

# Shallow-Water Asterozoans of Southeastern Polynesia

## I. Asteroidea

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### Abstract

A collection of shallow-water Asteroidea from southeastern Polynesia, representing 25 species in 18 genera and 10 families, is described. A new genus and species, *Devania naviculiforma* (Ophidiasteridae) and two new species, *Ctenophoraster marquesensis* (Astropectinidae) and *Allostichaster peleensis* (Asteroidea) are described and illustrated.

The following species are recorded from islands in southeastern Polynesia for the first time: *Luidia* cf. *maculata* (Marquesas Islands); *Astropecten polyacanthus* (Marquesas, Pitcairn and Easter(?) Islands); *A. triseriatus fijiensis* (Easter Island); *Culcita novaeguineae* (Marquesas, Gambier and Pitcairn Islands); *Fromia milleporella* (Line Islands); *Gomophia egyptiaca* (Tonga, Cook, Rapa and Society Islands); *Leiaster leachi* (Cook, Rapa and Marquesas Islands); *Linckia laevigata* (Tuamotu Archipelago and Pitcairn Island); *L. guildingi* (Marquesas, Gambier and Pitcairn Islands); *L. multifora* (Marquesas, Gambier, Pitcairn and Austral Islands); *Ophidiaster lorioli* (Austral, Rapa, Pitcairn and Line Islands); *Neoferdina cumingi* (Society Islands and Tuamotu Archipelago); *Asteropsis carinifera* (Tuamotu Archipelago, Marquesas and Line Islands); *Asterina burtoni* (Line Islands); *A. anomala* (Tonga); *Acanthaster planci* (Cook, Gambier, Pitcairn and Line Islands); *Valvaster striatus* (Cook Islands) and *Echinaster luzonicus* (Tonga).

The Asteroidea of southeastern Polynesia represent an attenuated tropical Indo-West Pacific fauna both in the number of species present and in the number of individuals of species common in the western Pacific.

### INTRODUCTION

This study is based primarily on collections made by the National Geographic Society-Smithsonian-Bishop Museum Marquesas Expedition, aboard the "Pele" in 1967 and by the "Westward" in 1970-1971, while further material was generously made available, on loan, by the Bernice P. Bishop Museum, Honolulu and one specimen by the Allan Hancock Foundation of the University of Southern California.

In 1967 the "Pele" took 169 specimens of Asteroidea, representing 10 genera and 12 species of which two are new. The "Westward" expedition collected 69 sea stars of 9 genera and 11 species including a new genus and species. Thirty five specimens of 12 genera and 16 species from other collections are included, making a total of 273 specimens, representing 25 species in 18 genera and 10 families.

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A number of species recorded from islands in southeastern Polynesia for the first time are from areas which have been little studied before. Specimens were taken by shore collecting, SCUBA diving to 40 meters, and dredging to 130 meters.

The most extensive earlier Pacific collections were those made by the U.S. Fisheries steamer "Albatross" in 1891, 1899-1900 and 1904-5. The Marquesas, Tuamotus, Society Islands, Cook Islands, Tonga, Fiji, the Gilbert and Ellice Islands and the Marshall Islands were among those visited (A. Agassiz, 1903). Ludwig (1905) and H. L. Clark (1920) described the Asteroidea of these expeditions. The "Albatross" worked among the Hawaiian Islands in 1902, taking 1650 specimens of 60 species between the shore and 1000 fathom line. The Asteroidea of this expedition were described by Fisher (1906) in a monographic account of the Asteroidea of the Hawaiian Islands.

The "Tanager" expedition (1923-24) to the tropical central Pacific added further to the known asteroid fauna of the area (Fisher, 1925).

While the deep water fauna of the central Pacific became well known, the shallow-waters received much less attention until recent years. A. H. Clark (1952 and 1954) recorded Asteroidea from the Marshall Islands and other widely scattered Pacific islands. Morrison (1954) and Chevalier *et al.* (1968) recorded sea stars from the Tuamotus in ecological studies of Raroia and Mururoa atolls, respectively. Recently, McKnight (1972) listed four species of sea stars from the Cook Islands and one from Tahiti.

Biogeographical considerations of the asterozoans now known from southeastern Polynesia with comparisons of the fauna known from various island groups were presented at the International Symposium on the Oceanography of the South Pacific held at Wellington, New Zealand in February, 1972 (Devaney, 1973).

Aside from type specimens which are already designated, other specimens are being divided, where possible, between the Bishop Museum, the National Museum of Natural History, and the Western Australian Museum.

The distribution of asteroids in southeastern Polynesia is shown in Table 4; localities and station data are given in an appendix pp. 143-204.

#### SYNOPSIS OF ASTEROIDEA RECORDED

##### Luidiidae

1. *Luidia* cf. *maculata* Müller and Troschel

##### Astropectinidae

2. *Astropecten polyacanthus* Müller and Troschel
3. *Astropecten* sp.
4. *A. triseriatus fijiensis* John
5. *Ctenophoraster marquesensis* n. sp.

##### Oreasteridae

6. *Culcita novaeguineae* Müller and Troschel

##### Ophidiasteridae

7. *Ophidiaster lorioli* Fisher
  8. *Leiaster leachi* (Gray)
  9. *Devania naviculiforma* n. gen. and n. sp.
  10. *Linckia laevigata* (Linnaeus)
  11. *L. multiflora* (Lamarck)
  12. *L. guildingi* (Gray)
  13. *Gomophia egyptiaca* Gray
  14. *Neoferdina cumingi* (Gray)
  15. *Fromia milleporella* (Lamarck)
  16. *Fromia* sp. (juv.)
- Poraniidae
17. *Asteropsis carinifera* (Lamarck)
- Asterinidae
18. *Asterina burtoni* Gray
  19. *Asterina anomala* H. L. Clark
  20. *Asterina* sp.
- Echinasteridae
21. *Echinaster luzonicus* (Gray)
- Acanthasteridae
22. *Acanthaster planci* (Linnaeus)
- Valvasteridae
23. *Valvaster striatus* (Lamarck)
- Asteriidae
24. *Arostole paschae* (H. L. Clark)
  25. *Allostichaster peleensis* n. sp.

## ABBREVIATIONS

## a. Institutions

- AHF —Allan Hancock Foundation, California, U.S.A.  
 BPBM —Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.  
 USNM —National Museum of Natural History (formerly, United States National Museum), Washington, D. C., U.S.A.  
 WAM —Western Australian Museum, Perth, Australia.

## b. Measurements

- |                 |  |
|-----------------|--|
| br —breadth     | m —meter(s)  |
| cm —centimeters | mm —millimeter(s)                                      |
| fms —fathoms    | R/r —Radius from arm tip to disc center/radius of disc |
| ft. —feet       |  |

## c. Others

- |                     |                     |
|---------------------|---------------------|
| Sta. —Station       | E —east (longitude) |
| No. —number         | W —west (longitude) |
| N —north (latitude) | temp. —temperature  |
| S —south (latitude) |                     |

## SYSTEMATIC ACCOUNT

## LUIDIIDAE

1. *Luidia* (*Maculaster*) cf. *maculata* Müller and Troschel

Müller and Troschel, 1842: 77; Döderlein, 1920: 262–266, Pl. 18, figs. 4, 13, Pl. 19, fig. 16, Pl. 20, figs. 23, 24; Clark and Rowe, 1971: 30, 43, Pl. 4.

## MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Ua Pou: “Pele” Sta. UP II, haul 2, one specimen, R/r= 37/5 mm (estimated, as all arms are broken).

## REMARKS

The color (dried from alcohol) is cream with patches of brown on the disc and three bands of brown on the arms. The oral surface is cream.

The specimen has 7 rays and runs down to *Luidia maculata* in Döderlein's key (1920).

The paxillae of the aboral surface near the base of the arms are well spaced and more or less circular, covered with short blunt thorny spinelets but no paxillar spines. The adambulacral plates bear a sabre shaped furrow spine and a large straight subambulacral spine followed by a pair of shorter, slightly curved spines set at a slight angle to the furrow. The inferomarginal plates bear three large spines (2 distally) at their outer end and two small spines flanked by a row of fine spinelets on either side.

There are no pedicellariae on the adambulacral, inferomarginal or oral plates. In each actinal intermediate area near the mouth is a large, short bladed, three valved pedicellaria with a ring of spinelets around the base.

The paxillae and their covering of spinelets are more widely spaced than in large specimens of *L. maculata* but they agree with those of specimens of *L. maculata* from the Moluccas, with R of 115 mm, which have regenerating arms of similar size to the Marquesas specimen. The present specimen differs from *L. maculata* in the shape of the 3 valved pedicellariae which have shorter broader blades than is usual in *L. maculata*. The lack of pedicellariae on the adambulacral plates is considered to be a juvenile character.

The specimen is referred to *L. maculata* with some hesitation but if it proves to be this species the known range is extended from the Philippines eastwards to the Marquesas Islands. H. L. Clark (1921) regards *L. maculata* as an Indian Ocean species which has not penetrated far into the Pacific.

## ASTROPECTINIDAE

2. *Astropecten polyacanthus* Müller and Troschel

Müller and Troschel, 1842: 69, Pl. 5, fig. 3; Döderlein, 1917: 128–137, Pl. 4, figs. 4–7; Clark and Rowe, 1971: 30, 44, Pl. 5, fig. 3.

## MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Eiao Island: "Pele" Sta. EO I., haul 2, 4 specimens, R/r=39/9, 42/9, 42/10, 44/10 mm. Nuku Hiva: "Pele" Sta. NH VIII, haul 5, one specimen, R/r=10/3 mm; "Pele" Sta. NH VIII, haul 7, one specimen, R/r=26/7 mm; "Pele" Sta. NH IX, haul 1, one specimen, R/r=59/15 mm; "Pele" Sta. NH XI, haul 1, one specimen, R/r=50/12 mm; "Pele" Sta. NH XI, haul 4, one specimen, R/r=45/10 mm; "Pele" Sta. NH XII, 3 specimens, R/r=34/8, 35/7, 37/9 mm; "Pele" Sta. NH XV, haul 1, 7 specimens, R/r=11/3, 15/4, 16/4, 19/5, 21/6, 25/6, 27/6 mm. Motu Iti: "Pele" Sta. MI I, haul 2, 2 specimens, R/r=8/4, 20/5 mm. Ua Pou: "Pele" Sta. UP II, haul 3, one specimen, R/r=12/4 mm. Tahuata: "Pele" Sta. TH I, haul 1, 3 specimens, R/r=31/7, 46/9, 57/12 mm; "Pele" Sta. TH I, haul 8, one specimen, R/r=32/7 mm; "Pele" Sta. TH X, haul 3, 4 specimens, R/r=12/3, 16/4, 17/5, 24/6 mm; "Pele" Sta. TH X, haul 4, 5 specimens, R/r=11/3, 14/3, 14/4, 15/4, 17/4 mm; "Pele" Sta. TH X, haul 5, 1 specimen, R/r=41/11 mm; "Pele" Sta. TH X, haul 6, 2 specimens, R/r=21/6, 60/12 mm; "Pele" Sta. TH X, haul 7, 1 specimen, R/r=19/4 mm; "Pele" Sta. TH X hauls 9, 10, 11: two specimens R/r=18/5, 37/8 mm; "Pele" Sta. TH X, haul 13, 2 specimens, both R/r=17/5 mm. Fatu Hiva: "Pele" Sta. FH I, haul 2, 2 specimens, R/r=9/3, 13/3 mm; "Pele" Sta. FH I, haul 3, one specimen, R/r=28/8 mm.

PITCAIRN GROUP—Pitcairn Island: "Pele" Sta. PIT VIII, haul 2, one specimen, fragment of arm.

## REMARKS

Forty-seven specimens were taken by dredging in 20 to 84 meters; all but one were from the Marquesas Islands.

Some specimens have unusually flattened inferomarginal spines ending in a divided point.

*Astropecten polyacanthus* is distributed from East Africa through the Indian Ocean and East Indies to Japan, Fiji and Hawaii. It is recorded here from the Marquesas and Pitcairn Islands for the first time.

3. *Astropecten* sp.

## MATERIAL EXAMINED AND LOCALITY

EASTER ISLAND—MIS XXIV c, one specimen (AHF No. 1333), R/r=43/8 mm, br=7 mm.

## REMARKS

The specimen (AHF No. 1333) taken by dredging is badly damaged and most of the spines of the actinal surface are broken or rubbed off except near the arm angle.

The arms are narrow, tapering evenly to the end. Superomarginals 26, inferomarginals 28. Paxillae are closely packed with 8 to 10 across base of ray. They have, in the center, one enlarged, rounded, spinelet and 1 to 3 smaller spinelets surrounded by 9 to 12 marginal spinelets.

The first superomarginal is enlarged and bears a stout conical spine, the next two to three plates lack spines but the remainder each bear a conical spine, smaller than that of the first superomarginal. The spines are placed centrally on the abactinal surface of the plate proximally but are nearer the outer margin distally. The surface of the superomarginals is covered with fine papilliform spinelets. The terminal plate bears 2 to 3 spines on each side.

The inferomarginals bear a long, scarcely flattened, curved, tapering marginal spine followed by a similar spine about two thirds of its length, then two to three smaller spines. The remainder of the plate is covered by fine papilliform spinelets, some of which are enlarged and flattened.

There are three subequal furrow spines, and three subambulacral spines.

Two actinal plates lie each side of each inter-radius.

The specimen resembles *A. polyacanthus* in the arrangement of the superomarginal spines but whereas in *A. polyacanthus* they stand close to the inner edge of the plate, in this specimen they are central or near the outer edge.

The inferomarginal spines differ in shape from those of *A. polyacanthus* but their arrangement is comparable.

This specimen may represent an Easter Island subspecies of *A. polyacanthus* but without further material I would hesitate to describe it as such.

