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Six New Tropical Sternaspid Species (Annelida, Sternaspidae) with Keys to Identify Genera and Species

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Sergio I. Salazar-Vallejo (2017) The study of tropical specimens of Sternaspidae (Annelida) in five museum collections allowed the recognition of six undescribed species. The species newly described are *Caulleryaspis villamari* sp. nov. from Peru, *Petersenaspis deani* sp. nov. from Pacific Costa Rica, *P. harrisae* sp. nov. from South Africa, *Sternaspis lindae* sp. nov. from the Gulf of Panama, *S. londognoi* sp. nov. from the Southern Caribbean Sea, and *S. sherlockae* sp. nov. from the Red Sea. Updated keys to identify sternaspid genera, and to species in each genus are included.

Key words: Shallow water, Sediments, Morphology, Taxonomy, Polychaetes.

BACKGROUND

The study of sternaspid polychaetes has been encouraged thanks to a recent revision (Sendall and Salazar-Vallejo 2013) that modified the contents in the family. There are currently three genera, instead of a single one, and the standardized characteristics for shields, and other body structures led to the recognition of about 20 species, and more are being found and described, and some other studies dealing with ecology, morphology or feeding biology have been published.

Salazar-Vallejo and Buzhinskaja (2013) described 6 abyssal species from the Pacific and provided a key to identify species in the three genera; three other species were described from Polar environments (Salazar-Vallejo 2014b), and an updated key to identify species of *Sternaspis* Otto, 1821 was also included. Four other contributions dealt with tropical and subtropical sternaspids. A *Sternaspis* species was described from the Philippine Islands (Salazar-Vallejo 2014a); two other *Sternaspis* species were described from China (Wu et al. 2015); four new species from the South China seas were described including one in *Petersenaspis* Sendall & Salazar-Vallejo, 2013, and three others in *Sternaspis* (Wu and Xu 2017); and five species were recorded for Vietnam, including three new species of *Sternaspis* (Zhadan et al. 2017). Another recent contribution dealt with a new species from austral Chilean fjords (Díaz-Díaz and Rozbaczylo 2017) which included a map with all described species.

A detailed morphometric study of the shields of three sternaspid species, together with analysis of distribution and depth data, was made by Méndez and Yáñez-Rivera (2015). Zhadan et al. (2017) clarified some problems in sternaspid morphology. The three more relevant external features are: First, the hooks present in the introvert are really neurochaetae; notochaetae are brittle and very small. Second, peg chaetae are made of a complex set of very abundant, closely packed delicate chaetae, embedded in a common sheat. Third, the anal peduncle is retractable,

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and carries abundant long, delicate papillae. Yoshino et al. (2016) studied the life history pattern of *S. costata* von Marenzeller, 1879 in Japan. They found that the species lives one year, is semelparous and concentrates its reproduction in September.

In this contribution, six new sternaspid species are described from tropical regions, mostly from shallow water. Updated keys to identify genera in the family, and to species in the three genera, are also included.

MATERIALS AND METHODS

In the following descriptions, the modifications proposed by Zhadan et al. (2017) have been made. Further, because there is no other shield along sternaspids body wall, they will be referred to as shields, because they are always placed over the ventral surface and in a posterior region.

Abbreviations

The following abbreviations are used in the text: BMNH: The Natural History Museum, London, England. LACM: Natural History Museum of Los Angeles County, Allan Hancock Foundation Polychaete Collection, USA. MNHN: Muséum National d'Histoire Naturelle, Paris, France. UMML: University of Miami, Rosenstiel School of Marine and Atmospheric Science, Museum of Marine Invertebrates. USNM: National Museum of Natural History, Smithsonian Institution, Washington, USA.

RESULTS

SYSTEMATICS

Annelida Lamarck, 1809
Order Sternaspida Dales, 1962
Family Sternaspidae Carus, 1863

Key to genera of Sternaspidae Carus, 1863
(modif. after Sendall & Salazar-Vallejo 2013)

1. Shield stiff 2
- Shield soft, often covered by adhered sediment particles, rarely without sediment; ribs sometimes visible, concentric lines rare; introvert hooks tapered; anterior abdomen with 7 segments ..... *Caulleryaspis* Sendall & Salazar-Vallejo, 2013

2(1). Introvert hooks tapered; shield ornamentation includes ribs, concentric lines, or both; anterior abdomen with 7 segments ..... *Sternaspis* Otto, 1821
- Introvert hooks subdistally expanded, spatulate; shield with ribs, without concentric lines; abdomen with 8 segments ..... *Petersenaspis* Sendall & Salazar-Vallejo, 2013

Caulleryaspis Sendall & Salazar-Vallejo, 2013

Type species: *Caulleryaspsis gudmundssoni* Sendall & Salazar-Vallejo, 2013, by original designation.

Caulleryaspis villamari sp. nov.

(Fig. 1)
urn:lsid:zoobank.org:act:38C77F7E-EAC6-477D-A4DF-265F6B52CDB0

Sternaspis fossor: Villamar 1989:36, 40 (*non* Stimpson, 1853, *partim*).
Sternaspis scutata: Villamar & Cruz 2007:151 (*non* Ranzani, 1817, *partim*).

Type material: Eastern Tropical Pacific, Peru. Holotype (USNM 1437645), and 10 paratypes (USNM 1437646), R.V. Anton Bruun, Cruise 16, Sta. 635A (06°27'S, 80°56'W to 06°23'S, 80°55'W), off Isla Lobos de Tierra, 160 m, 5 Jun. 1966 (shield dirty orange in smaller specimens, becoming grayish; largest paratype with abdomen 17 mm long, 12 mm wide; smaller paratypes abdomen 3.5-5.0 mm long, 3-5 mm wide).

Additional material: Eastern Tropical Pacific, Ecuador. 23 specimens (USNM 1437647), RV Anton Bruun, Cruise 18B, Sta. 777D (00°48'N, 80°37'W to 00°47'S, 80°37'W), 12 Sep. 1966, T.R. Menzies, coll. (small to very small specimens).

Description: Holotype (USNM 1437645) complete, flaccid. Body grayish, with introvert exposed, shield grayish (Fig. 1A). Integument papillae mostly eroded; remaining ones short, filiform, with fine sediment particles. Body 32 mm long, 10 mm wide, abdomen 20 mm long, about 28 segments.

Prostomium hemispherical, opaque, distorted after being depressed (Fig. 1B). Peristomium oval, with abundant papillae (mostly eroded), extended as a wide band over prostomium. Mouth oval, as large as prostomium, completely covered by papillae (most eroded).

First three chaetigers with 16-18 falcate, thin introvert hooks per bundle, each with a narrow darker band subdistally, tips transparent, straight in smaller hooks, curved in larger ones. Genital papillae whitish, thick, corrugated, digitate protruding from intersegmental groove between

segments 7 and 8. Pre-shield region with 7 segments; two capillary chaetae in segment 9, not visible in other segments (probably broken off).

Shield grayish, soft, with a thick integument layer, without sediment particles (Fig. 1C). Ribs faintly defined, no concentric lines. Anterior margins rounded; anterior depression shallow; anterior keels not visible. Lateral margins projected medially, reduced posteriorly. Fan truncate, not extended beyond posterior corners; median notch shallow, lateral notches shallow, displaced laterally; posterior margin barely crenulated.

Marginal chaetal fascicles include 10 lateral ones, chaetae in oval arrangement, and 8 posterior fascicles, chaetae in oblique series. Peg chaetae forming small, thick spines. Additional capillary chaetae broken, present in two fascicles on each side of peg chaetae.

Branchiae and interbranchial filaments lost. Branchial plates parallel, anteriorly expanded, rounded (Fig. 1D), with up to 14 longitudinal series of branchial scars.

Juveniles: Small paratypes with shields orange, soft (Fig. 1E), damaged. Smallest one with shield orange, with shallow anterior depression, anterior margins barely projected anteriorly, lateral margins straight, progressively thinner, posterior margin with shallow medial notch (Fig. 1F). Largest paratype with shield orange, anterior depression and posterior notch shallower than in smaller paratypes; lateral margins rounded, medially projected, posterior margin straight, barely crenulated (Fig. 1G).

Etymology: This species is named after Dr. Francisco Villamar, in recognition of his many publications on polychaetes from Ecuador. The epithet is a noun in the genitive case.

