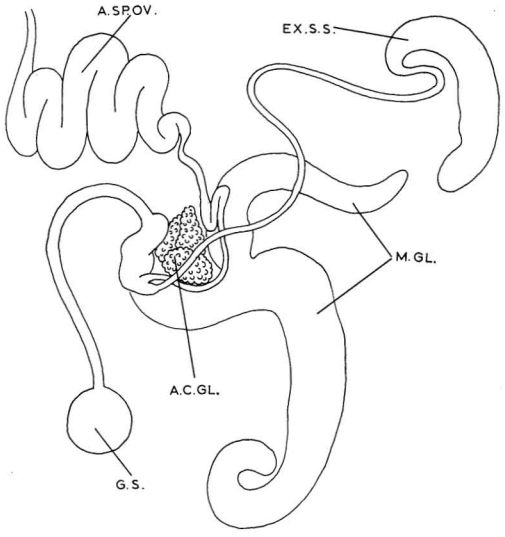

FIG. 12. *Philinopsis troubridgensis,* reproductive gland mass.

SYMBOLS: A.C.GL., albumen and capsule gland complex; A.SP.OV., ampullar region of spermoviduct; EX.S.S., exogenous sperm sac; G.S., gametolytic sac; M.GL., mucous gland.

nomic descriptions must include a good account of the color and body form of the living animal. Also, as I have shown, detailed anatomical accounts can be of great value and, in preserved material, are necessary to place an animal even in the correct genus.

As many species of the Aglajidae have been described from preserved specimens in which the color is destroyed and the shell crushed or dissolved, the identification of some species is impossible.

Philinopsis speciosa (Pease, 1860)

The original description of this species, the type of the genus *Philinopsis,* records the external features and the color. "Colour above—fawn, spotted and speckled with white; margins more or less varied with blackish and yellow; sides paler. Foot purplish fawn, and closely freckled with whitish, and broadly margined on both sides with the dorsal colours intermixed."

From a study of color photographs (provided by E. A. Kay) and preserved specimens, the color description can be extended. The ground color of the animal is light- to dark-brown. There are a pair of light orange-brown parallel lines on the headshield (at least in the color photographs of two specimens), similar to those sometimes present in *P. cyanea.* The white spots range from quite small to very large, the large white markings being somewhat broken by brown speckling. The margin of the parapodia is colored with black and orange-yellow markings. The foot appears to be a lighter color in the preserved animals, but it was not possible to confirm this from the photographs. From the preserved specimens it can be seen that the white spots are closely spaced, the ground color forming a reticulate pattern.

This species appears to be endemic to the Hawaiian Islands.

Philinopsis troubridgensis (Verco, 1909)

Fig. 7 *A, B*; 12; 13 *A, C*

This species was originally described from one large shell. Two specimens of a very large species of *Philinopsis,* approximately 70 mm in length when preserved, were made available by Mr. R. Burn. They were found cast up on the shore at St. Vincent Gulf, South Australia. Fortunately they were quickly preserved, making it possible to study their internal anatomy. Because