This specimen was collected at La Perouse Bay, Easter Island, by the S.I.O. Downwind expedition, stn. DW HD-76, Feb. 7, 1958; rock dredge, 40-22 fms, cobbles, coral, rock, coquina.

#### 4. *Astropecten triseriatus fijiensis* John

John, 1948: 501-502, Pl. 2, fig. 4.

##### MATERIAL EXAMINED AND LOCALITY

EASTER ISLAND—MIS XXIVb, one specimen, R/r=48/11 mm, br=12 mm, R=4.3r.

##### REMARKS

*A. triseriatus fijiensis* differs from *A. triseriatus* in the enlargement of the first pair of superomarginal plates and the unarmed condition of the second pair in most cases. This specimen, although smaller, agrees closely with the description of the subspecies.

The first superomarginal is enlarged and bears a stout spine, the second is reduced and spineless in 7 and bears a spine in 3 cases. The following 4 to 10 superomarginals bear a single spine near the inner margin of the plate while the remainder bear two fairly short conical spines.

The inferomarginal spines, adambulacral armature and the spines of the oral plates agree with the description of the subspecies.

*A. triseriatus fijiensis* was previously known only from the type locality, Fiji.

Genus *Ctenophoraster*

Fisher, 1906: 1014.

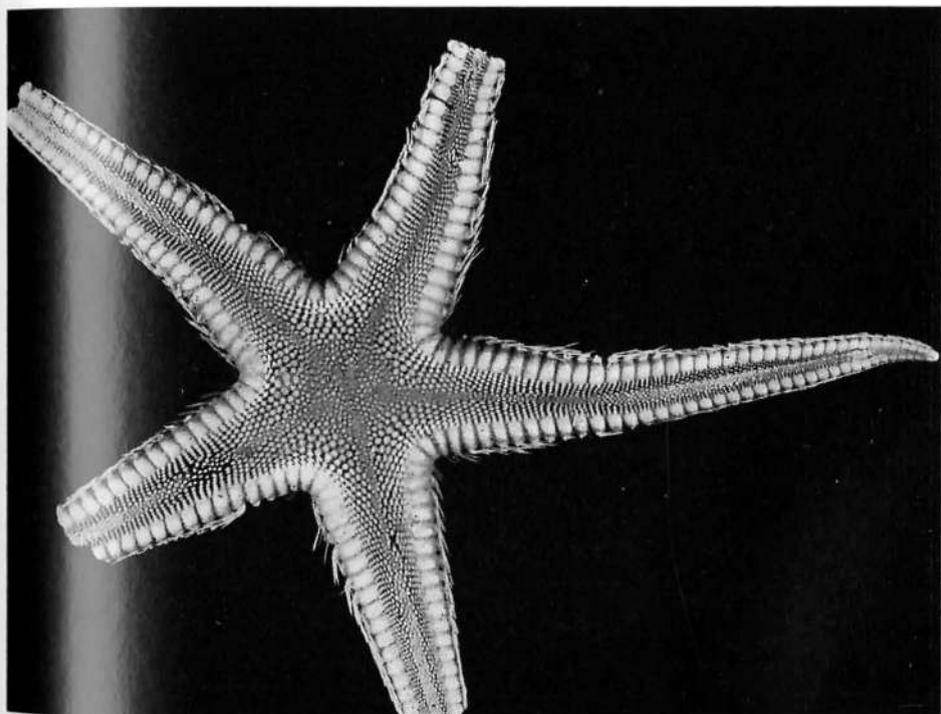
5. *Ctenophoraster marquesensis* n. sp.

Figs. 1-3

ETYMOLOGY: The name is derived from the type locality, Marquesas Islands.

## MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Eiao Island: "Pele" Sta. EO I, haul 1, 4 specimens, R/r=12/4, 20/6, 25/5, 26/6 mm. Nuku Hiva: "Pele" Sta. NH VII, hauls 4 to 6, one specimen R/r=27/6 mm; "Pele" Sta. NH VIII, haul 5, one specimen, R/r=15/4 mm (PARATYPE, USNM No. E 11588); "Pele" Sta. NH XV, haul 2, 4 specimens, R/r=49/11 (PARATYPE, BPBM No. W1925), 52/10 (PARATYPE USNM No. E11586), 56/12 (PARATYPE, WAM No. 24-72), 63/13 mm. Ua Pou: "Pele" Sta. UP II, haul 1, one specimen, R/r=20/5 mm; "Pele" Sta. UP II, haul 4, one specimen, R/r=58/11 mm (PARATYPE, USNM No. E11590); "Pele" Sta. UP II, haul 6, 3 specimens, R/r=16/5, 55/10, 64/11 mm. Tahuata: "Pele" Sta. TH I, haul 1, one specimen, R/r=61/11 mm (PARATYPE, WAM No. 25-72); "Pele" Sta. TH I, haul 2, 9 specimens, R/r=32/6, 35/6, 35/7 (PARATYPE, USNM No. E 11589), 35/8, 37/7,

Fig. 1. *Ctenophoraster marquesensis*, abactinal view of Holotype.

39/7 (PARATYPE, USNM No. E 11589), 40/7, 41/8, 50/10 mm; "Pele" Sta. TH I, hauls 2 to 7, 56 specimens,  $R/r=11/3$  (PARATYPE BPBM No. W 1926), 12/3 (2), 13/4, 14/3, 14/4, 17/4, 18/4, 19/4, 23/5, 24/5, 25/5, 26/6, 27/5 (2), 27/6, (PARATYPE, WAM No. 26-72), 28/5, 31/6, 31/7 (2), 32/4, 32/6, 32/7, 33/7 (PARATYPE WAM No. 27-72), 34/8, 35/7 (3) (one of which is

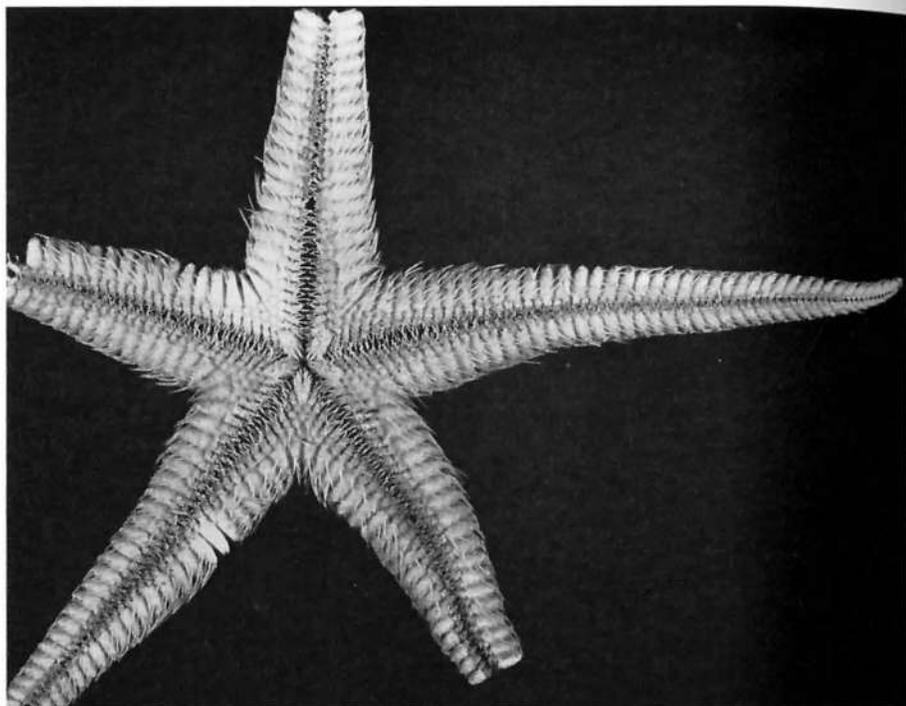


Fig. 2. *Ctenophoraster marquesensis*, actinal view of Holotype.

PARATYPE BPBM No. W 1926), 35/8, 36/6, 36/7, 36/8, 37/8, 38/7 (3), 39/7 (2), 39/8 (2), 40/7, 40/8, 41/7, 41/8, 41/9, 42/8, 43/8, 45/8, 45/9, (PARATYPE BPBM No. W 1926), 47/8, 47/10, 48/9, 49/8, 50/10, 60/7 mm, and one specimen too broken to measure; "Pele" Sta. TH IX, haul 1, one specimen,  $R/r=51/9$  mm; "Pele" Sta. TH X, haul 1, 2 specimens,  $R/r=45/8$  mm (PARATYPE, BPBM No. W 1927) and 48/9 mm (PARATYPE, WAM No. 28-72); "Pele" Sta. TH X, haul 2, 4 specimens,  $R/r=30/6$  (PARATYPE, USNM No. E 11587), 40/8, 56/10 (HOLOTYPE, BPBM No. W 1924) and 56/9 mm. Fatu Hiva: "Pele" Sta. FH I, haul 3, 2 specimens,  $R/r=22/6$ , 30/7 mm; "Pele" Sta. FH I, haul 4, one specimen  $R/r=11/4$  mm (PARATYPE, WAM No. 29-72).

DESCRIPTION OF HOLOTYPE (BPBM No. W 1924)

Rays 5,  $R=56$  mm,  $r=10$  mm,  $R=5.6r$ ; breadth of ray, between third and

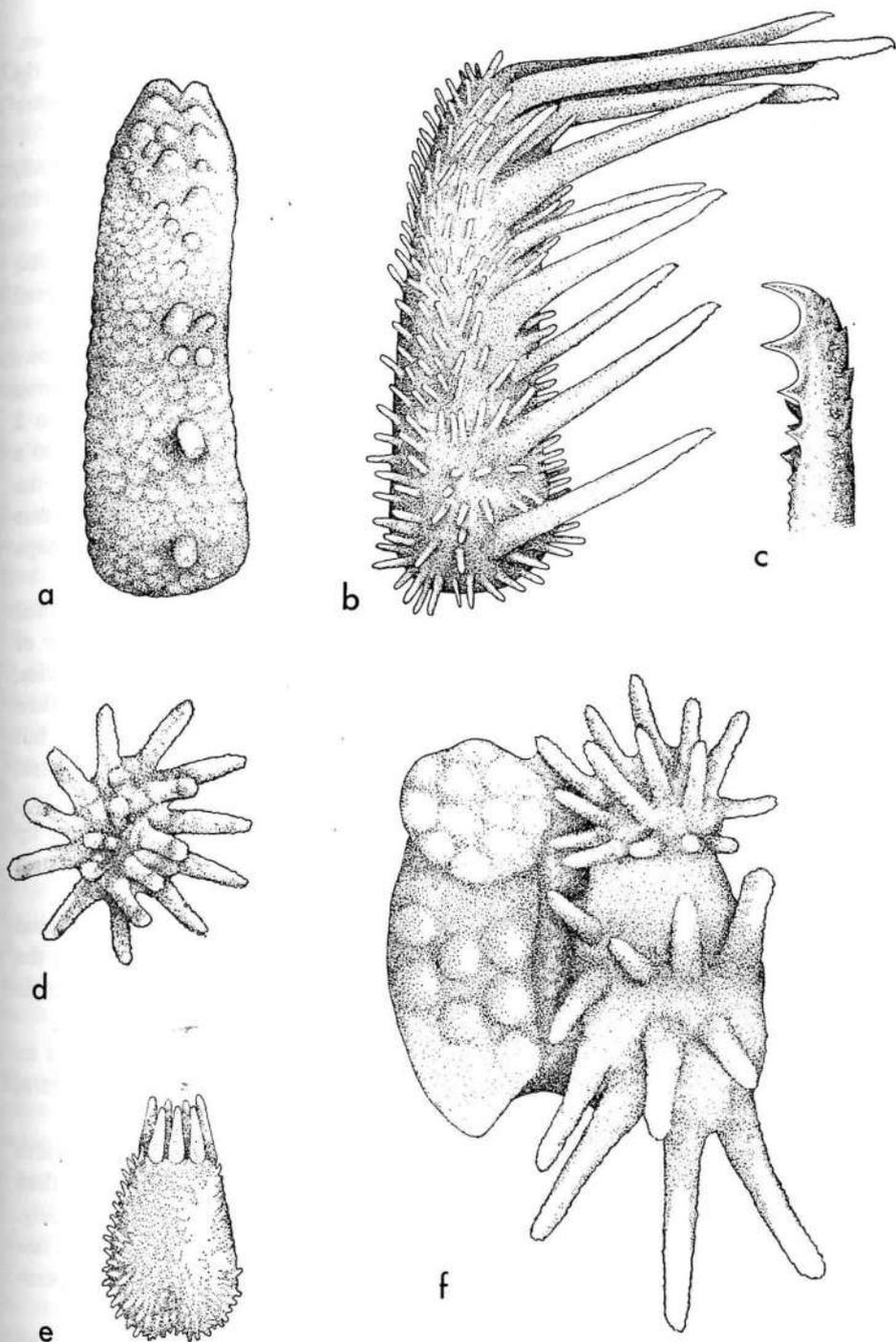


Fig. 3. *Ctenophoraster marquesensis*.

- a. eighth inferomarginal plate denuded.
- b. ninth inferomarginal plate, distal series of spines hidden.
- c. tip of one of the long spines, enlarged.
- d. abactinal paxilla from lateral area of ray.
- e. terminal plate.
- f. two adambulacral and actinal intermediate plates, those on the left denuded.

fourth superomarginals, 11 mm; dorsoventral dimension of ray at base 6 mm. Color (alive), aboral surface light brownish pink, center of disc and median strip on arms darker brownish pink. Oral surface white extending laterally to the outer part of the superomarginals and the fasciolar grooves.

Rays of moderate length, tapering evenly to the end (Figs. 1, 2); disc small, abactinal surface flat, the sides of the arms rounded; actinal surface flat with bevelled sides; interbrachial arcs acutely rounded.

Abactinal paxillae irregularly arranged over the central portion of the disc and in a median strip running the length of the arms. Small paxillae are scattered amongst the larger ones.

