ELASIPOD HOLOTHURIANS OF ANTARCTICA
I. GENUS *AMPERIMA* PAWSON 1965

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INTRODUCTION

The USNS *Eltanin*, laboratory ship of the United States Antarctic Research Program of the National Science Foundation, began intensive investigation of Antarctic waters in 1962. Leaving from Valparaiso, Chile, July 5, the ship carried out considerable sampling between 20° and 130° W. longitude, representing ten cruises (4 to 13) of which six are presented here. The six cruises covered an area bounded by 35° W. longitude and 120° W. longitude with all the 15 stations at 55° S. latitude (Fig. 1). These six cruises comprise 623 stations, 15 of which revealed species not only of the genus *Amperima* but of several other genera of benthic elasipod holothurians. Specimens were taken by a five- or ten-foot Blake Trawl fitted with a net with a mesh opening of ½ inch (1.25 cm.) or by a rock dredge.

Species of the genus *Amperima* (=*Periamma* Perrier, 1896) have been recorded from waters of the Indo-Pacific Oceans. A new species of the genus, *Amperima tui* Pawson (1965a), was collected recently North of New Zealand and another species *Amperima naresi* (Theel) was reported from the Sunda Trench (Hansen, 1956).

Most species of *Amperima* live in depths of over 3000 meters (Madsen, 1953). The deepest, however, was collected at about 7160 meters in the Sunda Trench by the Galathea Expedition (Hansen, 1956) and the new species described by Pawson (1965b) was taken at about 1120 meters. *Eltanin* specimens were procured from depths between about 131 and 4450 meters.

MATERIALS AND METHODS

A total of 163 specimens representing three species of the genus, one new to science, are here discussed. These specimens were collected south of the Antarctic Convergence in South Pacific Ocean.

Calcareous spicules were studied in slide preparations of portions of skin taken from different parts of the body; *i.e.*, the dorsal and ventral sides, the tentacles and tubefeet. These portions of skin were placed in 100% ethyl alcohol for about five minutes and then trans-

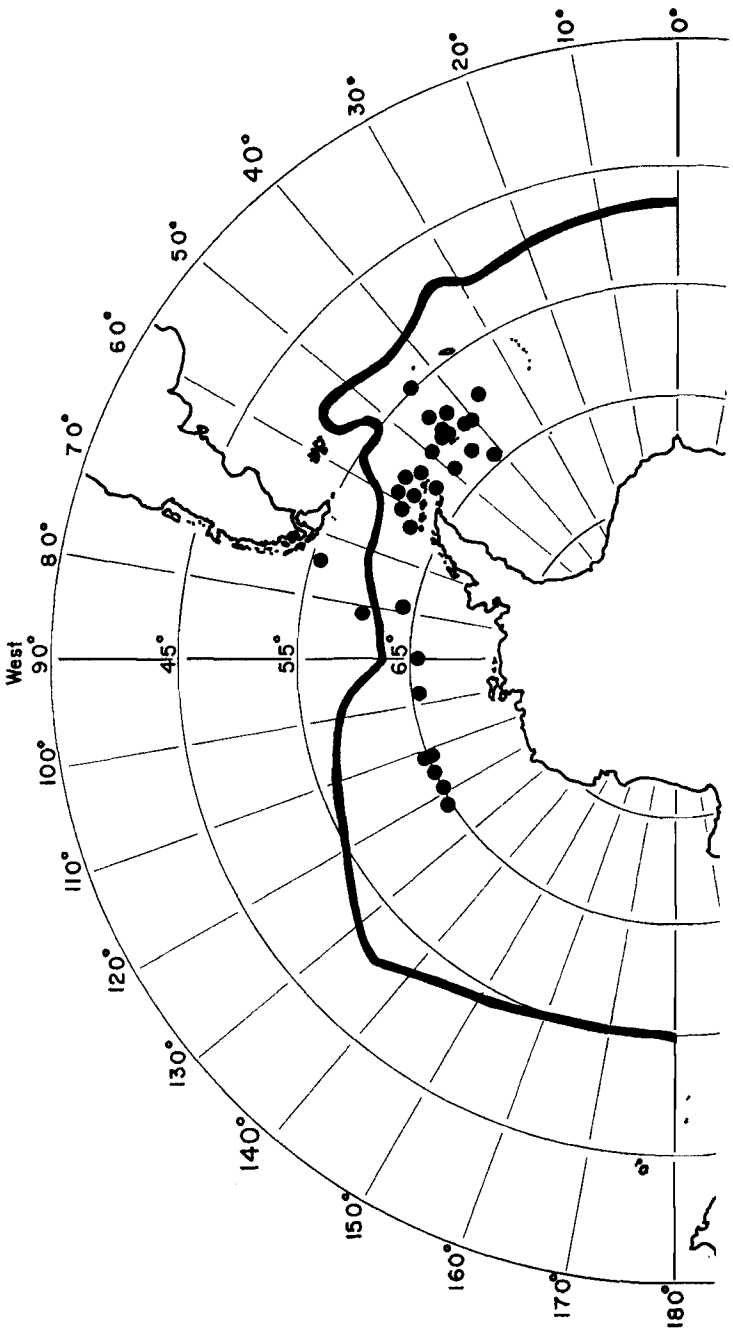

Figure 1. Map showing stations where elasipodid holothurians were collected.

ferred to toluene until cleared. Permount was used for permanent mounts.