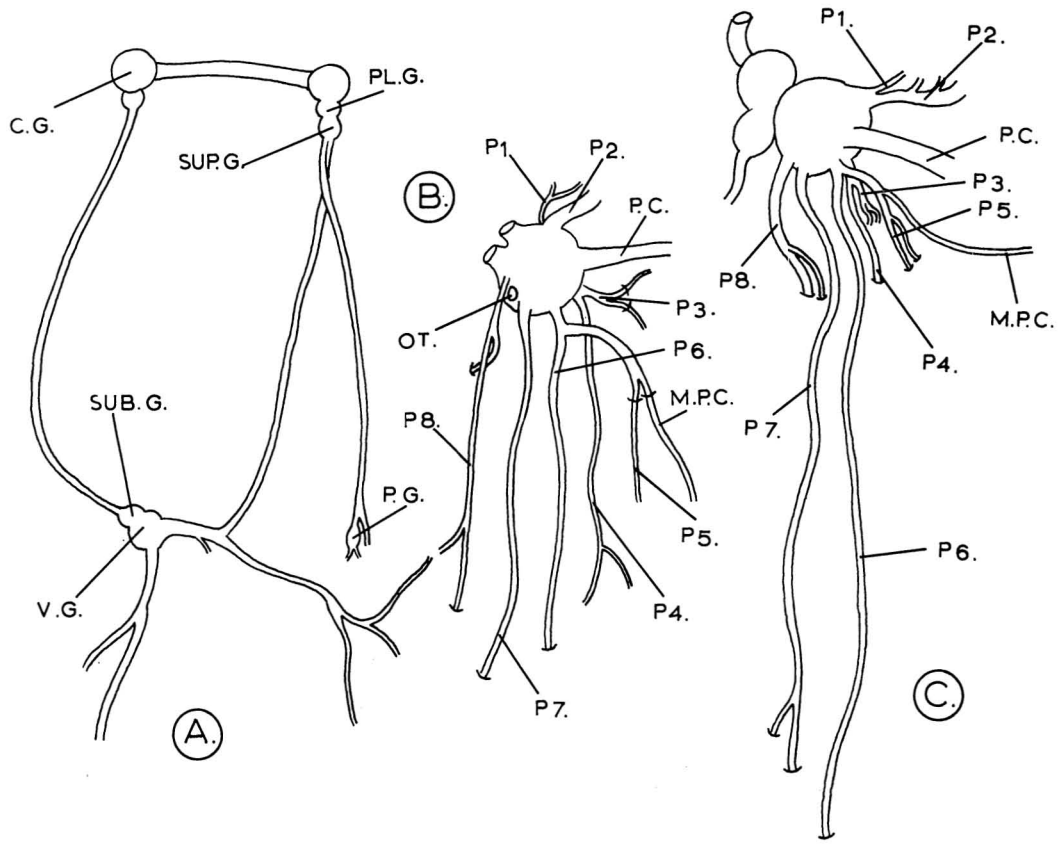

FIG. 13. *Philinopsis troubridgensis*: *A,* central nervous system; *C,* pedal nerves. *Philinopsis taronga*: *B,* pedal nerves.

SYMBOLS: C.G., cerebral ganglion; M.P.C., minor pedal commissure; OT., otocyst; P., pedal nerve; P.G., pallial ganglion; PL.G., pleural ganglion; SUB.G., subesophageal ganglion; SUP.G., supraesophageal ganglion; V.G., visceral ganglion.

these specimens were large, as was the original shell, and because they were both collected near the type locality, Burn (personal communication) feels that they can be safely ascribed to Verco's species. I agree with this conclusion.

The preserved animals were a fawnish white color, with a wide reticulate pattern of brown. Some black and yellow speckling on the edge of the parapodia was visible. As I have shown in this paper, *P. troubridgensis* is distinct from the other brown reticulate species that have been described, both in details of the penis and the reproductive system.

Philinopsis gigliolii (Tapparone-Canefri, 1874)

P. gigliolii was first described by Tapparone-Canefri from preserved specimens from Japan. In alcohol the color was "buff-white, irregularly reticulated with brown and ashy" (Pilsbry, 1896). It was subsequently redescribed and illustrated by Baba (1937, 1960). The animal is white with brown reticulate markings. Yellow dots speckle the surface, and the headshield, parapodia, and posterior shield are bordered by a broken yellow line.

From preserved specimens provided by Iwao Hamatani, the following points can be noted. On the ventral surface of the foot the brown reticulations merge so that the yellowish ground color shows only as scattered spots. In one specimen, the ventral surface is almost completely brown. On the parapodia, the reticulate brown lines are thinner and more widely spaced. A thin brown-black line is present just in from the

free margin of the parapodia. On the dorsal surface, the reticulate pattern is close so that the head and posterior shield appear to be brown with small yellow markings.

In some specimens there is a clear median yellow line on the headshield from the anterior end to the posterior median point; in some specimens this is broken in the middle. The median triangular point on the posterior edge of the headshield is yellow and bordered with dark brown or black. In one specimen a thin black line, as on the parapodia, runs along the edge of the posterior edge of the posterior shield.

In internal anatomy, there are no significant differences between *P. gigliolii* and *P. taronga.* The penial papilla of the former appears slightly longer, but, from the few specimens studied, the significance of such a feature cannot be determined. Another slight difference in the penial structure is that, in *P. gigliolii,* the muscular flap is attached all along one side to the penis sac wall; whereas in *P. taronga* it is free at the distal end.

In coloration these two species also approach one another, but *P. gigliolii* appears to be darker, and the black lines along the border of the parapodia, headshield, and posterior shield are not nearly so evident in *P. taronga.*

More extensive collecting may show that *P. gigliolii,* from the northern limit of the western Pacific, and *P. taronga,* from the southern extreme, may be variants of one species, but at this stage I prefer to consider them separately.

Philinopsis taronga (Allan, 1933) (*Chelidonura aureopunctata* Rudman, 1968)

Fig. 2, 3, 4, 6, 10, 11, 13*B,* 14 *C, D*

I originally considered that the animal I described as *Chelidonura aureopunctata* from New Zealand, was distinct from the Australian form *Philinopsis taronga.* I felt that differences in color, shape of the shell—as described by Allan (1933), and structure of the penis (see Burn, 1966) in *P. taronga* were significantly different from the New Zealand form. Since then, Mr. R. Burn has kindly sent me color photographs of the Australian form and informed me that his description of the penis (1966) was incorrect. The color and penis structure are obviously identical and I have no hesitation in relegating my species to the synonymy of *P. taronga.*

In color, it has a brown to dark purplish-brown reticulate pattern, with intervening opaque and colorless spaces containing a number of small yellow pigment spots. The headshield has small numerous opaque spaces, the front of the head often bordered with yellow markings which continue up the lateral edges. There are usually clear areas forming a broken median line on the headshield and a yellow spot in the peak of the posterior edge of the headshield. The opaque spaces are larger on the posterior shield, the brown forming a thin network. There is a broken yellow line bordering the parapodia and the edge of the posterior shield. On the ventral surface and the parapodia, the opaque spots are smaller and less numerous, the brown pigment forming a thick network.