On the lateral portion of the disc and rays paxillae are arranged in rows extending from superomarginal plates to central area of disc and rays. Five rows of paxillae correspond to 2 superomarginal plates on the arms and 6 rows to 2 superomarginals on the disc. At the base of the arm there are 5 or 6 paxillae to a row on either side of the radial area. The adambulacral plates, seen from the coelomic surface are much longer than wide and regularly arranged in transverse series except along the median radial strip where they are irregular in size, shape and arrangement.

Each paxilla on the disc has a short thick pedicel, convex but scarcely widened at the top, usually circular but oval where crowded, bearing a variable number of papilliform spinelets in the center, surrounded by a radiating peripheral series. The largest paxillae on the disc are in the inter-radial areas nearer the margin than the center of the disc; they have up to 16 central and 20 peripheral spinelets but paxillae of the central area of the disc have about 8 central and 16 peripheral spinelets. The largest paxillae on the arms are near the base of the ray, midway between the radial area and the margin, and have 8 or 9 central and up to 15 peripheral spinelets (Fig. 3d). The largest paxillae of the median radial strip have about 6 central and 10 peripheral spinelets.

Papulae are found between the transverse rows of paxillae on the arms and between the radiating disc paxillae but not in the central area of the disc or on the radial area of the arms. Papulae are arranged in a circlet of 6 around a single paxilla as illustrated for *C. diploctenus* (Fisher, 1919, Pl. 16, fig. 2a).

Madreporite equal in area to 3 large paxillae, situated a little more than its own diameter from the superomarginal plates. Striae radiate from near the adcentral side.

Superomarginal plates 40 in number from interradial line to end of ray, width and height nearly equal except in the interbrachial arc where they are higher than wide. They form a prominent border to the rays and are set slightly obliquely. Superomarginals covered with fine, short, round ended spinelets, longer in the fasciolar grooves. No pedicellariae, spines or tubercles are found on the superomarginals.

Terminal plate (Fig. 3e) covered with short spinelets (almost granules) and bears 7 pointed spines on its outer end. Spines and granules are easily dislodged.

Inferomarginals extend beyond superomarginals and define margin of ray. They correspond in number to the superomarginals, are short (1 mm) and wide (3.5 mm) curving towards their outer end so that the edge of the ray is bevelled. Inferomarginals carry two rows of spines on their outer ends, the adoral series extending to the actinal surface of the plate in an oblique line (Figs. 3a, b). From the outer end of the plate the adoral series consists of 2 short spines, 4 long, followed by another short spine; the series continues on the actinal surface with 3 long and several shorter spines. The aboral series has 3 spines, shorter than the adoral series and overlain by them. The long spines lie appressed to the sides of the rays and have hooked ends, characteristic of the genus (Fig. 3c). Surface of inferomarginals covered with papilliform spinelets, similar to those of the superomarginals.

Adambulacral plates wider than long, slightly oblique with the furrow end adoral to the outer end (Fig. 3f).

Furrow spines slender, blunt ended, slightly tapering, in radiating fans of 3, the central one longer than the laterals. Occasionally one of the furrow spines is enlarged, flattened and slightly curved. Subambulacral spines usually in 2 longitudinal series of 3 each with an additional 1 to 3 shorter spines on the outer part of the plate. There are sometimes 4 spines in each subambulacral series.

Mouth plates densely covered with spines. Along the edge of the plate next to the suture there is a vertical series, starting from deep in the mouth, of 4 to 5 heavy, flattened, blunt spines, decreasing in size from the innermost; the series continues to the outer end of the plate with about 5 more slender blunt spines. The spines of the furrow edge of the mouth plates are small and curved, about 7 in number. Between these and the large spines are a row of small spines, like those of the furrow series and one or two series of larger spines.

Actinal intermediate plates extend in a single series three quarters the length of the ray; a second series extends to the second inferomarginal and a third series consists of 2 to 3 plates in the arm angle. All are rounded to square in shape and carry up to 16 irregularly arranged small blunt spinelets. Exclusive of the series next to the adambulacrals there are about 12 plates, each having, in addition to the spinelets, a central tapering pointed spine.

Fasciculate pedicellariae, consisting of a group of about 5 spinelets surrounding a pit on the plate, occur rarely on the actinal plates adjacent to the adambulacrals near the mouth. Pedicellariae absent from adambulacral, inferomarginal and actinal plates of the rays.

#### COMPARISON WITH OTHER SPECIMENS

There are 92 specimens of *C. marquesensis* ranging in size from R of 11 mm to 64 mm; the R/r ratio varies from 3.3 to 5.8/1.

There is little variation between specimens apart from that related to size. A specimen of R=11 mm (PARATYPE, BPBM No. W 1926) has 13 superomarginal plates, 2 series of actinal plates interradially, one series extending to the 3rd inferomarginal or one quarter the length of the ray; furrow spines 3, subambu-

lacralspines reduced in number; inferomarginal spines scarcely developed. At  $R=15$  mm (PARATYPE, USNM No. E 11588) there are 17 superomarginals, actinal plates extend to the 4th inferomarginal, 3 series interradially; 4 inferomarginal spines. At  $R=27$  mm (PARATYPE, WAM No. 26-72), there are 25 superomarginals; the actinal plates extend to the 7th inferomarginal or nearly half the length of the ray. Adambulacrals armature has reached the adult condition but the actinal plates have not developed fully. Inferomarginals have 4 spines at their outer end, the second series and spines on actinal surface of inferomarginals are beginning to develop. At  $R=35$  mm (PARATYPE BPBM No. W 1926) there are 30 superomarginals, the actinals extend to the 16th inferomarginal or two thirds the length of ray; inferomarginal spines are nearly fully developed. A specimen of  $R=45$  mm (PARATYPE, BPBM No. W 1927) has several fasciculate pedicellariae on the actinal plates nearest the mouth. It also has a reduced radial strip on the arms so that the rows of paxillae are nearly continuous across some of the rays. Several other specimens have 1 or 2 pedicellariae but many have none.

*C. marquesensis* was taken by dredging in depths of 48 to 93 meters from bottoms of coarse sand, broken shell, and rubble. Most were taken on yellow sand with broken shell fragments.

Small gastropods found in the mouth and stomach of some specimens indicates that the species engulfs its prey whole.

Distribution: Known only from the Marquesas Islands.

#### REMARKS

This species adds a third to the little known genus *Ctenophoraster*, represented by *C. hawaiiensis* Fisher 1906, described from a single specimen ( $R/r=150/22$ ) from 104 meters off Laysan in the Hawaiian Islands, and *C. diploctenus* Fisher 1913 and 1919, described from a single specimen ( $R/r=105/15$  mm) from 216 meters in the China Sea near southern Luzon, Philippines.

All the known specimens of *C. marquesensis* are considerably smaller than either of the above species. It differs in many respects from *C. hawaiiensis* but is very close to *C. diploctenus*. The three species of *Ctenophoraster* may be separated by the following key:

- A Papulae occur on the mid-radial portion of the rays which has irregularly arranged plates; paxillae not forming regular rows across rays. Outer part of inferomarginal plates with 3 rows of spines.....*C. hawaiiensis*
- A' Papulae absent from mid-radial portion of rays. Outer part of inferomarginal plates with 2 rows of spines.....B
- B Paxillae are in continuous curved rows across rays.  $R=7r$ ..*C. diploctenus*
- B' Paxillae not in continuous rows across rays. Midradial area of rays has irregularly arranged plates.  $R=5r$ .....*C. marquesensis*

*C. marquesensis* differs from *C. diploctenus* in the following respects. The former has  $R=5r$  (3.3 to 5.8r) against  $R=7r$  for *C. diploctenus*. *C. marquesensis* has 40 superomarginals, *diploctenus*, 53. *C. marquesensis* has fewer spines on the

inferomarginals although both have 2 series of spines on the outer part of the plates. The terminal plate of *marquesensis* bears 7 spines but the condition for *diploctenius* is unknown. Fasciculate pedicellariae are found on the supero-marginal, inferomarginal, actinal and adambulacral plates of *diploctenius* but only on the actinal plates nearest the mouth in *marquesensis*, none at all in most specimens. Actinal plates of the inter-radius, exclusive of the series next to the adambulacrals number 17 in *diploctenius*, 12 in *marquesensis*.

Many of the above differences could be ascribed to the smaller size of *marquesensis*. The R/r ratio increases with size, so usually does the occurrence of pedicellariae. Since *C. marquesensis* is represented by a large series of specimens it seems likely that the sample represents the size range of the population, hence size, taken in conjunction with the difference in arrangement of the abactinal plates of the rays is considered to be a valid difference between the species.

## OREASTERIDAE

### 6. *Culcita novaeguineae* Müller and Troschel

Müller and Troschel, 1842: 38; Clark, 1921: 32; Livingstone, 1932: 265-273, pls. 14-17; Clark and Rowe, 1971: 34, 54.

#### MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Anuanuraro Atoll: WES XLVII, on coral knoll, one specimen (examined by D. M. Devaney).

MARQUESAS ISLANDS—Tahuata: Pele Sta. TH III, two specimens (one examined), R=124 mm, color (dried) papular areas orange-brown, remainder of abactinal surface purple, actinal surface yellow-orange, purple near ambulacral furrows. WES XXXVII, host for carapid fish, one specimen (examined by D. M. Devaney).

GAMBIER ISLANDS—Aukena Island: "Pele" Sta. GA IV, one specimen, R=121 mm, color (dried) abactinal surface purple, spines white, actinal surface cream, purple along ambulacral furrows.

PITCAIRN GROUP—Pitcairn Island: "Pele" Sta. PIT IIIb, one specimen, R=123 mm, color (dried) papular areas yellow, remainder of abactinal surface purple, actinal surface white, spines yellow. WES LXI, one specimen, R/r=95/80 mm. WES LXIII, two specimens (examined by D. M. Devaney); color (alive): a. upper surface reddish brown, spines all butter yellow; b. upper side light golden yellow with deep purple blotches; area of ambulacral groove and outer margin also deep purple.

#### REMARKS

*Culcita novaeguineae* is distributed from Mauritius through the East Indies to Fiji, Samoa and Hawaii. Morrison (1954) records it from reef patches in the lagoon of Raroia atoll, Tuamotus. *Culcita novaeguineae* is here recorded from the Marquesas, Pitcairn, and Gambier Islands for the first time.

## OPHIDIASTERIDAE

7. *Ophidiaster lorioli* Fisher

Fisher, 1906: 1077, Pl. 31, figs. 4a-d, Pl. 39, fig. 3; H. L. Clark, 1921: 84; Hayashi, 1938b: 281; Clark and Rowe, 1971: 36, 61.

## MATERIAL EXAMINED AND LOCALITIES

PITCAIRN GROUP—Pitcairn Island: "Pele" Sta. PIT IV, in *Pocillopora* coral, one specimen, R=23 mm; "Pele" Sta. PIT V, one specimen, R=17 mm; "Pele" Sta. PIT VI, haul 8, one specimen, R=32 mm; "Pele" Sta. PIT VII, haul 1, one specimen, R=11 mm; WES LXI, 2 specimens, R=16, 25 mm; WES LXV, one specimen, R=27 mm.

RAPAN ISLANDS—Ilots de Bass: WES XXXIV, along side of rocky spur, 9 specimens (7 examined), color, bright deep orange, R=15 to 78 mm. Rapa Island: WES XXVI, from stomach of fish, *Bodianus* sp., one specimen, R=15 mm (partly digested).

AUSTRAL ISLANDS—Tubuai Island: WES XIX, under boulder, one specimen, R=35 mm.

LINE ISLANDS—Palmyra Island: MIS III, two specimens, R=30, 32 mm.

SAMOAN ISLANDS—No locality or date: MIS Ia, one specimen (BPBM No. W 639), R=30 mm.

## REMARKS

Since *Ophidiaster lorioli* is known from few specimens, details of the above material and of the holotype are given in Table 1. The series of seven specimens from one locality (Ilots de Bass), ranging in size from R=15 to 78 mm, enable some observations to be made on growth changes in this species. All but two of the specimens have five arms, one has four and another six. The arms are fairly even in length though some are regenerating parts; small specimens tend to have cylindrical arms while some tapering occurs in large individuals.

The size of the papular areas and corresponding number of papulae increases markedly with the size of the specimen. There are 1-2 per area in one of R=11 mm, 6-12 in those of R=35 mm and up to 20 in the largest specimen of R=78 mm, decreasing to 2-3 near the ends of the arms.

The number of pedicellariae also increases with size from a total of two in a specimen of R=11 to 1-2 in each papular area and up to 12 in the actinal inter-radial area of large specimens. Most have a line of pedicellariae in the papular areas above the superomarginals and 2 or 3 in each inter-radius orally.

Pedicellariae on all the specimens are largest near the anus; most have 5-6 teeth fitting neatly into sockets in the alveoli but a few have 7 or 8 teeth.

The granules on the aboral plates and papular areas are undifferentiated in small specimens but in those with R of more than 30 mm the granules in the centre of the plates are enlarged and somewhat prismatic. Orally they are sometimes squamiform.

Frequently *O. lorioli* has two madreporites and often two anal apertures

Table 1. The variation in *Ophidiaster lorioli*.