The abbreviations AHF, USC and USNS stand for Allan Hancock Foundation, University of Southern California and United States Naval Ship.

Class HOLOTHUROIDEA
Order ELASIPODIDA
Family *Elpidiidae* Theel 1882

Amperima Pawson 1965 = *Periamma* Perrier, 1896 (see Pawson, 1965 for reasons); *Scotoplanes* Theel, 1882 (in part) and *Peniagone* Theel, 1882 (in part).

Diagnosis: Body oval to elongated. Tentacles ten, surrounding mouth. Anterior part of dorsal surface provided with a transverse row of papillae united at their bases and followed, oftentimes, by a few rudimentary processes. Ventral surface, on each side, carries a number of tubefeet distributed either along entire sides or restricted to only posterior half of body. Calcareous deposits include C-shaped bodies, three-armed spicules, and straight and curved rods.

Type species: *Amperima roseum* (Perrier, 1896).

Remarks: The genus *Amperima* is cosmopolitan. It consists of seven species, five of which are known from the Indo-Pacific Oceans.

Amperima robustum (Theel) 1882

Scotoplanes robustum Theel, 1882, p. 35-36; pl. VI, figs. 1-3; pl. XXXIV, figs. 6 and 7.

Material examined:

AHF, USC *Eltanin* station 393; Atlantic Ocean Drake Passage and Scotia Sea; Lat. 57°57′4″–58°43′1″ S., Long. 55°57′8″–55°47′9″ W.; December 28, 1962; depth 4008 meters; 1 specimen.

AHF, USC *Eltanin* station 413; North East of Drake Passage; Lat. 62°07′–62°07′9″ S., Long. 55°57′8″–55°47′1″ W.; January 1, 1963; depth 1,153 meters; 3 specimens.

AHF, USC *Eltanin* station 430; Moore Bay, Farlane Strait; Lat. 62°38′4″–62°40′8″ S., Long. 59°36′5″–59°23′1″ W.; January 7, 1963; depth 1,409 meters; 28 specimens.

AHF, USC *Eltanin* 474; Ushuaia Harbor, Argentina; Lat. 55°56′0″–56°24′5″ S., Long. 44°42′5″–44°52′0″ W.; February 13. 1963; depth 3,486 meters; 5 specimens.

Description: Body elongate, about twice as long as broad; mouth ventral; anus dorsal. Tentacles with smooth circular ends. Dorsal surface slightly convex, ventral surface almost flat. On anterior part of dorsal surface a transverse lobe with four distinct projections with central pair slightly larger than other two. Two very small processes shortly behind the base of lobe. Ventral margins with eleven pairs of tubefeet restricted to posterior half of body. Tubefeet discrete, decreasing in size toward posterior end of body.

Calcareous deposits largely dissolved but (in some animals) traces of the deposits can still be found consisting of three types: spinous three-armed bodies, C-shaped spicules, and curved and straight rods. C-shaped and three-armed bodies in the body wall while rods found in terminal ends of tentacles and tubefeet.

Calcareous ring similar to that of other species of *Amperima*. Skin smooth, thin, and soft. Color in alcohol light brown.

Remarks: Specimens are similar, in both external and internal aspects, to Theel's (1882) species.

Distribution: The above species is found in the Indo-Pacific Oceans.

Amperima naresi (Theel)
Figures 2 and 3

Peniagone naresi Theel, 1882, p. 47-49; pl. IX, figs. 1-2; pl. XXXIII, fig. 15.

Periamma naresi Hansen, 1956, p. 38-40; figs. 7 and 9.

Material examined:

AHF, USC *Eltanin* station 35, North end of Peru-Chile Trench, Lat. 8°23′0″–8°21′0″ S., Long. 81°03′1″–81°04′1″ W.; July 8, 1962; depth 4,240 meters; 21 specimens.

AHF, USC *Eltanin* station 469; Ushuaia Harbor, Argentina; Lat. 55°01′5″–55°10′5″ S., Long. 44°20′5″–44°23′0″ W.; January 12, 1963; depth 3,623 meters; 5 specimens.

AHF, USC *Eltanin* station 525; Weddell Sea, Antarctic Circle; Lat. 66°22′6″–66°20′4″ S., Long. 45°48′7″–45°51′7″ W.; February 27, 1963; depth 4,204 meters; 7 specimens.

AHF, USC *Eltanin* station 511; Weddell Sea, Antarctic Circle; Lat. 63°09′7″–63°17′5″ S., Long. 45°04′2″–45°01′5″ W.; February 24, 1963; depth 2,010 meters; 1 specimen.

AHF, USC *Eltanin* station 529; Eastern Pacific, Antarctic Basin;

Lat. 63°03′1″–63°0′ S., Long. 49°10′5″–49°20′0″ W.; March 3-4, 1963; depth 2,941 meters; 5 specimens.

AHF, USC *Eltanin* station 995; Eastern Bransfield Straits, South West of Elephant Island; Lat. 61°57′–61°52′5″ S., Long. 55° 53′0″–55°47′0″ W.; March 14, 1964; depth 2,562 meters; 12 specimens.