As I have already mentioned, this species has a great similarity to *P. gigliolii.* Another species with a brown reticulate pattern has been described by Eliot (1903) as *Doridium reticulatum.* It most probably belongs to *Philinopsis.* It was described from one specimen collected at Wasin Island, East Africa, and has not been recorded since. Apart from a few dull blue spots on the central region of the parapodial margin, the color description of *Doridium reticulatum* could fit either *Philinopsis gigliolii* or *P. taronga.* Until specimens of this form are found again, its true identity cannot be established.

Philinopsis virgo (Rudman, 1968)

Fig. 7*C, D*; 14*G, H*

This pure white species has been found only once, in deep water off the east coast of northern New Zealand.

Philinopsis pilsbryi (Eliot, 1900)

Fig. 1, 5, 8, 14*K*

SYNONYMY: *Philinopsis nigra* Pease, 1860; *Doridium alboventralis* Bergh, 1897; *Doridium pilsbryi* Eliot, 1900; *Chelidonura pilsbryi* Bergh, 1905; *Aglaja pilsbryi hawaiiensis* Pilsbry, 1920.

This species, widespread throughout the Indo-West-Pacific, is rather variable in color patterning, which has led to a number of different color forms being described as different species. To

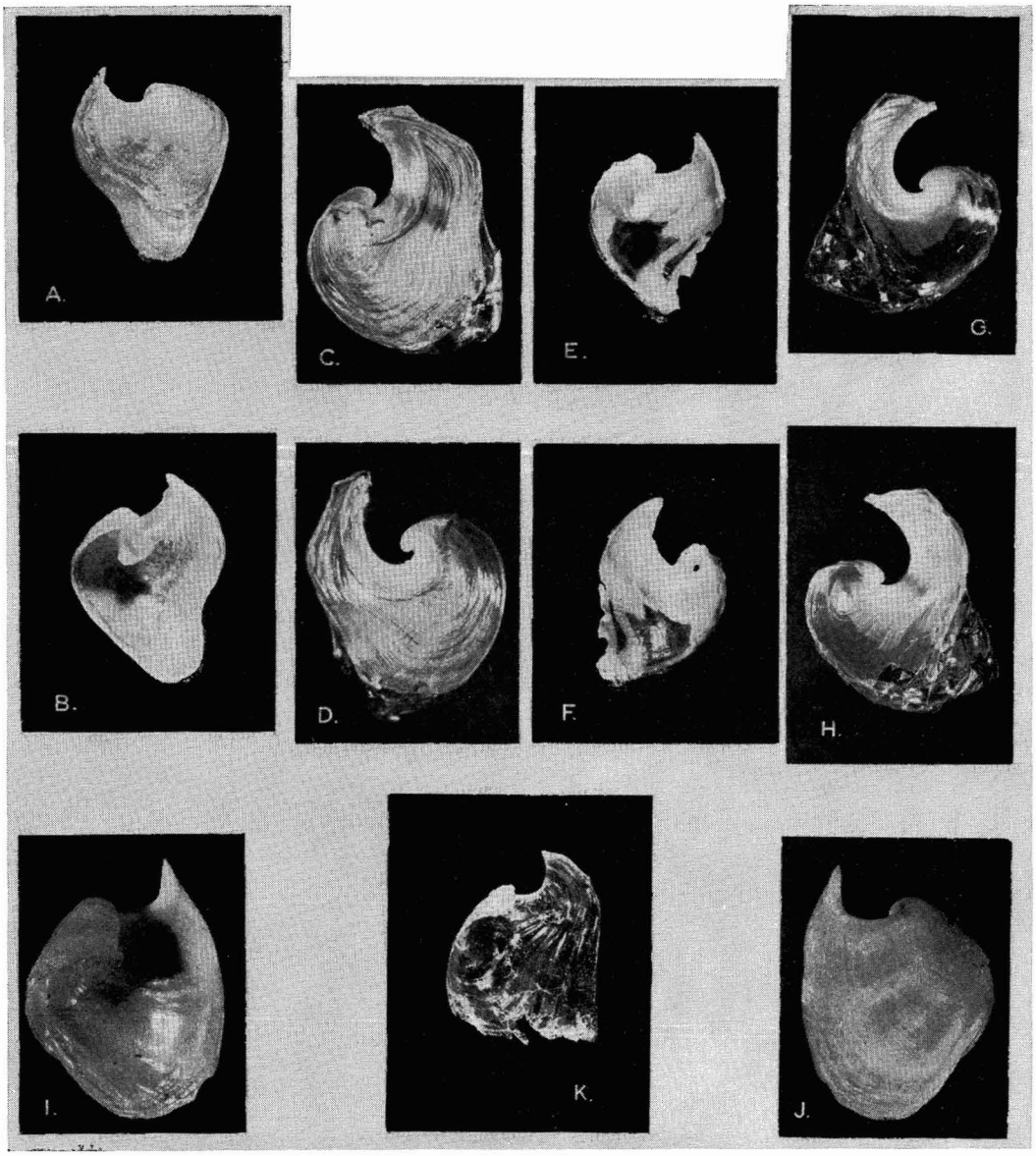

FIG. 14. Shells from *Philinopsis* and *Melanochlamys*. *A, B, Melanochlamys cylindrica,* coll. Narrow Neck, Waitemata Harbour, Auckland, 6 × 5 mm; *C, D, Philinopsis taronga,* coll. Paua Bay, Parengarenga Harbour, northern New Zealand, 7.4 × 5.5 mm; *E, F, Melanochlamys queritor,* coll. Pt. Lonsdale, Victoria, Australia, 4.5 × 3 mm; *G, H, Philonopsis virgo,* holotype, coll. 49 fathoms off Cavalli Island, northern New Zealand, 8.5 × 6 mm; *I, J, Melanochlamys lorrainae,* coll. west side of Puponga Point, Manukau Harbour, Auckland, 8 × 6 mm; *K, Philinopsis pilsbryi,* coll. Kandavu, Fiji, 9 × 7 mm (partly broken).
Photo, G. W. Batt.

add to the taxonomic confusion, it would seem that the various authors were not aware either of the variability of the color patterning or of each other's species names. Two color extremes are illustrated in Fig. 1. The general color of *P. pilsbryi* is white with a brown-black patterning, the ventral surface usually having very little black patterning.

Pease (1860) described *P. nigra* from Hawaii, the color of his specimens being "black, with two large white spots on the anterior end, also two on the headshield and two on the mantle lobe; sides white, and foot white, with three large black spots." This color form is commonly found in Hawaii and Fig. 1 (right) is from a photograph of a specimen from Hawaii.

Bergh's *Doridium alboventralis* is similar in color, though with even more black, and is obviously the same species.