Remarks: *Caulleryaspis villamari* sp. nov. has a soft shield, not stiff or brittle as in *Sternaspis* Otto, 1821. Because the shield is deprived of

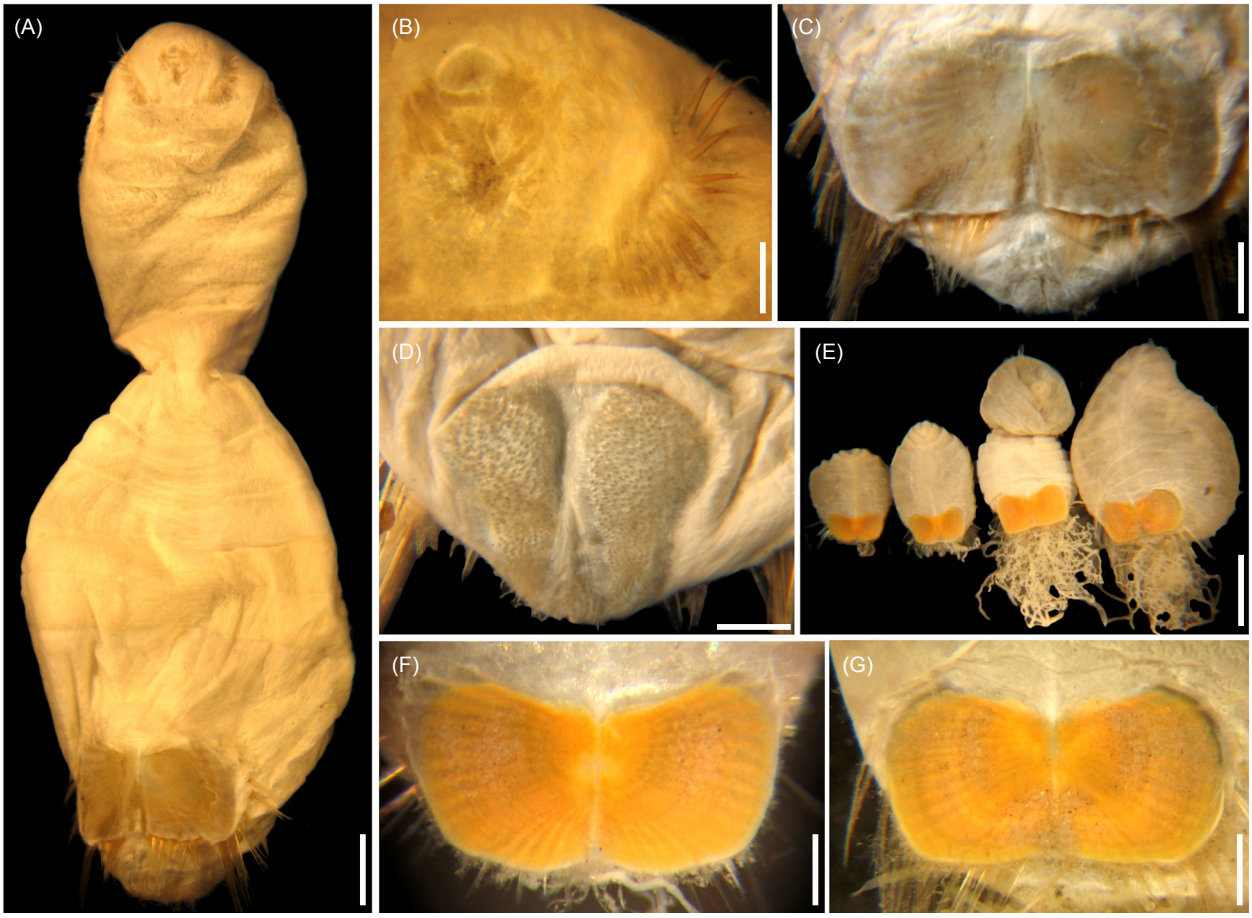

Fig. 1. *Caulleryaspis villamari* sp. nov. (A) Holotype (USNM 1437645), ventral view. (B) Same, close-up of prostomium, mouth and first series of hooks. (C) Same, shield. (D) Same, branchial plate after removal of branchiae and interbranchial filaments. (E) Smaller specimens (USNM 1437646), ventral view. (F) Close-up of shield of smallest one. (G) Close-up of shield of largest one. Scale bars: A = 2.7 mm, B = 0.6 mm, C, D = 1.3 mm, E = 2.8 mm, F = 0.4 mm, G = 0.7 mm.

sediment particles, it resembles *C. nana* (Zhadan, Tzetlin and Salazar-Vallejo 2017) n. comb., from Vietnam. Their main differences are indicated in the key below and include the color and presence of ribs in the shield; in *C. villamari* shields are yellowish to pale brown, with distinct ribs, whereas in *C. nana* shields are red to brownish without ribs. The juveniles are included here but with some hesitation because they are from abyssal depths. They differ from the juveniles another regional species, *Sternaspis maureri* Salazar-Vallejo & Buzhinskaja, 2013 because those herein regarded as related to *C. villamari* have orange shields with fans with small median notch, and poorly defined ribs, whereas in *S. maureri* shields are reddish with a distinct median notch, and ribs are better defined. Clarifying their affinities would need fresh material in order to assess their genetic attributes.

Distribution: Off northern Peru, in 160 m depth.

Key to species of *Caulleryaspis* Sendall & Salazar-Vallejo, 2013
(modif. Salazar-Vallejo & Buzhinskaja 2013)

1. Shield with sediment particles firmly adhered; shield surface not visible 2
- Shield without firmly adhered sediment particles; shield surface visible 4

2(1). Shield with anterior depression deep; peg chaetae robust 3
- Shield with anterior depression shallow; peg chaetae indistinct ..... *C. laevis* (Caullery, 1944) (Indonesia)

3(2). Shield with anterior margins angular; peg chaetae forming thick, large spines ..... C. gudmundssoni Sendall & Salazar-Vallejo, 2013 (North Atlantic, Iceland)
- Shield with anterior margins rounded; peg chaetae forming thin, small spines ..... *C. fauchaldi* Salazar-Vallejo & Buzhinskaja 2013 (Northeastern Pacific, Oregon to California)

4(1). Shield with lateral margins rounded, medially expanded, ribs barely visible ..... *C. nuda* Salazar-Vallejo & Buzhinskaja 2013 (Northeastern Pacific, off Oregon)
- Shield with lateral margins straight to barely curved 5

5(4). Ribs indistinct, shield dark red to brownish ..... C. nana (Zhadan, Tzetlin & Salazar-Vallejo, 2017) n. comb. (Vietnam)
- Ribs distinct, shield yellowish to pale brown ..... *C. villamari* sp. nov. (Eastern Pacific, Ecuador)

***Petersenaspis* Sendall & Salazar-Vallejo, 2013**

Type species: *Sternaspis papillata* Nonato, 1966, by original designation.

***Petersenaspis deani* sp. nov.**

(Fig. 2)
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Sternaspis scutata: Vargas et al. 1985:337; Maurer et al. 1988:48; Dean 1996:75 (*non* Ranzani, 1817, *partim*).

Type material: Eastern tropical Pacific, Costa Rica. Holotype (USNM 80322) and five paratypes (USNM 1437648), Golfo de Nicoya, Sta. 31-2 (09°44'00"N, 84°59'25"W), 22 m, 10 Jul. 1980, H.K. Dean, coll. (paratypes 6-10 mm long, 2-3 mm wide, abdomen 4.0-6.5 mm long; left shield plate 0.7-1.1 mm long, 0.6-1.1 mm wide; 14-16 introvert hooks per bundle).

Description: Holotype (USNM 80322) with body whitish, shield deep red (Fig. 2A); body papillae globose, scarce and small filamentous papillae throughout body. Larger, thin abundant papillae in dorsal surface of posterior end, surrounding the shield. Body 7 mm long, 3 mm wide, abdomen 4 mm long, about 30 segments.

Prostomium hemispherical whitish, opaque, projected, with a transverse depression, as large as mouth (Fig. 2B). Peristomium rounded, with abundant papillae over the mouth, extended behind prostomium. Mouth circular, extends from base of prostomium to anterior edge of first chaetiger.

First three chaetigers with 14-16 golden recurved, thin spatulate hooks, without subdistal dark areas. Genital papillae short, thick, blunt, protrude ventrally from body wall between segments 7 and 8. Pre-shield region with 8 segments, segments 9-13 with mostly single capillary chaetae.

Shield deep red, papillose, with ribs faintly defined but no concentric lines, sediment particles easily removed from shield (Fig. 2C); suture extended throughout shield. Anterior margins rounded; anterior depression very shallow; anterior keels not exposed. Lateral margins rounded, expanded medially, reduced posteriorly. Fan truncate, barely projected beyond posterior shield corners, margin smooth, with shallow median notch.