Description: Material from station 35: Body very elongate, almost cylindrical in shape. Largest specimen about 60 mm. long, 25 mm. broad; smallest about 25 mm. long, 10 mm. broad. Mouth anterior, subventral; anus terminal, posterodorsal. Tentacles of about equal length, terminal discs with small retractile processes, marginal processes largest. Dorsal surface strongly vaulted, ventral surface slightly convex, with four papillae (Fig. 2A) about 15 mm. from anterior end of body. Papillae united at base, in a transverse curved row. Two central papillae, (about 8 mm.) larger than outer papillae (4 to 6 mm.). Three to four mm. posterior to lateral papillae a pair of very small processes about 2 mm. long. Midventral radius naked; lateral radii each with a single row of eight to ten small conical tubefeet. First anterior pair, in largest specimen, located 15 to 22 mm. from crown of tentacles. Tubefeet present on posterior two thirds of body with last two pairs at posterior end united at base while others separated from each other.

Skin very soft, thin, translucent. Color in alcohol usually brown to light brown, occasionally somewhat greenish.

Integument with numerous, crowded calcareous deposits, comprising large and small spinous cross-shaped spicules, spinous three-armed bodies, curved, straight, and irregularly branched rods, and small, short C-shaped rods. C-shaped spicules varying in shape and degree of curvature, thickly scattered in all parts of body. Regular C-form with enlarged central part and a single process (Fig. 2C) most abundant. S- and Y-shaped bodies also occasionally present in body (Figs. 2B, D).

One specimen in station 469 has dorsal surface vaulted with an extremely large transverse lobe (Fig. 3A) on anterior part of body, its upper margin missing but might possibly possess four small projections. Behind base of lobe two small processes. Ventral surface slightly convex.

Elements in tubefeet and tentacles, except those at their distal extremities, similar to those found in body but smaller. At tips of tubefeet and tentacles some straight spinous rods (Figs. 2G, H, L,

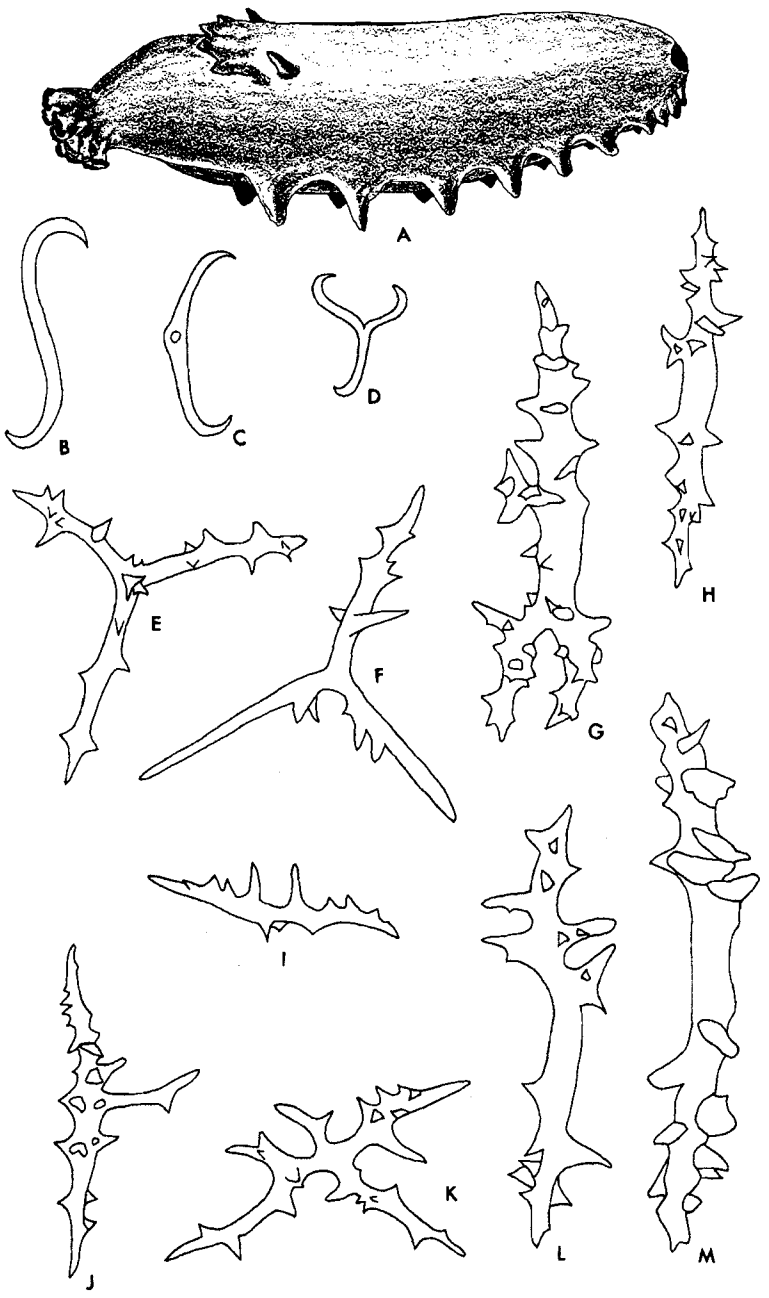

Figure 2. Amperima naresi (Theel). A. Side view, X3; B-D. Variations of the C-shaped deposits from the body wall, X40; E-F. Three-armed deposits from the body wall, X40; G-H, L-M. Rods deposits from the ends of both tentacles and tubefeet, X-40; I-K. Branched rods deposits from the body wall, X40.