Source of Specimen	Locality	R (mm)	r (mm)	br (mm)	R/br	No. of Papulae per Area	No. of Madreporites	No. of Anal Apertures
USNM Type <sup>a</sup> No. 21173	HAWAII S. coast Molo-kai Is, on reefs.	31	4.5	4.5	6.9/1	2-3	2	2
BPBM W639 MIS I	SAMOA	30	4.5	4.5	7.5/1	3-4(5) <sup>b</sup>	1	2
BPBM Acc. No. 7122 MIS III	PALMYRA IS.	32	4.5	5.0	6.4/1	4(3, 6)	3	2
"Pele"	PITCAIRN IS.	30	3.0	4.5	6.6/1	4(3, 6)	2	2
PIT IV		23	3.0	4.5	5.1/1	1-5(6)	2	2
PIT V		17	3.0	3.0	5.7/1	2-3(4)	2	1
PIT VI		32	5.0	5.5	5.5/1	4	1	1
PIT VII, haul 1		11	2.0	2.0	5.5/1	1-2	1	1
"Westward"								
WES LXV		27	3.5	4.0	6.8/1	3-5(7)	2	2
WES LXI		25	3.0	3.5	7.1/1	3-4(5)	1	1
WES LXI		16	2.5	2.5	6.4/1	1-2	1	1
"Westward"	RAPAN IS.							
WES XXXIV	Ilots de Bass	75	9	11	6.8/1	18-20	1	1
" "	" "	78	10	10	7.8/1	18-20	1	1
" "	" "	66	9	9.5	6.9/1	11	1	1
" "	" "	35	6	7	5/1	6-8	1	1
" "	" "	21	4	4	5.3/1	1-3	1	1
" "	" "	15	3	3	5/1	1-3	1	2
" "	" "	15	3	3	5/1	1-2	1	1
"Westward"								
WES XXVI	Rapa Is.	15	3	3	5/1	?	1	? specimen partly digested
"Westward"	AUSTRAL IS.							
WES XIX	Tubuai Island	35	4	6	5.8/1	12	2	2

<sup>a</sup> data from Fisher (1906).

<sup>b</sup> parenthesis ( ) denotes occasional occurrence.

although usually pentamerous. However the series of specimens from Ilots de Bass all have a single madreporite and all but one have a single anus. There appears to be no relationship between the size of the specimen and the number of madreporites. A single madreporite is also found in the specimen from Samoa and in four of the specimens from Pitcairn Island.

The presence of a granule between the adjacent furrow spines of two adjacent plates is given as a key character by Fisher (1906). This character appears variable in the specimens examined; in one, granules occur between adjacent furrow spines in one place, and between every pair of spines in another. The specimens from Samoa and Palmyra Island have granules between all the spines.

While a single granule is usual, the spines are sometimes separated by a vertical series of granules.

While all the specimens examined are clearly conspecific with one another, they show considerably more individual variation than has been recorded previously. Clark and Rowe (1971) state that *O. lorioli* has only 3-4 pores per area even at R of 50 mm. *O. cribrarius* Lütken has up to 12 pores per area but has smaller pedicellariae with narrow blades bearing two indistinct digits. Hayashi (1938a) has described a series of specimens from the Ogasawara (Bonin) Islands under the name of *O. cribrarius*. These seem to fall within the range of variation of specimens of *O. lorioli* from southeastern Polynesia. They differ only in color (dark reddish brown) and in the frequent occurrence of more than five rayed specimens.

*O. lorioli* was described originally from Hawaii and is also known from Samoa (H. L. Clark, 1921), the Marshall Islands (A. H. Clark, 1952) and Japan (Hayashi, 1938b). A closely related species, *O. robillardi* de Loriol, occurs at Mauritius.

*Ophidiaster lorioli* is recorded from Rapa Island, Ilots de Bass, Tubuai Island, Pitcairn Island and Palmyra Island for the first time.

#### 8. *Leiaster leachi* (Gray)

*Ophidiaster leachi* Gray, 1840: 284.

*Leiaster leachi*, de Loriol, 1885: 40-43, Pl. 14, figs. 1-2c.

*Leiaster leachi hawaiiensis* Fisher, 1925: 77, Pl. 8a, Fig. 9i.

*Leiaster leachi*, H. L. Clark, 1921: 73; 1938: 136-137, Pl. 9; Clark and Rowe, 1971: 36, 58.

#### MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Nuku Hiva: "Pele" Sta. NH X, one specimen, R/r=162/18 mm.

RAPAN ISLANDS—Rapa Island: WES XXVI, one specimen, R/r=95/10 mm, color (alive) cream, extensively spotted and blotched with irregular areas of pink and orange-red, madreporite red, terminal plate magenta.

COOK ISLANDS—WES IX, original label lost, label by D. M. Devaney states "I think this starfish was taken at Aitutaki, Cook Islands". One specimen R/r=103/9 mm, color (dry), dark red.

HAWAIIAN ISLANDS—Oahu: MIS XXIX, one specimen (BPBM No. W 1353), R/r=73/8 mm; MIS XXX, one specimen (BPBM No. W 1401), R/r=85/8 mm. Pearl and Hermes Reef: MIS XXXI, one specimen (BPBM No. W 675) R/r=67/7 mm.

#### REMARKS

Since specimens of *Leiaster* are rarely encountered details of the specimens examined are shown in Table 2.

All have four lobed skeletal plates with a subcircular central area of crystal bodies surrounded by a smooth border. The skin may be so thin that the crystal

Table 2. The variation in *Leiaster leachi*.

Source of Specimen	Locality	R (mm)	r (mm)	br (mm)	R/br	No. of Papulae per Area	Pedicellariae	Furrow Spines, g=Grooved	Skin T=thick t=thin	Color (dry)
Type of <i>L. leachi hawaiiensis</i> (Fisher 1925)	HAWAII Koloa, Kauai	108	10	12	9/1	10-15	X	3(2)g*	—	Yellow ochre, brownish on papular areas
BPBM W 1353 MIS XXIX	Makua, Oahu	73	8	8	9.1/1	9	X	3(2)	t	Yellow-brown
BPBM W 1401 MIS XXX	Oahu	85	8	10	8.5/1	10	X	3	t	Reddish-pink
BPBM W 675 MIS XXXI	Pearl & Hermes Reef	67	7	8	8.4/1	10	O	2	t	Yellow-brown
"Pele" Sta. NH X	MARQUESAS Is. Nuku Hiva	162	18	20	8.1/1	30-50	XXX	2(3)g	T	Yellow-brown
WES XXVI	RAPAN IS. Rapa.	95	10	11.5	8.2/1	8-12	O	2(3)	t	Cream, mottled with pink & orange-red. Madreporite red & terminal plate magenta.
WES XI	COOK IS. Aitutaki?	103	9	10	10.3/1	8-12	X	3(2)	T	Red, amb. furrows yellowish.

\* parenthesis ( ) denotes occasional occurrence.

bodies and outlines of the plates are clearly seen (t in Table 2) or fairly thick and wrinkled so that they are obscured (T). Pedicellariae may be absent, few, or abundant.

Differences in color, thickness of skin, number of furrow spines and the presence or absence of pedicellariae do not show any consistent relationship. All the specimens have the proportions of length and width of the combs of furrow spines as described for *Leiaster leachi hawaiiensis* by Fisher (1925), i.e., the base line of the comb of three is 0.6 of the length of the spines while the base line of a comb of two is 0.4 of the length of the spines. The same proportions are found in the furrow spines of some Indian Ocean specimens of *L. leachi*. The single large specimen has a slight grooving of the furrow spines sometimes found in large *L. leachi* from the Western Pacific and Indian Oceans.

From the specimens available there appears to be no geographical grouping of those with two or three furrow spines; both are found in the Hawaiian Islands.

The R:br ratio (8.1 to 10.3:1) of specimens from eastern Polynesia is slightly less than that of specimens from Australia, examined by the author, which have R:br of 8.9 to 11.2:1, while a specimen from Mauritius has R:br of 14.5:1. This difference may be a reflection of the size of the specimens, as all of the Indian Ocean ones are much larger than the specimens from eastern Polynesia.

The number of pores in a papular area increases markedly with size from 8-12 in specimens of R=100 mm or less to 30-50 in a specimen of R=162 mm.

H. L. Clark (1921) separated *L. leachi* from *L. speciosus* von Martens on the proportions of the arms (R:br ratio) and on the presence or absence of pedicellariae. Color was the sole distinguishing character used in his 1946 key as the other distinguishing features proved to be unreliable. Variegated orange-yellow and red specimens, with or without magenta, were referred to *L. leachi*, while crimson specimens were referred to *L. speciosus*. Clark and Rowe (1971) repeat this distinction between the two species with a footnote that *L. speciosus* may prove to be a synonym of *L. leachi*. Since no differences correlated with color are observed in the present specimens they are all referred to *Leiaster leachi* Gray, which ranges from Mauritius and the Red Sea (where A. M. Clark, 1967a, recorded a specimen with groups of 3 furrow spines) through the East Indies and Pacific to Hawaii.

It is doubtful whether Fisher's subspecies *L. leachi hawaiiensis*, based on a single specimen from Hawaii, can be maintained as it no longer has a geographical basis.

*Leiaster leachi* is recorded from the Marquesas, Rapa Island, Cook Islands and Pearl and Hermes Reef for the first time.

#### **Devania n. gen.**

ETYMOLOGY: Named in honor of the collector of the type species, Dr. D. M. Devaney.

TYPE SPECIES: *Devania naviculiforma* n. sp.

#### DIAGNOSIS

A genus of Ophidiasteridae with small disc and five slender cylindrical rays having a rigid compact skeleton covered with a very thin, smooth skin through which the outlines of the plates are visible. Plates of the rays, excluding adambulacral and actinal plates are in 7 regular longitudinal series with papulae in 8 series.

Between inferomarginal and adambulacral plates are two small actinal plates to each inferomarginal. Adambulacral plates imbricating, saucer shaped; armature spiniform, in two series; a single furrow spine to each plate.

Abundant large and small excavate pedicellariae (described below) lie loose in the skin.

#### REMARKS

The new species, on which this genus is based, while clearly an Ophidiasterid, does not fit into any of the described genera.

It appears to be most closely related to *Leiaster* which it resembles in the arrangement of the skeletal plates but the lateral connecting ossicles, usually prominent in *Leiaster*, are reduced and concealed by the primary plates; the smooth skin is also similar to *Leiaster*. However the unusual shape of the adambulacral plates with their spiniform armature of a single furrow spine per plate differs from the characteristic plates and armature of *Leiaster*. The pedicellariae are also unlike any found in *Leiaster* but the jaws of the pedicellariae resemble those of *Ophidiaster easterensis* Ziesenhenné 1963.

*Devania* differs from *Ophidiaster*, *Dactylosaster*, and *Copidaster* in lacking granules or scales on the skin.

Distribution: Known only from Raivavae Island in the Austral Group, South Pacific.

### 9. *Devania naviculiforma* n. sp.

Figs. 4 and 5

ETYMOLOGY: *navicula* (Lat.), boat; *forma* (Lat.) shape, in reference to the large boat-shaped pedicellariae.

#### MATERIAL EXAMINED AND LOCALITY

AUSTRAL GROUP—Raivavae Island: WES XV, from underside of overturned table *Acropora* coral, one specimen, dry (HOLOTYPE BPBM No. W 1928).

#### DESCRIPTION OF HOLOTYPE (BPBM No. W 1928).

R=40 mm, r=4.5 mm, br=5 mm, R=8.9 r and 8 br. Disc small, arms five, more or less cylindrical, tapering slightly distally. Body covered by thin smooth skin, not obscuring skeletal plates. Skin attached to upper edges of prominent pedicellariae and to upper margin of elevated madreporite, also forms webbing between furrow spines and between subambulacral spines. Madreporite circular, 1.3 mm in diameter, surface slightly concave, elevated about 0.3 mm

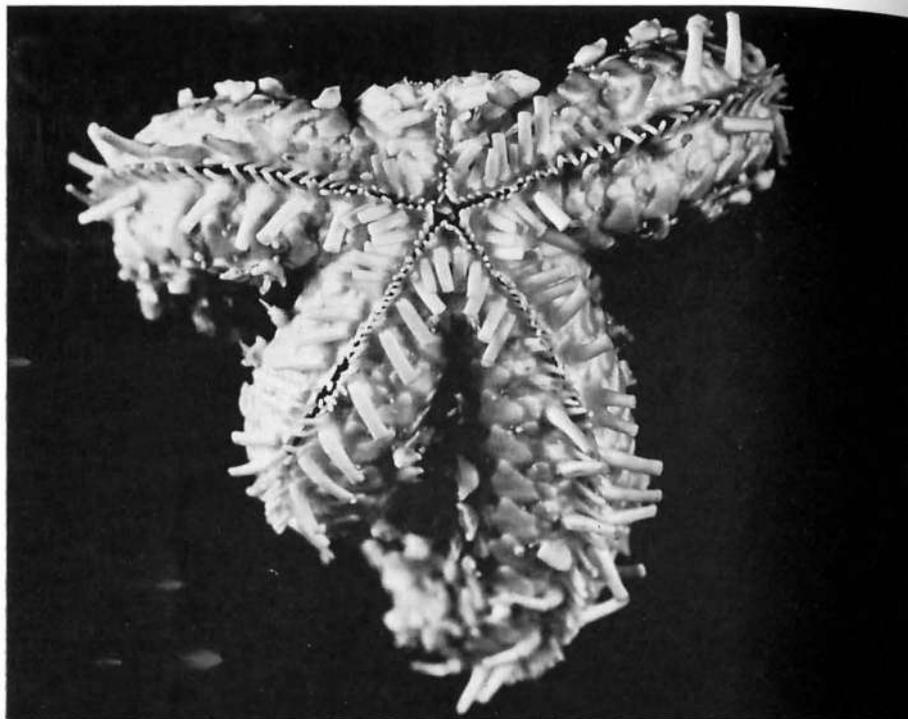


Fig. 4. *Devania naviculiforma*, actinal view of Holotype.