The name *pilsbryi* was first used by Eliot for a specimen from Samoa, which was similar in color to that illustrated in Fig. 1 (left) from Fiji. Eliot's specimen had an unusual greenish tinge rather than the normal white. Specimens seen from the Great Barrier Reef sometimes have an orange-brown tinge which suggests that these tinges are features of individuals rather than of different species.

The Hawaiian color variant was redescribed as a subspecies of *P. pilsbryi* in 1920 by Pilsbry.

Following the strict laws of priority, both *Philinopsis nigra* Pease, 1860, and *Doridium alboventralis* Bergh, 1897, have precedence over *Doridium pilsbryi* Eliot, 1900. However Article 23 (*b*) of the International Code of Zoological Nomenclature allows a senior synonym that has remained unused in the primary zoological literature for more than 50 years to be considered a forgotten name (nomen oblitum). As far as I can ascertain, the name *P. nigra* Pease, 1860, was last used by Pilsbry in 1896.

The name *Doridium alboventralis* Bergh, 1897, has been used twice in the last 50 years. It occurred in a discussion on a specimen of *Philinopsis pilsbryi* from the Red Sea (Marcus and Marcus, 1959) and again in 1966 in a list of species purporting to belong to the genus *Aglaja* by Marcus and Marcus. Neither of these uses would seem to revalidate *Doridium alboventralis*.

Philinopsis pilsbryi Eliot, 1900, however, has been widely used in the literature, often accompanied by details of the anatomy. A few of the major references are: Bergh, 1901; Eliot, 1903; White, 1945; Risbec, 1951. It would only confuse the present situation if we reverted either to *Philinopsis nigra* or *Doridium alboventralis*. I will, therefore, be making a separate application to the Commission on Zoological Nomenclature to have *Philinopsis nigra* and *Doridium alboventralis* placed on the list of rejected names under Article 23 (*b*).

Philinopsis gardineri Eliot, 1903

Fig. 9

SYNONYMY: *Chelidonura velutina* Bergh, 1905, in part (pl. III, fig. 6); *Aglaja splendida* Risbec, Marcus, 1965 (not of Risbec, 1951).

This species was originally described from specimens collected at Rotuma Island in the south Pacific Ocean. Unfortunately the color description of the living specimens had been almost obliterated in the preservative. Eliot described the colors of the preserved animal as "exposed parts of the two largest specimens are of uniform bluish-black, inside of the parapodia gray. The two smaller specimens are brownish and lighter at sides." Other points that Eliot considered important are the long narrow pharynx and the quasi-pinnate nature of the Hancock's organs.

A specimen of *Philinopsis* from Heron Island, Great Barrier Reef, Queensland, made available by Mr. R. Burn, also had a long narrow pharynx, wrinkling on the Hancock's organs, and, in preservative, was a black-gray color. No information on the living animal was available.