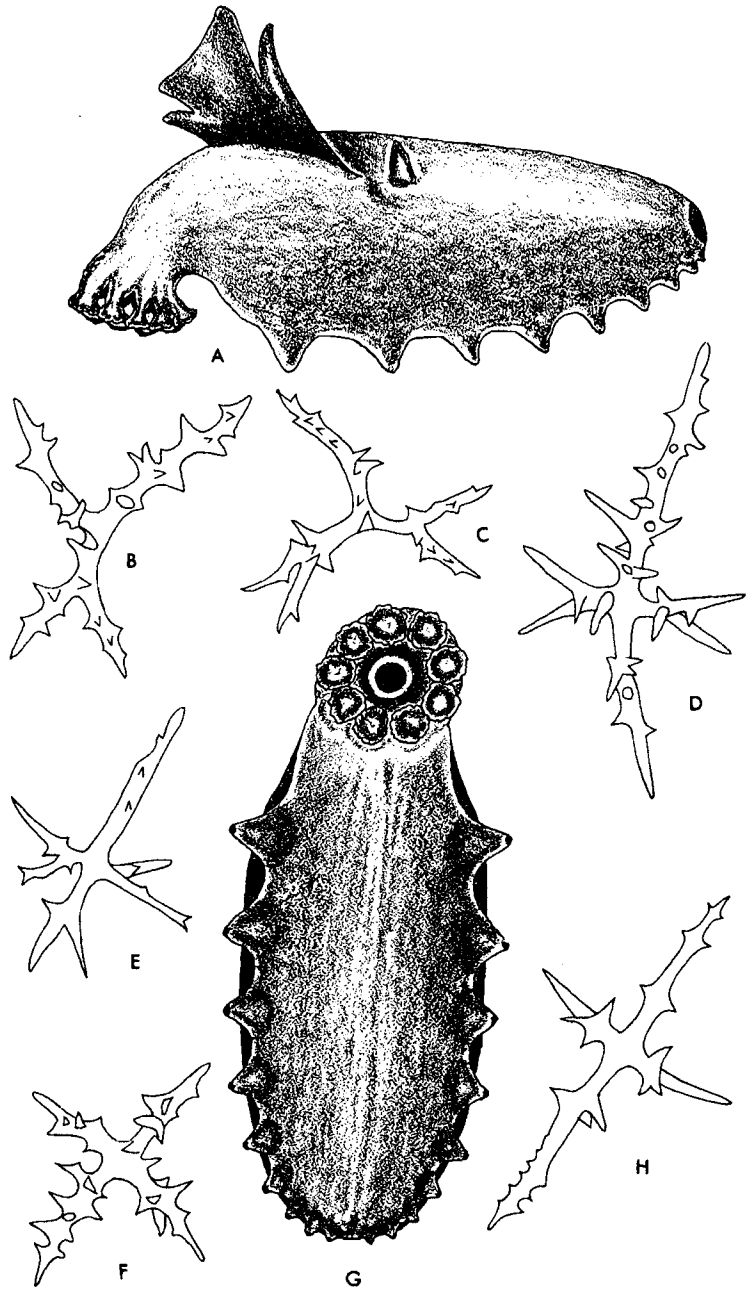

Figure 3. Amperima naresi (Theel). A. Side view, X2½; B-C, E. Branched rods deposits from the body wall, X40; F, H. Cross-shaped deposits from the body wall, X40; G. Ventral view, X2½.

M) present. Three-armed (Figs. 2E, F) and cross-shaped (Figs. 3D, F, H) bodies, branched and irregularly branched rods (Figs. 2C, I-K; Figs. 3B, C, E) more scattered; both three-armed and cross-shaped deposits sometimes with ends of arms branched.

Calcareous ring a delicate network. One single large, oval Polian vesicle. Intestine forming an elongated loop occupying most of body cavity. This loop connected to lateral interradii by strong thread-like muscles. Rectum attached to lateral interradii and to right ventral interradius of venter.

Longitudinal muscles thick, light green in alcohol. Circular muscles strongly developed. Gonad made up of large, single fascicle which gives rise to bundles of small, oval close-set caeca. Genital duct opens to exterior adjacent to stone canal, about 4 mm., posterior to base of tentacles on anterior part of dorsal surface.

Material from stations 469, 511, 525, 529, and 995: Body oval to globular. Largest specimen about 75 mm. long, 45 mm. broad; smallest about 25 mm. long, 18 mm. broad. Tentacles provided with large terminal discs with numerous retractable processes on surfaces and around margins. Dorsal surface convex; ventral side nearly flat. Anterior part of dorsal surface with four papillae, their ends appearing only on upper margin of a well developed transverse lobe. Two to four mm. posterior to second lateral papillae a pair of rudimentary processes. Along each ventrolateral margin a single row of nine tubefeet (Fig. 3G).