Marginal shield chaetal fascicles include 11 lateral ones, chaetae of each fascicle in oval arrangement, and 10 ill-defined posterior fascicles, each with 1-2 chaetae. Last lateral fascicle with longer chaetae. Peg chaetae or additional chaetae not present.

Branchial filaments abundant, helicoid, not

emerging from a branchial plate. Interbranchial papillae abundant, more or less straight, delicate, ½-⅓ as long as branchiae.

Variation: Paratypes with shields reddish, similar to holotype in general outline; the paratype follows the general pattern bur its lateral margins tend to be more curved, and individual plates become wider than long (Fig. 2D). The same specimen has a poorly defined, longer than wide branchial plate with 3 series of oblique branchial scars (Fig. 2E).

Etymology: This species name is after Dr. Harlan Dean, in recognition of his many useful publications about Central American polychaetes, and especially because he collected the specimens used for the description. The epithet is a noun in the genitive case.

Remarks: *Petersenaspis deani* sp. nov. resembles *P. capillata* (Nonato, 1968) as redescribed elsewhere (Sendall and Salazar-Vallejo 2013), because both species have shields with anterior depression shallow, and fans with a median notch. They differ in the relative color and number of introvert hooks per series; in *P. deani* introvert hooks are golden and more abundant (14-16), than in *P. capillata* where they are bronze and fewer (about 10). The fact that the type material of *P. deani* is generally smaller, has more introvert hooks than the corresponding one for *P. capillata*, and their discontinuous distribution, being one present in the Pacific coast of Costa Rica, whereas the other one thrives in Brazil, indicate they are different species.

Distribution: Only known from the type locality, Gulf of Nicoya, Costa Rica, in sediments at 22 m depth.

***Petersenaspis harrisae* sp. nov.**

(Fig. 3)

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Type material: Southwestern Indian Ocean, South Africa. Holotype (LACM 5691) and two paratypes (LACM 5692), off Durban, International Indian Ocean Expedition, R.V. Anton Bruun, Cruise 7, Sta. 356B (29°11'S, 31°37'E), rock dredge, 15 m, 29 Jul. 1964 (paratypes 2.5-7.0 mm long, 1.5-4.0 mm wide; shield reddish in smaller one, purple in larger one, left shield plate 0.7-2.0 mm long, 0.5-1.5 mm wide).

Additional material: Southwestern Indian Ocean, Madagascar. Three specimens (LACM 5694), one with introvert partly exposed, shield

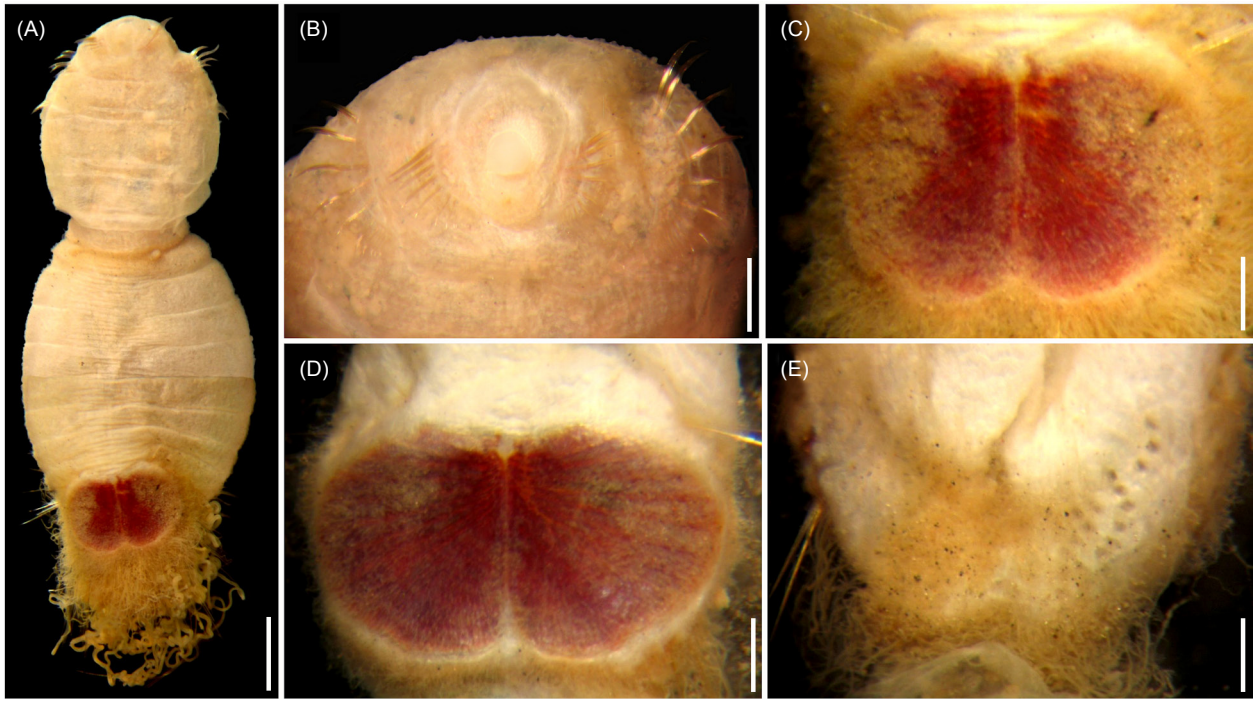

Fig. 2. *Petersenaspis deani* sp. nov. (A) Holotype (USNM 1437648), ventral view. (B) Same, anterior end, frontal view. (C) Same, shield. (D) Largest paratype (USNM 1437648), shield. (E) Same, branchial plate after removal of branchial and interbranchial filaments. Scale bars: A = 1 mm, B, D, E = 0.4 mm, C = 0.3 mm.

dark reddish to purple, ribs visible but without concentric lines; off Tulear, International Indian Ocean Expedition, R.V. Anton Bruun, Cruise 7, Sta. 363S (23°18'S, 43°36'E), Campbell grab, 33 m, 4 Aug. 1964 (8.0-8.5 mm long, 4.5-5.0 mm wide; left shield plate 1.8-1.9 mm long, 1.3-2.0 mm wide). One specimen (LACM 5693), complete, distorted by compression, inner organs macerated, introvert and anal peduncle exposed, shield dark purple, right plate broken, without concentric lines; off Tulear, International Indian Ocean Expedition, R.V. Anton Bruun, Cruise 7, Sta. 363U (23°19'S, 43°35'E), Campbel grab, 128 m, 6 Aug. 1964 (16 mm long, 4 mm wide, abdomen 10 mm long, left shield plate 2 mm long, 1.4 mm wide; chaetiger 3 with 17 hooks per bundle). Four specimens (MNHN 860), near Tuléar, Sta. Unnumb. (23°32.2'S, 43°35.8'E), dredge, 300 m, 20 Feb. 1973, C. Jouannic, coll. Very damaged, rotten, shields detached, like if taken from a fish's stomach contents. The shield is reddish with well-developed ribs, but no concentric lines; there is no deep notch close to the posterior corners. However, the introvert hooks are subdistally expanded and the specimens belong to an undescribed *Petersenaspis* species. It is interesting to note that shield surface papillae, which usually give it a velvety appearance, were removed, probably by erosion or by digestion, although there is no indication that it was taken from a fish stomach.

Description: Holotype (LACM 5691) complete;

Fig. 3. *Petersenaspis harrisae* sp. nov. (A) Holotype (LACM 5691), oblique lateral view. (B) Same, anterior end, frontal view. (C) Same, shield, slightly dislodged, frontal view. (D) Larger paratype (LACM 5692), frontal view. (E) Smaller paratype (LACM 5692), shield, frontal view. (F) Larger paratype, shield. (G) Same, branchial plate, left side without branchiae, papillae or sediment particles. Scale bars: A, D = 1 mm, B, E = 0.25 mm, C, G = 0.5 mm, F = 0.7 mm.

introvert body wall slightly broken. Body whitish, integument granulose with small abundant papillae covering most of body (Fig. 3A). Introvert slightly darker; introvert spines bronze; shield purple; introvert with more sediment particles; posterior lateral chaetal bundles with chaetae longer than body length.

Prostomium projected, blunt, conical (Fig. 3B). Peristomium rounded, equalized to the position of mouth, with papillae abundant in mouth area, not extended beyond it. Mouth circular, extended from base of prostomium to anterior edge of first chaetiger.