Specimens collected in Fiji were also available and in preservative the animal was black, the pharynx was long and narrow, and the Hancock's organs wrinkled. The penis structure was identical to that of Burn's specimen. Since then I have studied a number of specimens collected from Heron Island by Dr. T. E. Thompson. The internal anatomy of these is identical to that of the other material, and in preservative the specimens show a wide variability of pigmentation. Some are whitish gray with dark borders and others are black with lighter borders. According to Dr. Thompson's records, the living animal is a very dark chocolate-brown to black in color, with a royal blue edging to the parapodia and the posterior edge of the posterior shield.

Although the original description of *P. gardineri* is somewhat lacking in detail, the color pattern being important, it would seem that the specimens I have studied from Heron Island and Fiji are identical to those studied by Eliot

from Rotuma Island. The most distinctive features of preserved animals are the quite raised folds on the Hancock's organs, unusual for the family, and the long narrow pharynx. As I have listed further on in this paper, only three species of this genus have such a pharynx and the other two species, *P. pilsbryi* and *P. lineolata,* are quite distinct. It is possible that the Heron Island and Fijian specimens belong to a different species, but, because of the rarity of the narrow pharynx in the group, it would seem most reasonable to consider these forms to be Eliot's *P. gardineri.*

Bergh (1905) illustrated two aglajids which are black with blue edgings under the new name *Chelidonura velutina.* One of these specimens (pl. 3, fig. 5) is, in fact, *Chelidonura varians* Eliot, 1903, and the other (pl. 3, fig. 6) is almost certainly identical to the forms identified here as belonging to *Philinopsis gardineri* Eliot, 1903. Two specimens recorded by Marcus (1965) as *Aglaja splendida* Risbec, 1951, from the Palau Islands, Micronesia, colored black with blue borders, are also most probably *Philinopsis gardineri.* No anatomical evidence, however, is given, making verification impossible. Risbec's *Aglaja splendida,* also belonging to *Philinopsis,* has a different color pattern and the buccal bulb is large and inflated.

Philinopsis cyanea (Martens, 1879)

Fig. 15

SYNONYMY: *Doridium cyaneum* Martens, 1879; *Doridium nigrum* Martens, 1879 (not *P. nigra* Pease, 1860); *Doridium guttatum* Martens, 1880; *Doridium marmoratum* E. A. Smith, 1884; *Doridium capense* Bergh, 1907; *Aglaja iwasai* Hirase, 1936.

I collected 15 specimens of this species in Zanzibar during July 1971, and, as both Eliot (1903) and Macnae (1962) have reported, this species shows a wide range in color variation. I agree with Macnae in synonymizing Martens's three species *Doridium cyaneum, D. nigrum,* and *D. guttatum.* It will be impossible to confirm whether *D. marmoratum* E. A. Smith, from Torres Strait, is identical because it was described from preserved material. Farran's specimens from the Gulf of Manaar, identified as *D. marmoratum,* most certaintly fall within the color range of *Philinopsis cyanea.*

Doridium capense was also described from preserved animals, but Macnae has collected specimens from the type locality (East London, South Africa) which are most probably of Bergh's species. Macnae describes the color as "a rich brown marked and marbled with yellow, orange and white and with parapodia edged with ultramarine and the hindmost end of the headshield tipped with the same blue." Although Macnae considered *D. capense* to be distinct from *D. cyaneum,* specimens I found in Zanzibar illustrated a range of color encompassing both species.

Aglaja iwasai from Japan is also a color variant.

In Fig. 15 I have illustrated, in diagrammatic form, the color range found in specimens collected by me in Zanzibar. Anatomical studies of all color variants showed no differences. The ground color can vary from a light brown, to dark brown, to an almost black deep purplish-brown. Usually the edge of the parapodia, posterior end of the posterior shield, and the central peak of the hind edge of the headshield are blue, but the other color markings vary. A pair of orange lines may be found on the headshield and creamy yellow markings and orange markings may be found on various parts of the body. It is probably the most variable species of the genus, in terms of color markings.

DISCUSSION

In external features *Philinopsis* differs from *Melanochlamys,* an elongate, usually cylindrical form, with small parapodia and blunt posterior edge to the headshield, and from *Chelidonura* A. Adams, 1850, in which the most characteristic feature is the pair of long lobes extending backward from the end of the posterior shield. It also differs from some species of *Aglaja* sensu stricto, Renier, 1807, such as *A. tricolorata* Renier, 1807, where the posterior shield is extended into a thin flagellum.