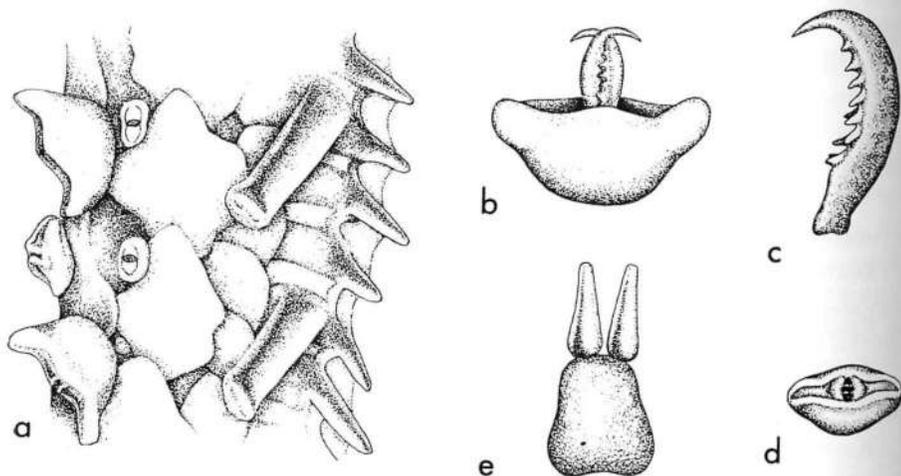


Fig. 5. *Devania naviculiforma*.

- a. actinal view from inferomarginal plates to ambulacral furrow, showing large and small pedicellariae.  
 b. large pedicellaria.  
 c. single jaw of large pedicellaria.  
 d. small pedicellaria.  
 e. terminal plate.

above disc. Madreporite lies half way between anus and margin of disc. Anus surrounded by 3 large and 3 small granules with 2 smaller accessory granules.

Skeleton of arms compact, consisting of 7 regular longitudinal series of overlapping plates. Supero- and infero-marginals not differentiated from the abactinal plates. Plates are diamond shaped, the adoral end of each overlapping the aboral end of the preceding one. Laterally the plates are contiguous or slightly overlapping obscuring connecting ossicles which are only visible internally.

There are no crystal bodies on the plates. The elongate terminal plate bears two spines on its distal end (Fig. 5e).

Between the inferomarginal and adambulacral plates is a series of irregularly squarish actinal plates, two of which correspond to each inferomarginal (Fig. 5a). Adambulacral plates correspond in number but not exactly in position to the actinal plates. Adambulacral plates are set at a slight angle to the furrow so that the furrow edge of each plate is distal to its outer edge. The plates are saucer shaped, the curved margin visible from the actinal and furrow view. The adoral side of one overlaps the concave aboral side of the preceding one.

Adambulacral armature spiniform, in two series, the outer series larger.

Furrow spines fine, slightly tapering, blunt ended, two per plate for the first 5-10 after the mouth plate, thereafter a single slightly larger spine per plate. A fine web of skin joins them nearly to their tips. A subambulacral spine is on each of the first 2 to 4 plates after the mouth plate, thereafter they become more widely spaced, somewhat irregularly. Distally there is one on every third or fourth plate. The spines are 2 mm long, taper slightly, then widen to a truncate end. They are slightly flattened and are grooved on the outer side. A fine web of skin connects them near the base.

The mouth plates each bear 3 spines of the furrow series and one larger flattened spine at the apex. The actinal surface of each mouth plate bears a spine corresponding in size and position with those of the subambulacral series.

Papulae in 8 series, 1-2 (?) in each area.

A few scattered calcareous grains are embedded in the skin of the papular areas and on the margin of some plates.

Pedicellariae excavate, abundant, very large and conspicuous. They lie on or between the plates of disc and arms but are embedded in the skin not touching the plates. Few are found on the oral surface.

Alveoli boat shaped, up to 1.5 mm long (Fig. 5b), jaws curved and glassy ending in a sharp point (Fig. 5c). Small oval pedicellariae with straight jaws are less abundant than the large ones (Fig. 5d).

The color of the dry specimen is light pink, darker on the pedicellariae and where the skin is wrinkled.

Distribution: Known only from the type locality.

#### REMARKS

The arms of the specimen are curled over the abactinal surface of the disc obscuring it from close study.

One arm has autotomized and three others are cracked in partial autotomy. Contraction of the apparently loose skin tends to obscure the papular pores making an accurate count impossible. Wrinkling of the skin and its attachment to the upper edges of the pedicellariae and madreporite suggest that in life it is probably inflated, possibly obscuring the pedicellariae.

The unique holotype was taken with a specimen of *Ophiocoma longispina* by SCUBA diving in 38–40 meters.

#### 10. *Linckia laevigata* (Linnaeus)

*Asterias laevigata* Linnaeus, 1758: 662.

*Linckia rosenbergi* von Martens, 1866: 63.

*Linckia laevigata*, H. L. Clark, 1921: 64–66 Pl. 9, figs. 1, 2; Pl. 26, fig. 1; Engel, 1940: 273–274; Clark and Rowe 1971: 36, 62; McKnight, 1972: 39, 42–43.

#### MATERIAL EXAMINED AND LOCALITIES

COOK ISLANDS—Rarotonga: WES I, one specimen (several others noted in crevices against boulder outcrops), bright blue, examined by D. M. Devaney.

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: “Pele” Sta. RL II, one specimen, R=75 mm.

PITCAIRN GROUP—Pitcairn Island: “Pele” Sta. PIT V, one specimen, R=65 mm.

SOCIETY ISLANDS—Tahiti: MIS XVIII, one specimen, R=162 mm; WES XV one specimen, R=140 mm, color alive, brown.

SAMOAN ISLANDS—Tutuila: MIS II, Nuu’uli, 2 specimens, R=80 and 36 mm.

#### REMARKS

The brown specimen from Tahiti has the characteristics of *L. laevigata* despite the color. A field label with the specimens from Samoa states “many of these small blue starfishes noted in shallow water (0–2 m) on sandy, algae-rubble bottom”. *Linckia laevigata*, one of the commonest shallow water asteroids of the western Pacific is far less common in eastern Polynesia. Intensive collecting by a French expedition to Mururoa Atoll in the Tuamotus (Chevalier *et al.*, 1968) failed to find any specimens while the “Pele” expedition took only one in the Tuamotus and none in the Marquesas islands. McKnight (1972) lists the species from Rarotonga and Mangaia in the southern Cook Islands. The records from the Tuamotu Archipelago and Pitcairn Island are new.

#### 11. *Linckia multifora* (Lamarck)

*Asterias multifora* Lamarck, 1816: 565.

*Linckia multifora*, H. L. Clark, 1921: 66; Clark and Rowe, 1971: 36, 62; McKnight, 1972: 39, 43.

#### MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Rangiroa Atoll: “Pele” Sta. RL II, one specimen, R=20 mm (longest ray of comet form). Manihi Atoll: “Pele” Sta. MA III,

under coral boulder at shore edge of seaward reef, one specimen, R=36 mm; "Pele" Sta. MA V, one specimen, R=17 mm.

MARQUESAS ISLANDS—Nuku Hiva: "Pele" Sta. NH VI, 0-5 meters, 4 specimens, R=14, 19, 22, 34 mm; "Pele" Sta. NH X, 3 specimens, R=21 (4 rays), 23, 42 mm.

GAMBIER ISLANDS—Mangareva: WES LIII, one specimen, R=22 mm, color (dry) light pinkish orange with deep orange spots, ends of arms bluish.

PITCAIRN GROUP—Pitcairn Island: "Pele" Sta. PIT V, one specimen, R=19 mm (comet form); "Pele" Sta. PIT VI, haul 8, one specimen R=14 mm.

SOCIETY ISLANDS—Tahiti: MIS XVII, one specimen, R=25 mm.

RAPAN ISLANDS—Rapa Island: WES XXV, from coral, one specimen, R=22 mm.

AUSTRAL ISLANDS—Tubuai Island: WES XIX, under boulder, one specimen R=33 mm, color (dry) orange-pink spotted with rusty red, arm tips bluish.

COOK ISLANDS—Rarotonga: WES V, on sand under boulder, one specimen, R=24 mm, color (dry) cream, spotted with rust red, arm tips bluish; WES II, one specimen, R=37 mm.

LINE ISLANDS—Fanning Island: MIS IX, 2 specimens, R=29 and 20 mm, one specimen with parasitic gastropod on arm.

#### REMARKS

All but the comet forms have two madreporites and slightly tapering arms which distinguish them from juvenile *Linckia laevigata*. Granules between the furrow spines are not developed in specimens of less than R=20 mm but juveniles smaller than this size can usually be recognized by their general facies. Most specimens have arms of unequal length with regenerating ends so the R measurement given in each case is of the longest ray.

This common Indo-Pacific species has previously been recorded from Samoa, Wake, Palmyra and Oahu Islands (Ely 1942), from Tonga (A. H. Clark, 1931), Fiji (Sladen, 1889) the Tuamotus (A. H. Clark, 1954) and Cook Islands (McKnight, 1972). The present collection extends the known range of *Linckia multifora* to the Marquesas, Gambier, Pitcairn, Rapa and Austral Islands.

#### 12. *Linckia guildingi* (Gray)

*Linckia pacifica* Gray, 1840: 285.

*Linckia ehrenbergi* de Loriol, 1885: 31, Pl. 10, figs. 1-7a.

*Linckia guildingi*, H. L. Clark 1921: 67; 1938: 133-134; Clark and Rowe, 1971: 36, 61-62; McKnight, 1972: 39, 42.

#### MATERIAL EXAMINED AND LOCALITIES

MARQUESAS ISLANDS—Tahuata: "Pele" Sta. TH III, one specimen, R/r=32/4 mm, color (dry) of the aboral surface is buff mottled with grey-brown.

SOCIETY ISLANDS—Tahiti: "Pele" Sta. TI IV, from live coral, one specimen, R/r=25/3 mm, color (dry) of the aboral surface is cream mottled with light brown.

- GAMBIER ISLANDS—Mangareva: WES LI, 2 specimens, R/r=176/17, 185/17 mm, brown when alive.
- PITCAIRN GROUP—Pitcairn Island: WES LXV, one specimen, R/r=30/4 mm, color (dry) light brown mottled with dark brown. Oeno Atoll: WES LV, one specimen, R/r=144/16 mm, brown when alive.
- COOK ISLANDS—Rarotonga: WES I, one specimen R/r=56/7 mm, color (dry) light brown with a few dark brown spots.

## REMARKS

Four of the seven specimens are juveniles with the characteristic mottled coloring.

Two madreporites are present in all the juvenile specimens but two adults from Mangareva (one 6 rayed) each have a single madreporite.

*Linckia guildingi* is one of the most widely distributed Indo-Pacific seastars but it has not previously been recorded from the Marquesas, Pitcairn and Gambier Islands. McKnight (1972) records this species from the Cook Islands.

13. *Gomophia egyptiaca* Gray

*Nardoa aegyptiaca*, de Loriol, 1891: 30. Fisher, 1906: 1087.

*Gomophia egyptiaca* Gray, 1840: 286; A. M. Clark, 1952: 206, Pl. 32; 1967a. 39, 54; 1967b: 176-178, 181; Clark and Rowe, 1971: 36-37, 64, Pl. 8, fig. 4.

## MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XIX, from coral (*Pocillopora meandrina*), one specimen, R/r=28/5 mm.

RAPAN ISLANDS—Rapa: WES XXVII, on silty sand patch under crevice of reef, one specimen, R/r=50/8 mm; WES XXIX, one specimen, R/r=48/9 mm; WES XXXII, on boulder rubble, 8 specimens (6 examined), R/r=43/7 mm, 50/9 mm (2), 55/9 mm, 46/9 mm, 56/10 mm. Color of all specimens (dry) is light pinkish orange. Color (alive, pinkish orange, arms banded with darker stripes of the same color, tips of tubercles white, granules between plates light pink. Another specimen had the aboral surface reddish pink, arms banded with darker and lighter tones, ends of arms white, scattered plates light pink and white, tips of tubercles white, granules between plates, tan.

COOK ISLANDS—Rarotonga: WES IVa, in rubble near base of coral in area of massive live *Porites* coral, one specimen, R/r=28/5 mm.

TONGAN ISLANDS—Tongatabu: MIS XXXII a, one specimen (BPBM No. W 799), R/r=50/9 mm.

## REMARKS

The prominent naked tipped tubercles of the aboral surface vary in size from less than 2 mm high in the Tahiti specimen, 2 mm in the Cook Islands specimen, and 2.5 mm in the Tonga specimen to 2.5-3.0 mm in the series from Rapa Island. A. M. Clark (1967b: 181) notes that the tubercles reach 2.5 mm high

when R is 60–65 mm. The Rapa Island specimens therefore have larger tubercles than usual for their size. Alternate superomarginals are tuberculate or 2 to 3 plates may be interpolated between the tuberculate plates.

There are no actinal papulae in any specimens. Intermarginal plates are conspicuous, usually a single row but a double row is found on the largest specimens.

*Gomophia egyptiaca* is distributed from Mauritius and the Red Sea through the East Indies to Fiji, Samoa and the Gilbert Islands. Sladen's (1889) record from the Sandwich (Hawaiian) Islands remains unconfirmed. The records from the Society Islands, Rapa, the Cook Islands and Tonga are new.

#### 14. *Neoferdina cumingi* (Gray)

*Ferdina cumingi* Gray, 1840: 283.

non *Ferdina cumingi*, H. L. Clark, 1921: 59.

*Neoferdina cumingi* (Gray); Livingstone, 1931: 307–308, Pl. 21, figs. 1–3, Pl. 23, figs. 1–2; Clark and Rowe, 1971: 36, 65.

#### MATERIAL EXAMINED AND LOCALITIES

SOCIETY ISLANDS—Tahiti: MIS XIX from coral (*Pocillopora meandrina*), one specimen,  $R/r=20/6$  mm; MIS XV, coral and coral rubble, one specimen,  $R/r=38/11$  mm. (BPBM No. W 1783).

TUAMOTU ARCHIPELAGO—Anaa Atoll: "Pele" Sta. AN IV, among dead coral rubble, one specimen,  $R/r=30/9$  mm.

WAKE ISLAND—MIS XXXIII, one specimen (HOLOTYPE of *N. cancellata tylota* (Fisher, 1925), (BPBM No. W 645),  $R/r=16.5/5.5$  mm.