First three chaetigers with 13-15 dark bronze, recurved spatulate hooks, without subdistal dark areas (Fig. 3B). Genital papillae not visible (small digitate in LACM 5694). Pre-shield region with 8 segments; lateral bundles of 2 capillary chaetae protruding from body wall along segments 9-12.

Shield purple, finely papillose, with ribs faintly defined but no concentric lines (Fig. 3C), nor sediment particles; suture extended throughout shield. Anterior margins rounded, anterior depression deep; anterior keels not exposed. Lateral margins rounded, expanded medially, reduced posteriorly. Fan truncate, barely projected beyond posterior shield corners, margin smooth, with a median notch.

Marginal shield chaetal fascicles include 10 lateral ones, chaetae in oval arrangement, and 10 posterior fascicles, chaetae in oval arrangement. First two posterior fascicles with very long, delicate chaetae; other fascicles with fewer, shorter chaetae. Peg chaetae not well-defined.

Branchiae scarce, arranged in 1-2 series, emerging from a distinct depression (flat in other specimens); branchial area with a projected ridge, with abundant delicate interbranchial papillae, better preserved towards margin of shield (Fig. 3G).

Variation: The intensity of pigmentation varies during ontogeny. Smaller paratype has a reddish shield (Fig. 3E), and chaetae paler, whereas the larger paratype has a darker shield (Fig. 3F), and additional specimens having their introvert partly exposed, show darker introvert hooks.

Etymology: This species is being named after my good friend and teacher, Leslie Harris, collection manager of the Allan Hancock Foundation polychaete collection in LACM, as a modest means to acknowledge her long standing support for my research activities. The epithet is a noun in the genitive case.

Remarks: *Petersenaspis harrisae* sp. nov. resembles *P. palpallatoci* Sendall & Salazar-Vallejo, 2013 from the Philippine Islands because both have shields with anterior margins projected forward. As indicated in the key below, they differ because in *P. harrisae* the fan has a median notch but no lateral notches, and ribs are barely defined, whereas in *P. palpallatoci* the fan has both, median and lateral notches, and ribs are well defined. In her analysis of the IIOE materials, Hartman (1974:199) recognized at least four different sternaspids but she did not include the current specimens.

Distribution: Only known from two localities in the Southwestern Indian Ocean, between South Africa and Madagascar, in sediments at 15-128 m depths.

Key to species of *Petersenaspis* Sendall & Salazar-Vallejo, 2013

(modif. after Sendall & Salazar-Vallejo 2013)

1. Shield orange or reddish 2
- Shield bluish, anterior margin projected forward, radial ribs barely visible; introvert neurohooks blackish or dark brown ..... *P. salazari* Wu & Xu, 2017 (South China Sea)

2(1). Shield with anterior margin truncate, radial ribs barely visible; fan with median notch 3
- Shield with anterior margin projected forward 4

3(2). First three chaetigers with about 10 neurohooks per side (body 20 mm long) ..... *P. capillata* (Nonato, 1966) (Southwestern Atlantic Ocean, Brazil)
- First three chaetigers with about 14-16 neurohooks per side (body 7 mm long) ..... *P. deani* sp. nov. (Eastern Pacific, Costa Rica)

4(2). Radial ribs well defined; fan with median and lateral notches ..... *P. palpallatoci* Sendall & Salazar-Vallejo, 2013 (Philippine Islands)
- Radial ribs barely defined; fan with median notch, no lateral notches ..... *P. harrisae* sp. nov. (Indian Ocean, South Africa)

Sternaspis Otto, 1821

Type species: *Sternaspis thalassemoides* Otto, 1821, by monotypy.

Sternaspis lindae sp. nov.

(Fig. 4)

urn:lsid:zoobank.org:act:A157B737-7606-487E-9893-2B6E87B2F35F

Sternaspis fossor: Chamberlin 1919:405-406 (*non* Stimpson, 1853, *partim*).

Type material: Eastern Tropical Pacific, Panama. Holotype (USNM 19478), and five paratypes (USNM 1437649), RV Albatross, Gulf

of Panama, Sta. 3391 (07°33'40"N, 79°43'20"W), 275 m, green mud, 9 Mar. 1891 (paratypes one previously dissected, body 12.5-14.5 mm long, 9.2-10.5 mm wide, left shield plate 3.1-3.3 mm long, 3.0-3.6 mm wide).

Additional material: Eastern Tropical Pacific. Panama. One specimen (UMML 22-1035), 18 km E off Isla Iguana, R.V. Pillsbury, Cruise 6703, Sta. 502 (07°40'N, 79°50.5'W to 07°40.3'N, 79°50.9'W), 79-77 m, 2 May 1967 (introvert partially exposed, body slightly macerated, 17 mm long, 7 mm wide, left shield plate 2.2 mm long, 2.4 mm wide). Three specimens (UMML 22-1038), R.V. Pillsbury, Cruise 6703, Sta. 512 (07°31'N, 79°42'W), 210 m, 4 May 1967 (introvert exposed in two specimens, invaginated in the other, shield with bands defined, brownish and dirty pink; body 18-25 mm long, 10-11 mm wide, left shield plate 3.5-3.8 mm long, 3.5-3.8 mm wide). One specimen (UMML 22-1043), 3 km SSE Taboga Island, R.V. Pillsbury, Cruise 6703, Sta. 483 (08°40.5'N, 79°30.7'W to 08°39.3'N, 79°31.7'W), 22-27 m, 1 May 1967 (juvenile, macerated, anal tube and gonopodial lobes eroded; body 14 mm long, 6 mm wide, shield left plate 1.4 mm long, 1.6 mm wide).

Colombia. One specimen (UMML 22-1045), Bahía Chupica, Chocó, R.V. Gillis, Sta. 9 (06°36.7'N, 77°27.4'W), mud and plant debris, 119-128 m, 16 Jan. 1972 (introvert invaginated, shield variegated, dirty orange and pale pink; body 15 mm long, 8 mm wide, left shield plate 2.6 mm long, 2.9 mm wide).

Description: Holotype (USNM 19478) with body maculated, whitish with black spots of different size; introvert barely exposed, integument smooth (Fig. 4A); abdomen with fine, long papillae arranged in discontinuous single transverse series per segment. Body papillae minute, abundant, mostly short, larger in introvert. Body 12.5 mm long, 8.5 mm wide, about 28 segments.

Prostomium, peristomium and mouth not visible. Additional specimens (UMML 22.1038)