The most important feature is the form of the reproductive system which differs from all other genera of the Aglajidae. From my studies of *Melanochlamys, Chelidonura,* and *Navanax* and from published information on *Aglaja*

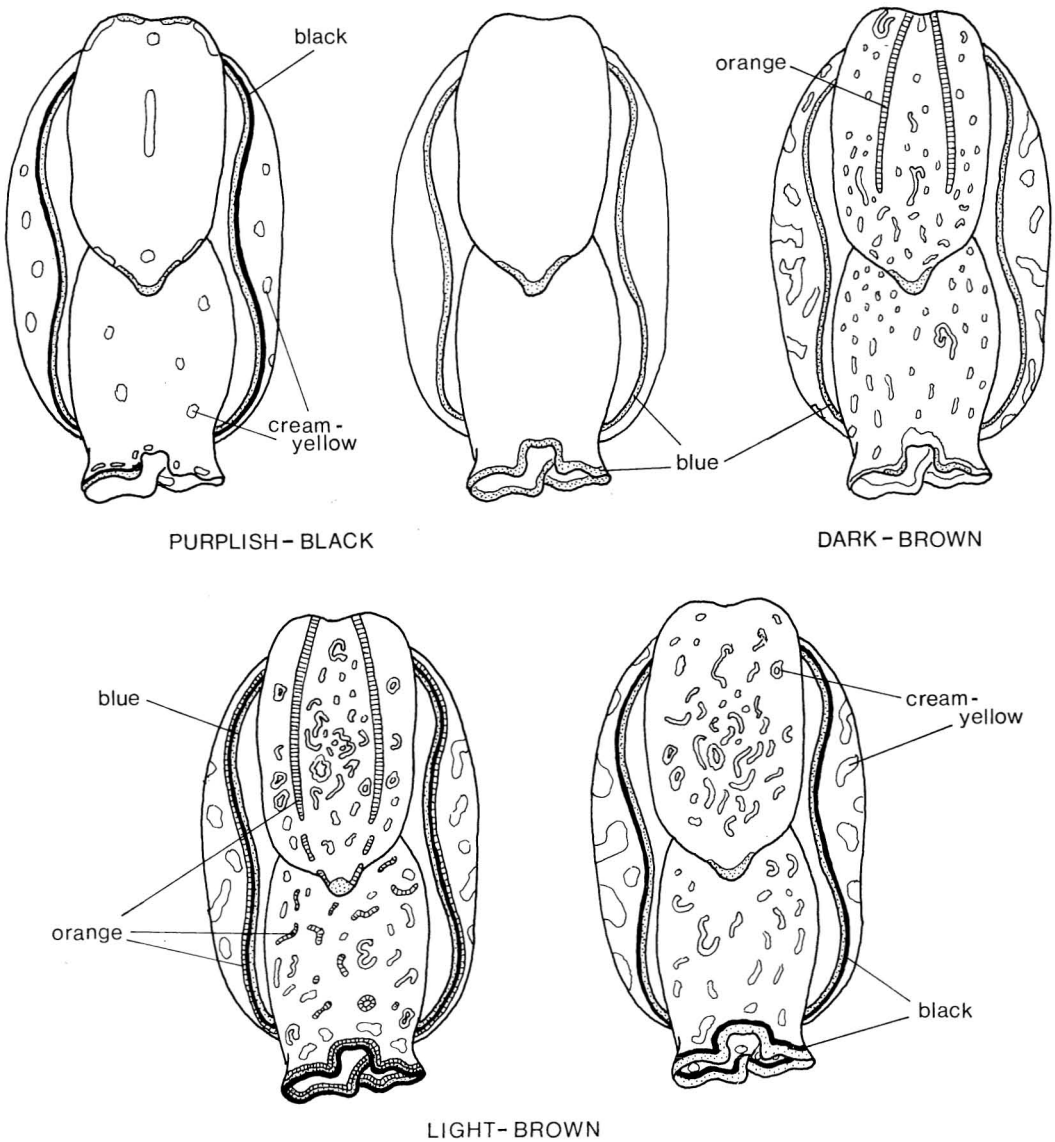

FIG. 15. *Philinopsis cyanea,* showing the range of color found in specimens collected in Zanzibar, July 1971.

(Guiart, 1901), *Philinopsis* is the only genus in which the unbranched spermoviduct and the duct from the exogenous sperm sac both open separately into the genital vestibule.

The shell (Fig. 14) is large and flat with a heavily calcified upper edge; the rest is thinly calcified. It is similar to the shell of *Aglaja* but quite different from the more calcified form possessed by *Melanochlamys* and some species of *Chelidonura.* The species of the genus can be divided into two groups. One group has a huge buccal bulb that is muscular, but thin, and can be partially everted such as in *Philinopsis taronga.* In the other group, the buccal bulb is a long muscular tube as in *P. pilsbryi.* There would seem to be a correlation between the type of buccal bulb a species possesses and the form of the penis. I do not consider that these

differences warrant a separation of the two groups into separate genera, for in all other features they are identical. The *P. taronga* group usually ingest molluscan prey, normally tectibranch opisthobranchs, and, although no information is available, it is probable that the *P. pilsbryi* group are vermivores. I have observed the development of a very similar organ (Rudman, 1969) in the vermivorous toxoglossan gastropods such as *Terebra dimidiata.* Listed in Table 1 are those species of the *Aglajidae* on which sufficient information is available to