Color in alcohol usually brown to purple, rarely yellowish white. Calcareous deposits consist mostly of small spinous triradiate bodies, unbranched and irregularly branched spicules and C-shaped rods.

Remarks: The latter description shows peculiarities of the specimens which make them slightly different from animals in station 35. Size and formation of the dorsal papillae is one of distinct differences among the described specimens but this is not unusual in this particular species. The same variation in size and shape of the velum were observed by Hansen (1956) in the "Galathea" collection.

Distribution: The species is known from both the Indian and Pacific Oceans.

Amperima velacula, new species
Figures 4, 5, and 6

Holotype: AHF 1966-10, 1 specimen (50 m. long.); USC *Eltanin* station 480; South Scotia Ridge; Lat. 58°06′–58°10′ S., Long. 44°55′5″–44°47′ W.; February 15, 1963; depth 2,837 meters.

Paratypes: AHF 1966-10, 3(25-50 mm.); USC *Eltanin* station 913; Mid-Pacific, Antarctic Basin; Lat. 65°48′–65°39′ S., Long. 115°–114°55′ W.; January 1, 1964; depth 4,773 meters.

AHF 1966-10 25 mm.; USC *Eltanin* station 411; South West of Elephant Island, South Shetland Island, Antarctic; Lat. 61°18′–61°19′5″ S., Long. 56°08′5″–56°10′2″ W.; January 1, 1963; depth 131 meters.

Additional material:

AHF 25 mm.; USC *Eltanin* station 579; South Georgia Island; Lat. 57°19′–57°22′2″ S., Long. 23°08′5″–23°10′2″ W.; April 21, 1963; depth 4,538 meters.

AHF 7(18-28 mm.); USC *Eltanin* 913; Mid-Pacific, Antarctic Basin; Lat. 65°48′–65°39′ S., Long. 115°–114°55′ W.; January 1, 1964; depth 4,773 meters.

AHF 25 mm.; USC *Eltanin* station 1,135; South Pacific Ocean; Lat. 66°17′–66°19′3″ S., Long. 98°28′5″–98°37′5″ W.; June 9, 1964; depth 4,630 meters.

AHF 5(18-25 mm.); USC *Eltanin* station 1146; Bellingshausen Sea; Lat. 65°56′–65°54′ S., Long. 112°30′–112°56′ W.; June 14, 1964; depth 4,850 meters.

AHF 51(5-30 mm.); USC *Eltanin* station 1148; Bellingshausen Sea; Lat. 65°14′3″–65°25′3″ S., Long. 117°29′5″–117°29′ W.; June 15, 1964; depth 4,850 meters

AHF 6(20-30 mm.); USC *Eltanin* station 411; South West of Elephant Island, South Shetland Island, Antarctic; Lat. 61°18′–61°19′5″ S., Long. 56°08′5″–56°10′2″ W.; January 1, 1963; depth 131 meters.

Diagnosis: *Amperima velacula* is characterized by the following features: deposits of various forms; *e.g.*, cross-shaped bodies, four-armed spicules, irregularly branched rods, and numerous 0-shaped spicula. Tubefeet 9 to 10 on each side. Dorsal papillae 6, of which the distal ends of 4 appear only on upper margin of a well developed transverse lobe and the other two placed either immediately behind the base or attached to base of ridge.

Description: Body shape from globular to elongated oval. Largest specimen about 50 mm. long and about 25 mm. broad at widest part; smallest specimen about 10 mm. long and about 5 mm. in breadth. Mouth anterior, subventral; anus posterodorsal. Two most ventral tentacles slightly shorter than rest. Size of discoidal ends of tentacles varies with size of animals. Tentacles discs with minute retractable processes on surface and around margins. Dorsal surface convex; ventral surface slightly flat. On anterior section of dorsal surface a thin transverse ridge bearing on upper margin four papillae (Fig. 4A); two central papillae slightly larger than other two. Distance of ridge from anterior end of body varies from about 4 to 10 mm. Posterior to base of ridge a rudimentary pair of processes. These processes sometimes attached at base of ridge and sometimes slightly behind it. Ridge of papillae measures about 2 to 4 mm. long and about 3 to 6 mm. broad. Midventral radius naked, ventrolateral radii each with a single row of 9 to 10 small, conical tubefeet. Anterior and some posterior tubefeet distinctly separated from each other while those near and around posterior end closely set and sometimes joined at base.