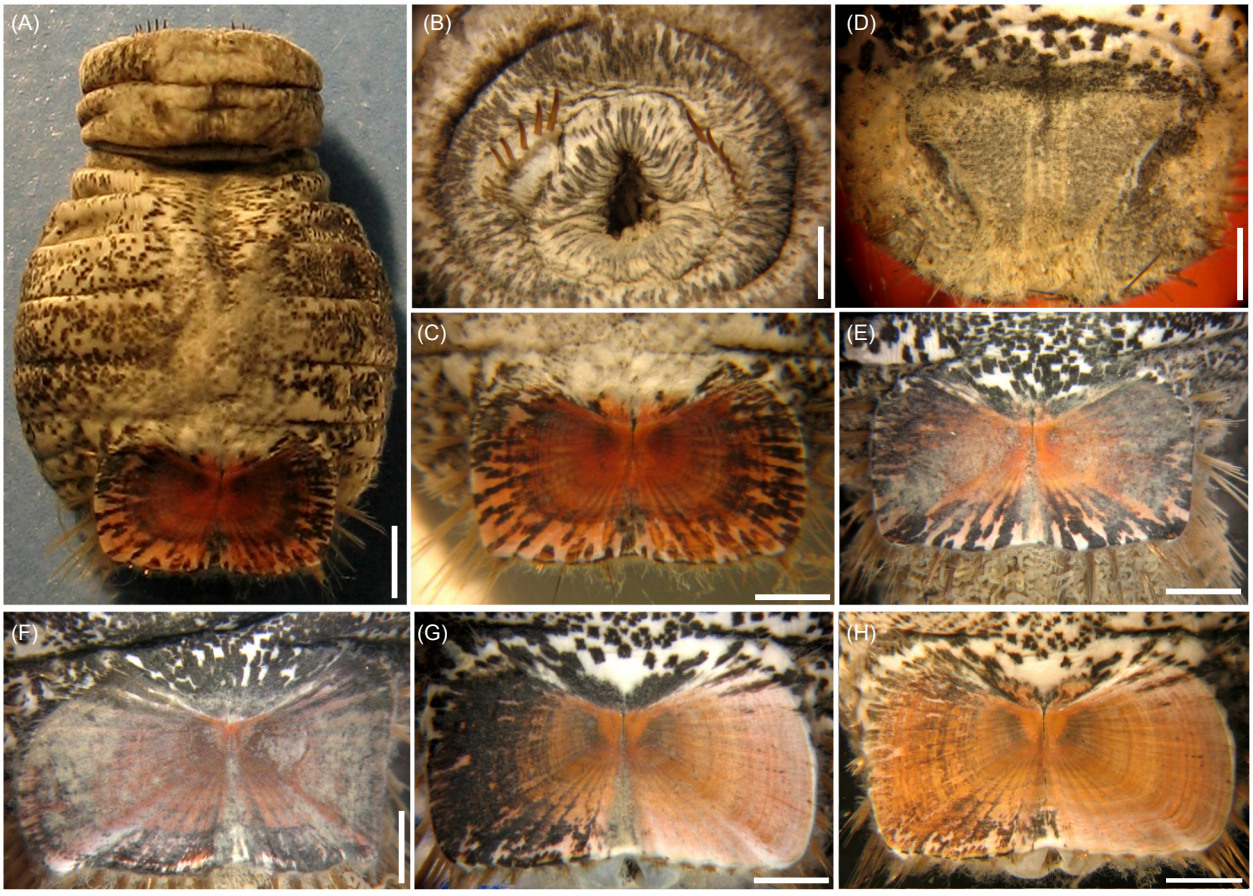

Fig. 4. *Sternaspis lindae* sp. nov. (A) Holotype (USNM 19478), ventral view. (B) Same, anterior end, frontal view. (C) Same, shield. (D) Same, branchial plate. (E-H) Paratypes (USNM 1437649), shields, E, F: Shields slightly cleaned by brushing off foreign particles and shield papillae, G: Another paratype, shield with left half cleaned, H: Same shield, after cleaning the right half. Scale bars: A = 1.8 mm, B = 1.2 mm, C-E = 1.3 mm, F = 1.1 mm, G, H = 1.5 mm.

with prostomium hemispherical, opalescent. Peristomium rounded, projected at the mouth, with papillae covering its surface; lateral mouth areas smooth; surface behind prostomium smooth. Mouth circular, with minute papillae not extended up to first hook series.

Introvert exposing chaetae of chaetiger 3 and chaetae of chaetiger 2. Chaetiger 3 with 12 large, falcate thick hooks, distally broken (Fig. 4B) (entire, tapered, up to 20 in UMML 22.1038); hooks from chaetiger 2 with subdistal to medial darker areas. Genital papillae short, thick, tapered (digitate or basally swollen in UMML 22.1038), protrude ventrally from intersegmental groove between segments 7 and 8. Pre-shield region with 7 segments; capillary chaetae not seen, probably broken.

Shield reddish, paler towards the lateral and posterior margins, with ribs and concentric lines; suture visible throughout ¾ of shield, indistinct in the posterior region (Fig. 4C). Anterior margins rounded; anterior depression deep; anterior keels partly visible, not completely exposed. Lateral margins projected laterally, reduced posteriorly. Fan truncate, slightly projected beyond the poorly defined posterior corners, barely crenulated; median notch very shallow.

Marginal chaetal fascicles include 10 lateral ones, chaetae ovally arranged, and seven posterior ones, chaetae in a slightly curved arrangement. First two lateral fascicles emerge from dorsal edge of shield. Peg chaetae and additional thin capillaries present.

Branchiae and interbranchial filaments lost (one paratype with thin helicoid branchiae and thinner, straight interbranchial filaments). Branchial plate anteriorly expanded, truncate (rounded in one paratype), with about 16 rows of branchiae in its widest region (Fig. 4D).

Variation: Shields bands are more or less defined. Anterior corners are angular to blunt, anterior keels are visible in three out of five shields. Fans are medially notched, the posterior margin is slightly crenulate to denticulate, and the posterolateral corners are slightly projected, if at all. One juvenile (UMML 22-1043) shows a shield with posterior fan margin denticulate.

Etymology: This species is after Linda Ward, good friend and colleague, because she has been very helpful and supportive of my research activities during many years. The epithet is a noun in the genitive case.

Remarks: *Sternaspis lindae* sp. nov. resembles *S. rietschi* (Caullery, 1944) as redescribed elsewhere (Sendall and Salazar-Vallejo 2013) because both species have shields with truncate fans and poorly defined posterior corners. They differ because in *S. lindae* the fan is smooth to barely crenulated, and the lateral margins are moderately projected laterally, whereas in *S. rietschi* the fan is crenulated and the lateral margins are markedly projected laterally. Further, *S. lindae* was found in 275 m depth in the Gulf of Panama, and *S. riestschi* was dredged in 1788 m depth in Indonesia. The specimens herein described were identified and recorded as *Sternaspis fossor* Stimpson, 1853 but in this species the fan is more projected posteriorly and concentric lines form distinct bands. Chamberlin (1919) indicated 10 specimens, but only 6 are available. On the other hand, the spotted pigmentation is apparently derived after some foreign component like ink or rubber seals stain, because it can be removed by brushing the body surface and cannot be regarded as diagnostic. The mottled pattern, if the stain has some affinity for glandular cells, would reveal their distribution including over the integument layer covering the shield. The additional specimens were not stained.

Distribution: Gulf of Panama, to NW Colombia, in muddy bottoms, 119-275 m water depth.

***Sternaspis londognoi* sp. nov.**

(Fig. 5)

urn:lsid:zoobank.org:act:9106E216-981A-4B96-A3A3-1EF1A2E9EC28

Sternaspis scutata: Gilbert 1984:45.3-45.4, Figs 45.1, 45.2 (*non* Ranzani, 1817).

Type material: Southwestern Caribbean, Panama. Holotype (LACM 5704) and paratype (LACM 5705), Caledonia Bay, R.V. Velero, Sta. 2, 3 Apr. 1939, intertidal, O. Hartman, coll. (paratype 16 mm long, 10 mm wide, abdomen 11 mm long; shield left plate 2.5 mm long, 3.6 mm wide). Two paratypes (LACM 5706), Caledonia Bay, R.V. Velero, Sta. 52, 25 Apr. 1939, 9 m, O. Hartman, coll. (15-17 mm long, 8 mm wide, abdomen 9-12 mm long; shield left plate 2.5-2.6 mm long, 3.0-3.3 mm wide).

Additional material: Gulf of Mexico, Texas. Eight specimens (USNM 43198), juveniles, off Galveston, Cruise PI-3, Sta. 12 (28°30'N, 94°37'W), 36 m, 4 Feb. 1966, C.J. Guice, coll. (3.0-5.5 mm long, 1.5-3.0 mm wide, abdomen 2.0-3.8 mm long, shield left plate 0.5-0.9 mm long, 0.5-

0.9 mm wide). Three specimens (USNM 43199), juveniles, off Bolivar Peninsula, 5 m, Jan. 1968, C.J. Guice, coll. (4.0-5.0 mm long, 2.0-3.0 mm wide, abdomen 2.5-3.5 mm long, shield left plate 0.8-1.0 mm long, 0.7-1.1 mm wide).

Gulf of Mexico, Louisiana. Two specimens (USNM 1437650), juveniles, R.V. Pelican, Sta. 90-2 (28°39.5'N, 91°06'W), 17 m, 11 Nov. 1938 (complete 3 mm long, 2 mm wide, abdomen 2 mm long, shield left plate 0.8 mm long, 0.7 mm wide).

Southwestern Caribbean, Colombia. One specimen (UMML 22-1033), 6.5 km E Río Magdalena eastern delta, R.V. Pillsbury, Cruise 6806, Sta. 788 (11°08'N, 74°47'W), 155-157 m, 31 Jul. 1968 (juvenile, introvert slightly exposed; body 12 mm long, 6 mm wide, shield left plate 1.8 mm long, 2.2 mm wide).

Surinam. Two specimens (UMML 22-1040), 140 km NE off Paramaribo, R.V. Pillsbury, Cruise 6806, Sta. 662 (06°49'N, 54°26.5'W to 06°51'N, 54°30'W), 44 m, 10 Jul. 1968 (macerated, larger one with anal tube exposed; body 18-25 mm long, 7-8 mm wide, shield left plate 2.3-2.4 mm long, 2.6-3.0 mm wide). One specimen (USNM 1185883), R.V. Coquette, Sta. 2 (06°23'N, 55°05.5'W), 27 m, mud, 11 May 1957 (introvert not exposed, genital papilla partly exposed; body 9.5 mm long, 7.5 mm wide).

Venezuela. Three specimens (UMML 22-1039), 2.8 km N off Cabo San Francisco, R.V.