#### REMARKS

Specimens of *Neoferdina* are rare and individual variation within the nominal species is still little known. Within a specimen, one ray can differ markedly from another in the arrangement of plates and papular pores as well as in the occurrence and arrangement of bare plates.

All four specimens have the first and following alternate superomarginal plates bare and have a series of bare carinal plates on each ray. The adambulacral armature is as described by Fisher (1925: 73) for *Ferdina cancellata tylota*.

The occurrence of transverse rows of convex plates on the arms shows considerable variation; the uncatalogued specimen from Tahiti has regular transverse rows of convex bare plates on two and part of a third arm but only scattered bare plates on the remaining two; BPBM No. W 1783, from the same locality has no transverse rows of bare plates; the Tuamotu specimen also lacks transverse rows of bare plates but has a few convex, granule covered plates forming incipient transverse rows on the arms; the type of *N. cancellata tylota* (BPBM No. W 645) has four somewhat irregular transverse rows of convex plates, some of which are bare.

Where the plates are in regular transverse rows the papulae are arranged in the same manner.

Livingstone (1931), who redescribed *N. cumingi*, noted that *N. cancellata* (Grube) is probably a synonym of *N. cumingi*. If this proves to be so, *N. cancellata tylota* (Fisher) should be included in the synonymy. Pending the resolution of this question, the present specimens are referred to *N. cumingi*.

This species has been found at Christmas Island (Indian Ocean) Fisher (1934) and Fiji (Pope and Marsh, in preparation). The validity of the type locality "West coast of Colombia" has been questioned by H. L. Clark (1921) and Fisher (1934). The records from the Society and Tuamotu Islands are new.

#### 15. *Fromia milleporella* (Lamarck)

*Asterias milleporella* Lamarck, 1816: 564.

*Fromia milleporella* Gray, 1840: 286; de Loriol, 1885: 44, Pl. 16, figs. 2-4; H. L. Clark, 1921: 40, Pl. 7, figs. 4, 5; Clark and Rowe, 1971: 34, 63, Pl. 8, fig. 10.

##### MATERIAL EXAMINED AND LOCALITIES

LINE ISLANDS—Palmyra Island: MIS V, one specimen, R/r=28/9 mm, color in alcohol, dark brown, 5 rays, 2 madreporites.

SAMOAN ISLANDS—MIS Ib, one specimen, (BPBM No. W 786), R/r=25/9 mm, 6 rays, 1 madreporite.

##### REMARKS

These two specimens agree closely with material from Fiji, where the species is common on intertidal coral reefs.

*Fromia milleporella* is found from the East African coast to the central Pacific but has not been recorded previously from Palmyra Island, and is still unknown in southeastern Polynesia.

#### 16. *Fromia* sp. (juv.)

##### MATERIAL EXAMINED AND LOCALITY

LINE ISLANDS—Fanning Island: MIS VIIb, in coral, one specimen, R/r=9/3 mm.

##### REMARKS

The specimen has five regular rays, with a flat abactinal surface. Crystal bodies are present on all plates. There are five superomarginal and six inferomarginal plates decreasing in size distally. A carinal series of plates extends to the ends of the rays with an incipient series on either side basally. The plates have a fine covering of granules, about 10/mm of length. Papulae occur singly on the arms and lateral areas of the abactinal surface only. The madreporite lies interradially, nearer the margin than the center of the disc. Pedicellariae are absent. The adambulacral armature consists of three furrow spines proximally and two (occasionally three) distally. Subambulacrals consist of two or three short spines with three enlarged granules on the outer part of the plate.

Although this specimen lacks alternate large and small superomarginal plates it may be a juvenile *F. monilis*. Without a growth series for comparison I cannot make a positive identification.

## PORANIIDAE

17. *Asteropsis carinifera* (Lamarck)

*Asterias carinifera* Lamarck, 1816: 556.

*Asterope carinifera* Müller and Troschel, 1840: 104; H. L. Clark, 1921: 33, Pl. 5, fig. 2.

*Gymnasteria carinifera*, de Loriol, 1885: 67-69, Pl. 20, figs. 7-10.

*Asteropsis carinifera*, A. M. Clark, 1967a: 37-38; Clark and Rowe, 1971: 38, 47, 51, 65.

## MATERIAL EXAMINED AND LOCALITIES

TUAMOTU ARCHIPELAGO—Anaa Atoll: MIS XXIII, one specimen, juvenile, R/r=5/3.5 mm.

MARQUESAS ISLANDS—Nuku Hiva: "Pele" Sta. NH IV, under coral head, one specimen, R/r=88/29 mm; "Pele" Sta. NH VI, one specimen, R/r=85/26 mm.

LINE ISLANDS—Christmas Island: MIS Xb, 2 specimens (BPBM No. W 673), R/r=40/16 mm and 27/12 mm.

## REMARKS

The juvenile specimen was compared with one of R=11 mm from Fiji, with a description of juvenile *A. carinifera* by de Loriol (1885) and notes on juveniles of the species by Clark and Rowe (1971). The marginal spines are represented only by prominent granules, carinal spines are lacking, and the adambulacral armature is not fully developed. Despite the lack of development of adult characters I have no hesitation in referring this specimen to *A. carinifera*. It differs in several respects from juvenile *Culcita* which superficially have a similar facies.

*Asteropsis carinifera*, fairly common on the coral reefs of the western Pacific, has an attenuated distribution among the islands of Eastern Polynesia. This species ranges from East Africa, Mauritius and the Red Sea, through the East Indies to Fiji and Hawaii. It is recorded from the Tuamotus, Marquesas and the Line Islands for the first time.

## ASTERINIDAE

18. *Asterina burtoni* Gray

*Asteriscus cepheus* Müller and Troschel, 1842: 41.

*Asterina cepheus*, Fisher, 1919: 411, Pl. 115, fig. 4; 1925: 79-80.

*Asterina burtoni* Gray, 1840: 289; H. L. Clark, 1921, 96; 1938: 144; 1946: 133; James and Pearse, 1969: 84-85; Clark and Rowe, 1971: 38, 68-70.

## MATERIAL EXAMINED AND LOCALITIES

LINE ISLANDS—Fanning Island: MIS VIIIa, in coral, one specimen, R/r=9/5 mm.

## REMARKS

A fuller synonymy is given by James and Pearse (1969) who also refer to

recent work on this species by Achituv (1969a, 1969b). This specimen was compared with three from Wake Island (BPBM No. W 636), identified by W. K. Fisher (1925) as *A. cepheus*, and with specimens of *A. burtoni* from N. W. Australia (identified by A. J. Dartnall). It falls within the range of variation of these specimens.

It has a single madreporite; about 20 short spinelets on the proximal edges of the abactinal plates; groups of 3-4 spinelets on actinal intermediate plates; furrow spines in fans of 5-6; 4 subambulacral spines per plate and a pair of suboral spines on each oral plate.

It is comparable with *A. anomala* in size and general facies, differing only in being pentamerous and having a single madreporite.

*Asterina burtoni* is widely distributed through the Indo-Pacific region from Mozambique and the Red Sea to Wake Island (Fisher, 1925), Society Is. (Ludwig 1905) and the Tuamotus (Clark 1946). The record from the Line Islands is new.

#### 19. *Asterina anomala* H. L. Clark

H. L. Clark, 1921: 95-96, Pl. 7, fig. 8, Pl. 23, fig. 5, Pl. 26, figs. 2, 3; 1938: 143-144; 1946: 133; Ely, 1942: 25-26, Pl. 7B; A. H. Clark, 1949a: 82, 118, 121; Clark and Rowe, 1971: 68; McKnight, 1972: 38.

##### MATERIAL EXAMINED AND LOCALITIES

TONGAN ISLANDS—Tongatabu: MIS XXXII b, one specimen (BPBM No. W 804), R/r=10/6 mm, 4 large and 3 small rays.

##### REMARKS

This specimen was compared with specimens from Lord Howe Island (Australia), named by H. L. Clark, and with specimens from Hawaii (BPBM No. W 827) and is identical in all respects.

Clark and Rowe (1971) question the validity of separating the fissiparous *A. anomala* from the non fissiparous *A. burtoni* but until the relationship of the two species has been further investigated it may be better to use both names to avoid confusion if the two species are later shown to be distinct.

This small and secretive species was not taken by the "Pele" or "Westward" Expeditions but McKnight (1972) reports it from the Cook Islands. It is known from northern and eastern tropical Australia (H. L. Clark 1946), the Marshall Islands (A. H. Clark, 1952) and Fiji (Pope and Marsh, in preparation). The record from Tonga is new.

#### 20. *Asterina* sp.

##### MATERIAL EXAMINED AND LOCALITIES

RAPAN ISLANDS—Rapa Island: WES XXXI, on underside of basalt boulders, 14 specimens (6 examined), R/r=4.5/3.5 mm to 5.5/4 mm.

##### REMARKS

The specimens are nearly pentagonal in shape, having a R/r ratio of 1.3 to

1.4/1. The abactinal plates are covered with crystal bodies and each bears a tuft of 5 (4-8) diverging fine hyaline spinelets which are easily rubbed off; the inferomarginal plates each have a cluster of very fine spinelets.

Each actinal intermediate plate bears a single tapering pointed spine. Furrow spines are in combs of 3 to 4 with a pair of sub-ambulacral spines. Oral plates each have five slender spines and a single sub-oral spine.

The madreporite is single, small and triangular in shape. Papulae tend to be confined to the central disc and radial areas but a few are scattered interradially.

These small asterinas, taken only at Rapa Island, are very close to *A. modesta* from the Panama region but a definite determination has not been made as this material will be included in a revision of the Asterinidae by A. J. Darnall, Tasmanian Museum (personal communication).

## ECHINASTERIDAE

### 21. *Echinaster luzonicus* (Gray)

*Othilia luzonica* Gray, 1840: 282.

*Echinaster luzonicus*, Müller and Troschel, 1842: 23.

*E. eridanella*, Müller and Troschel, 1842: 24.

*Othilia purpurea* Fisher, 1919: 432, Pl. 122, fig. 1, Pl. 132, figs. 7a, b.

*Echinaster luzonicus* H. L. Clark, 1921: 98-100, Pl. 10, figs. 2-4; 1946: 147; Clark and Rowe, 1971: 40, 72-73.

#### MATERIAL EXAMINED AND LOCALITIES

LINE ISLANDS—Palmyra Island: MIS V, one specimen, R/r=30/5 mm, 6 rays, 2 madreporites, color in alcohol, dark brown; MIS Va, one specimen (BPBM No. W 941), R/r=10/2 mm; MIS Vb, 3 specimens (BPBM No. W 1069), R/r=45/7 mm, (6 rays) 18/4 mm (5 rays) and 13/4 mm (5 rays).

TONGAN ISLANDS—Tongatabu: MIS XXXII a, one specimen (BPBM No. W 800), R/r=71/6 mm, 5 rays.

#### REMARKS

*Echinaster luzonicus* was recorded from Palmyra Island by A. H. Clark (1954) as *Othilia luzonica* but is not known from Hawaii or the islands of southeastern Polynesia. It is a common shallow-water species from Fiji westwards through the East Indies and northern Australia but whether it is specifically distinct from *E. purpureus* of the western Indian Ocean is not clear. The record from Tonga is new.

## ACANTHASTERIDAE

### 22. *Acanthaster planci* (Linnaeus)

*Asterias planci* Linnaeus, 1758: 823.

*Acanthaster mauritiensis*, de Loriol, 1885: 6-10, Pl. 12, figs. 1-3.

*Acanthaster planci*, Verrill, 1914: 364; Fisher, 1919: 441-442; H. L. Clark, 1921: 101; Ely, 1942: 28-29; Clark and Rowe, 1971: 38, 71; McKnight, 1972: 43.

MATERIAL EXAMINED AND LOCALITIES (Examined by D. M. Devaney)

SOCIETY ISLANDS—Tahiti: WES XIII, under dead coral, two small specimens; WES XV, one specimen.

TUAMOTU ARCHIPELAGO—Anuanuraro Atoll: WES XLVII, one specimen.

GAMBIER ISLANDS—Mangareva: WES LII, northwest side, two specimens.

PITCAIRN GROUP—Pitcairn Island: WES LVIII, one specimen, upper side dark reddish, spines largely reddish orange; WES LXII, one mature male specimen. Ducie Atoll: WES LXVI, on head of dead coral rock with very little live coral, not feeding, one specimen, purplish gray, shading out to brown on arms and bases of spines.

COOK ISLANDS—Aitutaki: WES VIII, two specimens. Rarotonga: WES IVa, on *Porites* coral. Several specimens observed, some feeding. Two specimens collected one yellowish with many pedicellariae.

LINE ISLANDS—Fanning Island: MIS IX, one small specimen.

#### REMARKS

Devaney and Randall (1973) have published a rather complete report on *Acanthaster planci* in the southeastern Polynesia area based on previous reports and the data gathered during the 1970-71 "Westward" expedition. Randall (1972) discusses the relationship between *Acanthaster* infestations and pesticide pollution. The fertilization and larval life through metamorphosis of this species has been completed recently by Henderson and Lucas (1971) in Australia.

The specimen from Ducie Atoll (approx. 125°W, 25°S) is the eastern record of this species. With the exception of the Marquesas and Rapan/Austral areas, this species has a nearly complete Indo-West Pacific distribution.

### VALVASTERIDAE

#### 23. *Valvaster striatus* (Lamarck)

*Asterias striata* Lamarck, 1816: 253.

*Valvaster striatus* Perrier, 1875: 112; de Loriol, 1885: 11, Pl. 8, fig. 1a-g; Koehler, 1910: 175-176, Pl. 7, figs. 6, 7, Pl. 8, figs. 3, 4; Fisher, 1906: 1093-1094, Pl. 38, fig. 4a; Clark and Rowe, 1971: 38, 71, Pl. 9, figs. 10, 11.