Skin thin, soft, and translucent. Of 76 specimens investigated, 58 possess, aside from small regular C-shaped elements, numerous minute 0-shaped bodies (Fig. 4E). These bodies thickly distributed in all parts of body except at ends of both tentacles and tubefeet. Average size of these spicules about 0.015 mm. in diameter. Remaining specimens lack 0-shaped deposits but possess regular C-shaped elements (Fig. 4H), have an average size of about 0.07 mm. In all specimens occasional S-shaped and Y-shaped bodies (Figs. 4F, G) also present in both dorsal and ventral sides. Rare, small wheels (Fig. 4C) with nine to eleven spokes usually present in ventral skin. In both dorsal and ventral sides, large, spinous triradiate (Figs. 4B, D) spicules thinly scattered, their arms mostly slender and long, straight and curved. One or two of some three-armed bodies bifurcated and usually one arm longer than other. Other deposits, cross-shaped (Fig. 5C) and three-armed (Fig. 5B), their arms short and very broad with extremely large spines heavily distributed along sides. Deposits with irregular spinous arms (Figs. 5A, D) occasionally present in body. Aside from spinous three-armed spicules, smooth, small ones present in inner part of skin. These smooth bodies very thinly scattered in integument. Branched, straight, and curved rods (Figs. 5A, B, E, F) including four-armed (Fig. 5G) elements present in tentacles. Branched and curved rods with large, irregularly distributed spine with arms of branched rods scattered more or less along sides and ends. Tubefeet, deposits similar to those in tentacles but much longer and more slender curved rods with smaller spines (Figs. 6C, D, E). Beside these rods few irregular triradiate (Fig. 6F) spicules found too.

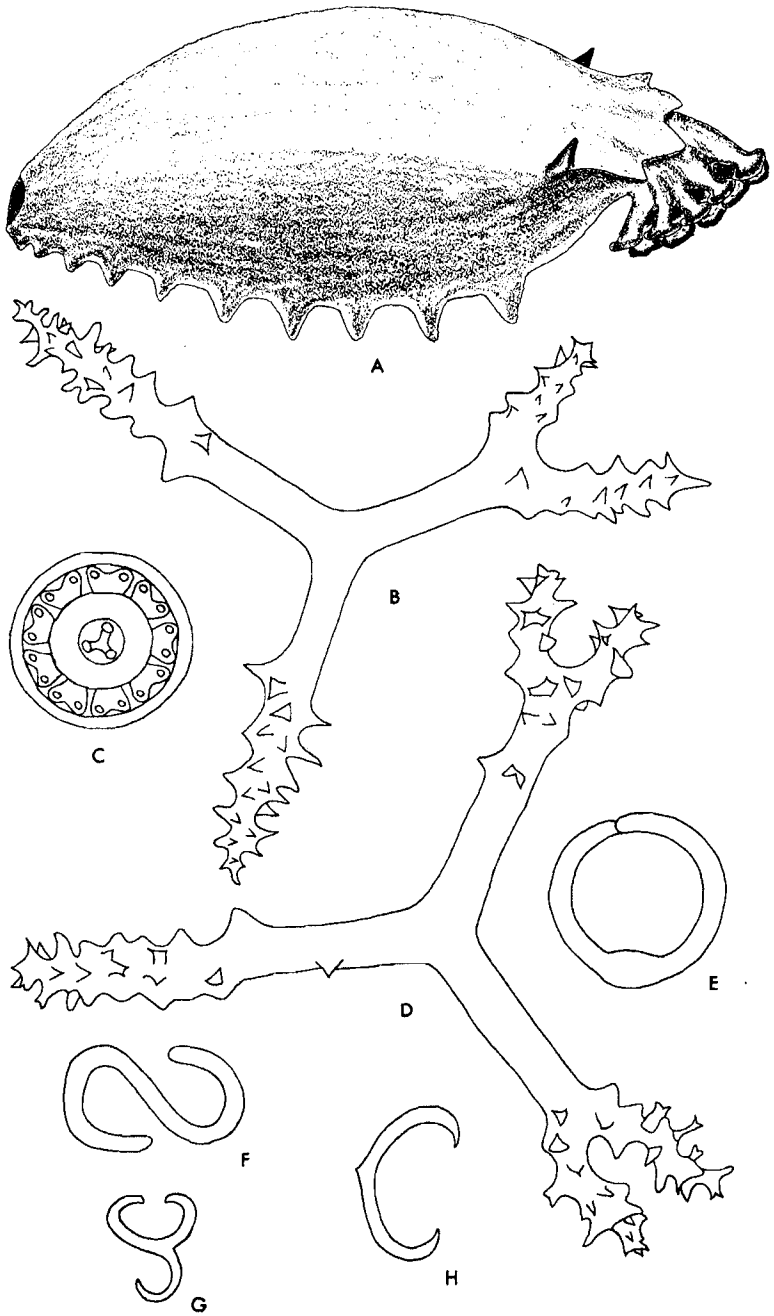

Figure 4. Amperima velacula, new species. A. Side view, X5; B-D. Three-armed deposits from the body wall, X40; C. Wheel deposit from the ventral skin, X40; E-H. Variations of the C-shaped deposits from the body wall, X40.