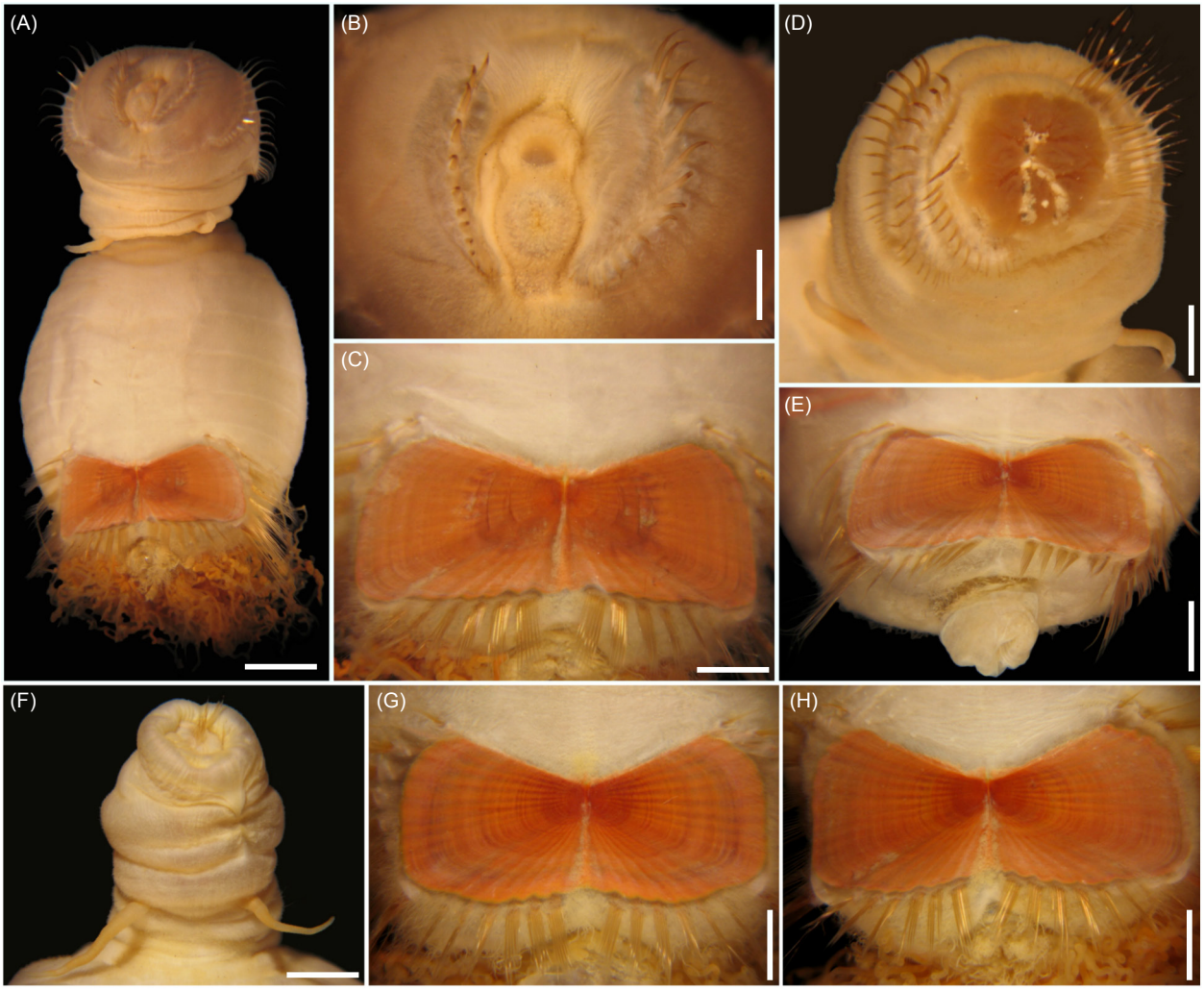

Fig. 5. *Sternaspis londognoi* sp. nov. (A) Holotype (LACM 5704), frontal view. (B) Same, anterior end, frontal view. (C) Same, shield, frontal view. (D) Paratype (LACM 5705), anterior end, frontal view, pharynx slightly exposed. (E) Same, shield, frontal view. (F) Another paratype (LACM 5706), anterior end with introvert barely exposed, and large genital papillae. (G) Same, shield, frontal view. (H) Another paratype (LACM 5706), shield, frontal view. Scale bars: A = 2.1 mm, B = 0.58 mm, C, D = 1.0 mm, E = 1.6 mm, F = 1.3 mm, G, H = 1.1 mm.

Pillsbury, Cruise 6806, Sta. 705 (10°45'N, 62°00'W to 10°45.5'N, 62°02.5'W), 77-86 m, 18 Jul. 1968 (juveniles, all with introvert exposed, one with anal tube exposed; body 9-13 mm long, 3-4 mm wide, shield left plate 1.5-1.6 mm long, 1.3-1.6 mm wide).

Panama. One specimen (UMML 22-1042), Golfo de los Mosquitos, R.V. Pillsbury, Cruise 6607, Sta. 445 (09°01'N, 81°24'W), 344 m, 21 Jul. 1966 (body markedly contracted, introvert exposed, shield looks wider than posterior abdomen; body 17 mm long, 6 mm wide, shield left plate 4 mm long, 5 mm wide).

Description: Holotype (LACM 5704) with body whitish, branchial filaments and shield orange, interbranchial papillae whitish (Fig. 5A). Integument finely papillose, body papillae not arranged in transverse groups. Body 16 mm long, 8 mm wide, abdomen 10 mm long; shield left plate 2.5 mm long, 3.3 mm wide.

Prostomium hemispherical, opalescent to translucent (Fig. 5B). Peristomium rounded, projected at the mouth and with papillae covering its surface; lateral mouth areas smooth, some papillae behind the prostomial lobe. Mouth circular, completely covered by minute papillae not extended up to first hook series. Pharynx partly exposed in paratype (Fig. 5D)

First three chaetigers with 15-22 slender, bronze, falcate hooks, each with subdistal dark area (Figs. 5B, D). One pair of large, tubular, tapered genital papillae in intersegmental groove between segments 7 and 8, very long in one paratype (Fig. 5F). Pre-shield region with 7 segments; capillary chaetae not seen in holotype; non-type specimens with 1-2 capillaries along several segments.

Shield orange, with ribs and concentric lines (Fig. 5C); suture indistinct. Anterior margins angular, anterior depression shallow; anterior keels not exposed. Lateral margins rounded, expanded medially and posteriorly, finely crenulated. Fan barely reaching posterior shield corners, medially projected, denticulated; three paratypes with fan not expanded medially (Figs. 5E, G-H), all with reddish central area.

Marginal chaetal fascicles include 9-10 lateral ones, chaetae in oval arrangement, and 8-9 posterior fascicles, chaetae in a slightly curved arrangement. Peg chaetae long, emerge from an extended fleshy cone; a small fascicle of delicate capillary chaetae emerge from the base of peg chaetae.

Branchial filaments orange, long, twisted; interbranchial filaments abundant, whitish. Branchial plates slightly divergent, expanded anteriorly; branchiae arranged in several series.

Variation: All introvert hooks have subdistal dark areas. Genital papillae can be very long but because they are delicate, they might be broken in the holotype. The shield plates are wider than long. Two paratypes have anal peduncles exposed. Juveniles have shields with plates longer than wide and become as long as wide when they are 11-13 mm long, and then progress to become wider than long; suture is visible throughout the shield, but lateral plates become fused as growth progresses.

Etymology: This species is being named after my good friend and colleague Dr. Mario H. Londoño-Mesa, from Universidad de Antioquia, Colombia, in recognition of his research papers on terebellid polychaetes, and for his continuous efforts for teaching in difficult conditions in his beloved country. The epithet is a noun in the genitive case, but the orthography has been modified to make it euphonic and resemble his first last name.

Remarks: *Sternaspis londognoi* sp. nov. resembles *S. africana* Augener, 1918 as redescribed elsewhere (Sendall and Salazar-Vallejo 2013), because both have abundant, thin introvert hooks, and shields fused with fans medially projected and with crenulated margin. Their main differences rely on the relative pigmentation of introvert hooks, on the relative size of genital papillae, and on the relative depth of the anterior depression and development of posterolateral corners. In *S. londognoi* introvert hooks have a subdistal dark area, genital papillae are thicker and longer, and the anterior depression is shallow and the posterolateral corners are well-developed, whereas in *S. africana* introvert hooks do not have a subdistal dark area, their genital papillae are short and thin, the anterior depression is deep, and the posterolateral corners are not pronounced. In her report for the Allan Hancock Atlantic Expedition, Hartman (1944) did not include sternaspids, probably because the specimens were placed elsewhere.