TABLE 1

SUMMARY OF SPECIES OF THE AGLAJIDAE ASSIGNED TO *Philinopsis*

GROUP AND SPECIES	DESCRIPTION	LOCATION FOUND
Philinopsis taronga group		
P. ceylonica (White, 1946)	Full anatomy (White, 1946). It is described from preserved animals and may be a synonym of *P. cyanea*	Ceylon
P. cyanea (Martens, 1870)	External features, buccal bulb; feeds on *Haminoea, Atys cylindrica, Bulla ampulla* (Eliot, 1903; Baba, 1937; Macnae, 1962; discussed here). (= *P. capensis,* feeds on annelid worms [Bergh, 1907])	Indo-West-Pacific; South Africa (Macnae, 1962); East Africa (Eliot, 1903; recorded here); Ryukyu Islands, Kyushu Island, Japan (Baba, 1937); New South Wales, Australia (Allan, 1959)
P. gigliolii (Tapparone-Canefri, 1874)	Anatomy described here; color illustrations in Habe, 1964	Kyushu, Shikoku, Honshu, Japan (Habe, 1964); Hainan Island, China (Lin Guang-yu and Tchang-Si, 1965)
P. minor (Tchang-Si, 1934)	Full anatomy, feeds on "small molluscs" (Tchang-Si, 1934)	Coast of China
P. speciosa Pease, 1860	Anatomy described here; feeds on "Bullae" (Pease, 1860)	Hawaii (Pease, 1860; E. A. Kay, personal communication)
P. splendida (Risbec, 1951)	Anatomical description (Risbec, 1951)	New Caledonia
P. taronga (Allan, 1933)	Anatomy described here; feeds on *Haminoea, Philine, Baryspira* (Rudman, in press)	Victoria, New South Wales, Queensland, Australia (Burn, 1966); northern New Zealand (Rudman, 1968)
P. troubridgensis (Verco, 1909)	Anatomy described here	St. Vincent Gulf, Victoria, Australia
P. virgo (Rudman, 1968)	Anatomy described here	Deep water off Cavalli Island, east coast of Northland, New Zealand (Rudman, 1968)
Philinopsis pilsbryi group		
P. gardineri (Eliot, 1903)	External features, buccal bulb (Eliot, 1903); anatomy described here	Rotuma (Eliot, 1903); Fiji; Great Barrier Reef, Queensland, Australia (this paper); Indonesia (Bergh, 1905); Palau Islands (Marcus, 1965)

TABLE 1 (*continued*)

GROUP AND SPECIES	DESCRIPTION	LOCATION FOUND
P. lineolata (H. & A. Adams, 1854)	Anatomical descriptions (Bergh, 1902; White, 1945)	"Australia" (H. and A. Adams, 1854); Thailand (Bergh, 1902); Andaman Islands (White, 1945); Honshu, Japan (Baba, 1949)
P. pilsbryi (Eliot, 1900)	Anatomical descriptions (White, 1945; Risbec, 1951); discussed here	Red Sea (Marcus and Marcus, 1959); Ceylon (White, 1945); Moluccas (Bergh, 1897, as *D. alboventralis*); Hawaii (Pease, 1860 as *P. nigra;* Pilsbry, 1920); New Caledonia (Risbec, 1951); Samoa (Eliot, 1900); Fiji (Bergh, 1901; own observations); Great Barrier Reef, Queensland, Australia (noted in this paper)

assign them correctly to *Philinopsis,* together with other data that are available.

Other described species also probably fall into this genus, but until more is known about them, their status cannot be determined. A full comparative discussion of *Philinopsis, Melanochlamys,* and the other genera of the Aglajidae will appear in a forthcoming paper which will deal with *Aglaja, Chelidonura,* and *Navanax,* the other genera in the family.

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LITERATURE CITED

ADAMS, A. 1850. *In* G. B. Sowerby, Thesaurus Conchyliorum. Vol. 2, p. 561, 601. Sowerby, London.

ADAMS, A., and H. ADAMS. 1858. Genera of Recent Mollusca. London.

ALLAN, J. 1933. Opisthobranchs from Australia. Rec. Aust. Mus. **18**(9):445–450.

———. 1959. Australian shells. Georgian House Pty., Ltd., Melbourne.

BABA, K. 1937. Opisthobranchia of Japan. J. Dep. Agric. Kyushu Univ. **5**(4):195–236.

———. 1949. Opisthobranchia of Sagami Bay. Iwanami Shoten, Tokyo. 194 p.

———. 1960. Opisthobranchia. *In*: Encyclopaedia zoologica, illustrated in colors. Vol. 3, pl. 60, Fig. 13. Hokuryu-kan Publ. Co., Tokyo.

BERGH, R. 1897. Opisthobranchien. Ergebnisse

einer Forschungsreise in den Molukken und Borneo. Abh. Senckenb. Naturf. Ges. **24**(1): 95–130, pl. 12, 13.

———. 1901. Malacologische Untersuchungen. Theil 5, Abtlg. 4, Abs. 3. (Bullacea), Lief. 1, 2. P. 209–312. *In*: C. Semper, Reisen im Archipel der Philippien. Wiesbaden.

———. 1902. The Danish Expedition to Siam 1899–1900. 1. Gastropoda Opisthobranchia. K. Danske Vidensk. Selsk. Ser. 6, **12**(2): 175–179.