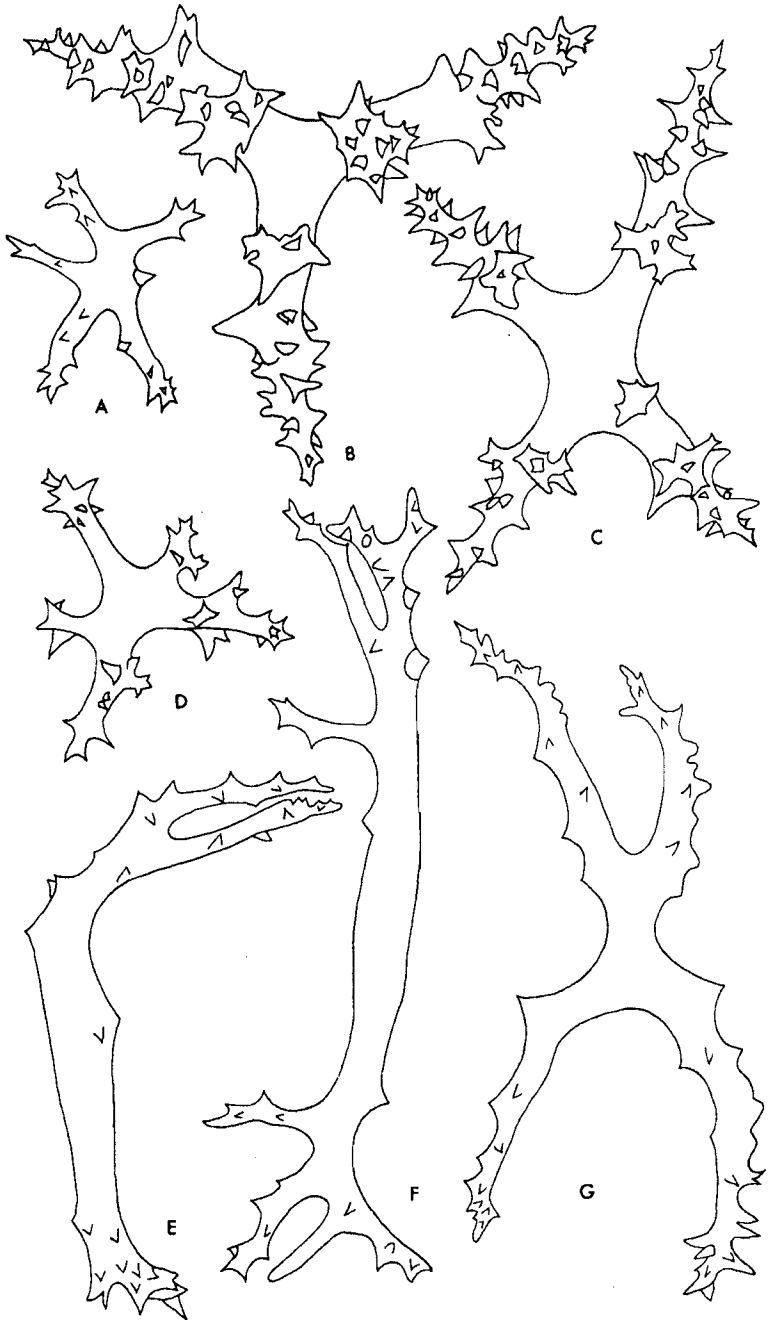

Figure 5. Amperima velacula, new species. A, D. Branched rods deposits from the body wall, X40; B. Three-armed deposit from the body wall, X40; C. Cross-shaped deposit from the body wall, X40; E-G. Branched and four-armed deposits from the ends of the tentacles, X40.