Distribution: Gulf of Mexico and Caribbean Sea in shallow water to shelf depths (0-344).

***Sternaspis sherlockae* sp. nov.**
(Fig. 6)
urn:lsid:zoobank.org:act:70BF765A-F219-4A81-8EA5-D3FD3DF860EC

Sternaspis scutata: Day 1967: 648, Fig. 31.I.a-d (*non* Ranzani, 1817).

Type material: Red Sea. Holotype (BMNH 2013.410) and paratype (BMNH 2013.411), Crossland Red Sea Expedition, 19 Jan. 1904 (paratype 19 mm long, 7 mm wide, abdomen 12 mm long, left shield plate 3 mm long, 3 mm wide).

Additional material: Red Sea. Two specimens (BMNH 1869.6.30.3), Gulf of Suez, R. McAndrew, coll. (smaller specimen with introvert invaginated, 8 mm long, 4.7 mm wide, left shield plate 1.1 mm long, 1.5 mm wide; larger specimen with introvert exposed 17 mm long, 6 mm wide, abdomen 10.7 mm long, left shield plate 2.5 mm long, 2 mm wide; both specimens with genital papillae whitish, thick, tapered).

Description: Holotype (BMNH 2013.410) complete, whitish, introvert grayish, swollen, shield reddish, banded, integument rugose, papillae mostly eroded (Fig. 6A). Body 16 mm long, 4 mm wide, abdomen 11 mm long, left shield plate 2.5 mm long, 2.4 mm wide.

Prostomium small, opaque, without eyespots (Figs. 6B, D). Peristomium rounded, slightly depressed below mouth, with small papillae extended ventrally, not extetended laterally or over the prostomial lobe. Mouth circular, completely covered with minute papillae.

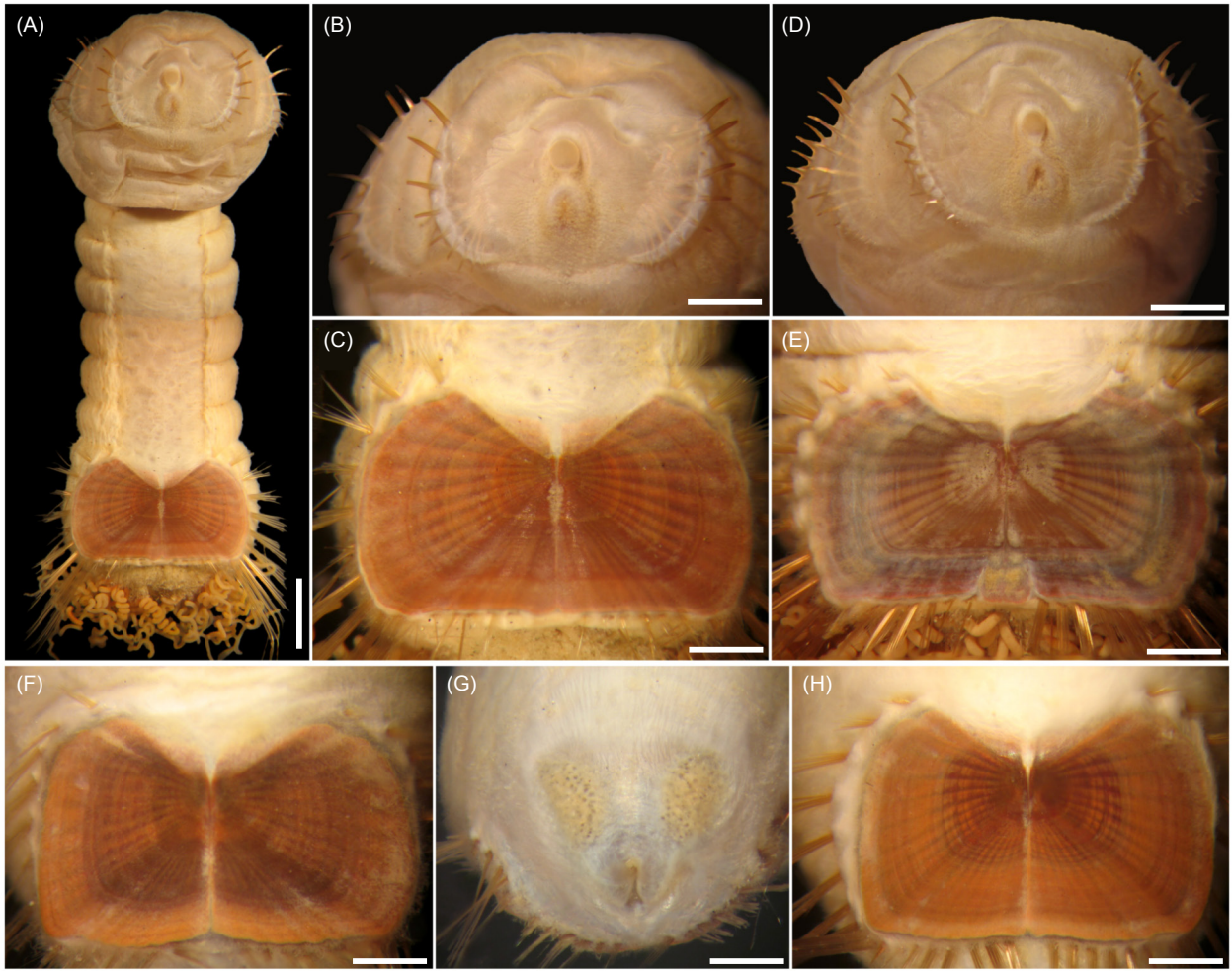

Fig. 6. *Sternaspis sherlockae* sp. nov. Holotype (BMNH 2013.410). (A) Ventral view. (B) Same, anterior end, frontal view. (C) Same, shield, frontal view; paratype (BMNH 2013.411). (D) Anterior end, frontal view. (E) Same, shield, frontal view, non-type specimens (BMNH 1869.6.30.3). (F) Smaller specimen, shield, frontal view. (G) Same, branchial plates, frontal view. (H) Larger specimen, shield, frontal view. Scale bars: A = 1.9 mm, B, E = 0.9 mm, C, G, H = 0.8 mm, D = 1.3 mm, F = 0.6 mm.

First three chaetigers with 10-12 hooks, broken, slightly falcate. Genital papillae not visible in type specimens (whitish, short, tapered lobes in additional materials). Pre-shield region with 7 segments, without fascicles of capillary chaetae.

Shield with ribs and concentric lines, reddish, banded, suture extended through ⅔ of shield length, posteriorly indistinct (Fig. 6C). Anterior margins angular; anterior depression deep; anterior keels visible, but not exposed (exposed in paratype). Lateral margins medially expanded, reduced posteriorly. Fan truncate, not extended beyond posterior corners; barely crenulate; without median or lateral notches.

Marginal chaetal fascicles include 10 lateral ones, chaetae ovally arranged, and seven posterior fascicles, chaetae in a slightly curved arrangement. Peg chaetae not seen, probably broken.

Branchiae abundant, helicoidal, yellowish. Interbranchial filaments shorter, thinner, grayish. Branchial plates (observed in non-type specimen) oval, slightly divergent, truncate, rounded anteriorly (Fig. 6G).

Variation: The paratype is larger than the holotype; its introvert has 12-14 hooks, its shield has two small, lateral notches and its anterior keels are visible (Fig. 6E). Smaller specimens have shields with suture visible throughout shield, but soon the lateral plates fuse posteriorly and the suture is not visible (Figs. 6F, H).

Etymology: This species name is a modest homage to Emma Sherlock (BMNH) in recognition of her kind support to all of my research activities. The epithet is a noun in the genitive case.

Remarks: *Sternaspis sherlockae* sp. nov. resembles *S. thorsoni* Sendall & Salazar-Vallejo, 2013, another species from the Indian Ocean, because both have reddish, banded shields with deep anterior depressions and truncate posterior margins. However, they differ because in *S. sherlockae* the posterior corners are rounded, not projected, whereas in *S. thorsoni* they are projected posteriorly as rounded lobes. Another perhaps more relevant difference is the number of introvert hooks; in *S. sherlockae* there are 12-14 hooks in 16 mm long specimens (holotype), whereas in *S. thorsoni* there are 16-20 hooks in 14 mm long specimens (holotype).