#### MATERIAL EXAMINED AND LOCALITIES

COOK ISLANDS—Rarotonga: WES VI, on coarse sand, one specimen, R/r=25/8 mm. Alive the disc is patterned aborally with brown, pink and cream. There are small patches of green inter-radially. At the base of each ray there is a redbrown area followed distally by a patch of pink. A band of deep brownish pink extends across the middle of the rays followed by a band of

cream. Distally the rays are mottled with green, pink and cream. Dried, the colors have faded but the color pattern is still discernible.

#### REMARKS

Some differences from de Loriol's (1885) description of a specimen of  $R=80$  mm from Mauritius can be attributed to the small size of this specimen. It has a more compact skeleton and hence the papular areas are smaller with 1-2 pores instead of 5-8 for the larger specimen. Fisher (1906) notes 3-5 pores per area for a specimen of intermediate size ( $R=50$  mm) from Hawaii.

The actinolateral plates of the Rarotonga specimen each bear a flattened spine tapering to a blunt point. Fisher records a variable condition for his Hawaiian specimen while de Loriol figures truncated spines on the Mauritius specimen.

The small spinelets surrounding the bivalved pedicellariae on the superomarginal plates are shorter and less pointed than those illustrated by de Loriol.

Aborally the carinal plates bear slightly more prominent spinelets than the surrounding plates, similar to those noted by Fisher for the specimen from Hawaii.

*Valvaster striatus* is a rare species known from Mauritius (de Loriol, 1885), the Bay of Bengal (Koehler, 1910), the Philippines (A. H. Clark, 1949b), and Hawaii (Fisher, 1906). The present specimen adds the Cook Islands to its known distribution while Pope and Marsh (in preparation) have found it in Fiji.

Re-examination of the type of *Valvaster spinifera* H. L. Clark from Torres Strait may show that it falls within the known variation of *V. striatus*.

## ASTERIIDAE

### 24. *Astrostole paschae* (H. L. Clark)

*Stylasterias paschae* H. L. Clark, 1920: 105, Pl. 4, fig. 3.

*Astrostole paschae*, Fisher, 1928: 130, Pl. 42, fig. 7.

#### MATERIAL EXAMINED AND LOCALITIES

EASTER ISLAND: MIS XXIVa one specimen  $R/r=107/10$  mm.

#### REMARKS

The specimen agrees fairly closely with the description of the holotype of *A. paschae* with the following differences.

The type had 9 rays (8 in this specimen); madreporite surrounded by 6 spines (4 in this specimen); inferomarginals with 3 spines, occasionally 2 (2 occasionally 3 in this specimen); most inferomarginals of the type carry a huge forciform pedicellaria (few do in this specimen); adambulacral plates with 2 subequal spines (the inner are much shorter than the outer in this specimen); oral plates with two long spines (this specimen has in addition a short lateral spine and several forciform pedicellariae). The large and small forciform pedicellariae of the adambulacral plates are as described for the type and the crossed pedicellariae agree with

Fisher's (1928) figure.

In the absence of further material for comparison, the specimen is referred to *Astrostole paschae*, known only from Easter Island.

Genus *Allostichaster* Verril, 1914: 363

25. *Allostichaster peleensis* n. sp.

Figs. 6-8

ETYMOLOGY

Named in honor of the 1967 expedition ship "Pele".

MATERIAL EXAMINED AND LOCALITIES

PITCAIRN GROUP—Pitcairn Island: "Pele" Sta. PIT VI, haul 7, one specimen, R/r=18/3 mm, HOLOTYPE (BPBM No. W 1929).

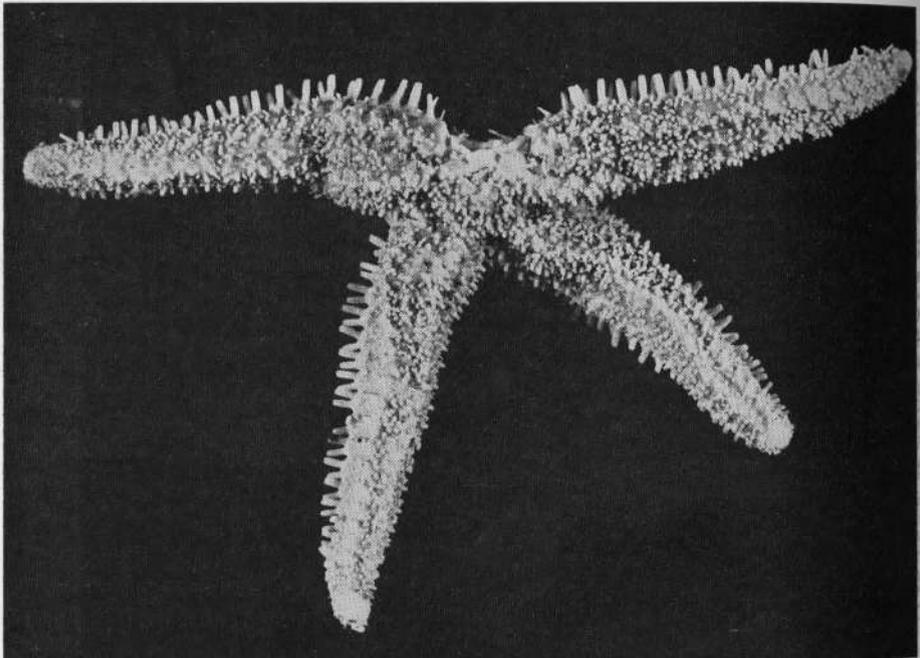


Fig. 6. *Allostichaster peleensis*, abactinal view of Holotype.

DESCRIPTION OF HOLOTYPE (BPBM No. W 1929). R=18 mm, r and br=3 mm, R=6r and br. The holotype and sole specimen has five subequal rays and appears to be non fissiparous; madreporite single, large, situated nearer margin than center of disc, surrounded by 8 spinelets on 3 sides, spinelets missing from the 4th side.

In center of disc is a large stellate plate and at the beginning of each

carinal series a large 4 lobed plate; plates of disc each have 4-6 spinelets; carinal plates (Fig. 8b) are 4 lobed with the proximal lobe of each overlapping the distal lobe of the preceding plate; basally carinals carry 5 spinelets, most have 3-4 (2 distally) and 4 pedicellariae.

Carinals linked to superomarginals by a single series of bar shaped dorsolateral plates extending to about half length of ray; dorsolaterals have one spinelet and about 4 pedicellariae; each is joined to the adjacent one by a short ossicle (Fig. 8a); distally carinal plates touch superomarginals. Superomarginals, 22 in number, wider than long, with a beaded surface, bear 2 spinelets and 8-12 pedicellariae on the adoral angled portion of each plate.

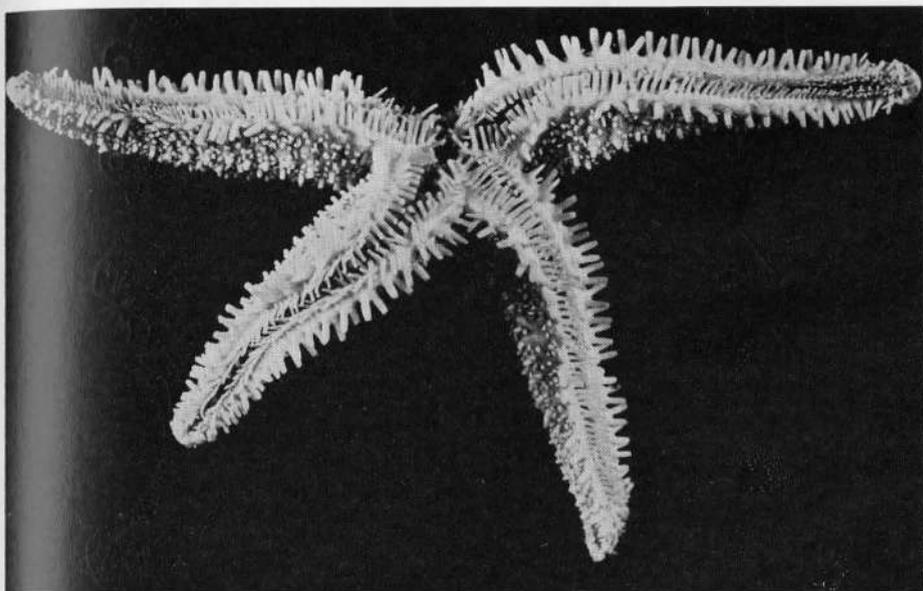


Fig. 7. *Allostichaster peleensis*, actinal view of Holotype.

Inferomarginals correspond in number and position to superomarginals and form a distinct angular margin to ray; basally each bears an oblique comb of 3 spines, the remainder have 2 spines and 2 (1-3) pedicellariae; the spines are flattened, not widened at the tip, approximately 1 mm long. Actinal plates rudimentary, 3-4 at base of rays. Adambulacral plates diplacanthid, with equal, flattened truncate spines, similar to those of the inferomarginals but shorter and thinner. Oral plates with 3 spines, slightly larger than the furrow spines and a fourth short spine deep in the mouth. Papular areas on disc and arms small, each with a single pore; no papulae on the oral surface. Crossed pedicellariae (Fig. 8c) are numerous on the plates and papular areas; straight pedicellariae are confined to the oral plates.

#### RELATIONSHIPS

*Allostichaster peleensis* is closely related to the Australian species *A. polyplax*

Müller and Troschel and *A. regularis* H. L. Clark. Differences between the three species are shown in Table 3, based on material in the Western Australian Museum and on data from H. L. Clark (1928) and A. M. Clark (1962).

While the differences in spinulation are not great and are subject to some individual variation the differences between *A. polyplax* and *A. regularis* are of the same order as those between these species and *A. peleensis*.

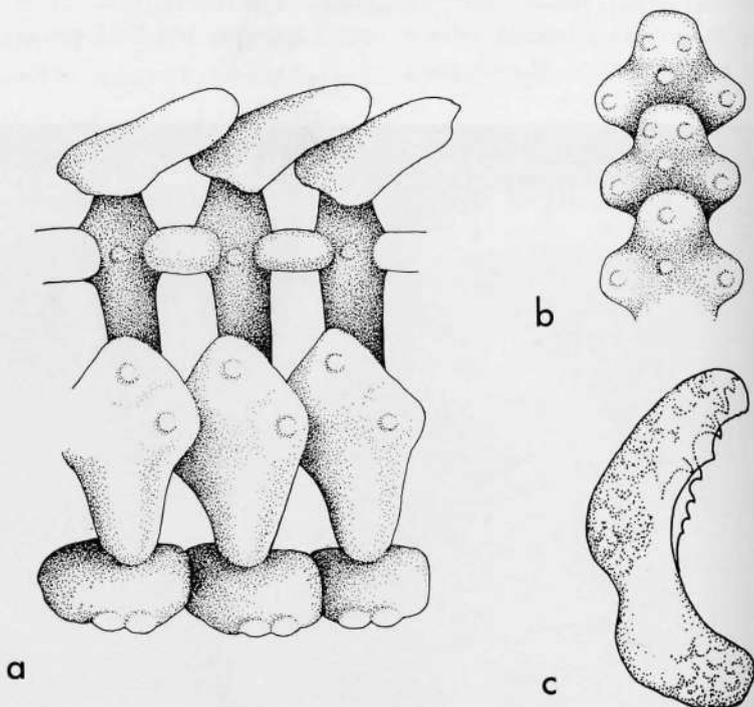


Fig. 8. *Allostichaster peleensis*.

- a. lateral view of skeleton of ray, carinal series at the top, inferomarginals at the bottom, right side is adoral.
- b. carinal plates of ray, from above.
- c. single jaw of crossed pedicellaria.

The shape of the dorsolateral plates together with the shape of the spinelets and of the inferomarginal and adambulacral spines are further differences between *A. peleensis* and the two Australian species.

*Allostichaster* is a genus of southern temperate waters, Australia, New Zealand and South America so *A. peleensis* may add a temperate element to the otherwise tropical asteroid fauna of Pitcairn Island.

Distribution: Known only from 101–119 meters off Pitcairn Island, from a bottom of coral rocks and rubble.

Table 3. Comparison of the diagnostic characters of *Allostichaster polyplax*, *A. regularis*, and *A. peleensis* n. sp.

<i>A. polyplax</i>	<i>A. regularis</i>	<i>A. peleensis</i>
Rays 7-8 Madreporite multiple	Rays 5 Madreporite single, halfway between centre and margin.	Rays 5 Madreporite single, near margin.
Papular areas on disc small. Carinal plates with 4-6 spinelets.	Papular areas on disc large. Carinal plates with 6-10 spinelets.	Papular areas on disc small. Carinal plates with 3-5 spinelets.
Dorsolateral plates rounded to squarish with 1-3 spinelets.	Dorsolateral plates with 2-6 spinelets.	Dorsolateral plates bar shaped with 1 spinelet.
Terminal plate with up to 18 spinelets.	Terminal plate with many granules and small spinelets.	Terminal plate with 2-3 spinelets.
Spinelets usually capitate.	Spinelets capitate.	Spinelets truncate.
Superomarginals with 4 spinelets.	Superomarginals with 5 spinelets.	Superomarginals with 2 spinelets.
Inferomarginals with 2(1-3) spines and 6 pedicellariae.	Inferomarginals with 3 (2-4) spines and 6 pedicellariae.	Inferomarginals with 2-3 spines and 1-3 pedicellariae.
Inferomarginal spines slightly widened at ends.	Inferomarginal spines widened at ends.	Inferomarginal spines not widened at ends.

## DISCUSSION

The shallow-water asteroid fauna of the southeastern Polynesia area (Table 4) is relatively poor compared with that of Fiji and the Western Pacific. Disregarding uncommon species, which are better represented where collecting has been most intense, there is a noticeable reduction, in the eastern Polynesia area, both in the number of species and of individuals of species common elsewhere. The 1967 "Pele" expedition found sea stars at only 11 of the 19 islands visited, the "Westward" at 9 of the 35 islands visited.