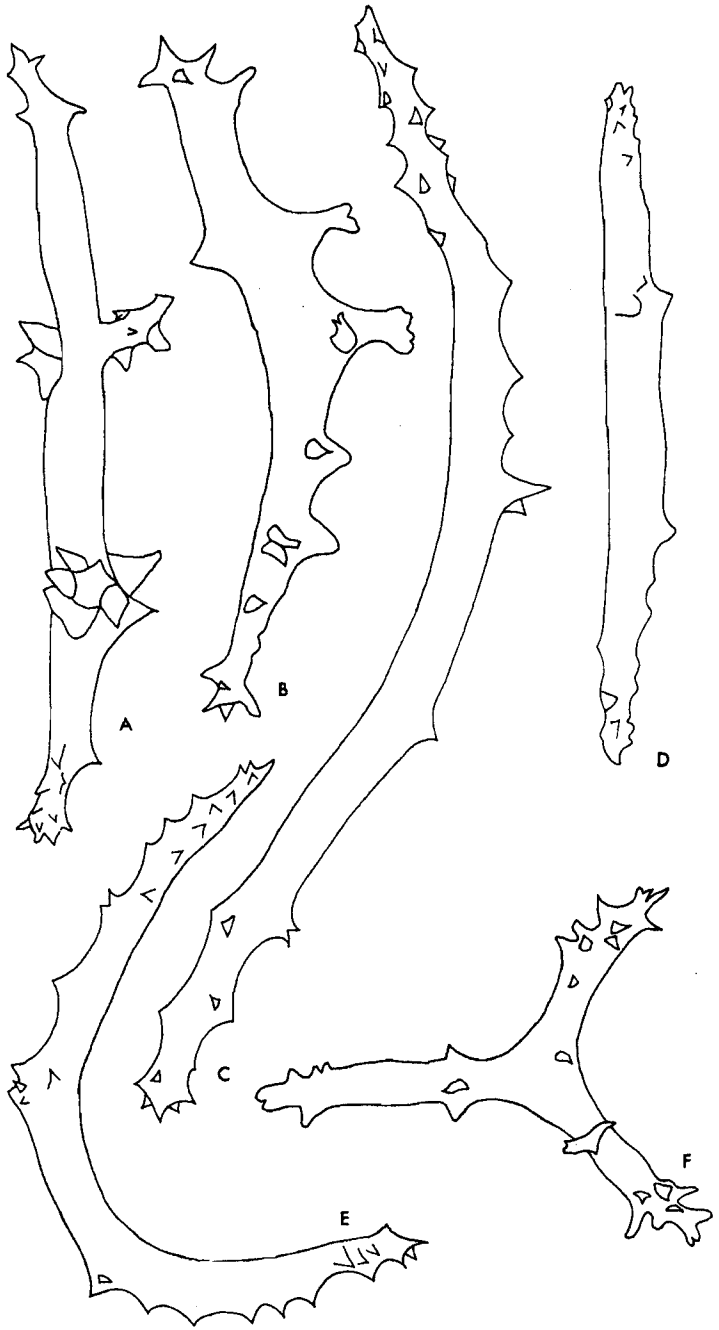

Figure 6. Amperima velacula, new species. A-B. Rods deposits from the ends of the tentacles, X40; C-E. Rods deposits from the ends of the Tubefeet, X40.

A single, elongated, white transparent Polian vesicle present. Gonad made up of single, large bundle provided with numerous small caeca. Genital duct opens adjacent to opening of stone canal between crown of tentacles and base of transverse lobe.

Large intestine with single loop, occupying posterior half of body cavity and supported by string-like bands individually attached in lateral interradii. Rectum connected to both left and right sides of ventral surface by tiny muscles. Longitudinal muscles yellowish and well developed, circular muscles weak.

Remarks: *Amperima robustum* (Theel) resembles *A. velacula* in nature of calcareous elements and number of dorsal papillae, but the species differ distinctly in the following respects: *A. robustum* has deposits composed of three-armed bodies; straight, curved and branched rods and regular C-shaped spicules while *A. velacula* has, aside from the above types of deposits, cross-shaped and four-armed spicules and other deposits with four or more irregular arms. In tubefeet, the former has 22 restricted to only the posterior half of the body while the latter has 18 to 20 distributed to about two-thirds from posterior end of body. The dorsal papillae of *A. robustum* are distinct and somewhat conical in shape projecting clearly from a very low ridge while those in *A. velacula* are vestigial and only their pointed tips appear on upper margin of a broad lobe. This lobe appears serrated at the place where the processes project.

Kolga furcata Herouard (1902) is somewhat similar with the specimens described here in number and shape of dorsal papillae, but *K. furcata* differs significantly in that it has 8 to 9 tubefeet along each of its ventrolateral margins while *A. velacula* has 9 to 10. In calcareous deposits, the former has mostly straight, curved and branched rods and few three-armed bodies. The latter, on the other hand, has more other types of elements besides the above forms discussed in the preceding presentation.

The sporadic presence of wheel spicules is not unusual in various other elasipodid. Ikman (1925) made a study of their nature and found them to be juvenile in character, hence, no consideration should be given as to their presence or absence when classifying such animals.

Distribution: The new species, being found in the Pacific Ocean, is possibly also present in the Indian Ocean. In the study of the generic content of the Tertiary and Recent echinoderm fauna of New Zealand and Australia, Fell (1953) found that Australia and New

Zealand have many characteristics at the generic level in common with those elements found from the regions of Northern Indian and Pacific Oceans.

Origin of name: from the Latin words, *vela*=vail and *cula*=little. *Velacula*=little vail.

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UNDERWATER SOUNDS ASSOCIATED WITH AGGRESSIVE BEHAVIOR IN DEFENSE OF TERRITORY BY THE PINFISH, *LAGODON RHOMBOIDES*

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The pinfish, *Lagodon rhomboides* (Linnaeus), a member of the family Sparidae, is probably one of the most common nonpelagic fishes along the mainland shores of the southeastern United States in vegetated, inshore, open marine habitats (Caldwell, 1957: 79). As further discussed by Caldwell (p. 147 f.), some, but not all, of this species are often highly territorial and frequently display considerable energy in the defense of their territory. The defense, usually by the larger fish of a group, consists of a vigorous chasing of the intruder by the defender, and special vigor is directed toward other pinfish that invade the territory. Rarely, if ever, are other fishes, or invertebrates, attacked. The territory seems usually to consist of a patch of bottom vegetation, an area around a rock of other piece of detritus, or even a patch of clear bottom. While the water immediately over the territory is defended for some distance, a section of open water in itself apparently is not defended as a territory. This territorial defense, seen both in captive and wild animals, is often most obvious to the casual observer from the surface on sunny days when the swiftly-moving fish (either those chasing or the ones being chased) turn on their sides in their maneuvers so that the light reflects off their silvery sides.

Underwater sound production is being investigated extensively today and a concerted attempt is being made to catalog and identify sounds of biological origin. As the following sounds made by the pinfish may contribute heavily to the total sound produced in certain areas, they are discussed and figured, and the concurrent behavior described.

On June 21, 1965, while recording various captive marine vertebrates at Florida's Gulfarium, Fort Walton Beach, we noticed considerable activity in a tank of several hundred gallons capacity con-