On the other hand, as indicated in the key below, *S. sherlockae* resembles *S. spinosa* from Indonesia, because both have shields with anterior margins acute and the posterior corners are not projected. These two species differ because the shield in *S. sherlockae* shield plates are longer than wide, and its anterior keels are divergent, and the branchial plates are parallel, whereas in *S. spinosa* the shield plates are wider than long, its anterior keels are parallel, and the branchial plates are divergent.

The record by Day (1967) of *S. scutata* resembles the holotype of *S. sherlockae* by having shield with alternating pale and brown bands, a wide deep anterior furrow, a fan with posterior margin crenulate, with a shallow median notch, and without projecting posterior corners. If they are conspecific, the species would extend along the Western Indian Ocean margin, from the Red Sea to South Africa, but this distribution needs confirmation based upon additional specimens.

Distribution: Red Sea, presumably in shallow water.

Key to species of *Sternaspis* Otto, 1821
(modif. after Salazar-Vallejo 2014b)

1. Shield fan with a distinct median notch 2
- Shield fan continuous, without distinct median notch 16
2(1). Shield with radial ribs and concentric lines distinct 3
- Shield with radial ribs distinct, concentric lines barely visible 13
3(2). Fan with median notch shallow 4
- Fan with median notch deep; shields usually with concentric bands 7
4(3). Shield with distinct pigmented concentric bands 5
- Shield without pigmented concentric bands 6
5(4). Fan with posterior margin straight, smooth, barely crenulated .... *S. affinis* Stimpson, 1864 (NE Pacific Ocean).
- Fan with posterior margin curved, slightly projected posteriorly, crenulated to dentate ..... *S. chinensis* Wu, Salazar-Vallejo & Xu, 2015 (Bohai, Yellow and East China seas)
6(4). Main rib barely projected, lateroposterior depressions shallow ..... *S. scutata* (Ranzani, 1817) (Mediterranean Sea and NE Atlantic Ocean)
- Main rib markedly projected, lateroposterior depressions deep ..... *S. liui* Wu, Salazar-Vallejo & Xu, 2015 (Yellow Sea)
7(3). Shield with posterior corners distinct in frontal view 8
- Shield with posterior corners poorly defined in frontal view 9
8(7). Radial ribs and concentric lines distinct, well defined; body whitish to grayish ..... *S. costata* von Marenzeller, 1879 (NW Pacific Ocean)
- Radial ribs and concentric lines barely defined; body brownish .... *S. sendalli* Salazar-Vallejo, 2014b (Antarctic Ocean)
9(7). Anterior keels usually exposed 10
- Anterior keels rarely exposed; fan barely projecting posteriorly beyond posterolateral corners 11
10(9). Shield with anterior corners projecting at least as far as

anterior keels, longer in larger specimens; fan margin crenulated in small specimens, dentate in larger ones ..... *S. buzhinskajae* Salazar-Vallejo, 2014b (Arctic Ocean)
- Shield with anterior corners projecting as far as anterior keels; fan margin smooth to crenulated, never dentate ..... *S. islandica* Malmgren, 1867 (NE Atlantic Ocean, Iceland)

11(9). Introvert and body with similar pigmentation or introvert paler; shield widest medially 12
- Introvert and body with different pigmentation, introvert darker; shield widest anteriorly ..... *S. annenkovae* Salazar-Vallejo & Buzhinskaja, 2013 (NW Pacific Ocean)

12(11). First three chaetigers with 6-12 neurohooks per bundle (body 15 mm long); fan projected beyond posterior corners ..... *S. fossor* Stimpson, 1853 (NW Atlantic Ocean)
- First three chaetigers with 15-22 neurohooks per bundle (body 16 mm long); fan rarely projected beyond posterior corners ..... *S. londognoi* sp. nov. (Grand Caribbean)

13(2). Main ribs markedly divergent; fan as wide as anterior margins or wider 14
- Main ribs moderately divergent; fan half as wide as anterior margins 15

14(13). Introvert hooks golden; genital papillae tapered, basally smooth ..... *S. maior* Chamberlin, 1919 (Eastern Pacific, Gulf of California).
- Introvert hooks bronze; gential papillae truncate, irregularly annulated throughout its length ..... *S. chilensis* Díaz-Díaz & Rozbaczylo, 2017 (*S. magellanica* Díaz-Díaz & Rozbaczylo, 2017:275 is a *nomen nudum*; Southern Chile)

15(13). Posterior margin truncate, with lateral notches; ribs well-developed ..... *S. maureri* Salazar-Vallejo & Buzhinskaja, 2013 (Central Eastern Pacific)
- Posterior margin with a median notch, lateral notches shallow or indistinct; ribs poorly developed ..... *S. williamsae* Salazar-Vallejo & Buzhinskaja, 2013 (Northeastern Pacific).

16(1). Fan margin crenulated, not projected posteriorly 17
- Fan margin denticulate, medially projected 27

17(16). Shield with ribs and concentric lines 18
- Shield with ribs; concentric lines indistinct 30

18(17). Shield anterior margins rounded 19
- Shield anterior margins acute 26

19(18). Shield with posterior corners distinct 20
- Shield with posterior corners indistinct, fan with posterior margin crenulate 23

20(19) Posterior corners barely projected beyond fan margin; introvert hooks thick, bronze ..... *S. thalassemoides* Otto, 1821 (NE Atlantic Ocean and Mediterranean Sea).
- Posterior corners projected beyond fan margin; introvert hooks thin, golden 21

21(20). Anterior keels shorter than anterior margins; fan markedly crenulated ..... *S. thorsoni* Sendall & Salazar-Vallejo, 2013 (Indian Ocean, Arabian Gulf)
- Anterior keels as long as anterior margins; fan barely crenulated 22

22(21). Shield plates longer than wide, concentric lines not forming bands; lateral margins straight to slightly curved ..... *S. piotrowskiae* Salazar-Vallejo, 2014a (Philippine Islands)
- Shield plates wider than long, concentric lines forming bands; lateral margins slightly curved to straight ..... *S. wui* Wu & Xu, 2017 & *S. sunae* Wu & Xu, 2017 (South China Sea; the only difference is in the lateral margin of introvert hooks, but otherwise very similar to each other)

23(19). Posterior margin medially crenulate, without lateral notches 24
- Posterior margin medially smooth, with shallow lateral notches 25

24(23). Anterior chaetigers with 6-10 neurohooks per side (body 18 mm long); shield with lateral margins markedly curved ..... *S. rietschi* Caullery, 1944 (Indonesia)
- Anterior chaetigers with 12 neurohooks per side (body 12.5 mm long); shield with lateral margins straight to slightly curved ..... *S. lindae* sp. nov. (Eastern Pacific, Panama)

25(23). Branchial plates parallel to slightly divergent; shield reddish without pigmented bands ..... *S. britayevi* Zhadan, Tzetlin & Salazar-Vallejo, 2017 (Vietnam)
- Branchial plates divergent; shield brownish with pigmented bands ..... *S. radiata* Wu & Xu, 2017 (South China Sea)

26(18). Shield plates wider than long; anterior keels with parallel inner margins; branchial plate divergent ..... *S. spinosa* Sluiter, 1882 (Indonesia, Java)
- Shield plates longer than wide, rarely as long as wide; anterior keels with divergent inner margins; branchial plate parallel ..... *S. sherlockae* sp. nov. (Red Sea)

27(16). Fan without lateral notches; body papillae arranged in distinct transverse rows ..... *S. africana* Augener, 1918 (Eastern Atlantic Ocean, Ghana to Angola).
- Fan with lateral notches; body papillae distributed homogeneously, not arranged in transverse rows 28

28(27). Introvert with about 15 pale hooks per bundle 29
- Introvert with about 10 dark hooks per bundle ..... *S. uschakovi* Salazar-Vallejo & Buzhinskaja, 2013 (Northern Pacific Ocean)

29(28). Shield reddish ..... *S. andamanensis* Sendall & Salazar-Vallejo, 2013 (Indian Ocean, Andaman Sea)
- Shield brownish ..... *S. papillosa* Zhadan, Tzetlin & Salazar-Vallejo, 2013

30(17). Shield with diagonal rib distinct; shield plates as long as wide ..... *S. princeps* Selenka, 1885 (SW Pacific Ocean, New Zealand)
- Shield with diagonal rib indistinct; shield plates wider than long ... *S. monroi* Salazar-Vallejo, 2014b (Antarctic Ocean)

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Competing interests: SISV declares he has no conflict of interest.

Availability of data and materials: The manuscript has been incorporated in ZooBank. Materials are deposited in collections of several research institutions.

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Ethics approval consent to participate: Not applicable.

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