———. 1905. Die Opisthobranchiata der Siboga Expedition. Siboga Exped. **50**:1–248.

———. 1907. The Opisthobranchiata of South Africa. Trans. S. Afr. Phil. Soc. **17**:23–30.

BURN, R. 1966. Some opisthobranchs from southern Queensland. J. Malacol. Soc. Aust. **9**:96–109.

CHEESEMAN, T. F. 1881. On a new genus of opisthobranchiate gastropods. Trans. N.Z. Inst. **13**:224.

ELIOT, C. N. E. 1900. Notes on tectibranchs and naked molluscs from Samoa. Proc. Acad. Nat. Sci. Philad. **52**:512–523.

———. 1903. Notes on some new or little known members of the family Doridiidae. Proc. Malacol. Soc. Lond. **5**:331–337.

GUIART, J. 1901. Contributions à l'étude des Gastéropodes Opisthobranches et en particulier des Céphalaspides. Mém. Soc. zool. Fr. **14**:5–219.

HABE, T. 1964. Shells of the western Pacific in colour. Vol. 2. Hoikusha Publ. Co., Japan.

HIRASE, S. 1936. A new *Aglaja* from Japan. J. Conch. **20**(9):258–261.

LIN GUANG-YU, and TCHANG-SI. 1965. Opisthobranchia from the intertidal zone of Hainan Is., China. Oceanolog. Limnolog. Sinica **7**(1):1–19.

MACNAE, W. 1962. Tectibranch molluscs from southern Africa. Ann. Natal Mus. **15**(16): 183–199.

MARCUS, E. 1965. Some Opisthobranchia from Micronesia. Malacologia **3**(2):263–286.

MARCUS, E., and E. MARCUS. 1959. Opisthobranchia aus dem Roten Meer und von den Malediven. Abh. Math.-nat. Kl. Akad. Wiss. Mainz **12**:873–933.

———. 1966. Opisthobranchs from tropical West Africa. Stud. Trop. Oceanogr. Miami **6**(8). 256 p.

MARTENS, E. VON. 1879. Übersicht der von ihm (W. Peters) von 1843 bis 1847 in Mossambique gessamelten Mollusca. Mber. königl. Akad. Wiss. Berlin: 727–749.

———. 1880. Mollusca. *In*: K. Möbius, Beitrage zur Meeresfauna der Insel Mauritius und der Seychellan. Berlin.

PEASE, W. H. 1860. Descriptions of new species of Mollusca from the Sandwich Islands. Proc. Zool. Soc. Lond. **28**:18–36.

PILSBRY, H. A. 1895. *Navarchus* (*Navanax,* a proposed substitution for *Navarchus* preoccupied). Nautilus **8**(11):131.

———. 1896. Manual of conchology. Vol. 16. Acad. Nat. Sci., Philadelphia.

———. 1920. Marine mollusks of Hawaii, 14. Proc. Acad. Nat. Sci. Philad. **72**:360–372.

RENIER, J. 1807. Tavole conoscienti di classificazione Animali. Part 8. Padova, Italy.

RISBEC, J. 1951. Notes sur les tectibranches de Nouvelle Calédonie. J. Soc. Océanist. **7**(7): 123–158.

RUDMAN, W. B. 1968. Three new species of the opisthobranch family Aglajidae from New Zeland. Trans. Roy. Soc. N.Z. Zool. **10**(23):211–216.

———. 1969. Observations on *Pervicacia tristis* (Deshayes, 1859) and a comparison with other toxoglossan gastropods. Veliger **12**(1): 53–64.

———. 1972. On *Melanochlamys* Cheeseman, 1881, a genus of the Aglajidae (Opisthobranchia, Gastropoda). Pacif. Sci. **26**(1): 50–62.

———. In press. Structure and functioning of the gut in the Bullomorpha (Opisthobranchia). Part 4. Aglajidae. J. Nat. Hist.

SMITH, E. A. 1884. Mollusca. *In*: Report on the zoological collections made in the Indo-Pacific Ocean during the voyage of H.M.S. Alert 1881–2, p. 34–116, pl. 4–7. Trustees British Museum, London.

TAPPARONE-CANEFRI, C. 1874. Zoologia del viaggio intorno al globo della regia fragata Magenta, durante gli anni 1865–68. Malacologia (Gasteropodi, Acefali e Brachiopodi). Mem. R. Accad. Torino **2**(28).

TCHANG-SI. 1934. Contribution à l'étude des opisthobranches de la côte de Tsingtao. Contr. Inst. Zool. Acad. Peiping 2(2):1–139.

VERCO, J. C. 1909. Notes on South Australian Mollusca. Proc. Roy. Soc. S. Aust. 33:270.

WHITE, K. 1945. On two species of *Aglaja* from the Andaman Islands. Proc. Malacol. Soc. Lond. 26(4):91–102.

———. 1946. On a new species of *Aglaja* from Ceylon. Proc. Malacol. Soc. Lond. 26(6): 167–172.