In contrast to the 25 species taken from this large area, 26 species have been found in shore and shallow-water collecting around Viti Levu, Fiji (Pope and Marsh, in preparation), while dredging in the Fiji group would undoubtedly increase this number considerably.

Biogeography of the Asteroidea and Ophiuroidea of southeastern Polynesia is discussed by Devaney (1973).

## ACKNOWLEDGEMENTS

I am indebted to the Bernice P. Bishop Museum of Hawaii for the opportunity to work on this collection and for the loan of additional specimens. My thanks are also due to the Allan Hancock Foundation of the University of Southern California for the loan of a specimen from Easter Island.

I also wish to thank the University of Western Australia for the use of laboratory and library facilities during the early part of the study and the

Table 4. Distribution of Asteroidea in southeast Polynesia and adjacent areas.

	SAMOAN IDS.	TONGAN IDS.	COOK IDS.	AUSTRALS/RAPAN	SOCIETY IDS.	TUAMOTU ARCH.	MARQUESAS IDS.	GAMBIER IDS.	PITCAIRN IDS.	EASTER IS.	LINE IDS.	HAWAIIAN IDS.
Luidiidae												
<i>Luidia (Maculaster) maculata?</i>							X					
Astropectinidae												
<i>Astropecten polyacanthus</i>							X		X	X?		HJ
<i>A. triseriatus fijiensis</i>										X		J
<i>A. triseriatus myobrachiuis.</i>												
<i>A. monacanthus</i>		L										
<i>Ctenophoraster marquesensis</i> n. sp.							X					
Archasteridae												
<i>Archaster typicus</i>	H	BN										H
Oreasteridae												
<i>Culcita novaeguineae</i>	I	K			K	CX	X	X	X			J
<i>C. schmideliana</i>						A						
Ophidiasteridae												
<i>Dactylosaster cylindricus</i>						K						EJ
<i>Fromia milleporella</i>	ENX										X	
<i>F. balansae</i>	C											
<i>F. pacifica</i>	C											
<i>F. monilis</i>	CE										X?	
<i>Gomophia egyptiaca</i>	E	X	X	X	X							N?
<i>Leiaster leachi</i>			X	X			X			F		JX
<i>Linckia guildingi</i>	N	N	MX		DNX	K	X	X	X			H

<i>L. multifora</i>	EN	BL	MX	X	KX	CX	X	X	X		JX	HN
<i>L. laevigata</i>	EX	BKL	MX		EKX	X			X			
<i>Ophidiaster lorioli</i>	EX			X					X		X	H
<i>O. cribrarius</i>		N										
<i>O. granifer</i>		CN										
<i>O. squameus</i>						E						GH
<i>O. perplexus</i>						C						
<i>Neoferdina cumingi</i>					X	X						
<i>Devania naviculiforma</i> n. g & n. sp.				X								
Poraniidae												
<i>Asteropsis carinifera</i>		L			EK	X	X				X	EH
Asterinidae												
<i>Asterina burtoni</i>					K	E?					X	
<i>Asterina</i> sp.				X								
<i>A. anomala</i>		X	M									G
Acanthasteridae												
<i>Acanthaster planci</i>	N		X		KMX	CX		X	X		X	EJ
Valvasteridae												
<i>Valvaster striatus</i>			X									H
Mithrodiidae												
<i>Mithrodia clavigera</i>	N	L			N	K						
Echinasteridae												
<i>Echinaster luzonicus</i>		X									CJX	
Asteriidae												
<i>Astrostole paschae</i>										DFX		
<i>Allostichaster peleensis</i> n. sp.									X			
No. of species (doubtful records excluded),	13	13	8	6	10	12	8	4	8	3	7	14

Key to Table 4

A—Chevalier *et al.*, 1968  
 B—Clark, A. H., 1931  
 C—Clark, A. H., 1954  
 D—Clark, H. L., 1920

E—Clark, H. L., 1921  
 F—Clark, J. F., unpubl.  
 G—Ely, 1942  
 H—Fisher, 1906

I—Fisher, 1919  
 J—Fisher, 1925  
 K—Ludwig, 1905  
 L—McKnight, 1968

M—McKnight, 1972  
 N—Sladen, 1889

X—present study material

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## REFERENCES

- Achituv, Y. 1969a. Observations on the biology of *Asterina burtoni* Gray. Israel J. Zool. 18:119.
- . 1969b. Studies on the reproduction and distribution of *Asterina burtoni* Gray and *A. wega* Perrier (Asteroidea) in the Red Sea and the eastern Mediterranean. Israel J. Zool. 18:329-342.
- Agassiz, A. 1903. The coral reefs of the tropical Pacific. Mem. Mus. Comp. Zool. Harv. 28:1-410.
- Chevalier, J. P., M. Denizot, J. L. Mongin, Y. Plessis, and B. Salvat. 1968. Etude Geomorphologique et Bionomique de l'Atoll de Mururoa (Tuamotu). Cahiers du Pacifique 12:1-144, pls. 1-24.
- Clark, A. H. 1931. Echinoderms from the Islands of Niuafoou and Nukualofa, Tonga Archipelago, with the description of a new genus and two new species. Proc. U.S. Natn. Mus. 80(5):1-12, pls. 1-8.
- . 1949a. Ophiuroidea of the Hawaiian Islands. Bull. Bernice P. Bishop Mus. 195:1-133.
- . 1949b. Collection of sea-stars from the Philippines. Proc. Biol. Soc. Wash. 62:73-77.
- . 1952. Echinoderms from the Marshall Islands. Proc. U.S. Natn. Mus. 102(3302): 265-303.
- . 1954. Records of Indo-Pacific Echinoderms. Pac. Sci. 8:243-263.
- Clark, A. M. 1952. The 'Manihine' Expedition to the Gulf of Aqaba, 1948-1949. VII. Echinodermata. Bull. Br. Mus. Nat. Hist. (Zool.) 1(8):203-214, pls. 31, 32.
- . 1962. Asteroidea. Rep. B.A.N.Z. Antarctic Res. Exped. 1929-31 Ser. B. 9:1-104, tables 1-14, plates 1-5, text figs. 1-18.
- . 1967a. Echinoderms from the Red Sea. Pt 2 (Crinoids, Ophiuroids, Echinoids and more Asteroids. Bull. Sea Fish Res. Stn. Israel 41:26-58, 5 figs.
- . 1967b. Notes on Asteroids in the British Museum (Natural History). V. *Nardoa* and some other Ophidiasterids. Bull. Br. Mus. Nat. Hist. (Zool.) 15(4):169-198, pls. 1-6.
- Clark, A. M. and F. W. E. Rowe. 1971. Monograph of shallow-water Indo-West Pacific Echinoderms. 1-238, pls. 1-31, Trustees of the British Museum (Nat. Hist.).
- Clark, H. L. 1920. Report on the scientific results of the expedition to the Eastern Tropical Pacific, 32, Asteroidea. Mem. Mus. Comp. Zool. Harv. 39(3):73-113, pls. 1-6.
- . 1921. The Echinoderm fauna of Torres Strait. Pap. Dep. Mar. Biol. Carnegie Inst. Wash. 10:viii+223, pls. 1-38.
- . 1928. The sea lilies, sea stars, brittle stars and sea urchins of the South Australian Museum. Rec. S. Aust. Mus. 3:361-482, figs. 108-142.
- . 1938. Echinoderms from Australia. Mem. Mus. Comp. Zool. Harv. 55:viii+596, figs. 1-63, 28 pls.
- . 1946. The Echinoderm fauna of Australia. Publs. Carnegie Instn. No. 566:1-567.
- Devaney, D. M. 1973. Zoogeography and faunal composition of Southeastern Polynesian Asterozoan Echinoderms. In Oceanography of the South Pacific 1972. Pub. by Nat. Comm. for UNESCO, Wellington, N.Z. p. 164-171.

- Devaney, D. M., and J. E. Randall. 1973. Investigations of *Acanthaster planci* in southeastern Polynesia during 1970-1971. *Atoll Res. Bull.* (169):1-23, pls. 1-3, figs. 1-13.
- Döderlein, L. 1917. Die Asteriden der Siboga Expedition. I. Die Gattung *Astropecten* und ihre Stammesgeschichte. *Siboga Exped.* 46a:1-191, 20 figs, pls. 1-17.
- . 1920. Die Asteriden der Siboga Expedition. II. Die Gattung *Luidia* und ihre Stammesgeschichte. *Siboga Exped.* 46b:193-291, 5 figs., pls. 18-20.
- Ely, C. A. 1942. Shallow water Asteroidea and Ophiuroidea of Hawaii. *Bull. Bernice P. Bishop Mus.* 176:1-63, figs. 1-18, pls. 1-13.
- Engel, H. 1940. *Linckia rosenbergi* von Martens, a synonym of *L. laevigata* (L.). *Zool. Mededeelingen.* 22:273-274.
- Fisher, W. K. 1906. The starfishes of the Hawaiian Islands. *Bull. U.S. Fish Commission* 23(3):987-1130, 49 pls.
- . 1913. Four new genera and fifty eight new species of starfishes from the Philippine Islands, Celebes and the Moluccas. *Proc. U.S. Natn. Mus.* 43:599-648.
- . 1919. Starfishes of the Philippine seas and adjacent waters. *Bull. U.S. Natn. Mus.* 100(3):xi+712, 156 pls.
- . 1925. Sea stars of tropical central Pacific. *Bull. Bernice P. Bishop Mus.* 27:63-88, fig. 9, pls. 5-8.
- . 1928. Asteroidea of the North Pacific, pt. 2. *Bull. U.S. Natn. Mus.* 76:1-245, 81 pls.
- . 1934. Note on a starfish from Christmas Island, Indian Ocean. *Bull. Raffles Mus.* 9:74.
- Gray, J. E. 1840. A synopsis of the genera and species of the class *Hypostoma* (*Asterias* Linn.). *Ann. Mag. Nat. Hist.* (1) 6:175-184, 275-290.
- Hayashi, R. 1938a. Seastars of the Ogasawara Islands. *Annotnes, Zool. Jap.* 17(1):59-68, 5 figs., 1 pl.
- . 1938b. Seastars in the vicinity of the Seto Marine Biological Laboratory. *Bull. Biogeogr. Soc. Japan* 8(19):271-292, 4 figs., pls. 5-7.
- Henderson, J. A., and J. S. Lucas. 1971. Larval development and metamorphosis of *Acanthaster planci* (Asteroidea). *Nature* 232(5313):655-657, figs. 1-4.
- James, D. B., and J. S. Pearce. 1969. Echinoderms from the Gulf of Suez and the northern Red Sea. *J. Mar. Biol. Ass. India* 11(1-2):78-125.
- John, D. D. 1948. Notes on asteroids in the British Museum (Natural History). 1. The species of *Astropecten*. *Novit. Zool.* 42(3):485-508, 4 pls.
- Koehler, R. 1910. Shallow-water Asteroidea. Echinoderma of the Indian Museum. *Calcutta.* 1-192, 20 pls.
- Lamarck, J. B. P. 1816. *Histoire naturelle des animaux sans vertèbres.* Paris Ed. I. 2:522-568.
- Linnaeus, C. von. 1758. *Systema Naturae* (Ed. 10) 1:661-666.
- Livingstone, A. A. 1931. On the restriction of the genus *Ferdina* Gray (Asteroidea). *Aust. Zool.* 6(4):305-309, pls. 21-24.
- . 1932. Notes on some representatives of the asteroid genus *Culcita*. *Aust. Zool.* 7(3):265-273, pls. 14-17.
- Loriol, P. de. 1885. *Catalogue raisonné des Echinodermes recueillis par M. V. de Robillard à l'île Maurice.* II. Stellérides. *Mém. Soc. Phys. Hist. Nat. Genève* 29(4):1-84, pls. 7-22.
- . 1891. Notes pour servir à l'étude des Echinodermes. III. *Mém. Soc. Phys. Hist. Nat. Genève, Vol. Suppl.* (8):1-31, pls. 10-12.
- Ludwig, H. 1905. Asteroidea. Reports on an exploration...by the U.S. Fish Commission steamer 'Albatross' during 1891, ...XXXV. Reports on the scientific results of the expedition to the tropical Pacific...on the U.S. Fish Commission steamer 'Albatross',

- from Aug., 1899-Mar., 1900...VII. Mem. Mus. comp. Zool. Harv. 32:xii+292, 35 pls.
- McKnight, D. G. 1968. Some echinoderms from Tongatabu Island and the south Minerva Reef. N. Z. J. Mar. Freshw. Res. 2(4):712-715.
- . 1972. Echinoderms collected by the Cook Islands Eclipse Expedition 1965. NZOI Records 1(3):37-43.
- Martens, E. von. 1866. Über ostasiatische Echinodermen. 3. Seesterne des Indischen Archipels. Arch. f. Naturgesch. 32(1):57-88.
- Morrison, J. P. E. 1954. Animal ecology of Raroia atoll, Tuamotus. Atoll Res. Bull. 34:1-26; 35:1-61, figs. 1-9.
- Müller, J., and F. H. Troschel. 1842. System der Aſteriden xx+134, pls. 1-12.
- Perrier, E. 1875. Révision de la collection de Stellérides du Museum d'Histoire Naturelle de Paris. Arch. Zool. Exp. Gen. 4:265-450.
- Randall, J. E. 1972. Chemical pollution in the sea and the crown-of-thorns starfish (*Acanthaster planci*). Biotropica 4(3):132-144.
- Sladen, W. P. 1889. Asteroidea. Rep. scient. Results Voy. "Challenger" (Zool.) 30:xlii+893, pls. 1-117.
- Verrill, A. E. 1914. Monograph of the shallow water starfishes of the North Pacific coast from the Arctic Ocean to California. Harriman Alaska Series, 14(1, 2):xii+408, 110 pls.
- Ziesenhene, F. C. 1963. A new sea star from Easter Island. Ann. and Mag. Nat. Hist. (13) 6, no. 68:461-464, fig. 1, pl. 15.